EFFLUENT LIMITATIONS GUIDELINES AND STANDARDS OF PERFORMANCE FOR THE INSULATION FIBERGLASS INDUSTRY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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DEVELOPMENT DOCUMENT

for

EFFLUENT LIMITATIONS GUIDELINES

and

NEW SOURCE PERFORMANCE STANDARDS

INSULATION FIBERGLASS MANUFACTURING INDUSTRY

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REVIEW NOTICE

This document presents conclusions of a study conducted by the Effluent Guidelines Division, U. S. Environmental Protection Agency in support of proposed requlations providing effluent limitations guidelines and standards of performance for new sources in the insulation fiberglass industry.

The conclusions and recommendations contained in this doucment may be subject to subsequent revisions during the document review process, and as a result the proposed effluent limitations guidelines, standards of performance and pretreatment standards contained within this document may be superceded by revisions prior to publication in the Federal Register on or before October 18, 1973, as required by the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251, 1314 and 1316, 86 Stat. 816 et seq.) (the "Act").

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ABSTRACT

This document presents the findings of an extensive study of the insulation fiberglass industry by the Environmental Protection Agency for the purpose of developing effluent limitations guidelines, Federal standards of performance, and pretreatment standards for the industry, to implement Sections 304, 306 and 307 of the "Act".

Effluent limitations guidelines contained herein set forth the degree of effluent reduction attainable through the application of the best practicable control technology currently available and the degree of effluent reduction attainable through the application of the best available technology economically achievable which must be achieved by existing point sources by July 1, 1977 and July 1, 1983 respectively. The standards of performance for new sources contained herein set forth the degree of effluent reduction which is achievable through the application of the best available demonstrated control technology, processes, operating methods, or other alternatives. The proposed regulations for all three levels of technology set forth above establish the requirement of no discharge of process waste waters to navigable waters.

Pretreatment Standards for "new sources" discharging to municipal sewerage systems are set forth in "Pretreatment of Discharges to Publicly Owned Treatment Works," ___ C.F.R. ___.

Supportive data and rationale for development of the proposed effluent limitations guidelines and standards of performance are contained in this report.

NOTICE: THESE ARE [illegible] IN THIS REPORT AND ARE
SUBJECT TO [illegible] REVIEW BY EPA.

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SECTION I

CONCLUSIONS

Notice

This document is a preliminary draft. It has not been formally released by EPA and should not, at this stage, be construed to represent Agency policy. It is being circulated for comment on its technical accuracy and policy implications.

For the purpose of establishing effluent limitations guidelines and standards of performance, the insulation fiberglass industry as a whole serves as a single logical category. Factors such as age, size of plant, process employed, geographic location, and waste control technologies do not justify the segmentation of the industry into any subcategories. Similarities in waste loads and available treatment and control technologies further substantiate this.

Presently, 6 of the 19 operating plants are achieving no discharge of waste wasters to surface waters. It is further concluded that the remainder of the industry can achieve the requirement as set forth herein by July 1, 1977. It is estimated that the costs of achieving such limitations and standards by all plants within the industry is less than $10 million. These costs would increase the capital investment in the industry 1.6 to 3.8 percent. As a result, the increased costs of insulation fiberglass to compensate for pollution control requirements would range from 0.6 to 3.8 percent under present conditions.

SECTION II

RECOMMENDATIONS

No discharge of process waste waters to navigable waters is recommended as the effluent limitations guidelines and standard of performance for the insulation fiberglass industry. This represents the degree of effluent reduction obtainable by existing point sources through the application of the best practicable control technology currently available, and the best available technology economically achievable. This also represents, for new sources, a standard of performance providing for the control of the discharge of pollutants which reflects the greatest degree of effluent reduction achievable through application of the best available demonstrated control technology, processes, operating methods or other alternatives.

The technologies on which such limitations and standards are based utilize reuse of the waste waters within the process.

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SECTION III

INTRODUCTION

Purpose and Authority

Section 301(b) of the Act requires the achievement by not later than July 1, 1977, of effluent limitations for point sources, other than publicly owned treatment works, which are based on the application of the best practicable control technology currently available as defined by the Administrator pursuant to Section 304(b) of the Act. Section 301 (b) also requires the achievement by not later than July 1, 1983, of effluent limitations for point sources, other than publicly owned treatment works, which are based on the application of the best available technology economically achievable which will result in reasonable further progress toward the national goal of eliminating the discharge of all pollutants, as determined in accordance with regulations issued by the Administrator pursuant to Section 304(b) to the Act. Section 306 of the Act requires the achievement by new sources of a Federal standard of performance providing for the control of the discharge of pollutants which reflects the greatest degree of effluent reduction which the Administrator determines to be achievable through the application of the best available demonstrated control technology, processes, operating methods, or other alternatives, including, where practicable, a standard permitting no discharge of pollutants.

Section 304(b) of the Act requires the Administrator to publish within one year of enactment of the Act, regulations providing guidelines for effluent limitations setting forth the degree of effluent reduction attainable through the application of the best practicable control technology currently available and the degree of effluent reduction attainable through the application of the best control measures and practices achievable including treatment techniques, process and procedure innovations, operation methods and other alternatives. The regulations proposed herein set forth effluent limitations guidelines pursuant to Section 304(b) of the Act for the insulation fiberglass subcategory of the glass manufacturing source category.

Section 306 of the Act requires the Administrator, within one year after a category of sources is included in a list published pursuant to Section 306(b) (1) (A) of the Act, to propose regulations establishing

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Federal standards of performances for new sources within such categories. The Administrator published in the Federal Register of January 16, 1973 (38 F.R. 1624), a list of 27 source categories. Publication of the list constituted announcement of the Administrator's intention of establishing, under Section 306, standards of performance applicable to new sources within the insulation fiberglass manufacturing subcategory of the glass manufacturing source category, which was included within the list published January 16, 1973.

Summary of Methods Used for Development of the Effluent Limitations Guidelines and Standards of Performance

The effluent limitations guidelines and standards of performance proposed herein were developed in the following manner. The point source category was first categorized for the purpose of determining whether separate limitations and standards are appropriate for different segments within a point source category. Such subcategorization was based upon raw material used, product produced, manufacturing process employed, and other factors. The raw waste characteristics for each subcategory were then identified. This included an analyses of (1) the source and volume of water used in the process employed and the sources of waste and waste waters in the plant; and (2) the constituents (including thermal) of all waste waters including toxic constituents and other constituents which result in taste, odor, and color in water or aquatic organisms. The constitutents of waste waters which should be subject to effluent limitations guidelines and standards of performance were identified.

The full range of control and treatment technologies existing within each subcategory was identified. This included an identification of each distinct control and treatment technology, including both inplant and end-of-process technologies, which are existent or capable of being designed for each subcategory. It also included an identification in terms of the amount of constituents (including thermal) and the chemical, physical, and biological characteristics of pollutants, of the effluent level resulting from the application of each of the treatment and control technologies. The problems, limitations and reliability of each treatment and control technology and the required implementation time was also identified. In addition, the non-water quality environmental impact, such as the effects of the application of such technologies upon other pollution problems, including air, solid waste, noise and radiation were also identified. The energy requirements of each of the control and treatment technologies was identified as well as the cost of the application of such technologies.

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The information, as outlined above, was then evaluated in order to determine what levels of technology constituted the "best practicable control technology currently available," "best available technology economically achievable" and the "best available demonstrated control technology, processes, operating methods, or other alternatives." In identifying such technologies, various factors were considered. These included the total cost of application of technology in relation to the effluent reduction benefits to be achieved from such application, the age of equipment and facilities involved, the process employed, the engineering aspects of the application of various types of control techniques process changes, non-water quality environmental impact (including energy requirements) and other factors.

The data for identification and analyses were derived from a number of sources. These sources included EPA research information, published literature, previous EPA technical guidance for insulation fiberglass manufacturing, qualified technical consultation, and on-site visits and interviews at exemplary insulation fiberglass manufacturing plants throughout the United States. All references used in developing the guidelines for effluent limitations and standards of performance for new sources reported herein are included in Section XIV of this document.

