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Research Triangle Park, NC 27711

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May 1995

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Hazardous Air Pollutant Emissions from Process Units in the Elastomer Manufacturing Industry--

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Hazardous Air Pollutant Emissions From Process Units in the Elastomer Manufacturing Industry--

Supplementary Information Document for Proposed Standards

Emission Standards Division

U.S. Environmental Protection Agency
Office of Air And Radiation
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

May 1995

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ENVIRONMENTAL PROTECTION AGENCY

Hazardous Air Pollutant Emissions from Process Units in the Elastomers Manufacturing Industry -- Basis and Purpose Document for Proposed Standards

1. The standards regulate organic hazardous air pollutant (HAP) emissions from the production of butyl rubber, epichlorohydrin elastomers, ethylene-propylene elastomers, Hypalon™, neoprene, nitrile butadiene rubber, polybutadiene rubber, polysulfide rubber, and styrene-butadiene rubber and latex. Only those elastomer product process units that are part of major sources under section 112(d) of the Clean Air Act (Act) will be regulated.

2. For additional information contact:

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3. Paper copies of this document may be obtained from:

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OVERVIEW

This Supplementary Information Document (SID) contains memoranda providing rationale and information used to develop the Polymers and Resins Group I Elastomers and Synthetic Rubbers proposal package. These memoranda were written by EC/R Incorporated under contract to the U.S. Environmental Protection Agency (EPA). The data and information contained in these memoranda were obtained through literature searches, industry meetings, plant visits, and replies to section 114 letters sent to industry.

The memoranda included in this SID are referred to in the Basis and Purpose Document and in the preamble to the proposed rule. These memoranda were compiled into this single document to allow interested parties more convenient access to this information. The memoranda included herein are also available from the docket (Docket A-92-44).

The memoranda included in this SID are listed below with their document numbers.

Document No.	Description
II-B-21	C. Clark and P. Norwood, EC/R Inc., to L. Evans, EPA:ESD:OCG. April 28, 1995. Industry Characterization and Production -- Elastomer Production Facilities (Polymers and Resins I).
II-B-22	P. Norwood, EC/R Inc., to L. Evans, EPA:ESD:OCG. May 10, 1995. Baseline Emissions for Elastomer Production Facilities (Polymers and Resins I).
II-B-23	C. Clark and P. Norwood, EC/R Inc., to L. Evans, EPA:ESD:OCG. May 10, 1995. Subcategorization for the Elastomer Production Industry (Polymers and Resins I).

Document No.	Description
II-B-24	P. Norwood, EC/R Inc., to L. Evans, EPA:ESD:OCG. May 10, 1995. MACT floors and Regulatory Alternatives for the Elastomers Production Industry (Polymers and Resins I).
II-B-25	C. Clark, EC/R Inc., to L. Evans, EPA:ESD:OCG. May 10, 1995. Potential for New Sources Producing Elastomers (Polymers and Resins I).
II-B-26	P. Norwood, EC/R Inc., to L. Evans, EPA:ESD:OCG. May 10, 1995. Estimated Regulatory Alternatives Impacts for Elastomer Production Facilities (Polymers and Resins I).

MEMORANDUM

Date: April 28, 1995

Subject: Industry Characterization and Production -- Elastomer Production Facilities (Polymers and Resins I)

To: Leslie Evans, ESD/OCG

From: Charlotte Clark and Phil Norwood, EC/R

The purpose of this memorandum is to describe the general production process for synthetic rubbers, or elastomers, and also to discuss production process variations found among the nine specific elastomers included in the Polymers and Resins I source category grouping. The majority of this memorandum was taken from a draft BID chapter prepared for the EPA/ESD by Radian Corporation under Contract No. 68D10117. A discussion of emissions sources from each production process is included in this memorandum; a discussion of specific process emissions and baseline emissions (emissions nationwide prior to any NESHAP standard) will be provided in a separate memorandum entitled "Polymers and Resins I Baseline Emissions."

An elastomer or synthetic rubber is a synthetic, polymeric material that can stretch to twice its original length and then return rapidly to approximately its original length when released.[1] Elastomers have long, flexible, chainlike molecules that are able to undergo rapid rotation (flex) as a result of thermal agitation. During processing, intermolecular bonds form an insoluble, three-dimensional network.[2] Elastomer production includes the production of latexes, because a latex is a water emulsion of a synthetic elastomer.

INTRODUCTION

The Clean Air Act as amended in 1990 (1990 Amendments) required the U.S. Environmental Protection Agency (EPA) to publish a list of categories of sources emitting any of 189 hazardous air pollutants (HAPs). The Initial Source Category List contained 39 production categories for polymers and resins.[3] For regulatory development purposes, the EPA divided these 39 categories into 4 groups, which have been given the names Polymers and Resins I-IV. Each group represents a different family of polymer and resin products that have similar production processes, product end use, air pollution emission characteristics, control device applicability and costs, and regulatory schedule requirements. Nine polymer and resin products that belong to the family of "elastomers," or synthetic rubbers, and that have similar production and air pollution

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emission characteristics were grouped together in the Polymers and Resins I Group. For the purpose of this regulatory effort, these nine source categories are collectively referred to either as Group I Polymers and Resins or as the elastomer source categories. Because these nine production categories have significant similarities, they are being considered together for regulation in the development of National Emission Standards for Hazardous Air Pollutants (NESHAP) for Elastomer and Synthetic Rubber Production. The Polymers and Resins I source category group is listed to propose regulations by May of 1995 and to promulgate regulations by May of 1996.

The nine source categories for the production of elastomers are listed below:

- Butyl Rubber Production;
- Epichlorohydrin Elastomers Production;
- Ethylene-propylene Elastomers Production;
- Hypalon™ Production;
- Neoprene Production;
- Nitrile Butadiene Rubber Production;
- Polybutadiene Rubber Production;
- Polysulfide Rubber Production; and
- Styrene-Butadiene Rubber and Latex Production.

The majority of the products from these nine source categories are used in the tire and tire products industry. Table 1 shows specific end uses of the nine elastomers discussed in this memorandum.

Within three of the nine elastomer production categories, significant variations in manufacturing processes and air pollution emissions exist. Therefore, the EPA has further divided these three categories -- butyl rubber, nitrile-butadiene rubber, and styrene-butadiene rubber -- into subcategories for the purposes of regulation in this NESHAP. The technical basis of these subcategorization decisions is described in a separate memorandum entitled "Polymers and Resins I -- Subcategorization."

Table 2 lists the nine elastomer source categories, and provides facility locations, annual production capacities, and the percentage of the total United States capacity manufactured by each facility for each elastomer type. The elastomers with the greatest production rates are styrene-butadiene rubber and latex, polybutadiene rubber, and ethylene-propylene rubber. Figure 1 shows the geographical distribution of the elastomer manufacturing facilities in the U.S. The majority of the elastomer manufacturing facilities in the nine Polymers and Resins I source categories are located in Texas, Louisiana, Ohio, and Kentucky.

Table 1. Major End Uses of Elastomer Products

Elastomer	Major End Uses
Butyl Rubber, [a]	Tires, tubes, and tire products; automotive and mechanical goods; adhesives, caulks, and sealants; pharmaceutical uses.
Epichlorohydrin rubber, [b]	Because of excellent oil and heat-resistant properties, widely used in seals, gaskets, hoses, belting, and coatings. Especially useful in automotive industry where heat, ozone, and oil resistance is necessary.
Ethylene-propylene rubber, [c]	Construction; automotive (radiator & heater hoses, weather stripping, gaskets, body & chassis parts; plastic blending; oil additives; industrial; wire and cable.
Hypalon™, [d]	Used in place of standard elastomers where superior resistance to oil, ozone, and heat is needed.
Neoprene, [e]	Industrial; mechanical; adhesives; latexes; wire and cable; cellular rubber; consumer products (including shoe soles, wet suits, and elastic swimwear).
Nitrile butadiene rubber and latex, [f]	Hoses, belting, and cable; o-rings and seals; latex; molded/extruded products; adhesives and sealants; sponges; footwear.
Polybutadiene rubber and latex, [g]	Tires and tire products; high impact resin modifiers; industrial products (conveyor belts, hoses, seals, and gaskets).
Polysulfide rubber, [h]	Insulating glass, construction, aircraft fuel tanks, concrete coatings, bindings
Styrene-butadiene rubber and latex, [i]	Tires and tire related products; mechanical goods; automotive; floor tiles, shoe soles.

[a] Butyl Elastomers. In: Chemical Economics Handbook. SRI, International. February 1989.
[b] Epichlorohydrin. In: Encyclopedia of Polymer Science and Engineering. Second Edition. 1985.
[c] Ethylene Propylene Elastomers. In: Chemical Economics Handbook. SRI International. August 1990.
[d] Kirk-Othmer Concise Encyclopedia of Chemical Technology. New York, John Wiley & Sons. 1985. p. 392.
[e] Chemical Profile of Polychloroprene. Chem Market Rep. May 13, 1991.
[f] Chemical Profile of Nitrile Rubber. Chem Market Rep. May 20, 1991.
[g] Chemical Profile of Butyl Rubber. Chem Market Rep. April 15, 1991.
[h] Polysulfides. In: Encyclopedia of Polymer Science and Engineering. Second Edition. Vol. 13. 1985.
[i] Chemical Profile of Styrene-Butadiene Rubber. Chem Market Rep. May 27, 1991.

Table 2. Elastomer Products and Capacities, [a]

Elastomers	Producer	Location	Annual Capacity ($1x10^6$ Mg/yr)	Percent of Total Domestic Capacity
Butyl rubber	Exxon Corporation	Baytown, TX	121[b]	100
Halobutyl rubber	Exxon Corporation	Baton Rouge, TX	109[b]	100
Epichlorohydrin rubber	Zeon Chemicals, Incorporated	Hattiesburg, MI	NA	100
Ethylene-propylene rubber	DSM Copolymer Rubber	Addis, LA	73.00[b]	19
	DuPont Company	Beaumont, TX	77.00[b]	20
	Exxon Corporation	Baton Rouge, LA	85.00[b]	22
	Miles, Incorporated	Orange, TX	52.00[b]	14
	Uniroyal Chemical Company	Geismar, LA	91.00[b]	24
		TOTAL	378.00	
Hypalon™ (chlorosulfonated polyethylene)	DuPont Company	Beaumont, TX	NA	100
Neoprene (polychloroprene)	DuPont Company	Laplace, LA	46.00[b]	28
		Louisville,KY	90.00[b]	55
	Miles, Incorporated	Houston, TX	27.00[b]	17
		TOTAL	163.00	
Nitrile butadiene rubber	DSM Copolymer Rubber	Baton Rouge, LA	15.00[b]	15
	The Goodyear Tire & Rubber Company	Houston, TX	28.00[b]	28
	Uniroyal Chemical Company	Painesville, OH	20.00[a]	20
	Zeon Chemicals, Incorporated	Louisville, KY	35.30[a]	36
		TOTAL	98.30	
Nitrile butadiene latex	Hampshire Chemical	Owensboro, KY	3.00[c]	NA
	Reichhold Chemicals, Incorporated	Cheswold, DE	5.00[c]	NA
		Kensington, GA	NA	NA
		TOTAL	8.00	
Polybutadiene rubber	American Synthetic Rubber Corp.	Louisville, KY	110.00[b]	20
	Bridgestone/Firestone Inc.	Lake Charles, LA	NA	NA
		Orange, TX	120.00[b]	21
	The Goodyear Tire & Rubber Company	Beaumont, TX	215.00[b]	38
	Miles, Incorporated	Orange, TX	115.00[b]	21
		TOTAL	560.00	
Polysulfide rubber	Morton International, Inc,	Moss Point, MS	NA	100

Table 2. Elastomer Products and Capacities, [a]

Elastomers	Producer	Location	Annual Capacity ($1x10^6$ Mg/yr)	Percent of Total Domestic Capacity
Styrene-butadiene rubber	American Synthetic Rubber	Louisville, Ky	NA	NA
	Ameripol Synpol	Port Neches, TX	335.00[b]	33
	Bridgestone/Firestone Inc.	Lake Charles, LA	150.00[b]	15
		Orange, TX	NA	NA
	DSM Copolymer Rubber	Baton Rouge, LA	125.00[b]	12
	General Tire Inc.	Odessa, TX	95.00[b]	9
	The Goodyear Tire & Rubber Co.	Beaumont, TX	20.00[b]	2
		Houston, TX	305.00[b]	30
	Miles, Incorporated	Orange, TX	NA	NA
		TOTAL	1030.00	
Styrene-butadiene latex	BASF Corporation	Chattanooga, TN (Polymer Dr)	174.00[c]	11
		Chattanooga, TN (Amnicola Hwy)	NA	4
	Dow Chemical, U.S.A.	Dalton, GA	66.00[c]	29
		Freeport, TX	--	
		Allyn's Point, CT	441.00[c]	
		Midland, MI	(Total Dow)	
		Pittsburg, CA	--	
	GenCorp	Mogadore, OH	198.00[c]	13
	The Goodyear Tire & Rubber Co.	Calhoun, GA	101.00[c]	66
	Hampshire Chemical	Owensboro, KY	11.00[c]	1
	Reichhold Chemicals, Inc.	Cheswold, DE	183.00[c]	12
		Kensington, GA	NA	2
	Rhone-Poulenc Inc.	Gastonia, NC	35.00[c]	4
	Rhom & Haas	Charlotte, NC	62.00[c]	2
		La Mirada, CA	26.00[c]	12
		TOTAL	1537.00	

[a] Products listed for a facility typically, but not always, reflect primary product manufactured at the site. Facilities actively producing each product were identified through responses by industry to the EPA Section 114 information request letter.

[b] Chemical Marketing Reporter Chemical Profiles. March 28, 1994 - Polychloroprene; April 4, 1994 - Butyl Rubber; May 9, 1994 - Polybutadiene; May 34, 1994 - SB Rubber; June 6, 1994 - EP Elastomers; and June 13, 1994 - Nitrile Rubber.

[c] SRI International, 1991 Directory of Chemical Producers. United States of America. Menlo Park, CA. 1991.

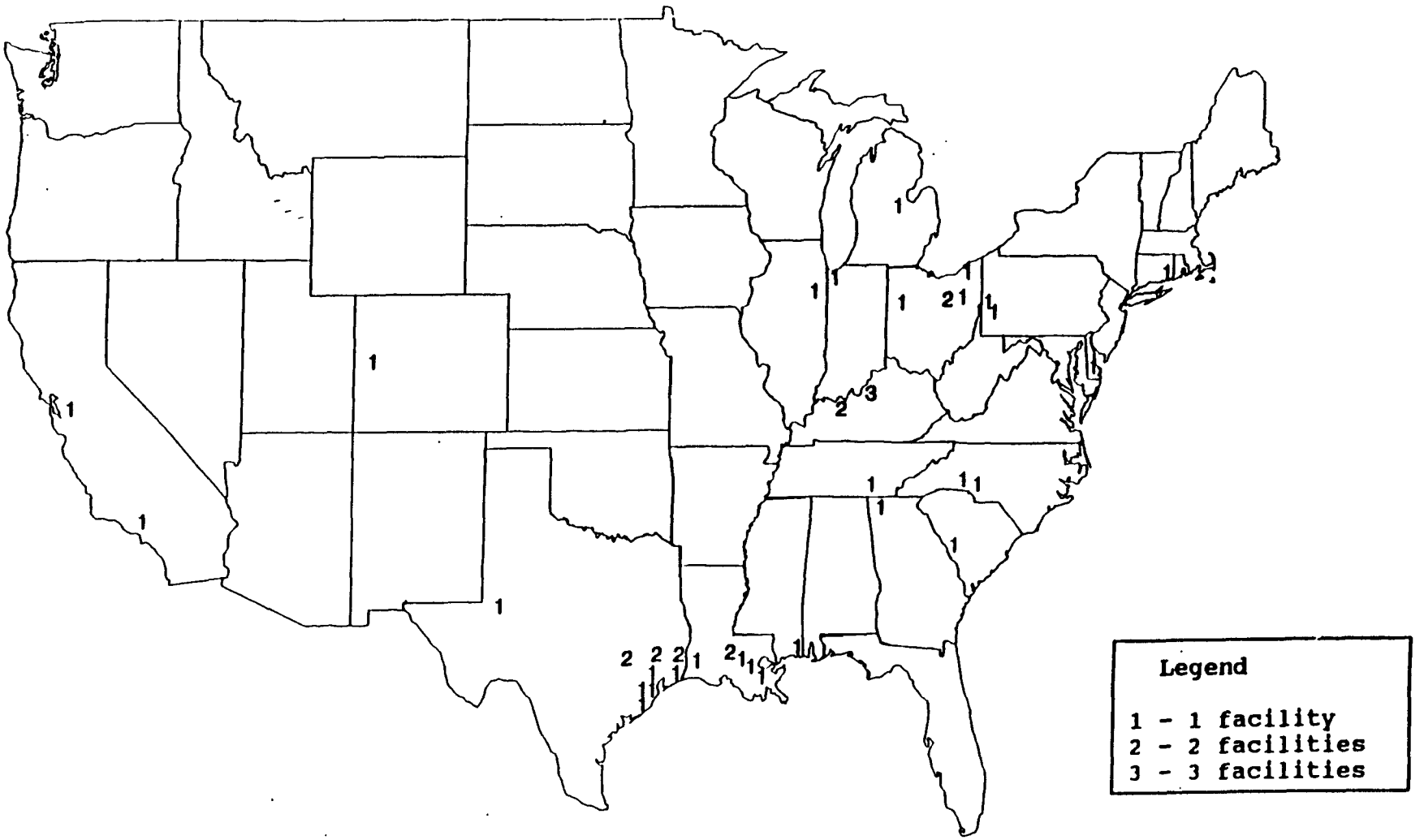

Figure 1. Geographic Distribution of U. S. Elastomer Production Facilities

DESCRIPTION OF ELASTOMER PRODUCTION AND EMISSION POINTS

A simplified process flow diagram of the polymerization process used to manufacture elastomers and synthetic rubbers is provided in Figure 2. In polymerization, a large number (hundreds to thousands) of relatively simple molecular units, or monomers, are chemically combined to form a macromolecule, or polymer.

For the purposes of this memorandum, the polymer manufacturing process will be divided into four process areas: (1) raw material storage and refining, (2) polymer formation in a reactor, (3) stripping and material recovery, and (4) finishing. Each of these areas is described briefly in this section; the subsequent sections describe the variations from this generic process that are needed to manufacture each of the elastomers products in the nine Polymer and Resins I source categories.

Raw Material Refining

The basic raw materials for polymerization are monomers and either organic solvents or water. In raw material refining, reaction inhibitors and impurities (e.g., residual undesired chemicals) are removed from the monomer and solvents. This refinement is commonly achieved through the use of steam distillation. Because this adds water to the raw materials, and because in certain types of polymerization reactions, water fouls the polymerization process, a process to dry the refined monomers and solvents must sometimes be added. A water adsorption column is commonly used to dry the materials in these instances.

Polymer Formation in a Reactor

In this step, monomers and either organic solvents or water are charged to a reactor. Additives, such as catalysts and modifiers, are also added at this step. Two types of polymerization are generally used in the elastomers manufacturing industry: solution and emulsion. In solution polymerization, monomers are dissolved in an organic solvent, while in emulsion polymerization, monomers are dispersed in water using a soap solution, or an "emulsifier." A third, less common type of polymerization sometimes used is the bulk process, in which one of the monomers acts as the solvent.

The reactor is a large vessel in which the temperature and pressure are controlled and the contents are well mixed to optimize the polymerization reaction. After the desired degree of polymerization has been achieved, the reaction is terminated with a chemical shortstopping agent, such as diethylhydroxylamine.

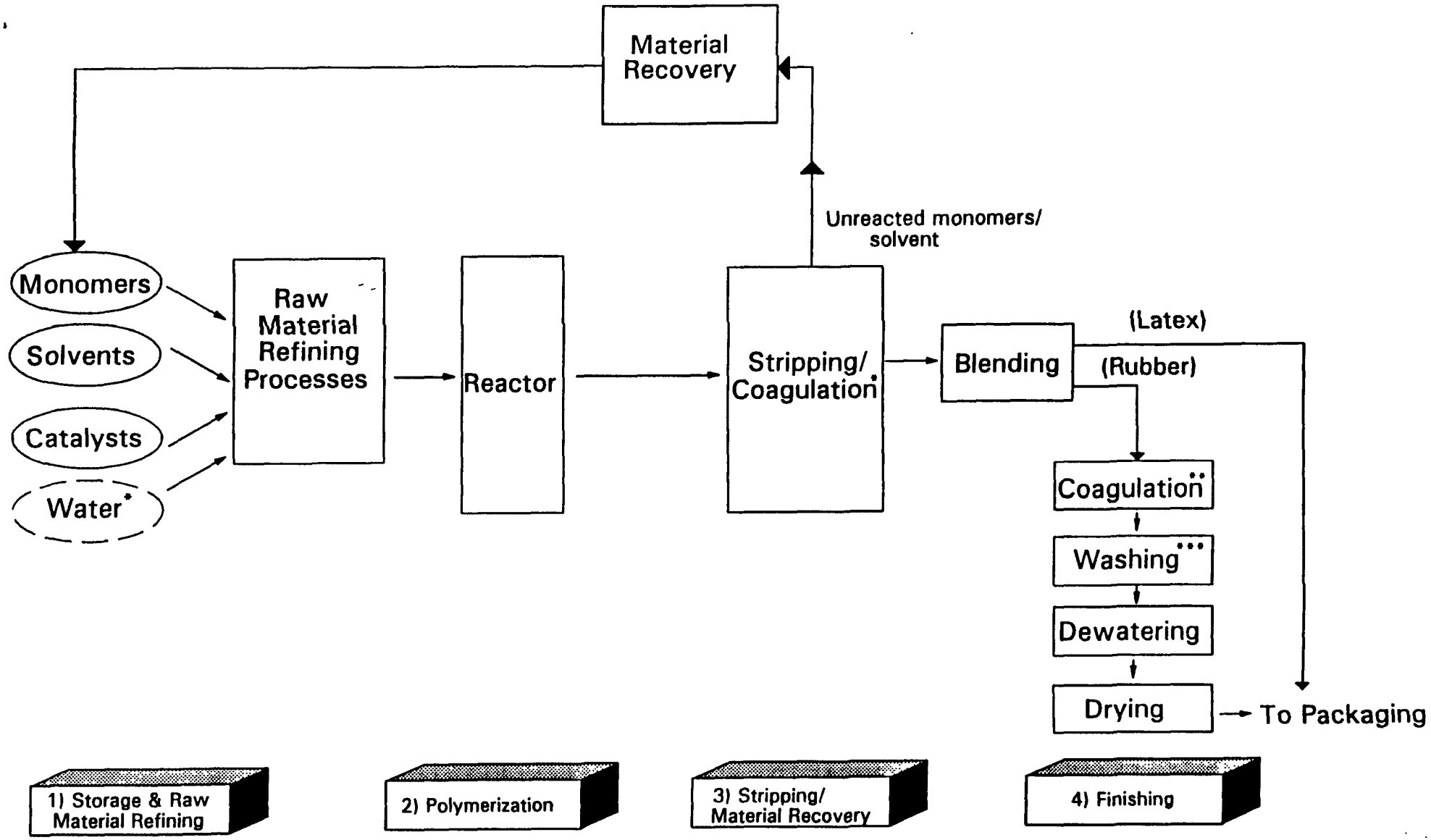

Figure 2. Simplified Flow Diagram for Elastomer Manufacturing Processes

*For Emulsion Processes

**Coagulation occurs during stripping in solvent & bulk processes, but during the finishing steps for emulsion processes

***Washing is not usually necessary in solution processes

Stripping and Material Recovery

Because the complete conversion of monomers to polymer chains is usually not obtained, unreacted monomer remains in the product following polymerization. In addition, if a solution process is used, organic solvents remain in the product, because they do not participate in the reaction. Therefore, the reactor contents are sent to a stripping operation following polymerization to recover product, unreacted monomers, and, if a solution process is used, solvent. This is usually accomplished using steam distillation. Stripping of the polymer both enhances product quality and facilitates recycling of monomer and/or solvent. Consumers of a polymer may specify the residual concentrations of monomer and solvent in the product.

Material recovery consists of removing relatively pure organic components from stripping operations vent streams. Typically, condensers are used to remove water vapor by reducing the temperature of the vent stream, and decanters then separate the condensed liquid into organic and water phases. In solution processes, agglomeration of product from the solution, or coagulation, is considered part of the stripping and material recovery operations. The steam that is used to strip residual monomers and solvent also acts to coagulate the polymer. In emulsion processes, coagulation is considered finishing, and is therefore included in the next section.

Finishing Operations

Finishing operations consist of blending, aging, coagulation (in emulsion processes), washing, and drying processes, depending on the ultimate use of the polymer. If the final polymer product is a latex emulsion, finishing operations are not required after coagulation. Blending involves addition of materials, such as anti-oxidants and extending oils, to enhance product quality. The aging process involves slow agitation of the polymer to allow off-gassing of residual compounds and to stabilize the latex.

In coagulation, product is agglomerated from the emulsion of polymer particles by adding an acid-brine solution. (As noted above, coagulation of solution processes is considered a part of stripping and material recovery.) Following coagulation, the polymer product is separated from the water and acid-brine slurry by filtration, washed to remove any remaining acid-brine solution, and dewatered again.

Drying of the polymer involves removing residual moisture remaining after the washing operation. This is commonly accomplished through the use of dewatering screens followed by extrusion and/or hot air dryers.

Elastomer Production Emission Points

There are four types of HAP emission sources commonly found at elastomer production facilities: storage and material handling, equipment leaks, process operations, and waste and wastewater collection and treatment operations.

Emissions from Storage and Material Handling

Different types of tanks are used to store various types of raw materials, products, and co-products, depending on the vapor pressure of the chemical. Table 3 presents vapor pressures of HAP compounds that are associated with the production of the elastomers identified in this memorandum. Those chemicals with vapor pressures greater than 14.7 pounds per square inch at atmospheric pressure (psia) (gases) are stored in pressurized vessels that are not vented to the atmosphere during normal operations. Liquids (chemicals with vapor pressures of 14.7 psia or less) are stored in horizontal, fixed roof, or floating roof atmospheric tanks, depending on the chemical properties and volumes to be stored. Liquids with vapor pressures less than 14.7 psia but greater than 11 psia are typically stored in fixed roof tanks that are vented to a control device.[4] Volatile liquids with vapor pressures less than 11 psia are usually stored in floating roof tanks because floating roof tanks have lower emission rates than fixed roof tanks within this vapor pressure range.

Emissions from atmospheric storage tanks typically occur as working losses. As a storage tank is filled with chemicals, volatile organic compound (VOC) laden vapors inside the tank become displaced and can be emitted to the atmosphere. Also, diurnal temperature changes result in breathing losses of VOC-laden vapors from atmospheric storage tanks.[4]

Residual concentrations of HAP are usually very low in finished elastomer products (less than 1 percent). However, because of the large volumes of finished elastomer produced, HAP and VOC emissions can still occur from raw and final product storage tanks, especially during product handling as a result of agitation, splashing, and contact with air during pneumatic transfer of dried elastomer product.

Emissions of HAP from storage tanks may be vented directly to the atmosphere or to control devices. Condensers can be used to recover vapors from vent streams before discharge to the atmosphere. Combustion of the vent stream in a flare is another method of reducing HAP emissions from storage tanks.

Table 3. Vapor Pressure of Compounds Associated With Elastomer Production[a]

Compound	Vapor pressure @ 20° C (psia)
Acrylonitrile	1.74
1,3-butadiene	34.72
Carbon tetrachloride	1.76
Chlorobenzene	
Chloroform	
Chloroprene	3.34
Ethylene dichloride	1.20
Ethylene oxide	
Epichlorohydrin	0.19
Hexane (n-Hexane)	2.35
Methyl chloride	72.03
Methylene chloride	
Propylene oxide	
Styrene	0.09
Toluene	0.42

[a] Lange. Handbook of Chemistry. 13th Edition. p. 10-28 and following.

Emissions From Equipment Leaks

Equipment leaks are continuous releases of process fluid or vapor from process equipment. These releases occur primarily at connections between components of equipment.[5] Emissions from pump seals, compressor seals, pipe flanges, valves, pressure relief devices, sample connections, and open-ended lines are collectively called equipment leaks. The characteristics of these emissions for the polymers and resins industry are similar to those associated with the Synthetic Organic Chemical Manufacturing Industry (SOCMI) and are thoroughly discussed in the Hazardous Organic NESHAP (HON); therefore, they will not be discussed in this memorandum.[4] Emissions from equipment leaks associated with operations downstream from coagulation equipment will be minimal due to low residual VOC and HAP content in the streams.

Equipment leak emissions are usually controlled by leak detection and repair (LDAR) procedures. Leaking components are identified, using an organic vapor analyzer or by inspection, and repaired or replaced.

Emissions From Process Operations

Process operations associated with elastomer production that may be HAP emission sources include vents and fugitives from monomer refining, polymerization, monomer stripping, material recovery, finishing, and drying operations.

Emissions from the reactors in the polymerization area result from initial charging of the reactants and/or from pressure relief, which may occur during the polymerization reaction. These emissions may be steady or sporadic depending on the mode of process operation, and generally comprise monomer(s) and solvent. The HAP concentration in reactor emissions can be relatively high due to the high concentrations of unreacted monomer and solvent present in the reactor. Reactor emissions are vented through pressure relief valves and are typically controlled by combustion in a flare.

While most of the monomer stripping and material recovery operations are not vented to the atmosphere, the decanters used in these processes for separating organic liquids from water may be open to the atmosphere, resulting in emissions of monomer(s) and solvent. Compressors, condensers, and distillation columns are used to refine the organic phase from decanters. Varying configurations of these components may be used depending on the physical characteristics of the materials being recovered and the economics of the situation. Because the recovery of materials is not complete, some vapor emissions of noncompressible or noncondensible gases (NCG's) occur. These gases often contain

residual HAP concentrations. The NCG streams may be flared if they are a significant emission source. These emissions can be batch emission but are usually continuous.

Emissions of HAP from vents associated with stripping and material recovery operations are typically flared or incinerated. These vent streams usually have higher HAP concentrations relative to vents from other processes that take place downstream from the stripping/recovery operations.

Finishing area operations may also be vented to the atmosphere. Emissions can be associated with the coagulation tanks, slurry or blending tanks, and dewatering screens and filters. Since the polymer has previously been stripped of VOC, the concentration of HAP in the product is much lower than during polymerization, stripping, or recovery operations; therefore, HAP concentrations in finishing area vent streams will also be much lower than the concentrations in reactor or stripper vent streams. Finishing area and dryer vents are generally uncontrolled, although combustion of the finishing area vent streams is practiced by some facilities.

Vents associated with drying are usually open to the atmosphere, and are often the largest source of process vent emissions from elastomer production. These vents are characterized by low HAP concentrations, but very large volumetric flow rates (e.g., 5 to 10 parts per million by volume (ppmv) HAP in 10,000-standard cubic feet per minute (scfm) vent stream). The elevated temperatures encountered in the dryers may increase the volatility of residual monomers and solvents that were not removed in the previous processing steps, and this may cause them to be emitted during drying operations.

Emissions From Wastewater Streams

In the manufacture of some elastomers, wastewater streams containing organic compounds are generated. Sources of wastewater containing HAP include the monomer refining, stripping, material recovery, and finishing processes, with the largest wastewater generation associated with the finishing process. No wastewater is produced in the drying operations. Specifically, sources of wastewater include: water used as a medium in a process; water used to wash impurities from reactants and elastomer products; water used to cool organic vapor streams; condensed steam from stripping and material recovery operations containing organics; and non-contact wastewater contaminated through equipment leaks (i.e., runoff). Potential sources of HAP emissions associated with wastewater collection and treatment systems include drains, manholes, trenches, surface impoundments, oil/water separators, storage and treatment tanks, junction boxes, sumps, and basins.[4] Organic compounds in the wastewater

can volatilize and be emitted to the atmosphere from these wastewater collection and treatment units if these units are open or vented to the atmosphere.

Control of HAP emissions from wastewater can be accomplished by reducing the contact between wastewater and the atmosphere. This can be done by covering the collection system and venting the vapors to a control device. The most effective method to reduce potential for atmospheric emission is reducing the HAP concentration in the wastewater. Carbon adsorption, steam, and air stripping can be used to reduce the HAP concentration in wastewater. Process modification may prevent the HAP from being discharged to wastewater.

PRODUCTION PROCESSES FOR SPECIFIC ELASTOMERS SOURCE CATEGORIES

The following sections define each of the nine elastomer source categories and describe the specific production process. The definition of each elastomer has been taken from the Source Category List.[6]

Butyl Rubber Production

The Butyl Rubber Production source category includes any facility that manufactures copolymers of isobutylene and isoprene. A typical composition of butyl rubber is approximately 97 percent isobutylene and 3 percent isoprene. Butyl rubber is very impermeable to common gases and resists oxidation. Table 1 summarizes major end uses of butyl rubber.

Modified, derivative, and halogenated copolymers and latexes are also included in this source category. Halogenated butyl rubbers are specialized butyl rubbers that are produced commercially by dissolving butyl rubber in hydrocarbon solvent and contacting the solution with gaseous or liquid elemental halogens, such as chlorine or bromine. Halogenated butyl rubber resists aging to a higher degree than the nonhalogenated type, and is more compatible with other types of rubber.[7]

Process Description for Butyl Rubber Production

A general process flow diagram for butyl rubber production is shown in Figure 3. Butyl rubber is typically made by a solution polymerization process in which isobutylene and isoprene are copolymerized in methyl chloride solvent. One U.S. facility was identified that actively produces butyl rubber. High vapor pressure necessitates that isobutylene monomer and methyl chloride solvent be stored in pressure vessels, although isoprene monomer may be stored in atmospheric tanks. Because this is a solution process, the monomers are sent from storage through drying towers to remove any water from these feed streams.

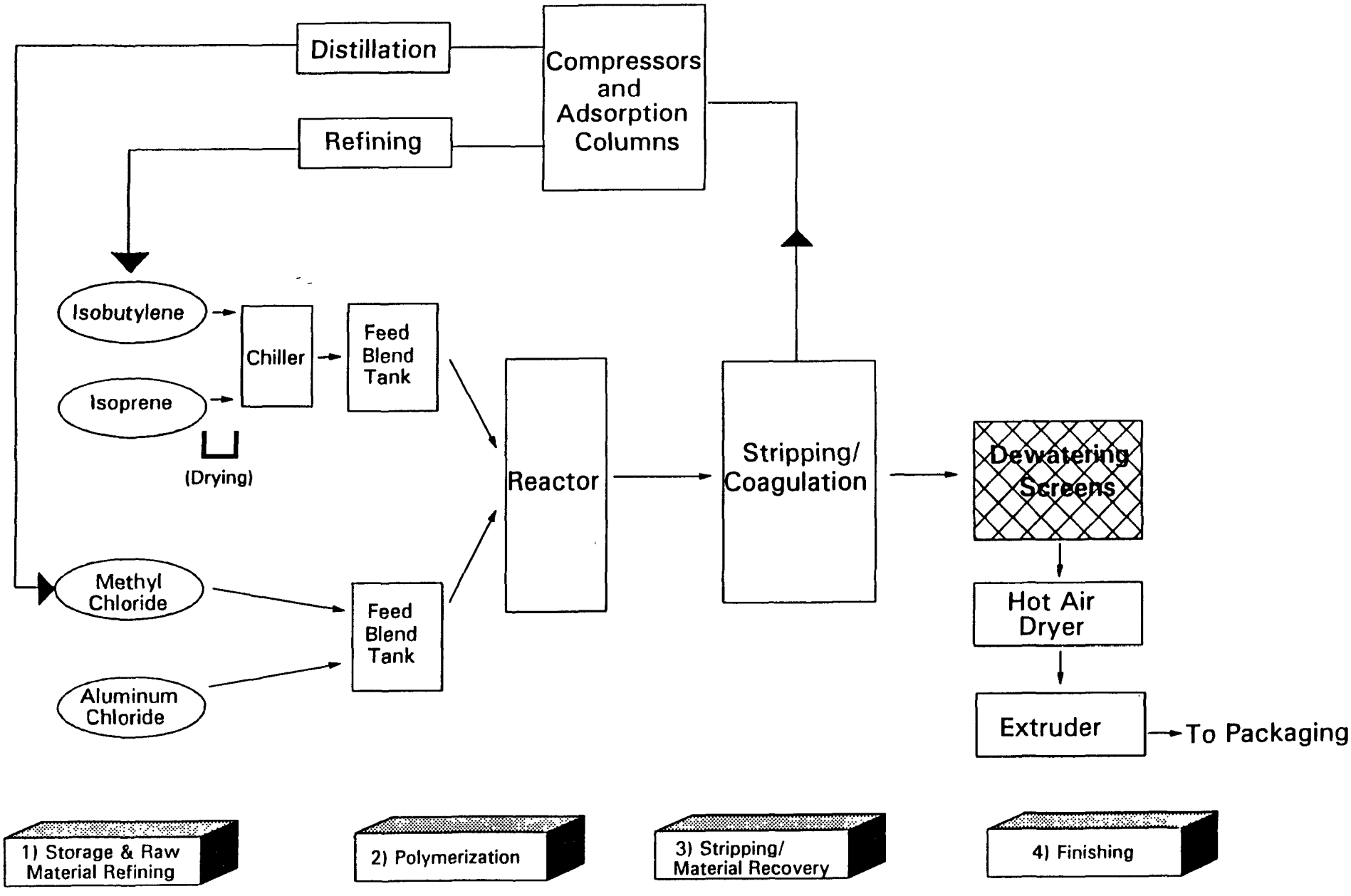

Figure 3. Butyl Rubber Production

The dried isoprene and isobutylene are chilled and then mixed in a feed blend tank. Methyl chloride (a HAP) is blended with a catalyst, aluminum chloride, in a separate feed tank. The monomer feed streams are chilled, so that the reaction occurs at a very low temperature (-100 to -90°C). The monomers are combined with the methyl chloride and aluminum chloride mixture in a reactor.

The resulting slurry is transferred from the reactor into an agitated tank (or several tanks in series), where steam and hot water are added to the stream to coagulate the polymer and strip the residual solvent and unreacted monomers.[8] Because the pressure is reduced and the temperature increased in this step, methyl chloride, unreacted isobutylene, and steam flash from the slurry as an overhead vapor. The overhead vapor is sent through compressors and adsorption columns to separate methyl chloride and water from isobutylene. The isobutylene stream is refined and recovered for recycle back to the reaction process. The methyl chloride is distilled from water and any other contaminants (e.g., short-chain oligomers), and recycled to the feed blend tank as solvent.

The butyl rubber leaves the stripping area in a water slurry and is passed through dewatering screens and a hot air dryer to remove most of the water. After drying, the rubber is then extruded and sent to final packaging. All process steps after the stripping area are open to the atmosphere.

Process Description for Halogenated Butyl Rubber Production

A general flow diagram for producing halogenated butyl rubber is shown in Figure 4. The production of halogenated butyl rubber (halobutyl) is also a solution process. One facility was identified that actively produces halogenated butyl rubbers (bromobutyl and chlorobutyl rubbers) in the U.S. Production of halogenated butyl rubber varies from butyl rubber production only in that, prior to stripping, the solution of polymer in an organic solvent is contacted with an elemental halogen, usually gaseous or liquid chlorine or bromine. Specifically, the methyl chloride solution of the butyl polymer is first transferred from the reactor into a solvent replacement process where methyl chloride is removed and hexane (another HAP) is added. This new solution of butyl polymer in hexane is then fed to the halogenation step, which occurs rapidly as a free radical substitution.

After halogenation, the hexane is stripped from the polymer using steam and reduced pressure. The overhead stream (hexane and steam) is processed to separate the hexane for recycle; the water is discharged. Coagulation takes place in the stripper. After coagulation, the polymer is held in slurry tanks. The polymer is dried by extrusion and sent to packaging.

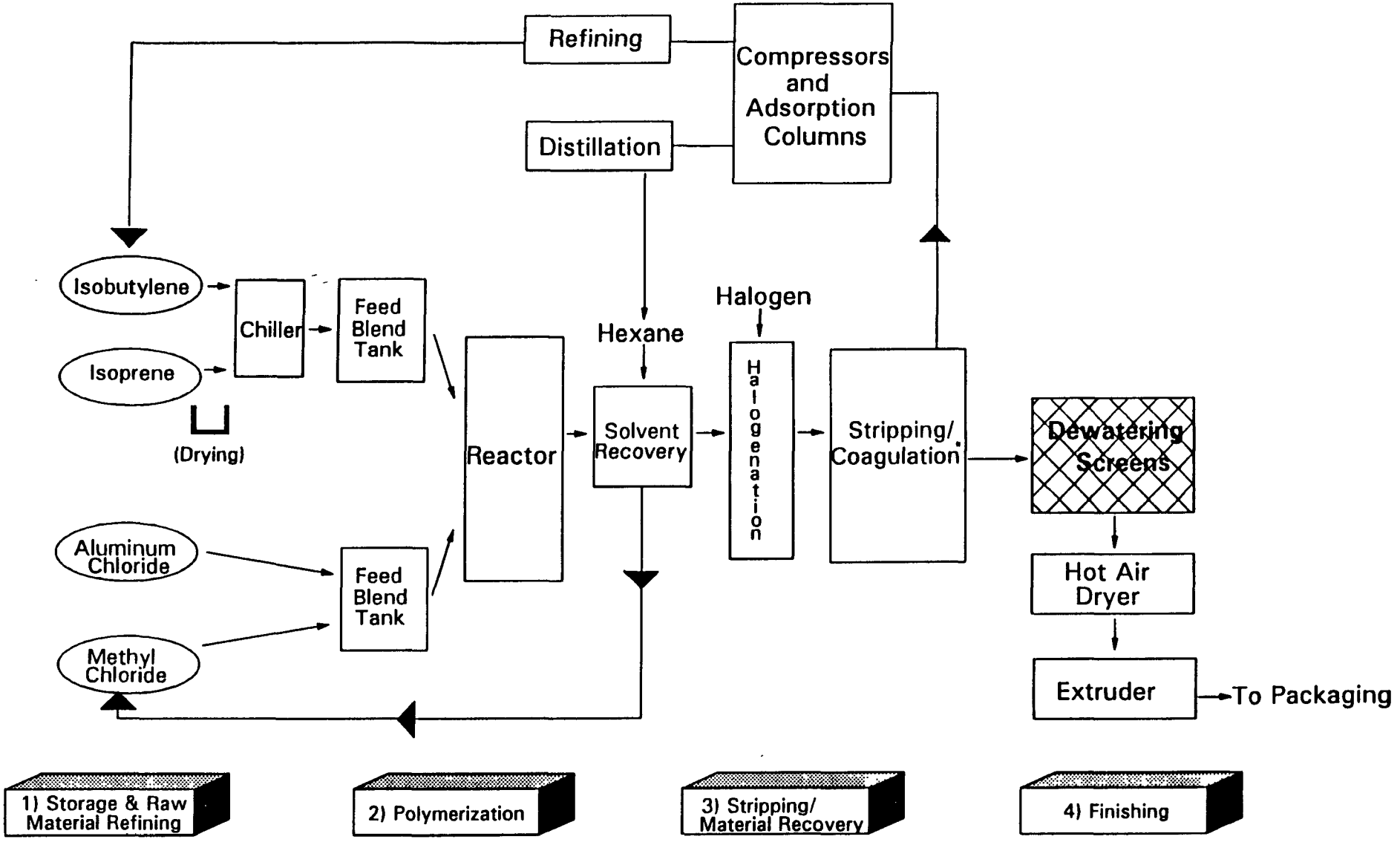

Figure 4. Halogenated Butyl Rubber Production

HAP and HAP Emission Points For Butyl Rubber Production

Methyl chloride is the prime HAP emitted from production of butyl rubber. Production of halogenated butyl rubber also emits hexane in addition to methyl chloride. Table 4 identifies potential HAP emission sources from butyl rubber (including halogenated butyl rubber) production. Emissions of HAP from pressurized storage tanks are negligible. Emissions from fixed roof tanks may vent directly to the atmosphere or to a control device. Emissions from the reactor vents during polymerization are low due to the very low reaction temperature of the butyl rubber polymerization process. Stripping area emissions are also low, because vapor streams from these process units are routed to the material recovery area. However, during maintenance of the material recovery process area, vapor streams from stripping operations are emitted directly to the atmosphere. The finishing operations and the dryer are significant sources of either methyl chloride or hexane emissions directly to the atmosphere. In halobutyl rubber production, the solvent replacement step is a potential source of methyl chloride emissions.

Sources of wastewater containing HAP include material recovery and finishing operations, as well as rainwater runoff from butyl rubber manufacturing processes. The methyl chloride distillation column and separation of methyl chloride from isobutylene are sources of methyl chloride to wastewater. The finishing area wastewater discharges are also likely to contain methyl chloride, although less than the other streams. Wastewater from rainwater runoff can contain HAP, although this is not a significant source. The discharge of HAP in rainwater runoff primarily depends on the location of the processes (i.e., which operations occur outside in uncovered areas) and general housekeeping practices (e.g., cleanup of leaks and spills).

Epichlorohydrin Rubber Production

The Epichlorohydrin Rubber Production source category includes any facility that polymerizes or copolymerizes epichlorohydrin (EPI) to form elastomers. The main products of this source category are polyepichlorohydrin, epi-ethylene oxide (EO) copolymer, epi-allyl glycidyl ether (AGE) copolymer, and epi-EO-AGE terpolymer.

Elastomers based on EPI are important commercial products because when vulcanized they are heat resistant, fuel and oil resistant, ozone resistant, and have a low temperature flexibility. In addition, they provide excellent resistance to vapor permeation by hydrocarbons, fluorocarbons, and air.[9] Table 1 summarizes major end uses of epichlorohydrin rubber.

Table 4. Potential Sources of HAP Emissions From Butyl and Halobutyl Rubber Production

	Methyl Chloride	Hexane[a]
Storage and Handling	X	X
Equipment Leaks	X	X
Process Vents		
Monomer Refining		
Polymerization	X	X
Stripping		
Material Recovery	X	X
Finishing	X	X
Drying	X	X
Wastewater		
Monomer Refining	X	X
Polymerization		
Stripping		
Material Recovery	X	
Finishing	X	
Drying		

[a] Hexane is only emitted from halobutyl rubber production.

Process Description for Epichlorohydrin Rubber Production

A general process flow diagram for epichlorohydrin rubber production is shown in Figure 5. Epichlorohydrin rubber is produced by a solution polymerization process. One facility in the U.S. was identified that actively produces epichlorohydrin rubber.

Epichlorohydrin (EPI) monomer is a HAP, and is generally stored in fixed roof atmospheric tanks. Toluene, which is also a HAP, is the solvent most commonly used to polymerize EPI, and is typically stored in fixed roof tanks at atmospheric pressure. If comonomers, such as ethylene oxide and propylene oxide, are used in the polymerization reaction, they are stored under pressure.

Dry epichlorohydrin is combined in a reactor with a catalyst and solvent, and in some cases, with comonomers. The catalyst typically used is a mixture of a trialkylaluminum compound, water, and acetylacetone. After polymerization, the reactor contents are transferred to a coagulation tank. In the coagulation tank, molecules in the rubber solution are cross-linked by adding difunctional reagents that react with the chloromethyl groups and release hydrochloric acid as a byproduct. Coagulation is then completed by adding a hot caustic solution to neutralize the hydrochloric acid.

Following coagulation, the rubber is steam stripped to remove any unreacted epichlorohydrin and solvent, which are recovered from the condensed steam overheads by distillation. Recovered monomer and solvent are sent back to raw material storage. After the material recovery operations, the rubber is dewatered, dried, and sent to packaging.

HAP and HAP Emission Points For Epichlorohydrin Rubber Production

The potential HAP emission sources for epichlorohydrin production are shown in Table 5. Emissions of HAP from fixed roof atmospheric tanks (epichlorohydrin and toluene) may vent directly to the atmosphere or to a control device. Pressurized storage vessels have negligible HAP emissions (ethylene and/or propylene oxide). The emissions from the reactor vents (polymerization) contain epichlorohydrin monomer and solvent, which is typically toluene. The vents from the material recovery stripper may contain small amounts of epichlorohydrin and toluene. Small amounts of toluene will also be emitted from the dryer vents.

Sources of wastewater containing HAP include the coagulation, material recovery, and polymer dewatering operations, as well as rainwater runoff from the epichlorohydrin production facility. Wastewater from the coagulation process (polymerization) will contain unreacted monomer and toluene. The

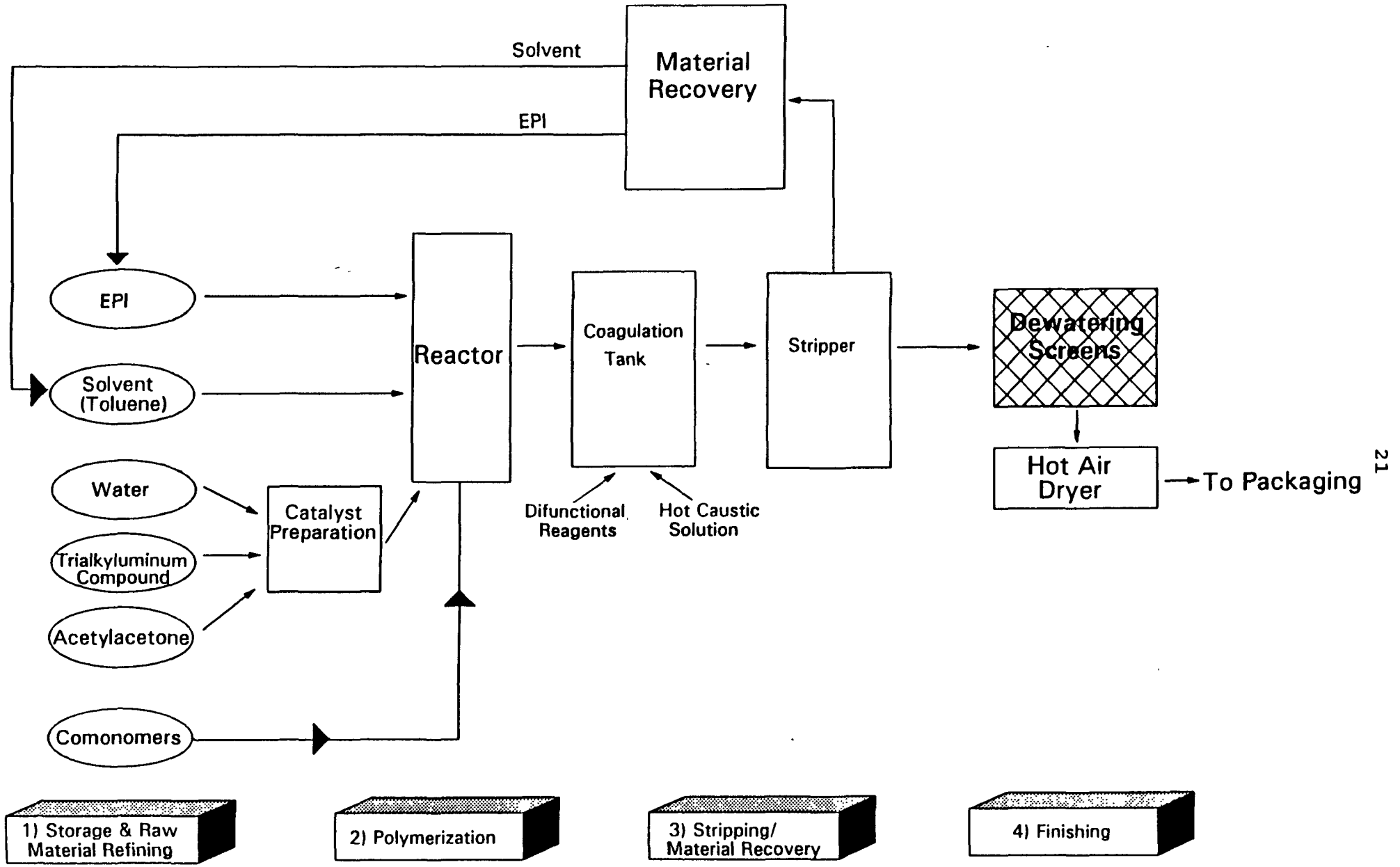

Figure 5. Epichlorohydrin Rubber Production

Table 5. Sources of HAP Emissions From Epichlorohydrin Rubber

	Epichlorohydrin	Toluene
Storage and Handling	X	X
Equipment Leaks	X	X
Process Vents		
Monomer Refining	X	X
Polymerization	X	X
Stripping	X	X
Material Recovery	X	X
Finishing	X	X
Drying	X	X
Wastewater		
Monomer Refining	X	X
Polymerization		
Stripping	X	X
Material Recovery	X	X
Finishing	X	X
Drying		

wastewater from the stripping operations will contain small amounts of monomer and solvent. Some monomer and solvent will also be present is the wastewater from the dewatering operations. Runoff from the elastomer production areas may contain monomer and solvent as well, depending on the facility's design and housekeeping practices.

Ethylene-Propylene Rubber Production

The Ethylene-Propylene Rubber Production source category includes any facility engaged in the production of ethylene-propylene copolymers or ethylene-propylene terpolymers. Ethylene-propylene copolymers (EPM's) result from the polymerization of ethylene and propylene and contain a saturated chain of the polymethylene type. The production of EPM accounts for 20 percent of current ethylene propylene elastomer production. The EPM polymer does not contain any double bonds, and therefore, cannot be vulcanized.[10] Where a vulcanized product is needed, a diene monomer is added to the reaction sequence to make a ethylene-propylene diene monomer (EPDM). This is sometimes termed a terpolymer. Both EPM and EPDM can be made by continuous solution polymerization, through the suspension process, or by bulk polymerization in a propylene slurry (therefore, this is sometimes termed "slurry" polymerization). Because no facilities were identified that actively use the bulk process, only the former two production processes are described below.[11] Table 1 summarizes major end uses of ethylene-propylene rubber.

<u>Process Description for Ethylene-Propylene Rubber Production by Solution</u>

A general process flow diagram for solution polymerization of EPM and EPDM is shown in Figure 6. Four facilities were identified in the U.S. that actively produce EPM and EPDM by the solution process.

Solution polymerization of EPM is a process where the ethylene and propylene monomers are compressed to liquid form and combined in the reactor with the catalyst and solvent. The monomers and solvent, which is most commonly hexane (a HAP), are mixed in a pressurized, back-flow, stirred reactor. The polymer-solvent solution is pumped from the reactor through an in-line mixer. In the mixer, a shortstopping agent is added to curtail further polymerization and water is added to begin coagulation.

Next, the mixture of water, solvent, unreacted monomer, and polymer is transferred to a decanter where the water is removed. The mixture is then pumped through another in-line mixer where antioxidant, and sometimes extender oil, is added. This mixture is then processed in a steam stripper to flash off the solvent and any unreacted propylene, and to complete polymer coagulation.

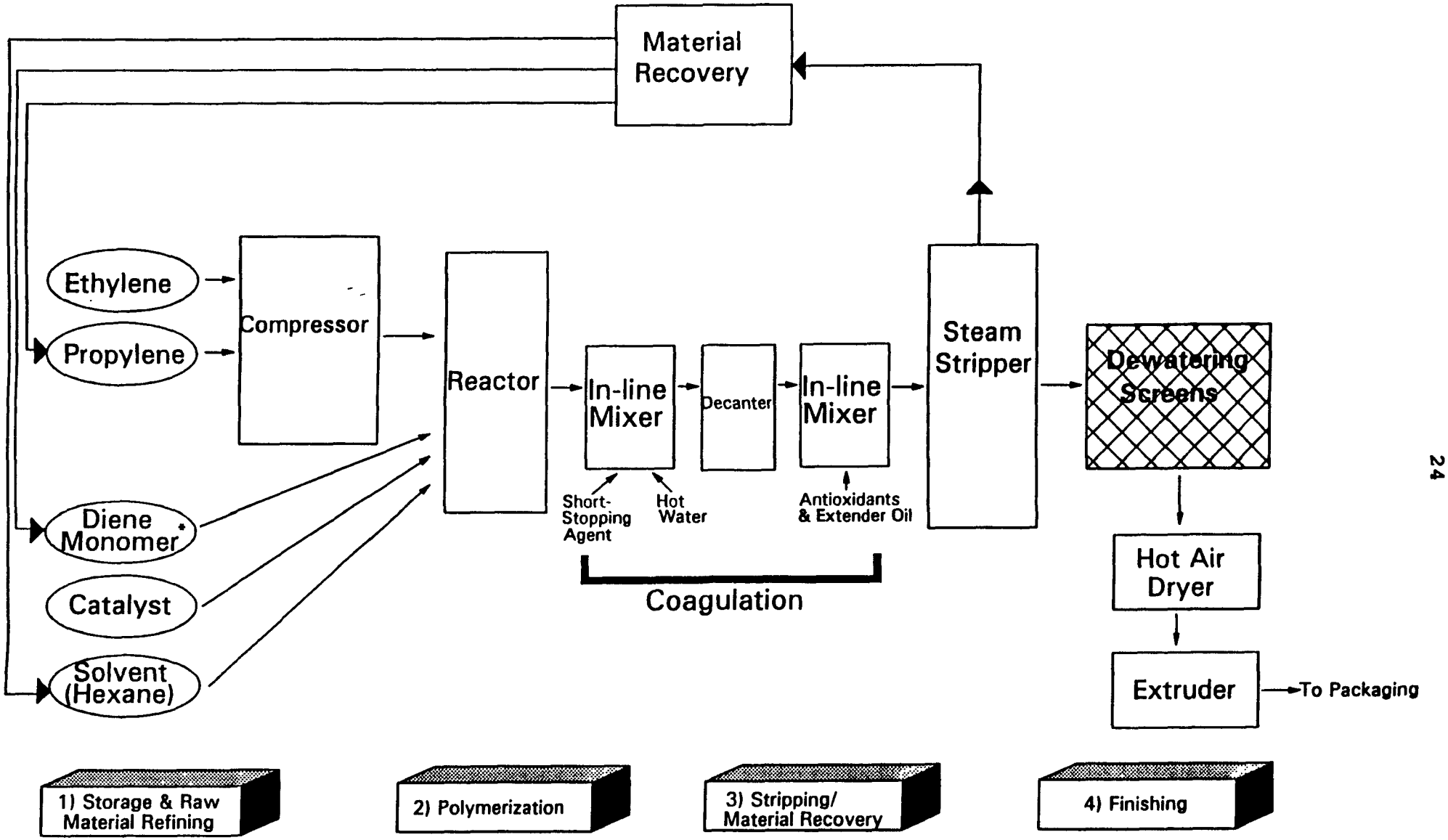

Figure 6. Ethylene-Propylene Rubber Production (by solution) (EPM and EPDM)

*In EPDM Production only

(The conversion of ethylene to polymer is almost 100 percent, so that ethylene recovery is not economical.) The overhead vapor is compressed, condensed, and distilled to separate the propylene, solvent, water, and other impurities (e.g., oligomers). The recovered propylene and solvent are recycled for reuse. The water and other impurities are discharged as waste or wastewater. The stripped, coagulated polymer is dewatered, dried, extruded, and then baled.

Manufacture of EPDM follows the same process described above, except that a diene monomer, most commonly ethylidene norbornene, is combined with ethylene and propylene in the reactor. Other monomers that can be used include 1,4-hexadiene or dicyclopentadiene. The diene monomer is recovered in the distillation steps that follow steam stripping.

Process Description for Ethylene-Propylene Rubber Production by the Suspension Process

Only one facility in the U.S. was identified that uses the suspension polymerization process to manufacture ethylene-propylene rubber. In the suspension polymerization process, rubber is actually suspended in rather than dissolved in the solvent as in the solution process.[12] No coagulation step is needed, because the solvent is simply washed off the rubber.

Suspension polymerization uses a boiling liquid reactor design with liquefied monomer as the autorefrigerant.[13] A mixture of cyclohexane and toluene is used to dissolve the catalyst prior to injection into the reactor(s). Suspension reactors operate at relatively high pressures and low temperatures.

HAP and HAP Emission Points For Ethylene-Propylene Production

The potential HAP emission sources from EPM and EPDM production by the solution process are shown in Table 6. Emissions of HAP such as hexane from fixed roof atmospheric storage tanks may vent directly to the atmosphere or to a control device. Emissions from the reactor vents will contain hexane, and distillation column vents will also be a source of solvent emissions during material recovery. Vents associated with dewatering, drying, and extrusion processes will emit solvent, although the concentration of solvent in the vent streams will be lower because polymer has previously been through stripping operations.

Wastewater discharges that may contain HAP include the decanter between the in-line mixers, the water from the post-stripping area distillation processes, the dewatering screens, and the extruder.

Table 6. Sources of HAP Emissions From Ethylene-Propylene Rubber Production By Solution Polymerization[a]

	Methylene Chloride	Hexane
Storage and Handling	X	X
Equipment Leaks	X	X
Process Vents		
Monomer Refining	X	
Polymerization	X	X
Stripping		
Material Recovery	X	X
Finishing	X	X
Drying	X	X
Wastewater		
Monomer Refining	X	
Polymerization		
Stripping	X	X
Material Recovery	X	X
Finishing	X	X
Drying		

[a] These are two possible solvents for the production of these processes. Both solvents are unlikely to be used concurrently.

Emissions of HAP from the suspension process are generally less than from the solution process, because although the suspension process solvent does contain a HAP (toluene), the dryer emissions are much lower because the rubber is not dissolved in the solvent.[12] Further, the hexane used in the solution process is a high boiling material relative to the monomers and has a greater ability to solvate the polymer; therefore, it is more difficult to completely remove from the polymer prior to finishing.[13] This also leads to higher emissions from the solution process compared to the suspension process.

Hypalon™ Production

The Hypalon™ Production source category includes any facility that produces a group of elastomers made of chlorosulfonated polyethylene, or Hypalon™. Hypalon™ is produced by reacting polyethylene with chlorine and sulfur dioxide, transforming the thermoplastic polyethylene into a vulcanizable elastomer. Hypalon™ offers superior resistance to oil, ozone, and heat compared with other elastomers and is used for wire and cable insulation, shoe soles and heels, automotive components, and building products.[14] Table 1 summarizes major end uses of Hypalon™.

Process Description for Production of Hypalon™

A general process flow diagram for Hypalon™ production is shown in Figure 7. As described below, although a solvent is used in this process, it is not a true polymerization solution reaction, because the raw material, polyethylene, is a polymer, not a monomer. One facility in the U.S. was identified that actively produces Hypalon. Production of Hypalon is conducted in a solvent reaction medium, which is usually carbon tetrachloride (a HAP), but can be chlorobenzene, chloroform, methylene chloride (also all HAP), or other similar compounds.

The chlorine used in manufacturing Hypalon™ is stored under pressure. Carbon tetrachloride solvent is generally stored in fixed roof atmospheric tanks.

