



Project Summary

Industrial Process Profiles for Environmental Use: The Plastics and Resins Industry

Three research reports, each concerning an aspect of the plastics and resins industry, are summarized here. Chapter 10 of the Industrial Process Profiles for Environmental Use (IPPEU) describes the plastics and resins production industry, which converts industrial organic chemicals into solid or liquid polymers. IPPEU Chapter 10a describes the plastics processing industry, which converts polymers and resins into consumer products. IPPEU Chapter 10b discusses plastics additives used in the processing and production of plastics.

This IPPEU (Chapters 10, 10a, and 10b) series is an update and expansion of material published in the 1977 report, "IPPEU Chapter 10, The Plastics and Resins Industry," EPA/600/2-77/023j.

This Project Summary was developed by EPA's Water Engineering Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in separate reports of the same title (see Project Report ordering information at back).

Introduction

The IPPEU Series Chapters 10, 10a, and 10b describe the plastics industry, the recipes and formulations used to manufacture plastics products, the manufacturing process, environmental and occupational impacts, and additives used in the industry.

IPPEU Chapter 10: The Plastics and Resins Production Industry

IPPEU Chapter 10 contains a detailed analysis of the plastics and resins production industry, which includes operations that convert industrial organic chemicals into solid or liquid polymers.

tions and descriptions of the industry, raw materials, products and manufacturers, environmental impacts, and occupational health concerns.

The following polymers are discussed: acrylic resins, acrylonitrile butadiene styrene (ABS), alkyd molding resins, amino resins, modified polyphenylene oxide and polyphenylene sulfide, epoxies, fluoropolymers, phenolic resins, polyacetal, polyamides, polyolefins (polybutylene, polyethylenes, polypropylene), polycarbonate, poly(ester-imide) and poly(ether-imide) resins, polyesters, polystyrenes, polyurethane, polyvinyl acetate and alcohol, polyvinyl chloride, polyvinylidene chloride and styrene acrylonitrile (SAN).

Raw materials for plastics and resins are industrial organic chemicals used as monomers or plasticizers and specialty chemicals used as additives to modify resin properties.

Polyethylenes, polyvinyl chloride, polypropylene, and polystyrene accounted for almost 80 percent (by weight) of the plastics produced in the United States in 1980. The types of companies involved in plastics production vary, but the principal producers are major oil and chemical, paint, tire and rubber, steel, and electrical manufacturing companies.

Plastic and resin production processes generate air emissions, wastewater, and solid waste. Volatile emissions are generally highest in processing steps upstream of the reactor and in mass and solution polymerization monomer and solvent recovery steps. Suspension and emulsion polymerization processes typically generate more particulate emissions.

The most significant source of wastewater in plastics production is the

water used for emulsion and suspension polymerization. Wastewater may contain monomer, comonomer, additives, and fillers.

Solid waste is generated from plastics production in one of two ways: polymer lost from the process (i.e., spills, routine cleaning, or particulate collection) and byproduct formation (i.e., low-molecular-weight polymers). Spent catalyst or additives also may constitute solid waste from some processes.

Some of the chemicals used as raw materials in plastics production are highly toxic and may produce serious adverse health effects in overexposed employees. However, effective engineering controls and personal protective equipment and clothing exist that greatly reduce worker exposure potential.

Successful application of these controls depends on plant-specific factors such as plant design, materials handled, process configuration, and management and employee dedication to maintaining a good occupational health program.

IPPEU Chapter 10a: The Plastics and Resins Processing Industry

IPPEU Chapter 10a contains a detailed analysis of the plastics and resins processing industry, which includes operations that convert polymers and resins into consumer products. Analytical elements include industry definition, raw materials, products, manufacturers, environmental impacts, and occupational health impacts.

For the purpose of this analysis, the Plastics and Resins Processing Industry has been divided into 11 segments, some of which are made up of a number of different processes: calendering, casting, coating, compounding, extrusion, finishing, foam (expandable bead, extruded thermoplastic, multi-component thermoset, and structural), laminating, molding (blow, compression injection, reaction injection, rotational, and transfer), reinforced plastics, and thermoforming.