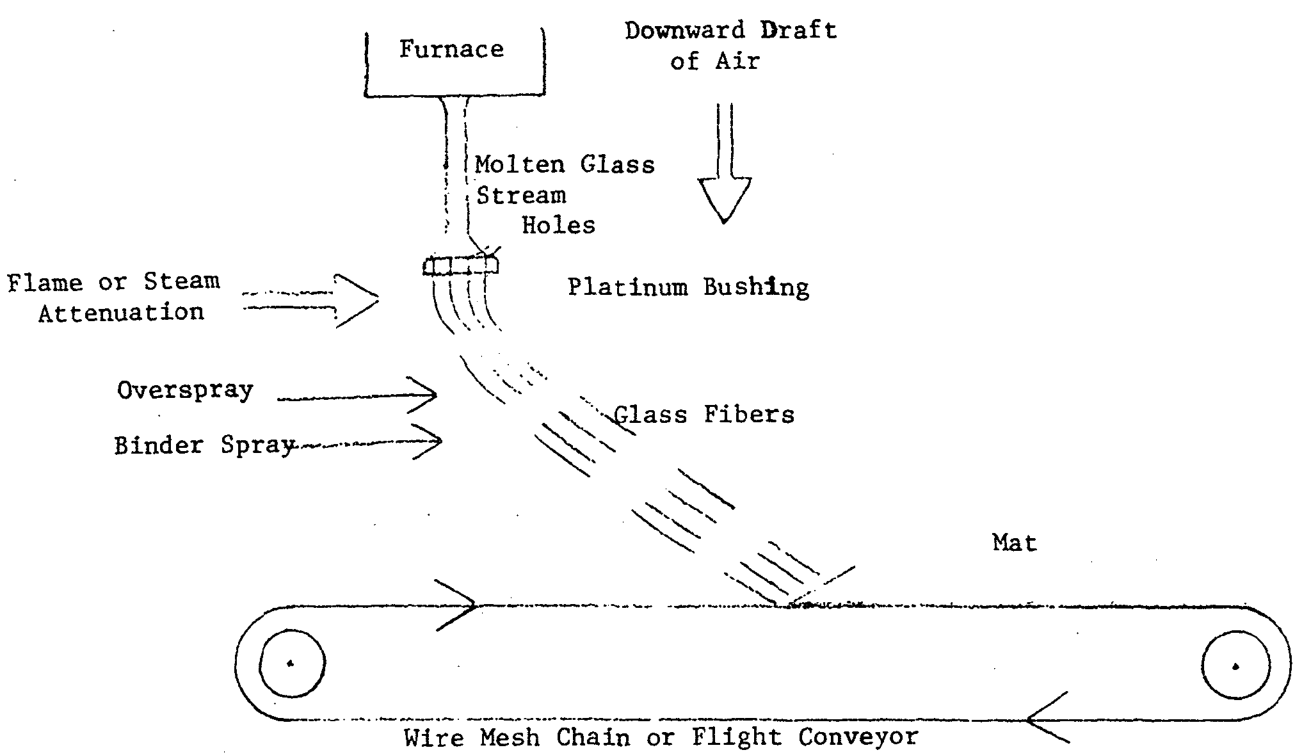
General Description of the Industry

The category covered by this document is the insulation fiberglass industry, a subpart of the Standard Industrial Classification 3296 in which molten glass is either directly or indirectly made, continuously fiberized and chemically bonded with phenolic resins into a wool-like insulating material. This will be referred to as a primary process in contrast to a secondary operation in which waste textile or wool fiberglass is processed into an insulation product. Insulation fiberglass research and development laboratories are also excluded in this report. The term insulation fiberglass is synonymous to the terms glass wool and construction fiberglass.

The modern fiberglass industry was born in the early 1930's when the Owens Illinois Glass Company and the Corning Glass Works combined their research organizations forming Owens-Corning Fiberglas. The original method of producing glass fibers was to allow molten glass to fall through platinum bushings, forming continuous thick threads of soft glass. The glass streams are then attenuated (drawn) into thin fibers by high velocity gas burners or steam. This process generally referred to as flame attenuation is pictured in Figure I.

FIGURE I

FLAME ATTENUATION PROCESS



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In the 1950's, Owens-Corning Fiberglass and the Cie de St. Gobain perfected the centrifugal or rotary process. A single stream of molten glass is fed into a rotating platinum distribution basket which distributes the glass on an outer rotating spinner. The spinner contains a large number of small holes arranged in rows in the wall. The molten glass is forced through the holes forming fibers which are then attenuated 90° from their forming direction by high velocity gas burners, air or steam as depicted in Figure II. The output of a single spinner may be 0.23-0.45 metric tons per hour (500-1000 lb/hr) and several spinners are used to feed fiber to one line.

Figure III shows the basic insulation fiberglass processes. The flame attenuation and rotary spinning processes have their own individual merits. The flame attenuated product has greater longitudinal strength because the fibers are attenuated in the same direction (away from the gas or steam blower) and the lengths consequently align in one direction to give added tensile strength. This property decreases damage to the product upon installation. Rotary spun fibers, on the other hand, are attenuated as they form on the circumference of a rotating disk. The fiber lengths thus assume random directions as they fall. Flame attenuated wools generally need less fiber (approximately 35% less) to achieve the same thermal properties as rotary spun wools. Since the two products are similarly priced, annual production ratings and plant capacities measured in kilograms can be somewhat misrepresentative when comparing the economics of the two processes. Rotary forming processes can produce more uniform and finer fibers. They are also capable of producing huge tonnages of wool, and for these reasons the rotary process now dominates the industry.

Borosilicate glasses and low alkali silicate glasses are generally used in making glass fibers because of their chemical durability. The surface area to weight ratio of the glass fibers in wool products is so great that even atmospheric moisture could seriously weather common silicate glass fibers. Table I is a compilation of the uses for the various types of glass and Table II lists their composition.

There are two methods of producing the molten glass that feeds the fiberizing machine in the forming area. The older method involves first producing approximately one inch glass marbles and then feeding the solidified marbles to a remelt furnace which in turn feeds the fiberizer with molten glass. The marbles may either be produced at the plant site or made at a centrally located plant and shipped to other plants. The original purpose of this seemingly redundant procedure is to insure glass uniformity before the fibers are made by visually inspecting the glass