To produce Hypalon™, a free radical initiator and polyethylene pellets are dissolved in an organic solvent inside a reactor. Chlorine and sulfur dioxide gases (or sulfurylchloride) are also added to the reactor. Because polyethylene is a polymer, the reaction to produce Hypalon™ is considered a substitution reaction by free radical chemistry. After the reaction is completed, the unreacted gaseous chlorine and sulfur dioxide are recovered from the reactor by vacuum.

Subsequent to the reactor, stripping and drying operations are combined into one operation. The mixture exiting the reactor

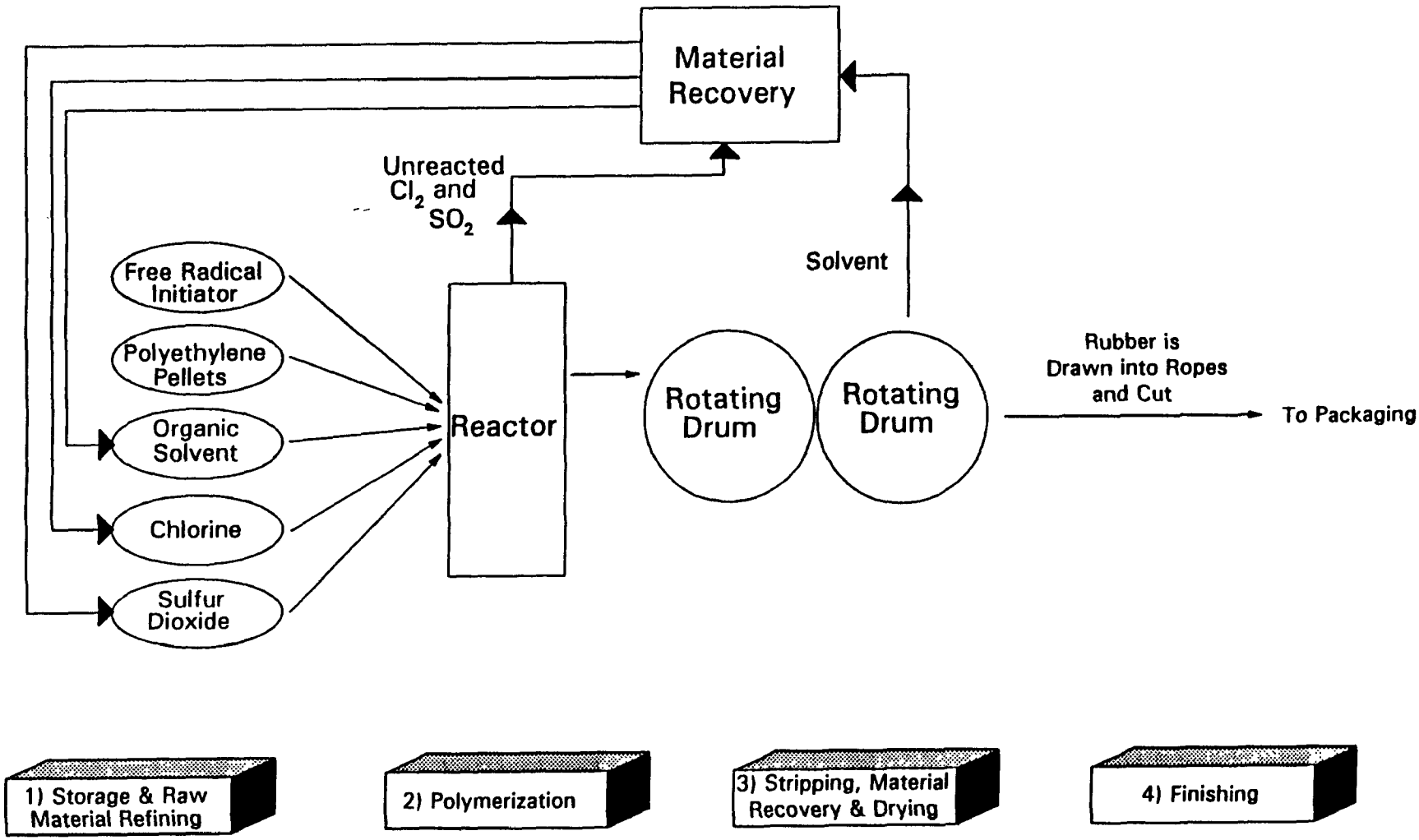

Figure 7. Hypalon™ Production

is fed over two rotating drums that are heated by steam. The heat volatilizes the dry solvent from the polymer as the dry product is formed; the solvent is vented to material recovery operations. Two vapor streams are generated -- one that is low concentration and one that is high concentration. The high concentration stream is compressed, condensed, and recycled as solvent. The low concentration stream is passed through a carbon adsorption column, which generates a solvent-rich stream upon regeneration (by steam), which is distilled to generate a recyclable solvent stream, water (which is discharged), and hazardous waste (which is incinerated). The recovered solvent is condensed and returned to solvent storage. The rubber product is drawn into ropes, cut, and sent to product packaging.

HAP and HAP Emission Points For Hypalon Production

Potential emissions of HAP from Hypalon™ production are shown in Table 7. Emissions of HAP from pressurized vessels are negligible. Emissions of solvent from fixed roof storage tanks may be vented directly to the atmosphere or to a control device. Chlorine gas and solvent may be emitted from vents associated with venting the reactor. Low solvent emissions are expected from the blending tank and filter vents.

The majority of HAP emissions (chloroform and carbon tetrachloride) come from the material recovery operation vents. Chloroform is generated during the substitution reaction. The distillation column is the only source of wastewater that may contain HAP.

Neoprene Rubber Production

The Neoprene Production source category includes any facility that produces polychloroprene, or Neoprene, by polymerization of chloroprene (2-chloro-1, 3-butadiene). The specific physical properties of Neoprene rubber depend on the compounding ingredients and processes used on the raw polychloroprene after it is produced. Neoprene resists oxidation, heat, oil, and flame. Table 1 summarizes major end uses of Neoprene rubber.

Process Description for Production of Neoprene Rubber and Latex

A general process flow diagram for the production of Neoprene by the batch emulsion process is shown in Figure 8. Neoprene is generally produced by a free radical emulsion process in the presence of elemental sulfur using a batch type of operation. Three facilities were identified in the U.S. that actively produce Neoprene rubber and latex. Although other methods may be used, no active facilities have been identified that do not use the conventional emulsion process.

Table 7. Sources of HAP Emissions From Hypalon™ (Chlorosulfonated Polyethylene) Production

	Cl_2	Carbon Tetrachloride	Chloroform
Storage and Handling	X	X	
Equipment Leaks	X	X	
Process Vents			
Monomer Refining			
Polymerization			
Stripping			
Material Recovery	X	X	X
Finishing			
Drying		X	X
Wastewater			
Monomer Refining		X	
Polymerization			
Stripping			
Material Recovery		X	X
Finishing			
Drying			

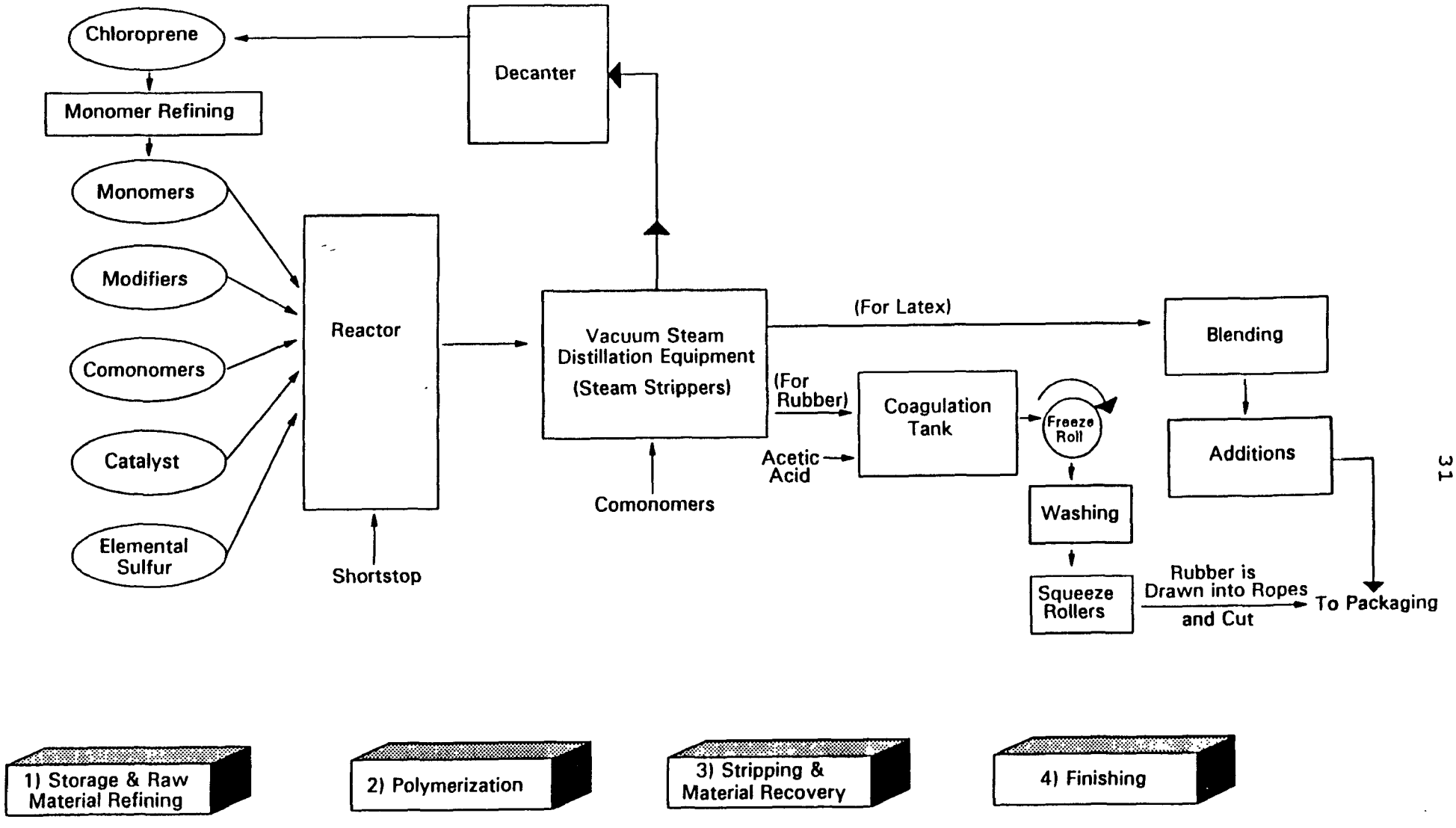

Figure 8. Neoprene and Latex Production
(By Batch Emulsion Process)

Comonomers such as 2,3-dichloro-1,3-butadiene and 2,3,4-trichloro-1-butene may be polymerized with chloroprene (a HAP) to produce desired properties of the rubber product. These comonomers are typically produced from chlorine (a HAP) and a fraction of the refined chloroprene stream, and are refined at the Neoprene production facility in a complex series of reaction, separation, and purification steps. Chloroprene and comonomers are typically stored in fixed roof atmospheric tanks. Before being sent to the reactor, polymerization inhibitors and impurities are removed by steam distillation.

The prepared monomers, modifiers, and any comonomers are emulsified with an alkaline-rosin soap, and are charged to the reactor. Catalyst and the appropriate amount of elemental sulfur, determined by the desired polymer chain length, are also added to the reactor. The temperature in the reactor is controlled by the circulation of cold brine through a water jacket surrounding the reactor. The extent of monomer conversion can be monitored by changes in the specific gravity of the reactor contents. At the desired conversion (between 70 and 90 percent), a shortstop (usually tetraethylthiuram disulfide) is added to terminate the polymerization reaction.

After polymerization, the crude Neoprene latex is sent from the reactor through vacuum steam distillation equipment to strip residual chloroprene from the polymer before it is coagulated and separated from the emulsion. Other comonomers are added in relatively small quantities, and should be 100 percent consumed during the reaction. During stripping, the latex is held in an agitated tank under vacuum. Steam is fed into the bottom of the tank and moves up through the latex, removing the unreacted chloroprene. The steam and chloroprene from the top of the tank are condensed, and the chloroprene is separated from the water by decanting. The recovered chloroprene is then recycled back to monomer refining operations.

Following stripping operations, the Neoprene latex is sent to product finishing operations. If the final product is to be a latex, finishing consists of blending the stripped latex and adding any product-specific additives (e.g., antioxidants). However, if the final product desired is solid Neoprene rubber, then the rubber must be isolated from the latex emulsion. The most prevalent polychloroprene isolation technique involves freezing.

In the freeze-roll isolation technique, the latex is combined with an amount of acetic acid that is not quite enough to begin coagulation. This "sensitizes" the latex, which is passed over a cooled drum where the latex sheet is frozen and the rubber is coagulated.[15] The rubber sheet is then removed from the drum and washed with warm water. The washed sheet is then sent through squeeze rollers to remove the washwater before being

dried with hot air. Finally, the dried rubber is formed into ropes, which are cut and bagged.

HAP and HAP Emission Points For Production of Neoprene Rubber and Latex

Table 8 shows the potential HAP emission sources for Neoprene production. Emissions of HAP (chloroprene) from storage tanks may be vented directly to the atmosphere or to a control device. Chloroprene is also emitted from the stripping operation vents. Emissions of chloroprene from the coagulation and separation areas are low primarily due to the low temperature of the freeze roll process. Emissions from dryer vents are made up of residual chloroprene monomer.

Sources of wastewater containing HAP include the monomer refining, stripping, isolation, and polymer washing operations, as well as rainwater runoff from Neoprene manufacturing areas. Wastewater from the monomer refining process is expected to contain mostly reaction inhibitors and impurities, although very low concentrations of chloroprene may be present. The comonomer refining processes generate chlorine and hydrogen chloride emissions and wastewater discharges that contain chlorine and hydrogen chloride. The wastewater stream with the greatest HAP concentration is associated with the stripping process. Wastewater from the decanters will have a high loading of chloroprene. Runoff from polymer production areas may have high concentrations of chloroprene monomer as well, depending on the facility's design and housekeeping practices. The wastewater streams from the isolation and washing areas, however, are expected to have low concentrations of chloroprene.

Nitrile Butadiene Rubber and Latex Production

The Nitrile Butadiene Rubber Production source category includes any facility that manufactures copolymers of unsaturated nitriles and dienes; the latter are usually acrylonitrile and 1,3-butadiene. Nitrile rubber resists oils, solvents, water, salts, and soaps. The rubber's resistance to gas and oil permeation increases with increasing acrylonitrile content, while its elastomeric properties increase with increasing butadiene content. Most grades of nitrile rubber available today have between 20 and 50 percent acrylonitrile content.[16] Table 1 summarizes major end uses of nitrile butadiene rubber and latex.

Process Description for Production of Nitrile Butadiene Rubber and Latex

A general process flow diagram for NBR and NBL is shown in Figure 9. Nitrile butadiene rubber (NBR) and latex (NBL) are produced by emulsion polymerization of acrylonitrile and butadiene. Solvent, bulk, or other methods can also be used to

Table 8. Sources of HAP Emissions From Neoprene (Polychloroprene) Production

	Cl_2	HCl	Chloroprene	Toluene
Storage and Handling	X		X	
Equipment Leaks	X		X	
Process Vents				
Monomer Refining	X	X	X	X
Polymerization			X	
Stripping			X	
Material Recovery			X	
Finishing			X	
Drying			X	
Wastewater				
Monomer Refining			X	X
Polymerization				
Stripping			X	
Material Recovery			X	
Finishing			X	
Drying				

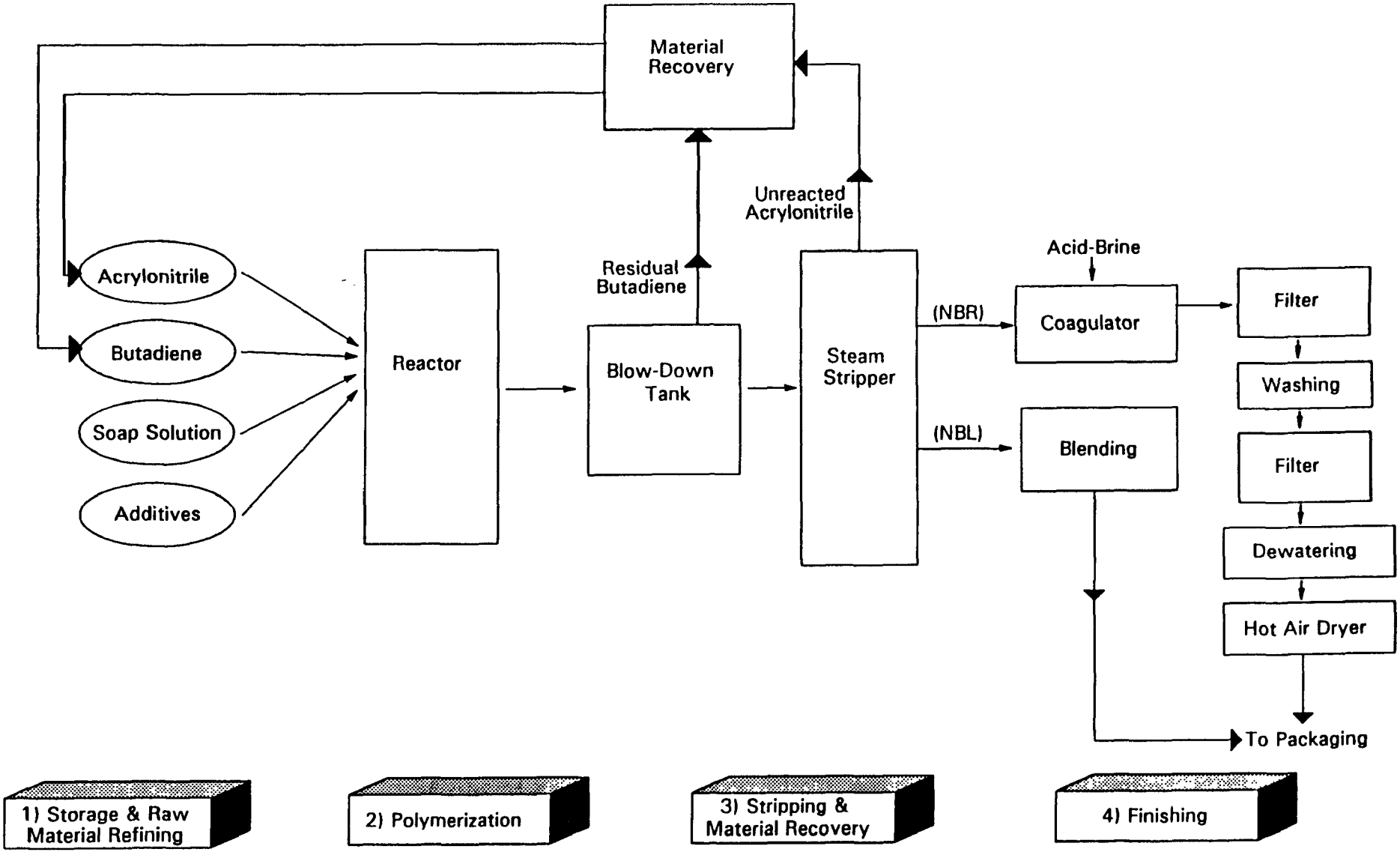

Figure 9. Nitrile Butadiene Rubber and Latex Production (NBR and NBL)

produce NBR and NBL. In the U.S., four facilities have been identified that currently produce NBR, and three facilities have been identified that currently produce NBL.

Acrylonitrile is generally stored in fixed roof atmospheric tanks. Butadiene is stored under pressure. To produce NBR and NBL, butadiene and acrylonitrile monomers are combined in a reactor with a soap solution and additives.

Once polymerization is completed, the reactor contents are expelled into a blow-down tank. This causes the residual butadiene to flash from the mixture. This vent stream is cooled to condense water and acrylonitrile. The uncondensed butadiene is compressed and sent back to monomer storage.

Following blow-down, the emulsion is sent to a steam stripper to remove the majority of unreacted acrylonitrile. The acrylonitrile is separated from the condensed steam by a decanter, purified, recovered by distillation, and sent back to monomer storage.

After steam stripping, the emulsion is coagulated by adding an acid-brine solution. The resulting crumb rubber is removed from the liquid by mechanical filtration, washed to remove residual acid-brine solution, filtered again, and mechanically dewatered. Finally, the product goes to a hot air dryer to remove the remaining water before packaging.

To produce NBL, the coagulation and drying steps described above are omitted, and the latex product is finished by blending small amounts of antioxidants and other specialty ingredients.

HAP and HAP Emission Points For Production of Nitrile Butadiene Rubber and Latex

Potential HAP emission sources from NBR and NBL production are shown in Table 9. Emissions of HAP from atmospheric storage tanks (acrylonitrile) may be vented directly to the atmosphere or to a control device. Butadiene emissions from pressure vessels are negligible. Butadiene is the dominant HAP emitted from the initial monomer recovery process (blow-down tank). Acrylonitrile and small amounts of butadiene are emitted from the stripping operations. The emissions from coagulation, filter, and washing vents contain mostly acrylonitrile, because the majority of butadiene has been removed from the latex in previous steps. Acrylonitrile is also emitted from the hot air dryer vents.

Sources of wastewater containing HAP include the stripping, coagulation, monomer recovery (including distillation columns), and polymer washing operations, as well as rainwater runoff. Since butadiene has a high vapor pressure, it is rapidly volatilized from wastewater and therefore present in very small

Table 9. Sources of HAP Emissions From Nitrile Butadiene Rubber and Latex Production

	Acrylonitrile	Butadiene
Storage and Handling	X	
Equipment Leaks	X	X
Process Vents		
Monomer Refining		
Polymerization	X	X
Stripping	X	X
Material Recovery	X	
Finishing	X	
Drying	X	
Wastewater		
Monomer Refining		
Polymerization		
Stripping	X	
Material Recovery	X	
Finishing	X	
Drying		

concentrations. Wastewater from the stripping process will contain acrylonitrile and small amounts of butadiene. The wastewater stream from the coagulation process will also contain acrylonitrile. Wastewater from the dewatering will have less acrylonitrile than sources upstream of this operation. Runoff from the polymer production areas may have high concentrations of acrylonitrile as well, depending on the facility's design and housekeeping practices.

Polybutadiene Rubber Production

The Polybutadiene Rubber Production source category includes any facility that polymerizes 1,3-butadiene to produce polybutadiene. Table 1 summarizes major end uses of polybutadiene rubber.

Process Description for Polybutadiene Rubber Production by Solution

A general process flow diagram for production of polybutadiene rubber (PBR) by solution polymerization is shown in Figure 10. Although PBR can be made through solution or emulsion polymerization, all five facilities identified as currently active in the U.S. use solution polymerization. Four of these facilities also manufacture styrene-butadiene rubber by solution. The production process is similar to that of NBR, except that the only monomer involved is 1,3-butadiene.

Because of its high volatility, butadiene must be stored under pressure. The typical solvents used in PBR production via the solution process are generally stored in fixed roof atmospheric tanks. Prior to being charged to the reactor, inhibitors are removed from the butadiene using a caustic contactor, and the monomer and solvent are thoroughly dried. The solvent most commonly used is hexane, although benzene, toluene, and cyclohexane can also be used. All of these solvents are HAP except cyclohexane. The solvent used in the polymerization process impacts the characteristics of the final polymer product.

Following the raw material drying process, butadiene, solvent, and catalyst are combined in the reactor. The catalysts used are organic lithium compounds or coordinating catalysts containing metals in reduced valence states.[17] The polymerization reaction proceeds to a percent conversion greater than 98 percent. Following polymerization, the reactor contents, called "cement" are transferred to a blow-down tank to remove unreacted butadiene monomer. The blow-down vapor stream is cooled to condense butadiene, and the butadiene is compressed and sent to monomer storage.

Following blow-down, the cement is transferred to a steam stripping operation, which causes the polymer to coagulate into

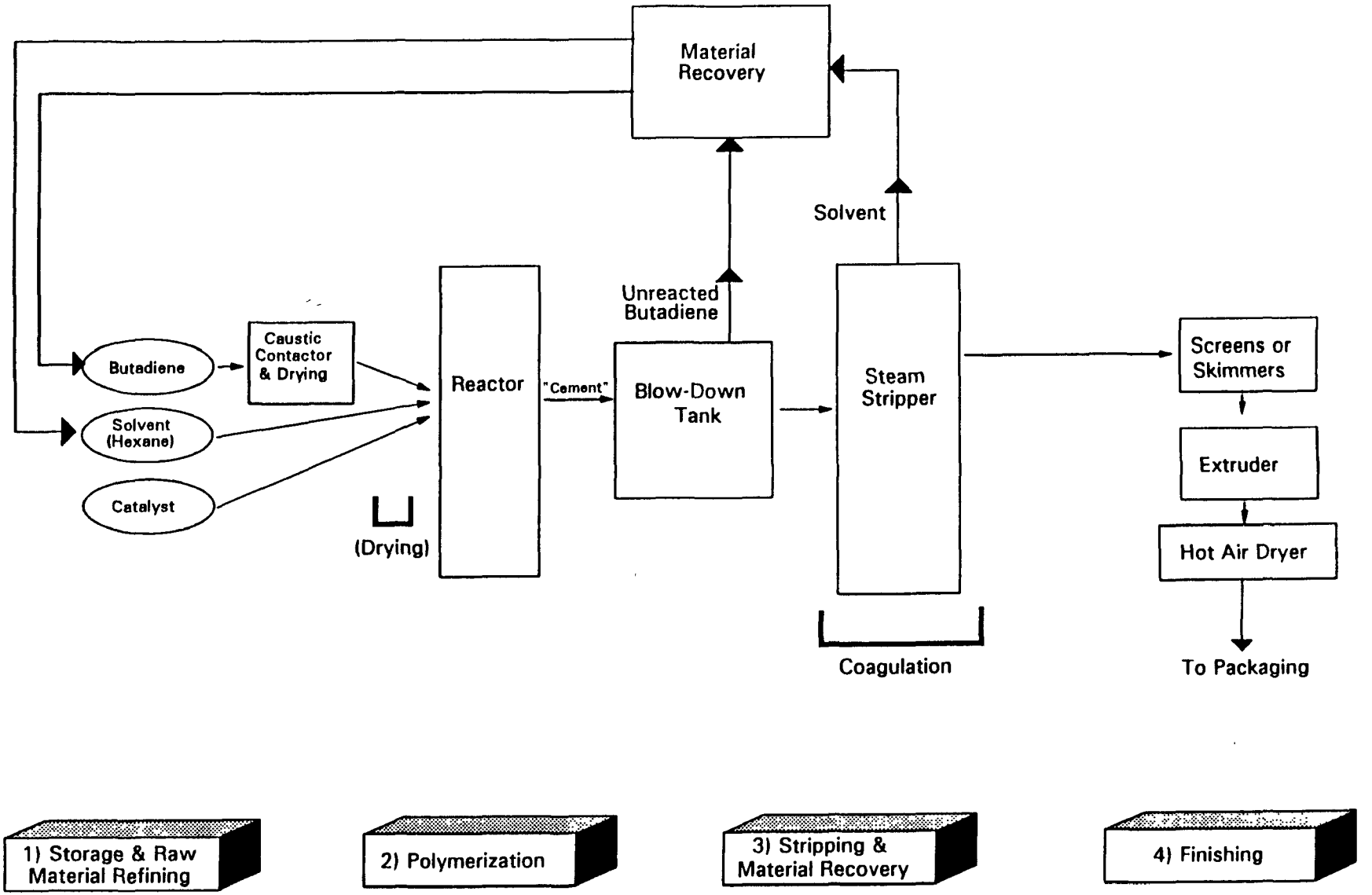

Figure 10. Polybutadiene Rubber (PBR) Production (By Solution)

crumb rubber. Solvent volatilized by the steam is recovered by condensing the overhead vapor and decanting the organic solvent. The solvent is recycled back to raw material drying operations before going to solvent storage.

The crumb rubber leaves the stripping operation in a water slurry, and is separated from the water by mechanical filters (screens or skimmers), extruded, and dried with hot air before being baled.

Polybutadiene Rubber and Latex Production by Emulsion

A general process flow diagram for PBR and PBL by emulsion polymerization is shown in Figure 11. No facilities were identified that currently produce polybutadiene rubber or latex by emulsion. In emulsion polymerization, butadiene monomer is combined in a reactor with emulsifiers and catalysts. Once polymerization is complete, the reactor contents are expelled into a blow-down tank, which flashes off butadiene. This vapor stream is condensed, compressed, and sent back to monomer storage.

To produce PBR, the emulsion is coagulated by adding an acid-brine solution. The resulting crumb rubber is removed from the water by mechanical filtration, washed to remove residual acid-brine solution, filtered to separate it from the wash water, and mechanically dewatered. Finally, the rubber product goes to a hot air dryer to remove the remaining water before packaging.

To produce PBL, the coagulation and drying steps described above are omitted, and specialty ingredients are blended into the emulsion from the blow-down tank. The finished latex is shipped out in 55-gallon drums or as bulk product in rail cars.

HAP and HAP Emission Points For Production of Polybutadiene Rubber

The potential HAP emission sources from PBR production by the solution process are shown in Table 10. Table 11 shows the potential HAP emission sources from PBR and PBL production by the emulsion process. In either case, emissions of HAP from pressure vessels are negligible. Fixed roof tank emissions may vent directly to the atmosphere or to a control device.

In the solution process, the emissions from the reactor vents contain butadiene and solvent. The vents from the blow-down tank system contain mostly butadiene. Solvent and small amounts of butadiene are emitted from stripping operation vents. Residual solvent is also emitted from the filtering, extruding, and drying operations.

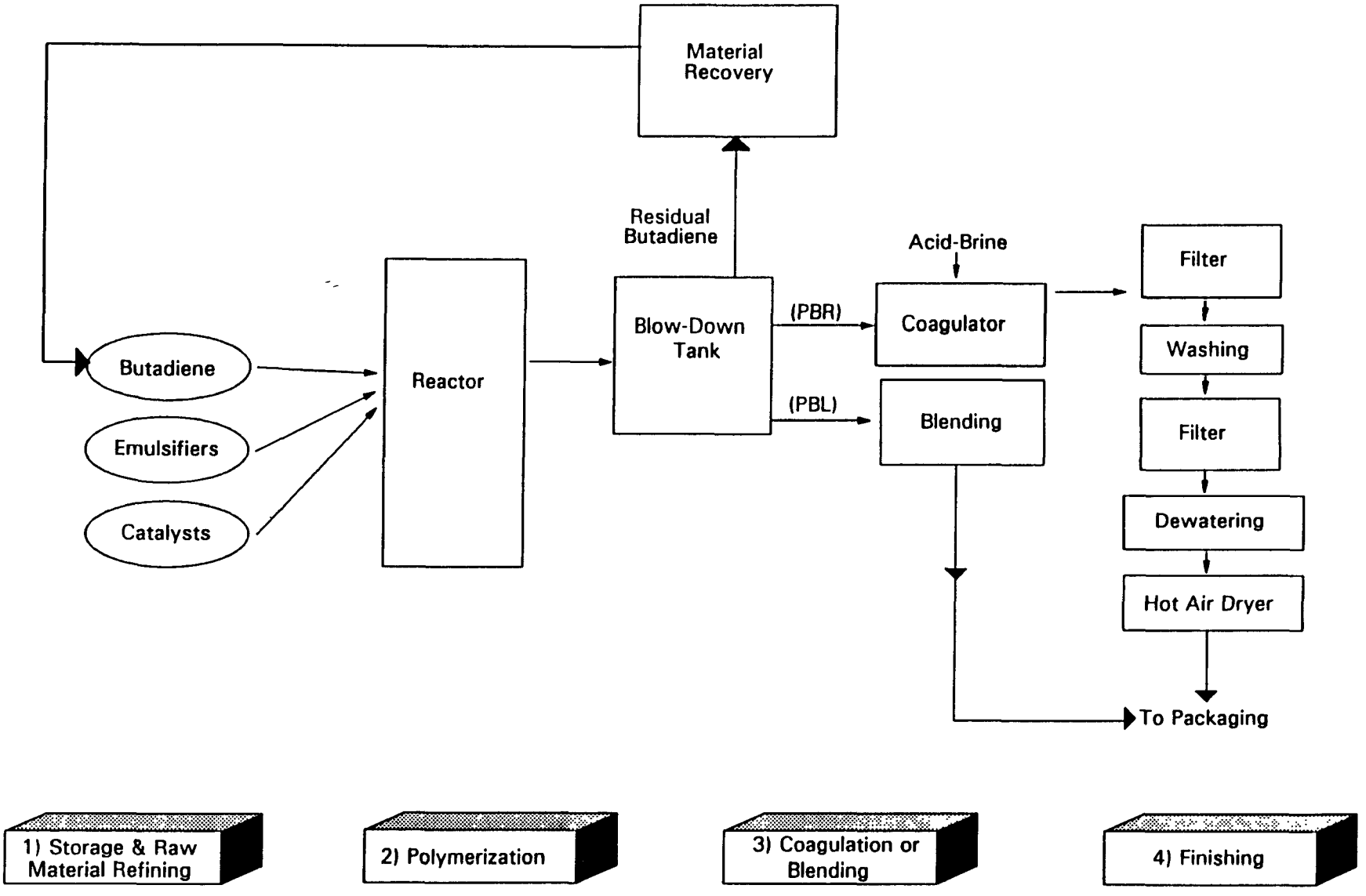

Figure 11. Polybutadiene Rubber and Latex (PBR and PBL) Production (By Emulsion)

Table 10. Potential Sources of HAP Emissions of HAP Emissions From Polybutadiene Rubber Production by Solution Polymerization

	Hexane[a]	Butadiene	Toluene[a]
Storage and Handling	X		X
Equipment Leaks	X	X	X
Process Vents			
Monomer Refining	X	X	X
Polymerization	X	X	X
Stripping			
Material Recovery	X	X	X
Finishing	X	X	X
Drying	X	X	X
Wastewater			
Monomer Refining	X		X
Polymerization			
Stripping	X		X
Material Recovery	X		X
Finishing	X		X
Drying			

[a] Other non-HAP solvents are sometimes used. Toluene and hexane are unlikely to be used together.

Table 11. Potential Sources of HAP Emissions From Polybutadiene Rubber and Latex Production By Emulsion Polymerization

	Butadiene
Storage and Handling	
Equipment Leaks	X
Process Vents	
Monomer Refining	X
Polymerization	X
Stripping	
Material Recovery	X
Finishing	X
Drying	X
Wastewater	
Monomer Refining	
Polymerization	
Stripping	
Material Recovery	
Finishing	
Drying	

Sources of wastewater containing HAP from the solution process include the monomer refining, stripping, material recovery, and polymer washing operations, as well as rainwater runoff. Because butadiene has a high vapor pressure, it volatilizes rapidly from wastewater and therefore, is present in very small concentrations. Wastewater from the monomer refining process will contain solvent and very small concentrations of butadiene. Wastewater from the stripping/coagulation and the solvent/monomer recovery processes will contain solvent and very small amounts of butadiene. Wastewater from the dewatering process will have less solvent than sources upstream of this operation. Runoff from the polymer production areas may have high concentrations of solvent, depending on the facility's design and housekeeping practices.

Because no organic solvent is used in the emulsion process, the only HAP emitted from process vents is butadiene. The majority of butadiene emissions come from the blow-down tank. Coagulation emissions contain some butadiene, and residual butadiene is emitted from the dryer vents due to the elevated temperature of the dryers.

Sources of wastewater containing HAP from the emulsion production process include the coagulation, monomer recovery, and polymer washing operations, and rainwater runoff. The wastewater stream from the coagulation process will also contain very small amounts of butadiene. Wastewater from the dewatering process will have even less butadiene than sources upstream of this operation. Runoff from the polymer production areas may have very low concentrations of butadiene as well, depending on the facility's design and housekeeping practices.

Polysulfide Rubber Production

The Polysulfide Rubber Production source category includes any facility engaged in polysulfide polymerization to produce a synthetic rubber that is resilient and has low temperature flexibility. Polysulfide rubber is used in the insulating glass industry; in construction (e.g., to fill irregular joints); in aircraft (as a sealant in integral fuel tanks); and as "flexibilizers" for epoxy resins, dental molding compounds, concrete coatings, and such.[18] Table 1 summarizes major end uses of polysulfide rubber.

Process Description For Production of Polysulfide Rubber

Figure 12 contains a general process flow diagram for the production of polysulfide rubber. One facility was identified in the U.S. that currently manufactures polysulfide rubber.

In the production process, ethylene oxide and hydrochloric acid are continuously reacted to form ethylene chlorohydrin.[19]

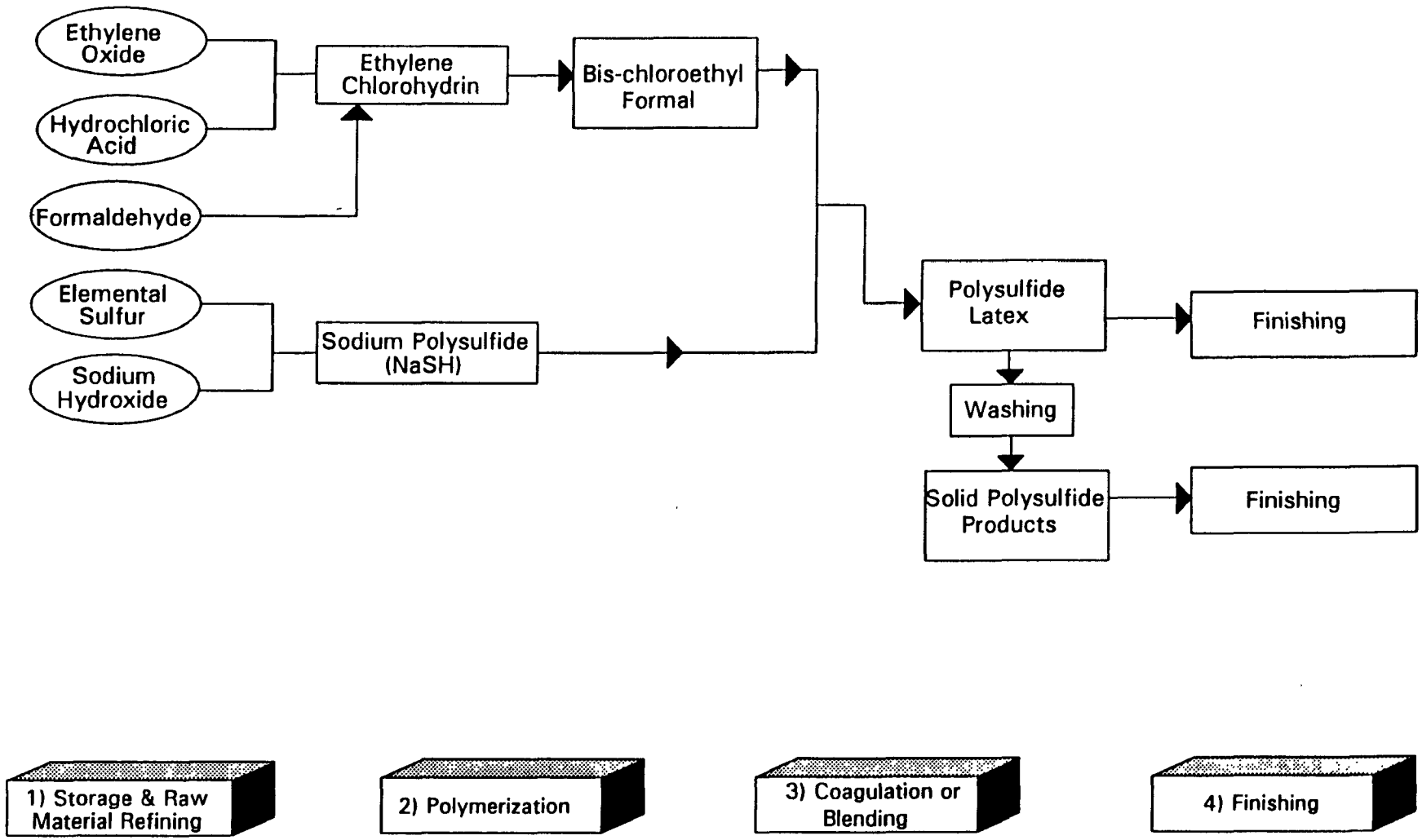

Figure 12. Polysulfide Rubber Production

Formaldehyde is added to the ethylene chlorohydrin to produce bis-chloroethyl formal, which is sometimes simply termed formal. In a separate continuous process, elemental sulfur and sodium hydroxide are reacted to form sodium polysulfide, which is called NaSH. The NaSH is reacted with the formal to form a latex product. To make a solid polysulfide product, the latex is washed and settled out, which removes the sodium vinyl chloride and NaSH, forming a solid product. Other polysulfide products can be made through process variations, such as chemically splitting the solid product, or substituting other HAP, such as ethylene dichloride, for formal in the NaSH reaction.

HAP and HAP Emission Points For Production of Polysulfide Rubber

The only potential sources of HAP emissions from production of polysulfide rubber are the pumps and valves that are in HAP service in the front end of the production process.[19] These HAP include formaldehyde, ethylene dichloride, and ethylene oxide. Industry representatives state that these HAP are totally consumed in the production process, so that no other potential emission sources exist.[19]

Styrene-Butadiene Rubber and Latex Production

The Styrene-Butadiene Rubber and Latex Production source category includes any facility that manufactures copolymers consisting of styrene and butadiene monomer units to produce styrene butadiene rubber or latex. Styrene-butadiene rubber (SBR) can be produced by either emulsion or solution polymerization. Styrene-butadiene latex (SBL) is produced by emulsion polymerization. Table 1 summarizes major end uses of styrene-butadiene rubber and latex.

Process Description for Styrene-Butadiene Rubber Production by Solution

A general process flow diagram for SBR by solution polymerization is shown in Figure 13. Four facilities have been identified in the U.S. that currently manufacture styrene-butadiene rubber by the solution process; all these facilities also produce polybutadiene rubber by solution. Styrene monomer has low volatility and may be stored in fixed roof tanks at atmospheric pressure. Butadiene must be stored under pressure because of its high vapor pressure. The solvents commonly used in the SBR solution process are typically stored in fixed roof atmospheric tanks. Prior to being charged to the reactor, a caustic contactor is used to remove inhibitors from butadiene, and steam is used to remove the inhibitors from styrene. Next, the monomers and solvent are thoroughly dried. Solvents used in solution polymerization are hexane and toluene, although hexane is the most common. Both of these solvents are HAP. The solvent

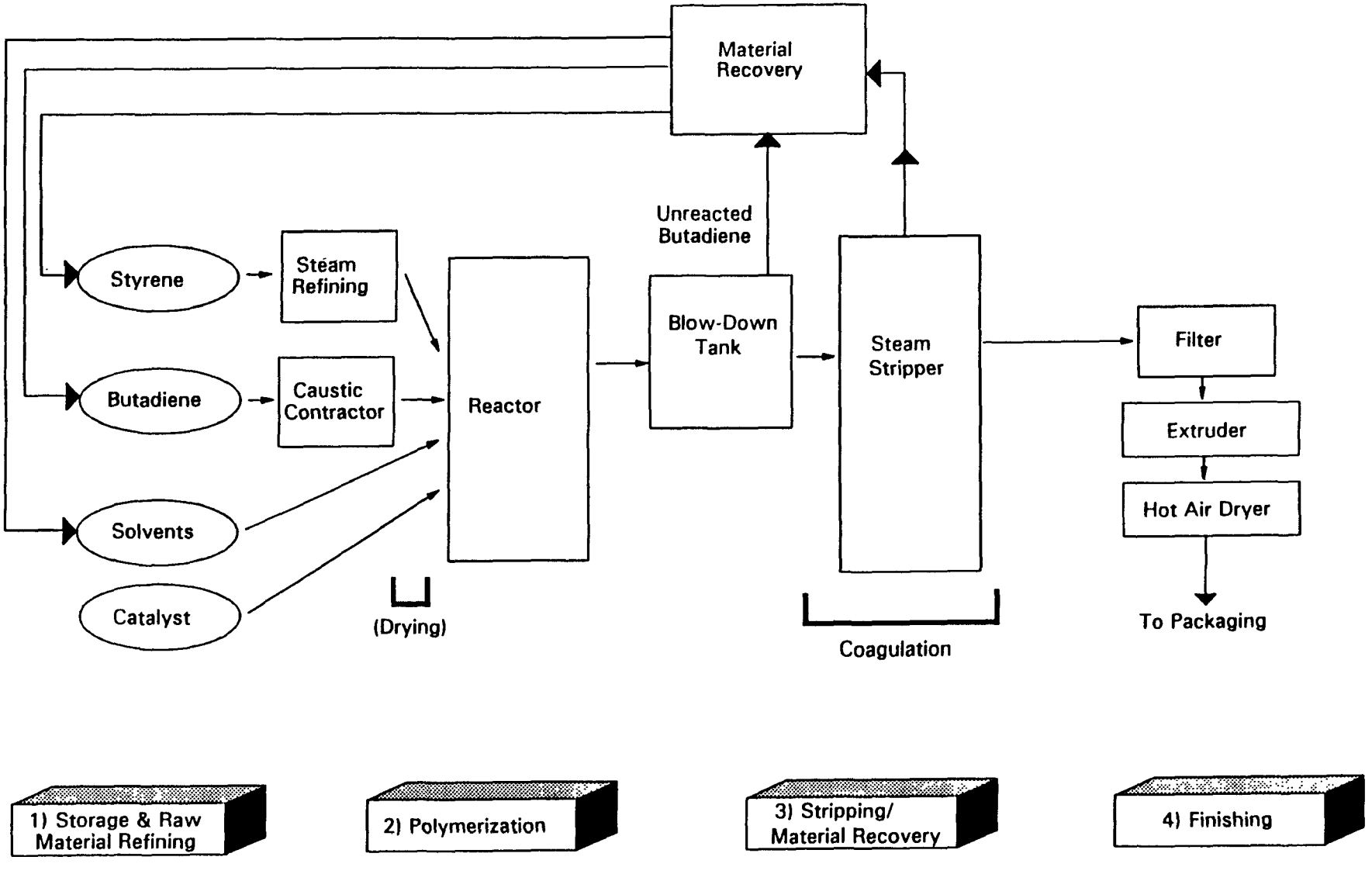

Figure 13. Styrene-Butadiene Rubber Production (By Solution)

used in the polymerization process impacts the characteristics of the final polymer product.

Following the drying process, butadiene, styrene, solvent, and catalyst are combined in the reactor. Once polymerization is completed, the cement is expelled to a blow-down tank to flash off most of the unreacted butadiene. This vent stream is cooled to condense any water and styrene. The butadiene is compressed and sent back to monomer storage.

Following blow-down, the rubber cement is sent to a steam stripper to remove any unreacted styrene and solvent, which are decanted from the condensed steam overheads. The solvent and styrene are separated by distillation and sent back to raw material storage. The steam added during stripping also serves to coagulate the polymer. The crumb rubber is removed from the water by mechanical filtration, extruded, and dried with hot air before being sent to packaging.

Styrene-Butadiene Rubber and Latex Production by Emulsion

A general process flow diagram for SBR and SBL by emulsion polymerization is shown in Figure 14. In the U.S., four facilities have been identified that produce SBR by the emulsion process, and 15 facilities have been identified that produce SBL by the emulsion process. The polymerization process for SBR and SBL is similar to emulsion NBR and NBL production, with styrene replacing the acrylonitrile monomer.

In emulsion polymerization, butadiene and styrene monomers are combined in a reactor with emulsifiers, soaps, and catalysts. Inhibitors are removed from the butadiene and styrene monomers using the same techniques described in solution polymerization.

Once polymerization is completed, the reactor contents are expelled from the reactor to a blow-down tank, which flashes off unreacted butadiene. The vapor stream from the blow-down tank is condensed and compressed to separate the butadiene from styrene and water. The butadiene and styrene are recycled.

Following blow-down, the emulsion is sent to a steam stripper to remove any unreacted styrene. The overhead stream from the steam stripper is condensed and decanted to separate the styrene from the water. The styrene is recycled.

If SBL is the final product, the latex is finished by blending with specialty ingredients. To produce SBR, the emulsion is coagulated by adding an acid-brine solution. After coagulation, the crumb rubber is separated from water by filtration, is washed to remove the remaining acid-brine solution, is filtered again to separate it from the wash water, and is mechanically dewatered. Finally, the rubber product goes

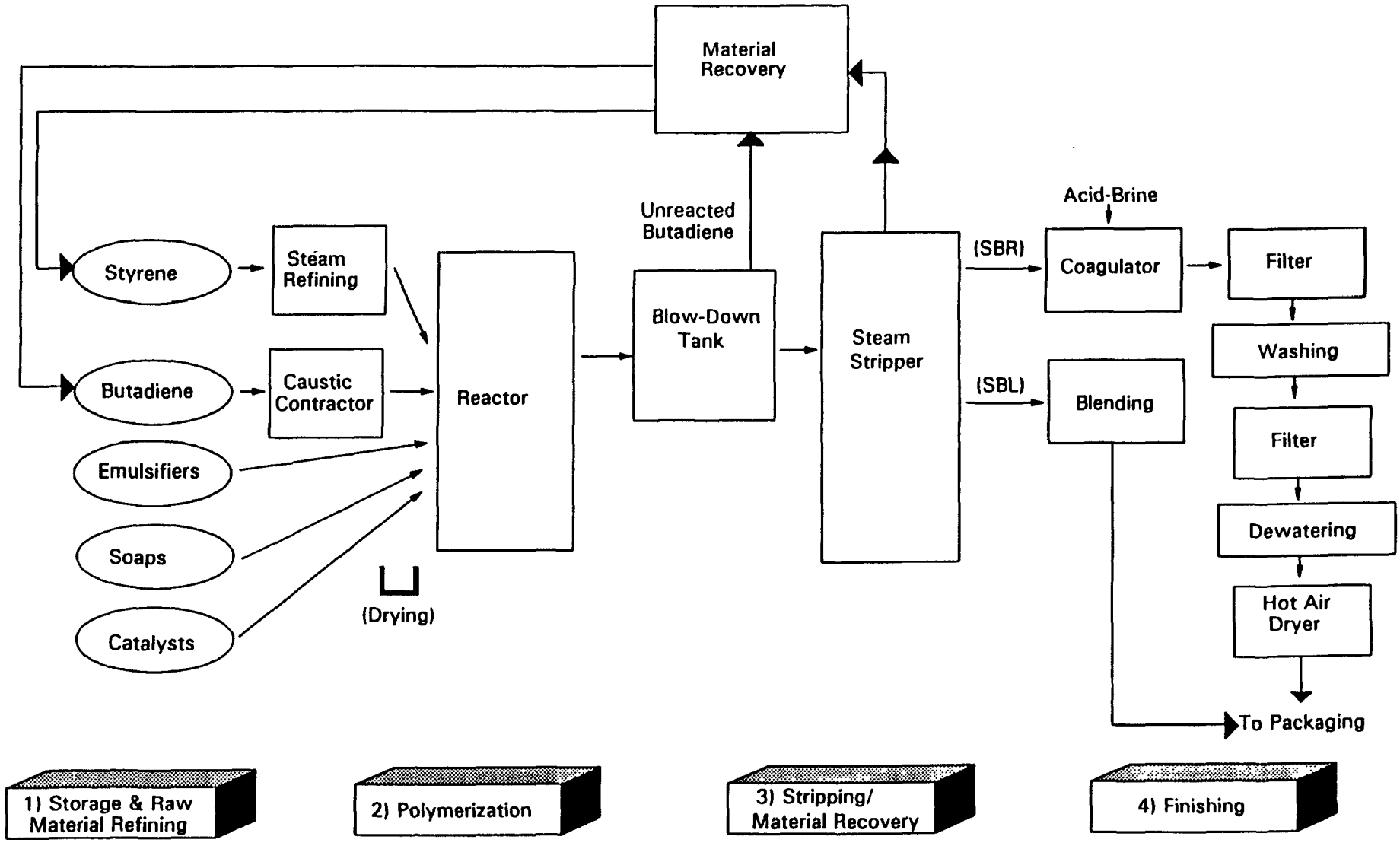

Figure 14. Styrene-Butadiene Rubber and Latex (SBR and SBL) Production (By Emulsion)

to a hot air dryer to remove the remaining moisture before packaging.

HAP and HAP Emission Points For Styrene-Butadiene Production

Table 12 shows potential HAP emission sources from process vents associated with production of SBR by the solution process. Table 13 shows the potential HAP emission sources from SBR and SBL production by the emulsion process. In either case, emissions of HAP from fixed roof atmospheric tanks may be vented directly to the atmosphere or to a control device. Pressurized storage vessels are assumed to have negligible emissions.

In the solution process, the emissions from the reactor vents contain butadiene monomers, styrene monomers, and solvent, which is usually hexane. The vents from the blow-down tank system contain mostly butadiene with a small amount of styrene. Styrene monomer and hexane, along with small amounts of butadiene, are emitted from stripping operation vents and material recovery operations. Styrene and solvent are also emitted from the finishing and drying process.

In the emulsion process, the only HAP emitted from process vents are styrene and butadiene. The majority of butadiene emissions come from the blow-down tank. Emissions from the stripping operation vents contain styrene, hexane, and small amounts of butadiene. Coagulation vent emissions contain styrene and hexane. The dryer vent HAP emissions are also comprised of styrene and hexane.

Sources of wastewater containing HAP from the solution process include the monomer refining, stripping, material recovery, and finishing operations, as well as stormwater outdoor runoff from the process areas. Because butadiene has a high vapor pressure, it is rapidly volatilized from wastewater and therefore, is present in very small concentrations. Wastewater from the monomer refining process, the stripping process, and the material recovery processes will contain solvent, styrene, and very small amounts of butadiene. Wastewater from the finishing operations will have less solvent and styrene than sources upstream of this operation. Runoff from the polymer production areas may have high concentrations of solvent and styrene as well, depending on the facility's design and housekeeping practices.

Sources of wastewater containing HAP from the emulsion process include the coagulation, monomer recovery, and polymer washing operations, as well as runoff from styrene-butadiene rubber manufacturing via the emulsion process. The wastewater stream from the coagulation process will contain styrene and very small amounts of butadiene. Wastewater from the monomer recovery processes will contain styrene and low concentrations of

Table 12. Potential Sources of HAP Emissions From Styrene-Butadiene Rubber and Latex Production by Solution Polymerization

	Styrene	Butadiene	Hexane[a]	Toluene[a]
Storage and Handling	X		X	X
Equipment Leaks	X	X	X	X
Process Vents				
Monomer Refining	X	X	X	X
Polymerization	X	X	X	X
Stripping	X	X	X	X
Material Recovery	X	X	X	X
Finishing	X		X	X
Drying	X		X	X
Wastewater				
Monomer Refining	X		X	X
Polymerization				
Stripping	X		X	X
Material Recovery	X		X	X
Finishing	X		X	X
Drying				

[a] Hexane and toluene are unlikely to be used concurrently.

Table 13. Potential Sources of HAP Emissions from Styrene-Butadiene Rubber and Latex Production by Emulsion Polymerization

	Styrene	Butadiene
Storage and Handling	X	
Equipment Leaks	X	X
Process Vents		
Monomer Refining		X
Polymerization	X	X
Stripping	X	X
Material Recovery	X	X
Finishing	X	
Drying[a]	X	
Wastewater		
Monomer Refining		
Polymerization		
Stripping	X	
Material Recovery	X	
Finishing	X	
Drying[a]		

[a] These emissions are for rubber production only (i.e., no dryer vent emissions for latex production).

butadiene. Wastewater from the dewatering process will have styrene and even less butadiene than sources upstream of this operation. Stormwater runoff from the polymer production areas may contain styrene and very low concentrations of butadiene as well, depending on the facilities design and housekeeping practices.

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E C/R Incorporated — Environmental Consulting and Research

MEMORANDUM

Date: May 10, 1995

Subject: Baseline Emissions for Elastomer Production Facilities (Polymers and Resins I)

From: Phil Norwood, EC/R

To: Leslie Evans, EPA/OAQPS/ESD/OCG

The purpose of this memorandum is to present the baseline hazardous air pollutant (HAP) emissions for the source categories that are included in the Polymers and Resins I project. The memorandum is organized by the four major emission source types identified at these "elastomer" production facilities: storage, process vents, wastewater, and equipment leaks. For each emission source type, the methodology used to estimate the baseline HAP emissions is presented, along with plant-specific estimates for each of the 12 elastomer subcategories.

The primary basis for the emission estimates was information submitted to the Environmental Protection Agency (EPA) by the elastomer producers in response to information collection activities conducted under the EPA's Section 114 authority.[1] The EPA sent a questionnaire to selected companies that produced elastomers in December 1991. The December 1991 questionnaire was specifically designed to obtain production, emissions, and emissions control information from the manufacture of polymers. Therefore, responses to this questionnaire contained not only HAP emissions estimates, but the parameters and background data used to calculate the emissions.

However, due to requirements limiting the burden of information collection request activities on industry, this questionnaire was only sent to nine companies. Therefore, a separate Section 114 questionnaire was sent to the remainder of the identified elastomer producers in May 1992. The May 1992 questionnaire was a "generic" Section 114 questionnaire that could be sent to all elastomer producers. However, due to the generic nature of this questionnaire, it was not as well suited to obtain the background data to support the HAP emission estimates. This was particularly true for emissions from storage, wastewater, and equipment leaks.

In late 1993, the EPA sent a series of "clarification" letters to address unclear areas in the original responses. The responses from the two questionnaires and the clarification letters are included in section II-D of Air Docket A-92-44.

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STORAGE VESSEL EMISSIONS

The December 1991 Section 114 questionnaire requested information on storage vessel capacity, the material stored (including HAP weight percent), the number of annual turnovers, control technology, and estimated HAP emissions. However, as noted above, the May 1992 questionnaire was not well suited to obtain storage vessel information, and in most cases only HAP emissions were reported. Therefore, the baseline emissions for storage, which are shown in Table 1, are taken directly from the Section 114 responses.

It should be noted that these emission estimates include only those vessels that store raw materials. Vessels storing raw products or intermediates were considered to be process operations and not storage, and emissions from these vessels were included in the process vent baseline emissions. Further, many of the final products of this industry are "bales" of solid crumb rubber, and not liquids. Any emissions reported from these solids were considered to be "back-end" process emissions due to the residual HAP remaining in the solid, and not storage emissions. While some facilities did produce latex, the HAP concentrations (and resulting HAP emissions) in this product were negligible.

PROCESS VENT EMISSIONS

As with storage vessels, the baseline process vent emission estimates were primarily taken from the Section 114 responses. Process emissions were separated into "front-end" and "back-end" emissions. The front-end includes prepolymerization operations, reaction, stripping, and material recovery. The back-end includes post-stripping operations, such as drying and finishing.

The combustion of process vent emissions, particularly front-end emissions, was common in most subcategories. However, significant differences existed in the reported destruction efficiencies. The destruction efficiencies ranged from 95 percent to 99.999 percent. Flares cannot be tested, but the EPA has determined that flares operated properly can achieve efficiencies of 98 percent and greater. Therefore, the flare efficiency reported most often was 98 percent. While thermal oxidizers/incinerators can be tested to show efficiencies greater than 98 percent, the EPA historically has not required replacement of flares with incinerators, and considers flares to be equally effective. In order to eliminate this potential bias against flares, process vent emissions controlled by a flare, thermal oxidizer, or incinerator were "adjusted" to assume 98 percent control.

The baseline process vent HAP emissions are provided in Table 2. Attachment 1 provides a vent-by-vent breakdown of the emission estimates.

TABLE 1. BASELINE HAP EMISSIONS FROM STORAGE VESSELS

Facility	Reported Storage HAP Emissions (Mg/yr)	Facility	Reported Storage HAP Emissions (Mg/yr)
Butyl Rubber			
BR-1	0		
Epichlorohydrin			
EPI-1	10.1		
Ethylene Propylene Rubber - 18.5 Mg/yr			
EPR-1	3.4	EPR-4	4.7
EPR-2	2.5	EPR-5	7.9
EPR-3	0		
Halobutyl Rubber			
HBR-1	64.8		
Hypalon™			
HYP-1	6.9		
Neoprene - 43.5 Mg/yr			
NEO-1	21.7	NEO-3	0.9
NEO-2	20.9		
Nitrile Butadiene Latex - 1.7 Mg/yr			
NBL-1	1.5	NBL-3	0.2
NBL-2	0		
Nitrile Butadiene Rubber - 1.4 Mg/yr			
NBR-1	31.5	NBR-3	0.2
NBR-2	0	NBR-4	0
Polybutadiene/Styrene Butadiene Rubber by Solution - 4.3 Mg/yr			
PBR/SBRS-1	0.8	PBR/SBRS-4	1.5
PBR/SBRS-2	0.1	PBR/SBRS-5	1.8
PBR/SBRS-3	0		
Polysulfide Rubber			
PSR-1	0.7		

TABLE 1. BASELINE HAP EMISSIONS FROM STORAGE VESSELS (continued)

Facility	Reported Storage HAP Emissions (Mg/yr)	Facility	Reported Storage HAP Emissions (Mg/yr)
Styrene Butadiene Latex - 8.6 Mg/yr			
SBL-1	1.2	SBL-9	0.6
SBL-2	0.6	SBL-10	1.0
SBL-3	0.5	SBL-11	0.5
SBL-4	0.2	SBL-12	0.4
SBL-5	0.9	SBL-13	0.8
SBL-6	0.3	SBL-14	0.9
SBL-7	0.5	SBL-15	0
SBL-8	0.3		
Styrene Butadiene Rubber by Emulsion - 7.6 Mg/yr			
SBRE-1	2.2	SBRE-3	0.2
SBRE-2	0	SBRE-4	5.2

TABLE 2. BASELINE HAP EMISSIONS FROM PROCESS VENTS[a]

Facility	Baseline Process Vent HAP Emissions (Mg/yr)		
	Front-End	Back-End	Total
Butyl Rubber			
BR-1	367.4	109.5	476.9
Epichlorohydrin			
EPI-1	0.7	16.5	17.2
Ethylene Propylene Rubber			
EPR-1	18.3	1,127.7	1,146.0
EPR-2	90.2	348.6	438.8
EPR-3	5.1	36.8	41.9
EPR-4	80.6	413.6	494.2
EPR-5	25.7	68.4	94.1
Subcategory Totals	219.9	1,995.1	2,215.0
Halobutyl Rubber			
HBR-1	683.5	280.5	964.0
Hypalon™			
HYP-1	49.8	28.6	78.4
Neoprene			
NEO-1	222.0	34.5	256.5
NEO-2	108.3	150.0	258.3
NEO-3	21.3	18.9	40.2
Subcategory Totals	351.6	203.5	555.1
Nitrile Butadiene Latex			
NBL-1	2.6		
NBL-2	0.001		
NBL-3	0.9		
Subcategory Totals	3.5		

TABLE 2. BASELINE HAP EMISSIONS FROM PROCESS VENTS (continued)

Facility	Baseline Process Vent HAP Emissions (Mg/yr)		
	Front-End	Back-End	Total
Nitrile Butadiene Rubber			
NBR-1	0.7	9.1	9.8
NBR-2	28.8	94.7	123.5
NBR-3	2.8	10.5	13.3
NBR-4	5.5	0.4	5.9
Subcategory Totals	37.8	114.7	152.5
Polybutadiene/Styrene Butadiene Rubber by Solution			
PBR/SBRS-1	3.2	390.4	393.6
PBR/SBRS-2	0	0	0
PBR/SBRS-3	0	205.5	205.5
PBR/SBRS-4	159.6	771.6	931.2
PBR/SBRS-5	6.0	1,035.7	1,041.7
Subcategory Totals	168.8	2,403.2	2,572.0
Polysulfide Rubber			
PSR-1	0	0	0
Styrene Butadiene Latex			
SBL-1	2.5		
SBL-2	22.9		
SBL-3	8.4		
SBL-4	0.8		
SBL-5	1.8		
SBL-6	5.1		
SBL-7	3.6		
SBL-8	6.1		
SBL-9	2.2		
SBL-10	0.8		
SBL-11	0.8		

TABLE 2. BASELINE HAP EMISSIONS FROM PROCESS VENTS (continued)

Facility	Baseline Process Vent HAP Emissions (Mg/yr)		
	Front-End	Back-End	Total
SBL-12	1.1		
SBL-13	0.6		
SBL-14	20.0		
SBL-15	212.0		
Subcategory Totals	288.7		
Styrene Butadiene Rubber by Emulsion			
SBRE-1	6.3	251.5	257.8
SBRE-2	7.3	72.7	80.0
SBRE-3	3.5	148.1	151.6
SBRE-4	2.5	379.3	381.8
Subcategory Totals	19.6	851.6	871.2

[a] Discrepancies between the totals in Table 2 and the attachment are attributed to differences in rounding.