The plastics and resins processing industry is made up of nearly 10,000 processors who produced an inventory of products valued at \$37 billion in 1982. The industry is made up of many plants, most of which are small and located in or near urban centers. A compounded annual growth rate of 6 percent is projected through 1990.

Raw materials for the industry are the basic resins and additives described in IPPEU Chapter 10 (*The Plastics and Resins Production Industry*) and IPPEU Chapter 10b (*Plastics Additives*).

Products of plastics processing operations are used as substitutes for wood, metal, glass, leather, or natural fibers. Primary uses of plastics are packaging, construction, housewares, transportation, electric and electronic products, paints, furniture, appliances, and toys.

Plastics processing operations produce air emissions, wastewater, and solid waste resulting from both polymer and additive raw materials. Many processing operations do not produce all three waste streams. Particulate emissions made up of polymer and additive fines are possible during feeding, loading, and blending of dry materials, part trimming, and grinding of thermoplastic scrap for recycle. Volatile emissions are possible from operations in which polymers and additives are heated.

Most process-related wastewater produced during polymer processing operations is generated from direct-contact cooling of newly formed plastic products. Contamination of wastewater results from material washed or leached from the polymer.

Solid waste is produced by the collection of particulates from feeding, handling, and grinding operations and by trimming of parts. Thermoplastic scrap may be recycled, but thermoset scrap must be disposed of.

Worker exposure to harmful chemical substances and physical agents depends on the materials being handled, plant design, and effectiveness of engineering controls and personal protective equipment and clothing. These factors are essentially plant-specific and are highly variable throughout the industry.

IPPEU Chapter 10b: Plastics Additives

IPPEU Chapter 10b analyzes the chemicals used as additives in the production and processing of plastics, environmental releases of these chemicals, and possible occupational exposures to them. The report describes in detail more than 2000 chemical additives used in the plastics industry.

The following additive classes are discussed in Chapter 10b: Antioxidants, antistatic agents, blowing agents and other additives for foamed plastics, catalysts for thermoplastic polymerization, colorants, coupling agents, curing

agents and catalysts for thermosetting resins, fillers and reinforcing for plastics, flame retardants, free radical initiators and related compounds, heat stabilizers, lubricants and other processing aids, plasticizers, preservatives, solution modifiers and other polymerization aids, and ultraviolet stabilizers.

The plastics additives are presented as major functional groups of chemicals and are further subdivided into chemically, functionally, or physically similar chemicals. An overview of each major functional group includes the properties and application of the subclasses, their environmental impacts, and possible occupational exposures. A notation is made for specific chemicals on the Appendix VIII, Michigan Hazardous Waste List and/or the priority pollutant list. Common worker exposure practices for each functional group of additives are also presented.

The overview refers to a series of three appendices that detail (1) the physical and chemical properties of polymer application of each chemical within the functional groups, (2) the industrial, commercial, and consumer uses and consumption volumes for each chemical.

The full reports were submitted in fulfillment of Contract No. 68-02-3994 under the sponsorship of the U.S. Environmental Protection Agency.

This Project Summary was prepared by staff of Radian Corporation, McLean, VA 22102-9990.

Mark J. Stutsman is the EPA Project Officer (see below).

This Project Summary covers the following reports:

"Industrial Process Profiles for Environmental Use: Chapter 10, The Plastics and Resins Production Industry," (Order No. PB 85-245 280/AS; Cost: \$52.95, subject to change).

"Industrial Process Profiles for Environmental Use: Chapter 10a, The Plastics and Resins Processing Industry," (Order No. PB 85-245 298/AS; Cost: \$34.95, subject to change).

"Industrial Process Profiles for Environmental Use: Chapter 10b, Plastics Additives," (Order No. PB 85-245 306/AS; Cost: \$58.95, subject to change).

The above reports will be available only from:

*National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650*

The EPA Project Officer can be contacted at:

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