FIGURE II

ROTARY SPINNING PROCESS

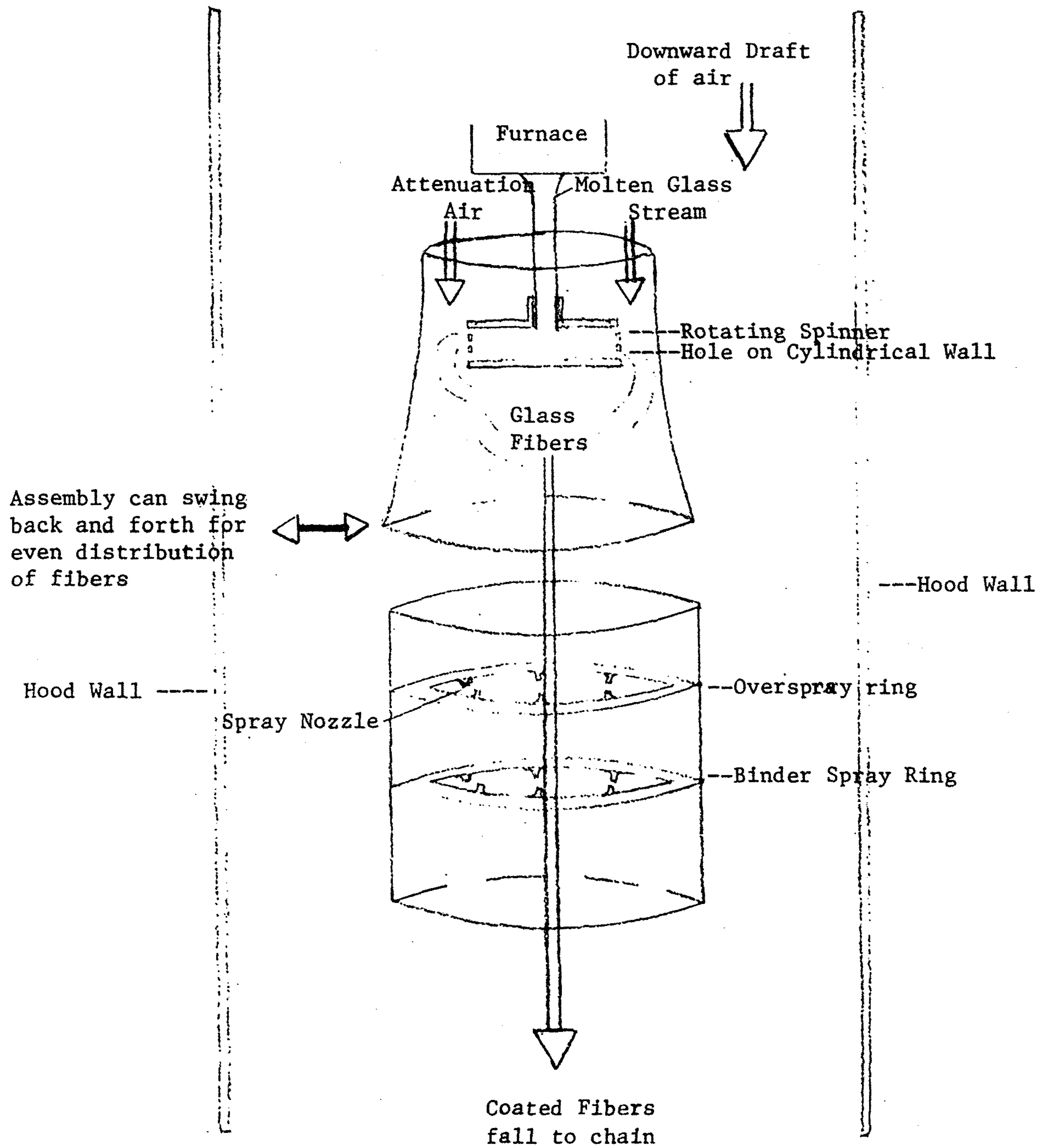

FIGURE III

HOW FIBERGLASS IS MADE

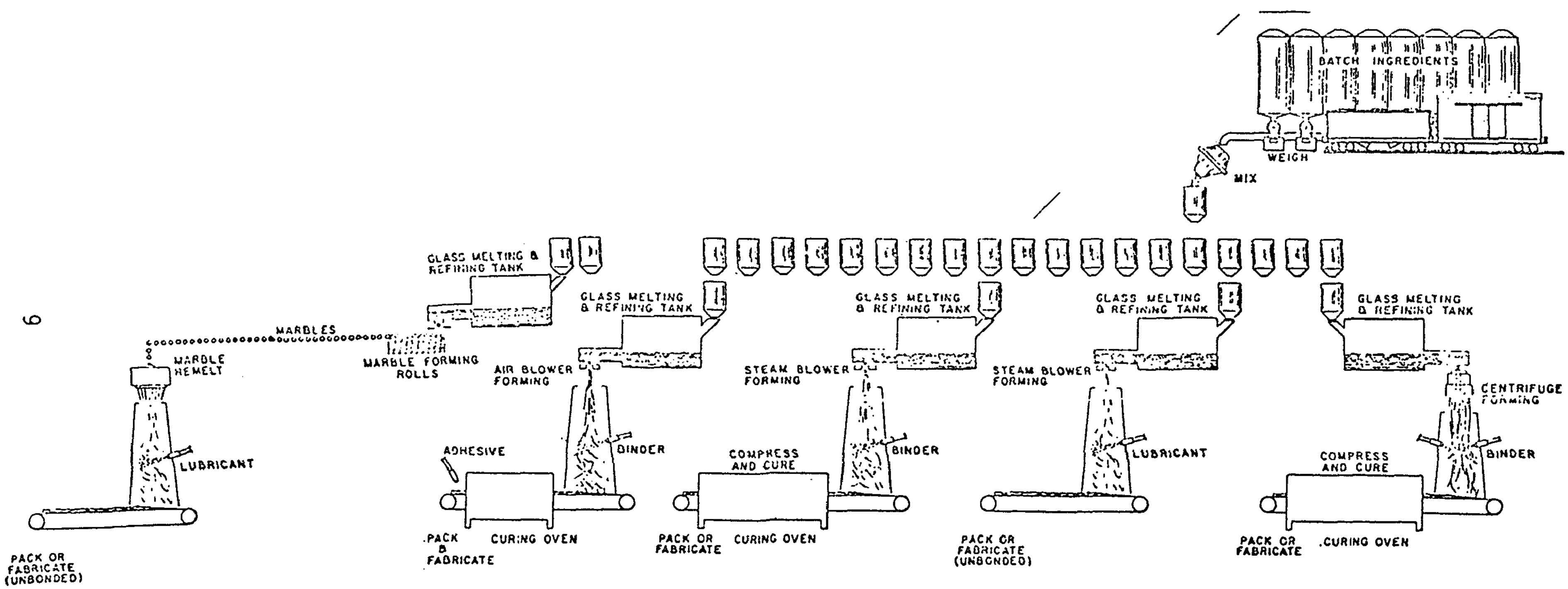

TABLE I

PROPERTIES RELATED TO APPLICATIONS
OF GLASS FIBERS

Glass Type	Fibrous-glass Forms	Fiber Diameter Range, mm	Fiber Diameter Range, in.	Dominant Characteristics	Principal Uses
1. Low-alkali lime-alumina borosilicate	Textiles and mats	0.00585 - 0.00965	0.0023 - 0.00038	Excellent dielectric and weathering properties	Electrical textiles. General textiles. Reinforcement for plastics, rubber, gyspum, papers. General-purpose mats
2. Soda-lime borosilicate	Mats	0.0101 - 0.0152	0.00040 - 0.00060	Acid resistance	Mats for storage - battery retainers, for corrosion protection, water proofing, etc. Chemical (acid) filter cloths, anode bags
	Textiles	0.00585 - 0.00965	0.00023 - 0.00038		
3. Soda-lime borosilicate	Wool (coarse)	0.00760 - 0.0152	0.00030 - 0.00060	Good weathering	Thermal insulations. Acoustical products
4. Soda-lime	Packs (coarse fibers)	0.114 - 0.254	0.0045 - 0.010	Low cost	Coarse fibers only, for air and liquid filters, tower packing, airwasher contact and eliminator packs
5. Lime-free soda borosilicate	Wool (fine)	0.00076 - 0.00508	0.00003 - 0.00020	Excellent weathering	Lightweight thermal insulations, sound absorbers, and shock-cushioning materials. All-glass high-efficiency filter papers and paper admixtures
	(Ultrafine)	0.0000(est)-0.00076	0.0000 - 0.00003		
6. High-lead silicate	Textile	0.00584 - 0.00965	0.00023 - 0.00038	X-ray opacity	Surgical pad strands, x-ray protection aprons, etc.

TABLE II

CHEMICAL COMPOSITIONS OF GLASSES USED TO FORM COMMERICAL FIBROUS GLASS (PERCENT) (4)

Type	SiO_2	Al_2O_3	CaO	MgO	B_2O_3	Na_2O	K_2O	ZrO_2	TiO_2	PbO	Fe
1. Low-alkali, lime-alumina borosilicate	54.5	14.5	22.0		8.5	0.5					
2. Soda-lime boro-silicate	65.0	4.0	14.0	3.0	5.5	8.5	0.5				
3. Soda-lime boro-silicate	59.0	4.5	16.0	5.5	3.5	11.0	0.5				
4. Soda-lime	73.0	2.0	5.5	3.5		16.0					
5. Lime-free soda forosilicate	59.5	5.0			7.0	14.5		4.0	8.0		2.0
6. High-lead silicate	34.0	3.0				0.5	3.5			59.0	

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marbles. The mechanical problems caused by seeds and bubbles are more troublesome in fibers than massive glass because of the small glass diameters involved. The assurance of better quality control in the glass making stage, however, has contributed to the replacement of the intermediate glass marble by direct feed furnaces. Currently only one company operates marble-feed, flame attenuated processes.