WASTEWATER OPERATION EMISSIONS

The December 1991 Section 114 questionnaire requested detailed information on HAP-containing wastewater streams. The responses to this questionnaire ranged from no information to emission estimates with detailed wastewater stream characteristics. Several facilities submitted wastewater emission estimates that were generated using computer models. Since the emission estimates provided were calculated using so many different techniques (and in many cases not provided at all), comparison of emissions between facilities was not possible. Therefore, it was necessary to develop a methodology to estimate wastewater emissions on a consistent basis. The following section discusses this methodology.

Wastewater Emission Estimation Methodology

The methodology used to estimate HAP emissions from wastewater operations consisted of four basic steps:
(1) identify wastewater streams,
(2) obtain/estimate stream characteristics,
(3) calculate uncontrolled HAP emissions, and
(4) identify controls and calculate HAP emissions after control.
The following sections describe each of these steps in more detail. In Attachment 2, an example is provided to demonstrate the application of this methodology.

Identify wastewater streams

At elastomer production facilities, wastewater streams that contain HAP were reported from a variety of locations in the process. For the wastewater analyses, the basic elastomer production process was separated into five different areas: (1) storage and material handling, (2) prepolymerization, (3) reaction, (4) stripping and material recovery, and (5) finishing. The origination (i.e., process area) of each reported wastewater stream was identified.

For each subcategory, a comparison was made between the number and locations of wastewater streams. For facilities that did not report any wastewater information, the assumption was made that wastewater streams were generated from the same process areas as other facilities in the subcategory. When facilities reported wastewater information, the number of streams identified was the number assigned to that facility. In other words, if a facility reported a wastewater stream from stripping/material recovery and one from finishing, an additional stream from prepolymerization would not have been assigned just because another facility in the subcategory reported a stream from that process area.

Obtain/estimate stream characteristics

For each wastewater stream, two main characteristics are needed to calculate uncontrolled emissions using the method described below: flow rate and speciated HAP concentration. These parameters must be determined/estimated at the wastewater stream's point of generation. If a facility provided this information, it was used. For those streams where flow and concentration were not provided, these characteristics were extrapolated from other facilities. The average (mean) concentration of all streams (for which "real" data were provided) originating from the same process area in the same subcategory was used. The average flow rate was also determined, and was weighted by production.

Calculate uncontrolled HAP emissions

From the point of generation, wastewater usually passes through a series of collection and treatment systems before being discharged from a facility. Many of these units are open to the atmosphere and allow organic-containing wastewaters to come in contact with ambient air, thus creating an opportunity for organic HAP emissions. The magnitude of the emissions depends on factors such as the physical properties of the pollutants, the temperature of the wastewater, and the design of the individual collection and treatment units. Since these properties were generally not available for wastewater generated at elastomer facilities, the fraction emitted (F_e) values from the Hazardous Organic NESHAP (HON) were used to predict the amount of HAP that would be emitted, relative to the amount in the stream.

Therefore, for each HAP in each wastewater stream, the uncontrolled emissions were calculated using the following equation:

$$E_{uncontrol_i} = (5.26 \times 10^{-4})\,(HAP_{conc_i})\,(Q)\,(F_{e_i})$$

where:

$E_{uncontrol_i}$ = Uncontrolled emissions of HAP i, Mg/yr

HAP_{conc_i} = Concentration of HAP i at the point of generation, ppmw

Q = Flow rate of wastewater stream at the point of generation, liters per minute

F_{e_i} = Fraction emitted value of HAP i, from Table 34 of Subpart G of 40 CFR 63.

Some concern was raised by industry regarding the use of the HON F_e values in estimating emissions from elastomer facilities. In particular, it was indicated that the surfactants and emulsifiers used in the emulsion processes could drastically change the amount of HAP emitted.[2] However, in the absence of any data specific to the elastomer industry, the HON values provide a reasonable (although conservative) estimate.

Identify controls and calculate HAP emissions after control

After each stream had been identified/assigned, flow rate and HAP concentration determined/extrapolated, and uncontrolled emissions calculated, wastewater controls were evaluated. The only way that control was assigned to a stream was if it were clearly identified in the Section 114 response (or other follow-up correspondence). In fact, while there was a general indication by industry that wastewater control was common, particularly among those producers using emulsion processes, the stream-specific information seldom identified control.[3,4]

Where control was identified for a particular stream, the HON chemical-specific fraction removed, or F_r, values were used to estimate the amount of organic HAP that would be removed from the stream. The controlled emissions were then calculated using the following equation:

$$E_{control_i} = (5.26 \times 10^{-4})\,(HAP_{conc_i})\,(Q)\,(1 - F_{r_i})\,(F_{e_i})$$

where:

$E_{control_i}$	=	Emissions of HAP i after control, Mg/yr
HAP_{conc_i}	=	Concentration of HAP i at the point of generation, ppmw
Q	=	Flow rate of wastewater stream at the point of generation, liters per minute
F_{r_i}	=	Fraction removed value, from Table 9 of Subpart G of 40 CFR 63.
F_{e_i}	=	Fraction emitted value, from Table 34 of Subpart G of 40 CFR 63.

Summary of Wastewater Emission Estimates

The baseline wastewater emission estimates are provided in Table 3. A stream by stream summary is included as Attachment 3.

EQUIPMENT LEAK EMISSIONS

The circumstances surrounding the emission estimates for equipment leaks were very similar to the situation described above for wastewater emissions. The December 1991 Section 114 questionnaire requested detailed information on components in HAP service, and the responses ranged from no information to detailed data on emissions and control techniques. The emission estimates provided in response to the December 1991 Section 114 questionnaire were made using a variety of approaches. A comparison of emissions not only reflected the variation in the levels of control, but also differences in the approaches used to estimate the emissions. The May 1992 Section 114 questionnaire did not address emissions from equipment leaks. Therefore, it

TABLE 3. BASELINE HAP EMISSIONS FROM WASTEWATER OPERATIONS

Facility	Baseline Wastewater HAP Emissions (Mg/yr)	Facility	Baseline Wastewater HAP Emissions (Mg/yr)
Butyl Rubber			
BR-1	148.5		
Epichlorohydrin			
EPI-1	6.7		
Ethylene Propylene Rubber - 19.6 Mg/yr			
EPR-1	0.1	EPR-4	15.8
EPR-2	0	EPR-5	0.1
EPR-3	3.6		
Halobutyl Rubber			
HBR-1	0		
Hypalon™			
HYP-1	0		
Neoprene - 21.1 Mg/yr			
NEO-1	5.5	NEO-3	4.0
NEO-2	11.6		
Nitrile Butadiene Latex - 103.9 Mg/yr			
NBL-1	98.0	NBL-3	5.9
NBL-2	0		
Nitrile Butadiene Rubber - 7.5 Mg/yr			
NBR-1	2.2	NBR-3	2.1
NBR-2	2.1	NBR-4	1.1
Polybutadiene/Styrene Butadiene Rubber by Solution- 25.6 Mg/yr			
PBR/SBRS-1	3.8	PBR/SBRS-4	2.0
PBR/SBRS-2	0.1	PBR/SBRS-5	2.8
PBR/SBRS-3	16.9		

TABLE 3. BASELINE HAP EMISSIONS FROM WASTEWATER OPERATIONS (continued)

Facility	Baseline Wastewater HAP Emissions (Mg/yr)	Facility	Baseline Wastewater HAP Emissions (Mg/yr)
Polysulfide Rubber			
PSR-1	0		
Styrene Butadiene Latex - 690.8 Mg/yr			
SBL-1	0.8	SBL-9	12.5
SBL-2	0.1	SBL-10	6.3
SBL-3	0	SBL-11	250.2
SBL-4	0	SBL-12	4.5
SBL-5	2.1	SBL-13	23.7
SBL-6	62.9	SBL-14	71.1
SBL-7	0.03	SBL-15	13.6
SBL-8	243.0		
Styrene Butadiene Rubber by Emulsion - 84.5 Mg/yr			
SBRE-1	49.5	SBRE-3	21.2
SBRE-2	10.0	SBRE-4	3.8

was necessary to develop a methodology to estimate equipment leak emissions on a consistent basis. The following section discusses this methodology.

Equipment Leak Emission Estimation Methodology

The EPA's Equipment Leak Emission Estimate Protocol Document[5] lists four approaches for estimating equipment leak emissions: (1) average emission factor, (2) screening ranges, (3) EPA correlation, and (4) unit-specific correlation. All of these approaches require equipment counts by type of equipment (i.e., valves, pumps, connectors, etc.) and possibly by type of service (i.e., heavy liquid, light liquid, and gas). Except for the Average Emission Factor Approach, all of the approaches require screening data. Due to the number of facilities for which screening data were not available, the average emission factor approach, modified to consider existing control programs, was selected to estimate the baseline emissions from equipment leaks.

The average emission factor approach uses emission factors developed by the EPA in combination with unit-specific information to estimate the uncontrolled emissions. This unit-specific information includes: (1) the number of each type of component, (2) the service each component is in, (3) the HAP concentration in each stream, and (4) the time period each component was in that service. For this analysis, average emission factors from the SOCMI industry were used. It was assumed that all components were in "pure" HAP service (i.e., the HAP concentration in each stream was 100 percent). It was also assumed that the components were in HAP service continuously (8,760 hours per year). Therefore, the items needed to complete the uncontrolled equipment leak emission estimates were the number of each type of component, and the type of service of each component.

Therefore, the methodology used to estimate HAP emissions from equipment leaks consisted of three basic steps:
(1) obtain/estimate component counts,
(2) identify/estimate existing level of control,
(3) calculate baseline HAP emissions.
The following sections describe each of these steps in more detail. In Attachment 4, an example is provided to demonstrate the application of this methodology.

As discussed in more detail below, the uncontrolled emission factors were adjusted to incorporate controls. The use of the average emission factor approach, coupled with the assumptions noted above, resulted in conservative HAP emission estimates.

<u>Obtain/estimate component counts</u>

As noted above, the December 1991 Section 114 questionnaire requested detailed information on components in HAP service.

Component counts were acquired for facilities completing this questionnaire. However, for facilities receiving the May 1992 Section 114 questionnaire, and facilities not completing the earlier questionnaire, it was necessary to estimate component counts. The components included in the analyses were: compressor seals, pumps in light liquid service, flanges/connectors, pressure relief valves, valves in gas service, valves in liquid service, open-ended lines, and sample lines.

For each component type at each facility, the ratio of number of components per unit of capacity was calculated (i.e., 0.03 pump per Megagram of capacity). Then, an average ratio was calculated for each subcategory for each component type, based on those facilities for which actual component counts were available. This average ratio was applied to the capacity of the "other" facilities to obtain estimates of the number of components.

Identify/estimate existing level of control

Many elastomer production facilities reported a leak detection and repair (LDAR) program, and/or some equipment to reduce emissions from leaking components in HAP service. Based on information submitted in response to the December 1991 Section 114 questionnaire, the control level was identified for each of the eight component types listed above. For LDAR programs, the two critical factors were the interval between monitoring inspections and the leak definition (i.e., HAP concentration that constituted a leak).

There were a number of facilities for which no information was provided. In these cases, baseline control levels were estimated based either on applicable State regulations, or on the equipment leak programs in place at similar facilities in the same State (this assumes that similar facilities in ozone nonattainment areas in the same State would have comparable permit conditions). In some cases, there was no indication from any facility that an equipment leak control program was in effect. Attachment 5 shows the baseline control levels for each component type at each facility, along with the bases for the levels.

Four of the subcategories (Hypalon™, Polybutadiene and Styrene Butadiene Rubber by Solution, Styrene Butadiene Latex, and Styrene Butadiene Rubber by Emulsion) are subject to the HON equipment leak provisions by virtue of Subpart I of 40 CFR 63. However, Subpart I only applies to certain HAP, and not necessarily all HAP that are used in the production of the listed products. For example, in the production of styrene butadiene rubber using a solution process, the HAP monomers used are styrene and butadiene, and the reaction takes place in an organic solvent, most commonly the HAP hexane. At a styrene butadiene rubber by solution facility, the components in styrene and

butadiene service would be subject to the HON equipment leak requirements, while the components in hexane service would not. Table 4 summarizes the applicability of Subpart I to elastomer subcategories.

The baseline control level information shown in Attachment 5 does not include the effects of Subpart I. The Subpart I impacts were incorporated as follows. First, an estimate was obtained of the total number of components in HAP service for each subcategory, using the detailed information submitted in response to the December 1991 Section 114 questionnaire. The total component population was separated into components that would be subject to Subpart I and those components that would not. The percentage of HON-subject components was applied to each component type at each facility.

For example, for the styrene butadiene latex subcategory, the 9 facilities receiving the December 1991 Section 114 questionnaire reported just over 56,600 total components in HAP service. Of these, around 34,000 (60 percent) were in either styrene or butadiene service. Therefore, for a SBL facility that reported valves in light liquid service, it was assumed that 60 percent would be subject to Subpart I (styrene or butadiene service), and that 40 percent would be subject to the baseline control level for that facility shown in Attachment 5.

Calculate baseline HAP emissions

For each facility, equipment leak emissions were calculated using the following equation:

$$E_{eqlk} = \frac{(WF_{HAP})\,(HRS)}{1,000} \sum_{i=1}^{n} (EF_i)\,(N_i)$$

where:

E_{eqlk} = HAP equipment leak emissions, Mg/yr

WF_{HAP} = Weight fraction of HAP in the stream, assumed to equal 1.0

HRS = Hours of operation per year, assumed to equal 8,760 hrs/yr

EF_i = Emission factor for component type i, kg/hr/component, adjusted for control (discussed below)

N_i = Number of component type i's in HAP service

The basic uncontrolled emission factors used were taken from the Protocol Document.[6] To adjust for control, control effectiveness values were obtained from the Protocol Document.[7] For example, the emission factor for valves in light liquid service is 0.00403 kg/hr/valve, and the control effectiveness for a quarterly LDAR program with a 10,000 ppmv leak definition is 61 percent. Therefore, the emission factor, adjusted for control, would be calculated as follows:

TABLE 4. SUMMARY OF SUBPART I APPLICABILITY TO ELASTOMER PRODUCTION SUBCATEGORIES

Elastomer Subcategory	Subject HAP's	Other HAP's used	Percentage of total components covered by Subpart I
Hypalon™	carbon tetrachloride, chloroform[a]	none identified	100%
Polybutadiene and Styrene Butadiene Rubber by Solution	styrene, butadiene	hexane, toluene, methanol	
Styrene Butadiene Latex	styrene, butadiene	acrylic acid, acrylonitrile, cumene, ethylbenzene, formaldehyde, methanol, vinylidene chloride	60%
Styrene Butadiene Rubber by Emulsion	styrene, butadiene	none identified	100%
Polysulfide Rubber	ethylene dichloride[a]	none identified	0%[b]

[a] In Subpart I, Hypalon™ is in a paragraph with several other products. In addition to the pollutants listed above, methylene chloride, tetrachloroethylene, and ethylene dichloride components would be covered if they were used in the production of Hypalon™.

[b] While Subpart I applies to facilities producing Polysulfide Rubber, the definition of polysulfide rubber in Subpart I describes a process no longer used by any facility in the United States. Therefore, it was assumed that Subpart I would not affect the Polysulfide Rubber subcategory.

$$EF_{qtr,10,000} = (0.00403\ kg/hr/valve)(1-0.61) = 0.00157\ kg/hr/valve$$

However, the Protocol document does not list control efficiencies for all control levels reported by elastomer facilities. Therefore, it was necessary to develop emission factors for all reported situations. During the EPA's development of regulations for the thermoplastics industry (Polymers and Resins IV), the information from the Protocol document was used to estimate emission factors for a wide range of potential control levels.[8] The documentation of these factors, which is contained in Attachment 6, were used in this analysis.

Summary of Equipment Leak Baseline Emission Estimates

The baseline equipment leak HAP emission estimate are provided in Table 5. Emissions by component type are provided in Attachment 7.

SUMMARY

The baseline emissions, by emission source type and by subcategory, are presented in Table 6. A plant by plant summary is included as Attachment 8. As shown in the table, the source categories with the highest HAP emissions are ethylene propylene rubber and polybutadiene/styrene butadiene rubber by solution. The largest source of emissions is "back-end" process operations, and the ethylene propylene rubber and polybutadiene/styrene butadiene rubber by solution subcategories make up almost 75 percent of the total back-end process emissions. In fact, the back-end process emissions from these two subcategories make up approximately one-third of the total baseline emissions from all the elastomer subcategories.

The baseline emissions from storage and wastewater operations make up less than 10 percent of the total HAP emissions for all subcategories. Except for polysulfide rubber, for which the single facility reported no emissions from any emission source type other than 1 Mg/yr from storage, storage emissions always made up less than 7 percent of the total baseline emissions for the subcategory. For wastewater, the two latex subcategories (styrene butadiene and nitrile butadiene latex) comprise over 70 percent of the total wastewater baseline emissions. The addition of the wastewater emissions from butyl rubber production accounts for almost 85 percent of the total wastewater baseline emissions. For all other subcategories, wastewater emissions constitute less than 7 percent of the total subcategory baseline emissions.

TABLE 5. BASELINE HAP EMISSIONS FROM EQUIPMENT LEAKS

Facility	Baseline Equipment Leak HAP Emissions (Mg/yr)	Facility	Baseline Equipment Leak HAP Emissions (Mg/yr)
Butyl Rubber			
BR-1	321.9		
Epichlorohydrin			
EPI-1	127.2		
Ethylene Propylene Rubber - 1,087.7 Mg/yr			
EPR-1	38.4	EPR-4	447.9
EPR-2	156.6	EPR-5	242.2
EPR-3	202.6		
Halobutyl Rubber			
HBR-1	268.5		
Hypalon™			
HYP-1	12.1		
Neoprene - 120.2 Mg/yr			
NEO-1	71.2	NEO-3	35.2
NEO-2	13.8		
Nitrile Butadiene Latex - 49.2 Mg/yr			
NBL-1	22.0	NBL-3	7.7
NBL-2	19.5		
Nitrile Butadiene Rubber - 425.2 Mg/yr			
NBR-1	52.9	NBR-3	45.8
NBR-2	161.6	NBR-4	164.9
Polybutadiene/Styrene Butadiene Rubber by Solution-843.2 Mg/yr			
PBR/SBRS-1	165.1	PBR/SBRS-4	174.8
PBR/SBRS-2	76.4	PBR/SBRS-5	189.5
PBR/SBRS-3	237.4		
Polysulfide Rubber			
PSR-1	0		

TABLE 5. BASELINE HAP EMISSIONS FROM EQUIPMENT LEAKS (continued)

Facility	Baseline Equipment Leak HAP Emissions (Mg/yr)	Facility	Baseline Equipment Leak HAP Emissions (Mg/yr)
Butyl Rubber			
Styrene Butadiene Latex - 443.8 Mg/yr			
SBL-1	27.4	SBL-9	74.2
SBL-2	11.6	SBL-10	36.0
SBL-3	69.9	SBL-11	65.1
SBL-4	26.5	SBL-12	5.9
SBL-5	5.1	SBL-13	45.7
SBL-6	12.6	SBL-14	23.0
SBL-7	11.4	SBL-15	10.5
SBL-8	18.9		
Styrene Butadiene Rubber by Emulsion - 83.2 Mg/yr			
SBRE-1	39.0	SBRE-3	85.0
SBRE-2	10.8	SBRE-4	25.4

TABLE 6. BASELINE EMISSIONS BY SUBCATEGORY

Subcategory	Baseline HAP Emissions (Mg/yr)					
	Storage	Process Vents		Wastewater	Equipment Leaks	Total
		Front-End	Back-End			
Butyl Rubber	0	367	110	149	322	948
Epichlorohydrin	10	1	16	7	127	161
Ethylene Propylene Rubber	19	220	1,995	20	1,088	3,342
Halobutyl Rubber	65	684	281	0	269	1,299
Hypalon	7	50	29	0	12	98
Neoprene	44	352	204	21	120	741
Nitrile Butadiene Latex	2	4	0	104	49	159
Nitrile Butadiene Rubber	1	38	115	8	425	587
Polybutadiene/Styrene Butadiene Rubber by Solution	4	169	2,403	26	843	3,445
Polysulfide	1	0	0	0	0	1
Styrene Butadiene Latex	9	289	0	691	444	1,433
Styrene Butadiene Rubber by Emulsion	8	20	852	84	83	1,047
PROJECT TOTAL	170	2,194	6,005	1,110	3,782	13,261
Percent of Total	1%	17%	45%	8%	29%	

REFERENCES

1. Clean Air Act (42 U.S.C. 7401 et. seq., as amended by P.L. 101-549, 104 Stat. 2399) Section 114.

2. Radian Corporation. Draft Meeting Minutes of a September 22, 1993 meeting between the Styrene Butadiene Latex Industry and the Environmental Protection Agency. {Docket Item No. II-E-11}

3. Radian Corporation. Draft Meeting Minutes of a September 21, 1993 meeting between the Styrene Butadiene Rubber by Emulsion Industry and the Environmental Protection Agency. {Docket Item No. II-E-7}

4. Radian Corporation. Draft Meeting Minutes of a September 22, 1993 meeting between the Ethylene Propylene Rubber and Nitrile Butadiene Latex Industries and the Environmental Protection Agency. {Docket Item No. II-E-10}

5. Protocol for Equipment Leak Emission Estimates. EPA-453/R-93-026. U.S. Environmental Protection Agency, Research Triangle Park, North Carolina. June 1993.

6. Protocol Document. p. 2-10.

7. Protocol Document, p. 5-2 and p. 5-8.

8. Memorandum, from Meardon, K., Pacific Environmental Services, to Group IV Resins Docket No. A-92-45. Determination of MACT Floors for Equipment Leaks. March 24, 1995.

ATTACHMENT 1. STREAM BY STREAM SUMMARY OF PROCESS VENT EMISSIONS

	Reported Emissions (Mg/yr)	Reported Control Level (%)	Adjusted Baseline (Mg/yr)
Facility PBR/SBRS–4			
Process "Front End"			
flare	22.3	98	22.3
Solvent Recovery Vents	133.9		133.9
Butadiene washing	3.4		3.4
Subtotal	159.6		159.6
Process "Back End"			
Dryer vents	589.0		589.0
Dewatering vents	182.6		182.6
Subtotal	771.6		771.6
Facility Process Vent Total	931.2		931.2
Facility PBR/SBRS–5			
Process "Front End"			
Flare exit	4.5	98.5	6.0
Subtotal	4.5		6.0
Process "Back End"			
Drum Dryer Stacks	471.0		471.0
Roof Fans	0.8		0.8
Crumb Dryers	563.9		563.9
Subtotal	1035.7		1035.7
Facility Process Vent Total	1040.2		1041.8
Polysulfide Rubber			
Facility PSR–1			
No HAP Emissions Reported from Process Vents			
Styrene Butadiene Latex			
Facility SBL–1			
Control device outlet	0.0	99.97	2.5
Recovered water storage	0.0		0.0
Facility Process Vent Total	0.1		2.5
Facility SBL–2			
Controlled			0.0
Uncontrolled	22.9		22.9
Scrubber outlet	22.9		
Cooling operation	0.0		
Water purification	0.0		
Facility Process Vent Total	22.9		22.9

ATTACHMENT 1. STREAM BY STREAM SUMMARY OF PROCESS VENT EMISSIONS

	Reported Emissions (Mg/yr)	Reported Control Level (%)	Adjusted Baseline (Mg/yr)
Facility SBL–3			
Control device outlet	0.0	99.99	8.4
Adjusting Tank	0.0		0.0
Facility Process Vent Total	0.0		8.4
Facility SBL–4			
Control device outlet	0.0	99.99	0.6
Vent when TO down	0.2		0.2
Facility Process Vent Total	0.2		0.8
Facility SBL–5			
Outlet from scrubber	1.8		1.8
Facility Process Vent Total	1.8		1.8
Facility SBL–6			
Rec styrene concentrator	0.0		0.0
Butadiene recovery	5.1		5.1
Facility Process Vent Total	5.1		5.1
Facility SBL–7			
Control device outlet	8.1	95	3.2
Building vent	0.3		0.3
Facility Process Vent Total	8.4		3.6
Facility SBL–8			
Controlled	3.0	99	5.9
Misc fugitive sources	0.2		0.2
Facility Process Vent Total	3.1		6.1
Facility SBL–9			
Control device outlet	0.3	99.5	1.4
Reactor purge (maintenance)	0.1		0.1
Knock–out pot maintenance	0.7		0.7
Facility Process Vent Total	1.2		2.2
Facility SBL–10			
Control device outlet	0.0	99.99	0.7
Reactor sampling	0.0		0.0
Facility Process Vent Total	0.0		0.8
Facility SBL–11			
Control device outlet	0.7	98	0.7
inerts removal	0.0		0.0
Facility Process Vent Total	0.8		0.8

ATTACHMENT 1. STREAM BY STREAM SUMMARY OF PROCESS VENT EMISSIONS

	Reported Emissions (Mg/yr)	Reported Control Level (%)	Adjusted Baseline (Mg/yr)
SBL–12			
Control device outlet	0.6	98	0.6
Product filtration	0.2		0.2
Production loading	0.2		0.2
Facility Process Vent Total	1.1		1.1
Facility SBL–13			
Control device outlet	0.1	99.5	0.6
Styrene decanter	0.1		0.1
Facility Process Vent Total	0.2		0.6
SBL–14			
Control device outlet	0.0	99.999	20.0
Waste styrene handling	0.0		0.0
Facility Process Vent Total	0.0		20.0
SBL–15			
Control device outlet	1.1	99.99	212.0
Facility Process Vent Total	1.1		212.0

ATTACHMENT 1. STREAM BY STREAM SUMMARY OF PROCESS VENT EMISSIONS

	Reported Emissions (Mg/yr)	Reported Control Level (%)	Adjusted Baseline (Mg/yr)
Styrene Butadiene Rubber by Emulsion			
SBRE-1			
Process "Front End"			
flare outlet	4.2	98	4.2
Charge tanks	0.0		0.0
Decanters	0.1		0.1
Cooling Towers	2.0		2.0
Subtotal	6.3		6.3
Process "Back End"			
C Dryers	8.4		8.4
D Dryers	8.8		8.8
F Dryers	18.2		18.2
J Dryers	20.7		20.7
K Dryers	22.5		22.5
L Dryers	22.3		22.3
M Dryers	22.4		22.4
P Dryers	23.0		23.0
Q Dryers	23.4		23.4
S Dryers	4.4		4.4
Packaging/Shipping Fugitives	1.8		1.8
Dryer Fugitives	11.4		11.4
Coagulation Fugitives	64.3		64.3
Subtotal	251.5		251.5
Facility Process Vent Total	257.8		257.8
Facility SBRE-2			
Process "Front End"			
flare-reactor, recover, storage	0.0	99.99	3.6
boiler - recovery	0.0	99.99	3.6
Subtotal	0.0		7.3
Process "Back End"			
Dryers	72.7		72.7
Subtotal	72.7		72.7
Facility Process Vent Total	72.8		80.0

ATTACHMENT 1. STREAM BY STREAM SUMMARY OF PROCESS VENT EMISSIONS

	Reported Emissions (Mg/yr)	Reported Control Level (%)	Adjusted Baseline (Mg/yr)
Facility SBRE-3			
Process "Front End"			
Butadiene recovery vent	3.5		3.5
Subtotal	3.5		3.5
Process "Back End"			
Dryer A	26.5		26.5
Dryer B	40.7		40.7
Dryer C	46.5		46.5
Coag Line	29.2		29.2
Process Bld Vents	5.2		5.2
Subtotal	148.1		148.1
Facility Process Vent Total	151.6		151.6
Facility SBRE-4			
Process "Front End"			
flare outlet	0.4	98	0.4
Coagulation tank – D	0.5		0.5
Coagulation tank – C	0.4		0.4
Coagulation tank – CC	0.2		0.2
Coagulation tank – B	0.4		0.4
Coagulation tank – A	0.4		0.4
Subtotal	2.5		2.5
Process "Back End"			
Dryer A	6.5		6.5
Dryer B	9.9		9.9
Dryer C	12.0		12.0
Dryer D	16.1		16.1
Dryer E	33.3		33.3
Dryer F	32.2		32.2
Dryer G	65.3		65.3
Dryer H	47.1		47.1
Dryer I	3.2		3.2
Dryer J	6.3		6.3
Dryer K	32.6		32.6
Dryer L	36.7		36.7
Dryer M	3.3		3.3
Dryer N	6.2		6.2
Dryer P	11.6		11.6
Dryer R	18.0		18.0
Dryer S	19.4		19.4
Dryer T	19.7		19.7
Subtotal	379.3		379.3
Facility Process Vent Total	381.7		381.7

Attachment 2

Wastewater emission calculation example

ATTACHMENT 2
Example - Wastewater Emission Calculation Methodology

Assume 3 plants in subcategory

Production information
Plant A: 1,000 tons/year
Plant B: 1,500 tons/year
Plant C: 750 tons/year

Submitted wastewater information

Plant A: 3 streams identified
Stream 1: originates from reactor {reaction area}
styrene concentration: 350 ppm
butadiene concentration: 800 ppm
flow rate: 2 lpm
Stream 2: originates from decanter following stripper {stripping/material recovery area}
styrene concentration: 350 ppm
flow rate: 15 liters/min
stream routed to steam stripper
Stream 3: originates from dewatering screen {finishing area}
styrene concentration: 50 ppm
flow rate: 125 liters/min

Plant B: 2 streams identified in process flow diagram, but no flow and concentration data provided. Also no control shown on flow diagram.
Stream 1: originates from decanter following stripper {stripping/material recovery area}
Stream 2: originates from dewatering screen {finishing area}

Plant C: no wastewater information provided

Step 1: Identify wastewater streams

For Plants A and B, the wastewater streams were those identified in the information submitted. Based on the information submitted by these facilities, it appears that it is common for facilities in the subcategory to have wastewater streams that originate from the stripping/material area (decanter) and the finishing area (dewatering screen). Therefore, two wastewater streams are assigned to Plant C originating from these two locations.

Step 2: Obtain/estimate stream characteristics

For Plant A, the stream characteristics provided were used. For Plants B and C, the stream characteristics were extrapolated from the information provided by Plant A.

Plant B:

Stripping/material recovery stream

styrene concentration - 350 ppm

flow rate - (15 l/min) x (1,500/1,000) = 22.5 l/min

Finishing area stream

styrene concentration - 50 ppm

flow rate - (125 l/min) x (1,500/1,000) = 187.5 l/min

Plant C:

Stripping/material recovery stream

styrene concentration - 350 ppm

flow rate - (15 l/min) x (750/1,000) = 11.25 l/min

Finishing area stream

styrene concentration - 50 ppm

flow rate - (125 l/min) x (750/1,000) = 93.75 l/min

Step 3: Calculate uncontrolled HAP emissions

Plant A:

Reactor stream

$E_{styrene}$ = (5.26×10^{-4})(350 ppm styrene)(2 l/min)(0.8[a]) = 0.3 Mg/yr

$E_{butadiene}$ = (5.26×10^{-4})(750 ppm butadiene)(2 l/min)(0.95[b]) = 0.75 Mg/yr

$E_{total\ HAP}$ = 0.3 + 0.75 = 1.05 Mg/yr

Stripping/material recovery stream

$E_{styrene}$ = (5.26×10^{-4})(350 ppm styrene)(15 l/min)(0.8) = 2.2 Mg/yr

Finishing stream

$E_{styrene}$ = (5.26×10^{-4})(50 ppm styrene)(125 l/min)(0.8) = 2.6 Mg/yr

Plant B:

Stripping/material recovery stream

$E_{styrene}$ = (5.26×10^{-4})(350 ppm styrene)(22.5 l/min)(0.8) = 3.3 Mg/yr

Finishing stream

$E_{styrene}$ = (5.26×10^{-4})(50 ppm styrene)(187.5 l/min)(0.8) = 3.9 Mg/yr

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[a] Fraction emitted (F_e) value for styrene from Table XX of Subpart G of the HON.

[b] Fraction emitted (F_e) value for 1,3-butadiene from Table XX of Subpart G of the HON.

Plant C:

Stripping/material recovery stream

$E_{styrene}$ = $(5.26 \times 10^{-4})(350 \text{ ppm styrene})(11.25 \text{ l/min})(0.8)$ = 1.7 Mg/yr

Finishing stream

$E_{styrene}$ = $(5.26 \times 10^{-4})(50 \text{ ppm styrene})(93.75 \text{ l/min})(0.8)$ = 2.0 Mg/yr

Step 4: Identify controls and calculate HAP emissions after control

The only stream for which control was identified was the stripping/material stream at Plant A. The controlled emissions for this stream were calculated as follows:

$E_{controlled}$ = (2.2 Mg/yr styrene) x (1 - 0.99[c]) = 0.022 Mg/yr

Summary

The attached table summarizes the wastewater emissions for this subcategory.

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[c] Fraction remmoved (F_r) value for styrene from Table XX of Subpart G of the HON.

Attachment 3

Stream by stream breakdown of baseline wastewater emissions

Attachment 3. Baseline Wastewater Emissions By Facility

Plant ID	Process Area Where Stream Originated[a]	Number of Streams	HAP	Facility HAP Emissions (Mg/yr) Uncontrolled	Controlled
Butyl Rubber					
BR-1	Stripping and Material Recovery	13	Methyl chloride Methanol Ethyl benzene Cumene Xylenes	148.49	148.49
	Finishing	8	Methanol Methyl chloride Ethyl benzene Cumene Xylenes		
Epichlorohydrin					
EPI-1	Stripping and Material Recovery	2	Toluene	6.72	6.72
Ethylene Propylene Rubber					
EPR-1	Stripping and Material Recovery	3	Hexane Butadiene	8.85	0.09
EPR-2	None				
EPR-3[a]	Stripping and Material Recovery	1	Toluene	3.61	3.61
EPR-4[a]	Stripping and Material Recovery	1	Hexane	15.80	15.80
EPR-5[a]	Stripping and Material Recovery	1	Hexane	6.90	0.07
Halobutyl Rubber					
HBR-1	None				
Hypalon					
HYP-1	None				

Attachment 3. Baseline Wastewater Emissions By Facility

Plant ID	Process Area Where Stream Originated[a]	Number of Streams	HAP	Facility HAP Emissions (Mg/yr) Uncontrolled	Controlled
Neoprene					
NEO-1[a]	Reactor	2	Chloroprene Glycol Ether	5.45	5.45
	Stripping and Material Recovery	2	Chloroprene Toluene		
NEO-2	Prepolymerization	8	Chloroprene Glycol Ether HCl Toluene	11.59	11.59
	Reactor	2	Chloroprene Glycol Ether		
	Stripping and Material Recovery	4	Chloroprene Glycol Ether HCl Toluene		
NEO-3[a]	Reactor	2	Chloroprene Glycol Ether	3.95	3.95
	Stripping and Material Recovery	3	Chloroprene Toluene		
Nitrile Butadiene Latex					
NBL-1	Reactor	2	Acrylonitrile Butadiene	97.99	97.99
	Stripping and Material Recovery	1	Acrylonitrile		
NBL-2	NONE				
NBL-3[a]	Reactor	2	Acrylonitrile Butadiene	5.93	5.93
	Stripping and Material Recovery	1	Acrylonitrile		

Attachment 3. Baseline Wastewater Emissions By Facility

Plant ID	Process Area Where Stream Originated[a]	Number of Streams	HAP	Facility HAP Emissions (Mg/yr) Uncontrolled	Controlled
Nitrile Butadiene Rubber					
NBR-1	Prepolymerization	1	Butadiene	2.19	2.19
	Stripping and Material Recovery	1	Acrylonitrile		
	Finishing	1	Acrylonitrile		
NBR-2[a]	Prepolymerization	1	Butadiene	2.08	2.08
	Stripping and Material Recovery	1	Acrylonitrile		
	Finishing	1	Acrylonitrile	2.08	2.08
NBR-3[a]	Prepolymerization	1	Butadiene		
	Stripping and Material Recovery	1	Acrylonitrile		
	Finishing	1	Acrylonitrile	2.09	2.09
NBR-4[a]	Prepolymerization	1	Butadiene		
	Stripping and Material Recovery	1	Acrylonitrile		
	Finishing	1	Acrylonitrile	1.1	1.1
Polybutadiene and Styrene Butadiene Rubber by Solution					
PBR/SBRS-1[a]	Prepolymerization	1	Total HAPS	3.81	3.81
	Stripping and Material Recovery	18	Hexane		
			Styrene		
	Finishing	1	Hexane		
PBR/SBRS-2[a]	Prepolymerization	1	Total HAPS	0.12	0.12
	Stripping and Material Recovery	1	Butadiene		
			Methanol		
	Finishing	3	Methanol		
PBR/SBRS-3[a]	Prepolymerization	2	Total HAPS	16.92	16.92
	Stripping and Material Recovery	4	Butadiene		
			Styrene		
			Toluene		
			Total HAPS		
	Finishing	2	Toluene		

Attachment 3. Baseline Wastewater Emissions By Facility

Plant ID	Process Area Where Stream Originated[a]	Number of Streams	HAP	Facility HAP Emissions (Mg/yr) Uncontrolled	Controlled
PBR/SBRS-4[a]	Prepolymerization	2	Total HAPS	1.96	1.96
	Stripping and Material Recovery	4	Hexane Styrene Butadiene		
	Finishing	2	Hexane		
PBR/SBRS-5[a]	Prepolymerization	1	Total HAPS	2.79	2.79
	Stripping and Material Recovery	2	Hexane Butadiene		
	Finishing	1	Hexane		
Polysulfide Rubber					
PSR-1	NONE				
Styrene Butadiene Latex					
SBL-1	Stripping and Material Recovery	1	Styrene	0.80	0.80
SBL-2	Stripping and Material Recovery	1	Styrene	0.11	0.11
SBL-3	None	0			
SBL-4	None	0			
SBL-5	Reactor	1	Cumene Ethylbenzene Styrene	2.13	2.13
	Stripping and Material Recovery	1	Styrene		
SBL-6[a]	Reactor	1	Total HAPS	62.93	62.93
	Stripping and Material Recovery	3	Butadiene Styrene Xylenes		
	Finishing		Styrene		
SBL-7	Reactor	2	Styrene	0.03	0.03
	Stripping and Material Recovery	1	Styrene		
SBL-8	Stripping and Material Recovery	1	Butadiene Styrene	242.85	242.85
SBL-9	Stripping and Material Recovery	1	Butadiene Styrene	12.49	12.49

Attachment 3. Baseline Wastewater Emissions By Facility

Plant ID	Process Area Where Stream Originated[a]	Number of Streams	HAP	Facility HAP Emissions (Mg/yr) Uncontrolled	Controlled
SBL-10	Stripping and Material Recovery	1	Butadiene Styrene	6.26	6.26
SBL-11[a]	Reactor	1	Total HAPS	250.20	250.20
	Stripping and Material Recovery	3	Butadiene Styrene Total HAPS		
	Finishing	1	Styrene		
SBL-12[a]	Reactor	1	Total HAPS	4.47	4.47
	Stripping and Material Recovery	3	Butadiene Styrene Total HAPS		
	Finishing	1	Styrene		
SBL-13[a]	Reactor	1	Total HAPS	23.67	23.67
	Stripping and Material Recovery	3	Butadiene Styrene Total HAPS		
	Finishing	1	Styrene		
SBL-14[a]	Reactor	1	Total HAPS	71.08	71.08
	Stripping and Material Recovery	3	Butadiene Styrene		
	Finishing	1	Styrene		
SBL-15[a]	Reactor	1	Total HAPS	13.56	13.56
	Stripping and Material Recovery	3	Butadiene Styrene Total HAPS		
	Finishing	1	Styrene		
Styrene Butadiene Rubber by Emulsion					
SBRE-1	Prepolymerization	2	Butadiene Styrene	91.65	49.48
	Reactor	1	Butadiene Styrene		
	Stripping and Material Recovery	2	Butadiene		

Attachment 3. Baseline Wastewater Emissions By Facility

Plant ID	Process Area Where Stream Originated[a]	Number of Streams	HAP	Facility HAP Emissions (Mg/yr) Uncontrolled	Controlled
			Styrene		
SBRE-2[a]	Prepolymerization	2	Butadiene Styrene	14.21	10.02
	Reactor	2	Butadiene Styrene		
	Stripping and Material Recovery	3	Butadiene Styrene		
	Finishing	1	Styrene		
SBRE-3	Reactor	1	Styrene	21.15	21.15
	Stripping and Material Recovery	2	Styrene		
	Finishing	1	Styrene		
SBRE-4	Prepolymerization	2	Butadiene Styrene	3.82	3.82
	Reactor	3	Butadiene Styrene		
	Stripping and Material Recovery	4	Butadiene Styrene		

[a] The existence of, or characteristics of, at least one wastewater stream at this facility was extrapolated from other facilities in the subcategory.

Attachment 1

Vent-by-vent breakdown of baseline process vent emissions

ATTACHMENT 1. STREAM BY STREAM SUMMARY OF PROCESS VENT EMISSIONS

	Reported Emissions (Mg/yr)	Reported Control Level (%)	Adjusted Baseline (Mg/yr)
Butyl Rubber			
Facility BR-1			
Process "Front End"			
Flare exit – methyl chloride	1.0	99.5	4.2
Flare exit (HCl)	146.8		146.8
Maintenance Operations Vent	216.4		216.4
Subtotal	364.2		367.4
Process "Back End"			
Dryer Operations Vent	109.5		109.5
Subtotal	109.5		109.5
Facility Process Vent Total	473.8		476.9
Epichlorohydrin			
Facility EPI-1			
Process "Front End"			
Flare tower outlet	0.4	99	0.7
Subtotal	0.4		0.7
Process "Back End"			
French Press/Shaker Screen	16.2		16.2
Tunnel Dryer	0.3		0.3
Subtotal	16.5		16.5
Facility Process Vent Total	16.8		17.2
Ethylene Propylene Rubber			
EPR-1			
Process "Front End"			
Raw hex strip	10.0		10.0
Recycled hex dry	2.9		2.9
Sampling	0.5		0.5
Samp Drying	4.0		4.0
Sampling	0.9		0.9
Subtotal	18.3		18.3
Process "Back End"			
Dryers	12.5		12.5
Dryers	112.6		112.6
Dryers	300.8		300.8
Dryers	300.8		300.8
Dewater	401.0		401.0
Subtotal	1127.7		1127.7
Facility Process Vent Total	1146.0		1146.0

ATTACHMENT 1. STREAM BY STREAM SUMMARY OF PROCESS VENT EMISSIONS

	Reported Emissions (Mg/yr)	Reported Control Level (%)	Adjusted Baseline (Mg/yr)
Facility EPR–2			
Process "Front End"			
Monomer pure (boiler) – hex	0.1	99.5	0.2
Monomer pure (flare) – hex	0.0	99.5	0.0
Reactor sampling	12.3		12.3
Boiler out – HCl	69.1		69.1
Flare out – HCl	8.6		8.6
Subtotal	90.1		90.2
Process "Back End"			
Finishing vent	348.6		348.6
Subtotal	348.6		348.6
Facility Process Vent Total	438.7		438.9
Facility EPR–3			
Process "Front End"			
flare exit	1.8	98	1.8
Slurry tank	1.4		1.4
Slurry tank	0.8		0.8
Slurry tank	1.1		1.1
Subtotal	5.1		5.1
Process "Back End"			
Shaker screen	0.6		0.6
Dewaterer	0.4		0.4
Dryer/Hot Box	15.3		15.3
G–Stack	20.6		20.6
Subtotal	36.8		36.8
Facility Process Vent Total	41.9		41.9

ATTACHMENT 1. STREAM BY STREAM SUMMARY OF PROCESS VENT EMISSIONS

	Reported Emissions (Mg/yr)	Reported Control Level (%)	Adjusted Baseline (Mg/yr)
Facility EPR-4			
Process "Front End"			
flare exit	2.8	99.8	28.2
Sampling	33.1		33.1
chromat vent	18.3		18.3
solvent recover	1.1		1.1
Subtotal	55.3		80.6
Process "Back End"			
E9,13	25.6		25.6
E11,15	69.9		69.9
E12	13.6		13.6
E16	8.9		8.9
E17	4.7		4.7
E23,28	11.9		11.9
E24,29	6.2		6.2
E25,27	17.1		17.1
E26,30	46.6		46.6
E33,35	20.9		20.9
E34,36	11.5		11.5
E37,38	15.2		15.2
E39,40	37.8		37.8
E41,43	75.8		75.8
E42,44	26.2		26.2
ES7,S8	21.6		21.6
Subtotal	413.6		413.6
Facility Process Vent Total	468.8		494.2
Facility EPR-5			
Process "Front End"			
reactor vent to flare	0.0	99.99	0.1
EN slop tanks	1.1		1.1
in-process tanks	18.1		18.1
coagulation /stripping	6.4		6.4
Subtotal	25.6		25.7
Process "Back End"			
expellers	14.0		14.0
dryers	54.4		54.4
Subtotal	68.4		68.4
Facility Process Vent Total	94.0		94.0

ATTACHMENT 1. STREAM BY STREAM SUMMARY OF PROCESS VENT EMISSIONS

	Reported Emissions (Mg/yr)	Reported Control Level (%)	Adjusted Baseline (Mg/yr)
Halobutyl Rubber			
Facility HBR-1			
Process "Front End"			
Flare exit			
hexane	13.7	99.5	54.9
methyl chloride	80.9	99.5	323.6
HCl	305.0		305.0
Subtotal	399.6		683.5
Process "Back End"			
Finishing	280.5		280.5
Subtotal	280.5		280.5
Facility Process Vent Total	680.1		964.0
Hypalon			
Facility HYP-1			
Process "Front End"			
EPN-112	49.8		49.8
BLW-338	0.0		0.0
Subtotal	49.8		49.8
Process "Back End"			
Dryer	4.9		4.9
Dryer	12.1		12.1
Dryer	7.0		7.0
Dryer	4.6		4.6
Subtotal	28.6		28.6
Facility Process Vent Total	78.4		78.4
Neoprene			
Facility NEO-1			
Process "Front End"			
Stripper Vents	162.5		162.5
Kettles	32.1		32.1
Chloroprene Refining	19.7		19.7
Water Wash	6.1		6.1
Blend Tank	1.5		1.5
Subtotal	222.0		222.0
Process "Back End"			
Dryer Hot Compart	34.5		34.5
Dryer Cool	0.0		0.0
Subtotal	34.5		34.5
Facility Process Vent Total	256.6		256.6

ATTACHMENT 1. STREAM BY STREAM SUMMARY OF PROCESS VENT EMISSIONS

	Reported Emissions (Mg/yr)	Reported Control Level (%)	Adjusted Baseline (Mg/yr)
Facility NEO–2			
Process "Front End"			
BCD Tank Car Unload	1.0		1.0
CD Column Cond	17.5		17.5
CD Column Heels	15.4		15.4
Incinerator	0.4		0.4
HCl Fume Scrubber	1.4		1.4
Chlorine scrubber	0.1		0.1
TCB Still	2.0		2.0
Chlorine car scrubber	0.0		0.0
Poly Kettles w/o condensers	30.2		30.2
Poly Kettles with condensers	39.1		39.1
Stabilizer Tanks	1.2		1.2
Subtotal	108.3		108.3
Process "Back End"			
Aging Tanks	6.0		6.0
Aging Tanks	8.6		8.6
Strippers	44.9		44.9
Emulsion Storage Tanks	45.4		45.4
Dryers	25.0		25.0
Dryers	8.3		8.3
Dryers	1.8		1.8
Dryers	9.8		9.8
Product Storage	0.2		0.2
Subtotal	150.0		150.0
Facility Process Vent Total	258.3		258.3
Facility NEO–3			
Process "Front End"			
V–1	9.0		9.0
V–2	1.9		1.9
V–3	5.5		5.5
V–4	1.5		1.5
V–8	2.3		2.3
V–9	1.3		1.3
Subtotal	21.3		21.3
Process "Back End"			
V–19	18.9		18.9
Subtotal	18.9		18.9
Facility Process Vent Total	40.3		40.3

ATTACHMENT 1. STREAM BY STREAM SUMMARY OF PROCESS VENT EMISSIONS

	Reported Emissions (Mg/yr)	Reported Control Level (%)	Adjusted Baseline (Mg/yr)
Nitrile Butadiene Latex			
Facility NBL–1			
Process "Front End"			
flare exit	5.5	95	2.2
building vent	0.4		0.4
Facility Process Vent Total	5.9		2.6
Facility NBL–2			
Process "Front End"			
flare exit	0.002	95	0.001
misc small vents	0.000		0.000
Facility Process Vent Total	0.002		0.001
Facility NBL–3			
Process "Front End"			
flare outlet	0.5	98	0.5
product filter	0.2		0.2
product storage	0.2		0.2
product loading	0.2		0.2
Facility Process Vent Total	0.9		0.9
Nitrile Butadiene Rubber			
Facility NBR–1			
Process "Front End"			
flare outlet	0.7	98	0.7
Subtotal	0.7		0.7
Process "Back End"			
B Dryers	2.7		2.7
T Dryers	0.8		0.8
Dryer Fugitives	0.2		0.2
FUG–MP	0.7		0.7
Coagulation Fugitives	2.8		2.8
VV	2.0		2.0
Subtotal	9.1		9.1
Facility Process Vent Total	9.8		9.8

ATTACHMENT 1. STREAM BY STREAM SUMMARY OF PROCESS VENT EMISSIONS

	Reported Emissions (Mg/yr)	Reported Control Level (%)	Adjusted Baseline (Mg/yr)
Facility NBR-2			
Process "Front End"			
Pre-Mix	1.2		1.2
Reactor	0.0		0.0
Blowdown	1.8		1.8
Recovery	2.0		2.0
Blend Tanks	4.5		4.5
Fugitives	19.2		19.2
Subtotal	28.8		28.8
Process "Back End"			
Batch Coag/Wash	0.2		0.2
Feed/Settle Tank	0.2		0.2
Drying-Steam Jet	2.2		2.2
#1 Spray Feed	0.9		0.9
#1 Spray Dryer	6.5		6.5
#2 Spray Feed	0.0		0.0
#2 Spray Dryer	47.6		47.6
National Coag/Wash	4.6		4.6
National Dewater Rm	1.5		1.5
National Dryer	24.1		24.1
F-Dewater	0.1		0.1
F-Dryer	6.6		6.6
Subtotal	94.7		94.7
Facility Process Vent Total	123.4		123.4
Facility NBR-3			
Process "Front End"			
Dilute Acrylonitrile Accumulator	1.0		1.0
BD recover scrubber outlet	1.8		1.8
Subtotal	2.8		2.8
Process "Back End"			
Flocculator	7.5		7.5
Flocculator	2.2		2.2
Drying	0.7		0.7
Subtotal	10.5		10.5
Facility Process Vent Total	13.3		13.3

ATTACHMENT 1. STREAM BY STREAM SUMMARY OF PROCESS VENT EMISSIONS

	Reported Emissions (Mg/yr)	Reported Control Level (%)	Adjusted Baseline (Mg/yr)
Facility NBR–4			
Process "Front End"			
flare–reactor, recover, storage	0.0	99.99	3.6
boiler – recovery	0.0	99.99	1.8
AN water stripper exit	0.1		0.1
Subtotal	0.1		5.5
Process "Back End"			
Dryers	0.4		0.4
Subtotal	0.4		0.4
Facility Process Vent Total	0.5		5.9
Polybutadieneand Styrene Butadiene Rubber by Solution			
Facility PBR/SBRS–1			
Process "Front End"			
Incinerator outlet	1.6	99	3.2
880 crumb tank chiller	0.01		0.0
840 crumb tank chiller	0.01		0.0
Subtotal	1.6		3.2
Process "Back End"			
Dryer Beds	1.1	98	1.1
Dryer Beds	0.9	98	0.9
Finishing room exhausts	166.2		166.2
Finishing room exhaust	115.2		115.2
Finishing room exhausts	107.0		107.0
Subtotal	390.4		390.4
Facility Process Vent Total	392.1		393.7
Facility PBR/SBRS–2			
No HAP Emissions Reported from Process Vents			
Facility PBR/SBRS–3			
Process "Front End"	None Reported		
Process "Back End"			
Boiler exit	186.3	90	186.3
Cond. outlet (crumb storage)	19.3	95	19.3
Subtotal	205.5		205.5
Facility Process Vent Total	205.5		205.5

Attachment 4

Equipment leak emission calculation example

ATTACHMENT 4
Example - Equipment Leak Emission Calculation Methodology

Assume 3 plants in subcategory
Assume that category is not subject to Subpart I

Capacity information

Plant A: 1,500 Mg/year
Plant B: 2,000 Mg/year
Plant C: 1,000 Mg/year

Submitted equipment leak information

Plant A:

Component Type	Number	Baseline Control
Gas Valves	3,000	Q-10000
Liquid valves	2,000	Q-10000
Pump seals (light liquid)	35	Q-10000
Compressor seals	10	Q-10000
Pressure relief valves	50	Rupture Disk
Flange/connectors	7,500	-
Open-ended lines	100	-
Sampling connectors	15	-

Plant B:

Component Type	Number	Baseline Control
Gas Valves	6,000	M-10000
Liquid valves	2,500	M-10000
Pump seals (light liquid)	55	Q-10000
Compressor seals	30	Q-10000
Pressure relief valves	25	Q-10000
Flange/connectors	13,000	Q-10000
Open-ended lines	400	Capped
Sampling connectors	5	Closed Loop

Plant C:

No information submitted

Other pertinent information

Plants A and C are located in the same State, where an equipment leak regulation exists. Plant A is in compliance.

Step 1: Obtain/estimate component counts

Component counts were provided by Plants A and B. Estimates were made for Plant C by multiplying the average number of components per unit of capacity, calculated from Plants A and B, by Plant C's capacity.

	Capacity (Mg/yr)	Gas Valves #	Gas Valves #/cap	Liq Valves #	Liq Valves #/cap	Pump Seals #	Pump Seals #/cap	Comp Seals #	Comp Seals #/cap	Press Rlf Valves #	Press Rlf Valves #/cap	Flanges/ connectors #	Flanges/ connectors #/cap	Open-end Lines #	Open-end Lines #/cap	Sampling connectors #	Sampling connectors #/cap
Plant A	1,500	3000	2.000	2000	1.333	35	0.023	10	0.007	50	0.033	7500	5.000	100	0.067	15	0.010
Plant B	2,000	6000	3.000	2500	1.250	55	0.028	30	0.015	25	0.013	13000	6.500	400	0.200	5	0.003
Avg #/cap			2.500		1.292		0.025		0.011		0.023		5.750		0.133		0.006
Plant C	1,000	2500		1292		25		11		23		5750		133		6	

Step 2: Identify/estimate existing level of control

Plants A and B provided control levels. Plant A and Plant C are located in the same State, which has an equipment leak regulation. Therefore, the control level for Plant C was assumed to be equal to that of Plant A (and the State regulation).

Step 3: Calculate baseline HAP emissions

From the Pacific Environmental Services, Inc. (PES) memorandum contained in Attachment 5, the following emission factors were obtained that correspond to the control levels reported by the facilities. (The units were converted to kilograms pounds, which were the units in the PES memorandum).

	Component-specific emission factors (kg/hr/source)							
	Gas Valves	Liq Valves	Pump Seals	Comp Seals	Press Rlf Valves	Flange/ connects	Openend Lines	Sample connects
Uncontrol						0.00183	0.0017	0.01497
Q-10000	0.00183	0.00138	0.01089	0.15268	0.05806	0.00016		
M-10000	0.00075	0.00064					0	
RuptDisk					0			
CapLines								

The number of a particular type of component was then multiplied by the appropriate emission factor (assuming 8,760 hours per year and a HAP concentration of 1.0) to obtain the annual baseline emissions for each component type. For instance, for gas valves at Plant A:

$$E_{gasvlv} = \frac{(1.0\%HAP)\,(8760hrs/yr)}{1,000kg/Mg}(0.00183kg/hr/valve)\,(3,000valves) = 48Mg/yr$$

The following table shows baseline equipment leak emissions for the example facilities, by component. The sum of HAP emissions for all component types represents the total baseline emissions for equipment leaks.

	Baseline HAP Emissions (Mg/yr)								
	Gas Valves	Liq Valves	Pump Seals	Comp Seals	Press Rlf Valves	Flange/ connects	Openend Lines	Sample connects	TOTAL
Plant A	48.0	24.2	3.3	13.4	0.0	120.1	1.5	2.0	212.5
Plant B	39.3	14.0	5.2	40.1	12.7	18.0	0.0	0.0	129.5
Plant C	40.0	15.7	2.4	14.5	0.0	92.1	2.0	0.8	167.5

Attachment 5

Baseline equipment leak control levels

ATTACHMENT 5. SUMMARY OF EQUIPMENT LEAK CONTROL TECHNIQUES USED IN BASELINE EMISSIONS ANALYSIS

		Baseline Equipment Leak Control Techniques[a]								
		Valves								
Facility ID	State	Gas	Liquid	Pumps	Compress	Pressure Relief Vlv	Flange/ Connect	Open-end Lines	Sampling connect	Basis[b]
BR-1	TX			A-1000	CPS	RDI				114
EPDM-1	TX	M-10000	M-10000	M-10000		RDI	M-10000	BL	CPS	114
EPDM-2	LA	Q-10000	Q-10000	Q-10000	Q-10000	Q-10000				114
EPDM-3	TX	A-100	A-100		A-100	A-100	A-100	A-100		114
EPDM-4	LA	Q-10000	Q-10000	Q-10000	Q-10000	Q-10000				SR/OF
EPDM-5	LA	Q-10000	Q-10000	Q-10000	Q-10000	Q-10000				SR/OF
EPI-1	MS		Q-10000	Q-10000		Q-10000	Q-10000	Q-10000		114
HBR-1	LA	Q-10000	Q-10000	Q-10000	Q-10000	Q-10000				114
HYP-1	TX	M-10000	M-10000	M-10000		RDI	M-10000	BL	CPS	114/OF
NBL-1	DE	A-1000*	A-1000	Q-1000	A-1000	RDI	A-1000	A-1000		114
NBL-2	GA	A-1000	A-1000*	Q-1000*	A-1000	A-1000*	A-1000	A-1000		114
NBL-3	KY	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	114
NBR-1	TX	CVS	Q-500	Q-500		RDI	Q-500	BL	Q-500	114
NBR-2	KY	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	SR/OF
NBR-3	OH			Q-10000	Q-10000	Q-10000	Q-10000		Q-10000	OF
NBR-4	LA	Q-10000	Q-10000	Q-10000	Q-10000	Q-10000				SR/OF
NEO-1	LA	Q-10000	Q-10000	Q-10000	Q-10000	Q-10000				SR/OF
NEO-2	KY	WEEK	WEEK	WEEK			WEEK		WEEK	114
NEO-3	TX	Q-10000	Q-10000	Q-10000					Q-10000	114
PSR-1	MS	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	114
PBR/SBRS-1	TX	Q-10000	Q-10000	Q-10000	CVS	RDI	Q-10000		Q-10000	114
PBR/SBRS-2	TX	A-100	A-100		A-100	RDI	A-100	BL		114
PBR/SBRS-3	KY	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	SR/OF
PBR/SBRS-4	LA	Q-10000	Q-10000	Q-10000	Q-10000	Q-10000				SR/OF
PBR/SBRS-5	TX	Q-10000	Q-10000	Q-10000	Q-10000	Q-10000				SR

ATTACHMENT 5. SUMMARY OF EQUIPMENT LEAK CONTROL TECHNIQUES USED IN BASELINE EMISSIONS ANALYSIS

		Baseline Equipment Leak Control Techniques[a]								
		Valves				Pressure	Flange/	Open-end	Sampling	Basis[b]
Facility ID	State	Gas	Liquid	Pumps	Compress	Relief Vlv	Connect	Lines	connect	
SBL-1	GA	A-1000	A-1000*	M-1000	CPS	A-1000	A-1000	A-1000		114
SBL-2	CT	A-10000	A-10000		A-10000	RDI	CVS	BL	CVS	114
SBL-3	MI	A-10000	A-10000		A-10000					114
SBL-4	CA	Q-1000	Q-1000	Q-1000	Q-1000	A-1000	Q-1000	Q-1000	BL	114
SBL-5	TX	Q-10000	Q-10000			RDI	A-500	BL		114
SBL-6	GA	Q-10000	Q-10000	M-10000	M-10000	RDI	Q-10000	Q-10000		114/OF
SBL-7	DE	A-1000	A-1000*	A-1000	A-1000	RDI	A-1000	BL		114
SBL-8	GA	A-1000	A-1000*	Q-1000	A-1000	A-1000*	A-1000	A-1000		114
SBL-9	TN									114
SBL-10	TN									114
SBL-11	OH			Q-10000	Q-10000	Q-10000	Q-10000		Q-10000	114
SBL-12	KY	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NO INFO
SBL-13	NC									NO INFO
SBL-14	CA	Q-1000	Q-1000	Q-1000	Q-1000	Q-1000	Q-1000	Q-1000	BL	OF
SBL-15	NC									NO INFO
SBRE-1	TX	Q-500	Q-500	Q-500	CPS/CVS	CPS/CVS	Q-500	Q-500	Q-500	114
SBRE-2	LA	Q-10000	Q-10000	Q-10000	Q-10000	Q-10000				SR/OF
SBRE-3	TX	Q-10000	Q-10000	Q-10000	Q-10000	Q-10000				SR
SBRE-4	TX	Q-10000	Q-10000	Q-10000	Q-10000	Q-10000				SR

[a] Codes for control techniques:

A-annual monitoring, Q-quarterly monitoring, M-monthly monitoring
500, 1000, 10000 represent the leak definition (ppmv HAP detected)
CPS – closed purge system, RDI – rupture disk, BL – blocked lines, CVS – closed vent system

[b] Basis means the source(s) used to identify/predict the baseline level of control.