Direct melt furnaces always feed rotary forming processes because rotary spinners have high volume production capabilities which can only be matched by direct melt furnaces. Furthermore the high cost of a glass furnace usually necessitates that it be large, which in turn requires a large plant capacity in order to be profitable. Both marble feed and direct melt processes feed flame attenuation forming processes.

When production changes occur in a direct melt process the molten glass flow is temporarily diverted from the fiberizers and quenched with water. The glass immediately solidifies and fractures into fragments resembling a mixture of sand and aggregate, which is termed cullet. A major portion of the cullet is collected at the machine in hoppers for reuse into the melting furnace. If the furnace is not bled by producing cullet, the lighter components in the molten glass will volatilize and the composition of the glass will be altered.

The quality of water needed for cullet cooling is not especially critical and this water may be reused, with make up water added to compensate for the water flashed off by contact with the hot glass. It is not important that the water be cooled, but sufficient suspended solids must be removed so as to prevent damage to the pumps. Colloidal silica suspensions can be controlled by sufficient blowdown.

After the molten glass is divided into fibers and attenuated, the fibers are sprayed in mid-air with a phenolic water-soluble binder and forced by a downward air draft onto a conveyor chain which travels at 127 to 508 linear cm/sec (50-200 ft/sec). In many plants the newly formed fibers are oversprayed with water at the same time that the binder is applied. This overspray serves to cool the almost molten glass, minimizing volatilization and early polymerization of the binder.

The binder is a thermosetting resin composed of a dilute solution of phenol-formaldehyde (resin) and other chemical agents such as ammonia and surfacants. The latter two compounds serve as stablizers inhibiting rapid polymerization of the resin. The resin itself is a complex mixture of methylolphenols in both the monomer and polymer states. A more detailed

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description of binders is given in reference 7. For some products lubricants are applied to the new formed fibers singly or in addition to the binder. The lubricant, usually a mineral oil, is used to minimize skin irritation (fiber abrasion) of persons handling the insulation. Tables III, IV, and V list the binders and lubricants used for the various products. It should be noted that some mat and pack products in these tables are textile products not covered by this document. The properties and uses of each product are also listed. The binder is diluted with water before it is applied to the product. The quality of the diluted water is important in that it must not contain solids of such size as to plug the spray nozzles and in that it must not contain sufficient concentrations of chemicals that would interfer with the curing properties of the binder.

As the fibers fall to the chain a thick mat is formed. This mat then proceeds by conveyor through curing and cooling ovens, it is compressed, and an appropriate backing (asbetos, paper, aluminium, etc.) may be applied. The product is then sized and/or rolled and packaged.

There is currently a large demand for blow mold. This is made by shredding standard insulation so that it may be poured into existing walls. The thermal properties, however, are inferior to backed two inch insulation.

The cured phenolic resin imparts a yellow color to the glass wool which may not be appealing to the customer. Consequently, various dyes sometimes are applied to the fiberglass in the binder spray.

Two types of chains have been used in the forming area. Flexible wire mesh conveyor belts were originally used, but many have since been replaced by flight conveyors. These are hinged steel plates containing numerous holes or slits. The air stream which transports the glass fibers to the conveyor also contains droplets of resinous binder which have not adhered to the glass fibers. Many of these droplets deposit resin on the chain, and if not removed, the resin build-up will eventually restrict passage of the air stream. When the deposit becomes sufficiently great, blanket formation is no longer possible, necessitating replacement of the conveyor.

A wire mesh chain has historically been cleaned while in service to extend its useful operating period before becoming "blinded" with resin deposits by routing the chain through a shallow pan containing a hot caustic water solution (refer to Figure IV). Fresh caustic make-up to the pans created caustic overflow containing phenolic resin and glass fiber.

TABLE III

PRIMARY FIBROUS-GLASS-WOOL PRODUCTS

Product	Nominal Fiber Diameter, mm	Nominal Fiber Diameter, In.	Density Range, g/Cu. Cm.	Density Range, lb/cu. ft.	Binder	Maximum[1] Temperature Limit, °C	Major Application
Unbonded wool ("white")	0.013	0.0005	0.024 up	1.5 up 3.0 std.	Oil only	538	Heated equipment & appliances
Bonded wool (molded)	0.0096	0.00038			Phenolic resin	204	Pipe insulation-low temperature and low pressure heated pipe
Bonded wool	0.0086	0.00034	0.024-0.060	1.5-3.75	Phenolic resin	204	Appliance insulation
Bonded wool	0.013	0.0005	0.032-0.060	2.0-3.73	Phenolic resin	204	Appliance insulation
Bonded wool	0.016	0.0006	0.096	6.0	Phenolic plus high-temp resin	316	Duct insulation-fire barrier insulation
	0.016	0.0006	0.032-0.19	2.0-12.0	Phenolic resin	204	General purpose and fabricated forms, rolls, batts, blocks, boards, (plain, faced, asphalted), metal-mesh blankets; duct insulation, pouring wool
Bonded wool (fine fiber)	0.0010	0.00004	0.0096	0.6	Phenolic resin high-temp resin	316	Aircraft insulation
Bonded wool	0.0020	0.00008	0.0080	0.5	Phenolic resin Silicone oil		Flotation application
Bonded wool (fine fiber)	0.0030	0.00012	0.12-0.032	0.75-2.0	Phenolic plus high-temp resin	316 (600)	Wrapped on pipe insulation insulation
	0.0030	0.00012	0.12-0.032	0.75-2.0	Phenolic resin	204 (400)	General purpose insulation-sound control-shock cushing
	0.0030	0.00012	0.0048-0.0080	0.3-0.5	Phenol resin Silicone oil		Clothing interliner Seat cushioning
Bonded wool (fine fiber)	0.0043	0.00017	0.012-0.032	0.75-2.0	Phenol resin	204 (400)	Railroad-car, truck-trailer, and furnace insulation
Basic fine	0.00051	0.00002					
Fibers (bulk)	0.0030	0.00012			Unbonded		Fibers for papermaking
	0.0005-0.0030				Unlubricated		

[1]Maximum surface temperature in contact with insulation under most favorable conditions, organic lubricants and binders begin to oxidize from hot surface at 135°C. Actual loss of organic material depends on amount present, access to oxygen, and thickness and density of insulation. There is no low-temperature limitation so far discovered down to -185°C.

TABLE IV

FIBROUS-GLASS MATS--BASIC FORMS

Product	Nominal Fiber Diameter, mm	Nominal Fiber Diameter, in.	Weight Range, g/sq. cm.	Thickness[1] Range, mm	Notes
		Primary Mat Products			
Staple fiber mat	0.015 - 0.016	0.00060 - 0.00065		0.25 - 2.5	Resins, starch, gelatin and sodium silicate binder. Fibers in random lay
Reinforcing mat	0.058 - 0.096	0.00023 - 0.00038	0.015 - 0.091		Cut strands of continuous filament bonded in jack-straw (random) arrangement. Resin-type binders
Staple mat (random-reinforced)	Base mat, 0.016	0.00065			Base mat of staple fibers intertwined with endless continuous-filament strand in a random arrangement. Phenolic binder
Staple mat (parallel-reinforced)	Base mat 0.0.6	0.00065		0.5	Base mat of staple fibers interlaid with parallel strands of continuous filament for undirectional strength. Phenolic binder

[1] Thickness measured at 2.75 psi. That is 11 lb. load on 1/4-in. diameter platen.