114 – from Section 114 questionnaire response
SR – from State equipment leak regulation
OF – extrapolated from other similar facilities in the same State
NO INFO – no information was available to indicate any equipment leak control program

Attachment 6

Documentation of equipment leak emission factors

A-92-45
II-B-29

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MEMORANDUM

TO: Group IV Resins Docket No. A-92-45

FROM: Ken Meardon
Pacific Environmental Services, Inc.

DATE: March 24, 1995

SUBJECT: Determination of MACT Floors for Equipment Leaks

The purpose of this memo is to describe the methodology used to calculate the MACT floors for the source categories covered by the Group IV Resins national emission standards for hazardous air pollutants (NESHAP). The same basic methodology, as described below, was used for each source category/subcategory.

Basic Methodology

The basic methodology consisted of estimating uncontrolled equipment leak emissions, identifying the level of control at each facility based on that facility's specific leak and detection repair (LDAR) program (if one was in place), applying the "controlled" equipment leak factors to estimate emissions after control, and then calculating the percent emission reduction achieved at each facility within each source category/subcategory. The information on the percent reduction achieved by the specific programs was then used to determine the MACT floors for each source category/subcategory.

Each individual plant was grouped with all other plants on the basis of the type of polymer or resin produced. Where a plant produced polymers or resins in more than one source category/subcategory, the equipment components were separated, where possible, according to the type of polymer or resin. If this was not possible, then all of the components were included in each applicable source category/subcategory for purposes of determining the MACT floors.

Estimating Uncontrolled Emissions

This step required determining (1) the equipment component counts at each plant and (2) the emission factors for each component category (e.g., valve in gas service, pump in light liquid service).

A number of facilities provided information on the component counts at a plant. Where these counts were provided, they were used directly in the estimation.

For facilities that did not provide equipment component counts, an estimate had to be made for each component type. There are many variables that affect the number of components at a facility. Such variables include, but are not limited to, the age of the facility, the number of process lines, and the capacity of each line and of the facility. Thus, for example, it is generally recognized that the number of components and thus emissions are related to the capacity of a facility. However, sufficient information was not available to perform any sophisticated analysis for estimating the number of components for those facilities.

The available information on equipment components was identified and estimates of the number of each component was made in terms of component per process line and component per design capacity. The results of this analysis showed, that for this industry, but unlike for the synthetic organic chemical industry (SOCMI), estimating the number of components by components-per-capacity was not necessarily unreasonable. The size of individual process lines within a subcategory was fairly similar and many of the facilities are of the same generation. Therefore, for estimation purposes, it was decided to use the information provided on individual facilities within the source category/subcategory, calculate an average count for each component type, and then ratio the design capacity of the target plant with the average design capacity of the plants that provided actual equipment counts.

To estimate uncontrolled emissions, the emission factors reported in the 1993 Protocol document[1] were used. These factors were used to provide a consistent baseline for estimating the impact of various LDAR programs in use in the source categories. For the several facilities that provided specific and clear information, the estimates of emissions were adjusted to account for low HAP concentrations and reduced hours of operation.

Identifying Level of Controls

A number of facilities provided information on the control programs being used to reduce emissions from equipment leaks. Other facilities simply identified a LDAR program, but did not provide any details. Still other facilities did not indicate any control programs for equipment leaks.

For facilities that provided information on the specific programs, these programs were used directly. For facilities that indicated that a LDAR program was being used,

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[1] U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. Protocol for Equipment Leak Emission Estimates. EPA-453/R-93-026, June 1993.

but did not provide specifics, the State regulation that appears to be applicable to the plant was used to estimate the specifics. In most cases, this resulted in assuming a CTG-like level of control. In one or two instances, a LDAR program was indicated, but no State program could be identified. It is assumed that the LDAR program was therefore due to plant policy. For facilities that did not indicate any programs for equipment leaks, no control was assumed unless the facility was located in a State with a LDAR program that was obviously directed toward that plant or type of plant.

Controlled Emission Factors

The controlled emission factors associated with various LDAR programs used in determining the MACT floors are summarized in Table 1. Table 2 shows the percent reduction of the controlled emission factors over the uncontrolled emission factors. In most instances, the controlled emission factors are based primarily on information found in the 1993 Protocol document. The footnotes to Table 1 detail the derivation of the controlled emission factors.

Calculation of Emission Reduction and Controlled Emission Rates

Using the equipment component counts, uncontrolled emission factors, and controlled emission factors, the amount of emission reduction achieved by component and for the entire plant was calculated for each plant. The percent emission reductions were then calculated. Table 3 summarizes the estimated percent reductions for each facility within each source category/subcategory.

MACT Floor Determination

MACT floors were then determined for existing and new facilities within each source category/subcategory. For source categories with less than 5 source categories all of the facilities were used to estimate the MACT floor. The MACT floor was calculated by taking the average of the percent emission reductions achieved by each of the facilities. Thus, for example, the four facilities producing ABS using the batch emulsion process were estimated to reduce equipment leak emissions by 91.2, 84.1, 82.0, and 79.5 percent. The average of these four percent reductions is 84.2 percent, which was used to represent the MACT floor for existing sources in this subcategory.

For source categories/subcategories with more than five facilities, the five facilities with the highest percent reductions were identified, and the MACT floor was calculated as the average percent reduction achieved by these five facilities. For example, the top five polystyrene facilities using a continuous process were identified as achieving 85.8, 81.9, 80.8, 79.6, and 78.6 percent reduction. The average of these five percent reductions is 81.3 percent.

For new facilities, the MACT floor was identified as the best performing facility within the source category/subcategory based on the estimated percent reduction. For example, in the ABS, batch emulsion source category, the Monsanto, Addyston, OH, facility was estimated to be reducing equipment leak emissions by 91.2 percent. This was then selected as the MACT floor for new sources in this subcategory.

In all cases, the MACT floors estimated for existing and new sources were equivalent to or less stringent than the HON.

TABLE 1

SUMMARY OF EMISSION FACTORS (lbs/hr) FOR VARIOUS EQUIPMENT LEAK CONTROL PROGRAMS

PROGRAM	Leak Definition (ppm)	EQUIPMENT CATEGORY[a]									
		V,G	V,LL	V,HL	P,LL	P,HL	PRVs	OELs	Comp.	Samp. Conn.	Connectors
Uncontrolled[b]	--	0.0131	0.00887	0.000506	0.0438	0.01896	0.2288	0.00374	0.5016	0.033	0.00403
Annual	10,000	0.0087[c]	0.0062[c]		0.034[c]		0.1784[c]		0.419[c]		0.00052[d]
Annual	1,000	0.0083	0.00395[e]		0.0305		0.1724				0.000334[d]
Semiannual	10,000										0.000392[f]
Quarterly LDAR	10,000	0.0043[g]	0.0035[e]		0.024[h]		0.128[i]		0.3366[j]		0.000349[f]
Quarterly LDAR	1,000	0.00345[g]	0.00273[e]		0.0172[h]		0.1166[k]				0.000194[d]
Quarterly LDAR	500	0.00323[g]	0.00257[e]		0.0157[h]		0.1152[l]				0.000166[d]
Quarterly LDAR[m]	200	0.00323	0.00257		0.0157		0.1152				0.000166
Quarterly LDAR	100										0.000166
Monthly LDAR	10,000	0.00165[g]	0.00141[e]		0.0135[h]						0.000264[d]
Monthly LDAR	1,000	0.0013[g]	0.00106[e]		0.011[h]						0.000124[d]
Monthly LDAR	500	0.0012[g]	0.001[e]		0.011[h]						0.0001[d]
Monthly LDAR	100	0.0010	0.001		0.011						
No Detectable Emissions[n]	500						0.007		0.007		
HON	varies	0.001[o]	0.0011[o]		0.011[o]		0.007				0.000286[d]
Maintain Less Than 2% Leakers[p]	10,000	0.00201	0.00232		0.00942		0.135		0.23		0.002655
	1,000	0.000336	0.000379		0.00225						0.00055
Maintain less than 1% leakers[q]	10,000				0.00676		0.1164		0.213		0.00142
Maintain less than 0.5% leakers[r]	10,000	0.000718	0.000853								

TABLE 1

SUMMARY OF EMISSION FACTORS (lbs/hr) FOR VARIOUS EQUIPMENT LEAK CONTROL PROGRAMS

PROGRAM	Leak Definition (ppm)	EQUIPMENT CATEGORY[a]									
		V,G	V,LL	V,HL	P,LL	P,HL	PRVs	OELs	Comp.	Samp. Conn.	Connectors
No Evidence of Leaks[s]	10,000	0.00122	0.00129		0.00999	0.007	0.0978	0.0033	0.186		0.00054
"Inspect as suspect"											0.00334[t]
Closed-vent System	--				0.00438[u]	0.001896[u]	v		0.05016[u]		
DMS w/Barrier Fluid[w]	--				0	0			0		
Rupture Disk[w]	--						0				
Weld Together[w]	--										0
Blind, Cap, Plug, Second Valve[w]	--							0			
Closed-loop Sampling[w]	--									0	

-- = Not Applicable

FOOTNOTES TO TABLE 1

[a] V = valves; P = pumps; PRVs = pressure relief valves; OELs = open-ended lines; Comp. = compressors; Samp. Conn. = sampling connections; G = gas service; LL = light liquid service; HL = heavy liquid service.

[b] U.S. Environmental Protection Agency. Protocol for Equipment Leak Emission Estimates. EPA-453/R-93-026. June 1993. page 2-10. (1993 Protocol document). Converted from kg/hr to lbs/hr by: kg/hr x 2.2 = lbs/hr.

[c] Estimated be averaging uncontrolled emission factors and emission factors for quarterly LDAR with leak definition of 10,000 ppm. For example, for valves in gas service: (0.0131 + 0.0043)/2 = 0.0087 lbs/hr. For some components, this is a conservative estimate as annual programs may not be effective in reducing emissions.

[d] Derivation of emission factors based on taking known values (shown in double-lined boxes in the following tables), bounding unknown values, and taking mid-points as estimates of unknown emission factors. The first table shows known and estimated leak frequencies. The second table shows the known and estimated emission factors. These values were based upon the 1993 Protocol document data and equations, and apply only to connectors in gas/vapor service and to connectors in light liquid service.

CONNECTOR LEAK FREQUENCIES

LDAR PERIOD	LEAK DEFINITION (ppm)			Uncontrolled
	500	1000	10000	
Annual	0.25	0.213	0.138	
Quarterly	0.125	0.106	0.069	
Monthly	0.063	0.053	0.0345	
Uncontrolled	3.9	3.78	1.55	1.55

CONNECTOR EMISSION FACTORS (lbs/hr)

LDAR PERIOD	LEAK DEFINITION (ppm)			Uncontrolled
	500	1000	10000	
Annual	0.000286	0.000334	0.00052	
Quarterly	0.000166	0.000194	0.000349	
Monthly	0.000102	0.000124	0.000264	
Uncontrolled				1.55

Detailed Discussion

For annual LDAR, the leak frequency and emission factor at 500 ppm are known (0.25% and 0.000286 lbs/hr). As leak definition goes from 500 to 1000, the leak frequency will decrease. We also know that the emission factor will increase as the leak frequency increases (within the same LDAR monitoring period). Using this information, emission factors for 1,000 and 10,000 ppm were calculated as follows:

Annual at 1,000 ppm. The leak frequency at 1,000 ppm will be less than 0.25%. Using this leak frequency and the appropriate equation from page 5-19 of the 1993 Protocol document, we can calculate a "maximum" emission factor, which is calculated to be 0.00017 kg/hr. Next, the emission factor at 1,000 ppm must be greater than that at 500 ppm, which we know to be 0.000134 kg/hr. These two emission factors "bound" the estimate for annual LDAR at 1,000 ppm. The emission factor for 1,000 ppm was then estimated as the mid-point of these two numbers, which is 0.000152 kg/hr (= (0.000134 + 0.00017)/2) or 0.000334 lbs/hr.

Annual at 10,000 ppm. The first step was to estimate the leak frequency at 1,000 ppm. In the previous step, we estimated the emission factor at 1,000 ppm to be 0.000134 kg/hr. Using the appropriate equation on page 5-19 of the 1993 Protocol document, we can "back-calculate" the equivalent leak frequency, which is calculated to be 0.213 percent. The leak frequency at 10,000 ppm will be less than 0.213 percent. Using this leak frequency in the appropriate equation on page 5-19 yields an emission factor of 0.000321 kg/hr. We also know that the emission factor will be greater than that at 1,000 ppm, which was estimated to be 0.00015 kg/hr. The emission factor for 10,000 ppm is then bounded by these two emission factors, 0.000152 and 0.000321 kg/hr. The emission factor for 10,000 is then taken again as the mid-point between these two estimates (0.000236 kg/hr or 0.00052 lbs/hr).

Emission Factors for Quarterly and Monthly LDAR. In the absence of any information, leak frequencies were assumed to decrease by 50 percent from annual to quarterly and 50 percent from quarterly to monthly. The resulting leak frequencies were then used in the appropriate equations on page 5-19 to estimate emission factors.

FOOTNOTES TO TABLE 1
(continued)

[e] Derivation of emission factors based on taking known values (shown in double-lined boxes in the following tables), bounding unknown values, and taking mid-points as estimates of unknown emission factors. The first table shows known and estimated leak frequencies. The second table shows the known and estimated emission factors. These values were based upon the 1993 Protocol document data and equations. See footnote d for a detailed discussion of the methodology used to estimate the unknown values. The leak frequency for annual at 1,000 ppm was based on the mid-point of uncontrolled and quarterly at 1,000 ppm leak frequencies.

LIGHT LIQUID SERVICE VALVES LEAK FREQUENCIES

LDAR PERIOD	LEAK DEFINITION (ppm)			Uncontrolled
	500	1000	10000	
Annual		3.3		
Quarterly	2.42	2.26	1.60	
Monthly	0.896	0.83	0.54	
Uncontrolled	8.5	8.3	4.34	4.34

LIGHT LIQUID SERVICE VALVES EMISSION FACTORS (lbs/hr)

LDAR PERIOD	LEAK DEFINITION (ppm)			Uncontrolled
	500	1000	10000	
Annual		0.00395		
Quarterly	0.00257	0.00273	0.0035	
Monthly	0.00099	0.00106	0.00141	
Uncontrolled				0.00887

[f] Estimated by averaging the emission factors for annual LDAR and monthly LDAR both with leak definition of 10,000 ppm.

[g] Derivation of emission factors based on taking known values (shown in double-lined boxes in the following tables), bounding unknown values, and taking mid-points as estimates of unknown emission factors. The first table shows known and estimated leak frequencies. The second table shows the known and estimated emission factors. These values were based upon the 1993 Protocol document data and equations. See footnote d for a detailed discussion of the methodology used to estimate the unknown values. The leak frequency for annual at 1,000 ppm was based on the mid-point of uncontrolled and quarterly at 1,000 ppm leak frequencies.

GAS SERVICE VALVES LEAK FREQUENCIES

LDAR PERIOD	LEAK DEFINITION (ppm)			Uncontrolled
	500	1000	10000	
Annual				
Quarterly		3.095	2.33	
Monthly		1.13	0.79	
HON	1.00			
Uncontrolled	13.6	13.3	7.48	7.48

FOOTNOTES TO TABLE 1
(continued)

GAS SERVICE VALVES EMISSION FACTORS (lbs/hr)

LDAR PERIOD	LEAK DEFINITION (ppm)			Uncontrolled
	500	1000	10000	
Annual				
Quarterly	0.00323	0.00345	0.00429	
Monthly	0.00121	0.001298	0.00165	
HON	0.00099			
Uncontrolled				0.0131

[h] Derivation of emission factors based on taking known values (shown in double-lined boxes in the following tables), bounding unknown values, and taking mid-points as estimates of unknown emission factors. The first table shows known and estimated leak frequencies. The second table shows the known and estimated emission factors. These values were based upon the 1993 Protocol document data and equations. See footnote d for a detailed discussion of the methodology used to estimate the unknown values. The leak frequency for annual at 1,000 ppm was based on the mid-point of uncontrolled and quarterly at 1,000 ppm leak frequencies.

LIGHT LIQUID SERVICE PUMPS LEAK FREQUENCIES

LDAR PERIOD	LEAK DEFINITION (ppm)			Uncontrolled
	500	1000	10000	
Annual				
Quarterly	7.2	6.5	3.75	
Monthly	4.49	4.02	1.77	
HON		4.02		
Uncontrolled	17.6	17.1	7.48	7.48

LIGHT LIQUID SERVICE PUMPS EMISSION FACTORS (lbs/hr)

LDAR PERIOD	LEAK DEFINITION (ppm)			Uncontrolled
	500	1000	10000	
Annual				
Quarterly	0.0157	0.0172	0.024	
Monthly	0.010	0.011	0.0135	
HON		0.011		
Uncontrolled				0.0438

[i] Based on emission reduction of 44 percent from uncontrolled level. U.S. Environmental Protection Agency. Fugitive Emission Sources of Organic Compounds -- Additional Information on Emissions, Emission Reductions, and Costs. EPA 450/3-82-010. April 1982. (1982 AID document) p. 4-61.

[j] Based on 33 percent reduction, CTG.

[k] Total estimated emission reduction effectiveness of 49 percent. Based on an estimated percent reduction of 44 percent for a quarterly LDAR program with a leak definition of 10,000 ppm (see footnote d above) plus 5 percent based on increased effectiveness of decreasing the leak definition from 10,000 ppm to 1,000.

[l] Assumed to be 1 percent more effective than with leak definition of 1,000 ppm.

FOOTNOTES TO TABLE 1
(continued)

[m] Assumed 200 ppm leak definition had same emission factor as 500 ppm.

[n] 1993 Protocol document, p. 2-21:

$$1.90 \times 10^{-5} \times (500)^{0.824} = 0.00318 \text{ kg per hour}$$

$$0.007 \text{ lbs per hour}$$

[o] 1993 Protocol document, p. F-4. The emission factor for pumps, light liquid service also applies to agitators.

[p] Calculated using the following equation:

$$\frac{\text{(Uncontrolled Emission Rate - Emission Rate at 1\%)}}{\text{Uncontrolled Emission Rate}}$$

Emission rates at 1% were calculated using the equations on p. 5-19 of the 1993 Protocol document. For example, the average leak rate (kg/hr) for valves in gas service with a leak definition of 10,000 ppm can be calculated as follows:

$$\begin{aligned} \text{Average Leak Rate} &= (0.0781 \times 0.01) + 0.000131 \\ &= 0.000912 \text{ kg/hr} \\ &= 0.00201 \text{ lbs/hr} \end{aligned}$$

[q] Assume maintain 1% leakers means an average of 0.5% leakers actually occur. Used the leak rates for >10,000 and for <10,000 (see first table in footnote s) to estimate emission factors based on percent leaking and not leaking. For example,

For PRVs: kg/hr = (1.691 x 0.005) + (0.0447 x 0.995) = 0.05293
lbs/hr = 0.05293 x 2.2 = 0.1164

[r] Assume maintain 0.5% leakers means an average of 0.25% leakers actually occur. Used the leak rates for >10,000 and for <10,000 (see first table in footnote s) to estimate emission factors based on percent leaking and not leaking. For example,

For valves in gas service: kg/hr = (0.0782 x 0.0025) + (0.000131 x 0.9975) = 0.000326
lbs/hr = 0.000326 x 2.2 = 0.000718

[s] Calculation of Emission Factors for "No Evidence of Leaks" Program; Leak Definition of 10,000 ppm.

CALCULATION OF PERCENT OF COMPONENTS WITH <10,000 PPM AND ≥10,000 PPM

EQUIPMENT TYPE	AVERAGE EMISSION FACTOR (kg/hr)[a]	≥ 10,000 ppm Emission Factor (kg/hr)[b]	< 10,000 ppm Emission Factor (kg/hr)[b]	PERCENT OF COMPONENTS ≥10,000 PPM[c]	PERCENT OF COMPONENTS <10,000 PPM[c]
Valves, gas service	0.00597	0.0782	0.000131	7.48	92.52
Valves, light liquid service	0.00403	0.0892	0.000165	4.341	95.659
Valves, heavy liquid service	0.00023	0.00023	0.00023	NA	NA
Pump seals, light liquid service	0.0199	0.243	0.00187	7.48	92.52
Pump seals, heavy liquid service	0.00862	0.216	0.00210	3.048	96.952
Pressure relief valves	0.104	1.691	0.0447	3.6	96.4
Open ended lines	0.0017	0.01195	0.00150	1.91	98.09
Compressor seals	0.228	1.608	0.0894	9.13	90.87
Connectors	0.00183	0.113	0.000081	1.55	98.45

NOTE: Program assumed not applicable to sampling connections.

FOOTNOTES TO TABLE 1
(concluded)

Footnotes to first table in footnote s:

[a] 1993 Protocol document, p. 2-10.

[b] 1993 Protocol document, p. 2-16.

[c] Calculated based on average emission factor and the ≥ 10,000 and <10,000 ppm emission factors. For example, solving for valves in gas service as follows:

$$0.00597 \text{ kg/hr} = 0.0782 (X) + 0.000131 (Y)$$
$$1.00 = X + Y$$

where: X = percent of components with ≥10,000 ppm

Y = percent of components with <10,000 ppm

CALCULATION OF NO EVIDENCE OF LEAKS (10,000 PPM LEAK DEFINITION) EMISSION FACTORS

EQUIPMENT TYPE	EMISSION FACTOR (kg/hr) at 10,000 ppm[a]	PERCENT <10,000 PPM	PROGRAM EMISSION FACTOR	
			kg/hr	lbs/hr
Valves, gas service	0.005806	92.52	0.000555	0.00122
Valves, light liquid service	0.0098823	95.659	.000587	0.00129
Valves, heavy liquid service	0.00023[b]	NA	0.00023	0.000506
Pumps, light liquid service	0.03756	92.52	0.004539	0.00999
Pumps, heavy liquid service	0.03756	96.952	0.00318	0.007
Pressure relief valves	0.03756	96.4	0.0444	0.0977
Open-ended lines	0.0015[c]	98.09	0.00147	0.00324
Compressor seals	0.03756	90.87	0.0845	0.186
Connectors	0.01058	98.45	0.000244	0.00054

[a] Calculated using correlation equations found on page 2-21 of the 1993 Protocol document.

[b] Based on average emission factor for source.

[c] Assumed same as <10,000 ppm emission factor.

Sample calculation:

Valves, gas service: 0.000555 kg/hr = (0.005806 x 0.0748) + (0.000131 x 0.9252)

[t] Assumed to be midway in effectiveness between "uncontrolled" and "maintain less than 2% leakers (10,000 ppm)."

[u] Based on 90 percent control efficiency. 1993 Protocol document, p.5-2. Actual efficiency of a closed-vent system depends on percentage of vapors collected and efficiency of control device to which the vapors are routed.

[v] Control efficiency of closed-vent system installed on a pressure relief device may be lower than other closed-vent systems, because they must be designed to handle both potentially large and small volumes of vapor. 1993 Protocol document, p. 5-2.

[w] Based on 100 percent control efficiency. 1993 Protocol document, P. 5-2.

TABLE 2

SUMMARY OF PERCENT REDUCTION BY COMPONENT FOR VARIOUS EQUIPMENT LEAK CONTROL PROGRAMS[a]

PROGRAM	Leak Definition (ppm)	EQUIPMENT CATEGORY[b]									
		V,G	V,LL	V,HL	P,LL	P,HL	PRVs	OELs	Comp.	Samp. Conn.	Connectors
Uncontrolled	--										
Annual	10,000	33.6	30.1		22.4		22.0		16.5		87.1
Annual	1,000	36.6	55.5		30.4		24.7				91.7
Semiannual	10,000										90.3
Quarterly LDAR	10,000	67.2	60.5		45.2		44.1		32.9		91.3
Quarterly LDAR	1,000	73.7	69.2		60.7		49.0				95.2
Quarterly LDAR	500	75.3	71.0		64.2		49.7				95.9
Quarterly LDAR	200	75.3	71.0		64.2		49.7				95.9
Quarterly LDAR	100										95.9
Monthly LDAR	10,000	87.4	84.1		69.2						93.4
Monthly LDAR	1,000	90.1	88.0		74.9						96.9
Monthly LDAR	500	90.8	88.7		77.2						97.5
Monthly LDAR	100	92.4	88.7		77.2						
No Detectable Emissions	500						96.9		98.6		
HON	varies	92.4	87.6		74.9		96.9				92.9
Maintain Less Than 2% Leakers	10,000	84.7	73.8		78.5		41.0		54.1		34.1
	1,000	97.4	95.7		94.9						86.4
Maintain less than 1% leakers	10,000				84.6		49.1		57.5		64.8
Maintain less than 0.5% leakers	10,000	94.5	90.4								
No Evidence of Leaks	10,000	90.7	85.5		77.2	63.1	57.3	11.8	62.9		86.6

TABLE 2

SUMMARY OF PERCENT REDUCTION BY COMPONENT FOR VARIOUS EQUIPMENT LEAK CONTROL PROGRAMS[a]

PROGRAM	Leak Definition (ppm)	EQUIPMENT CATEGORY[b]									
		V,G	V,LL	V,HL	P,LL	P,HL	PRVs	OELs	Comp.	Samp. Conn.	Connectors
"Inspect as suspect"											17.1
Closed-vent System	--				90.0	90.0			90.0		
DMS w/Barrier Fluid	--				100	100			100		
Rupture Disk	--						100				
Weld Together	--										100
Blind, Cap, Plug, Second Valve	--							100			
Closed-loop Sampling	--									100	

[a] Calculated using the controlled emission factors and the uncontrolled emission factors reported in Table 1.

[b] V = valves; P = pumps; PRVs = pressure relief valves; OELs = open-ended lines; Comp. = compressors; Samp. Conn. = sampling connections; G = gas service; LL = light liquid service; HL = heavy liquid service.

TABLE 3

SUMMARY OF ESTIMATED PERCENT EMISSION REDUCTIONS AND MACT FLOORS FOR EQUIPMENT LEAKS

SOURCE CATEGORY/ SUBCATEGORY	FACILITY	PERCENT REDUCTION	MACT FLOORS	
			EXISTING FACILITIES	NEW FACILITIES
ABS - Batch Emulsion	Monsanto, Addyston	91.2	84.2	91.2
	GE, Washington	84.1		
	Dow, Midland	82.0		
	Monsanto, Muscatine	79.5		
ABS - Batch Suspension	Monsanto, Addyston	96.1	87.1	96.1
	Monsanto, Muscatine	78.0		
ABS - Continuous - Mass	Monsanto, Addyston	90.3	62.4	90.3
	Dow, Midland	82.7		
	Dow, Torrance	71.9		
	Dow, Allyn's Point	38.9		
	Dow, Hanging Rock	28.1		
ABS Continuous - Emulsion	GE, Washington	84.1	64.0	84.1
	GE, Ottawa	43.9		
ABS - Latex	BF Goodrich, Akron	32.7	32.7	32.7

TABLE 3

SUMMARY OF ESTIMATED PERCENT EMISSION REDUCTIONS AND MACT FLOORS FOR EQUIPMENT LEAKS

SOURCE CATEGORY/ SUBCATEGORY	FACILITY	PERCENT REDUCTION	MACT FLOORS	
			EXISTING FACILITIES	NEW FACILITIES
PS Continuous	Dow, Joilet	85.8	81.3	85.8
	BASF, Holyoke	81.9		
	Monsanto, Addyston	80.8		
	Huntsman, Chesapeake	79.6		
	Novacor, Indian Orchard	78.6		
	Dow, Torrance	76.9		
	Novacor, Decatur	75.9		
	Huntsman, Belpre	72.5		
	Dow, Riverside	70.8		
	BASF, Santa Ana	70.7		
	Dow, Midland	59.5		
	BASF, Joilet	51.5		
	Dow, Allyn's Point	47.4		
	GE, Selkirk	46.8		
	American Polymers	33.0		
	Fina Oil, Carville	25.7		
	Dow, Hanging Rock	23.9		
	Amoco, Joilet	22.1		
	Huntsman, Peru	0		
	Chevron, Marietta	0		
	Kama, Hazelton	*		

* Insufficient information to estimate emissions and emission reductions.

TABLE 3

SUMMARY OF ESTIMATED PERCENT EMISSION REDUCTIONS AND MACT FLOORS FOR EQUIPMENT LEAKS

SOURCE CATEGORY/ SUBCATEGORY	FACILITY	PERCENT REDUCTION	MACT FLOORS	
			EXISTING FACILITIES	NEW FACILITIES
EPS	Huntsman, Rome	75.4	40.4	75.4
	Scott, Saginaw (1)	33.0		
	Scott, Forth Worth	33.0		
	BASF, South Brunswick	28.4		
	Arco, Monaca	32.4*		
	Huntsman, Peru	0		
	Arco, Painesville	0		
Batch	Huntsman, Chesapeake	78.5	49.0	78.5
	American Polystyrene, Torrance	69.9		
	American Polymers, Oxford	33.8		
	ARCO, Monaca	32.4		
	Scott, Saginaw (1)	30.7		
	Scott, Saginaw (2)	30.7		
	Dart, Leola	29.7		
	Amoco, Willow Springs	26.5		
	Dart, Ownesboro (1)	0		
	Rohm and Haas, Phila.	0		
	Dart, Owensboro (2)	0		
	Huntsman, Peru	0		

* Estimate based on equipment counts for entire facility; see PS-batch estimate.

TABLE 3

SUMMARY OF ESTIMATED PERCENT EMISSION REDUCTIONS AND MACT FLOORS FOR EQUIPMENT LEAKS

SOURCE CATEGORY/ SUBCATEGORY	FACILITY	PERCENT REDUCTION	MACT FLOORS	
			EXISTING FACILITIES	NEW FACILITIES
MBS	Elf Atochem	94.0	61.1	94.0
	Kaneka	84.7		
	Rohm and Haas	4.7		
Nitrile	BP Chemicals	74.5	74.5	74.5
SAN - Batch	Monsanto, Addyston	88.9	82.6	88.9
	Monsanto, Muscatine	76.3		
SAN - Continuous	Monsanto, Addyston	88.6	77.8	88.6
	Dow, Midland	77.0		
	GE, Bay St. Louis	67.8		
MABS	GE, Washington	84.1	84.1	84.1
ASA/AMSAN	GE, Selkirk	0	0	0

TABLE 3

SUMMARY OF ESTIMATED PERCENT EMISSION REDUCTIONS AND MACT FLOORS FOR EQUIPMENT LEAKS

SOURCE CATEGORY/ SUBCATEGORY	FACILITY	PERCENT REDUCTION	MACT FLOORS	
			EXISTING FACILITIES	NEW FACILITIES
PET - DMT/BATCH	Hoechst-Celanese (HC), Spartanburg	0	0	0
	BASF, Lowland, TN	0		
	Tennessee Eastman (TE), Kingsport, TN	0		
	HC, Shelby, NC	0		
	3M, Decatur, AL (1)	0		
	3M, Decatur, AL (2)	0		
	3M, Greenville, SC	0		
	ICI, Fayetteville, NC	0		
	ICI, Hopewell, VA	0		
	Eastman Kodak, Rochester, NY	0		
PET - DMT/CONT.	HC, Spartanburg, SC	0	0	0
	DuPont, Copper River, SC	0		
	DuPont, Circleville, OH	0		
	DuPont, Florence, SC	0		
	DuPont, Kinston, NC	0		
	DuPont, Old Hickory, TN	0		
	DuPont, Brevard, NC	0		
	DuPont, Cape Fear, NC	0		
	Carolina Eastman (CE), Columbia, SC	0		
	TE, Kingsport, TN	0		

TABLE 3

SUMMARY OF ESTIMATED PERCENT EMISSION REDUCTIONS AND MACT FLOORS FOR EQUIPMENT LEAKS

SOURCE CATEGORY/ SUBCATEGORY	FACILITY	PERCENT REDUCTION	MACT FLOORS	
			EXISTING FACILITIES	NEW FACILITIES
PET - TPA/CONT.	Carolina Eastman, Columbia, SC (Plant 3)	28.1	11.9	28.1
	Carolina Eastman, Columbia, SC (Plant 2)	28.1		
	Hoechst-Celanese, Salisbury, NC	3.2		
	Hoechst-Celanese, Spartanburg	0		
	DuPont, Copper River, SC	0		
	DuPont, Kinston, NC	0		
	DuPont, Cape Fear, NC	0		
	Wellman, Palmetto, SC	0		
	YKK, Macon, GA	0		
	Tennessee Eastman, Kingsport, TN	0		
	Hoechst-Celanese, Greer, SC	0		
	Allied-Signal, Moncure, NC	0		
	Shell, Pt. Pleasant, WV	0		
PET - TPA/Batch	Shell, Pt. Pleasant, WV	0	0	0

Attachment 7

Component-specific summary of baseline equipment leak HAP emissions

ATTACHMENT 7. COMPONENT–SPECIFIC SUMMARY OF BASELINE EQUIPMENT LEAK HAP EMISSIONS

	BASELINE EMISSIONS (Mg/yr)								
	Comp Seals	Pumps Light liq	Flange/ Connect	Pressure Rlf Valve	Valves– Gas	Valves– Liquid	Open– End lines	Sample Lines	BASELINE TOTAL
BR–1	0.0	2.1	89.9	0.0	139.4	86.8	0.0	3.7	321.9
EPI–1	0.0	0.0	4.9	21.4	0.0	12.3	0.5	88.2	127.2
EPR–1	26.0	4.2	3.5	0.0	4.5	0.0	0.0	0.3	38.4
EPR–2	10.7	1.3	75.4	8.7	0.0	60.5	0.0	0.0	156.6
EPR–3	6.7	6.8	18.1	109.3	24.9	36.2	0.6	0.0	202.6
EPR–4	16.1	7.0	248.8	84.6	19.9	64.8	5.7	1.1	447.9
EPR–5	8.0	3.7	135.0	45.9	10.8	35.2	3.1	0.5	242.2
HBR–1	2.7	0.5	163.7	18.9	19.8	63.0	0.0	0.0	268.5
HYP–1	0.0	0.0	7.1	0.0	1.4	3.7	0.0	0.0	12.1
NEO–1	0.0	2.2	42.5	5.6	7.0	8.7	5.1	0.0	71.2
NEO–2	0.0	4.6	4.3	0.0	1.7	2.3	0.0	0.8	13.8
NEO–3	0.0	0.7	13.8	10.0	2.4	4.8	0.0	3.5	35.2
NBL–1	3.3	1.0	2.6	0.0	0.0	11.1	1.3	2.8	22.0
NBL–2	1.7	0.7	0.5	4.8	11.2	0.0	0.6	0.0	19.5
NBL–3	0.0	0.3	2.1	0.9	3.3	0.7	0.2	0.1	7.7
NBR–1	20.0	1.4	12.2	0.0	2.1	16.6	0.0	0.7	52.9
NBR–2	10.0	2.1	91.6	15.5	11.3	30.6	0.2	0.4	161.6
NBR–3	5.4	0.8	5.4	5.6	7.6	20.7	0.2	0.3	45.8
NBR–4	9.4	1.5	121.1	11.2	4.9	15.9	0.3	0.5	164.9

ATTACHMENT 7. COMPONENT–SPECIFIC SUMMARY OF BASELINE EQUIPMENT LEAK HAP EMISSIONS

	BASELINE EMISSIONS (Mg/yr)								
	Comp Seals	Pumps Light liq	Flange/ Connect	Pressure Rlf Valve	Valves– Gas	Valves– Liquid	Open– End lines	Sample Lines	BASELINE TOTAL
PBR/SBRS–1	0.3	11.7	3.9	0.0	4.5	23.4	0.0	121.2	165.1
PBR/SBRS–2	1.3	7.8	27.8	0.0	13.0	26.5	0.0	0.0	76.4
PBR/SBRS–3	1.6	6.9	61.2	106.1	12.3	31.5	0.5	17.4	237.4
PBR/SBRS–4	1.1	5.5	63.1	61.1	6.3	19.3	0.5	17.9	174.8
PBR/SBRS–5	1.1	6.0	68.4	66.4	6.8	20.9	0.5	19.4	189.5
PSR–1	0	0	0	0	0	0	0	0	0
SBL–1	0.0	0.5	15.6	0.8	1.3	6.0	2.0	1.2	27.4
SBL–2	1.3	0.9	3.0	0.0	2.2	4.3	0.0	0.0	11.6
SBL–3	4.0	2.2	34.6	17.8	3.8	7.2	0.0	0.3	69.9
SBL–4	0.5	6.0	1.6	13.1	1.0	4.2	0.0	0.0	26.5
SBL–5	0.0	0.0	1.3	0.0	1.3	2.5	0.0	0.0	5.1
SBL–6	3.7	0.8	1.4	0.0	2.1	4.5	0.0	0.0	12.6
SBL–7	1.3	1.0	2.1	0.0	0.0	5.8	0.0	1.1	11.4
SBL–8	0.7	0.9	1.1	3.0	12.6	0.0	0.7	0.0	18.9
SBL–9	2.4	2.2	29.9	13.1	7.3	12.8	0.5	6.1	74.2
SBL–10	1.6	1.1	14.4	6.2	3.5	6.1	0.2	2.9	36.0
SBL–11	2.7	2.3	8.0	11.2	11.2	19.6	0.8	9.4	65.1
SBL–12	0.0	0.2	2.5	1.1	0.6	1.0	0.0	0.5	5.9
SBL–13	1.6	1.3	18.4	8.0	4.5	7.9	0.3	3.8	45.7
SBL–14	1.6	1.1	4.2	8.8	2.2	4.7	0.5	0.0	23.0
SBL–15	0.0	0.3	4.4	1.8	1.1	1.9	0.1	0.9	10.5
SBRE–1	0.0	0.5	21.0	0.0	2.6	14.9	0.0	0.0	39.0
SBRE–2	0.0	0.1	5.8	0.0	0.7	4.1	0.0	0.0	10.8
SBRE–3	0.0	0.1	4.3	0.0	0.5	3.1	0.0	0.0	8.0
SBRE–4	0.0	0.3	13.7	0.0	1.7	9.7	0.0	0.0	25.4

Attachment 8

Facility-specific baseline emissions summary

FACILITY–SPECIFIC BASELINE EMISSIONS

Subcategory/ Facility ID	Baseline HAP Emissions (Mg/yr)					
	Storage	Process Vents Front–End	Process Vents Back–End	Waste–water	Equipment Leaks	Total
Butyl Rubber						
BR–1	0.0	367.4	109.5	148.5	321.9	947.3
Epichlorohydrin						
EPI–1	10.1	0.7	16.5	6.7	127.2	161.2
Ethylene–Propylene Rubber						
EPR–1	3.4	18.3	1,127.7	0.1	38.4	1,187.9
EPR–2	2.5	90.2	348.6	0.0	156.6	598.0
EPR–3	0.0	5.1	36.8	3.6	202.6	248.1
EPR–4	4.7	80.6	413.6	15.8	447.9	962.6
EPR–5	7.9	25.7	68.4	0.1	242.2	344.2
Subcategory Totals	18.5	219.9	1,995.1	19.6	1,087.7	3,340.8
Halobutyl Rubber						
HBR–1	64.8	683.5	280.5	0.0	268.5	1,297.3
Hypalon						
HYP–1	6.9	49.8	28.6	0.0	12.1	97.4
Neoprene						
NEO–1	21.7	222.0	34.5	5.5	71.2	354.9
NEO–2	20.9	108.3	150.0	11.6	13.8	304.6
NEO–3	0.9	21.3	18.9	4.0	35.2	80.4
Subcategory Totals	43.5	351.6	203.5	21.1	120.2	739.9

FACILITY–SPECIFIC BASELINE EMISSIONS

Subcategory/ Facility ID	Baseline HAP Emissions (Mg/yr)					
	Storage	Process Vents Front–End	Process Vents Back–End	Waste–water	Equipment Leaks	Total
Nitrile Butadiene Latex						
NBL–1	1.5	2.6	na	98.0	22.0	124.1
NBL–2	0.0	0.0	na	0.0	19.5	19.5
NBL–3	0.2	0.9	na	5.9	7.7	14.7
Subcategory Totals	1.7	3.5		103.9	49.2	158.3
Nitrile Butadiene Rubber						
NBR–1	0.0	0.7	9.1	2.2	52.9	64.9
NBR–2	0.9	28.8	94.7	2.1	161.6	288.0
NBR–3	0.5	2.8	10.5	2.1	45.8	61.7
NBR–4	0.0	5.5	0.4	1.1	164.9	171.9
Subcategory Totals	1.4	37.8	114.6	7.5	425.2	586.5
Polybutadiene/Styrene Butadiene Rubber by Solution						
PBR/SBRS–1	0.8	3.3	390.4	3.8	165.1	563.4
PBR/SBRS–2	0.1	0.0	0.0	0.1	76.4	76.6
PBR/SBRS–3	0.0	0.0	205.5	16.9	237.4	459.8
PBR/SBRS–4	1.5	159.6	771.6	2.0	174.8	1,109.5
PBR/SBRS–5	1.8	6.0	1,035.7	2.8	189.5	1,235.9
Subcategory Totals	4.3	168.9	2,403.2	25.6	843.2	3,445.2
Polysulfide Rubber						
PSR–1	0.7	0.0		0.0		0.7

FACILITY–SPECIFIC BASELINE EMISSIONS

Subcategory/ Facility ID	Baseline HAP Emissions (Mg/yr)					
	Storage	Process Vents Front–End	Process Vents Back–End	Waste–water	Equipment Leaks	Total
Styrene Butadiene Latex						
SBL–1	1.2	2.5	na	0.8	27.4	31.9
SBL–2	0.6	22.9	na	0.1	11.6	35.2
SBL–3	0.5	8.4	na	0.0	69.9	78.9
SBL–4	0.2	0.8	na	0.0	26.5	27.5
SBL–5	0.9	1.8	na	2.1	5.1	9.9
SBL–6	0.3	5.1	na	62.9	12.6	80.9
SBL–7	0.5	3.6	na	0.0	11.4	15.4
SBL–8	0.3	6.1	na	242.8	18.9	268.1
SBL–9	0.6	2.2	na	12.5	74.2	89.6
SBL–10	1.0	0.8	na	6.3	36.0	44.0
SBL–11	0.5	0.8	na	250.2	65.1	316.5
SBL–12	0.4	1.1	na	4.5	5.9	11.9
SBL–13	0.8	0.6	na	23.7	45.7	70.9
SBL–14	0.0	20.0	na	13.6	23.0	56.6
SBL–15	0.9	212.0	na	71.1	10.5	294.5
Subcategory Totals	8.6	288.7		690.6	443.8	1,431.7
Styrene Butadiene Rubber by Emulsion						
SBRE–1	2.2	6.3	251.5	49.5	39.0	348.5
SBRE–2	0.0	7.3	72.7	10.0	10.8	100.8
SBRE–3	0.2	3.5	148.1	21.1	8.0	180.9
SBRE–4	5.2	2.5	379.3	3.8	25.4	416.2
Subcategory Totals	7.6	19.5	851.6	84.4	83.2	1,046.3

MEMORANDUM

Date: May 10, 1995

Subject: Subcategorization for the Elastomer Production Industry (Polymers and Resins I)

To: Leslie Evans, ESD/OCG

From: Charlotte Clark and Phil Norwood, EC/R

This memorandum serves to discuss categorization and subcategorization of sources within the Polymers and Resins I emissions source grouping. These sources produce elastomers, or synthetic rubbers, that are primarily used in the tire and automotive products industries.

INTRODUCTION

The Clean Air Act as amended in 1990 (1990 Amendments) required the U.S. Environmental Protection Agency (EPA) to publish a list of and establish standards for all major and certain area source categories and subcategories of sources emitting any of 189 hazardous air pollutants (HAP). Designation of categories or subcategories is critical to a regulatory effort, because the Maximum Achievable Control Technology (MACT) standard is set based on a measure of central tendency (such as average) of emissions achieved by all members of the best performing 12 percent of the existing sources in the category or subcategory.

Definition of Category and Subcategory

The terms category and subcategory are not defined in Section 112. However, the preamble to the Initial Source Category List defines a "category" of sources as "...a group of sources having some common features suggesting that they should be regulated in the same way and on the same schedule."[1] Because no statutory definition of category or subcategory existed, and in response to comments provided on the draft source category list, the EPA elected in the source category list Federal Register notice to use the term "category" to designate all of the groupings of sources that emit HAP on the list.[2] The EPA made clear that this decision did not affect the authority of the Agency to further disaggregate source categories into subcategories when establishing standards at a later date. Such subcategories would be developed in order to accurately reflect differences in air emission characteristics within a source category.

For the purpose of this memorandum, the term source category will be generally used to describe groups actually consisting of original source categories (as included in the EPA's original list). The term subcategory will be used to reflect further divisions of listed source categories or the re-combination of source and subcategories.

Elastomer Categories

The Initial Source Category List contained 39 production categories for polymers and resins.[3] For regulatory development purposes, the EPA developed 4 groups of Polymer and Resin production processes, which have been given the names Polymers and Resins I-IV. Each grouping of polymer and resin products has similar production processes, product end use, air pollution emission characteristics, control device applicability and costs, and regulatory schedule requirements. Nine polymer and resin products that are considered "elastomers," or synthetic rubbers and that have similar production, air pollution emission, and market share characteristics were grouped together in the Polymers and Resins I Group. For the purpose of this regulatory effort, these nine source categories are collectively referred to either as Group I Polymers and Resins or as the elastomer source categories. Because these nine production categories have significant similarities, they are being considered together for regulation in the development of single National Emission Standards for Hazardous Air Pollutants (NESHAP) for Elastomer and Synthetic Rubber Production.

EPA's draft schedule published September 24, 1992 (57 FR 44147) slated the above categories of elastomers for NESHAP promulgation by November 15, 1994. Due to the similarities between the elastomer products and processes, and the fact that all nine shared the same regulatory schedule, the EPA studied these nine source categories together in the Polymers and Resins I project. The EPA plans to propose the Polymers and Resins I standard in May 1995, and promulgation is scheduled for May 1995. Promulgation by this date will avoid the "hammer" provisions of section 112(j) of the amended Clean Air Act.

The nine source categories for the production of elastomers are listed below:

- Butyl Rubber Production;
- Epichlorohydrin Elastomers Production;
- Ethylene-propylene Elastomers Production;
- Hypalon™ Production;
- Neoprene Production;
- Nitrile Butadiene Rubber Production;
- Polybutadiene Rubber Production;
- Polysulfide Rubber Production; and
- Styrene-Butadiene Rubber and Latex Production.

SOURCE CATEGORIES

For six of the source categories listed, subcategorization was not necessary. The following paragraphs describe each of these source categories. Figure 1 provides a schematic diagram of all source categories and subcategories of elastomers production.

Epichlorohydrin Rubber

Only one facility was identified that manufactures epichlorohydrin rubber. Therefore, no variation is believed to exist in production process or in HAP emitted, and no subcategorization was warranted for the epichlorohydrin rubber source category.

Ethylene-Propylene Rubber

The ethylene-propylene rubber (EPR) source category was not divided into subcategories. Four facilities were identified that manufacture EPR by the solution process, and one facility was identified that manufactures EPR by the suspension process. These plants manufacture several related EPR products -- one a co-polymer product that cannot be vulcanized, and one a terpolymer product that can be vulcanized. Although some variation exists in production process between these facilities, the variations were not sufficient to result in differences in the level of the standard. Therefore, subcategorization of this source category was not warranted.

Hypalon™ Rubber

Only one facility was identified that manufactures Hypalon™ rubber. Therefore, no variation is believed to exist in production process or in HAP emitted, and no subcategorization was warranted for the Hypalon™ source category.

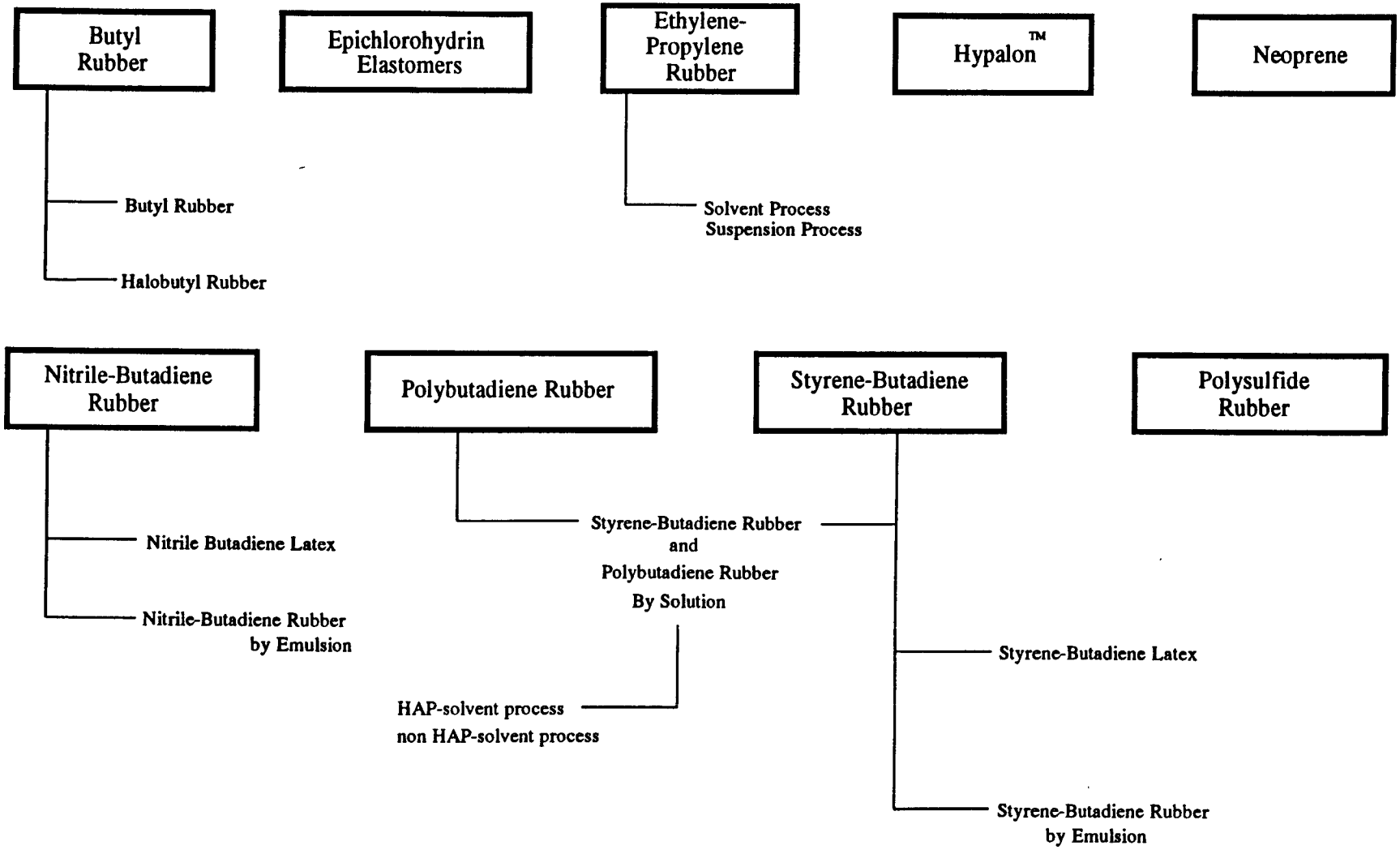
Neoprene Rubber and Latex

Three facilities were identified that manufacture neoprene rubber and latex. All use similar production processes that have similar HAP air emission characteristics. Therefore, for the purposes of this regulatory effort, one source category was appropriate.

Polybutadiene Rubber

Five facilities were identified that produce polybutadiene rubber; all use a solution process. Although polybutadiene rubber can be made using the emulsion process, no active facilities were identified that use this process. All five active facilities use similar production processes that have similar HAP emission characteristics. Therefore, for the purposes of this regulatory effort, one subcategory was appropriate.

Figure 1. Polymers and Resins I Subcategorization Plan



Note that, because of significant similarities between production of polybutadiene rubber and styrene-butadiene rubber by solution, these two products were combined into one subcategory (see styrene-butadiene rubber discussion below).

Polysulfide Rubber

Only one facility was identified that manufactures polysulfide rubber. Therefore, no variation exists in process or HAP emitted, and no subcategorization was warranted for the polysulfide rubber source category.

SUBCATEGORIZATION

Within three of the nine elastomer production source categories, although product end use and production process are similar, significant variations do exist in manufacturing process and air pollution emissions. Therefore, the EPA has further divided these three categories -- butyl rubber, nitrile-butadiene rubber, and styrene-butadiene rubber -- into subcategories for the purposes of regulation in the NESHAP. Another category, polybutadiene rubber, was combined with one of the new subcategories due to similarities in process and emissions. The following sections of this memorandum describe the technical basis for each subcategorization decision.

Butyl Rubber

The butyl rubber source category was divided into subcategories for production of butyl rubber and production of halobutyl rubber. One facility was identified that actively produces butyl rubber, and one facility was identified that actively produces halobutyl rubber. Butyl rubber is typically made by a precipitation (slurry) polymerization process in which isobutylene and isoprene are copolymerized in methyl chloride solvent. Halobutyl rubber, or halogenated butyl rubber, is produced by dissolving butyl rubber in hydrocarbon solvent (typically hexane) and contacting the solution with gaseous or liquid elemental halogens such as chlorine or bromine.

Halobutyl rubber was made a separate subcategory from butyl rubber because of variations in both production process and HAP emitted. The production process varies in that halobutyl rubber is formed by using butyl rubber as the raw material and performing two additional steps -- solvent replacement and halogenation. The HAP emitted varies, because hexane, a listed HAP, is the typical hydrocarbon solvent used to make halobutyl rubber in the solvent replacement process. Hexane is not used, or emitted from the production of non-halogenated butyl rubber. Further, halobutyl rubber has different end uses than butyl rubber, because it resists aging to a higher degree than nonhalogenated rubber, and therefore, is more compatible with other types of rubber.[4]

Nitrile-Butadiene Rubber and Latex

The nitrile-butadiene subcategory was divided into subcategories for production of rubber and production of latex. Manufacture of nitrile butadiene rubber (NBR) was identified at four domestic facilities, and manufacture of nitrile butadiene latex (NBL) was identified at 3 domestic facilities (none of which also manufacture NBR). In both the rubber and latex emulsion processes, butadiene and acrylonitrile monomers are combined in a reactor with a soap solution and additives. The unreacted butadiene and acrylonitrile are then removed. For nitrile butadiene rubber, the polymer is coagulated and dried; in the case of nitrile-butadiene latex, the polymer is not coagulated or dried, but rather is blended with other specialty ingredients. The coagulation and drying production steps cause HAP emissions, and therefore, will be defined and regulated as back-end operations under this NESHAP. Latex production does not contain these production steps, and is not believed to produce significant HAP after the steam stripping operations. Therefore, NBR and NBL were differentiated into separate subcategories for the purposes of this NESHAP.

Styrene-Butadiene Rubber

The styrene-butadiene rubber source category was divided into subcategories for production of rubber by solution, production of rubber by emulsion, and production of latex.

Four facilities were identified that produce styrene-butadiene rubber (SBR) by solution. All of these facilities also produce polybutadiene rubber by solution. Production of SBR by solution uses the same equipment as production of polybutadiene rubber by solution, and the processes are identical, except that styrene is also added to the polymerization operation. For that reason, one combined subcategory was created for production of both SBR and polybutadiene rubbers by solution. This process is subcategorized from the emulsion process, because of the use of HAP solvents (not used in the emulsion process).

Four facilities were identified that produce SBR by emulsion, and 15 facilities were identified that produce styrene-butadiene latex (SBL) by emulsion. In both the rubber and latex emulsion production processes, butadiene and styrene monomers are combined in a reactor with a soap solution and additives. The unreacted butadiene and styrene are then removed. For SBR, the polymer is coagulated and dried; in the case of SBL, the polymer is not coagulated or dried, but rather is blended with other specialty ingredients. The coagulation and drying production steps cause HAP emissions, and therefore, will be defined and regulated as back-end operations under this NESHAP. Latex production does not contain these production steps, and is not believed to produce significant HAP after the steam stripping operations. Therefore, SBR and SBL by emulsion were differentiated into separate subcategories for the purposes of this NESHAP.

REFERENCES

1. U.S. Environmental Protection Agency. Initial List of Categories of Sources Under Section 112(c)(1) of the Clean Air Act Amendments of 1990: Notice. Federal Register. July 16, 1992. 57 FR 31578.

2. Reference 1, p. 31579.

3. Reference 1, p. 31592.

4. Austin, G.T. Shreve's Chemical Process Industries. Fifth Edition. New York, McGraw-Hill Book Company. 1984. p. 704.

E C/R Incorporated — Environmental Consulting and Research

MEMORANDUM

Date: May 10, 1995

Subject: MACT Floors and Regulatory Alternatives for the Elastomer Production Industry (Polymers and Resins I)

From: Phil Norwood, EC/R

To: Leslie Evans, EPA/OAQPS/ESD/OCG

This memorandum presents the approach used to develop maximum achievable control technology (MACT) floors and regulatory alternatives for the Polymers and Resins I project. This memorandum is organized in three sections. First, a brief background of the project and the regulatory process is provided. Second, a discussion is provided of considerations taken in determining MACT floors. Third, procedures used to determine MACT floors are described, followed by a subcategory-specific presentation of the results of the analysis. The final section is a discussion of the development of regulatory alternatives more stringent than the MACT floors.

BACKGROUND

Source Categories and Subcategorization

Title III of the amended Clean Air Act requires the Environmental Protection Agency (EPA) to develop air emission standards for all major sources emitting any of the 189 hazardous air pollutants (HAP's) identified in Section 112(b) of the Act. On July 16, 1992 (57 FR 31676), the EPA published the initial list of categories for which standards are expected to be developed. This list included nine source categories of "elastomers." These source categories are as follows.

- Butyl rubber
- Epichlorohydrin elastomers
- Ethylene propylene rubber
- Hypalon™
- Neoprene
- Nitrile butadiene rubber
- Polybutadiene rubber
- Polysulfide rubber
- Styrene-butadiene rubber

EPA's draft schedule published September 24, 1992 (57 FR 44147) slated the above categories of elastomers for NESHAP promulgation by November 15, 1994. Due to the similarities between the elastomer products and processes, and the fact that all nine shared the same regulatory schedule, the EPA studied these nine source categories together in the Polymers and

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Resins I project. The EPA plans to propose the Polymers and Resins I standard in May 1995, and promulgation is scheduled for May 1996. Promulgation by this date will avoid the "hammer" provisions of section 112(j) of the amended Clean Air Act.

Based on differences in processes, HAP emissions, and emission control techniques, the EPA developed the subcategorization plan shown in Figure 1. The rationale for subcategorization is addressed in a separate memorandum.[1] For the purpose of this memorandum, the term "subcategory" will be generally used to describe each of these elastomer processes, although some of these process types actually consist of source categories (as included in the EPA's original list), subcategories of source categories, or the re-combination of subcategories. The final 12 subcategories include:

- Butyl rubber (BR)
- Epichlorohydrin elastomers (EPI)
- Ethylene propylene rubber (EPDM)
- Halobutyl rubber (HBR)
- Hypalon™ (HYP)
- Neoprene (NEO)
- Nitrile butadiene latex (NBL)
- Nitrile butadiene rubber (NBR)
- Polybutadiene and styrene-butadiene rubber by solution (PBR/SBR-S)
- Polysulfide rubber (PSR)
- Styrene-butadiene latex (SBL)
- Styrene-butadiene rubber by emulsion (SBR-E)

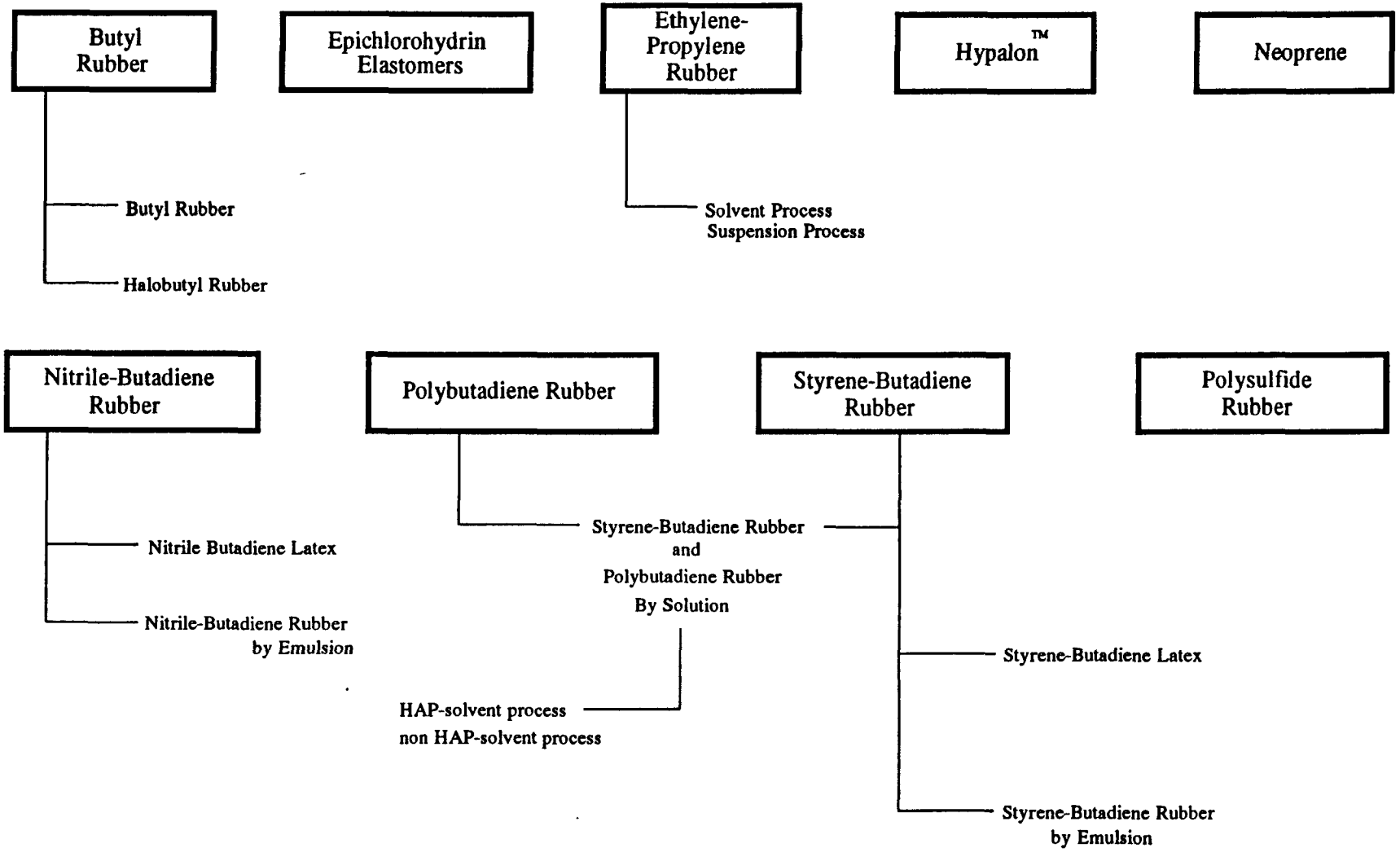
The approach discussed below for developing the MACT floors and first regulatory alternatives was applied separately to each of these subcategories.