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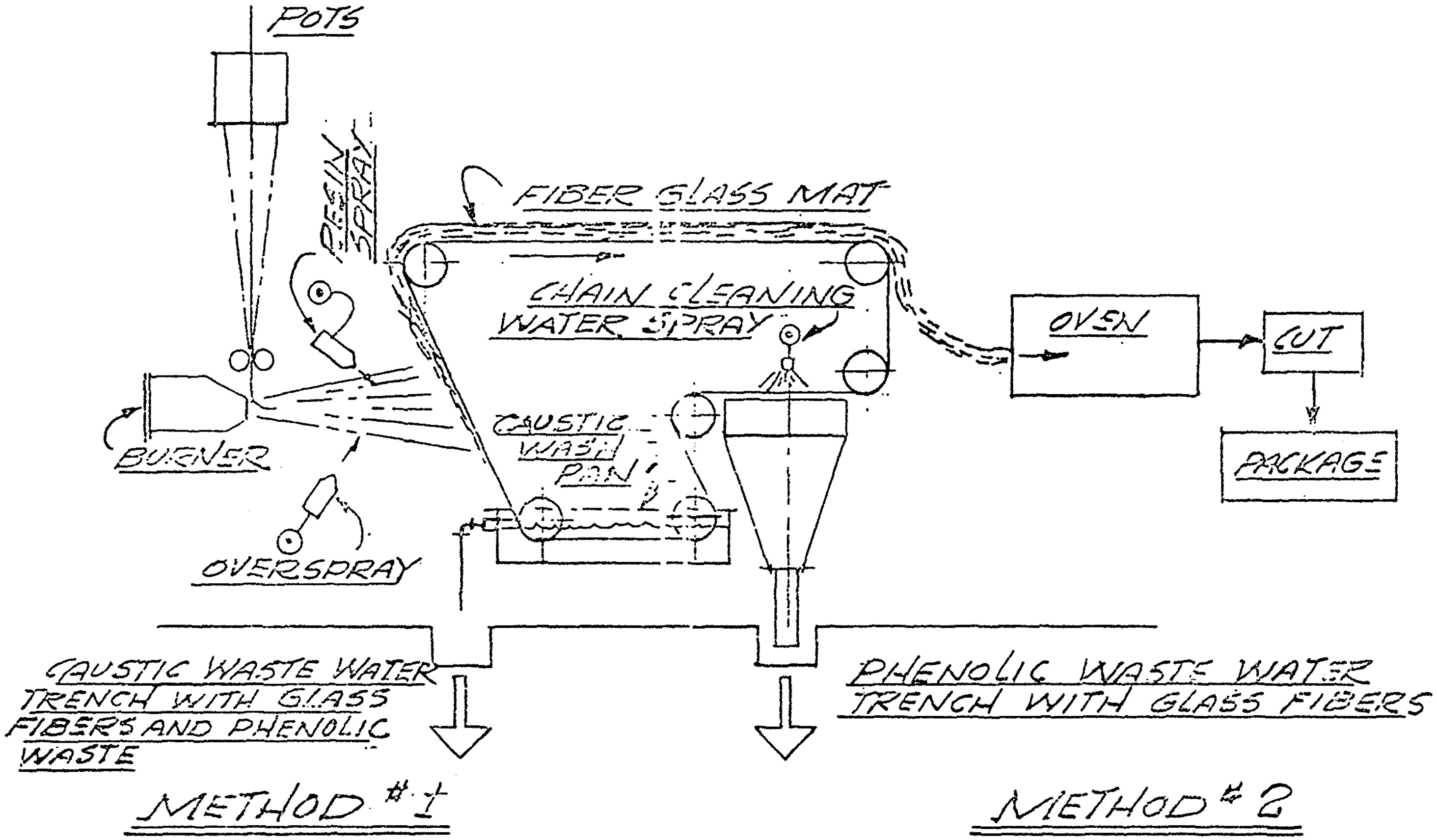
TABLE V

FIBROUS GLASS PACKS--BASIC FORMS

Product	Fiber Diameter mm, Nominal	Fiber Diameter, in., Nominal	Notes
Bonded packs (coarse fibers)	0.11 0.15 0.20 2.5	0.0045 0.0060 0.0080 0.100	Packs 1/2 and 1 in. thick water-soluble or insoluble binders. Used in air filters, air washers and as distillation column packing
Curly wool	0.029	0.00115	Bulk wool - usually lubricated. Special uses in process industries

FIGURE IV - WIRE MESH CHAIN CLEANING (5)



Caustic Chain Cleaning

Water Spray Chain Cleaning

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Another method of chain cleaning uses either fixed position pressurized water sprays or rotating water sprays. Unlike the caustic soda bath processes, the waste waters from this method are amenable to treatment and recirculation. Water spray chain cleaning has replaced caustic chain cleaning at all but one plant which uses a combination of the two methods. Although both methods have been used to clean wire mesh chains, it is impratical to caustic clean flight conveyors. Unlike the flexible wire mesh chains, the hinged plates of the flight conveyor cannot be so easily routed through a pan. Furthermore a flight conveyor is more expensive than a wire mesh chain, and corrosion caused by the caustic is of greater concern. Spray cleaning has the added advantage of cooling the forming chain, thereby decreasing both volitilization and polymerization of the phenolic resin and thereby lessening both air and water treatment problems.

Pipe insulation is made in various ways. One principal method involves wrapping uncured insulation about mandrels and curing the bundels batchwise in ovens. The mandrel is a perforated pipe of the appropriate dimensions. Caustic is still used by the industry to batch clean mandrels. However, the volumes involved are much less than those required for chain washing and are consequently much less of a problem.

Another source of water pollution is hood wash water. The hood is either a stationary or rotating wall used to maintain the air draft in the forming area. It is necessary to wash the hood in order to keep any wool that has agglomerated there from falling onto the chain and causing nonuniformity of the product.

Air scrubbing water can be another major source of water pollution. However, each plant has its own method of air pollution abatement with some even using completely dry processes.

Sales and Growth

The insulation fiberglass industry is a rapidly expanding industry as illustrated by the fact that the industry is currently at 100 percent production and several more plants and expansions are planned to be built. Current annual production is estimated at 0.77 million metric tons (1700 million pounds) per year. Profits before tax on sales range from about

9 percent to 20 percent with a median of 12 percent. Table VI summarizes recent product and sales. Supply and demand projections estimate 8 percent growth per year for the next five years. This picture may substantially change in light of the fuel crisis, a situation which will create even more demand for insulation materials.

The principal federal government influence on demand is brought about through changes or modifications in building code requirements. Such a change took place recently when the Department of Housing and Urban Development, Federal Housing Administration, revised the Minimum Property Standards for multi-family and single-family housing in order to fulfill the Department's commitments to the National Energy Conservation policy. The revision, which took effect in July 1971 for single-family construction and in June 1972 for multi-family construction, went into effect immediately for all mortgage insurance projects for which a letter of feasilbility has not been issued and for low rent public housing projects for which a program reservation has not been issued. This implementation will definitely provide more economical operating costs for the heating of residential units and will also conserve the nation's energy resources.

The major uses for glass wool are wall insulation, roof decking, acoustical tile, pipe insulation, ventilation ducts, and appliance and equipment insulation. In the areas of home insulation and acoustical tile, fiberglass has largely replaced its competition (e.g. mineral wool, perlite, urethane, wool fiberboard, Tectum, lightweight concrete or gypsum, foam glass, and ceramic insulation) because of the combined low cost, light weight, excellent thermal properties, and fireproofing properties. The principal competion for non-residential uses are urethane, styrene, and calcium silicate.

An estimated breakdown of products for the year 1971 is given below. As seen Batt insulation (standard two inch insulation) is the principal product.

ESTIMATE OF U.S. CONSUMPTION OF
WOOL GLASS FIBER, 1971

Batt Insulation	450	1000
Acoustic Tiles	41	90
Board Insulation	80	175
Pipe, Appliance and Equipment	75	165
Miscellaneous	25	60
TOTAL	673 Thousand metric tons	1490 Million lb

TABLE VI

U.S. SHIPMENTS AND VALUE OF WOOL GLASS FIBER 1964-1971 (11)

	1964			1965			1966			1967		
Insulation Use	MM lb	$ MM	¢/lb	MM lb	$ MM	¢/lb	MM lb	$ MM	¢/lb	MM lb	$ MM	¢/lb
Structural Building	368	76	20.7	438	93	21.1	484	105	22.6	484	109	22.5
Industrial, Pipe & Equipment	570	151	26.5	608	158	26.0	608	173	28.5	554	170	30.7
Total	938	227	24.2	1046	251	24.0	1072	278	25.9	1038	279	26.9

	1968			1969			1970			1971		
Insulation Use	MM lb	$ MM	¢/lb	MM lb	$ MM	¢/lb	MM lb	$ MM	¢/lb	MM lb	$ MM	¢/lb
Structural Building	557	133	23.9	627	158	25.2	644.8	165.6	25.7	--	--	--
Industrial, Pipe & Equipment	567	179	31.6	675	198	29.3	541.5	190.6	35.2	--	--	--
Total	1124	312	27.8	1302	356	27.3	1186.3	355.8	30.0	1518.7	426.9	28.2

Note: Values are average manufacturers' net selling prices, f.o.b. plant, after discounts and allowances, and excluding freight and excise taxes.

Source: Department of Commerce "Current Industrial Reports"

In summary, the insulation fiberglass industry is a rapidly growing one. At present only four companies produce fiberglass insulation. The nineteen existing plants and the estimated production by their parent companies are listed in Table VII. Figure V is a production size distribution graph of these plants. Because a high volume production is necessary and the glass fiber operation is difficult to scale down, there are no very small plants when compared to other industries. The smallest plant produces 2270 metric tons (5 million pounds) of specialty products per year.

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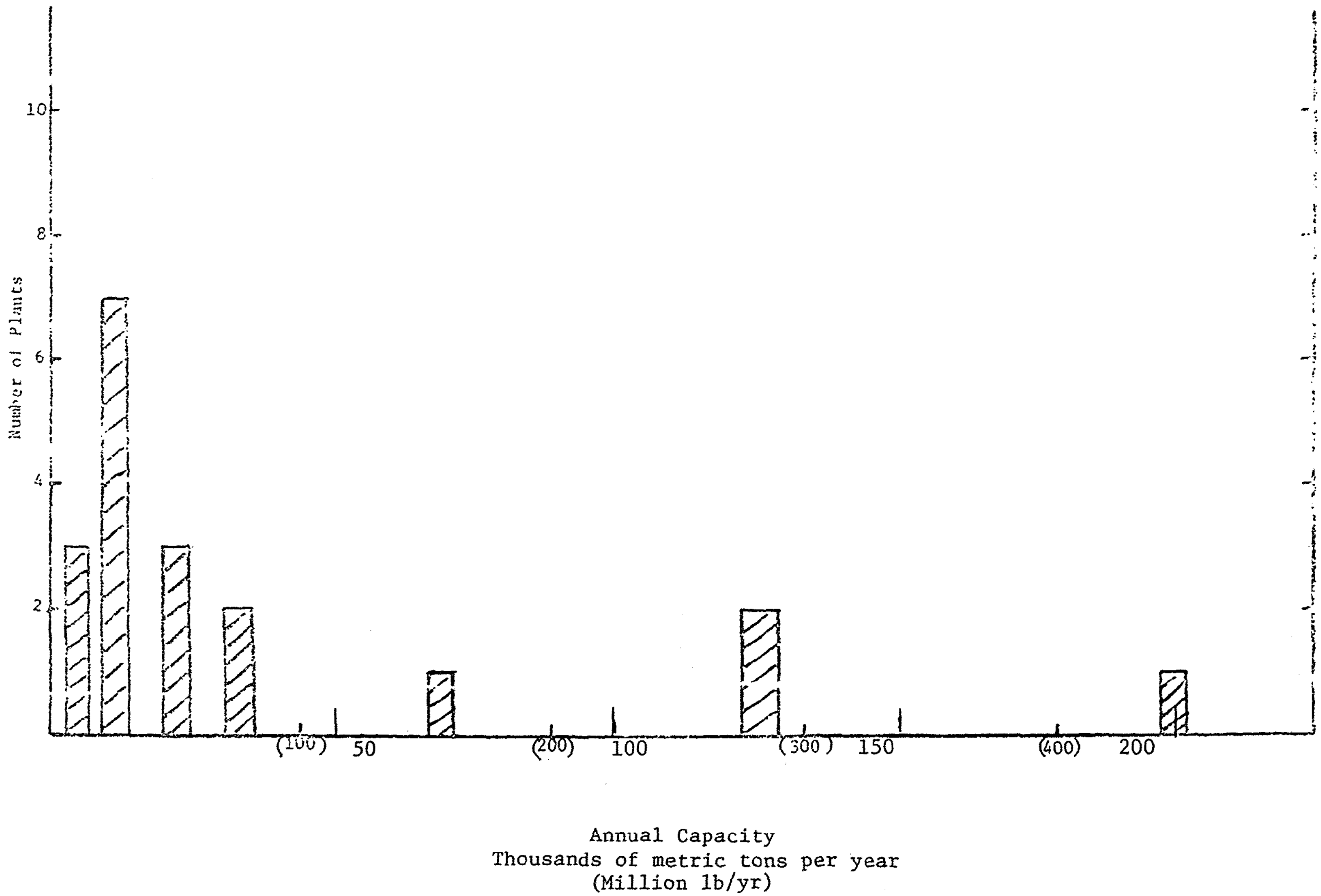
TABLE VII

INSULATION FIBERGLASS PLANTS

Company	Approximate Percent of Industry Production	Plant Locations
Owens-Corning Fiberglas Inc.	77	Barrington, N.J. Fairburn, GA Kansas City, KS Newark, OH Santa Clara, CA Waxahachie, TX
Johns-Manville	10	Cleburne, TX Corona, CA Defiance, OH (3) Parkersburg, WVA Penbyrn, NJ Richmond, IN Winder, GA
Pittsburgh Plate Glass Industries	3	Shelbyville, IN
Certain-Teed St. Gobain	10	Berlin, NJ Kansas City, KS Mountaintop, PA

FIGURE V SIZE DISTRIBUTION OF GLASS WOOL PLANTS



SECTION IV

INDUSTRY CATEGORIZATION

Introduction

In developing effluent limitations guidelines and standards of performance for new sources for a given industry, a judgment must be made by EPA as to whether effluent limitations and standards are appropriate for different segments (subcategories) within the industry. The factors considered in determining whether such subcategories are justified are:

1. Manufacturing Process
2. Chain Cleaning Process
3. Plant Size
4. Plant Age
5. Raw Materials
6. Product
7. Plant Location
8. Air Pollution Control Equipment
9. Wastes Generated
10. Treatability of Waste Waters

As the result of an intensive literature search, plant inspections, and communications with the industry, it is the judgment of this Agency that the primary insulation fiberglass industry can be considered as a single category. Not included are secondary plants which process waste, textile fiberglass and research and development facilities.

Factors Considered

1. Manufacturing Process

As described in Section III of this document, there are two types of glass fiber forming processes: flame attenuation and rotary spinning. Upon review of raw waste water loads and inspections of both types of processes, it is concluded that the manner of fiber forming has no direct effect on the quality of the waste waters, and hence subcategorization on this point is not needed. The different manufacturing processes, however, do have different air volume requirements which will affect wet air pollution control. This point is later considered.

2. Chain Cleaning Process

As described in Section III, there are also two basic methods for cleaning the forming chain of the glass fibers and phenolic resins. One method consists of dragging the wire mesh chain, on its return path to the forming area, through a hot caustic bath. The second method consists of spraying the wire mesh chain or flight conveyor with high velocity water.

The resultant wastes from caustic cleaning are extremely difficult to treat and unless considerable dilution is provided, the wastes are not suitable for recycling. The principle reason for this is that the only practical sink for the waste waters in a completely closed system is for overspray and binder dilution, and that unless diluted caustics are incompatible with phenolic resins. The blowdown from spray washing is amenable to treatment and recycle.

Two subcategories therefore would seem appropriate. However, at the present time only one plant employs caustic chain wash. The remainder of the industry has switched to spray washing and has future plans to employ only spray washing equipment. The one existing plant that uses caustic baths does so in conjunction with spray washing equipment and it is not necessary in this case to blowdown from the caustic bath. The carryover caustic on the chain is so diluted by the wash water volumes that no problems are anticipated in the new recycle system.