Clean Air Act Requirements

The amended Clean Air Act contains requirements for the development of regulatory alternatives for sources of HAP emissions. Section 112(d) requires emission standards for HAP's to reflect the maximum degree of reduction in emissions of HAP's that is achievable "...taking into consideration the cost of achieving such emission reduction, and any non-air quality health and environmental impacts and energy requirements..." This control level is referred to as MACT.

The Clean Air Act also provides guidance on determining the MACT "floor," which is the least stringent level allowed for MACT standards. For new sources, emission standards "shall not be less stringent than the emission control that is achieved in practice by the best controlled similar source." For existing sources, the emissions standards must be at least as stringent as either "the average emission limitation achieved by the best performing 12 percent of the existing sources" or "the average

Figure 1. Polymers and Resins I Subcategorization Plan



emission limitation achieved by the best performing 5 sources" for categories or subcategories with less than 30 sources.

Two interpretations have been evaluated by the EPA for representing the MACT floor for existing sources. One interpretation is that the MACT floor is represented by emissions level achieved by all members of the best performing 12 percent. The second interpretation is that the MACT floor is represented by the "average" of the best performing sources, where the average is based on a measure of central tendency, such as the arithmetic mean, median, or mode. In a June 6, 1994 Federal Register notice, the EPA presented its interpretation of the statutory language concerning the MACT floor for existing sources. This interpretation is that the "average" is more appropriate, given the statutory language. The determination of MACT floors for the Polymers and Resins I subcategories was consistent with this interpretation.

While the MACT floor represents the least stringent level of control for a standard, the EPA can consider regulatory alternatives more stringent than the floor. The Clean Air Act specifies that the EPA consider cost, non-air quality health and environmental impacts, and energy requirements in the evaluation of regulatory alternatives more stringent than the MACT floor.

CONSIDERATIONS IN DETERMINING MACT FLOORS

Several fundamental decisions must be made before the MACT floor can be determined for individual subcategories. These decisions are discussed below.

Best Performing Facilities

One of the most basic decisions to be made is the determination of the "best performing" facilities. All of the subcategories in this project have less than 30 sources, meaning that the MACT floor must be based on the best performing 5 sources. Only one subcategory, SBL, contains more than 5 sources. Therefore, for all subcategories except SBL, the MACT floor is based on the "average emission limitation" of all sources in the subcategory. The determination of the best performing 5 SBL sources is discussed in the SBL section.

Grouping of Emission Sources

Two approaches were considered in the analysis to describe MACT floors. One approach is to cluster all sources of emissions at an affected source together. The EPA considered basing the MACT floors on emission factors (weight of HAP emitted per weight of product), including all emission source types at each of the sources in the subcategory. A standard founded on this approach would allow the owner or operator to control selected emission points, as long as the facility-wide HAP emission factor was

below the level specified in the standard. This approach was abandoned for several reasons, including confidentiality concerns, the reliance on inconsistent data to determine the floors, and the problems associated with the development of standard methodologies to verify emissions that are applicable for all sources in the subcategory.

A second approach is an analysis where emission sources are considered by emission source type. This type of "plank" analysis was used for this project. For this project, emission points at elastomer facilities were assigned to one of five emission source types: storage vessels, "front-end" process vents, "back-end" process vents, wastewater streams, and equipment leaks. The process "front-end" includes prepolymerization, reaction, stripping, and material recovery operations, while the "back-end" includes all operations after stripping (predominately drying and finishing).

Additional grouping decisions may be made in the determination of MACT floors within each emission source type. Consideration can be given to the following: equipment type, equipment size, equipment contents, stream characteristics, and other elements that can affect the emission potential of an emission point or the ability to reduce emissions from the point.

For instance, the floor for storage vessels could be determined without regard to size or contents, or storage vessels of similar size containing the same material (i.e., all styrene vessels 10,000 gallons or less) could be analyzed together. Similarly, the average emission limitation could be determined for all process vents, or process vents could be separated into types according to the origin of the vent stream (reactor vent, stripper vent, etc.) Process vent types could also be based on generic parameters such as HAP content, flow rate, etc.

Format of the Average Emission Limitation

As discussed above, MACT floors for subcategories in this project were identified using the "average" interpretation. The MACT floor levels were established by determining some measure of central tendency of the emission control for each emission source type in each subcategory. The average emission limitation could be expressed in several different formats, such as an emission factor, a percent reduction, a work practice standard, a specific type of equipment, or a variety of other options. The environmental and cost impacts could change depending on the choice of the MACT floor format.

Use of HON in Floor Determinations

As described above, many complexities exist in the determination of MACT floors. Although, the EPA considered direct approaches to determine the MACT floors, problems arose in

each approach. Most of these problems were a result of the fact that, while facilities in a subcategory produce the same product, specifics of the process (and associated emission points) varied considerably. Thus, comparison of control techniques was inappropriate, when the origin and characteristics of streams of the same emission source type were so different.

The EPA studied methods to simplify the MACT floor analysis, and decided to use the Hazardous Organic NESHAP, or HON (40 CFR 63 subparts F, G, and H), in the MACT floor analysis. The rationale for this conclusion is provided in this section.

First, many similarities exist in the equipment, emissions, and control techniques between the elastomer industry and the synthetic organic chemical manufacturing industry (SOCMI) regulated by the HON. The HAP monomers and solvents used in the elastomer industry are all SOCMI chemicals, and some elastomer processes are co-located with SOCMI processes.

The HON contains emission limitations for five emission source types: process vents, storage vessels, transfer operations, wastewater, and equipment leaks. These source types closely resemble those of Polymers and Resins I. For each emission source type, applicability is based on "generic" characteristics of an emission point such as HAP emissions, HAP concentration, flow rate, size of the equipment, etc. These characteristics are also common to Polymers and Resins I emissions source types.

Another practical reason for using the HON requirements is that the HON provides "ready-made" alternatives. The HON takes into account equipment type, equipment size, equipment contents, stream characteristics, and other important aspects of the floor determination discussed above.

Due to the similarities between the SOCMI and elastomer industries, and other reasons discussed above, the EPA concluded that the HON requirements for storage vessels, process vents, wastewater, and equipment leaks are appropriate to use to determine the MACT floor for the elastomer industry. The determination of the MACT floor using the HON is described in the procedures section of this memorandum.

Other Emission Source Types

The HON requirements noted above apply to three of the five elastomer emission source types and part of a fourth: storage vessels, wastewater, and equipment leaks, as well as front-end process vents from continuous processes. However, the HON process vent provisions exempt vents from batch processes, and some of the front-end operations in the elastomer industry are operated in a batch mode. In addition, the process back-end operations in the elastomer industry are unlike any operations in

the HON. Therefore, different approaches were needed to determined the floors for these two emission source types.

Use of the Batch processes ACT for batch front-end process vents

The EPA also would have preferred a direct approach for determining MACT floors for batch front-end process vents. However, the variability in processes, the fact that vents were seldom identified as batch vents, and the fact that many batch vents were combined with continuous vents, made any direct approach infeasible. Therefore, the EPA also looked for an approach that was feasible to implement.

In 1993, the EPA published the guidance document, "Control of Volatile Organic Compound Emissions From Batch Processes" (EPA-453/R-93-017). This alternative control technique (ACT) document provides guidance to State and local air pollution regulatory agencies on the development of regulations for air emissions from batch processes.

The guidance in the document is intended to apply to all batch operations. While the polymer and resin process described in the document (epichlorohydrin-based non-nylon polyamide) was not an elastomer process, the equipment, emission sources and control technologies for the industry studied are similar to those in the elastomer industry.

A great deal of the analysis in the ACT was dedicated to the generation of process vent applicability criteria for three levels of control: 90, 95, and 98 percent control. As with the HON, the applicability criteria are based on general vent stream characteristics, and not on process-specific parameters. These characteristics include the volatility of the organic material in the vent stream, the annual emissions, and the average flow rate of the stream.

Due to the similarities between the processes studied in the ACT, and the general nature of the applicability criteria, the EPA concluded that these criteria were appropriate to use in defining the MACT floor for front-end process vents from batch processes in the elastomer industry. The determination of the MACT floor using the Batch ACT is also described in the procedures section of this memorandum.

Back-end process vents

Many of the elastomer subcategories produce dry elastomer products. As described in detail in the industry description memorandum, the processes to "finish" the crumb rubber include many unit operations that do not have process vents comparable to SOCMI process vents. The emissions from many of the back-end operations are not completely captured and vented to traditional vent stacks. Finishing operations are often located in large

warehouse-type buildings, and process fugitive emissions are removed from the work space through roof fans and other general building ventilation. In addition, the vents from the largest emission source, crumb dryers, typically have large flow rates and low HAP concentrations due to the high air flow necessary to properly dry the polymer. HON process vent control methods are not conducive to or cost-effective for these dryer vents. Therefore, for the process back-end, the MACT floors were determined on a subcategory-specific basis, as described in the procedures section of this memorandum.

PROCEDURES USED TO DETERMINE MACT FLOORS

Two basic procedures were used to determine the MACT floors for the Polymers and Resins I subcategories. The first, the HON-based approach, compared existing levels of control with the level of control that would be required at elastomer facilities if the HON requirements were applied. This approach was used for storage vessels, wastewater, and equipment leaks. For front-end process vents, the same approach was used, except that the 90 percent control level from the Batch ACT was used for batch processes, and the HON process vent provisions were used for continuous processes. The 90 percent Batch ACT control level was selected, because the estimated cost-effectiveness for this level was comparable to the cost-effective of the HON continuous vent provisions (approximately $3,000 per Megagram). A second approach was used to assess the average emission limitation for back-end process emissions, and was based on emission reduction techniques used for each specific subcategory. Both of these approaches are discussed in more detail below.

HON-Based Approach - Existing Sources

The concept of this approach is to determine how controls at elastomer facilities compare to the level of control that would be required by the HON (and by the Batch ACT). This type of analysis does not define specific floors in terms of numeric values. Rather, the conclusion of each floor analysis using this HON-based approach is whether the MACT floor is less stringent than, more stringent than, or equal to, the HON-level of control. This section describes the general HON-based approach used for all emission source types (i.e., storage vessels, front-end process vents, wastewater streams, equipment leaks), followed by specifics of the individual emission source types.

General approach

For each facility in each subcategory, the existing controls were identified for each emission point. The existing level of control was then compared to the level of control that would be required by the HON/Batch ACT, and the emission point was noted as being controlled at a level less stringent than the HON/Batch ACT requirements (less than HON), a level equivalent to the

HON/Batch ACT requirements (equal to HON), or a level more stringent than the HON/Batch ACT requirements (greater than HON).

After each emission point at each facility was characterized, all emission points of a given emission source type were grouped together and a facility-wide determination was made for each emission source type. For instance, if an emission point was controlled at a level less stringent than the HON, and no other emission point of the same type was controlled at a level more stringent than the HON, the facility was classified as "less than HON" for that emission source type. If all controls at the facility were equivalent to the HON levels, the facility was classified as "equal to HON." If one or more points was controlled at a level more stringent than the HON, and no point of the same type was controlled at a level less stringent than the HON, the facility was classified as "greater than HON."

A clarification is necessary related to uncontrolled emission points. If an emission point was uncontrolled, and the HON/Batch ACT would not require control for that point, the level of control is equivalent to the HON/Batch ACT level of control. Therefore, the floor for a subcategory could be the HON/Batch ACT, when in fact all emission points of that particular emission source type were uncontrolled.

If a facility reported different levels of control (in comparison to the HON) within one emission source type, an additional analysis was necessary to classify the facility. In these situations, the existing emission level was compared to the emission level that would be required if HON controls were applied. If the existing emissions were less than the HON-level emissions, the facility was classified "greater than HON," but if the HON-level emissions were lower, the facility was classified "less than HON."

The floor for each emission source type was then defined for each subcategory as less than, equal to, or greater than, the HON level of control. This determination was based on the majority of individual facility classifications for the subcategory.

Storage vessels

The applicability of the existing HON storage tank provisions is based on tank size and vapor pressure of the total organic HAP in the storage tank. Vessels meeting the capacity/vapor pressure criteria must be controlled using one of three control techniques: (1) an internal floating roof, (2) an external floating roof, or (3) a closed vent system to a control device (95 percent emission reduction). If the maximum true organic HAP vapor pressure of the vessel contents is high enough, the control option is limited to a closed vent system vented to a control device. Pressure tanks (greater than 23 psi) are exempt from the HON requirements.

In order to evaluate the applicability of the HON provisions to elastomer storage vessels, the maximum true vapor pressures of monomers, solvents, and additives used at elastomer facilities were estimated, and the level of control that would be required determined.

For each facility in each subcategory, the existing storage vessel controls were noted and summarized by individual HAP. The existing level of control was then compared to the HON-level of control for each vessel, and the MACT floors were determined as discussed above in the general HON-approach section. Table 1 shows the level of control that would be required by the HON for HAP's used in the elastomer industry.

Front-end process vents

The HON process vent provisions apply to continuous process vents emitting streams containing more than 0.005 weight-percent HAP. Control (98 percent) is required for each process vent with a flow rate greater than or equal to 0.005 standard cubic meters per minute, an organic HAP concentration greater than or equal to 50 ppmv, and a total resource effectiveness (TRE) index value less than or equal to 1.

The Batch ACT process vent provisions apply to volatile organic compound (VOC) emissions from batch process vents. In this analysis, only the organic HAP emissions were considered. The first level of applicability in the Batch ACT is based on annual emissions. If annual HAP emissions, calculated before a control or recovery device, are less than specified levels, control is not required. For the 90 percent control level, these "cutoff" levels are between 7,300 and 11,800 kilograms per year, depending on the volatility of HAP's emitted. If annual emissions were greater than the cutoff level, emissions were input into an equation from the ACT to determine a cutoff flow rate. If the actual flow rate of the batch vent stream is less than the cutoff flow rate, 90 percent control is required.

EC/R applied the HON or Batch ACT criteria to each process vent for which the necessary vent stream parameters were provided. In some instances, EC/R was able to estimate the necessary parameters. In situations where a continuous vent stream was controlled using a thermal oxidizer or flare, EC/R applied the HON criteria to the stream prior to the control device, to assess whether the stream would have required control based on the HON criteria. Similarly, in situations where a batch vent stream was controlled using a control or recovery device, the Batch ACT criteria were applied prior to the device. The existing level of control was then compared to the level of control that would be required by the HON or Batch ACT.

Information was seldom provided that identified whether the vent was continuous or batch. The HON criteria were applied to

TABLE 1. HON STORAGE TANK REQUIREMENTS FOR ELASTOMER RAW MATERIALS

HAP Stored	Control Required by HON[a]	
	Large[b] Tanks	Small[b] Tanks
Acrylamide	None	None
Acrylic acid	Control	Control
Acrylonitrile	Control	Control
1,3-Butadiene	Restricted Control	Restricted Control
Carbon tetrachloride	Control	Control
Chloroprene	Control	Control
Epichlorohydrin	None	None
Ethyl Acrylate	None/Control	None
Ethylene dichloride	Control	None
Formaldehyde[d]	None	None
n-Hexane	Control	Control
Methyl chloride	Restricted Control	Restricted Control
Toluene	Control	None
Styrene	None/Control	None
Vinylidene chlorine	Restricted Control	Restricted Control

[a] The HON requires control by one of three methods: internal floating roofs, external floating roofs, or closed vent systems to a control device that achieves 95 percent control. "Control" indicates storage vessels containing the noted HAP have choice of one of these three options. "Restricted control" indicates that the only acceptable control option is a closed vent system and a control device. None/Control means that controls are not required for existing sources, but control would be required for vessels at new sources.

[b] Large vessels are those with capacities greater than 40,000 gallons. Small tanks are those with capacities between 20,000 and 40,000 gallons.

[c] Formaldehyde is stored as formalin, which is a 50 percent formaldehyde solution in water. While the vapor pressure of pure formaldehyde would require control by a closed vent system and a control device, the vapor pressure of formaldehyde over water would is quite low and would not trigger any HON control.

all vents, unless the vent clearly originated from a batch process, in which cases the Batch ACT was used. In a few situations the vent appeared to be a batch vent, but this was not explicitly stated. In these situations both the HON and Batch ACT were applied.

For each reported vent stream at each facility, EC/R identified the vent as "greater than HON/ACT," "less than HON/ACT," or "greater than HON/ACT." Then the front-end process vent level of control for each facility was classified, and the subcategory floor determined as discussed above in the general HON-approach section.

Wastewater

The HON requires wastewater streams at existing sources that have a total volatile organic HAP concentration of 1,000 ppmw or greater and a flow rate of 10 liters per minute or greater (at the point of generation), or a total volatile organic HAP concentration of 10,000 ppmw or greater at any flow rate, to be managed in controlled equipment and treated to reduce the HAP concentration.

EC/R applied these criteria to uncontrolled wastewater streams at each facility. Where possible, the wastewater stream characteristics provided by industry were used. Where appropriate data were not provided, EC/R extrapolated flow rates, HAP concentrations, and emissions from other facilities in the subcategory. The stream characteristics were then compared to the HON applicability criteria to assess whether the HON would require control. In situations where a wastewater stream was controlled using a steam stripper or other HON-acceptable control method, EC/R compared the flow and HAP concentration of the stream prior to the control device, to assess whether the stream would have required control based on the HON criteria.

It should be noted that the information regarding wastewater control appears to be inconsistent. During meetings with industry representatives, control of wastewater using steam strippers has been indicated to be quite common in this industry.[2,3,4] However, the plant-specific data provided in response to Section 114 information requests, which were used in the floor analyses, do not show significant control.

Each wastewater stream, and in turn each facility, was classified as "less than HON," "equal to HON," or "greater than HON." The floor for wastewater for each subcategory was then determined as discussed above in the general HON-approach section.

Equipment Leaks

The HON equipment leak provisions require a combination of leak, detection, and repair (LDAR) procedures and equipment requirements. Six of the subcategories included in this project are subject to the HON equipment leak provisions through subpart I of part 63. Specifically, these subcategories are EPDM, HYP, PBR/SBR-S, PSR, SBL, and SBR-E. Therefore, all facilities in these subcategories are required to have a HON equipment leak program in place. However, the requirements of subpart I are HAP-specific and may not affect all components in HAP service at the facility. Facilities that reported the use of HAP's other than those covered by subpart I were assumed to not be controlled to the HON level.

In order to compare the existing control levels to the HON levels for the remaining subcategories, baseline control levels were assessed for each type of component at each facility. These levels were based on information submitted by the facility or on State equipment leak regulations affecting the facility.

A qualitative assessment was then made for each facility to determine whether the existing level of control was less than, equal to, or greater than the HON. For facilities in these subcategories, the baseline level of control was always determined to be less than the HON.

HON-Based Approach - New Sources

The HON-based approach used for new sources was similar to the existing source approach. The existing level of control for each emission point was compared with the level that would be required by the HON new source requirements. No difference exists in the Batch ACT requirements for new and existing sources.

After each emission point at each facility was characterized as less than, greater than, or equal to, the new source HON, all emission points of a given emission source type were grouped together and a facility-wide determination was made for each emission source type. This determination was conducted as described in the existing source general approach discussion.

The new source floor was then defined for each emission source type for each subcategory as less than, equal to, or greater than, the new source HON level of control. This determination was based on the single facility with the highest level of control in the subcategory. If a single facility was classified as equivalent to the new source HON, and no facilities were classified as greater than the new source HON, the new source floor was identified as the new source HON level of control. However, if one facility was classified as greater than

the new source HON, the determination of a new source floor greater than the new source HON level was necessary.

Approach For Process Back-End Emissions - Existing Sources

As noted above, emissions from the back-end of elastomer production processes are not amenable to HON-type applicability and control provisions. In only one instance did a facility report that add-on control was used to reduce back-end HAP emissions [a facility producing polybutadiene rubber and styrene-butadiene rubber by solution (PBR/SBR-S)]. However, facilities in three subcategories [ethylene propylene rubber (EPR), PBR/SBR-S, and SBR-E] reported permit conditions requiring that the amount of residual HAP remaining in the polymer be reduced by "improved stripping" prior to drying (i.e., "residual HAP limits").

MACT floors were determined on a subcategory-specific basis for the back-end emissions from these three subcategories. The format for each floor is in terms of stripper performance, or the amount of HAP remaining in the polymer after the stripping step. In the cases of EPR and PBR/SBR-S, the floor is expressed as the weight of residual HAP per weight of dry polymer. In the case of SBR-E, the floor is expressed as the weight of residual HAP per weight of latex leaving the stripper. These formats were selected to be compatible with the formats of applicable State permit conditions for the three subcategories.

A number of statistical parameters can be used to establish the numerical level of the MACT floor, including the arithmetic mean, median, or mode. Because the format of the floor is in terms of HAP per polymer produced, and production data were often claimed as confidential, the selection of any specific parameter is complicated by the need to maintain confidentiality, and by the small number of plants in each subcategory. That is, if the floor for a given subcategory was based on a rigorously computed arithmetic mean, companies could use the floor to calculate production figures for their competitors. To avoid this problem, the floor for each subcategory was established at a level between the mean, median, and mode. The confidential files for this docket contain a memorandum that describes in more detail the basis of the MACT floors for back-end operations.[5]

In each case, the floor is expressed as a maximum weekly average residual HAP level. For SBR-E, the weekly floor was computed from maximum weekly average HAP in latex data submitted by the plants. For EPR and PBR/SBR-S, the weekly floors are based largely on annual emissions and production data submitted by the plants. A limited amount of weekly data were used to adjust the annual data to allow for some temporal variability in residual HAP levels.

The weekly time frame was selected for two reasons. First, the waiting period to obtain residual monomer results for a given sample will be up to three days for some categories. The weekly timeframe allows a plant to compensate for a "bad" batch and still achieve the standard. Second, some grades of polymer are more difficult to strip than others. Because the MACT floor is based on an overall average, some of the less strippable grades may have residual HAP levels that exceed the average floor level. A shorter timeframe might preclude plants from producing these grades at all. The weekly timeframe gives plants the opportunity to continue producing these grades, as long as average emissions are below the standard.

Carbon disulfide emissions. The discovery of carbon disulfide emissions from dryer vents at SBR-E facilities occurred relatively late in the information gathering process for this standard. Therefore, the amount of information available to determine the floor for this emission source was limited. Data were provided that indicated measured carbon disulfide concentrations in dryer stacks. The MACT floor was calculated as the average of the concentrations for those grades of SBR-E polymer that used a sulfur-containing shortstopping agent in their production.

Approach For Process Back-End Emissions - New Sources

The new source MACT floors for back-end process emissions should represent the level achieved by the best-performing single facility. However, a major problem exists in the use of this approach, because the emission factor or residual HAP level for a single facility is almost always confidential, so the actual level of the standard could not be revealed.

Therefore, the following approach was used to set the new source MACT floor. The ratio of the existing source MACT floor emission factor/residual HAP level to the best performing single facility emission factor/residual HAP was determined for each subcategory. The arithmetic average of all subcategory ratios was then applied to the existing source floor levels to determine new source floors.

The following example is provided to illustrate this approach. Assume existing source MACT floor emission factors for three subcategories were 5, 10, and 15 kilograms per Megagram of rubber. The corresponding emission factors for the three best controlled facilities in each subcategory were 2, 3, and 5, respectively. The ratios of the best controlled source to the existing source floor are therefore 0.4 (2÷5), 0.3 (3÷10), and 0.33 (5÷15). The arithmetic average of the ratios is 0.34. This average ratio was then applied to each of the existing source floors to set the new source level, which would be 1.7, 3.4, and 5.15 kilograms per Megagram.

RESULTS OF ANALYSIS

Table 2 presents a summary of the MACT floors. In the following sections, results of the analyses are presented. For each subcategory, the existing and new source MACT floor conclusions are provided, along with a brief discussion. Attachment 1 to this memorandum includes a series of tables detailing the facility-specific existing control levels and floor conclusions.

Butyl Rubber

Butyl rubber is a single plant subcategory. Therefore, the existing level of control at this facility represents the MACT floor for the subcategory.

The three HAPs stored at the butyl rubber facility are hexane, methyl chloride, and methanol. All of the storage vessels are controlled in accordance with the HON. Therefore, the floor for storage vessels was determined to be equal to the HON.

All front-end process vent streams are controlled by a flare. However, the streams would be classified as halogenated vent streams under the HON. The HON does not allow the control of a halogenated vent stream using a flare, but would require the stream be controlled by an incinerator followed by a scrubber. Therefore, the existing level of control for these vents is less stringent than the HON. In addition, an uncontrolled maintenance vent exists that appears to be a batch process vent. Application of the Batch ACT criteria showed that this vent would require control. The floor for front-end process vents was determined to be less stringent than the HON/ACT.

Because no add-on control or permit conditions were reported for the process back-end, the floor for process back-end emissions was defined as no control.

Uncontrolled wastewater streams were reported by the facility that would be subject to the HON control requirements. Therefore, the floor for wastewater was determined to be less stringent than the HON.

The facility reported that equipment leak emissions were controlled by the combination of a leak detection and repair program and some "leakless" equipment. However, elements of the program were less stringent than the HON level, so the floor for equipment leaks was determined to be less stringent than the HON.

In summary, the MACT floors for the butyl rubber subcategory are as follows. For storage vessels, the floor was determined to be equal to the HON. For front-end process vents, wastewater, and equipment leaks, the floor was determined to be less stringent than the HON (HON/ACT). For back-end process

TABLE 2. SUMMARY OF MACT FLOOR DETERMINATIONS FOR ELASTOMER SUBCATEGORIES

Subcategory	MACT Floors				
	Storage	Front-End Process Vents	Back-End Process Emissions	Wastewater	Equipment Leaks
Butyl	= HON	< HON/ACT	no control	< HON	< HON
Epichlorohydrin	= HON	< HON/ACT	no control	= HON	< HON
Ethylene Propylene	< HON	< HON/ACT	MACT floor emission factor	= HON	< HON
Halobutyl	< HON	< HON/ACT	no control	= HON	< HON
Hypalon®	= HON	= HON/ACT	no control	= HON	= HON
Neoprene	< HON	< HON/ACT	no control	= HON	< HON
Nitrile Butadiene Latex	< HON	= HON/ACT	no control	= HON	< HON
Nitrile Butadiene Rubber	< HON	= HON/ACT	no control	= HON	< HON
Polybutadiene/Styrene Butadiene Rubber by Solution	= HON	= HON/ACT	MACT floor emission factor	= HON	< HON
Polysulfide	= HON	= HON/ACT	no control	= HON	< HON
Styrene Butadiene Latex	= HON	= HON/ACT	no control	= HON	= HON
Styrene Butadiene Rubber by Emulsion	= HON	= HON/ACT	MACT floor latex styrene concentration	= HON	= HON

emissions, the floor was determined to be no control.

Epichlorohydrin Elastomer

Epichlorohydrin elastomer is a single plant subcategory. Therefore, the existing level of control at this facility represents the MACT floor for the subcategory.

The HAP's reported to be stored at the epichlorohydrin facility are epichlorohydrin, propylene oxide, ethylene oxide, and toluene. All of the storage vessels are controlled in accordance with the HON, so the floor for storage vessels was determined to be equal to the HON.

All reported front-end process vent streams are controlled by a flare. However, sufficient information was not provided to estimate the stream characteristics prior to the flare. This control, and therefore the floor, was assumed to be equal to the HON/ACT.

Because no add-on control or permit conditions were reported for the process back-end, the floor for process back-end emissions was defined as no control.

No wastewater streams were reported by the facility that would be subject to the HON control requirements, and no wastewater control was reported. Therefore, the floor for wastewater was determined to be equal to the HON.

The facility reported that equivalent leak emissions were controlled by a leak detection and repair program. However, elements of the program were less stringent than the HON level, so the floor for equipment leaks was determined to be less stringent than the HON.

In summary, the MACT floors for the epichlorohydrin elastomer subcategory are as follows. For storage vessels and wastewater, the floor was determined to be equal to the HON. For equipment leaks, the floor was determined to be less stringent than the HON. The floor for front-end process vents was assumed to be equal to the HON/ACT. For back-end process emissions, the floor was determined to be no control.

Ethylene Propylene Rubber

Five active facilities were identified that produce ethylene propylene rubber. As discussed in the subcategorization memorandum, four of the EPDM facilities employ a solution process that uses a HAP solvent (hexane), and the fifth uses a suspension process.[1] The suspension process facility was included in the determination of MACT floors using the HON-based approach. However, the differences in the processes made consideration of

the suspension process inappropriate in the calculation of the process back-end floor.

The HAP's stored at EPDM facilities include hexane and toluene. Four of the five EPDM facilities reported existing storage tank controls that were less stringent than the level of control that would be required by the HON. The controls less stringent than the HON included hexane tanks controlled by condensers with control efficiencies less than the HON, and toluene and hexane storage tanks with fixed roof uncontrolled tanks. One facility did not report sufficient information to determine a classification for storage tank controls. Because four of the five facilities are controlled at a level less stringent than the HON, the floor for storage vessels was determined to be less stringent than the HON.

No EPDM facility reported a batch process, so the HON process vent provisions were applied to all front-end process vents. At one facility, the estimated TRE of a controlled stream was greater than 1.0, so controls at this facility were more stringent than the HON. One facility reported that a halogenated vent stream was controlled by a boiler, and an uncontrolled vent stream with a TRE less than 1.0. Another facility also had an uncontrolled vent stream with a TRE less than 1.0. Controls at these two facilities were less stringent than the HON. One facility reported controls in accordance with the HON. The final facility did not report sufficient information for front-end process vents. With two facilities equal to the HON, one less than, and one greater than, the floor for front-end process vents was determined to be less stringent than the HON/ACT.

One EPDM facility reported a residual HAP permit condition, establishing that the reduction of back-end HAP emissions was demonstrated for this subcategory. The average, mode, and median annual emission factors were determined and adjusted to weekly, as described in the approach section. For existing sources, the floor was determined to be 7 kg HAP per megagram dry crumb rubber, on a weekly average basis. The new source floor was determined to be 4 kg/Mg. As noted above, the suspension process EPDM facility was not included in the back-end floor analysis.

No wastewater streams exist at EPDM facilities with reported (or extrapolated) characteristics that would require control by the HON, and no wastewater controls were reported. Therefore, the floor was determined to be equal to the HON for wastewater.

Four facilities reported that equipment leak emissions were controlled by a leak detection and repair program, and one facility also reported some leakless equipment. However, elements of the programs at three of these facilities were less stringent than the HON level. The program at the fourth facility appeared to be very similar the HON. One facility did not report any program. Because four of five facilities were less than the

HON, the floor for equipment leaks was determined to be less stringent than the HON.

In summary, the MACT floors for the ethylene propylene rubber subcategory are as follows. For storage vessels, front-end process vents, and equipment leaks, the floor was determined to be less stringent than the HON (HON/ACT). For wastewater, the floor was determined to be equal to the HON. For back-end process emissions, the floor was determined to be the arithmetic average of the back-end emission factors for the facilities using the solution process.

Halobutyl Rubber

Halobutyl rubber is a single plant subcategory. Therefore, the existing level of control at this facility represents the MACT floor for the subcategory.

At the halobutyl rubber facility, hexane was stored in fixed roof uncontrolled tanks, and control would be required by the HON. Therefore, the floor for storage vessels was determined to be less stringent than the HON.

At the butyl rubber facility, three halogenated streams are controlled by a flare. The HON does not allow the control of a halogenated vent stream using a flare, but would require the stream be controlled by an incinerator followed by a scrubber. A fourth vent stream entering the flare has a TRE greater than 1.0, which is control more stringent than the HON. A comparison was made between the existing HAP emissions level and the emissions level that would result from application of only HON controls. The result is that the HAP emissions at the existing level of control were over three times greater than the emissions that would result after application of the HON. This difference was primarily due to the reduction in the Hcl emissions from the flare. Therefore, the floor for front-end process vents was determined to be less stringent than the HON/ACT.

Because no add-on control or permit conditions were reported for the process back-end, the floor for process back-end emissions was defined as no control.

No wastewater streams were reported by the facility that would be subject to the HON control requirements, and no wastewater control was reported. Therefore, the floor for wastewater was determined to be equal to the HON.

The facility reported that equipment leak emissions were controlled by a leak detection and repair program. However, elements of the program were less stringent than the HON, so the floor for equipment leaks was determined to be less stringent than the HON.

In summary, the MACT floors for the halobutyl rubber subcategory are as follows. For wastewater, the floor was determined to be equal to the HON. For storage, front-end process vents, and equipment leaks, the floor was determined to be less stringent than the HON (HON/ACT). For back-end process emissions, the floor was determined to be no control.

Hypalon™

Hypalon™ is a single plant subcategory. Therefore, the existing level of control at this facility represents the MACT floor for the subcategory.

At the Hypalon™ facility, all storage vessels are controlled in accordance with the HON, and the floor for storage vessels was determined to be equal to the HON.

This facility reported two uncontrolled front-end process vents. Both vents had TREs greater than 1.0, and would not require control by the HON. Therefore, the floor for front-end process vents was determined to be equal to the HON.

Because no add-on control or permit conditions were reported for the process back-end, the floor for process back-end emissions was defined as no control.

No wastewater streams were reported that would require control by the HON, and no wastewater control was reported. Therefore, the floor for wastewater was determined to be equal to the HON.

As noted earlier, Hypalon™ is one of the subcategories subject to the HON equipment leak provisions. All components in HAP service at this facility are expected to be subject to the HON requirements. Therefore, the floor was determined to be equal to the HON for equipment leaks.

In summary, all MACT floors for the Hypalon™ subcategory were determined to be equal to the HON (HON/ACT), except for back-end process emissions. For back-end process emissions, the floor was determined to be no control.

Neoprene

Three active facilities were identified that produce neoprene. These three facilities were used in the determination of MACT floors.

The primary HAP used in this subcategory is chloroprene, and all three facilities reported that chloroprene storage vessels were controlled at a level less stringent than the HON. Therefore, the floor for storage vessels was determined to be less stringent than the HON.

Two of the facilities reported information for uncontrolled front-end process vents where control would be required by the HON. Therefore, the floor for front-end process vents was determined to be less stringent than the HON.

Because no add-on control or permit conditions were reported for the process back-end at any neoprene facility, the floor for process back-end emissions was defined as no control.

No reported wastewater streams exist at neoprene facilities with characteristics that would require control by the HON, and no wastewater control was reported. The floor for wastewater was determined to be equal to the HON.

All three neoprene facilities reported that equipment leak emissions were controlled by a leak detection and repair program. However, elements of all three programs were less stringent than the HON, so the floor for equipment leaks was determined to be less stringent than the HON.

In summary, the MACT floors for the neoprene subcategory are as follows. For wastewater, the floor was determined to be equal to the HON. For storage, front-end process vents, and equipment leaks, the floor was determined to be less stringent than the HON (HON/ACT). For back-end process emissions, the floor was determined to be no control.

Nitrile Butadiene Latex

Three facilities were identified that produce nitrile-butadiene latex. Each of these facilities also produce styrene-butadiene latex, and equipment is sometimes shared between these two products. A separate analysis was conducted for NBL, although the primary product at one or more of these facilities may be SBL, and not NBL.

The HAP's reported to be stored at NBL facilities include acrylonitrile, styrene, ethyl acrylate, 1,3-butadiene, acrylic acid, vinylidene dichloride, and formaldehyde (formalin). Each facility reported that acrylonitrile was stored in fixed roof uncontrolled tanks, which would require control under the HON. Similarly, acrylic acid was stored in fixed roof uncontrolled tanks at two facilities. The butadiene and vinylidiene chloride were stored in pressure tanks. Because all three facilities were controlling storage vessels at a level less than the HON, the MACT floor was determined to be less stringent than the HON.

It is believed that at least some of the front-end operations at NBL facilities are batch. However, information submitted by the facilities did not identify which of the front-end process vents were from batch processes. Therefore, the HON and Batch ACT 90 percent applicability criteria were applied to all vents for comparison with existing controls. Each facility

controls one or more front-end process vents using a combustion device. Both the HON and Batch ACT were determined to require control for all these vents. Further, all uncontrolled vents at these facilities would not be subject to control under either the HON or Batch ACT. Therefore, the level of control for NBL front-end process vents was determined to be equal to the HON/ACT.

As indicated by the word "latex" contained in the name of the subcategory, the final product is a latex and not a dried solid. Operations after the stripper at NBL facilities have little HAP emission potential due to the low residual acrylonitrile concentrations. The floor for NBL back-end process emissions was determined to be no control.

No wastewater controls were reported at any NBL facility. At two facilities, all reported streams were below the HON applicability criteria. At the third facility, one uncontrolled wastewater stream was reported for which the HON would require control. Because two of three facilities were at the HON level, the floor for wastewater was determined to be equal to the HON.

Because these facilities also produce SBL, each is subject to the HON equipment leak provisions for components in styrene and butadiene service used to produce SBL. Many of the components in butadiene service are anticipated to be shared with the NBL process. Therefore, an equipment leak program equivalent to the HON is required at each NBL facility. However, each facility was assumed to be controlled at a level less stringent than the HON because components in acrylonitrile service are not subject to the HON provisions. Therefore, the floor for equipment leaks was determined to be less stringent than the HON.

In summary, the MACT floors for the nitrile butadiene latex subcategory are as follows. For front-end process vents and wastewater, the floor was determined to be equal to the HON (HON/ACT). For storage and equipment leaks, the floor was determined to be less stringent than the HON. For back-end process emissions, the floor was determined to be no control.

Nitrile-Butadiene Rubber

Four active facilities were identified that produce nitrile butadiene rubber. At one facility, the NBR equipment is also used to produce SBR by the emulsion process, as well as SBL. Information submitted by this facility related to NBL production was included in the floor analyses for this subcategory.

Industry requested that separate subcategories be created for batch NBR and continuous NBR processes, because two facilities use continuous processes and two use batch processes[6,7] The EPA recognizes differences in emissions and control technologies for batch and continuous processes. However, separate subcategories were not created because the EPA

believes that the use of both the HON and Batch ACT process vent provisions is satisfactory to address differences in batch and continuous process vents. Furthermore, the EPA believes the HON storage, wastewater, and equipment leak provisions are applicable to batch processes, and that batch processes may be compared with continuous processes using the HON-based approach described earlier in this memorandum.

Two facilities reported storage vessel controls less stringent than the HON. At one, acrylonitrile was stored in fixed roof uncontrolled tanks, and the other facility vented an acrylonitrile storage vessel to a scrubber with an efficiency less than the 95 percent required by the HON. At one facility, all HAP storage tanks are vented to a flare. The fourth facility did not submit sufficient information to allow a classification for storage vessels. Therefore, because two of three facilities submitting sufficient information were controlled at a level less than the HON, the floor was determined to be less stringent than the HON for storage vessels.

The two continuous process facilities control front-end process vents with combustion devices meeting the HON requirements. These vents are estimated to require control under the HON process vent provisions, making these two facilities equal to the HON. At the two batch facilities, all front-end process vents were uncontrolled, but all vents would not require control based on the Batch ACT criteria. Therefore, the floor for NBR front-end process vents was determined to be equal to the HON/Batch ACT.

Because no add-on control or permit conditions were reported for the process back-end at any NBR facility, the floor for process back-end emissions was defined as no control.

Based on the available information, no wastewater streams are estimated to exist at NBR facilities with characteristics that would require control by the HON. Further, no wastewater control was reported at any NBR facility. Therefore, the floor for NBR wastewater was determined to be equal to the HON.

Two facilities reported that emissions from equipment leaks were controlled by leak detection and repair programs. However, elements of the programs were less stringent than the HON, so these two facilities were determined to be less stringent than the HON. For the facility that also produces SBR-E, a HON program is in place for components in styrene and butadiene service used to produce SBR-E. Many of the components in butadiene service are estimated to be shared with the NBR process at this facility. However, this facility was also assumed to be controlled at a level less stringent than the HON because components in acrylonitrile service are not subject to the HON provisions. The final facility did not report any program to reduce emissions from leaking equipment. Therefore, the floor

for equipment leaks was determined to be less stringent than the HON.

In summary, the MACT floors for the nitrile butadiene rubber subcategory are as follows. For front-end process vents and wastewater, the floor was determined to be equal to the HON (HON/ACT). For storage and equipment leaks, the floor was determined to be less stringent than the HON. For back-end process emissions, the floor was determined to be no control.

Polybutadiene Rubber and Styrene-Butadiene Rubber by Solution

Four active facilities were identified that produce both PBR and SBR using the solution process, and another facility that produces PBR using the solution process. As discussed in the subcategorization memorandum, the four facilities producing both SBR and PBR use a HAP (hexane or toluene) solvent.[1] The facility producing only PBR reported the use of a non-HAP solvent. Representatives of this company have indicated that one of their two PBR processes is in the process of switching to a HAP solvent.[8] The non-HAP process facility was included in the determination of MACT floors using the HON based approach. However, the differences in the processes made consideration of the non-HAP process facility inappropriate in the calculation of the back-end floor.

Two of the facilities reported storage vessel controls more stringent than the HON. In both instances, this was because styrene tanks, which would not require control under the HON, were controlled with floating roofs. The three remaining facilities controlled hexane, styrene, and butadiene in a manner that was equivalent to HON controls. Therefore, the floor for PBR/SBR-S storage vessels was determined to be equal to the HON.

It was assumed that all front-end process vents at these facilities are continuous, so the HON process vent provisions were used to determine the floor. At two facilities, all front-end vents were combined and routed to a flare, and one or more of the vent streams would not have required control under the HON. Therefore, these two facilities were classified as greater than the HON. One facility controlled all vents that would have required control under the HON, and all uncontrolled vents would not have required HON control. The final two facilities did not report any control, and did not report any vent streams that would have required HON control. Because three facilities were determined to be equivalent to the HON, the floor for PBR/SBR-S front-end process vents was determined to be equal to the HON.

One PBR/SBR-S facility reported a permit condition limiting dryer emissions, and another reported that all dryer vents were vented to a boiler. These instances establish that the reduction of PBR/SBR-S back-end HAP emissions was demonstrated for this subcategory. The average, mode, and median annual emission

factors were determined and adjusted to weekly, as described in the approach section. For existing sources, the floor was determined to be 5 kg HAP per megagram dry crumb rubber, on a weekly average basis. The new source floor was determined to be 3 kg/Mg. As noted above, the facility using a non-HAP solvent was not included in the back-end floor analysis.

No wastewater streams exist at PBR/SBR-S facilities with reported (or extrapolated) characteristics that would require control by the HON, and no facilities reported wastewater controls. Therefore, the floor for wastewater was determined to be equal to the HON.

Producers of PBR and SBR are subject to the HON equipment leak provisions, but only for components in styrene and butadiene service. Therefore, each PBR/SBR-S facility is required to have a HON equipment leak program in place. However, each of the four HAP solvent facilities was assumed to be controlled at a level less stringent than the HON because components in hexane or toluene service are not subject to the HON provisions. Therefore, the floor for equipment leaks was determined to be less stringent than the HON.

In summary, the MACT floors for the polybutadiene and styrene-butadiene by solution subcategory are as follows. For storage vessels, front-end process vents, and wastewater, the floor was determined to be equal to the HON (HON/ACT). For equipment leaks, the floor was determined to be less stringent than the HON. For back-end process emissions, the floor was determined to the average of the back-end emission factors for the facilities using a HAP solvent.

Polysulfide Rubber

Polysulfide rubber is a single plant subcategory. Therefore, the existing level of control at this facility represents the MACT floor for the subcategory.

At the polysulfide rubber facility, ethylene oxide, ethylene dichloride, and formaldehyde (formalin) were stored in accordance with HON requirements. Therefore, the floor was determined to be equal to the HON for storage tanks.

The front-end process vent information submitted by the polysulfide rubber facility indicated that no control was present. No control would be required by the HON, so the floor was determined to be equal to the HON for front-end process vents.

Because no add-on control or permit conditions were reported for the process back-end, the floor for process back-end emissions was defined as no control.

No wastewater streams were reported by the facility that would be subject to the HON control requirements, and no wastewater control was reported. Therefore, the floor for wastewater was determined to be equal to the HON.

The facility reported no information on the control of emissions from equipment leaks. Therefore, the floor for equipment leaks was determined to be less stringent than the HON.

In summary, the MACT floors for the polysulfide rubber subcategory are as follows. For storage vessels, front-end process vents, and wastewater, the floor was determined to be equal to the HON. For front-end process vents, and equipment leaks, the floor was determined to be less stringent than the HON. For back-end process emissions, the floor was determined to be no control.

Styrene-Butadiene Latex

As noted above, the styrene-butadiene latex subcategory was the only subcategory containing more than 5 sources. Seventeen facilities were identified that currently produce SBL. One of these facilities began operations after the original information requests were made, so this facility was not included in the floor analyses. Another facility is a styrene-butadiene rubber by emulsion facility that removes a stream of latex (after stripping but prior to coagulation) from the rubber production line and blends and finishes it to make a final latex product. This facility was also not included in the MACT floor analyses.

The first step was to identify the best performing 5 facilities. Because the MACT floor analysis was conducted on a "plank" basis, the best performing 5 facilities were determined separately for each emission source type.

For storage vessels, the HON storage vessel provisions were used to determine the best performing 5 facilities. Each SBL facility was classified as less than, greater than, or equal to the HON storage vessel control level. This analysis showed that one facility controls storage vessels at a level more stringent than the HON, six with controls equal to the HON, and six with controls less stringent than the HON. A facility's relationship to the HON was assumed to be a direct reflection of the level of control. In other words, those facilities with controls greater than the HON were considered to be the best controlled facilities. Therefore, the best controlled five facilities consist of four with controls equal to the HON, and one with controls greater than the HON. The floor for SBL storage vessels was determined to be equal to the HON.

For front-end process vents, an emission factor approach was used to identify the best performing 5 facilities. The use of an emission factor (HAP emissions per unit of production) would take

into account process modifications and other pollution prevention actions that decrease HAP emissions, eliminating the need for add-on control. The five SBL facilities with the lowest emission factors were identified as the best controlled. The HON/Batch ACT approach was then used to determine the "average" control of these five. Of these five, one was determined to control at a level more stringent than the HON/ACT, and the remaining four were classified as equal to the HON/ACT. Therefore, the floor for SBL front-end process vents was determined to be equal to the HON/ACT.

The final product is a latex, meaning a liquid rather than a dried solid. Operations after the stripper at SBL facilities have little HAP emission potential due to the low residual styrene concentrations. The floor for SBL back-end process emissions was determined to be no control.

Similar to storage vessels, a HON-comparison approach was used to identify the five SBL facilities with the best wastewater control. Actually, no SBL facility reported wastewater control for any stream. Two facilities reported (or extrapolated) streams that would require control under the HON, making them less stringent than the HON. Therefore, the remaining 13 facilities, and the MACT floor for SBL wastewater, were determined to be equal to the HON.

The HON was used to identify the best controlled facilities for equipment leaks. Producers of SBL are subject to the HON equipment leak provisions for components in styrene and butadiene service. Several facilities reported the use of other HAP's in the production of SBL, but seven reported the use of styrene and butadiene only. Therefore, all components in HAP service at these seven facilities are required to be controlled at the HON level. No facility reported a program more stringent than the HON level. Therefore, the floor for SBL equipment leaks was determined to be equal to the HON.

In summary, all MACT floors for the styrene-butadiene latex subcategory were determined to be equal to the HON, except for back-end process emissions. For back-end process emissions, the floor was determined to be no control.

Styrene-Butadiene Rubber by Emulsion

Four active facilities were identified that produce styrene-butadiene rubber using the emulsion process. These four facilities were used in the determination of MACT floors.

Two of the four SBR-E facilities reported existing storage tank controls equal to the HON. One facility reported that styrene was stored in tanks vented to a carbon adsorber, which is more stringent control than the HON. The fourth facility did not report sufficient information to allow a comparison to the HON

level of control. The majority of facilities in this subcategory (for which information was available) controlled emissions equal to the HON. Therefore, the floor for SBR-E storage vessels was determined to be equal to the HON.

For front-end process vents, three facilities reported control for all vents with TREs less than 1.0 and all streams with TREs greater than 1.0 were uncontrolled. Therefore, these three facilities were classified as equal to the HON. Sufficient information was not available to reach a conclusion for the fourth facility. Therefore, the floor for SBR-E front-end process vents was determined to be equal to the HON.

Three of the four SBR-E facilities reported permit conditions limiting the amount of residual styrene in the stripped latex prior to coagulation. This establishes that the reduction of SBR-E back-end HAP emissions was demonstrated for this subcategory. Residual styrene in latex information was provided by each of the four facilities. The average, mode, and median maximum weekly residual styrene limits were determined as described in the approach section. For existing sources, the floor was determined to be 0.35 kg HAP per megagram latex, on a weekly average basis. The new source floor was determined to be 0.2 kg/Mg.

One SBR-E facility reported a controlled wastewater stream whose extrapolated flow and concentration were below the HON applicability levels, making the wastewater controls at this facility greater than the HON. Two facilities reported no control, and no streams that would require control. The fourth facility reported control for a stream that would not require control under the HON, but also reported flows and concentrations for two uncontrolled streams that would require HON control. For this facility, a comparison was done between the existing emission levels and the levels that would be present if control was applied only to the HON streams. This revealed that total plantwide emissions would be slightly lower at the HON level of control, resulting in the classification of this facility as less than the HON. With two facilities equal to the HON, one more stringent, and one less stringent, the MACT floor for SBR-E wastewater was determined to be equal to the HON.

As noted previously, producers of SBR are subject to the HON equipment leak provisions for components in styrene and butadiene service. No SBR-E facility reported the use of any HAP other than styrene and butadiene, leading to the conclusion that all components in HAP service are subject to HON control. Therefore, the floor for equipment leaks was determined to be equal to the HON.

In summary, all MACT floors for the styrene-butadiene rubber by emulsion subcategory were determined to be equal to the HON, except for back-end process emissions. For back-end process

emissions, the floor was determined to be the average residual styrene concentration in the stripped latex.

REGULATORY ALTERNATIVES BEYOND THE MACT FLOORS

Except in a few limited cases, only one regulatory alternative was developed and analyzed for each subcategory. Table 3 presents the regulatory alternatives by subcategory for the Polymers and Resins I subcategories. The rationale for the level of this alternative is discussed below.

If the MACT floor for an emission source type was determined to be less stringent than the HON/ACT level of control, the regulatory alternative included the HON/ACT level of control for that emission source, and not the MACT floor. The rationale for this action was that in the extensive evaluation of the HON requirements, the EPA concluded that the cost and other impacts of the HON-level of control were reasonable for storage vessels, continuous process vents, wastewater, and equipment leaks. Similarly, the EPA determined that the cost and other impacts associated with the Batch ACT 90 percent level of control were reasonable. Based on these previous analyses, the EPA determined that an increased stringency of the single regulatory alternative beyond the MACT floor level was acceptable.

While the EPA did make the general decision described in the previous paragraph without regard to specifics of the elastomer industry, industry specific considerations were considered in subsequent analyses when the MACT floor was determined to be less stringent than the HON/ACT. If special circumstances were identified for a subcategory that increased the cost (or other impacts) of the HON or Batch ACT controls to a level the EPA no longer considered reasonable, a regulatory alternative less stringent than the HON level (but at least as stringent as the MACT floor) was identified and analyzed. The only occurrences of this type were for process vents at the butyl rubber and halobutyl subcategories, which are both single-plant subcategories.

For butyl rubber and halobutyl front-end process vents, the MACT floor was determined to be less stringent than the HON/ACT. As discussed in the results section of this memorandum, both facilities had unique circumstance related to a halogenated vent streams controlled by a flare. This circumstance was that halogenated vent streams were vented to a flare, resulting in hydrogen chloride emissions. The HON would not allow a halogenated vent stream to be controlled by a flare, meaning that these facilities would need to install incinerators to control the halogenated organic compound, followed by scrubbers to control the hydrogen chloride generated by the combustion of the halogenated organic. The only emission reduction that could be attributed to the HON level of control would be the hydrogen chloride emissions, while the full cost of the incinerators and

TABLE 3. SUMMARY OF EXISTING SOURCE REGULATORY ALTERNATIVES FOR ELASTOMER SUBCATEGORIES

Subcategory	Existing Source Regulatory Alternatives				
	Storage	Front-End Process Vents	Back-End Process Emissions	Wastewater	Equipment Leaks
Butyl and Halobutyl					
Reg Alt I	HON	HON/ACT, exempting halogenated vent streams controlled by flare before proposal date	no control	HON	HON
Reg Alt II	HON	HON/ACT	no control	HON	HON
Epichlorohydrin, Hypalon®, Neoprene, Nitrile Butadiene Latex, Nitrile Butadiene Rubber, Polysulfide, Styrene Butadiene Latex					
Reg Alt I	HON	HON/ACT	no control	HON	HON
Ethylene Propylene, Polybutadiene/Styrene Butadiene Rubber by Solution					
Reg Alt I	HON	HON/ACT	MACT floor emission factor	HON	HON
Styrene Butadiene Rubber by Emulsion					
Reg Alt I	HON	HON/ACT	MACT floor latex styrene concentration	HON	HON

scrubbers would be incurred. This made the HON level of control very cost-ineffective for these subcategories. An intermediate regulatory alternative was developed that required the HON level of control for all front-end process vents, except for halogenated vent streams that were already vented to a flare. The HON level of control was maintained as a second regulatory alternative for both subcategories.

If the MACT floor was determined to be equal to the HON, the regulatory alternative was set at the MACT floor (i.e., the HON/ACT). If a MACT floor had been determined to be more stringent than the HON/Batch ACT, the regulatory alternative would have needed to reflect the MACT floor. However, as discussed in the results section of this memorandum, this situation did not occur for any emission source type for any subcategory for existing sources.

During the development of the HON, alternatives more stringent than the promulgated levels were considered and rejected by the EPA. Therefore, controls more stringent than the HON levels were not considered, because the EPA had previously considered them unacceptable.

Similarly, the Batch ACT analyzed and estimated impacts for control levels more stringent than the 90 percent level. As noted above, the 90 percent level was selected because of the relationship of the costs to the environmental benefits. Therefore, consideration of batch process vent control levels more stringent than the 90 percent Batch ACT level was unnecessary.

Similar to existing sources, if the new source floor was determined to be less stringent than the new source HON level, the first regulatory alternative was raised to the new source HON level.

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MEMORANDUM

Date: May 10, 1995

Subject: Potential for New Sources Producing Elastomers (Polymers and Resins I)

To: Leslie Evans, ESD/OCG

From: Charlotte Clark, EC/R CRC

The purpose of this memorandum is to discuss the potential for construction or reconstruction of affected sources that would produce elastomers in the Polymers and Resins I source category. Specifically, the memorandum discusses the potential for this new source growth within 5 years of proposal of the standard, or by 2001. This potential was predicted using actual and projected data on facility capacity, production, and growth.

CONCLUSION

No new sources that would be subject to the proposed rule are expected to be constructed or reconstructed before 2001 for three reasons. First, industry production capacity for these elastomers currently exceeds demand by a significant margin, and excess available capacity at domestic synthetic rubber producers can easily accommodate the expected increase in demand over that time period. In support of this, no company has identified any plans to construct or reconstruct a facility that would be subject to the proposed standard. Second, synthetic rubber production has become a global market, and a significant amount of unutilized capacity exists in other areas of the world. Third, new elastomers products (not included in the categories listed under this rule) have emerged that will, if successful, reduce demand for the listed elastomers. Therefore, estimates of impacts and costs performed for this regulatory effort assume no construction or reconstruction of new sources in the first five years of the standard.

BACKGROUND

The U.S. Environmental Protection Agency (EPA) is in the process of establishing national emission standards for hazardous air pollutants (NESHAP) for emissions of organic hazardous air pollutants (HAP) from production of any of nine elastomeric materials. These nine products are identified by the following source category designations:

- Butyl rubber
- Epichlorohydrin elastomers
- Ethylene propylene rubber

- Hypalon™
- Neoprene
- Nitrile butadiene rubber
- Polybutadiene rubber
- Polysulfide rubber
- Styrene butadiene rubber and latex

An important component of the regulatory process is identification of all facilities in the U.S. that are actively producing any of the listed elastomers; these sites are termed "existing" sources. Currently, 35 existing plant sites have been identified that produce one or more of the elastomers listed above. Because many of these produce more than one listed elastomer on site, and because each elastomer product process unit is defined as an affected source, 43 total existing affected sources have been identified for this regulatory effort.

An additional component of the regulatory process is consideration of the potential for construction of new production sites or for significant reconstruction of existing production sites. Assessment of this potential is important, because regulations for new or reconstructed sources are likely to be more stringent than for existing sources. Specifically, new sources must be controlled to a level equal to the best controlled similar existing source, whereas existing sources must be controlled to a level equal to a central measure of some percent of existing sources (for example, average of the best performing 5 sources).

EVALUATION OF NEW SOURCE POTENTIAL

Potential for new sources was evaluated in three steps. First, existing production capacity was compared to current demand. Three sources were used to obtain capacity, production, and demand information: Chemical Marketing Reporter[1], Chemical Engineering News[2], and the International Institute of Synthetic Rubber Producers (IISRP).[3,4,5] Applicable excerpts from these resources are included as Attachment 1.

Table 1 presents data on production capacity and demand for six of the nine source categories; similar data for the other three source categories -- epichlorohydrin elastomer, Hypalon™, and polysulfide rubber -- are either not available or are considered confidential. All three of the source categories not presented in the table are single plant source categories; further, the polysulfide facility is anticipated to be an area source not subject to the MACT standard. Therefore, the six listed source categories were considered to be representative of the source categories not listed in the table. These data show that, for 1993, domestic elastomers facilities operated at between 43 and 86 percent capacity. Thus, production is well below capacity industry wide, even considering a increase in

demand over the last couple of years.[5]

Table 1. Elastomer Production Capacity and Production in 1993

Elastomer	Production Capacity in 1993, Mg/yr	Production in 1993, Mg/yr	Production as a Percent of Capacity
Butyl Rubber	350,000	195,000	56
Ethylene Propylene	378,000	275,000	70
Nitrile Rubber	133,500	115,000	86
Polybutadiene	656,000	445,000	68
Polychloroprene	163,000	70,000	43
Styrene Butadiene	1,030,000	875,000	85

In the second step, demand was projected to the year 2001, which is five years after proposal of the standard. The purpose of this step was to consider whether new capacity would be needed to meet increased demand by the year 2001. Because the information cited above projected demand to 1998, demand to the year 2001 was estimated using two approaches. In the first approach, average annual growth was calculated for the 1994-1998 time period using information provided by IISRP, and this growth percent was applied to each of the years 1999, 2000, and 2001. In the second approach, a 1.5 percent annual growth factor was applied to each subcategory or type of elastomer. This percent was supplied by the IISRP.[5] In both approaches, although both the capacity and projection data include Canada, only one significant synthetic rubber producer exists in Canada (a butyl rubber facility), and therefore, the numbers were deemed representative of US production, capacity, and demand.[5]

This second step resulted in projected demand for domestic elastomer product that ranged from 46.2 to 94.7 percent of domestic capacity. Only two elastomers had projected capacity use of over 90 percent. Table 2 provides a summary of capacity projections using both the approaches described above for all 6 source categories for which data are available. Again, these data suggest that throughout the domestic industry, production will continue to be well below domestic capacity, regardless of the approach used to estimate future demand.

In the third step, industry and trade organization sources were asked to provide input regarding whether facilities would be constructed or reconstructed by the year 2001. These representatives stated that no new or reconstructed growth is

Table 2. Production Capacity Projected to the Year 2001 for Certain Elastomers Source Categories

Elastomer	Approach 1, [a]			Approach 2, [b]		
	Growth Per Year, %	Projected Production, 2001, Mg/yr	Projected Capacity, 2001, Mg/yr	Growth Per Year, %	Projected Production, 2001, Mg/yr	Projected Capacity, 2001, Mg/yr
Butyl Rubber	0.9	124,103	93.0	1.5	126,445	94.7
Ethylene Propylene	2.8	325,000	86.0	1.5	313,500	82.9
Nitrile Rubber	1.0	937,300	91.0	1.5	950,950	92.3
Polybutadiene	1.4	499,780	76.2	1.5	501,600	76.5
Polychloroprene (Neoprene)	0.7	73,543	45.1	1.5	75,240	46.2
Styrene Butadiene	1.3	217,875	62.3	1.5	219,450	62.7

[a] For approach 1, average annual growth was calculated for the 1994-1998 time period using information provided by IISRP, and this growth percent was applied to each of the years 1999, 2000, and 2001.

[b] For approach 2, a 1.5 percent annual growth factor (as suggested by IISRP) was applied to each subcategory or type of elastomer.

expected for three reasons.

First, industry sources stated that no plans for construction of new sources or reconstruction of existing sources have been identified that would result in affected sources subject to the new source provisions of the draft rule. Construction of one new source that would produce a listed elastomer is planned, but the production process of this source is not projected to cause the emission of any organic HAP. Specifically, in October 1994, Union Carbide announced plans to build a ethylene propylene rubber (EPR) unit at its Seadrift, Texas facility.[6] The unit would begin operation by late 1996, would produce EPR through a gas-phase production process, and would not require the use of any solvents. Solvents are the only organic HAP expected to be emitted from the EPR process, because although ethylene and propylene are volatile organic compounds (VOC), they are not listed HAP.

Second, industry sources cited excess capacity in the international market as further evidence that no new domestic capacity will be needed by the year 2001. The increases in demand over the last few years have been accommodated easily through excess capacity both domestically and internationally. European facilities currently operate at 50 to 55 percent of capacity, facilities in the far east operate at 75 to 80 percent of capacity, and Russian facilities operate at 25 percent of capacity, for example.[5] Should demand increase more than expected, increased international production with import to the US could fill the necessary demand without the need to construct new or reconstruct existing facilities. Table 3 contains a summary of the forecast by the IISRP of the five-year market for various elastomer products.[4]

Third, industry sources believe that some new products (not included in the categories listed under this rule) are under development that will, if successful, reduce demand for the listed elastomers.[5] For example, Exxon and Dow have initiated a joint venture to produce a new type of elastomer that would compete directly with existing synthetic rubber products.

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Table 3. Chemical Profiles and Forecasts for Selected Elastomers[a,b]

Product	Demand, metric tons/yr	Annual Growth 1984-1993	Est. Annual Growth 1994-1998	Strength	Weakness	Outlook
Butyl Rubber	1993 - 195,000 1994 - 200,000 1998 - 210,000	0-1%	1-2%	Tried and true product with large, established demand. {Production and pricing stable; demand should grow as economy picks up.	Mature market that should grow slowly in the 1990s. Domestic production peaked in 1979 and has fallen by 1/4 since then. Imported tires are a threat, and exports will decrease after 1995, when Sovbutital opens a facility in Siberia.	Sluggish overall growth, but healthier demand than in past decade. Adhesives and sealants are promising markets.
Ethylene Propylene Rubber	265,000 270,000 300,000	3-4%	2-3%	Exports have doubled over past decade. Growth looks solid over next few years. Building and construction uses are healthy.	Auto and construction industries are vulnerable to periodic downturns. Polypropylene poses tough competition, and most end uses offer only modest to flat growth.	Although growth could taper off in the 1990s, automotive and construction industry are healthy and producers are gradually raising capacities.
Neoprene (Polychloroprene)	70,000 70,000 72,000	-3%	1-2%	Losses to competing rubbers and elastomers have slowed, because easy substitutions have been made. Export market is growing, and domestic sales assisted by increased exports of finished goods.	Markets for thermoplastic rubbers and chlorinated polyethylene will continue to erode through 1995. Adhesive segment threatened by environmental restrictions on solvents, and only a portion of the market will adopt water-based polychloroprene systems.	Old-line elastomer past its days of high growth. Future applications include us in modified asphalt and automotive engine mounts.

a Facsimile, from Theismann, B., International Institute of Synthetic Rubber Producers, Inc., to Norwood, P., EC/R Inc.. July 14, 1994. Market forecast for 1994/1998 and publication order form.

b Demand is domestic, including exports, but not imports.

Product	Demand, metric tons/yr	Annual Growth 1984-1993	Est. Annual Growth 1994-1998	Strength	Weakness	Outlook
Nitrile Butadiene Rubber	115,000 117,000 121,000	0-1%	1-2%	Product should grow slowly over next decade due in part to a resurgent auto market. High-temperature product is finding new uses in high-tech auto applications	Vulnerable to downturns in the automotive market, which account for half of demand. Fierce competition in rubber hose and belting has kept pricing soft.	Product is mature with almost no growth for two decades.
Polybutadiene	445,000 455,000 480,000	1-2%	1-2%	Growing use in impact modification of styrenics and in tire retread market. Increasingly strong exports.	Mature product. Natural and solution styrene-butadiene rubber have replaced some uses. Tire industry is vulnerable to price cutting, overcapacity, and periodic recessions in automotive sales.	Average growth is sluggish and sporadic. Exports have provided a windfall, although these are mostly to the producers' overseas divisions.
Styrene-Butadiene Rubber	875,000 875,000 910,000	-1-0%	0-1%	Conversion of automobile tires to radial design has peaked, and exports are strong. Domestic auto industry is healthy, and demand is growing.	Highly dependent on tire manufacturing; vulnerable to downturns in automotive industry.	Consumption is flat with little change of real, long-term improvement.Use of performance tires is increasing, and could help product. Industry is gradually shifting from emulsion polymerization to solution polymer technology.

ATTACHMENT 1

CHEMICAL PROFILE

POLYCHLOROPRENE

March 28, 1994

PRODUCER	CAPACITY*
DuPont, Laplace, La.	46
DuPont, Louisville, Ky.	90
Miles, Houston, Tex.	27
Total	163

*Thousands of metric tons per year of polychloroprene, also known as neoprene.
Profile last published 5/13/91; this revision, 3/28/94.

DEMAND

1993: 70,000 metric tons; **1994:** 70,000 metric tons; **1998:** 72,000 metric tons. (Figures represent US sales and imports, but not exports. Exports are roughly 54,000 metric tons per year, and imports are about 8,000 metric tons.)

GROWTH

Historical (1984-1993): minus 3 percent per year; **future:** 0 to 1 percent per year through 1998.

PRICE

Historical (1981-1994): High, $1.51 per pound, general purpose grade, f.o.b. plant; $1.91 per pound for rubber, adhesive and latex grades; low, 87c. per pound, general purpose grade. **Current:** $1.51 per pound for general purpose grade; $1.91 per pound for rubber, adhesive and latex grades.

USES

Industrial (belts, hoses, flooring), 33 percent; mechanical, 30 percent; adhesives, 10 percent; latexes, 10 percent; wire and cable, 6 percent; cellular rubber, 4 percent; miscellaneous, including consumer products, 7 percent.

STRENGTH

Losses to competing rubbers and elastomers has slowed, as easy substitutions have already been made. The export market for US polychloroprene is growing, particularly to Latin America, Asia Pacific (except Japan) and countries with controlled economies. Domestic sales are being helped by increasing exports of finished goods.

WEAKNESS

Slow erosion of the markets for thermoplastic rubbers and chlorinated polyethylene will continue through 1995. The adhesive segment is threatened by environmental restrictions on solvents, and only part of the market is likely to adopt water-based polychloroprene systems.

OUTLOOK

Polychloroprene is an old-line elastomer passed its days of high growth. Future applications include use in modified asphalt, where it is displacing SBR, and automotive engine mounts, where high under-the-hood temperatures are defeating parts made of natural rubber.

Report F

By I

MTBE PLANT PLANS DEVEL
joint venture of Enterprise Products
Midsouth Pipeline Company, has a
barrel-a-day methyl tert-butyl ethe
Belvieu, Tex.

The facility has been contemplat
Engineering and design work is und
Construction most likely will take
into production toward the fourth q

Elsewhere, the 15,000-barrel-a-d
three months ahead of schedule, co
take about half of Mitchell Energy
Mitchell owns one-third, Enterpris
third.

And the 15,000-barrel-a-day MT
plant of Texaco Chemical at Port N
speaking recently in Houston, repo
unit following acquisition of Texac

CHEMICAL COMMUTING: T
has extended the deadline for Hous
the number of vehicles being driver
that a network of certified trainers

Under the Employer Trip Redu
1990, companies with more than 10
Houston/Galveston must increase
a.m. by 25 percent or face fines. Pla
mid-1994, to go into effect by 1996,

Under new deadlines, employers
September 15 and those with 100-1
Dow Chemical Company and othe
study by Texas Transportation Ins
meet ETRA requirements (CMR,

BRIO SITE CULPABLE: The B
point for recycling of hazardous w
declared a Superfund site several
Resource Conservation Commissi
found downstream in portions of C

TNRCC says VOCs were confi
and levels of 1,1,2-trichloroethane
parts per million.

CHINA PETROCHEMICALS:
Group Inc., Pasadena, Calif., has c
basic petrochemicals and derivativ
the next decade. Driving forces wi
movement toward a free market e

RECYCLING AT NAN YA: N
Plastics, will build a $2.5 million p
manufacturing location. When co
recycled material.

BUSINESS BRIEFS

Witco Opens Center

Witco Corporation has opened an office in

and iron free dry aluminum sulfate (alum) in the US. Prior Chemical says it is pleased to

ing, developing, and implementing

CHEMICAL PROFILE

BUTYL RUBBER

April 4, 1994

PRODUCER	CAPACITY*
Exxon, Baton Rouge, La.	109,000
Exxon, Baytown, Tex.	121,000
Polysar, Sarnia, Ontario	120,000
Total	350,000

*Metric tons per year, including chlorobutyl and bromobutyl rubber capacity. Bayer AG acquired Nova Corporation's Polysar rubber division in May 1990, and the division is now called Polysar Rubber Corporation. Profile last published 4/1/91; this revision, 4/4/94.

DEMAND

1993: 195,000 metric tons; 1994: 200,000 metric tons; 1998: 210,000 metric tons. (Includes imports of 55,000 to 60,000 metric tons per year, but not exports, which average 45,000 to 50,000 metric tons.)

GROWTH

Historical (1984-1993): 0 to 1 percent per year; future: 1 to 2 percent per year through 1998.

PRICE

Historical (1981-1994): High, $1.26 per pound, regular grade, works; low, 69c. per pound, same basis. Current: $1.07 to $1.26 per pound, regular grades list; Exxon's Vistanex MM lists between $1.30 and $1.37 per pound.

USES

Tires, tubes and related products, 80 percent; automotive products, 8 percent; adhesives, caulks and sealants, 6 percent; pharmaceutical uses, 3 percent; other, 3 percent.

STRENGTH

Butyl rubber is a tried-and-true product with a large, established demand in tires and automotive goods. Production and pricing are stable, and demand should grow as the economy picks up.

WEAKNESS

Butyl rubber is an extremely mature market that grew very slightly in the 1980s and should continue to grow at less than GDP in the 1990s. US butyl rubber production peaked at 194,000 metric tons in 1979, and it has since fallen by over one-quarter. Imported tires remain a threat to domestic rubber consumption, and exports of butyl rubber could fall after 1995, when Sovbutital opens a 90,000-metric-ton facility in Siberia.

OUTLOOK

Overall growth for butyl rubber should remain sluggish, but demand for tire rubber should be healthier than it was in the past decade. Small uses of butyl rubber remain weak, but adhesives and sealants are promising markets.

Report F

By

MONT BELVIEU LPG UPDAT
should reach 540,000 barrels a day b
ago. And as the raw NGL pipeline s
fractionator feeds could be availabl
problems.

C. R. Eldred, manager of Houstor
division of Chevron USA Inc., told
Woodlands March 24 that the Mon
storage/processing area in the worl

Cost of environmental regulatior
import capability; segregated storag

Mont Belvieu facilities could inc
next three to five years to comply w
executive. One immediate problem
has been disposed of in caprock mu
process which could protract 400,0

Excluding ethane rejection, whic
he predicts that fractionators will o
This means potential raw NGL su

LPG imports will rise and fall, h
handling capacity on that basis. As
material, fluoride contamination h
by defluorination and segregation
butanes is also "an ever-increasing
fractionators, reducing front-end f
monitored more closely and these

MTBE FORECAST: S. Craig W
world methyl tert-butyl ether (M
1993 to 25 million tons in 1998. W
million tons in 1993 to 11.7 millior

The US butane demand picture
dehydrogenation consumption of
and 83,000 barrels in 1998, while t
barrels in 1990 to 130,000 barrels i

Things to watch for: some non-
pressure (RVP) standards rather t
with the Clean Air Act. Further, h
of a factor than earlier had been th
of MTBE requirements by 2000.

LPG WORLD HIGHLIGHTS:
director, told the conclave that de
growth will surpass base demand
after 1996.He foresees an increasi
Also, increased world supplies an
pressures on the world butane ma

STERLING INJECTION WEI
proposes to reissue an exemption
Solid Waste Amendments (HSW
Act (RCRA) for a hazardous wast
St. South in Texas City.

BUSINESS BRIEFS

EM Offers USP Grades

tor of Luxate aliphatic diisocyanates in the

Conn. The import/export compa

CHEMICAL PROFILE

POLYBUTADIENE

May 9, 1994

PRODUCER	CAPACITY*
American Synthetic, Louisville, Ky.	110,000
Bridgestone/Firestone, Orange, Tex.	120,000
Goodyear, Beaumont, Tex.	215,000
Negromex, Altamira, Mex.	13,000
Negromex, Salamanca, Mex.	20,000
Polysar, Orange, Tex.	115,000
Polysar, Sarnia, Ontario, Can.	63,000
Total	656,000

*Metric tons per year, net rubber basis, solution polymerized polybutadiene rubber. Firestone was acquired by Bridgestone Corporation of Japan in 1988. The company produces small quantities of high-vinyl polybutadiene at Lake Charles, La. Polysar was bought by Bayer AG in 1990, and it is now the Polysar Rubber division of Miles Inc. Profile last published 4/15/91; this revision, 5/9/94.

DEMAND

1993: 445,000 metric tons; 1994: 455,000 metric tons; 1998: 480,000 metric tons. (Figures represent US consumption. They include imports of 50,000 to 90,000 metric tons per year, but exclude exports, which surpassed 125,000 metric tons in 1992.)

GROWTH

Historical (1984-1993): 1 to 2 percent per year; **future:** 1 to 2 percent per year through 1998.

PRICE

Historical (1981-1994): High, 82c. per pound, clear rubber grade, t.l. or c.l., f.o.b. works; low, 43c. per pound, same basis. **Current:** 67.75 to 80c. per pound, list, clear rubber grade; 67.75c. to 82c. per pound, list, clear plastic grade, same basis. Selling prices follow butadiene. Rubber grade selling prices range from 45c. to 55c. per pound; plastic grade, 53c. to 62c. per pound.

USES

Tires and treads for automobiles, trucks and buses, 75 percent; high impact resin modification, 22 percent; industrial products (conveyor belts, hoses, seals and gaskets) and other, 3 percent.

STRENGTH

Use in the impact modification of styrenics is growing, and the tire retread market, which uses polybutadiene elastomers to improve tread wear, is enjoying 5 to 6 percent annual growth. Exports are very strong and have grown from less than 25,000 metric tons in 1986 to over 125,000 metric tons in 1992.

WEAKNESS

Polybutadiene is a mature product that has averaged only 1 to 2 percent annual growth since the mid-1970s. Natural and solution SBR have taken some business from polybutadiene. The tire industry remains vulnerable to price cutting, overcapacity and periodic recessions in automotive sales.

OUTLOOK

Average growth remains a sluggish 1 to 2 percent annual rate, but it is highly sporadic, and demand can rise or fall substantially in any given year. Exports have been a windfall during the past eight years, but most of these exports are to the producers' overseas divisions.

Report

MARAVEN PROJECT CON
of Maraven, a branch of Petrol
produce 234,000 barrels daily o
27,000 barrels of high-sulfur re

In addition to this expansion
(MTBE), tert-amyl methyl eth
under construction. An additic
communications system for Ve

M. W. Kellogg of Houston, (
being Bechtel Corporation (H
N.J.—is operating a worldwide
together.

In addition, Kellogg is suppl
a program management team
Maraven.

Partnering with AT&T and
F-W and data is exchanged vi
communications satellite, to ar
system includes electronic ma
network and video conference

John Menzies, Kellogg vice-
speaking from Caracas to Hou
costs over the life of the projec
expenses and salaries, the hool

He estimates that were it no
whereby funds for the Marave
communications network coul
owing to increased efficiencies

Allan V. Dyke, director of w
Vennet experience will give h
we're in a very strong position
the scale of the Maraven proje
expansion program, the syster

TNRCC-RRC SPAT, CON
Commission last week was sor
news release charging TNRC
"hurting the state's fledgling al
use of standards adopted by C

Bill Campbell, assistant exe
Protection Agency decisions a
page, TNRCC hopes to issue
to initiate a solution to alterna

Until the recent rules chang
Campbell says, TNRCC thou
saving Texas taxpayers the ex
procedures.

HOWELL CORPORATIO
earnings of $2.5 million last ye
declined to $411 million from
& Chemicals unit netted $85,
from the $1.7 million loss on r

BUSINESS BRIEFS

Sun Chemical's New Site

Sun Chemical Corporation, Fort Lee, N.J.,

ISO 9001. The certification applies to the manufacture of tantalum and niobium prod-

ings within its performance ad
ness unit. The literature exam

CHEMICAL PROFILE

SB RUBBER

May 30, 1994

PRODUCER	CAPACITY*
Ameripol-Synpol, (E) Port Neches, Tex.	335,000
Bridgestone/Firestone, (S) Lake Charles, La.	150,000
Copolymer, (E) Baton Rouge, La.	125,000
General Tire, (E) Odessa, Tex.	95,000
Goodyear, (S) Beaumont, Tex.	20,000
Goodyear, (E) Houston, Tex.	305,000
Total	1,030,000
Emulsion-polymerized solid rubber (E)	860,000
Solution-polymerized solid rubber (S)	170,000

***Metric tons per year of emulsion (E) and solution (S) polymerized solid styrene butadiene rubber (SBR). Capacity figures are for net dry rubber, including extended oils. Ameripol's capacity includes a small amount of emulsion-polymerized material. American Synthetic Rubber, Louisville, Ky., is wholly owned by Michelin et Cie and produces some solution-polymerized SBR for captive use. Bridgestone Corporation of Japan acquired Firestone in 1988. DSM of the Netherlands acquired Copolymer in 1989. Profile last published 5/27/91; this revision, 5/30/94.**

DEMAND

1993: 875,000 metric tons; **1994:** 875,000 metric tons; **1998:** 910,000 metric tons. (Includes exports of 150,000 to 225,000 metric tons per year, but not imports of 60,000 to 70,000 metric tons.)

GROWTH

Historical (1984-1993): minus 1 to 0 percent per year; **future:** 0 to 1 percent per year through 1998.

PRICE

Historical (1981-1994): High, 64c. per pound, dry SBR type 1712, oil extended, f.o.b. works; low, 42c. per pound, same basis. **Current:** 64c. per pound, list, same basis. Market price is roughly 40c. to 42c. per pound.

USES

Tires and tire-related products including tread rubber, 80 percent; mechanical goods, 11 percent; automotive, 6 percent; other, including floor tile and shoe soles, 3 percent.

STRENGTH

Conversion of automobile tires to radial design has peaked, and exports of SBR are strong. The domestic auto industry is healthy, and demand for SBR is growing again.

WEAKNESS

SBR is highly dependent on tire manufacturing for the auto industry. The product suffered a huge drop in demand between 1977 and 1985, and it remains vulnerable to downturns in the automotive industry.

OUTLOOK

SBR consumption is flat and shows little chance of real, long-term improvement. However, the product is finally growing again after a sharp decline between 1977 and 1985, and a modest drop from 1985 through 1990. The increasing use of performance tires could help SBR, and the industry is gradually shifting from emulsion polymerization to solution polymer technology.

Report F

By

EXXON BENICIA UPGRADE: July at its Benicia, Calif., refinery o gasoline requirements of California benzene, vapor pressure, olefins an will cost an additional 12 to 17 cent

Ralph M. Parsons Company, Pas construction services. The project addition of hydrotreating, fractiona

The venture also encompasses a (MTBE) unit, to be built by Pasade Completion of the entire project is in California for cleaner-burning ga

MTBE UNIT OF BEF OPENS: plant of Belvieu Environmental Fu Belvieu, an estimated three months Company, Enterprise Products Co Company.

The three also will provide equal undergoing start-up. Sun will buy a and marketing operations. Enterpri

DESULFURIZATION PILOT P the nation's first continuous pilot pl remove sulfur from petroleum feed offered by Energy BioSystems Co desulfurization of petroleum feeds of Gas Technology, Chicago (CMR

Petrolite Corporation, St. Louis, the facility, which will be built by research facilities in St. Louis. Depe commercial biochemical desulfuriz

MOTCO, BRIO DEVELOPME Con Inc. for installation of a slurry block migration of underground co method will be employed at the tro

The Brio group, comprised of ma (PRPs) as Motco—a who's who of suspended cleanup efforts and decl plan which could involve isolation incineration, which had been favor

STRESS ON C-5 SUPPLY: US d annually from 1985 to 1992, when i polyisoprene for tires and the produ

But according to a study by DeW piperylene and other C-5 based ch for isoamylene-based tert-amyl me

ROHM AND HAAS TRANSAC Coast Waste Disposal Authority at be bought up by Rohm and Haas th

BUSINESS BRIEFS

Zeneca Unit Changes Name

to market and sell its line of enhanced oil

CHEMICAL PROFILE

EP ELASTOMERS

June 6, 1994

PRODUCER	CAPACITY*
Copolymer, Addis, La.	73,000
Du Pont, Beaumont, Tex.	77,000
Exxon, Baton Rouge, La.	85,000
Polysar, Orange, Tex.	52,000
Uniroyal, Geismar, La.	91,000
Total	378,000

***Metric tons per year of ethylene-propylene (EPM) and terpolymer (EPDM) elastomers. Capacity is based on net rubber and does not include fillers, such as carbon black. EPDM accounts for 80 to 85 percent of current production. DSM acquired Copolymer in 1989, and Bayer AG purchased Nova Corporation's Polysar rubber division in 1990. Union Carbide opened a semiworks facility in South Charleston, W.Va., in 1992. Profile last published 4/8/91; this revision, 6/6/94.**

DEMAND

1993: 265,000 metric tons; **1994:** 270,000 metric tons; **1998:** 300,000 metric tons. (Includes exports, which have doubled to 80,000 metric tons over the past 10 years, but not imports of 10,000 to 15,000 metric tons per year.)

GROWTH

Historical (1984-1993): 3 to 4 percent per year; **future:** 2 to 3 percent per year through 1998.

PRICE

Historical (1981-1994): High, $1.38 per pound, EPDM general purpose terpolymer, standard grade, bulk, f.o.b. works; low, 78c. per pound, same basis. **Current:** $1.38 per pound, general purpose, standard grade. List prices vary considerably, depending on grade and properties.

USES

Automotive parts, 40 percent; building and construction, 18 percent; oil additives, 14 percent; industrial uses, 13 percent; wire and cable, 8 percent; miscellaneous, 7 percent.

STRENGTH

Exports of EP elastomers have doubled over the past decade, and a healthy US auto industry promises solid growth over the next few years. Building and construction uses are healthy, particularly single-ply roofing, and wire and cable insulation is also growing modestly.

WEAKNESS

Although the auto and construction industries are presently healthy, they are vulnerable to periodic downturns. Polypropylene poses tough competition for EP elastomers, and most end uses offer only modest to flat growth.

OUTLOOK

EP elastomers grew faster than GDP during the 1980s. Their growth could taper off in the 1990s, but the automotive and construction industries are presently healthy and producers are gradually raising their capacities.

Report F

B

MITSUBISHI METALLOCEN
market for extrusion coating heat
which 40 percent goes to light-du
40 percent is used in industrial ar
Mitsubishi Petrochemical Com
with Kernel 57 L, a metallocene-
speaking recently before MetCon
processability of the resin—a dra
making the materials more attrac

METALLOCENE CATALYS
MetCon meeting by Dr. Norman
Argonne, Ill. He concludes that o
million capital investment is requ
heterogenized catalyst system wi
cyclopentadienyl zirconocene di
zirconocene basis).
He reckons the metallocene sy
given a trimethylaluminum price
finished polymer would be 3.9 ce
properties will support good dem

HOUSTON-GALVESTON E
vehicle emissions testing progran
Harris (City of Houston), Galves
The region is deemed a "severe r
Texas Natural Resource Cons
program, called Texas Air Care,
vehicles to be tested every other
reduction can be achieved only t
industry already has reduced its

PERMITTING: Environmenta
Pollutant Discharge Elimination
million-pound-a-year polyprop
have been formulated for plants
Biotech Corporation in Houston
Permits have been formulated
the Mobil Chemical polyethylen
Gulf Coast Waste Disposal Auth
Hampshire Chemical Corporati

SETPOINT DOINGS: Setpoi
processing software house, says
established an office in Leiden, t
president Mark L. Darby has be
director of software products an
industry sales.

ALUMINA PLANT GETS IS
alumina refinery of Kaiser Alum
quality certification, covering m
alumina and alumina trihydrate.

BUSINESS BRIEFS

Norton Opens Tokyo Office

Norton Performance Plastics Corporation,

Drug Administration approval for its polypropylene film resin. Exxon Chemical

Milford, Conn. The 14-acre site, e
be completed by November, will m

CHEMICAL PROFILE

NITRILE RUBBER

June 13, 1994

PRODUCER	CAPACITY*
DSM, (S) Copolymer, Baton Rouge, La.	15,000
Goodyear, (S) Houston, Tex.	28,000
Goodrich, (L) Akron, Ohio	9,100
W.R. Grace, (L) Owensboro, Ky.	3,000
Polysar (Miles), (H) Orange, Tex.	1,600
Polysar (Bayer), (S) Sarnia, Ont., Canada	20,000
Uniroyal, (S) Painsville, Ohio	20,000
Zeon, (H) Houston, Tex.	1,500
Zeon, (S) Louisville, Ky.	35,300
Total	133,500

*Metric tons per year of dry rubber, latex and hydrogenated capacity. (S)—solid rubber; (L)—latex; (H)—hydrogenated. Solid and latex capacity figures are flexible, as some production units can swing to make SB and PVC blends. BASF no longer produces at Sarnia, Ont., or Chattanooga, Tenn. Polysar was acquired by Bayer AG in May 1990; its US operations are run by Bayer's US subsidiary, Miles Inc. Profile last published 5/20/91; this revision, 6/13/94.

DEMAND

1993: 115,000 metric tons; **1994:** 117,000 metric tons; **1998:** 121,000 metric tons. (Consumption estimates are for North America and are based on forecasts by International Institute of Synthetic Rubber Producers. Data includes all types of nitrile rubber.)

GROWTH

Historical (1984-1993): 0 to 1 percent; **future:** 1 to 2 percent per year through 1998.

PRICE

Historical (1981-1994): High, $1.60 per pound, medium to high acrylonitrile content, bulk, works; low, 85c. per pound, same basis. **Current:** (list) $1.40 per pound, medium-acrylonitrile; $1.55 per pound, high-acrylonitrile.

USES

Hose, belting and cable, 28 percent; O-rings and seals, 20 percent; latex, 15 percent; molded and extruded products, 15 percent; adhesives and sealants, 10 percent; sponges, 5 percent; footwear, 2 percent; other, 5 percent.

STRENGTH

A resurgent auto market is boosting nitrile rubber, and the product should grow, albeit slowly, for the rest of the decade. High-temperature NR is finding new uses in high-tech auto applications.

WEAKNESS

Nitrile rubber is growing at less than GDP and is vulnerable to downturns in the automotive market, which accounts for roughly half of demand. Fierce competition in rubber hose and belting has kept pricing soft in those areas in recent years.

OUTLOOK

An upturn in the auto market is brightening nitrile rubber's outlook, though the product is mature and has shown almost no growth for two decades. IISRP rates 1993 North American consumption of solid nitrile rubber at 78,500 metric tons and expects it to reach nearly 84,000 metric tons by 1998. The institute places 1993 nitrile latex consumption at 36,300 metric tons and predicts it will reach 38,300 metric tons by 1998.

Report F

By D

NGL WEAK, MITCHELL EARN
Development Corporation net earnin
million in Q1 last fiscal year due to w
both revenues and volumes, and lowe

Operating earnings for the quarter
from $25.2 million in last year's like p
Q1 1994. Processing volumes fell by n
43,200 barrels per day because some p
temporarily shut down.

"The good news," says Mitchell, is
liquids, have rebounded by about $5
industry, which buys three-fourths o
than-three-year slump, and new dem
plants—one that came on line this sp

GCF FIRE EFFECT: Mitchell's Q1
charge for insurance deductibles rela
of the Gulf Coast Fractionators NGL

Mitchell owns 38.75 percent of GC
NGL Holding Inc. (38.75 percent) ar
The unit is due back on line in Augu
capacity to 120,000 barrels daily

FORMOSA OLEFINS ON LINE:
Point Comfort is now producing mar
propylene. The firm has been tweak
brought up to snuff toward the end o
Mounger's start-up prediction (CMI
year of ethylene and 500 million pou

HUNTER TO FIGHT ON: A Te
Resource Conservation Commission
by Hunter Industrial Facilities Inc., t
near Dayton was upheld in March ir
appeal by Hunter.

The firm reportedly will appeal a
next week or so. Hunter has sought t
dome.

The plan has been controversial fr
project was safe, but TNRCC chairr
Peggy Garner ruled that Hunter hac
the salt dome, failed to provide an ac
urgent need for the facility.

RISK MANAGEMENT FORMU
chemical facilities, devised by E.I. du
the Texas Chemical Council/Assoc
safety seminar in Galveston.

The DuPont method involves fou
leadership and commitment, implen
process safety and risk management

The presentation characterized th
owner-operators, employees, the pu

BUSINESS BRIEFS

Dow's New Order Policy

Paulo, has obtained ISO 9002 certification.

Construccion S de RL de CV, will p

International Institute of
Synthetic Rubber Producers, Inc

Britt Theismann
Information and Systems Director

⇨⇨⇨⇨⇨ **Mr. Phil Norwood**
ECR

Fax: **919 493 6393**

Fax

Message:

Attached is our 1994/1998 forecast and our publication order form. Should you have any additional questions we look forward to assisting you further.

Best Regards,

Britt Theismann

BT/07010.94

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NEWS RELEASE

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For Further Information
Contact: B. D. Theismann
(PR 94.04)

For Immediate Release

North American Synthetic Rubber Consumption Increased by 4.0% in 1993 to 2.8 Million Metric Tons — Future to Remain Stable

HOUSTON, TEXAS USA, 7 February 1994—Synthetic Rubber (SR) consumption increased by 4% in 1993 to a total of 2,784 thousand metric tons, reaching a high water mark in total SR consumption in North America for the second year in a row, according to the International Institute of Synthetic Rubber Producers (IISRP).

"This rate of growth out-paced our predicted growth rate of 2.9% for 1993," said Conrad Jankowski, managing director of the IISRP. Jankowski added, "The SR industry also outpaced GDP growth in North America, attributable to stronger than expected new car sales and stronger than expected results from non-tire, non-automotive elastomers. Record levels of consumption were attained for Polybutadiene rubber (BR) at 484 thousand metric tons, Styrene-butadiene rubber (SBR) latex at 78 thousand metric tons, Carboxylated SBR latex rubber at 606 thousand metric tons, and Acrylonitrile butadiene rubber (NBR) at 78.5 thousand metric tons."

"We expect 1994 to more closely reflect traditional rates of growth for SR," said Jankowski. SR consumption in North America is expected to increase by 2.5% in 1994 to reach 2,853 thousand metric tons.

In 1993, SR usage in tires was 45.3% of total SR consumption. Excluding Carboxylated latex, tire usage represented 58.3% of SR consumption.

SBR latex exhibited the highest rate of growth at 10.7%, followed by Carboxylated latex at 9.4%. Ethylene Propylene Rubber (EPR) increased by 3.8% SBR, both solid emulsion and solid solution polymers, increased by 2.5%, while NBR and BR increased by 1.7% and 1.0% respectively.

For 1994, Carboxylated SBR latex is expected to continue a high level of growth at 5.8%. EPR is expected to lead the more traditional SR elastomers at 3% growth, while Polychloroprene rubber (CR), and NBR are expected to increase by 1.4%, and 1.3% respectively. SBR latex is

–more–

expected to increase by 2.7%. Among tire elastomers SBR is expected to increase by1.4%, BR by 2.0%, Butyl (IIR) by 1.3%, while Polyisoprene rubber (IR) consumption is expected to decrease by as much as 8% in 1994. With the exception of CR, most SR elastomers are expected to continue the same pace of growth over the five-year period 1994/1998. CR is expected to slow to an annual average growth rate of 0.6%. The IISRP consumption forecast projects that in 1998 SR consumption in North America will be 3,176 thousand metric tons for an overall annual growth rate of 2.7%

Thermoplastic Elastomers (TPE's) are expected to continue a 7% annual rate of growth through the balance of the 1990's.

Consumption of natural rubber (NR) reflected an increase of 2.3% in 1993 with consumption of 1,043 thousand metric tons. Over the five-year period NR consumption is projected to average 1.3% annually.

The IISRP North American consumption forecast is prepared annually be the Institute's Americas section statistical committee. The committee is made up of representatives from the major SR producers in North and South America. IISRP member companies participating in the forecast are Polysar Rubber Corp.; DuPont; Ameripol Synpol Corp.; Goodyear Tire & Rubber Co.; Uniroyal Chemical Co.; American Synthetic Rubber Corp., Firestone Synthetic Rubber & Latex Co.; General Tire, Inc.; Advanced Elastomer Systems; DSM Copolymer, Inc.; Zeon Chemicals USA, Inc.; EniChem Elastomer Americas,Inc.; and Shell Chemical Co.

The IISRP is an international not-for-profit trade association with about 50 corporate members who produce 90% of the world supply of synthetic rubber Its members are domiciled in 21 countries. Incorporated in 1960 and headquartered in Houston, Texas USA, the Institute also supports secretariat offices in London and Tokyo.

(30)

International Institute of Synthetic Rubber Producers, Inc.

New Rubber Consumption Forecast

North America

Thousand Metric Tons

Type of Rubber	1992 Historical Estimate	% Tire Usage 1992	1993 Late Estimate	% Change 1992 - 93	% Tire Usage 1993	1994 Forecast	% Change 1993 - 94	1998 Forecast	Annualized Growth Rate 1993-98
SBR Solid	800.9	84%	821.0	2.5%	84%	832.4	1.4%	885.8	1.5%
SBR Latex	70.5	5%	78.0	10.7%	5%	80.1	2.7%	86.4	2.1%
Carboxylated Latex	554.0	0%	606.0	9.4%	0%	641.1	5.6%	801.1	5.7%
Polybutadiene	479.4	74%	484.0	1.0%	74%	493.5	2.0%	527.3	1.7%
Ethylene Propylene	207.2	4%	215.0	3.8%	4%	221.5	3.0%	249.3	3.0%
Polychloroprene	70.0	0%	71.3	1.9%	0%	72.3	1.4%	73.4	0.6%
Nitrile Solid	77.2	1%	78.5	1.7%	1%	79.5	1.3%	83.7	1.3%
Nitrile Latex	36.6	0%	36.3	-0.8%	0%	37.3	2.8%	38.3	1.1%
Other Synthetics	381.2	52%	393.6	3.3%	51%	395.8	0.6%	430.4	1.8%
Total Synthetic Rubber	**2,677.0**	**46.3%**	**2,783.7**	**4.0%**	**45.3%**	**2,853.6**	**2.5%**	**3,175.7**	**2.7%**
TPE's	299.0	0.0%	320.0	7.0%	0.0%	342.1	6.9%	446.4	6.9%
Sub-Total Rubber *	**2,976.0**	**41.6%**	**3,103.7**	**4.3%**	**40.6%**	**3,195.6**	**3.0%**	**3,622.1**	**3.1%**
Natural Rubber	995.2	75.4%	1,043.0	4.8%	75.4%	1,067.0	2.3%	1,114.0	1.3%
Total Rubber	**3,971.2**	**50.1%**	**4,146.7**	**4.4%**	**49.4%**	**4,262.6**	**2.8%**	**4,736.1**	**2.7%**

* % *Synthetic rubber tire usage excluding carboxylated latices: 1992- 58.3%, 1993 - 57.9%*

TELEPHONE CALL SUMMARY

PROJECT NO.: ESD-225

CALL INCOMING X
OUTGOING ___

EC/R STAFF: Phil Norwood

DATE: July 14, 1994

CONVERSATION WITH: Britt Theismann

TITLE: Information and Systems Director

COMPANY: International Institute of Synthetic Rubber Producers (IISRP)

ADDRESS: Houston, TX

TELEPHONE NO.: (713) 783-7253

SUMMARY: Mr. Theisman, in his role as Information and Systems Director, is responsible for all industry growth projections for the IISRP. He called me in response to my call yesterday to Mr. Conrad Jankowski of the IISRP inquiring about demand estimates for 2001.

Mr. Theisman indicated that IISRP projects synthetic rubber demand for 5 years into the future. 1998 estimates are currently available, and 1999 projections will be published in August. He said that these projections include Canada, but there is only one significant synthetic rubber producer in Canada (a Butyl Rubber facility).

I asked Mr. Theisman about a possible approximation that we could use to estimate the 2001 demand. He suggested assuming a 1.5% annual growth rate in demand. I asked whether it might be better to calculate the projected annual percentage growth between 1994 and 1998, then apply this annual percentage until 2001. He said that the Institute clearly feels it would be better to assume a 1.5% annual increase. This is because the industry underwent a large decline several years ago, and has had a large increase in the last couple of years. They believe it will now level out.

I explained that we were trying to predict whether any new synthetic rubber facilities will be built before 2001. He said that he felt strongly that no new facilities would be built, nor would existing capacity be expanded, in the U.S. in the next 10 years. He gave several reasons for this statement, including:

- The demand is well below capacity for most types of synthetic rubber, even with the recent increases in demand
- Synthetic rubber production has become a global market, and there is also unutilized capacity in other areas of the world. Examples included Europe, which is producing 50-55% of capacity, and the Far East and Russia, which are producing 75-80% and 25% of capacity, respectively.
- Exxon and Dow have initiated a joint venture to produce a new type of elastomer. While this new elastomer is not a synthetic rubber, it will compete directly with existing synthetic rubber products.

Mr. Theisman said that he would send me a recent press release with the 1998 demand projections, as well as a list of related publications available from the IISRP.

E C/R Incorporated — Environmental Consulting and Research

MEMORANDUM

Date: May 10, 1995

Subject: Estimated Regulatory Alternative Impacts for Elastomer Production Facilities (Polymers and Resins I)

From: Phil Norwood, EC/R

To: Leslie Evans, EPA/OAQPS/ESD/OCG

The purpose of this memorandum is to present the estimated impacts of the hazardous air pollutant (HAP) control options for existing sources that are associated with the regulatory alternative(s) considered by the Environmental Protection Agency (EPA) for the proposed elastomer production rule. This memorandum is organized in five sections. The first section briefly describes the regulatory alternative for which impacts were developed. The second presents primary environmental impacts, and is followed by sections on secondary environmental impacts (air pollution, water pollution, and solid and hazardous waste impacts), energy impacts, and costs.

As discussed in a separate memorandum,[1] no new sources that would be subject to the proposed rule are expected to be constructed or reconstructed before 2001. Therefore, no impacts were estimated for new sources.

DESCRIPTION OF THE REGULATORY ALTERNATIVE(S)

The proposed regulation for elastomer producers will address HAP emissions from five general emission source types: (1) storage, (2) process "front-end," (3) process "back-end," (4) equipment leaks, and (5) wastewater. The process "front-end" includes prepolymerization, reaction, stripping, and material recovery operations, while the "back-end" includes drying and finishing operations.

The regulatory alternatives considered for subcategories are summarized in Table 1. Unique facility-specific circumstances led to the consideration of an exemption for certain process vents in the single facility subcategories of butyl and halobutyl rubber. Throughout this memorandum, reference will be made to the regulatory alternative, although it is recognized that the EPA considered two separate alternatives. Details of the determination of the maximum achievable control technology "floors," and the establishment of the regulatory alternative, are provided in a separate memorandum.[2] The following briefly summarizes the applicability and control requirements of the regulatory alternative are summarized below.

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TABLE 1. SUMMARY OF EXISTING SOURCE REGULATORY ALTERNATIVES FOR ELASTOMER SUBCATEGORIES

Subcategory	Existing Source Regulatory Alternatives				
	Storage	Front-End Process Vents	Back-End Process Emissions	Wastewater	Equipment Leaks
Butyl and Halobutyl					
Reg Alt I	HON[a]	HON/ACT[b], exempting halogenated vent streams controlled by flare before proposal date	no control	HON[c]	HON[d]
Reg Alt II	HON	HON/ACT	no control	HON	HON
Epichlorohydrin, Hypalon®, Neoprene, Nitrile Butadiene Latex, Nitrile Butadiene Rubber, Polysulfide, Styrene Butadiene Latex					
Reg Alt I	HON	HON/ACT	no control	HON	HON
Ethylene Propylene, Polybutadiene/Styrene Butadiene Rubber by Solution, Styrene Butadiene Rubber by Emulsion					
Reg Alt I	HON	HON/ACT	MACT floor residual HAP limitation	HON	HON

[a] Storage vessel requirements contained in Subpart G of Part 63.

[b] Process vent requirements contained in Subpart G for continuous processes, and 90 percent control level from EPA's Batch Processes Alternative Technique Guideline Document for batch processes.

[c] Wastewater requirements contained in Subpart G of Part 63.

[d] Equipment leak requirements contained in Subpart H of Part 63.

The storage tank, wastewater, and equipment leak provisions all are identical to those in the Hazardous Organic NESHAP (HON). For storage tanks, required control measures range from floating roofs to closed vent systems routed to a control device. The applicability of the storage tank provisions, and the determination of the level of control required, are based on the size of the tank and the vapor pressure of the contents. In general, the storage tank provisions apply only to pure solvent and pure monomer storage vessels at elastomer facilities, since the HAP concentrations (and resulting HAP vapor pressure) in raw, intermediate, and final products are very low.

The applicability of the wastewater provisions is determined by the wastewater flow rate and the HAP concentration at the point of generation (i.e., at the exit of the process unit where the wastewater is generated). A simple description of the wastewater provisions is that the wastewater must be kept in tanks, impoundments, containers, drain systems, and other vessels that do not allow exposure to the atmosphere, until this wastewater is recycled or treated to reduce the HAP concentration.

The equipment leak provisions allow several compliance options for facilities. In general, facilities are required to develop and implement leak detection and repair (LDAR) programs for pumps, valves, agitators, and connectors in HAP service. Compressors, pressure relief devices, sampling connection systems, open-ended valves or lines, and surge control vessels and bottoms receivers in HAP service are subject to equipment standards that require the installation of certain types of emission-reducing, or emission-eliminating, equipment.

While the process vent provisions also closely resemble the HON, there are a few differences. The HON requires the calculation of the Total Resource Effectiveness (TRE) index for each vent stream. A process vent with a TRE index at or below the threshold value of 1.0 must be controlled. The control may be in the form of a 98 percent reduction in emissions using add-on control, or a process change that alters the vent stream characteristics so that the TRE index is above 1.0. The regulatory alternative for front-end process vents from continuous processes are based on the HON TRE.

At the butyl rubber and halobutyl rubber facilities, halogenated vent streams were vented to a flare, resulting in hydrogen chloride emissions. The HON would not allow a halogenated vent stream to be controlled by a flare, meaning that these facilities would need to install incinerators to control the halogenated organic compound, followed by scrubbers to control the hydrogen chloride generated by the combustion of the halogenated organic. The only emission reduction that could be attributed to the HON level of control would be the hydrogen chloride emissions, while the full cost of the incinerators and

scrubbers would be incurred. Therefore, an intermediate regulatory alternative was therefore developed that required the HON level of control for all front-end process vents, except for halogenated vent streams that were already vented to a flare. The HON level of control was maintained as the second regulatory alternative for both subcategories.

For batch processes, the regulatory alternative for front-end process vents is based on EPA's Alternative Control Techniques Document for Batch Processes.[3] Similar to the TRE method, this approach determines whether control is required based on vent stream characteristics.

For three subcategories (ethylene propylene rubber, polybutadiene/styrene butadiene rubber by solution, and styrene butadiene rubber by emulsion) the regulatory alternative for back-end process operations is a residual HAP limit. For polybutadiene/styrene butadiene rubber by solution and ethylene propylene rubber, this limit is in units of kilogram (kg) of HAP per Megagram (Mg) of dry rubber processed in the strippers. The units for styrene butadiene rubber by emulsion are kg HAP per Mg of latex. The regulatory alternative does not require any additional control for facilities in other subcategories.

The impacts analysis for this project is being conducted on a facility-specific basis. Using information provided by the facilities and applicable State regulations, a baseline level of control was established for each facility. This baseline level of control was then compared to the regulatory alternative level, to determine which facilities would be required to install controls to meet the provisions of the regulatory alternative. Table 2 shows the instances where it is predicted that control will be required.

Subpart I of 40 CFR 63 requires that certain components in HAP service at styrene butadiene rubber and latex, polybutadiene rubber, and Hypalon® facilities comply with the Subpart H provisions (negotiated regulation for equipment leaks). For the styrene butadiene rubber by emulsion and Hypalon® subcategories, it was estimated that there are no additional components in HAP service that are not now required to meet the Subpart H level. Therefore, no emission reductions are achieved, or costs or other impacts incurred, at facilities in these two subcategories. This is also true for the covered components at styrene butadiene latex, styrene butadiene rubber by solution, and polybutadiene rubber by solution facilities. However, it was determined that there are components at facilities in these categories not covered. Emission reductions and the costs for these components, and for all other facilities, were calculated as the incremental emission reductions and costs between the existing control program and the Subpart H level. Six facilities reported no equipment leak control program, and they would achieve emission reductions and incur costs from an uncontrolled level.

TABLE 2. PLANT-SPECIFIC IDENTIFICATION OF AREAS REQUIRING CONTROL TO MEET THE REGULATORY ALTERNATIVE

Plant	Location of Predicted Emission Control				
	Storage	Process Front-End	Process Back-End	Equipment Leaks	Wastewater
Butyl Rubber					
BR-1		X[a]		X	X
Epichlorohydrin Rubber					
EPI-1	X			X	
Ethylene-Propylene Rubber					
EPR-1		X	X	X	
EPR-2	X	X		X	
EPR-3				X	
EPR-4				X	
EPR-5				X	
Halobutyl Rubber					
HBR-1	X	X[a]		X	
Hypalon™					
HYP-1					
Neoprene					
NEO-1		X		X	
NEO-2		X		X	
NEO-3				X	
Nitrile Butadiene Latex					
NBL-1				X	X
NBL-2				X	
NBL-3				X	
Nitrile Butadiene Rubber					
NBR-1				X	
NBR-2	X			X	
NBR-3				X	
NBR-4				X	

[a] Front-end process vent control required at the butyl rubber and halobutyl rubber facilities to meet the first regulatory alternative. Additional front-end process vent control is required to meet the second regulatory alternative.

TABLE 2. PLANT-SPECIFIC IDENTIFICATION OF AREAS REQUIRING CONTROL TO MEET THE REGULATORY ALTERNATIVE

Plant	Location of Predicted Emission Control				
	Storage	Process Front-End	Process Back-End	Equipment Leaks	Wastewater
Polysulfide Rubber					
PSR-1					
Polybutadiene/Styrene Butadiene Rubber by Solution					
SBR/PBRS-1				X	
SBR/PBRS-2				X	
SBR/PBRS-3				X	
SBR/PBRS-4			X	X	
SBR/PBRS-5			X	X	
Styrene Butadiene Latex					
SBL-1				X	
SBL-2		X		X	
SBL-3				X	
SBL-4				X	
SBL-5				X	
SBL-6				X	
SBL-7				X	
SBL-8				X	X
SBL-9				X	
SBL-10				X	
SBL-11				X	X
SBL-12				X	
SBL-13				X	
SBL-14				X	
SBL-15				X	
Styrene Butadiene Rubber by Emulsion					
SBRE-1					X
SBRE-2					
SBRE-3			X		
SBRE-4			X		

PRIMARY ENVIRONMENTAL IMPACTS

The primary purpose of the regulatory alternative is to reduce HAP emissions. This section presents the nationwide primary air pollution impacts (i.e., HAP emission reduction) resulting from the application of the regulatory alternative discussed above. The HAP emission reductions were calculated by theoretically applying sufficient controls to each emission source to bring them into compliance with the regulatory alternative. Control technologies and the efficiencies used in the calculation of emission reductions are shown in Table 3. It should be noted that the required control was only incremental for equipment leaks. That is, for process vents, storage tanks, and wastewater, the controls were always applied to previously uncontrolled sources.

Table 4 shows the subcategory-specific HAP baseline emissions, by emission source type, and Table 5 shows the expected HAP emission reductions. As shown in Table 5, the regulatory alternative is expected to reduce HAP emissions by almost 6,400 Mg/yr. This represents a 48 percent reduction from baseline. Baseline HAP emissions from the Epichlorohydrin and Nitrile-Butadiene Latex subcategories are expected to be reduced by 77 and 85 percent, respectively. These percentages represent the maximum reductions anticipated. It was projected that the single facilities in the Hypalon® and Polysulfide Rubber subcategories would not require any additional control to meet the regulatory alternative level.

Around 49 percent of the total HAP emission reduction will be achieved through the equipment leak provisions. The combination of equipment leaks and process vents accounts for 80 percent (almost 6,000 Mg/yr) of the total expected HAP emission reduction. Attachment 1 contains baseline emissions and expected emission reductions for each facility.

SECONDARY ENVIRONMENTAL IMPACTS

While the primary impact of the regulatory alternative is to reduce HAP emissions, the application of control technologies can also have other environmental effects. These impacts can be positive, such as a reduction in non-HAP volatile organic compound air emissions; or negative, such as the generation of additional wastewater or solid waste. In this section the secondary impacts on air pollution, water pollution, and solid and hazardous wastes are discussed.

Air Pollution

For the sources included in this project, the secondary air pollution impacts are the increased criteria pollutant emissions caused by the on-site combustion of organic HAP's and fuels.

TABLE 3. CONTROL TECHNOLOGIES SELECTED TO COMPLY WITH REGULATORY ALTERNATIVES AND ASSOCIATED EMISSION REDUCTIONS

Emission Source Type	Selected Control Technology	Percentage Reduction
Storage Tanks	Internal Floating Roof[a] with liquid-mounted primary seal, controlled fittings, and rim-mounted secondary seal	95[b]
Process Vents	Thermal incinerator[c] Flare Thermal incinerator + scrubber	98[d]
Wastewater	Steam stripper	[e]
Equipment Leaks	Compressors: closed-vent system	90[f]
	Open-ended lines: gate valve	100[f]
	Sample connections: closed purge system	100[f]
	Pressure-relief valves: rupture disk assembly	100[f]
	Pumps, valves, connectors: leak detection and repair programs	[g]

[a] All storage tanks needing control were fixed roof, uncontrolled tanks containing a HAP material that required a floating roof.

[b] HON BID 1B, page 2-57.

[c] VENTCOST, a process vent costing algorithm developed by Radian Corporation, was used to calculate costs. VENTCOST costs out flares, incinerators, and incinerators plus scrubbers, and selects the most cost-effective alternative.

[d] HON BID 1B, page 3-2 for flares, page 3-8 for incinerators, page 3-12 for scrubbers.

[e] Compound-specific fraction removed (F_r) values obtained from Table 9 of promulgated HON. It was assumed that 100 percent of the organic material stripped from the wastewater is returned to the process.

[f] Equipment Leak Protocol Document, page 5-2.

[g] Since most facilities have some type of LDAR program, the emission reductions were incremental from the existing level, rather than from uncontrolled. The percentage reductions were obtained from page 5-8 of the Equipment Leak Protocol Document.

TABLE 4. BASELINE EMISSIONS BY SUBCATEGORY

Subcategory	Baseline HAP Emissions (Mg/yr)					
	Storage	Process Vents		Wastewater	Equipment Leaks	Total
		Front-End	Back-End			
Butyl Rubber	0	367	110	149	322	948
Epichlorohydrin	10	1	16	7	127	161
Ethylene Propylene Rubber	19	220	1,995	20	1,088	3,342
Halobutyl Rubber	65	684	281	0	269	1,299
Hypalon	7	50	29	0	12	98
Neoprene	44	352	204	21	120	741
Nitrile Butadiene Latex	2	4	0	104	49	159
Nitrile Butadiene Rubber	1	38	115	8	425	587
Polybutadiene/Styrene Butadiene Rubber by Solution	4	169	2,403	26	843	3,445
Polysulfide	1	0	0	0	0	1
Styrene Butadiene Latex	9	289	0	691	444	1,433
Styrene Butadiene Rubber by Emulsion	8	20	852	84	83	1,047
PROJECT TOTAL	170	2,194	6,005	1,110	3,782	13,261
Percent of Total	1%	17%	45%	8%	29%	

TABLE 5. EMISSION REDUCTION BY SUBCATEGORY

Subcategory	HAP Emission Reduction (Mg/yr)						Percent Reduction from Baseline
	Storage	Process Vents		Wastewater	Equipment Leaks	Total	
		Front-End	Back-End				
Butyl Rubber - Reg AltI		211		102	293	606	64%
Reg AltII		358		102	293	753	78%
Epichlorohydrin	4				120	124	77%
Ethylene Propylene Rubber	2	85	979		1,020	2,087	62%
Halobutyl Rubber- Reg AltI	62	38			233	333	26%
Reg AltII	62	87			233	382	30%
Hypalon							0%
Neoprene		258			96	354	48%
Nitrile Butadiene Latex				94	41	135	85%
Nitrile Butadiene Rubber	1				364	364	62%
Polybutadiene/Styrene Butadiene Rubber by Solution			882		637	1,519	44%
Polysulfide						0	0%
Styrene Butadiene Latex	0	22		272	323	627	44%
Styrene Butadiene Rubber by Emulsion			195	48		243	23%
PROJECT TOTAL - Reg Alt I	69	615	2,056	516	3,136	6,393	48%
Percent of Total	1%	10%	32%	8%	49%		
PROJECT TOTAL - Reg Alt II	69	811	2,056	516	3,136	6,590	50%

This combustion results in the emission of nitrogenous oxides (NO_x), carbon monoxide (CO), particulate matter (PM), and sulfur dioxide (SO_2).

The emission of these five criteria pollutants will also occur as a result of the combustion of coal, oil, or natural gas used to generate the additional energy needed for control equipment. These off-site air impacts were not included in this analysis, although energy impacts are addressed later in this memorandum.

There is no on-site combustion associated with the selected control technologies for either storage tanks or equipment leaks. Therefore, no secondary air impacts are expected from these technologies.

Table 6 presents the estimated secondary air impacts for process vent and wastewater control technologies. The total criteria air pollutant emissions are estimated to be around 282 Mg/yr, with NO_x emissions from incinerators and boilers accounting for around 258 Mg/yr. The emissions associated with wastewater controls constitute only around 4.5 Mg/yr. Brief discussions of the methodologies used to calculate the emissions shown in Table 6 follow. More detailed information is included in Attachment 2.

Process vents. Secondary air impacts from process vent controls are a result of the combustion of organic HAP's (and supplemental fuel) in flares and incinerators. Testing at a polymer and resin process unit using an incinerator for VOC control measured NO_x ranging from 20.2 to 38.6 ppmv.[4] NO_x emissions were calculated using 21.5 ppmv, which is consistent with the procedures used in the SOCMI CTG.[5] Measured NO_x concentrations in flare outlet streams are were lower than those from incinerators, ranging from 0.4 to 8.2 ppmv.[6] The concentration used in this analysis was 8.2 ppmv. The outlet flow rate from the incinerator or flare was used, in conjunction with these concentrations, to calculate NO_x emissions.

CO, PM, and SO_2 emissions were calculated using emission factors from AP-42[7] for natural gas combustion in boilers with a total heat input design of between 10 and 100 million Btu/hr. The emission factors used are 35 lbs emitted per million ft^3 of natural gas burned for CO, 3 lbs per million ft^3 for PM, and 0.6 lb per million ft^3 for SO_2. The combined volume of supplemental natural gas and organic HAP was multiplied by the emission factors to estimate emissions.

Wastewater. Steam stripping was the control technology that was analyzed for wastewater. Secondary air impacts associated with steam stripper operation can occur from two sources: (1) combustion of fossil fuels for steam generation, and

TABLE 6. SECONDARY AIR IMPACTS

Subcategory		Air Emissions (Mg/yr) Resulting From							
		Process Vent Control				Wastewater Control			
		PM	SO_2	CO	NO_x	PM	SO_2	CO	NO_x
Butyl Rubber -	Reg Alt I	0.01	0.003	0.2	0.2	0.06	0.01	0.10	1.10
	Reg Alt II	0.1	0.029	1.7	2.8	0.06	0.01	0.10	1.10
Ethylene Propylene Rubber -		0.1	0.024	1.4	30.3				
Halobutyl Rubber-	Reg Alt I	0.001	0.00003	0.001	0.01				
	Reg Alt II	0.007	0.001	0.08	0.1				
Neoprene		0.004	0.001	0.04	0.1				
Nitrile Butadiene Rubber						0.03	0.003	0.05	0.56
Polybutadiene/Styrene Butadiene Rubber by Solution		1.0	0.2	12.1	181.7				
Styrene Butadiene Latex		0.001	0.0002	0.01	0.00	0.08	0.01	0.12	1.35
Styrene Butadiene Rubber by Emulsion		0.2	0.049	2.8	42.9	0.05	0.005	0.08	0.89
TOTAL -	Reg Alt I	1.4	0.3	16.4	155.0	0.22	0.02	0.35	3.90
	Reg Alt II	1.6	0.3	18.2	257.9	0.22	0.02	0.35	3.90

(2) handling or combustion of the recovered organic compounds. For the purpose of this evaluation, it was assumed that recovered organics are handled properly.

It was assumed that steam is generated on-site in an industrial boiler burning fuel oil with a thermal efficiency of 80 percent. The fuel oil consumption was calculated using a heating value of 150,000 Btu per gallon of fuel oil. The fuel oil was assumed to be #6 fuel oil, containing 1.5 percent sulfur by weight. The emission factors for this situation are 3.15 lb emitted per 1000 gallons of fuel oil burned for PM, 0.285 lb/1000 gal for SO_2, 5 lb/1000 gal for CO, and 55 lb/1000 gal for NO_x.[8]

Water Pollution

Potential water pollution impacts from several of the control technologies are associated with the regulatory alternative. The wastewater and equipment leak controls actually have positive effects on water quality, although these effects are minimal.

Steam strippers remove organic compounds from wastewater, thereby improving the quality of the wastewater being discharged to the wastewater treatment plant or to a publicly-owned treatment works (POTW) facility. Therefore, their use has a positive impact on water quality.

Reduction of organic HAP emissions from equipment in liquid service may result in reduced loading to wastewater streams. However, the nature of these organic materials is that they evaporate to the air. Overall, the impacts, both positive and negative, on wastewater from the equipment leak provisions would be minor.

The potential for water pollution is also present with storage tank improvements. Before an internal floating roof can be installed or upgraded, the tank must be emptied and cleaned. A small amount of wastewater will be generated during tank cleaning, but it is not expected that this source of water pollution will result in adverse impacts on water quality.

The largest impact on water pollution is associated with process vent controls. Control of organic HAP emissions using combustion does not result in any significant increase in wastewater discharge, since no water effluents are generated by the thermal incinerator or flare. However, the use of an incinerator/scrubber system for control of halogenated organic HAP vent streams results in increased water consumption.

In a scrubber control system, water is used to remove the acid gas contained in the thermal oxidizer outlet stream. The amount of wastewater generated is equal to the amount of water needed by the scrubber to absorb the acid gas leaving the

incinerator. It is estimated that almost 46 million gallons of wastewater will be generated annually from acid scrubbers at Butyl rubber, Ethylene-Propylene Rubber, and Neoprene facilities. Almost 41 million of this total are from the butyl rubber facility. A key assumption used in this analysis is that 17 gallons of scrubber water flow is required for each 1,000 scfm of vapor entering the scrubber. This ratio was used in the HON analysis.[9] Details of this estimate are provided in Attachment 3.

It is not expected that the increased wastewater flow will affect plant wastewater treatment or sewer capacity. However, the absorbed acid gas may cause the water leaving the scrubber to have a low pH. This acidic effluent could lower the pH of the total plant effluent if it is released into the plant wastewater system. Some process units may recover the acidic scrubber effluent for reuse or resale.

The water effluent guidelines for individual States may require that industrial sources maintain the pH of water effluent within specified limits. To meet these guidelines, the water used as a scrubbing agent may need to be neutralized prior to discharge to the plant wastewater system. The scrubber effluent can be neutralized by adding caustic (NaOH) to the scrubbing water. The amount of caustic needed depends on the amount of acid gas in the waste gas from the combustion device.

The salt formed in the neutralization step must be purged from the system and properly eliminated. The methods of disposal include direct wastewater discharge or salt recovery. Salt recovery is only justified for large vent streams containing a high percentage of halogens. In developing the cost impacts presented later in this memorandum, the cost of caustic needed for neutralization was not included. Further, the costs associated with the disposal of the salt were not judged to be significant in comparison to the control costs, and, therefore, were not included in the projected impacts.

The use of scrubbers to remove hydrochloric acid from the incinerator exhaust gas also has the potential to result in small increases in the quantities of organic compounds released into plant wastewater. However, only small amounts of organic compounds are released into the scrubber wastewater, and the flow of wastewater from the scrubber is small in comparison to total plant wastewater, especially in installations where there are multiple chemical processing units using a central wastewater treatment process unit. Therefore, the increase in the release of organic compounds in plant wastewater is not likely to be significant.

Solid and Hazardous Waste

In general, there are few solid or hazardous waste impacts associated with the implementation of the regulatory alternative for the subcategories included in this project. There are no significant solid or hazardous wastes generated as a result of storage tank control by tank improvements, or as a result of process vent control using a thermal incinerator, flare, or scrubber.

Solid waste from equipment replacement includes seals, packing, rupture disks, and other used equipment components, such as pumps and valves. Metal solid wastes such as mechanical seals, rupture disks, and valve parts could be sold to companies that can recycle the metal. Although additional monitoring of equipment may result in a greater rate of replacement for faulty equipment, it may also reduce equipment failure. Overall, no significant impact is expected on solid waste as a result of implementing the equipment leak provisions.

Solid and hazardous waste could be generated from the use of steam strippers to control wastewater emissions. The possible sources include organic compounds recovered in the steam stripper overheads condenser, solids removed during feed pretreatment, and wastes generated in the control of system vent emissions. System vent emissions, if not sent to a combustion control device, may be collected on a sorbent medium that requires either disposal or regeneration. If the sorbent is disposed of, it creates additional solid waste.

Although waste generation can increase for any nonrecyclable organics that cannot be used as supplemental fuel, these organic wastes would most likely have been removed otherwise from the wastewater via the air (volatile organics only) or via an oil/water separator. Similarly, solids removed from the wastewater in cases where pretreatment is necessary would have likely been removed in a clarifier or activated sludge unit.

ENERGY IMPACTS

The energy demands associated with the control technologies for the regulatory alternative include the need for additional electricity, natural gas, and fuel oil. The storage tank and equipment leak controls are not expected to require any additional energy. The total nationwide energy demands that would result from implementing the process vent and wastewater controls are presented in Table 7. Overall, the controls will require around 1.18×10^{12} Btu annually. More detailed information is provided in Attachment 4.

The amount of electricity required to operate the fans and blowers was estimated by calculating the horsepower required to

TABLE 7. ENERGY IMPACTS

Subcategory	Energy Impacts (10^6 Btu/yr) From		
	Process Vent Control		Wastewater Control
	Electricity	Natural Gas	Fuel Oil
Butyl Rubber - Reg Alt I	96	6,300	6,575
Reg Alt II	595	97,792	6,575
Ethylene Propylene Rubber	7,261	75,052	
Halobutyl Rubber- Reg Alt I	0	535	
Reg Alt II	72	758	
Neoprene	42	196	
Nitrile Butadiene Rubber			3,375
Polybutadiene/Styrene Butadiene Rubber by Solution	43,070	753,688	
Styrene Butadiene Latex	0	418	8,088
Styrene Butadiene Rubber by Emulsion	10,195	176,329	5,363
TOTAL - Reg Alt I	60,664	1,012,518	23,401
Reg Alt II	61,235	1,104,234	23,401

transport the vent stream. Electricity to operate fans and pumps for scrubbers and steam strippers was calculated in a similar manner.

The use of a combustion device generally results in an increased natural gas usage for device start-up, supporting combustion of the vent stream, or to promote flame stability, if the heat content of the vent stream is low. The fuel impacts are equal to the design fuel requirement. The fuel requirements are dependent on the flow rate and the heat content of the HAP stream.

Wastewater steam strippers require additional energy to produce the steam. As discussed in the secondary air pollution impacts from wastewater control section, it was assumed that this energy was generated through the combustion of fuel oil in a boiler. The fuel usages are based on the steam stripper design, and the boiler characteristics that were discussed previously.

COST IMPACTS

The costs to the affected industry due to the application of the requirements of the regulatory alternative include the costs of any control equipment that must be purchased, along with the costs of the installation of that control equipment. There are also costs for the operation of control equipment. There may also be costs associated with certain work practices and other programs that reduce HAP emissions. Finally, there are costs associated with the required reporting, recordkeeping, and monitoring. In the next section, the methodology used to estimate the cost impacts is discussed, followed by a presentation of the estimated costs.

Cost Estimation Methodologies

The costs can be separated into two basic types: (1) those directly associated with control equipment or practices, and (2) those associated with monitoring, reporting, and recordkeeping.