For these reasons subcategorization according to chain cleaning techniques is not necessary.

3. Plant Size

It has been determined from the data and from inspections that for other than volumes of waters, plant size has no effect upon the quality of waste waters and therefore it is not an adequate topic for subcategorization. Plant size will only affect costs of treatment systems when these costs are not directly related to plant capacity. Smaller plants will bear a somewhat higher treatment systems cost than larger plants.

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4. Plant Age

Glass wool plants span an age of from 2 years to more than 25 years since plant start up. About 30 percent of the plants are 10-15 years old while 25 percent are less than 10 years old. All plants that are at least 2 years old have undergone considerable upgrading of the production processes and in many cases facilities have been expanded with installation of state of the art processes. The major effects of plant age will be of more significance in the cost of installing water recycling systems rather than differences in waste water characteristics. Hence, plant age is not an appropriate basis for subcategorization.

5. Raw Materials

The raw materials required for wool glass are much the same as for standard massive glass: 65 percent silica and 35 percent fluxing oxides (e.g. limestone and borates). The compositions of typical glasses and their uses have previously been listed in Tables I and II respectively. Once the glass is made either as fibers or cullet, it is for all practical purposes inert, and thus will not chemically affect waste water quality.

The type of resin used, however, will exert some influence on both air and water quality. The industry is continually formulating new binder mixtures in an effort to minimize air and water pollution problems.

However, the industry should not be subcategorized according to type of binder used for the following reasons. Different products can require different binders and these can be made at different times on the same machine. Composition changes in the binder can occur at any time, as the industry tries to improve the product and decrease raw material costs. The individual characteristics of each machine within every plant determine how quickly the waste resin will set up (i.e., polymerize), and this is the principal factor affecting water quality. No matter what resin is used, the general waste characteristics are the same and the treatment system will not be affected as long as biological treatment is not practiced.

6. Product

The type of product made will affect the chain wash water quality in that different products may require different resins. However, for the same reasons given above, the industry should not be subcategorized on this topic.

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7. Plant Location

Geographical location will have an effect on waste water quality only if water softening is required. From those plants inspected, it was learned that the degrees of water treatment varies considerably among the industry. Waste water treatment practices on the softener backwash also vary significantly, with some plants being able to incorporate these waste streams into the wash water system. Treatment of water treatment system wastes are common to industry as a whole, and as such does not merit subcategorization for each separate industry.

Geographic location may influence how a particular plant handles its blowdown and waste streams. Three plants in rural areas with relatively warm and dry climates are using evaporation ponds. Another plant has sufficient land to use for spray irrigation. However, all plants have the option of disposing of their blowdown in the overspray or binder solution and subcategorization by geographic location is not necessary.

8. Air Pollution Control Equipment

The type of system used to control air pollution will definitely affect the water treatment scheme. In plants where dry air pollution control equipment is adequate, high pressure, low volume chain sprays are feasible, easing the water treatment problem.

However, each company has its option on how to handle its air problems, and as such water quality should not be jeapordized when alternate methods of air quality control are available. This item is therefore not suitable for subcategorization.

9. Waste Generated

From evaluation of the available data it is concluded that the types of wastes generated are common to all insulation fiberglass plants. The only exceptions are dyes and water treatment backwashes. The former parameter presents no problem in so far as quality of recycled water. The latter was previously covered under geographical location. Therefore the industry should not be subcategorized according to wastes generated.

10. Treatability of Waste Waters

From discussions with the industry and from plant inspections it was concluded that in a recycle system for a insulation fiberglass plant only three basic parameters in the process water affect its treatability, suspended solids, dissolved solids, and pH. The recycled waters can be adequately treated by course filtration, pH control (if necessary), fine filtration or coagulation - settling, and sufficient blowdown as can be handled. With proper design of the treatment system there should be no forseeable reason other than plant expansion that these basic systems need to altered in order to accommodate varying waste load characteristics. Therefore treatability of waste water factors indicate that all insulation fiberglass plants fit into a single category.

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SECTION V

WASTE CHARACTERIZATION

General

A general water flow diagram for an insulation fiberglass plant is pictured in Figure VI. A complete analysis for each waste stream has not been done by the industry since only the combined waste stream has been of interest. As previously discussed, the principal process waste streams within the process are the chain cleaning water and water sprays used on the exiting forming air.

Flow Analysis

Table VIII lists chain wash water flows for plants of various sizes. As seen there is no correlation between plant size and water usage for chain washing. This is to be expected because each of the four insulation fiberglass producers uses chain sprays of different pressures and therefore different flow rates.

As previously mentioned, each company also employs different methods of air pollution control. In those plants employing water sprays to clean the forming air, this water flow may be the major process water flow. Lastly, the different types of glass furnaces or melting pots have varying cooling water requirements.

In summary, it is not possible to give a typical process water usage for a given production or even to give a meaningful range of flows.

Raw Waste Loads

Table IX summarizes the raw waste loads for several plants. Although the numbers are not completely comparable because of treatment differences and different blowdown percentages, the table nevertheless shows a wide variance in waste water composition. Other factors affecting the raw waste load include binder composition, chain temperature, and other thermal and time factors affecting the rate of resin polymerization.

One particular waste stream addressed by this report is cullet cooling water. Suspended solids concentrations are extremely variable and depend upon how many fiberizers are being by-passed. One company estimated concentrations in the waste water to range from a few hundred to tens of thousands mg/l after simple settling. The same company did a size distribution study of the suspended solids that appears as Table X.