Control costs

The methodologies used to estimate the capital and annual control costs for the expected regulatory alternative are the same as the methodologies used to estimate the costs of the HON. These methodologies are described in detail in Volume 1B of the HON Background Information Document.[10] Parameters used in the costing analysis are shown in Table 8.

The regulatory alternative includes flexibility in the manner in which compliance may be achieved. In order to estimate capital and annual costs, a single option was designated for each

TABLE 8. PARAMETERS USED IN POLYMERS AND RESINS I COST ANALYSIS

Parameter	Value
Base Year	July 1989
Chemical Engineering Plant Cost Index	356
Natural Gas Cost	$3.03/ft^3
Electricity Cost	$0.0509/kwh
Water Cost	$0.22/ 1000 liters
Operating Labor Rate	$13.20/hr
Maintenance Labor Rate	$14.50/hr
Interest Rate	7 percent[a]
Raw Chemical Cost Used for Recovery Credits	$9.98/Mg[b]
Equipment Life	
Steam stripper	15 years
Flare, incinerator, scrubber	10 years[c]
Internal floating roof	10 years
Closed-vent systems	10 years
Gate valves for open-ended lines	10 years
Closed-purge systems	10 years
Monitoring instrument	6 years
Rupture disks	2 years
Pump seals	2 years

[a] In the HON cost analysis, an interest rate of 10 percent was used.

[b] An average raw chemical cost of HAP's used in the elastomer industry was calculated using 1989 chemical costs obtained from Mannsfield's Chemical Products Synopsis.

[c] The HON BID assumed a 15 year equipment life for flares, and 10 years for incinerators and scrubbers. However, VENTCOST uses a single capital recovery factor for all equipment.

emission source type. Table 9 provides more detail on how the costs were developed.

For equipment leaks and storage tanks, EC/R developed spreadsheets that calculated costs using the HON methodologies. VENTCOST, a costing algorithm developed by Radian Corporation and used in the HON impacts assessment, was used to estimate thermal incinerator, flare, and scrubber costs for process vents. Similarly, a spreadsheet developed by Radian was used to estimate the cost of steam strippers for wastewater streams. Electronic copies of these programs may be found in Section II-I of the docket (Docket item numbers II-I-3 and 4).

Monitoring, reporting, and recordkeeping costs

In addition to the control costs, the facilities will incur monitoring, reporting, and recordkeeping (MRR) costs. At the time of the initial impacts assessment, the exact details of the MRR requirements of the proposed rule were not known, although it was expected that they would resemble those in the HON. Therefore, estimates of the MRR costs for the regulatory alternative were made based on the HON MRR costs.

The HON SF-83 analysis[11] was used to obtain average facility MRR costs. For facilities in subcategories already subject to the HON equipment leak requirements, adjustments were made to the average facility MRR costs, since these requirements would be present in the absence of an elastomer standard. A nationwide total MRR cost was then calculated by multiplying the number of plants by the appropriate average facility MRR costs. The ratio of the annual MRR cost to the total annual control cost was calculated, which was 0.31. This analysis is documented in a separate EC/R memorandum,[12] which is included as Attachment 5.

To estimate the MRR costs on a facility-specific basis, the nationwide MRR cost to control cost ratio discussed above was multiplied by the estimated facility-specific control costs. For instance, if the annual costs associated with installation and operation of an incinerator were $100,000, the estimated annual MRR costs would be $31,000, making the total estimated annual costs $131,000. On a facility-specific basis, this type of analysis probably overstates the MRR costs for those facilities where control is required, and understates the MRR costs for facilities where no additional control is required (where there would be no estimated MRR costs). However, this analysis does provide a reasonable nationwide estimate for the entire Polymers and Resins I project.

As noted above, it was necessary to estimate the MRR costs before the details of the MRR requirements of the proposed regulation were known. The impacts shown in this memorandum are based on these earlier estimates. However, the results of the SF-83 analysis for the proposed elastomer regulation[13]

TABLE 9. DESCRIPTION OF CONTROL OPTIONS FOR WHICH COSTS WERE DEVELOPED

Emission Source Type	Selected Method of Compliance for Costing	Comments
Storage	Internal floating roof	This was the only type of storage tank control that was predicted to be necessary at the subject facilities. No information was available on the number of existing floating roof tanks with substandard seals, fittings, etc. Therefore, no costs were estimated on the upgrade of existing floating roof tanks.
Process Front-End	Flare, incinerator, or incinerator + scrubber	Subject vents determined by TRE. Choice of most cost-effective control device determined by VENTCOST.
Process Back-End	Flare, incinerator, or incinerator + scrubber	Subject vents determined by TRE. Choice of most cost-effective control device determined by VENTCOST. For subcategories with back-end emission factor limitations, a selected number of vents were selected that would reduce emissions sufficiently to achieve the emission factor level. Vents were selected based on the total HAP emissions and the TRE index value.
Equipment Leaks		
LDAR		For facilities with no previous LDAR program, the cost of purchasing a monitoring instrument, and for an initial monitoring event for all components, was estimated. Costs of an initial monitoring episode were estimated on a component-specific basis for facilities with partial LDAR programs. For instance, if a facility indicated that they currently have a LDAR program for pumps and valves but not for connectors, costs were estimated for an initial monitoring event for connectors only.
Pumps	monthly monitoring	
Valves	monthly monitoring	
Connectors	annual monitoring	

TABLE 9. DESCRIPTION OF CONTROL OPTIONS FOR WHICH COSTS WERE DEVELOPED

Emission Source Type	Selected Method of Compliance for Costing	Comments
Equipment Leaks (continued)		
Equipment standards		
Compressors	closed vent system	For compressors, costs are based on connecting the closed vent system to an existing enclosed combustion device or vapor recovery header and do not reflect the cost of adding a control device specifically to control the degassing vents.
Open-ended lines	install gate valve	
Sample connections	closed purge system	
Pressure-relief valves	rupture disk assembly	
Wastewater	steam stripper	Subject streams determined based on flow and concentration at the point of waste generation. Costs developed for a steam stripper for each wastewater stream. The costs do not reflect the cost of adding a control or recovery device specifically to control air emissions from the steam stripper. In addition, no recovery credit is claimed.

($4.1 million for all subcategories) are relatively consistent with the preliminary estimates used in this analysis ($4.4 million).

Estimated Costs of Compliance

The estimated total capital investments and total annual costs are presented by subcategory in Table 10. More detailed cost information is provided in Attachment 6.

TABLE 10. ESTIMATED TOTAL CAPITAL INVESTMENT AND TOTAL ANNUAL COSTS BY SUBCATEGORY

Subcategory	Total Capital Investment ($1000)	Annual Cost ($1000)					Annual Emission Reduction (Mg/yr)	Overall Cost Effectiveness ($/Mg)
		Direct	Indirect	MRR[a]	Rec Cred[b]	Total		
Butyl - RA I[c]	691	867	140	312	3	1,316	606	2,200
RA II[d]	1,049	1,412	264	519	3	2,192	753	2,900 (6,000)[e]
Epichlorohydrin	491	21	164	57	1	241	124	1,900
Ethylene Propylene	5,957	951	1,906	886	10	3,732	2,087	1,800[f]
Halobutyl - RA I[c]	328	123	125	77	2	322	335	1,000
RA II[d]	500	681	173	265	2	1,117	384	2,900 (16,200)[e]
Hypalon	0	0	0	0	0	0	0	NA
Neoprene	560	462	223	213	1	897	354	2,500
Nitrile Butadiene Latex	465	84	102	58	<1	243	135	1,800
Nitrile Butadiene Rubber	397	180	161	106	4	444	365	1,200
Polysulfide	0	0	0	0	0	0	0	NA
Polybutadiene/Styrene Butadiene Rubber by Solution	11,780	3,434	2,933	1,974	6	8,335	1,519	5,500[f]
Styrene Butadiene Latex	1,480	309	478	244	3	1,028	627	1,600
Styrene Butadiene Rubber by Emulsion	3,942	830	782	500	0	2,112	243	8,700[f]
TOTAL - RA I[c]	26,092	7,262	7,015	4,426	31	18,672	6,392	2,900
RA II[d]	26,621	8,365	7,187	4,821	31	20,343	6,588	3,100 (8,500)[e]

Footnotes for Table 10

[a] Monitoring, Reporting, and Recordkeeping Costs

[b] Recovery Credits

[c] Regulatory Alternative I

[d] Regulatory Alternative II

[e] Incremental cost effectiveness in going from Regulatory Alternative I to Regulatory Alternative II

[f] These cost-effectiveness values are primarily due to the high costs estimated to control back-end process emissions. The costs developed are costs for incineration devices to sufficient back-end vents so that emissions will be reduced to a level equivalent to the level achieved by meeting the residual HAP limit by stripping. Extrapolation of industry estimates of the cost of enhanced stripping place the cost of enhanced stripping as low as 10 percent of the cost of incineration.

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4. Lee, K.W. et al., Radian Corporation. Polymers and Resins, Volatile Organic Compound Emissions from Incineration, Emissions Test Report, ARCO Chemical Company, LaPorte Plant, Deer Park, Texas. Volume I: Summary of Results. Prepared for the United States Environmental Protection Agency, Research Triangle Park, North Carolina. EMB Report No. 81-PMR-1. March 1982. pp. 12 through 15.

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9. Memorandum from Ferrero, B., Radian Corporation, to Project File 6.1. Estimating Liquid to Vapor Flowrate Ratios in Scrubber Columns. February 5, 1992.

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11. HON SF-83 and Supporting Statement

12. Memorandum, from Norwood, P., EC/R Incorporated to Evans, L. U.S. Environmental Protection Agency. Estimated Monitoring, Reporting, and Recordkeeping Costs for Polymers and Resins I. August 9, 1994.

13. SF-83 and Supporting Statement.

ATTACHMENT 1

FACILITY-SPECIFIC BASELINE EMISSIONS AND EMISSION REDUCTIONS

FACILITY–SPECIFIC BASELINE EMISSIONS

Subcategory/ Facility ID	Baseline HAP Emissions (Mg/yr)					
	Storage	Process Vents Front–End	Process Vents Back–End	Waste–water	Equipment Leaks	Total
Butyl Rubber						
BR–1	0.0	367.4	109.5	148.5	321.9	947.3
Epichlorohydrin						
EPI–1	10.1	0.7	16.5	6.7	127.2	161.2
Ethylene–Propylene Rubber						
EPR–1	3.4	18.3	1,127.7	0.1	38.4	1,187.9
EPR–2	2.5	90.2	348.6	0.0	156.6	598.0
EPR–3	0.0	5.1	36.8	3.6	202.6	248.1
EPR–4	4.7	80.6	413.6	15.8	447.9	962.6
EPR–5	7.9	25.7	68.4	0.1	242.2	344.2
Subcategory Totals	18.5	219.9	1,995.1	19.6	1,087.7	3,340.8
Halobutyl Rubber						
HBR–1	64.8	683.5	280.5	0.0	268.5	1,297.3
Hypalon						
HYP–1	6.9	49.8	28.6	0.0	12.1	97.4
Neoprene						
NEO–1	21.7	222.0	34.5	5.5	71.2	354.9
NEO–2	20.9	108.3	150.0	11.6	13.8	304.6
NEO–3	0.9	21.3	18.9	4.0	35.2	80.4
Subcategory Totals	43.5	351.6	203.5	21.1	120.2	739.9

FACILITY–SPECIFIC BASELINE EMISSIONS

Subcategory/ Facility ID	Baseline HAP Emissions (Mg/yr)					
	Storage	Process Vents Front–End	Process Vents Back–End	Waste–water	Equipment Leaks	Total
Nitrile Butadiene Latex						
NBL–1	1.5	2.6	na	98.0	22.0	124.1
NBL–2	0.0	0.0	na	0.0	19.5	19.5
NBL–3	0.2	0.9	na	5.9	7.7	14.7
Subcategory Totals	1.7	3.5		103.9	49.2	158.3
Nitrile Butadiene Rubber						
NBR–1	0.0	0.7	9.1	2.2	52.9	64.9
NBR–2	0.9	28.8	94.7	2.1	161.6	288.0
NBR–3	0.5	2.8	10.5	2.1	45.8	61.7
NBR–4	0.0	5.5	0.4	1.1	164.9	171.9
Subcategory Totals	1.4	37.8	114.6	7.5	425.2	586.5
Polybutadiene/Styrene Butadiene Rubber by Solution						
PBR/SBRS–1	0.8	3.3	390.4	3.8	165.1	563.4
PBR/SBRS–2	0.1	0.0	0.0	0.1	76.4	76.6
PBR/SBRS–3	0.0	0.0	205.5	16.9	237.4	459.8
PBR/SBRS–4	1.5	159.6	771.6	2.0	174.8	1,109.5
PBR/SBRS–5	1.8	6.0	1,035.7	2.8	189.5	1,235.9
Subcategory Totals	4.3	168.9	2,403.2	25.6	843.2	3,445.2
Polysulfide Rubber						
PSR–1	0.7	0.0		0.0		0.7

FACILITY–SPECIFIC BASELINE EMISSIONS

Subcategory/ Facility ID	Baseline HAP Emissions (Mg/yr)					
	Storage	Process Vents Front–End	Process Vents Back–End	Waste–water	Equipment Leaks	Total
Styrene Butadiene Latex						
SBL–1	1.2	2.5	na	0.8	27.4	31.9
SBL–2	0.6	22.9	na	0.1	11.6	35.2
SBL–3	0.5	8.4	na	0.0	69.9	78.9
SBL–4	0.2	0.8	na	0.0	26.5	27.5
SBL–5	0.9	1.8	na	2.1	5.1	9.9
SBL–6	0.3	5.1	na	62.9	12.6	80.9
SBL–7	0.5	3.6	na	0.0	11.4	15.4
SBL–8	0.3	6.1	na	242.8	18.9	268.1
SBL–9	0.6	2.2	na	12.5	74.2	89.6
SBL–10	1.0	0.8	na	6.3	36.0	44.0
SBL–11	0.5	0.8	na	250.2	65.1	316.5
SBL–12	0.4	1.1	na	4.5	5.9	11.9
SBL–13	0.8	0.6	na	23.7	45.7	70.9
SBL–14	0.0	20.0	na	13.6	23.0	56.6
SBL–15	0.9	212.0	na	71.1	10.5	294.5
Subcategory Totals	8.6	288.7		690.6	443.8	1,431.7
Styrene Butadiene Rubber by Emulsion						
SBRE–1	2.2	6.3	251.5	49.5	39.0	348.5
SBRE–2	0.0	7.3	72.7	10.0	10.8	100.8
SBRE–3	0.2	3.5	148.1	21.1	8.0	180.9
SBRE–4	5.2	2.5	379.3	3.8	25.4	416.2
Subcategory Totals	7.6	19.5	851.6	84.4	83.2	1,046.3

FACILITY–SPECIFIC EMISSION REDUCTIONS

Subcategory/ Facility ID	HAP Emissions Reduction (Mg/yr)						Percentage Reduction from Baseline
	Storage	Process Vents Front–End	Process Vents Back–End	Waste–water	Equipment Leaks	Total	
Butyl Rubber							
BR–1 – Alt I		211.4		101.6	293.3	606.3	64%
BR–1 – Alt II		358.3		101.6	293.3	753.2	80%
Epichlorohydrin							
EPI–1	4.1				119.6	123.7	77%
Ethylene–Propylene Rubber							
EPR–1		9.8	979.3		28.4	1017.5	86%
EPR–2	2.2	75.0			132.3	209.5	35%
EPR–3					239.3	239.3	96%
EPR–4					402.7	402.7	42%
EPR–5	0.2				217.7	217.9	63%
Subcategory Totals	2.4	84.8	979.3	0.0	1,020.4	2,086.9	62%
Halobutyl Rubber							
HBR–1 – Alt I	62.3	38.4			232.8	333.5	26%
HBR–1 – Alt II	62.3	87.4			232.8	382.5	29%
Hypalon							
HYP–1						0.0	0%
Neoprene							
NEO–1		190.1			62.8	252.9	71%
NEO–2		67.7			1.0	68.7	23%
NEO–3					31.9	31.9	40%
Subcategory Totals	0.0	257.8	0.0	0.0	95.7	353.5	48%

FACILITY–SPECIFIC EMISSION REDUCTIONS

Subcategory/ Facility ID	HAP Emissions Reduction (Mg/yr)						
	Storage	Process Vents Front–End	Process Vents Back–End	Waste–water	Equipment Leaks	Total	Percentage Reduction from Baseline
Nitrile Butadiene Latex							
NBL–1				94.1	16.2	110.3	89%
NBL–2					17.2	17.2	88%
NBL–3					7.1	7.1	48%
Subcategory Totals	0.0	0.0		94.1	40.5	134.6	85%
Nitrile Butadiene Rubber							
NBR–1					26.2	26.2	40%
NBR–2	1.1				150.1	151.2	52%
NBR–3					38.1	38.1	62%
NBR–4					149.7	149.7	87%
Subcategory Totals	1.1	0.0	0.0	0.0	364.1	365.2	62%
Polybutadiene/Styrene Butadiene Rubber by Solution							
PBR/SBRS–1					132.9	132.9	24%
PBR/SBRS–2					21.9	21.9	29%
PBR/SBRS–3					199.5	199.5	43%
PBR/SBRS–4			380.4		135.7	516.1	47%
PBR/SBRS–5			501.2		147.1	648.3	52%
Subcategory Totals	0.0	0.0	881.6	0.0	637.1	1,518.7	44%
Polysulfide Rubber							
PSR–1						0.0	0%

FACILITY–SPECIFIC EMISSION REDUCTIONS

Subcategory/ Facility ID	HAP Emissions Reduction (Mg/yr) Storage	Process Vents Front–End	Process Vents Back–End	Waste–water	Equipment Leaks	Total	Percentage Reduction from Baseline
Styrene Butadiene Latex							
SBL–1					9.1	9.1	28%
SBL–2		22.3			6.7	29.0	82%
SBL–3					59.9	59.9	76%
SBL–4					16.7	16.7	61%
SBL–5					2.0	2.0	20%
SBL–6					7.3	7.3	9%
SBL–7					6.0	6.0	39%
SBL–8				240.4	13.8	254.2	95%
SBL–9					63.9	63.9	71%
SBL–10					31.0	31.0	70%
SBL–11				31.6	49.2	80.8	26%
SBL–12					5.0	5.0	42%
SBL–13					39.4	39.4	56%
SBL–14					13.3	13.3	23%
SBL–15					8.9	8.9	3%
Subcategory Totals	0.0	22.3		272.0	332.2	626.5	44%
Styrene Butadiene Rubber by Emulsion							
SBRE–1				48.1		48.1	14%
SBRE–2						0.0	0%
SBRE–3			85.2			85.2	47%
SBRE–4			109.8			109.8	26%
Subcategory Totals	0.0	0.0	195.0	48.1	0.0	243.1	23%

ATTACHMENT 2

CALCULATION OF SECONDARY AIR POLLUTION IMPACTS

CALCULATION OF SECONDARY AIR POLLUTION FROM PROCESS VENT CONTROL DEVICES

Plant	HAP MW lb/lbmole	HAP rate lbs/hr	hrs/yr	HAP Flow 10^6 ft3/yr	nat. gas. flow scfm	nat. gas. flow 10^6 ft3/yr	total fuel flow 10^6 ft3/yr	outlet flow rate (scfm)	Emissions (Mg/yr) PM	SO2	NOx	CO
BR-1*	50.5	33.2	8760.0	2.3	173.3	91.1	93.3	4133	0.1	0.0	2.5	1.5
BR-1*	50.5	61.5	2600.0	1.2	2.7	0.4	1.7	251	0.0	0.0	0.0	0.0
BR-1	50.5	238.0	2000.0	3.7	52.5	6.3	10.0	1595	0.0	0.0	0.2	0.2
EPDM-1	86.0	20.5	1075.0	0.1	1.2	0.1	0.2	17	0.0	0.0	0.0	0.0
EPDM-1	86.0	155.3	4260.0	3.0	55.8	14.3	17.3	23906	0.0	0.0	7.0	0.3
EPDM-1	86.0	207.1	4260.0	4.0	59.7	15.3	19.3	30642	0.0	0.0	9.0	0.3
EPDM-1	86.0	155.3	4260.0	3.0	173.7	44.4	47.4	48654	0.1	0.0	14.3	0.8
EPDM-2	66.2	37.3	8760.0	1.9	2.0	1.0	3.0	114	0.0	0.0	0.1	0.0
HBR-1	86.0	11.4	7563.0	0.4	1.2	0.5	0.9	6	0.0	0.0	0.0	0.0
HBR-1*	60.6	476.2	1260.0	3.9	2.9	0.2	4.1	1617	0.0	0.0	0.1	0.1
NEO-1	88.5	79.5	4500.0	1.6	0.5	0.1	1.7	284	0.0	0.0	0.1	0.0
NEO-1	88.5	105.9	665.0	0.3	0.4	0.0	0.3	220	0.0	0.0	0.0	0.0
NEO-2	88.5	28.9	2974.0	0.4	0.1	0.0	0.4	62	0.0	0.0	0.0	0.0
NEO-2	88.5	64.4	1032.0	0.3	0.3	0.0	0.3	157	0.0	0.0	0.0	0.0
SBL-2	54.0	8.5	5900.0	0.4	1.2	0.4	0.8	4	0.0	0.0	0.0	0.0
SBRE-4	104.0	19.3	7446.0	0.5	57.8	25.8	26.4	13092	0.0	0.0	6.7	0.4
SBRE-4	104.0	13.9	7446.0	0.4	52.7	23.5	23.9	11639	0.0	0.0	6.0	0.4
SBRE-3	103.2	12.8	7008.0	0.3	161.4	67.8	68.2	33103	0.1	0.0	16.0	1.1
SBRE-3	103.2	14.6	7008.0	0.4	140.6	59.1	59.5	29546	0.1	0.0	14.2	0.9
SBR/PBRS-4	86.2	67.2	8760.0	2.7	478.2	251.3	254.0	100478	0.3	0.1	60.6	4.0
SBR/PBRS-4	86.1	30.6	8760.0	1.2	1.2	0.6	1.8	13	0.0	0.0	0.0	0.0
SBR/PBRS-5	86.0	67.2	8760.0	2.7	477.3	250.9	253.6	100477	0.3	0.1	60.6	4.0
SBR/PBRS-5	86.0	61.6	8760.0	2.5	477.3	250.9	253.3	100477	0.3	0.1	60.6	4.0
									1.6	0.3	257.9	18.2

* These streams would not require control under Regulatory Alternative I.

Calculation Methodology Description

Secondary air pollution from process vent control devices

- HAP MW is weighted-average molecular weight of all HAPs in vent stream. For example,
  a vent stream for facility EPDM-2 contains 302,178 lbs/yr of chloroprene (MW=65) and 25,000 lbs/yr of hexane (MW=86).

  302,178 ÷ 65 = 4,649 lb-moles chloroprene/yr
  25,000 ÷ 86 = 291 lb-moles hexane/yr

  Stream HAP MW = 327,178 total lbs/yr ÷ 4,940 total lb-moles
  = 66.2 lb/lb-mole

- HAP emission rate (lbs/hr) and operating schedule (hrs/yr) obtained from information provided by companies

- HAP flow is calculated from the HAP emissions rate assuming ideal gas behavior. For example,
  a vent stream for facility BR-1 emits methyl chloride at a rate of 33.2 lbs/hr for 8760 hrs/yr. The volumetric flow rate of HAP is

$$\frac{33.2\ \text{lb}}{\text{hr}} \times \frac{8{,}760\ \text{hrs}}{\text{yr}} \times \frac{\text{lb-mole}}{50.5\ \text{lb}} \times \frac{392\ \text{ft}^3}{\text{lb-mole}} = 2.3 \times 10^6\ \text{ft}^3/\text{yr}$$

- The natural gas flow rate and outlet flow rate were calculated by VENTCOST.

- NO_x emissions from incinerators and flares were calculated assuming 21.5 ppmv and 8.2 ppmv, respectively, which is consistent with the methodology used in the SOCMI CTG. For example,
  the outlet flow rate from the incinerator controlling a stream at facility EPDM-1 is 23,906 scfm. The incinerator operates 8760 hrs/yr. NO_x emissions were calculated as follows:

$$\frac{23{,}906\ \text{ft}^3}{\text{min}} \times \frac{60\ \text{min}}{\text{hr}} \times \frac{8{,}760\ \text{hrs}}{\text{yr}} \times \frac{21.5\ \text{ft}^3\ NO_x}{1 \times 10^6\ \text{ft}^3} \times$$

$$\frac{1\ \text{lb-mole}}{392\ \text{ft}^3} \times \frac{46\ \text{lbs}\ NO_x}{1\ \text{lb-mole}} \times \frac{\text{Mg}}{2{,}200\ \text{lbs}} = 14.3\ \text{Mg}\ NO_x\ \text{emissions/yr}$$

Calculation Methodology Description

Secondary air pollution from process vent control devices (continued)

- The emission factors used to calculate SO_2, PM, and CO emissions are from AP-42 (page 1-4.2), which are emission factors for natural gas combustion in boilers. The factors used were for a furnace with a total heat input of between 10 and 100 million Btu/hr. These emission factors are

  SO_2 - 0.6 lbs emitted per million ft^3 of natural gas burned
  PM - 1-5 (3 used) lbs per million ft^3
  CO - 35 lbs per million ft^3

- The combined volume of supplemental natural gas and organic HAP was multiplied by the emission factors to estimate emissions. For example,
  a vent stream at the SBRE-4 facility had a natural gas flow rate of 59.1×10^6 ft^3/yr, and a HAP flow rate of 0.4×10^6 ft^3/yr. The annual CO emissions from the combustion of this stream in a thermal incinerator are as follows:

$$\frac{59.5 \times 10^6 \text{ ft}^3}{\text{yr}} \times \frac{35 \text{ lbs } NO_x}{10^6 \text{ ft}^3} \times \frac{\text{Mg}}{2{,}200 \text{ lbs}} = 0.9 \text{ Mg CO emissions/yr}$$

CALCULATION OF SECONDARY AIR POLLUTION FROM WASTEWATER CONTROL

Plant	Subcategory	Steam Requirements (10^9 Btu/yr)	Fuel Oil Required* (gal/yr)	Emissions (Mg/yr) PM	SO2	CO	NOx
SBL-8	SBL	4.68	39,000	0.06	0.01	0.09	0.98
SBL-11	SBL	1.79	14,917	0.02	0.00	0.03	0.37
SBRE-1	SBRE	4.29	35,750	0.05	0.00	0.08	0.89
NBL-1	NBL	2.7	22,500	0.03	0.00	0.05	0.56
BR-1	Butyl Rubber	5.26	43,833	0.06	0.01	0.10	1.10
				0.22	0.02	0.35	3.90

* Assuming 150,000 Btu/gallon, and a boiler efficiency of 80 percent

Calculation Methodology Description

Secondary air pollution from wastewater control devices (steam strippers)

- Steam requirements calculated by Radian steam stripper costing spreadsheet.

- Fuel oil required was calculated using the following:
  - a heating value of 150,000 Btu per gallon of fuel oil
  - it is a #6 fuel oil containing 1.5 percent sulfur by weight
  - the boiler has a thermal efficiency of 80 percent

  For example, the fuel oil required to produce steam for a stream at facility SBL-8 was calculated as follows:

$$\frac{4.68 \times 10^9 \text{ Btu}}{\text{yr}} \times \frac{\text{gal fuel oil}}{150{,}000 \text{ Btu}} \times \frac{1}{0.8} = 39{,}000 \text{ gal fuel oil/yr}$$

- The emission factors used are from AP-42 (page 1-3.2), which are emission factors for fuel oil combustion in industrial boilers. These emission factors are

  PM - 3.15 lb emitted per 1000 gallons of fuel oil burned
  SO_2 - 0.285 lb/1000 gal
  CO - 5 lb/1000 gal
  NO_x - 55 lb/1000 gal

- The fuel oil required was multiplied by the emission factors to estimate emissions. For example,
  the vent stream at the SBL-8 facility required 39,000 gal/yr of fuel oil. The annual NO_x emissions from the combustion of this stream in a boiler to produce energy for steam is:

$$\frac{39 \times 1{,}000 \text{ gal}}{\text{yr}} \times \frac{55 \text{ lbs } NO_x}{1{,}000 \text{ gal}} \times \frac{\text{Mg}}{2{,}200 \text{ lbs}} = 0.98 \text{ Mg } NO_x \text{ emissions/yr}$$

ATTACHMENT 3

CALCULATION OF WATER POLLUTION IMPACTS

WASTEWATER GENERATED BY SCRUBBERS

Plant	Flow Rate to Scrubber (scfm)	hrs/yr	Water Flow Rate (1000 gal/yr)
BR-1 *	4,133	8,760	36,929
BR-1 *	251	2,600	666
BR-1	1,595	2,000	3,254
EPDM-1	0	1,075	0
EPDM-1	0	4,260	0
EPDM-1	0	4,260	0
EPDM-1	0	4,260	0
EPDM-2	114	8,760	1,019
HBR-1	0	7,563	0
HBR-1 *	1,617	1,260	2,078
NEO-1	284	4,500	1,304
NEO-1	220	665	149
NEO-2	62	2,974	188
NEO-2	157	1,032	165
SBL-2	0	5,900	0
SBRE-4	0	7,446	0
SBRE-4	0	7,446	0
SBRE-3	0	7,008	0
SBRE-3	0	7,008	0
SBR/PBRS-4	0	8,760	0
SBR/PBRS-4	0	8,760	0
SBR/PBRS-5	0	8,760	0
SBR/PBRS-5	0	8,760	0
			45,752

* These streams would not require control under Regulatory Alternative I.

Calculation Methodology Description

Wastewater generated by scrubbers controlling vent streams

- Flow rate to scrubber calculated by VENTCOST.
- Water flow rate calculated using the ratio of 17 gallons of scrubber water flow per 1,000 scfm of vapor at the scrubber inlet. This ratio represents an average liquid to vapor ratio based on a vendor survey conducted by Radian in the development of the HON.[1] An example of this calculation is as follows:

  An incinerator at facility NEO-2 has an outlet flow rate of 157 scfm that is sent to a scrubber to remove HCl. The water flow to the wastewater system is calculated as follows:

$$\frac{0.157 \times 1000\ ft^3}{min} \times \frac{17\ gal}{1000\ ft^3} \times \frac{60\ min}{hr} \times \frac{1{,}032\ hrs}{yr} = 165 \times 10^3\ gal/yr$$

[1] Memorandum from Ferrero, B., Radian Corporation, to Project File 6.1. Estimating Liquid to Vapor Flowrate Ratios in Scrubber Columns. February 5, 1992.

ATTACHMENT 4

CALCULATION OF ENERGY IMPACTS

CALCULATION OF ENERGY IMPACTS FROM PROCESS VENT CONTROL

Plant ID	Annual Electricity Cost	Electricity 10^6 Btu/yr	Natural Gas Use 1000 ft3/yr	Natural Gas 10^6 Btu/yr
BR-1*	$7,203	483	91,068	91,068
BR-1*	$222	15	424	424
BR-1	$1,438	96	6,300	6,300
EPDM-1	$0	0	76	76
EPDM-1	$24,835	1,666	14,270	14,270
EPDM-1	$32,177	2,159	15,252	15,252
EPDM-1	$51,068	3,426	44,408	44,408
EPDM-2	$147	10	1,046	1,046
HBR-1	$0	0	535	535
HBR-1*	$1,078	72	223	223
NEO-1	$346	23	142	142
NEO-1	$130	9	16	16
NEO-2	$52	3	20	20
NEO-2	$99	7	18	18
SBL-2	$0	0	418	418
SBRE-4	$23,918	1,605	25,813	25,813
SBRE-4	$21,401	1,436	23,547	23,547
SBRE-3	$56,319	3,779	67,846	67,846
SBRE-3	$50,310	3,375	59,123	59,123
SBR/PBRS-4	$213,791	14,344	251,330	251,330
SBR/PBRS-4	$0	0	620	620
SBR/PBRS-5	$214,080	14,363	250,869	250,869
SBR/PBRS-5	$214,080	14,363	250,869	250,869
		61,235		1,104,234

* These streams would not require control under Regulatory Alternative I.

Calculation Methodology Description

Energy impacts of process vent control

- Annual electricity costs calculated by VENTCOST.
- Factors used to calculate the electrical energy are:

  Cost of electricity - $0.0509 per Kw-h
  Energy conversation factor - 3,415 Btu/Kw-h

  For example, a stream at facility SBR/PBRS-4, it was estimated that the annual electricity cost would be $213,791.

$$\frac{\$213,791}{yr} \times \frac{Kw\text{-}h}{\$0.0509} \times \frac{3,415\ Btu}{Kw\text{-}h} = 14,363 \times 10^6\ Btu/yr$$

- The natural gas use was calculated by VENTCOST.
- The energy expended through the use of natural gas was calculated assuming a heating value of 1,000 Btu/ft^3. For example, a stream at EPDM-2 requires 1,046,000 ft^3 natural gas per year.

$$\frac{1,046,000\ ft^3}{yr} \times \frac{1,000\ Btu}{ft^3} = 1,046 \times 10^6\ Btu/yr$$

CALCULATION OF ENERGY IMPACTS FROM WASTEWATER CONTROL

		Electricity Requirements		Fuel Oil Requirements	
Plant	Subcategory	Kwh/yr	10^6 Btu/yr	gal/yr	10^6 Btu/yr
SBL-8	SBL	21,257	72.6	39,000	5,850
SBL-11	SBL	8,130	27.8	14,917	2,238
SBRE-1	SBRE	19,479	66.5	35,750	5,363
NBL-1	NBL	12,272	41.9	22,500	3,375
BR-1	Butyl Rubber	23,862	81.5	43,833	6,575
			290.25		23,400

Calculation Methodology Description

Energy impacts of wastewater control (steam strippers)

- Annual electricity costs calculated by Radian steam stripper costing spreadsheet.

- The factor used to calculate the electrical energy are:

  Energy conversation factor - 3,415 Btu/Kw-h

  For example, for the combined stream at facility SBRE-1, it was estimated that the annual electricity demand would be 19,479 Kw-h.

$$\frac{19{,}479 \text{ Kw-h}}{\text{yr}} \times \frac{3{,}415 \text{ Btu}}{\text{Kw-h}} = 66.5 \times 10^6 \text{ Btu/yr}$$

- The methodology for calculating the amount of fuel oil required is discussed in Attachment 2.

- The amount of fuel oil was multiplied by 150,000 Btu/gal to obtain the energy from fuel oil used. For example, the combined stream at facility BR-1 uses 43,833 gallons of fuel oil per year to produce steam.

$$\frac{43{,}833 \text{ gal}}{\text{yr}} \times \frac{150{,}000 \text{ Btu}}{\text{gal}} = 6{,}575 \times 10^6 \text{ Btu/yr}$$

ATTACHMENT 5

EC/R MEMORANDUM PROVIDING THE BASIS FOR PRELIMINARY MONITORING, REPORTING, AND RECORDKEEPING COST ESTIMATES

E C/R Incorporated — Environmental Consulting and Research

MEMORANDUM

Date: August 9, 1994

Subject: Preliminary Monitoring, Recordkeeping, and Reporting Costs for Polymers and Resins I

From: Phil Norwood, EC/R

To: Leslie Evans, EPA/OAQPS/ESD/CPB

This memorandum presents estimated monitoring, recordkeeping, and reporting (MRR) costs for the Polymers and Resins I project. These estimates are based on the MRR cost estimates for the Hazardous Organic NESHAP (HON), and are intended to be a preliminary estimate. A more detailed analysis, specific to the requirements of the selected regulatory alternative for Polymers and Resins I, will be necessary at a later date.

This estimation was made using the methodology from the HON SF-83 analysis. Copies of the HON SF-83 and supporting statement are included as Attachment 1. In the HON analysis, the average technical hours per monitoring, reporting, and recordkeeping activity were estimated for a representative facility. These numbers were multiplied by the number of activities per year to obtain an estimated number of technical hours per year for the representative facility (source). The estimated technical hours needed per source are shown in Table 1.

Warren Johnson of EPA, the author of the HON SF-83 and supporting statement, indicated that the HON estimates include costs for monitoring equipment. He said that monitoring equipment costs were converted to technical labor hours, and that these were included in the "gather information, monitor, and inspect" activity. However, the SF-83 supporting information does not provide details on this conversion.

For the Polymers and Resins I MRR cost estimate, EC/R used the technical hours per source estimates shown in Table 1, and the other information shown in Table 2. Since it is expected that many of the control requirements (as well as monitoring, recordkeeping, and reporting requirements) for the Polymers and Resins I regulation will be identical to those in the HON, this should provide a reasonable preliminary estimate for this project. However, a future analysis should take into account the actual monitoring, reporting, and recordkeeping requirements of the Polymers and Resins I regulation. Also, the assumptions for the HON representative plant should be examined and modified to reflect a representative Polymers and Resins I facility.

University Tower, Suite 404 • 3101 Petty Road, Box 37 • Durham, North Carolina 27707
Telephone: (919) 493-6099 • Fax: (919) 493-6393

TABLE 1. TECHNICAL HOURS NEEDED TO COMPLY WITH MONITORING, REPORTING, AND RECORDKEEPING REQUIREMENTS

Activity	Tech hrs/yr per source Overall[a]	Eq Leaks
Read rule and instructions	167	18
Plan activities	276	12
Training	111	10
Create, Test, Research and Development	2499	1220
Gather Info., Monitor/Inspect[b]	1250	750
Process/Compile and Review	20	4
Complete Reports	151	125
Record/Disclose	35	21
Store/File	27	1

[b] Overall includes equipment leaks.
[b] This estimate incorporates costs of monitoring equipment.

TABLE 2. OTHER INFORMATION USED TO CALCULATE MONITORING, REPORTING, AND RECORDKEEPING COSTS

Other Labor	
Managerial Hours	5% of technical labor hours
Clerical Hours	10% of technical laborhours
Labor Rates	
Technical	$33 per hour
Managerial	$49 per hour
Clerical	$15 per hour

For each subcategory, the overall technical labor hours per event per source (shown in Table 1) were multiplied by the number of facilities, to obtain the total estimated technical labor hours per year for the subcategory. The managerial and clerical hours were then calculated using the percentages in Table 2. Each type of labor hour was then multiplied by the appropriate labor rate in Table 2 to obtain the annual cost for each event. The sum of the individual event annual costs represent the total MRR costs for the subcategory.

Several subcategories (Hypalon™, Styrene-Butadiene Latex, Styrene-Butadiene Rubber by Emulsion, and Polybutadiene Rubber/Styrene-Butadiene Rubber by Solution) are already subject to the HON equipment leaks provisions. For these subcategories, the total technical labor hours needed per event per facility were calculated by subtracting the equipment leak technical labor hours from the overall. For instance, the technical hours per year per source for training would be 111 - 10 = 101.

Table 3 shows the total estimated costs for monitoring, reporting, and recordkeeping for Polymers and Resins I. The total MRR cost for the project is around $5.3 million per year, which is approximately 31 percent of the total control costs.

TABLE 3. ESTIMATED MONITORING, REPORTING, AND RECORDKEEPING COSTS

Subcategory	MRR[a] Costs 1000$/yr
Butyl Rubber	$168
Halobutyl Rubber	$168
Epichlorohydrin Elastomers	$168
Ethylene–Propylene Rubber	$838
Hypalon	$88
Neoprene	$503
Nitrile–Butadiene Latex	$503
Nitrile–Butadiene Rubber by Emulsion	$670
Styrene–Butadiene Latex	$1,404
Styrene–Butadiene Rubber by Emulsion	$351
Poly–/Styrene–Butadiene Rubber by Soln	$439
TOTAL P&R I MRR COSTS ($/yr)	$5,299
Total Control Costs ($/yr)	$16,982
%MRR to total	31%

[a] Monitoring, recordkeeping, and reporting

ATTACHMENT 1

HON SF-83 AND SUPPORTING STATEMENT

Form 83
(December 1983)

Request for OMB Review

4-70-19
IV-B-?

ant
d instructions before completing form. Do not use the same SF 83 uest both an Executive Order 12291 review and approval under erwork Reduction Act.
er all questions in Part I. If this request is for review under E.O. complete Part II and sign the regulatory certification. If this it is for approval under the Paperwork Reduction Act and 5 CFR skip Part II, complete Part III and sign the paperwork certification.

Send three copies of this form, the material to be reviewed, and for paperwork—three copies of the supporting statement, to:

Office of Information and Regulatory Affairs
Office of Management and Budget
Attention: Docket Library, Room 3201
Washington, DC 20503

I.—Complete This Part for All Requests.

rtment/agency and Bureau/office originating request
ted States Environmental Protection Agency
ice of Air and Radiation

2. Agency code
2 0 6 0

of person who can best answer questions regarding this request
et S. Meyer, MD-13; Warren R. Johnson, MD-13

Telephone number
(919) 541-5254/512

of information collection or rulemaking
ordkeeping and Reporting for the Hazardous Organic NESHAP (HON) for the Synthetic Organic mical Manufacturing Industry (SOCMI) and Other Processes Subject to the Negotiated gulation for Equipment Leaks

authority for information collection or rule (*cite United States Code, Public Law, or Executive Order*)
42 USC 7412 or 7414

cted public (*check all that apply*)
☐ Individuals or households
☐ State or local governments
3 ☐ Farms
4 ☒ Businesses or other for-profit
5 ☐ Federal agencies or employees
6 ☐ Non-profit institutions
7 ☒ Small businesses or organizations

II.—Complete This Part Only If the Request Is for OMB Review Under Executive Order 12291

ation Identifier Number (RIN)
___ ___ ___ ___ ___ ___ ___ ___. or. None assigned ☐

of submission (*check one in each category*)

ification
☐ Major
☐ Nonmajor

Stage of development
1 ☐ Proposed or draft
2 ☐ Final or interim final, with prior proposal
3 ☐ Final or interim final, without prior proposal

Type of review requested
1 ☐ Standard
2 ☐ Pending
3 ☐ Emergency
4 ☐ Statutory or judicial deadline

section affected
_____ CFR _____

s this regulation contain reporting or recordkeeping requirements that require OMB approval under the Paperwork Reduction Act 5 CFR 1320? . . . . . ☐ Yes ☐ N

major rule, is there a regulatory impact analysis attached? . . . . . 1 ☐ Yes 2 ☐ N
No," did OMB waive the analysis? . . . . . 3 ☐ Yes 4 ☐ N

fication for Regulatory Submissions
mitting this request for OMB review, the authorized regulatory contact and the program official certify that the requirements of E.O. 12291 and any applicable irectives have been complied with.

ure of program official | Date

ure of authorized regulatory contact | Date

MB use only)

III.—Complete This Part Only If the Request is for Approval of a Collection of Information Under the Paperwork Reduction Act and 5 CFR 1320.

stract—Describe needs, uses and affected public in 50 words or less

romulgated standard will require control of emissions of 110 hazardous air pollutants from roduction of about 400 synthetic organic chemicals. Affected chemical plants would maintain ds and submit initial and sometimes semiannual or quarterly reports of emission measurements elated information.

pe of information collection (*check only one*)

ormation collections not contained in rules

☐ Regular submission

2 ☐ Emergency submission (*certification attached*)

ormation collections contained in rules

☐ Existing regulation (*no change proposed*)

☐ Notice of proposed rulemaking (NPRM)

☒ Final, NPRM was previously published

6 Final or interim final without prior NPRM

A ☐ Regular submission

B ☐ Emergency submission (*certification attached*)

7. Enter date of expected or actual Federal Register publication at this stage of rulemakir (*month, day, year*): Feb. 28, 1994

pe of review requested (*check only one*)

☒ New collection

☐ Revision of a currently approved collection

☐ Extension of the expiration date of a currently approved collection without any change in the substance or in the method of collection

4 ☐ Reinstatement of a previously approved collection for which approval has expired

5 ☐ Existing collection in use without an OMB control number

ency report form number(s) (*include standard/optional form number(s)*)

1414.02

nual reporting or disclosure burden

umber of respondents	389
umber of responses per respondent	4
otal annual responses (*line 1 times line 2*)	1,556
ours per response	1341.18
otal hours (*line 3 times line 4*)	2,086,870

nual recordkeeping burden

umber of recordkeepers	389
nnual hours per recordkeeper	105
otal recordkeeping hours (*line 1 times line 2*)	40,840
ecordkeeping retention period	5 years

al annual burden

equested (*line 17·5 plus line 18·3*)	2,127,710
n current OMB inventory	-0-
ifference (*line 1 less line 2*)	2,127,710

planation of difference

rogram change	2,127,710
djustment	-0-

rrent (*most recent*) OMB control number or comment number

quested expiration date

ears from promulgation (or approval if later)

22. Purpose of information collection (*check as many as apply*)

1 ☐ Application for benefits

2 ☐ Program evaluation

3 ☐ General purpose statistics

4 ☒ Regulatory or compliance

5 ☐ Program planning or management

6 ☐ Research

7 ☐ Audit

23. Frequency of recordkeeping or reporting (*check all that apply*)

1 ☒ Recordkeeping

Reporting

2 ☐ On occasion

3 ☐ Weekly

4 ☐ Monthly

5 ☒ Quarterly

6 ☒ Semi-annually

7 ☐ Annually

8 ☐ Biennially

9 ☒ Other (*describe*): Initial

24. Respondents' obligation to comply (*check the strongest obligation that app*

1 ☐ Voluntary

2 ☐ Required to obtain or retain a benefit

3 ☒ Mandatory

e the respondents primarily educational agencies or institutions or is the primary purpose of the collection related to Federal education programs? ☐ Yes ☒ N

oes the agency use sampling to select respondents or does the agency recommend or prescribe the use of sampling or statistical analysis respondents? ☐ Yes ☒ N

egulatory authority for the information collection

40 CFR 63 ; or _____ FR _____ ; or, Other (*specify*): _____

work Certification

mitting this request for OMB approval, the agency head, the senior official or an authorized representative, certifies that the requirements of 5 CFR 1320 y Act, statistical standards or directives, and any other applicable information policy directives have been complied with.

ture of program official

Date

ector, Office of Air Quality Planning and Standards

PART A OF THE SUPPORTING STATEMENT

1. Identification of the Information Collection

(a) Title and Number of the Information Collection.

"Reporting and Recordkeeping Requirements for the Hazardous Organic NESHAP (HON) for the Synthetic Organic Chemical Manufacturing Industry (SOCMI) and Other Processes Subject to the Negotiated Regulation for Equipment Leaks."

(b) Short Characterization.

Respondents are owners or operators of processes in SOCMI industires, styrene-butadiene rubber production, polybutadiene production, chloride production, pesticide production, chlorinated hydrocarbon use in production of chemicals, pharmaceutical production, and miscellaneous butadiene use. It is estimated that about 370 existing plants will be subject to the standards. All sources must be in compliance with the requirements of the standard for equipment leaks within 18 months of the effective date of that rule. In addition, new sources must be in compliance with the standard for process vents, storage, transfer, and wastewater emissions (Subpart G) at startup. Existing sources are not required to comply with Subpart G until three years after the effective date of the rule.

Generally, respondents are required by law to submit onetime reports of start of construction, anticipated and actual start-up dates, and physical or operational changes to existing facilities. In addition, Subpart G requires respondents to submit five types of reports: (1) Initial Notification, (2) Implementation Plan, (3) Notification of Compliance Status, (4) Periodic Reports, and (5) several event triggered reports. The Initial Notification report identifies sources subject to the rule and the provisions which apply to these sources. In the Implementation Plan, an owner or operator details how the source will comply with the provisions of Subpart G. The Notification of Compliance Status is submitted to provide the information necessary to demonstrate that compliance has been achieved. The Periodic Reports provide the parameter monitoring data for the control devices, results of any performance tests conducted during the period, and information on instances where inspections revealed problems. Subparts H and I require the source to submit an initial report detailing the equipment and process units subject to, and schedule for implementing each phase of, the standard. Owners and operators also have to submit semiannual reports of the monitoring results from the leak detection and repair program in the equipment leak standard, and quarterly reports for all points included in an emissions average. All records are to be maintained by the source for a period of at least 5 years.

All reports are submitted to the respondent's State agency, if it has an approved Title V permit program implementation authority, or the appropriate Environmental Protection Agency (EPA) Regional Office. The reports required by Subparts G, H and I are used to determine that sources subject to the rule are in compliance with the rule.

2. Need for and use of the Collection.

(a) Need/Authority for the collection.

Section 112 of the Clean Air Act, as amended in 1990, requires that EPA establish standards to limit emissions of hazardous air pollutants (HAP) from stationary sources. The sources subject to the proposed rule can potentially emit 149 of the 189 HAP's listed in Section 112. Section 114 of the Act gives the EPA authority to collect data and information necessary to enforce standards established under Section 112.

Certain records and reports are necessary to enable the Administrator to (1) identify sources subject to the standards and (2) ensure that the standards, which are based on "MACT", maximum achievable control technology, are being achieved.

(b) Use/Users of the Data.

The information will be used by Agency enforcement personnel to: (1) identify sources subject to the standards; (2) identify the control methodology being applied; and (3) ensure that the emission control devices are being properly operated and maintained on a continuous basis.

In addition, records and reports are necessary to enable EPA to identify plants that may not be in compliance with the standards. Based on reported information, EPA can decide which plants should be inspected and what records or processes should be inspected at the plants. The records that plants maintain would indicate to EPA whether plant personnel are operating and maintaining control equipment properly.

3. The Respondents and the Information Requested.

(a) Respondents/SIC Codes.

Respondents are owners or operators of HAP-emitting chemical production processes that are used to produce any of the approximately 400 listed SOCMI chemicals. Most of the processes are classified in the four-digit Standard Industrial Classification (SIC) Codes 2869 for Industrial Organic Chemicals and 2865 for Cyclic Organic Crudes and Intermediates. However, not all processes classified in these two SIC codes would be regulated by this proposal.

(b) Information Requested.

(i) Data items. Attachment 1, Source Data and Information Requirements, summarizes the recordkeeping and reporting requirements.

(ii) Respondent Activities. The respondent activities required by the standards are shown in the first column of Tables 1a and 1b, which are introduced in Section 6(a).

4. The Information Collected--Agency Activities, Collection Methodology, and Information Management.

(a) Agency Activities.

A list of Agency activities is provided in Table 2, introduced in Section 6(c).

(b) Collection Methodology and Management.

Information contained in the one-time-only reports will be entered into the Aerometric Information Retrieval System (AIRS) Facility Subsystem (AFS) maintained and operated by EPA's Office of Air Quality Planning and Standards (OAQPS). Data obtained during periodic visits by Agency personnel from records maintained by the respondents will be tabulated and published for internal EPA use in compliance and enforcement programs.

(c) Small Entity Flexibility.

Minimizing the information collection burden for all sizes of organizations is a continuing effort on EPA's part. The EPA has reduced the recordkeeping and reporting requirements to include only the information needed by EPA to determine compliance with the standards.

The burden to respondents has been minimized by requiring the collection and reporting of information which is clearly essential to ensure that sources comply with the standards.

(d) Collection Schedule.

Collection of data will begin after promulgation of the rule, scheduled for February 1994.

The schedule for the submission of the five types of reports required by Subpart G, (1) Initial Notification, (2) Implementation Plan, (3) Notification of Compliance Status, (4) Periodic Reports, and (5) other reports, is detailed below.

The Initial Notification is due 120 days after the date of promulgation for existing sources. For new sources, it is due 180 days before commencement of construction or reconstruction, or 90 days after promulgation of Subpart G, whichever is later.

Existing sources must submit the Implementation Plan at different times for emission points included in averages and emission points not included in averages. The Implementation Plan for emission points included in the average would be due 18 months prior to the date of compliance. The Implementation Plan for emission points not included in an emissions average would be due 12 months prior to the date of compliance. For new sources, Implementation Plans would be submitted with the Notification of Compliance Status. An Implementation Plan would be required only for sources that have not yet submitted an operating permit application.

The Notification of Compliance Status would be submitted 150 days after the source's compliance date for both new and existing sources.

Generally, periodic Reports would be submitted semiannually. However, there are two exceptions. Quarterly reports must be submitted for all points included in an emissions average. In addition, if monitoring results show that the parameter values for an emission point are outside the established range for more than 1 percent of the operating time in a reporting period, or the monitoring system is out of service for more than 5 percent of the time, the regulatory authority may request that the owner or operator submit quarterly reports for that emission point. After 1 year, semiannual reporting can be resumed, unless the regulatory authority requests continuation of quarterly reports.

Other reports would be submitted as required by the provisions for each kind of emission point. The due date for these kinds of reports is tied to the event that precipitated the report itself. Examples of these special reports include requests for extensions of repair, notification of scheduled inspections for storage vessel and wastewater management units, process changes, and startup, shutdown, and malfunctions.

Subparts H and I, the equipment leak standards, would require the submittal of an initial report and semiannual reports of leak detection and repair experiences and any changes to the processes, monitoring frequency and/or initiation of a quality improvement program. The schedule for submission of these reports is detailed below.

For existing sources, the owner or operator would be required to submit the initial report within 90 days after the applicability date of the standard. The standard establishes a staggered implementation scheme with 5 groups of applicability dates. The standard would apply to the first group of processes 6 months after promulgation. Thereafter, the standard would apply to another group every 3 months until all processes are implementing the program. For new sources, the initial report shall be submitted with the application for construction, as under Subpart G.

Every 6 months after the initial report, a report must be submitted that summarizes the monitoring results from the leak detection and repair program and provides a notification of initiation of monthly monitoring or implementation of a quality improvement program, if applicable.

5. Nonduplication, Consultations, and Other Collection Criteria.

(a) Nonduplication.

A search of EPA's existing standards and ongoing ICR's revealed no duplication of information-gathering efforts. However, certain reports required by State or local agencies may duplicate information required by the standards. In such cases, a copy of the report submitted to the State or local agency can be provided to the Administrator in lieu of the report required by the standards.

(b) Consultations.

Consultations with numerous representatives of the chemical industry, environmental organizations, and state/local air pollution control agencies were conducted throughout the rule development. Table 3 provides a list of some of the persons consulted. The standard was also discussed at meetings of the National Air Pollution Control Techniques Advisory Committee (NAPCTAC) held in January and November of 1991. A 90-day public comment period was provided after proposal, during which all affected parties were given the opportunity to comment on the proposed rule. In addition, a 30-day public comment period was provided after supplemental notice on the proposed General Provisions impacts on the HON, and certain Emissions Averaging policy considerations. All received comments were considered and some reflected in the development of the final rule.

(c) Effects of Less Frequent Collection.

If the relevant information were collected less frequently, the EPA would not be reasonably assured that a source is in compliance with the standards. In addition, EPA's authority to take administrative action would be significantly reduced; Section 113(d) of the CAA limits the assessment of administrative penalties to violations which occur no more than 12 months before initiation of the administrative proceeding. Since administrative proceedings are less costly and require use of fewer resources than judicial proceedings, both EPA and the regulated community benefit from preservation of EPA's administrative powers.

(d) General Guidelines.

Except for some equipment leaks provisions (Subparts H and I) which only require 2-year retention, this rule requires that facility owners or operators retain records for a period of 5 years, which exceeds the 3-year retention period contained in the guidelines in 5 CFR 1320.6. The 5-year records retention period is consistent with the provisions of the soon-to-be final General Provisions of 40 CFR Part 63, and with the 5-year records retention requirement in the operating permit program under Title V of the Clean Air Act.

(e) Confidentiality and Sensitive Questions.

(i) Confidentiality. Information obtained by EPA is safeguarded according to the Agency policies set forth in Title 40, Chapter 1, Part 2, Subpart B, Confidentiality of Business Information. See 40 CFR 2; 41 FR 36902, September 1, 1976; amended by 43 FR 3999, September 8, 1978; 43 FR 42251, September 28, 1978; 44 FR 17674, March 23, 1979. Even where the Agency has determined that information received from a "person" in response to an Information Collection Request (ICR) is eligible for confidential treatment under 40 CFR Part 2, Subpart B, the Agency may nonetheless disclose the information if it is "relevant in any proceeding" under the statute [42 U.S.C. Section 7414 (C); 40 CFR 2.301 (g)]. The information collection complies with the Privacy Act of 1974 and Office of Management and Budget (OMB) Circular 108.

(ii) Sensitive Questions. Information to be reported consists of emission data and other information that are not of a sensitive nature. No sensitive personal or proprietary data are being collected.

6. Estimating Burden and Cost of the Collection.

(a) Estimating Respondent Burden.

The existing source annual burden estimates for reporting and recordkeeping are presented in Table 1a. The new source annual burden estimates for reporting and recordkeeping are presented in Table 1b. These estimates are shown separately since the technical hours for new sources must include compliance at startup and periodic records burdens in addition to pre-compliance requirements. Generally, with the exceptions of new sources and some equipment leaks provisions, periodic reports and recordkeeping requirements begin after the compliance date, which is three years from promulgation.

In addition to Tables 1a and 1b, an extract of the equipment leaks standards (Subparts H and I) contribution to the overall existing source annual burden estimates for reporting and recordkeeping is presented in Table 4. This is to highlight the burden which can be directly attributed to the equipment leaks standards (Subparts H and I) during the first three years after promulgation. The equipment leaks standards were developed through regulatory negotiation.

Information collection requirements include one-time-only reports and periodic reports. The burden estimates for the one-time only reports are treated/considered as average annual burdens by dividing the cumulative three year total technical hour estimate by three before including it in column (c), "technical hours per year per source."

The estimates of total technical-hours per year per source and the number of activities per respondent per year listed in each table are based upon experience with similar information collection requirements in SOCMI NSPS and the number of emission points in each source.

(b) Estimating Respondent Costs.

The information collection activities for the first three years for sources subject to the standards are presented in Tables 1a and 1b. To stay consistent with the control cost estimates, labor rates and associated costs are based on the 1989 Comprehensive Assessment and Information Rule (CAIR) economic analysis, and estimated hourly rates are as follows: Technical at $33, management at $49, and clerical at $15. The total burden costs may be converted to 1992 CAIR rates by multiply the technical hours by $49.0/hour (this includes assumed managerial and clerical cost considerations). However, any conversions to 1992 CAIR rates should not be used to compare with control costs, which are estimated in 1989 dollars.

It is important to note that an average was taken of costs covering a period of three years for reporting and recordkeeping to a typical source. Therefore, total recurrent annual burden hours would be as indicated in Table 1a for existing sources and Table 1b for new sources.

(c) Estimating Agency Burden and Cost.

Because the information collection requirements were developed as an incidental part of standards development, no costs can be attributed to the development of the information collection requirements.

Because reporting and recordkeeping requirements on the part of the respondents are required under Section 112 of the Clean Air Act, no operational costs will be incurred by the Federal Government. Publication and distribution of the information are part of the AFS operated and maintained by OAQPS, with the result that no Federal costs can be directly attributed to the ICR.

Examination of records to be maintained by the respondents will occur incidentally as part of the periodic inspection of sources that is part of EPA's overall compliance and enforcement program and, therefore, is not attributable to the ICR. The only costs that the Federal Government will incur are user costs associated with the analysis of the reported information, as presented in Table 2. Labor rates and associated costs are based on the CAIR economic analysis, and estimated hourly rates are as follows: technical at $33, management at $49, and clerical at $15.

(d) Bottom Line Burden Hours and Costs/Master Tables.

(i) The simple collection. The bottom line respondent burden hours and costs, presented in Tables 1a and 1b, are calculated by adding person-hours per year down each column for technical, managerial, and clerical staff, and by adding down the cost column. The estimated total nationwide burden in the first 3 years of the rule is an estimated 2,127,710 hours per year (1,850,180 technical, 92,510 managerial and 185,020 clerical hours) at a cost of 68,364.37 thousand dollars per year.

(ii) The Agency Tally. The bottom line Agency burden hours and costs, presented in Table 2, are calculated as in the respondent table, by adding person-hours per year down each column for technical, managerial, and clerical staff, and by adding down the cost column. In this case, the total cost is the sum of the total salary cost and the total travel expenses for tests attended. The estimated total hours and costs in the first 3 years of the rule are 23,188 hours per year (20,162 technical, 1,009 managerial, and 2,017 clerical hours) at a cost of 760.37 thousand dollars per year.

(iii) The complex collection. This section does not apply since this is a simple collection.

(e) Reasons for Change in Burden.

This section does not apply because this is a new collection.

Table 1a. Existing Source Annual Respondent Burden and Cost of Reporting and Recordkeeping Requirements of the HON Provisions

Burden Item	Average Hours per Activity (a)	Number of Activities per year per source (b)	Technical Hours per year per source (c)	Est'd. Number Existing Sources (d)	Estimated Technical Hours per year (e)	Estimated Managerial Hours per year (f)	Estimated Clerical Hours per year (g)	Annual Cost in $Thousands per year (h)
1) Read Rule and Instructions	3.6	47	167	371	61,957	3,098	6,196	2,289.32
2) Plan Activities	5.9	47	276	371	102,396	5,120	10,240	3,783.55
3) Training	5.8	19	111	371	41,181	2,059	4,118	1,521.63
4) Create, Test, Research & Development	17.9	140	2,499	371	927,129	46,356	92,713	34,257.40
5) Gather Info., Monitor/Inspect	2.5	500	1,250	371	463,750	23,188	46,375	17,135.59
6) Process/Compile & Review	20.0	1	20	371	7,420	371	742	274.17
7) Complete Rep'ts	75.5	2	151	371	56,021	2,801	5,602	2,069.97
8) Record/Disclose	17.5	2	35	371	12,985	649	1,299	479.79
9) Store/File	6.8	4	27	371	10,017	501	1,002	370.14
TOTAL BURDEN AND COST					1,682,856	84,143	168,287	62,181.56

See attachment 2 for assumptions and further description of activities.

Table 1b. New Source Annual Respondent Burden and Cost of Reporting and Recordkeeping Requirements of the HON Provisions

Burden Item	Average Hours per Activity (a)	Number of Activities per year per source (b)	Technical Hours per year per source (c)	Est'd. Number of New Sources (d)	Estimated Technical Hours per year (e)	Estimated Managerial Hours per year (f)	Estimated Clerical Hours per year (g)	Annual Cost in $Thousands per year (h)
1) Read Rule and Instructions	2.7	94	250	18	4,500	225	450	166.28
2) Plan Activities	3.8	94	355	18	6,390	320	639	236.14
3) Training	3.5	38	132	18	2,376	119	238	87.81
4) Create, Test, Research & Development	2.4	1,780	4,266	18	76,788	3,839	7,679	2,837.30
5) Gather Info., Monitor/Inspect	1.4	2,047	2,943	18	52,974	2,649	5,297	1,957.40
6) Process/Compile & Review	0.8	48	40	18	720	36	72	26.60
7) Complete Rep'ts	11.4	49	557	18	10,026	501	1,003	370.45
8) Record/Disclose	10.0	49	489	18	8,802	440	880	325.23
9) Store/File	5.2	51	264	18	4,752	238	475	175.60
TOTAL BURDEN AND COST					167,328	8,367	16,733	6,182.81

See attachment 2 for assumptions and further description of activities.

Table 2. Annual Burden and Cost for the Federal Government

Burden Item	Average Hours per Activity (a)	Number of Activities per year (b)	Estimated Technical Hours per year (c)	Estimated Managerial Hours per year (d)	Estimated Clerical Hours per year (e)	Annual Cost in $Thousands per year (f)
PERFORMANCE TESTS:						
1) Initial	40	14	560	28	56	20.69
2) Repeat	40	3	120	6	12	4.43
LITIGATION:	2,080	3	6,240	312	624	230.57
REPORTS REVIEW:						
1) Initial	2	124	248	12	25	9.15
2) Implementation Plan or Permit	20	124	2,480	124	248	91.64
3) Compl. status	40	124	4,960	248	496	183.27
4) Review equip. leak monitoring	7	742	5,194	260	519	191.93
5) Notification of const./recon.	6	6	36	2	4	1.35
6) Notification of anticipated startup	6	6	36	2	4	1.35
7) Notification of actual startup	6	6	36	2	4	1.35
8) Notif. of performance test	6	6	36	2	4	1.35
9) Review of test results	24	6	144	7	14	5.31
10) Review periodic reports	4	18	72	4	7	2.68
TOTAL BURDEN AND COST (Salary)			20,162	1,009	2,017	745.07
TRAVEL EXPENSES						15.30
TOTAL ANNUAL COST						760.37

See attachment 3 for assumptions and further description of activities.

Table 3. Persons Consulted on the Reporting and Recordkeeping Requirements in the Rule Development

David Driessen	Natural Resources Defense Council	(202) 783-7800
Larry Goodheart	Chevron Corp.	(510) 242-4145
David Gustafson	DOW Chemical USA	(517) 636-2953
Joe Hovious	Union Carbide	(203) 794-5183
Ali Khan	Indiana Air Pollution Control	(219) 391-8297
Karen Olsen	Texas Air Pollution Control Board	(512) 451-5711
Gus Von Bodungen	Louisiana Department of Environmental Quality	(504) 394-5374

Table 4. Existing Source Annual Respondent Burden and Cost of Reporting and Recordkeeping Requirements of the HON Equipment Leaks Provisions (Subparts H and I) Alone

Burden Item	Average Hours per Activity (a)	Number of Activities per year per source (b)	Technical Hours per year per source (c)	Est'd. Number Existing Sources (d)	Estimated Technical Hours per year (e)	Estimated Managerial Hours per year (f)	Estimated Clerical Hours per year (g)	Annual Cost in $Thousands per year (h)
1) Read Rule and Instructions	4.5	4	18	371	6,678	334	668	246.76
2) Plan Activities	3.0	4	12	371	4,452	223	445	164.52
3) Training	2.5	4	10	371	3,710	186	371	137.11
4) Create, Test, Research & Development	0.8	1,500	1,220	371	452,620	22,631	45,262	16,724.31
5) Gather Info., Monitor/Inspect	0.5	1,500	750	371	278,250	13,913	27,825	10,281.36
6) Process/Compile & Review	1.0	4	4	371	1,484	74	148	54.82
7) Complete Rep'ts	0.1	1,500	125	371	46,375	2,319	4,638	1,713.58
8) Record/Disclose	5.0	4	20	371	7,420	371	742	274.17
9) Store/File	0.3	4	1	371	371	19	37	13.73
TOTAL BURDEN AND COST					801,360	40,070	80,136	29,610.36

These burdens are the equipment leaks regulatory negotiation contribution to the overall existing source burden in Table 1a. See attachment 2 for assumptions and further description of activities.

Attachment 1
SOURCE DATA AND INFORMATION REQUIREMENTS

Information Requirements	Citation
NOTIFICATION	
Notification of construction or reconstruction	63.151, 63.182
Notification of anticipated date of initial startup	63.151, 63.182
Notification of actual date of initial startup	63.151, 63.182
Notification of modification	63.118, 63.122, 63.130, 63.146, 63.151, 63.152, 63.182
REPORTING - INITIAL	
Initial report requirements	63.117, 63.122, 63.129, 63.146, 63.151, 63.182
Reporting of operating parameter levels	63.118, 63.122, 63.129, 63.146, 63.151, 63.182
Statement of compliance or noncompliance	63.151, 63.152, 63.182
REPORTING - SEMIANNUAL & QUARTERLY	
Exceedances of parameter boundaries established during the most recent performance test	63.105, 63.118, 63.122, 63.130, 63.146, 63.148, 63.151, 63.152, 63.182
Any change in equipment or process operation that increases emission levels above requirements of the standard	63.118, 63.122, 63.130, 63.146, 63.151, 63.152, 63.182
Written report of performance tests	63.117, 63.122, 63.129, 63.146, 63.151, 63.152, 63.182
RECORDKEEPING	
Record of data measured during each performance test	63.117, 63.118, 63.123, 63.129, 63.130, 63.147, 63.148, 63.151, 63.152, 63.181
Record of periods of operation during which the performance boundaries esdtablished during the most recent performance tests are exceeded	63.118, 63.123, 63.130, 63.147, 63.148, 63.151, 63.152
Records of Monthly visual inspections	63.118, 63.147, 63.147, 63.181
Records of Annual visual inspections	63.123, 63.147, 63.148, 63.181

Attachment 2
Assumptions and Item Descriptions for Tables 1a, 1b and 4

Assumptions are:

(A) that there are 371 existing sources with a 5% increase (new sources) in the first three years after promulgation. The 5% increase (new sources) is expected to be new expansion at existing facilities, as opposed to new facilities altogether, but given to possibility that this growth could all occur as new facilities, this table assumes the startup of 18 new facility startups in the first three years. Since new facilities must be in compliance at startup, the general periodic recordkeeping and reporting burdens are included, which accounts for the difference in the technical hours per source.

(B) that the average representative source, new and existing, will consist of the following points of burden:

20 parameters to monitor at control devices throughout the facility
10 affected storage tanks of various capacities
3 affected major wastewater streams
4 affected transfer rack operations
1 overall leak detection and repair program for 2,000 points
1 emissions averaging program that involves 10 emission points
1 facility wide inventory of emission points, Group 1 and Group 2

(C) that there are 5% (.05) managerial and 10% (.10) clerical hours required for every technical hour.

(D) that some activities necessary to generate reports involve creating records in the process, and that these activities are assumed to be reports activities alone, to avoid double counting these as records activities as well. Therefore, only items 8 and 9 are considered records burdens directly.

Item Descriptions:

(a) Average Hours per Activity is back calculated by dividing (b) into (c). Since the activities within each burden category can vary significantly, it is too inaccurate to assume an average to use to calculate (c). Estimated activity technical hours are summarized to obtain (c) first, then back calculate for (a) with an estimated (b).

(b) Estimated Number of Activities per year per source represents the assumed typical number of separate activities a source may encounter during one year. This number may vary from facility to facility depending on consolidation of activities, collocated readings, etc. Since so much variability exists, it important to note that this is our best guess at an average facility experience. This number was only used to back calculate (a).

(c) Technical Hours per year per source is the actual best estimate of the burden for each burden item. The three year separate activity burdens were divided by three, where appropriate, and then summarized to include in this column. The technical hours for new sources is higher because some periodic compliance reports and records are required at startup. Existing sources do not encounter these reports and record burdens for three years after promulgation.

(d) Estimated Number of Existing and New Sources reflect the number given in assumption (A), above.

(e) Estimated Technical Hours per year is the product of (c) and (d).

(f) Estimated Managerial Hours per year is 5% of (e).

(g) Estimated Clerical Hours per year is 10% of (e).

Attachment 2 (continued)
Assumptions and Item Descriptions for Tables 1a and 2b

(h) Estimated Annual Cost in $Thousands per year is the total cost of technical, managerial and clerical hours and overhead using 1989 CAIR rates using this formula:

$$\frac{(H^t \times \$33/\text{hour}) + (H^m \times \$49/\text{hour}) + (H^c \times \$15/\text{hour})}{1{,}000} = (h)$$

Where:

H^t is (e), or technical hours
H^m is (f), or managerial hours, and
H^c is (g), clerical hours

1) Read Rule and Instructions are the activities, less training, which involve comprehending the provisions in the standard and understanding how they apply to the respective points at a facility.

2) Plan Activities represents such burdens as design, redesign, scheduling as well as drafting the implementation plan, and selecting methods of compliance.

3) Training represents the portion (assumed 40%) of activities from 1) Read Rule and Instruction which an average facility would elect to provide class room instruction for. The standard does not require specific training itself.

4) Create, Test, Research & Development are the activities involving testing, retesting, establishing operating range for parameters and analyzing point by point applicability. Monitor related refit, calibration and maintenance activities are also included under this heading.

5) Gather Information, Monitor and Inspect are the activities involving physical inspections of equipment, collection of monitored data and other related activities.

6) Process/Compile & Review are the activities that involve analysis of the information collected for accuracy, compliance and appropriate reports and records required as a result.

7) Complete Reports represents the activities normally associated with filling out forms. Since the standard requires no standard forms, these activities relate to the preparing of formal reports and cover letters as appropriate.

8) Record/Disclose are activities which are solely recordkeeping which occur once the appropriate report information has been extracted (see assumption (D)) above. These activities involve software translation, duplication or archival processes normally associated with data management and storage common to this industry.

9) Store/File are again activities which are solely recordkeeping which occur once the appropriate report information has been extracted (see assumption (D) above). These activities involve the management life cycle of records, from the time they are filed and boxed up, to the time they are disposed.

TOTAL BURDEN AND COST is the sum of each of the columns (e), (f), (g) and (h).

Attachment 3
Assumptions and Item Descriptions for Table 2

Assumptions are the same as attachment 2, and:

(A) that EPA personnel would attend 10% of the performance tests. Performance tests are required only for new sources in the first 3 years after promulgation. If the 18 new source equivalents are considered to have 20 parameters each from 8 control devices (2.5 parameters per control), this would mean the equivalent of 144 tests (8 x 18), approximately. Its important to note, however, that EPA attendance is dependent upon EPA available resources, and not the number of tests.

(B) that 20% of the initial tests must be repeated due to failure of initial test.

(C) that all existing and new sources must submit an initial report within 120 of promulgation and an implementation plan or permit application within 12 or 18 months of the compliance date. There are about 370 plant sites. The new sources are most likely to be collocated within existing plants and be included in those existing source reports.

(D) that semiannual reports of results from equipment leak detection and repair program are required by the equipment leak standard. Sources are required to comply with the equipment leak standard by 6 months after promulgation.

(E) that travel expenses equal:

(2 people/trip)(17 trips)($400 travel/trip + $50 per diem/trip)

Item Descriptions:

(a) Average Hours per Activity are estimates of the specific activities and are the basis for estimating the overall burden (unlike tables 1a, 1b and 4).

(b) Number of Activities per year represents the number of reports expected to be reviewed and other related activities during the course of the year. Under the performance test headings, these numbers are based upon assumptions (A) and (B), above. For one time reports, the total number of reports expected over the three year period was divided by three to get an annual average incorporating assumption (C), above.

(c) Estimated Technical Hours per year is the product of (a) and (b).

(d) Estimated Managerial Hours per year is 5% of (c).

(e) Estimated Clerical Hours per year is 10% of (c).

(f) Estimated Annual Cost in $Thousands per year is the total cost of technical, managerial and clerical hours and overhead using 1989 CAIR rates using this formula:

$$\frac{(H^t \times \$33/\text{hour}) + (H^m \times \$49/\text{hour}) + (H^c \times \$15/\text{hour})}{1{,}000} = (h)$$

Where:

H^t is (e), or technical hours
H^m is (f), or managerial hours, and
H^c is (g), clerical hours

PERFORMANCE TESTS:

1) Initial represents the activities during EPA attendance at an initial performance test.
2) Repeat represents the same activities as 1) Initial, except for a repeat performance test.

LITIGATION: Represents the cost of litigating an average of three case per year.

Attachment 3 (continued)
Assumptions and Item Descriptions for Table 2

REPORTS REVIEW:

1) Initial represents the EPA review of all initial reports received.

2) Implementation Plan or Permit Applications represents the EPA review of all implementation plans, or permit applications if submitted in lieu of an implementation plan.

3) Compliance Status represents compliance status verification by the EPA for the portions of the standard which a source must comply with before the compliance date (see assumption (D) above).

4) Review equipment leak monitoring represents the review and screening of periodic reports received as a result of the equipment leaks standard.

5) Notification of construction/reconstruction represents the EPA review of this notification from new sources.

6) Notification of anticipated startup represents the EPA review of this notification from new sources.

7) Notification of actual startup represents the EPA review of this notification from new sources.

8) Notification of performance test represents the EPA review of this notification from new sources.

9) Review of test results represents the EPA review of performance test results for new sources.

10) Review periodic reports represents the EPA review of periodic reports for new sources, only. Generally, periodic reports are not required from existing sources until after the compliance date, which is 3 years after promulgation, except for equipment leaks which is included under 4), above.

TOTAL BURDEN AND COST is the sum of each of the columns (e), (f), (g) and (h).

ATTACHMENT 6

DETAILED COST INFORMATION

FACILITY–SPECIFIC SUMMARY OF COSTS

Subcategory / Facility	Capital TCI[a] ($)	Annual Costs ($/yr) Direct	Annual Costs ($/yr) Indirect	MRR Costs[b] ($/yr)	Total Costs Annual Annual Costs w/MRR Direct	Total Costs Annual Annual Costs w/MRR Indirect	RC[c] ($/yr)	TAC[c] ($/yr)	AER[d] (Mg/yr)	CE[e] ($/Mg)
1st Reg Alt										
Butyl Rubber										
BR–1	$691,158	$866,995	$140,222	$312,237	$1,135,763	$183,691	$2,911	$1,316,543	606	$2,172
$/Mg									$2,200	
Ethylene–Propylene Rubber										
EPR–1	$3,861,224	$407,307	$740,027	$355,674	$533,572	$969,436	$282	$1,502,726	1018	$1,477
EPR–2	$242,625	$143,078	$111,431	$78,898	$187,432	$145,974	$1,314	$332,092	210	$1,585
EPR–3	$656,428	$126,417	$392,853	$160,974	$165,606	$514,637	$2,376	$677,868	239	$2,833
EPR–4	$769,418	$177,901	$428,340	$187,935	$233,050	$561,125	$3,998	$790,178	403	$1,962
EPR–5	$426,890	$96,169	$233,145	$102,087	$125,981	$305,419	$2,161	$429,239	218	$1,970
Subcategory Total	$5,956,585	$950,872	$1,905,795	$885,567	$1,245,642	$2,496,592	$10,131	$3,732,103	2,087	$1,788
$/Mg									$1,800	
Epichlorohydrin Rubber										
EPI–1	$491,203	$20,944	$163,900	$57,302	$27,437	$214,710	$1,187	$240,959	124	$1,949
$/Mg									$1,900	
Halobutyl Rubber										
HBR–1	$328,055	$122,772	$124,940	$76,791	$160,831	$163,671	$2,311	$322,191	334	$966
$/Mg									$1,000	
Hypalon										
HYP–1	$0	$0	$0	$0	$0	$0	$0	$0	0	$0
$/Mg									ERR	
Nitrile–Butadiene Latex										
NBL–1	$414,327	$47,164	$78,027	$38,809	$61,785	$102,216	$161	$163,840	110	$1,485
NBL–2	$37,934	$23,612	$19,305	$13,304	$30,932	$25,290	$171	$56,050	17	$3,251
NBL–3	$12,476	$13,207	$4,580	$5,514	$17,301	$6,000	$71	$23,230	7	$3,266
Subcategory Total	$464,737	$83,983	$101,912	$57,628	$110,018	$133,505	$403	$243,120	135	$1,805
$/Mg									$1,800	
Nitrile–Butadiene Rubber										
NBR–1	$64,465	$2,612	$13,532	$5,005	$3,422	$17,727	$260	$20,888	26	$796
NBR–2	$125,669	$84,536	$52,004	$42,327	$110,742	$68,125	$1,490	$177,377	151	$1,173
NBR–3	$73,200	$33,938	$32,381	$20,559	$44,459	$42,419	$378	$86,500	38	$2,273
NBR–4	$133,932	$59,302	$63,475	$38,061	$77,686	$83,152	$1,486	$159,352	150	$1,064
Subcategory Total	$397,265	$180,388	$161,391	$105,951	$236,308	$211,422	$3,614	$444,116	365	$1,216
$/Mg									$1,200	
Neoprene										
NEO–1	$299,424	$291,130	$117,269	$126,604	$381,380	$153,623	$623	$534,380	253	$2,113
NEO–2	$206,508	$156,821	$77,081	$72,509	$205,436	$100,976	$10	$306,401	69	$4,460
NEO–3	$54,273	$14,288	$29,128	$13,459	$18,717	$38,158	$317	$56,558	32	$1,772
Subcategory Total	$560,205	$462,239	$223,478	$212,572	$605,533	$292,756	$950	$897,339	354	$2,538
$/Mg									$2,500	

FACILITY–SPECIFIC SUMMARY OF COSTS

Subcategory / Facility	Capital TCI[a] ($)	Annual Costs ($/yr) Direct	Annual Costs ($/yr) Indirect	MRR Costs[b] ($/yr)	Total Costs Annual Annual Costs w/MRR Direct	Total Costs Annual Annual Costs w/MRR Indirect	RC[c] ($/yr)	TAC[c] ($/yr)	AER[d] (Mg/yr)	CE[e] ($/Mg)
Styrene–Butadiene Latex										
SBL–1	$22,117	$6,928	$6,424	$4,139	$9,076	$8,416	$91	$17,401	9	$1,908
SBL–2	$34,522	$24,513	$15,984	$12,554	$32,112	$20,940	$66	$52,985	29	$1,829
SBL–3	$93,164	$27,098	$50,909	$24,182	$35,498	$66,690	$595	$101,594	60	$1,695
SBL–4	$77,888	$14,638	$47,903	$19,388	$19,176	$62,753	$166	$81,763	17	$4,895
SBL–5	$0	$2,106	$0	$653	$2,759	$0	$20	$2,739	2	$1,364
SBL–6	$17,431	$5,529	$3,720	$2,867	$7,243	$4,873	$72	$12,044	7	$1,659
SBL–7	$8,387	$6,353	$1,952	$2,574	$8,322	$2,557	$60	$10,819	6	$1,798
SBL–8	$488,820	$60,093	$95,840	$48,339	$78,722	$125,551	$137	$204,136	254	$803
SBL–9	$43,513	$17,543	$19,795	$11,575	$22,981	$25,932	$308	$48,605	31	$1,566
SBL–10	$88,539	$36,458	$41,190	$24,071	$47,760	$53,959	$634	$101,084	64	$1,583
SBL–11	$472,633	$70,702	$127,573	$61,465	$92,620	$167,120	$489	$259,251	81	$3,208
SBL–12	$6,638	$2,992	$3,284	$1,946	$3,920	$4,302	$50	$8,172	5	$1,619
SBL–13	$54,740	$22,383	$25,298	$14,781	$29,322	$33,140	$391	$62,071	39	$1,577
SBL–14	$60,631	$6,670	$32,987	$12,294	$8,738	$43,213	$132	$51,818	13	$3,886
SBL–15	$11,456	$5,230	$5,544	$3,340	$6,851	$7,263	$89	$14,025	9	$1,568
Subcategory Total	$1,480,479	$309,236	$478,402	$244,168	$405,099	$626,707	$3,299	$1,028,507	627	$1,641
$/Mg									$1,600	
Styrene–Butadiene Rubber by Emulsion										
SBRE–1	$450,345	$37,780	$81,520	$36,983	$49,492	$106,791	$0	$156,283	48	$3,249
SBRE–2	$0	$0	$0	$0	$0	$0	$0	$0	0	$0
SBRE–3	$2,351,680	$542,748	$459,741	$310,772	$711,000	$602,261	$0	$1,313,261	85	$15,414
SBRE–4	$1,139,844	$249,497	$240,654	$151,947	$326,841	$315,257	$0	$642,098	110	$5,848
Subcategory Total	$3,941,869	$830,025	$781,915	$499,701	$1,087,333	$1,024,309	$0	$2,111,641	243	$8,686
$/Mg									$8,700	
Styrene–Butadiene and Polybutadiene Rubber by Solution										
SBR/PBRS–1	$377,404	$35,759	$78,052	$35,281	$46,844	$102,248	$1,320	$147,772	133	$1,112
SBR/PBRS–2	$6,165	$36,460	$2,051	$11,938	$47,763	$2,687	$218	$50,232	22	$2,291
SBR/PBRS–3	$524,096	$80,964	$295,477	$116,697	$106,063	$387,074	$1,981	$491,156	200	$2,462
SBR/PBRS–4	$3,806,102	$1,128,920	$958,226	$647,015	$1,478,885	$1,255,276	$1,347	$2,732,814	516	$5,296
SBR/PBRS–5	$7,066,495	$2,152,072	$1,599,610	$1,163,021	$2,819,214	$2,095,489	$1,460	$4,913,244	648	$7,579
Subcategory Total	$11,780,263	$3,434,175	$2,933,415	$1,973,953	$4,498,769	$3,842,774	$6,325	$8,335,218	1,519	$5,488
$/Mg									$5,500	
TOTALS	$26,091,819	$7,261,629	$7,015,371	$4,425,870	$9,512,734	$9,190,136	$31,131	$18,671,739	6,392	$2,921
									$2,900	

FACILITY–SPECIFIC SUMMARY OF COSTS

Subcategory / Facility	Capital TCI[a] ($)	Annual Costs ($/yr) Direct	Annual Costs ($/yr) Indirect	MRR Costs[b] ($/yr)	Total Costs Annual Annual Costs w/MRR Direct	Total Costs Annual Annual Costs w/MRR Indirect	RC[c] ($/yr)	TAC[c] ($/yr)	AER[d] (Mg/yr)	CE[e] ($/Mg)
2nd Reg Alt										
Butyl Rubber BR–1	$357,423	$544,939	$123,568	$207,237	$713,870	$161,874	$0	$875,744	147	$5,961
$/Mg										
Halobutyl Rubber HBR–1	$171,801	$558,535	$48,443	$188,163	$731,681	$63,460	$0	$795,141	49	$16,227
$/Mg										
	$529,224	$1,103,474	$172,011	$395,400	$1,445,551	$225,334	$0	$1,670,885	196	$8,529

FACILITY–SPECIFIC SUMMARY OF COSTS

Subcategory / Facility	Capital TCI[a] ($)	Annual Costs ($/yr) Direct	Annual Costs ($/yr) Indirect	MRR Costs[b] ($/yr)	Total Costs Annual Annual Costs w/MRR Direct	Total Costs Annual Annual Costs w/MRR Indirect	RC[c] ($/yr)	TAC[c] ($/yr)	AER[d] (Mg/yr)	CE[e] ($/Mg)
Compare										
Butyl Rubber										
1st Reg Alt	$691,158	$866,995	$140,222	$312,237	$1,135,763	$183,691	$2,911	$1,316,543	606	$2,172
2nd Reg Alt	$357,423	$544,939	$123,568	$207,237	$713,870	$161,874	$0	$875,744	147	$5,961
Total	$1,048,581	$1,411,934	$263,790	$519,474	$1,849,634	$345,565	$2,911	$2,192,287	753	$2,911
Avg CE									$2,900	
Incremental CE									$6,000	
Halobutyl Rubber										
1st Reg Alt	$328,055	$122,772	$124,940	$76,791	$160,831	$163,671	$2,311	$322,191	334	$966
2nd Reg Alt	$171,801	$558,535	$48,443	$188,163	$731,681	$63,460	$0	$795,141	49	$16,227
Total	$499,856	$681,307	$173,383	$264,954	$892,512	$227,132	$2,311	$1,117,332	383	$2,921
Avg CE									$2,900	
Incremental CE									$16,200	
Overall										
1st Reg Alt	$26,091,819	$7,261,629	$7,015,371	$4,425,870	$9,512,734	$9,190,136	$31,131	$18,671,739	6,392	$2,921
2nd Reg Alt	$529,224	$1,103,474	$172,011	$395,400	$1,445,551	$225,334	$0	$1,670,885	196	$8,529
Total	$26,621,043	$8,365,103	$7,187,382	$4,821,270	$10,958,285	$9,415,471	$31,131	$20,342,624	6,588	$3,088
Avg CE									$3,100	
Incremental CE									$8,500	

FACILITY-SPECIFIC SUMMARY OF COSTS

Subcategory / Facility	Storage TCI[a] ($)	Annual Costs ($/yr) Direct	Annual Costs ($/yr) Indirect	MRR Costs[b] ($/yr)	TAC[c] ($/yr)	AER[d] (Mg/yr)
1st Reg Alt						
Butyl Rubber						
BR-1				$0	$0	
$/Mg						ERR
Ethylene-Propylene Rubber						
EPR-1				$0	$0	
EPR-2	$23,134		$2,679	$830	$3,509	2.2
EPR-3				$0	$0	
EPR-4				$0	$0	
EPR-5	$13,090		$1,613	$500	$2,113	0.2
Subcategory Total	$36,224		$4,292	$1,331	$5,623	2.4
$/Mg						$2,300
Epichlorohydrin Rubber						
EPI-1	$48,440		$5,889	$1,826	$7,715	4.1
$/Mg						$1,900
Halobutyl Rubber						
HBR-1	$140,675		$15,045	$4,664	$19,709	62
$/Mg						$300
Hypalon						
HYP-1				$0	$0	
$/Mg						ERR
Nitrile-Butadiene Latex						
NBL-1						
NBL-2						
NBL-3						
Subcategory Total	$0		$0	$0	$0	$0
$/Mg						ERR
Nitrile-Butadiene Rubber						
NBR-1						
NBR-2	$13,090		$1,603	$497	$2,100	1.1
NBR-3						
NBR-4						
Subcategory Total	$13,090		$1,603	$497	$2,100	1.1
$/Mg						$1,900
Neoprene						
NEO-1				$0	$0	
NEO-2				$0	$0	
NEO-3				$0	$0	
Subcategory Total	$0		$0	$0	$0	0
$/Mg						ERR

FACILITY–SPECIFIC SUMMARY OF COSTS

Subcategory / Facility	Storage TCI[a] ($)	Annual Costs ($/yr) Direct	Annual Costs ($/yr) Indirect	MRR Costs[b] ($/yr)	TAC[c] ($/yr)	AER[d] (Mg/yr)
Styrene–Butadiene Latex						
SBL–1				$0	$0	
SBL–2				$0	$0	
SBL–3				$0	$0	
SBL–4				$0	$0	
SBL–5				$0	$0	
SBL–6				$0	$0	
SBL–7				$0	$0	
SBL–8				$0	$0	
SBL–9				$0	$0	
SBL–10				$0	$0	
SBL–11				$0	$0	
SBL–12				$0	$0	
SBL–13				$0	$0	
SBL–14				$0	$0	
SBL–15				$0	$0	
Subcategory Total	$0		$0	$0	$0	$0
$/Mg						ERR
Styrene–Butadiene Rubber by Emulsion						
SBRE–1				$0	$0	
SBRE–2				$0	$0	
SBRE–3				$0	$0	
SBRE–4				$0	$0	
Subcategory Total	$0		$0	$0	$0	$0
$/Mg						ERR
Styrene–Butadiene and Polybutadiene Rubber by Solution						
SBR/PBRS–1				$0	$0	
SBR/PBRS–2				$0	$0	
SBR/PBRS–3				$0	$0	
SBR/PBRS–4				$0	$0	
SBR/PBRS–5				$0	$0	
Subcategory Total	$0		$0	$0	$0	$0
$/Mg						ERR
TOTALS	$238,429	$0	$26,829	$8,317	$35,146	70
						$500

FACILITY–SPECIFIC SUMMARY OF COSTS

Subcategory / Facility	Storage					
	TCI[a] ($)	Annual Costs ($/yr) Direct	Annual Costs ($/yr) Indirect	MPR Costs[b] ($/yr)	TAC[c] ($/yr)	AER[d] (Mg/yr)
2nd Reg Alt						
Butyl Rubber BR–1 $/Mg						
Halobutyl Rubber HBR–1 $/Mg						
	$0	$0	$0		$0	0

FACILITY-SPECIFIC SUMMARY OF COSTS

Subcategory / Facility	Storage					
	TCI[a] ($)	Annual Costs ($/yr) Direct	Annual Costs ($/yr) Indirect	MRR Costs[b] ($/yr)	TAC[c] ($/yr)	AER[d] (Mg/yr)
Compare						
Butyl Rubber						
1st Reg Alt	$0	$0	$0		$0	0
2nd Reg Alt	$0	$0	$0		$0	0
Total	$0	$0	$0		$0	0
Avg CE						ERR
Incremental CE						ERR
Halobutyl Rubber						
1st Reg Alt	$140,675	$0	$15,045		$19,709	62
2nd Reg Alt	$0	$0	$0		$0	0
Total	$140,675	$0	$15,045		$19,709	62
Avg CE						$300
Incremental CE						ERR
Overall						
1st Reg Alt	$238,429	$0	$26,829		$35,146	70
2nd Reg Alt	$0	$0	$0		$0	0
Total	$238,429	$0	$26,829		$35,146	70
Avg CE						$500
Incremental CE						ERR

FACILITY-SPECIFIC SUMMARY OF COSTS

Subcategory / Facility	Process Front-End TCI[a] ($)	Annual Costs ($/yr) Direct	Indirect	MRR Costs[b] ($/yr)	TAC[c] ($/yr)	AER[d] (Mg/yr)	Process Back-End TCI[a] ($)	Annual Costs ($/yr) Direct	Indirect	MRR Costs[b] ($/yr)	TAC[c] ($/yr)	AER[d] (Mg/yr)
1st Reg Alt												
Butyl Rubber												
BR-1	$172,058	$455,167	$50,524	$156,764	$662,455	211				$0	$0	
$/Mg						$3,100						ERR
Ethylene-Propylene Rubber												
EPR-1	$29,976	$3,307	$6,919	$3,170	$13,396	10	$3,750,102	$382,818	$714,382	$340,132	$1,437,332	979
EPR-2	$102,745	$115,947	$56,957	$53,600	$226,504	75				$0	$0	
EPR-3				$0	$0					$0	$0	
EPR-4				$0	$0					$0	$0	
EPR-5				$0	$0					$0	$0	
Subcategory Total	$132,721	$119,254	$63,876	$56,770	$239,900	85	$3,750,102	$382,818	$714,382	$340,132	$1,437,332	979
$/Mg						$2,800						$1,500
Epichlorohydrin Rubber												
EPI-1				$0	$0					$0	$0	
$/Mg						ERR						ERR
Halobutyl Rubber												
HBR-1	$29,486	$22,743	$17,584	$12,501	$52,828	38				$0	$0	
$/Mg						$1,400						ERR
Hypalon												
HYP-1				$0	$0					$0	$0	
$/Mg						ERR						ERR
Nitrile-Butadiene Latex												
NBL-1				$0	$0					$0	$0	
NBL-2				$0	$0					$0	$0	
NBL-3				$0	$0					$0	$0	
Subcategory Total	$0	$0	$0	$0	$0	0	$0	$0	$0	$0	$0	0
$/Mg						ERR						ERR
Nitrile-Butadiene Rubber												
NBR-1				$0	$0					$0	$0	
NBR-2				$0	$0					$0	$0	
NBR-3				$0	$0					$0	$0	
NBR-4				$0	$0					$0	$0	
Subcategory Total	$0	$0	$0	$0	$0	0	$0	$0	$0	$0	$0	0
$/Mg						ERR						ERR
Neoprene												
NEO-1	$221,004	$251,539	$82,671	$103,605	$437,815	190				$0	$0	
NEO-2	$204,054	$156,698	$76,583	$72,317	$305,598	68				$0	$0	
NEO-3				$0	$0					$0	$0	
Subcategory Total	$425,058	$408,237	$159,254	$175,922	$743,413	258	$0	$0	$0	$0	$0	0
$/Mg						$2,900						ERR

FACILITY–SPECIFIC SUMMARY OF COSTS

Subcategory / Facility	Process Front–End TCI[a] ($)	Annual Costs ($/yr) Direct	Indirect	MRR Costs[b] ($/yr)	TAC[c] ($/yr)	AER[d] (Mg/yr)	Process Back–End TCI[a] ($)	Annual Costs ($/yr) Direct	Indirect	MRR Costs[b] ($/yr)	TAC[c] ($/yr)	AER[d] (Mg/yr)
Styrene–Butadiene Latex												
SBL–1				$0	$0					$0	$0	
SBL–2	$29,351	$17,668	$14,806	$10,067	$42,541	22				$0	$0	
SBL–3				$0	$0					$0	$0	
SBL–4				$0	$0					$0	$0	
SBL–5				$0	$0					$0	$0	
SBL–6				$0	$0					$0	$0	
SBL–7				$0	$0					$0	$0	
SBL–8				$0	$0					$0	$0	
SBL–9				$0	$0					$0	$0	
SBL–10				$0	$0					$0	$0	
SBL–11				$0	$0					$0	$0	
SBL–12				$0	$0					$0	$0	
SBL–13				$0	$0					$0	$0	
SBL–14				$0	$0					$0	$0	
SBL–15				$0	$0					$0	$0	
Subcategory Total	$29,351	$17,668	$14,806	$10,067	$42,541	22	$0	$0	$0	$0	$0	0
$/Mg						$1,900						ERR
Styrene–Butadiene Rubber by Emulsion												
SBRE–1				$0	$0					$0	$0	
SBRE–2				$0	$0					$0	$0	
SBRE–3				$0	$0		$2,351,680	$542,748	$459,741	$310,772	$1,313,261	85
SBRE–4				$0	$0		$1,139,844	$249,497	$240,654	$151,947	$642,098	110
Subcategory Total	$0	$0	$0	$0	$0	0	$3,491,524	$792,245	$700,395	$462,718	$1,955,358	195
$/Mg						ERR						$10,000
Styrene–Butadiene and Polybutadiene Rubber by Solution												
SBR/PBRS–1				$0	$0					$0	$0	
SBR/PBRS–2				$0	$0					$0	$0	
SBR/PBRS–3				$0	$0					$0	$0	
SBR/PBRS–4				$0	$0		$3,270,738	1074243	654018	$535,761	$2,264,022	380
SBR/PBRS–5				$0	$0		$6,485,918	2092816	1269534	$1,042,329	$4,404,679	501
Subcategory Total	$0	$0	$0	$0	$0	0	$9,756,656	$3,167,059	$1,923,552	$1,578,089	$6,668,700	882
$/Mg						ERR						$7,600
TOTALS	$788,674	$1,023,069	$306,044	$412,025	$1,741,138	615	$16,998,282	$4,342,122	$3,338,329	$2,380,940	$10,061,391	2,056
						$2,800						$4,900

FACILITY-SPECIFIC SUMMARY OF COSTS

Subcategory / Facility	Process Front-End TCI[a] ($)	Annual Costs ($/yr) Direct	Annual Costs ($/yr) Indirect	MRR Costs[b] ($/yr)	TAC[c] ($/yr)	AER[d] (Mg/yr)	Process Back-End TCI[a] ($)	Annual Costs ($/yr) Direct	Annual Costs ($/yr) Indirect	MRR Costs[b] ($/yr)	TAC[c] ($/yr)	AER[d] (Mg/yr)
2nd Reg Alt												
Butyl Rubber BR-1	$357,423	$544,939	$123,568	$207,237	$875,744	147						
$/Mg						$6,000						
Halobutyl Rubber HBR-1	$171,801	$558,535	$48,443	$188,163	$795,141	49						
$/Mg						$16,200						
	$529,224	$1,103,474	$172,011		$1,670,885	196	$0	$0	$0		$0	0

FACILITY-SPECIFIC SUMMARY OF COSTS

Subcategory / Facility	Process Front-End TCI[a] ($)	Annual Costs ($/yr) Direct	Annual Costs ($/yr) Indirect	MRR Costs[b] ($/yr)	TAC[c] ($/yr)	AER[d] (Mg/yr)	Process Back-End TCI[a] ($)	Annual Costs ($/yr) Direct	Annual Costs ($/yr) Indirect	MRR Costs[b] ($/yr)	TAC[c] ($/yr)	AER[d] (Mg/yr)
						$8,500						
Compare												
Butyl Rubber												
1st Reg Alt	$172,058	$455,167	$50,524		$662,455	211	$0	$0	$0		$0	0
2nd Reg Alt	$357,423	$544,939	$123,568		$875,744	147	$0	$0	$0		$0	0
Total	$529,481	$1,000,106	$174,092		$1,538,199	358	$0	$0	$0		$0	0
Avg CE						$4,300						ERR
Incremental CE						$6,000						ERR
Halobutyl Rubber												
1st Reg Alt	$29,486	$22,743	$17,584		$52,828	38	$0	$0	$0		$0	0
2nd Reg Alt	$171,801	$558,535	$48,443		$795,141	49	$0	$0	$0		$0	0
Total	$201,287	$581,278	$66,027		$847,970	87	$0	$0	$0		$0	0
Avg CE						$9,700						ERR
Incremental CE						$16,200						ERR
Overall												
1st Reg Alt	$788,674	$1,023,069	$306,044		$1,741,138	615	$16,998,282	$4,342,122	$3,338,329		$10,061,391	2056
2nd Reg Alt	$529,224	$1,103,474	$172,011		$1,670,885	196	$0	$0	$0		$0	0
Total	$1,317,898	$2,126,543	$478,055		$3,412,023	811	$16,998,282	$4,342,122	$3,338,329		$10,061,391	2056
Avg CE						$4,200						$4,900
Incremental CE						$8,500						ERR

FACILITY–SPECIFIC SUMMARY OF COSTS

Subcategory / Facility	Equipment Leaks TCI[a] ($)	Annual Costs ($/yr) Direct	Indirect	MRR Costs[b] ($/yr)	RC[c] ($/yr)	TAC[c] ($/yr)	AER[d] (Mg/yr)	Wastewater TCI[a] ($)	Annual Costs ($/yr) Direct	Indirect	MRR Costs[b] ($/yr)	TAC[c] ($/yr)	AER[d] (Mg/yr)
1st Reg Alt													
Butyl Rubber													
BR–1	$34,735	$370,818	$3,088	$115,911	$2,911	$486,906	293	$484,365	$41,010	$86,610	$39,562	$167,182	102
$/Mg							$1,700						$1,600
Ethylene–Propylene Rubber													
EPR–1	$81,146	$21,182	$18,726	$12,372	$282	$51,998	28				$0	$0	
EPR–2	$116,746	$27,131	$51,795	$24,467	$1,314	$102,079	132				$0	$0	
EPR–3	$656,428	$126,417	$392,853	$160,974	$2,376	$677,868	239				$0	$0	
EPR–4	$769,418	$177,901	$428,340	$187,935	$3,998	$790,178	403				$0	$0	
EPR–5	$413,800	$96,169	$231,532	$101,587	$2,161	$427,126	218				$0	$0	
Subcategory Total	$2,037,538	$448,800	$1,123,245	$487,334	$10,131	$2,049,249	1,020	$0	$0	$0	$0	$0	0
$/Mg							$2,000						ERR
Epichlorohydrin Rubber													
EPI–1	$442,763	$20,944	$158,011	$55,476	$1,187	$233,245	120				$0	$0	
$/Mg							$2,000						ERR
Halobutyl Rubber													
HBR–1	$157,894	$100,029	$92,311	$59,625	$2,311	$249,654	233				$0	$0	
$/Mg							$1,100						ERR
Hypalon													
HYP–1	$0	$0	$0	$0	$0	$0	0				$0	$0	
$/Mg							ERR						ERR
Nitrile–Butadiene Latex													
NBL–1	$29,845	$14,704	$6,387	$6,538	$161	$27,469	16	$384,482	$32,460	$71,640	$32,271	$136,371	94
NBL–2	$37,934	$23,612	$19,305	$13,304	$171	$56,050	17				$0	$0	
NBL–3	$12,476	$13,207	$4,580	$5,514	$71	$23,230	7				$0	$0	
Subcategory Total	$80,255	$51,523	$30,272	$25,357	$403	$106,749	41	$384,482	$32,460	$71,640	$32,271	$136,371	94
$/Mg							$2,600						$1,400
Nitrile–Butadiene Rubber													
NBR–1	$64,465	$2,612	$13,532	$5,005	$260	$20,888	26				$0	$0	
NBR–2	$112,579	$84,536	$50,401	$41,830	$1,490	$175,277	150				$0	$0	
NBR–3	$73,200	$33,938	$32,381	$20,559	$378	$86,500	38				$0	$0	
NBR–4	$133,932	$59,302	$63,475	$38,061	$1,486	$159,352	150				$0	$0	
Subcategory Total	$384,175	$180,388	$159,788	$105,455	$3,614	$442,016	364	$0	$0	$0	$0	$0	0
$/Mg							$1,200						ERR
Neoprene													
NEO–1	$78,420	$39,591	$34,598	$22,999	$623	$96,564	63				$0	$0	
NEO–2	$2,454	$123	$498	$192	$10	$803	1				$0	$0	
NEO–3	$54,273	$14,288	$29,128	$13,459	$317	$56,558	32				$0	$0	
Subcategory Total	$135,147	$54,002	$64,224	$36,650	$950	$153,926	96	$0	$0	$0	$0	$0	0
$/Mg							$1,600						ERR

FACILITY–SPECIFIC SUMMARY OF COSTS

Subcategory / Facility	Equipment Leaks TCI[a] ($)	Annual Costs ($/yr) Direct	Indirect	MRR Costs[b] ($/yr)	RC[c] ($/yr)	TAC[d] ($/yr)	AER[e] (Mg/yr)	Wastewater TCI[a] ($)	Annual Costs ($/yr) Direct	Indirect	MRR Costs[b] ($/yr)	TAC[d] ($/yr)	AER[e] (Mg/yr)
Styrene–Butadiene Latex													
SBL–1	$22,117	$6,928	$6,424	$4,139	$91	$17,401	9				$0	$0	
SBL–2	$5,171	$6,845	$1,178	$2,487	$66	$10,445	7				$0	$0	
SBL–3	$93,164	$27,098	$50,909	$24,182	$595	$101,594	60				$0	$0	
SBL–4	$77,888	$14,638	$47,903	$19,388	$166	$81,763	17				$0	$0	
SBL–5	$0	$2,106	$0	$653	$20	$2,739	2				$0	$0	
SBL–6	$17,431	$5,529	$3,720	$2,867	$72	$12,044	7				$0	$0	
SBL–7	$8,387	$6,353	$1,952	$2,574	$60	$10,819	6				$0	$0	
SBL–8	$24,237	$21,003	$12,180	$10,287	$137	$43,333	14	$464,583	$39,090	$83,660	$38,053	$160,803	240
SBL–9	$43,513	$17,543	$19,795	$11,575	$308	$48,605	31				$0	$0	
SBL–10	$88,539	$36,458	$41,190	$24,071	$634	$101,084	64				$0	$0	
SBL–11	$135,861	$41,292	$63,053	$32,347	$489	$136,203	49	$336,772	$29,410	$64,520	$29,118	$123,048	32
SBL–12	$6,638	$2,992	$3,284	$1,946	$50	$8,172	5				$0	$0	
SBL–13	$54,740	$22,383	$25,298	$14,781	$391	$62,071	39				$0	$0	
SBL–14	$60,631	$6,670	$32,987	$12,294	$132	$51,818	13				$0	$0	
SBL–15	$11,456	$5,230	$5,544	$3,340	$89	$14,025	9				$0	$0	
Subcategory Total	$649,773	$223,068	$315,416	$166,930	$3,299	$702,116	332	$801,355	$68,500	$148,180	$67,171	$283,851	272
$/Mg							$2,100						$1,000
Styrene–Butadiene Rubber by Emulsion													
SBRE–1	$0	$0	$0	$0	$0	$0	0	$450,345	$37,780	$81,520	$36,983	$156,283	48
SBRE–2	$0	$0	$0	$0	$0	$0	0				$0	$0	
SBRE–3	$0	$0	$0	$0	$0	$0	0				$0	$0	
SBRE–4	$0	$0	$0	$0	$0	$0	0				$0	$0	
Subcategory Total	$0	$0	$0	$0	$0	$0	0	$450,345	$37,780	$81,520	$36,983	$156,283	48
$/Mg							ERR						$3,200
Styrene–Butadiene and Polybutadiene Rubber by Solution													
SBR/PBRS–1	$377,404	$35,759	$78,052	$35,281	$1,320	$147,772	133				$0	$0	
SBR/PBRS–2	$6,165	$36,460	$2,051	$11,938	$218	$50,232	22				$0	$0	
SBR/PBRS–3	$524,096	$80,964	$295,477	$116,697	$1,981	$491,156	200				$0	$0	
SBR/PBRS–4	$535,364	$54,677	$304,208	$111,254	$1,347	$468,792	136				$0	$0	
SBR/PBRS–5	$580,577	$59,256	$330,076	$120,693	$1,460	$508,565	147				$0	$0	
Subcategory Total	$2,023,607	$267,116	$1,009,863	$395,864	$6,325	$1,666,518	637	$0	$0	$0	$0	$0	0
$/Mg							$2,600						ERR
TOTALS	$5,945,887	$1,716,688	$2,956,219	$1,448,601	$31,131	$6,090,377	3,136	$2,120,547	$179,750	$387,950	$175,987	$743,687	516
							$1,900						$1,400

FACILITY–SPECIFIC SUMMARY OF COSTS

Subcategory / Facility	Equipment Leaks							Wastewater					
	TCI[a] ($)	Annual Costs ($/yr) Direct	Annual Costs ($/yr) Indirect	MRR Costs[b] ($/yr)	RC[c] ($/yr)	TAC[c] ($/yr)	AER[d] (Mg/yr)	TCI[a] ($)	Annual Costs ($/yr) Direct	Annual Costs ($/yr) Indirect	MRR Costs[b] ($/yr)	TAC[c] ($/yr)	AER[d] (Mg/yr)
2nd Reg Alt													
Butyl Rubber BR–1 $/Mg													
Halobutyl Rubber HBR–1 $/Mg													
	$0		$0		$0	$0	0	$0	$0	$0		$0	0

FACILITY-SPECIFIC SUMMARY OF COSTS

Subcategory / Facility	Equipment Leaks TCI[a] ($)	Annual Costs ($/yr) Direct	Annual Costs ($/yr) Indirect	MRR Costs[b] ($/yr)	RC[c] ($/yr)	TAC[d] ($/yr)	AER[e] (Mg/yr)	Wastewater TCI[a] ($)	Annual Costs ($/yr) Direct	Annual Costs ($/yr) Indirect	MRR Costs[b] ($/yr)	TAC[d] ($/yr)	AER[e] (Mg/yr)
Compare													
Butyl Rubber													
1st Reg Alt	$34,735		$3,088		$2,911	$486,906	293	$484,365	$41,010	$86,610		$167,182	102
2nd Reg Alt	$0		$0		$0	$0	0	$0	$0	$0		$0	0
Total	$34,735		$3,088		$2,911	$486,906	293	$484,365	$41,010	$86,610		$167,182	102
Avg CE							$1,700						$1,600
Incremental CE							ERR						ERR
Halobutyl Rubber													
1st Reg Alt	$157,894		$92,311		$2,311	$249,654	233	$0	$0	$0		$0	0
2nd Reg Alt	$0		$0		$0	$0	0	$0	$0	$0		$0	0
Total	$157,894		$92,311		$2,311	$249,654	233	$0	$0	$0		$0	0
Avg CE							$1,100						ERR
Incremental CE							ERR						ERR
Overall													
1st Reg Alt	$5,945,887		$2,956,219		$31,131	$6,090,377	3136	$2,120,547	$179,750	$387,950		$743,687	516
2nd Reg Alt	$0		$0		$0	$0	0	$0	$0	$0		$0	0
Total	$5,945,887		$2,956,219		$31,131	$6,090,377	3136	$2,120,547	$179,750	$387,950		$743,687	516
Avg CE							$1,900						$1,400
Incremental CE							ERR						ERR

Storage Tank Costs

Facility	Tank Contents	Number of Tanks Represented	Capacity (gallons)	Diameter (feet)	Baseline Emissions[a] (Mg/yr)	Emission Reduction (Mg/yr)	Internal Floating Roof Costs Initial Costs ($) Degassing	Capital[b]	Annual Cost[c] ($/yr)	Cost Effectiveness[d] ($/Mg)
EPR-2	Hexane	1	216,000	35	2.4	2.2	$4,159	$18,975	$2,679	$1,156
EPR-5	Toluene	1	40,000	20	0.2	0.2	$1,750	$11,340	$1,613	$8,228
					2.6	2.4			$4,291	$1,708
HBR-1	"Cement"	3	176,000	25	57.5	54.6	$11,233	$41,655	$5,372	$95
HBR-1	"Cement"	1	1,210,000	70	1.2	1.1	$10,071	$36,790	$5,226	$4,444
HBR-1	"Cement"	1	1,020,000	60	6.9	6.6	$9,226	$31,700	$4,446	$658
						62.3	$30,530	$110,145	$15,045	$234
NBR-2	Acrylonitrile	1	40,000	20	1.2	1.1	$1,750	$11,340	$1,603	$1,363
EPI-1	Toluene	3	65,900	25	4.3	4.1	$6,785	$41,655	$5,889	$1,400
				OVERALL	73.6	69.9	$44,975	$193,455	$26,828	$384

[a] The baseline emissions shown are as reported by the facilities. There are inconsistencies in the methods used to calculate the emissions, resulting in differences in the emission estimates not expected based on the tank parameters.

[b] Includes the installation of a new bolted, floating deck having a liquid-mounted primary seal and controlled deck fittings.

[c] Includes capital recovery costs (7% for 10 years) and recovery credits (using average 1989 chemical cost of $9.98/Mg).

[d] Calculated assuming a 98.4 percent emission reduction (page 2-57 of HON BID 1B). Due to the inconsistencies in the baseline emissions discussed above, the cost-effectiveness values also vary greatly.

Process Vent Costs

			Thermal Incinerator/Flare				Scrubber				Ductwork			
			Capital Cost	Annual Costs ($/yr)			Capital Cost	Annual Costs ($/yr)			Capital Cost	Annual Costs ($/yr)		
	Location	Control Device(s)	($)	Direct[b]	Indirect[c]	Total	($)	Direct[b]	Indirect[c]	Total	($)	Direct[b]	Indirect[c]	Total
Butyl Rubber														
BR-1	Front-End	Incin + Scrubber	$110,196	$301,423	$34,611	$336,034	$128,753	$82,474	$36,594	$119,068	$7,994	$19,527	$10,984	$30,511
BR-1	Front-End	Incin + Scrubber	$68,679	$8,488	$16,833	$25,321	$38,443	$128,249	$21,106	$149,355	$3,356	$4,778	$3,440	$8,218
BR-1	Front-End	Incin + Scrubber	$88,072	$24,724	$19,376	$44,100	$78,794	$426,339	$28,026	$454,365	$5,192	$4,104	$3,122	$7,226
Ethylene-Propylene Rubber														
EPR-1	Front-End	Flare	$29,976	$3,307	$6,919	$10,226	$0	$0	$0	$0	$0	$0	$0	$0
EPR-1	Back-End	Thermal Incin	$988,324	$74,245	$187,308	$261,553	$0	$0	$0	$0	$13,585	$9,453	$4,790	$14,243
EPR-1	Back-End	Thermal Incin	$1,143,304	$82,640	$215,574	$298,214	$0	$0	$0	$0	$17,500	$11,373	$5,508	$16,881
EPR-1	Back-End	Thermal Incin	$1,557,731	$185,482	$291,157	$476,639	$0	$0	$0	$0	$29,678	$19,625	$10,045	$29,671
EPR-2	Front-End	Incin + Scrubber	$68,679	$27,395	$27,039	$54,434	$30,710	$72,624	$19,780	$92,404	$3,356	$15,928	$10,138	$26,067
Halobutyl Rubber														
HBR-1	Front-End	Flare	$29,486	$22,743	$17,584	$40,327	$0	$0	$0	$0	$0	$0	$0	$0
HBR-1	Front-End	Incin + Scrubber	$88,350	$4,227	$18,201	$22,428	$79,177	$551,879	$28,092	$579,971	$4,274	$2,429	$2,150	$4,578
Neoprene														
NEO-1	Front-End	Incin + Scrubber	$68,679	$12,902	$19,981	$32,883	$40,046	$100,967	$21,381	$122,348	$3,356	$8,305	$5,506	$13,811
NEO-1	Front-End	Incin + Scrubber	$68,679	$1,890	$13,628	$15,517	$36,888	$126,261	$20,839	$147,100	$3,356	$1,214	$1,336	$2,548
NEO-2	Front-End	Incin + Scrubber	$68,679	$8,280	$17,453	$25,733	$26,570	$51,998	$19,070	$71,068	$3,356	$5,402	$3,846	$9,248
NEO-2	Front-End	Incin + Scrubber	$68,679	$2,909	$14,236	$17,144	$33,414	$86,229	$20,244	$106,473	$3,356	$1,880	$1,734	$3,614
Polybutadiene/Styrene Butadiene Rubber by Solutio														
PBR/SBRS-4	Back-End	Thermal Incin	$3,188,415	$976,224	$610,529	$1,586,753	$0	$0	$0	$0	$52,499	$71,291	$23,864	$95,155
PBR/SBRS-4	Back-End	Flare	$29,824	$26,728	$19,625	$46,353	$0	$0	$0	$0	$0	$0	$0	$0
PBR/SBRS-5	Back-End	Thermal Incin	$3,188,395	$974,827	$610,526	$1,585,352	$0	$0	$0	$0	$54,564	$71,581	$24,241	$95,822
PBR/SBRS-5	Back-End	Thermal Incin	$3,188,395	$974,827	$610,526	$1,585,352	$0	$0	$0	$0	$54,564	$71,581	$24,241	$95,822
Styrene Butadiene Latex														
SBL-2	Front-End	Flare	$29,351	$17,668	$14,806	$32,474	$0	$0	$0	$0	$0	$0	$0	$0
Styrene Butadiene Rubber by Emulsion														
SBRE-4	Back-End	Thermal Incin	$574,154	$117,193	$117,050	$234,244	$0	$0	$0	$0	$9,236	$12,246	$5,733	$17,979
SBRE-4	Back-End	Thermal Incin	$548,197	$108,284	$112,316	$220,600	$0	$0	$0	$0	$8,257	$11,774	$5,555	$17,329
SBRE-3	Back-End	Thermal Incin	$1,199,943	$268,758	$230,456	$499,214	$0	$0	$0	$0	$17,500	$18,835	$7,002	$25,837
SBRE-3	Back-End	Thermal Incin	$1,118,066	$237,618	$215,527	$453,145	$0	$0	$0	$0	$16,151	$17,537	$6,756	$24,293

Equipment Leak Costs

Facility	Capital Cost[a] ($)	Initial Monitoring[b] ($)	Annual Cost ($/yr) Direct[c]	Indirect[d]	Rec Cred[e]	Total	HAP Emission Reduction[f] (Mg/yr)	Cost-Effectiveness ($/Mg)
Butyl Rubber								
BR-1	$11,452	$23,283	$370,818	$3,088	$2,911	$370,994	293.3	$1,265
Epichlorohydrin Rubber								
EPI-1	$442,763	$0	$20,944	$158,011	$1,187	$177,769	119.6	$1,487
Ethylene-Propylene Rubber								
EPR-1	$81,146	$0	$21,182	$18,726	$282	$39,626	28.4	$1,394
EPR-2	$116,746	$0	$27,131	$51,795	$1,314	$77,612	132.3	$586
EPR-3	$654,224	$2,204	$126,417	$392,853	$2,376	$516,895	239.3	$2,160
EPR-4	$769,418	$0	$177,901	$428,340	$3,998	$602,243	402.7	$1,495
EPR-5	$413,800	$0	$96,169	$231,532	$2,161	$325,539	217.7	$1,495
	$2,035,334	$2,204	$448,800	$1,123,245	$10,131	$1,561,915	1020.5	$1,531
Halobutyl Rubber								
HBR-1	$157,894	$0	$100,029	$92,311	$2,311	$190,028	232.8	$816
Hypalon[g]								
HYP-1	$0	$0	$0	$0	$0	$0	0.0	
Neoprene								
NEO-1	$78,420	$0	$39,591	$34,598	$623	$73,566	62.8	$1,171
NEO-2	$2,454	$0	$123	$498	$10	$610	1.0	$610
NEO-3	$54,273	$0	$14,288	$29,128	$317	$43,100	31.9	$1,351
	$135,147	$0	$54,002	$64,224	$950	$117,276	95.7	$1,225
Nitrile-Butadiene Latex								
NBL-1	$29,845	$0	$14,704	$6,387	$161	$20,930	16.2	$1,291
NBL-2	$37,934	$0	$23,612	$19,305	$171	$42,746	17.2	$2,479
NBL-3	$11,961	$515	$13,207	$4,580	$71	$17,716	7.1	$2,490
	$79,740	$515	$51,522	$30,272	$403	$81,392	40.6	$2,007
Nitrile-Butadiene Rubber								
NBR-1	$64,465	$0	$2,612	$13,532	$260	$15,884	26.2	$606
NBR-2	$107,379	$5,200	$84,536	$50,401	$1,490	$133,446	150.1	$889
NBR-3	$70,138	$3,062	$33,938	$32,381	$378	$65,941	38.1	$1,733
NBR-4	$133,932	$0	$59,302	$63,475	$1,486	$121,290	149.7	$810
	$375,914	$8,261	$180,388	$159,788	$3,614	$336,561	364.1	$924
Polybutadiene/Styrene Butadiene Rubber by Solution[g]								
SBR/PBRS-1	$377,404	$0	$35,759	$78,052	$1,320	$112,491	132.9	$846
SBR/PBRS-2	$4,919	$1,247	$36,460	$2,051	$218	$38,293	21.9	$1,746
SBR/PBRS-3	$519,716	$4,380	$80,964	$295,477	$1,981	$374,460	199.5	$1,877
SBR/PBRS-4	$535,364	$0	$54,677	$304,208	$1,347	$357,538	135.7	$2,636
SBR/PBRS-5	$580,577	$0	$59,256	$330,076	$1,460	$387,872	147.1	$2,637
	$2,017,980	$5,627	$267,117	$1,009,863	$6,325	$1,270,655	637.1	$1,994
Polysulfide Rubber								
PSR-1	$0	$0	$0	$0	$0	$0	0.0	
Styrene-Butadiene Latex[g]								
SBL-1	$22,117	$0	$6,928	$6,424	$91	$13,261	9.1	$1,454
SBL-2	$4,969	$202	$6,845	$1,178	$66	$7,958	6.7	$1,194
SBL-3	$92,647	$517	$27,098	$50,909	$595	$77,412	59.9	$1,292
SBL-4	$77,888	$0	$14,638	$47,903	$166	$62,375	16.7	$3,734
SBL-5	$0	$0	$2,106	$0	$20	$2,086	2.0	$1,039
SBL-6	$17,431	$0	$5,529	$3,720	$72	$9,177	7.3	$1,264
SBL-7	$8,387	$0	$6,353	$1,952	$60	$8,245	6.0	$1,370
SBL-8	$24,237	$0	$21,003	$12,180	$137	$33,046	13.8	$2,393
SBL-9	$42,380	$1,133	$17,543	$19,795	$308	$37,030	31.0	$1,193
SBL-10	$86,177	$2,363	$36,458	$41,190	$634	$77,013	63.9	$1,206
SBL-11	$133,027	$2,834	$41,292	$63,053	$489	$103,856	49.2	$2,110
SBL-12	$6,442	$197	$2,992	$3,284	$50	$6,226	5.0	$1,234
SBL-13	$53,292	$1,448	$22,383	$25,298	$391	$47,290	39.4	$1,201
SBL-14	$60,631	$0	$6,670	$32,987	$132	$39,525	13.3	$2,972
SBL-15	$11,116	$340	$5,230	$5,544	$89	$10,685	8.9	$1,195
	$640,740	$9,034	$223,068	$315,416	$3,299	$535,186	332	$24,851
Styrene-Butadiene Rubber by Emulsion[g]								
SBRE-1	$0	$0	$0	$0	$0	$0	0.0	
SBRE-2	$0	$0	$0	$0	$0	$0	0.0	
SBRE-3	$0	$0	$0	$0	$0	$0	0.0	
SBRE-4	$0	$0	$0	$0	$0	$0	0.0	
	$0	$0	$0	$0	$0	$0	0.0	
	$5,896,964	$48,923	$1,716,689	$2,956,219	$31,131	$4,641,776	3,136	$1,480

Wastewater Steam Stripper Costs

Subcategory	Facility	Stream ID	HAP	Baseline Emissions (Mg/yr)	Emissions Reduction (Mg/yr)	HAP Emission Reduction (Mg/yr)	Steam Stripper Costs: Capital[a] ($)	Annual Costs ($/year): Direct[b]	Indirect[c]	Total[d]	Cost Effectiveness ($/Mg)
SBL	SBL-8	S-1	Butadiene	0.45	0.4	240.4	$464,583	$39,090	$83,660	$122,750	$511
			Styrene	242.4	240.0						
SBL	SBL-11	S-2	Styrene	31.87	31.6	31.6	$336,772	$29,410	$64,520	$93,930	$2,977
SBRE	SBRE-1	R-1	Styrene	4.53	4.5	48.1	$450,345	$37,780	$81,520	$119,300	$2,480
			Butadiene	11.8	11.7						
		S-1	Styrene	8.96	8.9						
			Butadiene	23.3	23.1						
NBL	NBL-1	S-1	Acrylonitrile	97.99	94.1	94.1	$384,482	$32,460	$71,640	$104,100	$1,107
Butyl Rubber	BR-1	S/MR-2	Methyl chloride	19.6	19.4	101.6	$484,365	$41,010	$86,610	$127,620	$1,256
		S/MR-3	Methyl chloride	37.4	37.0						
		S/MR-4	Methanol	0.12	0.0						
			Methyl chloride	33.5	33.2						
		F-2	Methyl chloride	12.1	12.0						
			Methanol	0.06	0.0						
		OVERALL				515.8	$2,120,547			$567,700	$1,101

[a] Includes direct equipment costs for feed tanks, feed preheater, stripping column, primary condenser, overhead collection decanter, flame arrestor, and pumps. Also includes direct installation costs for piping, foundation and supports, electrical, erection and handling, painting, and insulation, along with indirect installation costs (engineering and supervision, construction and field expense, construction fee, start-up and testing, and contingency).

[b] Includes utility costs (electricity, steam, and cooling water); operating, maintenance, and supervision labor; and maintenance materials.

[c] Includes overhead, property taxes, insurance, administrative charges, and capital recovery charges (7% for 15 years).

[d] Does not include any recovery credit.

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(Please read Instructions on reverse before completing)

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15. SUPPLEMENTARY NOTES

16. ABSTRACT

This document contains technical memoranda that provide rationale and information used to develop the Polymers and Resins Group I Elastomers and Synthetic Rubbers proposal package. The memoranda included in this document provide detailed background information for the Basis and Purpose Document for the proposed standards (EPA-453/R-95-005a). The memoranda address industy characterization, baseline emissions, subcategorization, MACT floors and regulatory alternatives, the potential for new sources, and the estimated regulatory alternative impacts.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air Pollution Pollution Control Hazardous Air Pollutants	Air Pollution Control Elastomers Manufacturing Industry	

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