FIGURE VI

GENERAL WATER FLOW DIAGRAM FOR AN INSULATION FIBERGLASS PLANT

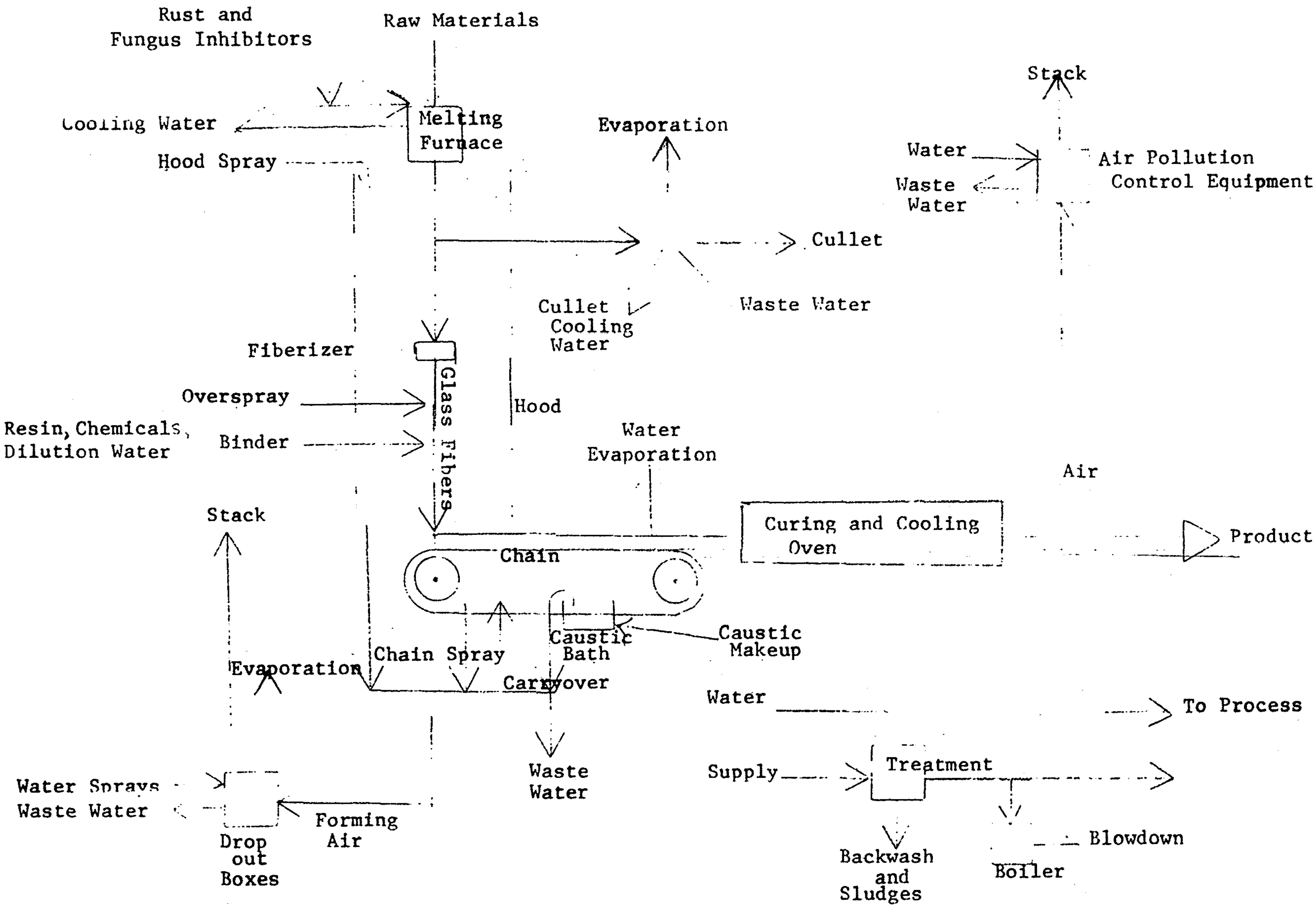

TABLE VIII

CHAIN WASH WATER USAGE

Plant	Plant Size[1]		Water Usage Chain Sprays	
	Thousands of Metric Tons Per Year	Million pounds per year	liters/sec.	gpm
A	120	270	44	700
B	34	75	38	600
C	34	75	14	200
D	27	60	63	1000
E	16	35	50	800
F	16	35	8	120
G	14	30	3	48

[1] All production figures are estimates.

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TABLE IX

RAW WASTE LOADS
FOR INSULATION FIBERGLASS PLANTS

Plant	Phenol mg/l	BOD5 mg/l	COD mg/l	TSS mg/l	TDS mg/l	TURBIDITY	pH	Percent Blowdown[3]
H	363	156	2500-4000	116-561				
F[1]	2564	7800	43,603	360	3000-5000			8.3
G	4.11			76	822		7.7-8.9	13.0
A	212	991	6532	769	10,000-20,000[2]			1.5
B[1]	240	6200	23,000	200	16,000	200	8.0	1.0
D[1]					40,000[2]			2.3
I	11-98	900	3,290	690	2,080		6.1-12.2	

1 - Sample taken from water recirculation system

2 - Given by company with no backup data

3 - Defined as percent total process water used as overspray or binder dilution

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TABLE X

SIEVE ANALYSIS
ON WASTE CULLET WATER

U.S. Sieve Number	µm Equivalent	% By Weight Retained
50	297	98.30
100	149	1.20
140	105	0.30
200	74	0.05
325	44	0.01
400	37	0.05
Finer Passed		0.09
		100.00%

As seen from the table 99.50 percent of the cullet should be amenable to primary settling. However, especially at high cullet producing times, an appreciable amount of minus 100 mesh glass particles can remain suspended in the waste water. Visual inspections at some plants noted cullet scattered about the river banks below discharges of cullet cooling water.

Summary

In summary, water usage and raw waste loads are not relatable in a practical manner to production levels or techniques. Of the nineteen existing plants, there may be as many different formulas for relating these factors. There are significant differences between plants even within the same company. A compensating factor, however, is the fact that all such wastes are amenable to the same general type of chemical and/or physical treatment.

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SECTION VI

SELECTION OF POLLUTANT PARAMETERS

Selected Parameters

Upon review of the Corps of Engineers Permit Applications for discharge of waste waters from insulation fiberglass plants, EPA data, industry data, and observations made during EPA plant inspections the following chemical, physical, and biological constitutents constitute pollutants as defined in the Act.

- Phenols
- BOD_5
- COD
- Dissolved Solids
- Total Suspended Solids
- Oil and Grease
- Ammonia
- pH
- Alkalinity
- Color
- Turbidity
- Temperature (Waste heat)
- Specific Conductance

The rationale for the selection of the above parameters follow. These parameters are present in the raw waste streams of all fiberglass insulation plants. Pollutants in cooling systems (algae and corrosion inhibitors) and in water treatment backwashes are covered by the Effluent Limitation Guidelines Development Documents for Steam-Electric Power Generation and Water Treatment.

Phenols

The basic constituents of the binder are phenol, formaldehyde, urea, and ammonia which react to form various mono and poly methylol phenols. Therefore, free phenols will always occur in any water that has contact with uncured resin. Phenol concentrations range from 1 milligram per liter (mg/l) in once through process waters to several hundred mg/l in recycled waters. In the case of the higher concentrations, these consist of colloidal suspensions of resins in a partially polymerized state. However, as some companies have found, a significant portion of the total phenols also occur in a free state.

Biochemical Oxygen Demand (5 day)

Because of the nature of the organic compounds used in the binder, a BOD_5 will exist. Values range from 40 mg/l to 7,800 mg/l, with the higher values again representing recycled waters. Data from one industrial biological treatment plant show that this constituent is easily treatable.

Chemical Oxygen Demand

For the same reasons as given above, a sizeable chemical oxygen demand will exist in the raw waste stream. Values range from 150 mg/l to 43,603 mg/l, the higher values occurring in recycled waters. A 94 percent reduction was accomplished by an activated sludge plant, but the resultant levels in the effluent were still high (300 mg/l).

Dissolved Solids

Dissolved (filtrable) organics and super-fine colloidal organics, that are classified as being filtrable according to Standard Methods (12), will increase the background dissolved solids concentrations significantly as a result of chain washing and wet air pollution control. Values range from net increases of 200 mg/l to gross concentrations of 40,000 mg/l. A closed water cycle will significantly raise the level of this parameter.

Total Suspended Solids

Conglomerated glass fibers and partially polymerized resins will appear as suspended solids in the chain wash water. Values have been reported to be as high as 770 mg/l in untreated waste waters.

Oil and Grease

Mineral oils are frequently added to the binder to alleviate abrasion problems. The amounts of lubricant used are proprietary information but relatively small. Slight oil sheens have been noted in the waste streams of some plants during inspections. Values for final effluents range from 7.5 mg/l to 140 mg/l.

Ammonia

Ammonia is typically added to the binder for stabilization purposes. The rate of binder polymerization is decreased by an increasing pH. Ammonia is also added to the chain wash water to inhibit polymerization in order to minimize screen and filter plugging. Ammonia concentrations in effluents range from 0.6 mg/l to 4.83 mg/l.

pH

As previously mentioned the binder polymerization reaction is pH dependent. Unless neutralization is practiced, waste water from a fiberglass insulation plant will be alkaline with a pH greater than 9.0.

Alkalinity

The presence of alkalinity has already been established in the pH discussion. Alkalinity determined as equivalent mg/l of calcium carbonate ranges from 285 mg/l to 5,000 mg/l.

Color

Color will result from both the polymerized resin (yellow to brown) and any dye that is added to the product in the binder spray. Colored waste streams have been seen at nearly all the plants inspected. It is especially notable at plants with process water recirculation systems.

Turbidity

Turbidity is a measure of the light absorbing properties of the constitutents in water. For a fiberglass insulation plant these result from colloidal suspensions and from dyes. Values range from 55 to 133 Jackson Turbidity Units for once through waters.

Temperature

Since high temperatures are required to make molten glass (2700°F.), thermal increases in contact and non-contact waters will be noted.

Specific Conductance

Specific conductance is a measure of the capacity of water to convey an electric current. This property is related to the total concentration of ionized substances in the water and the water temperature. Thus in the absence of a large amount of colloidal solids that are analytically classified as dissolved (filtrate), specific conductance will be proportional to the total dissolved solids concentration. For qualitative measurements this is a quicker and more practical method of monitoring dissolved solids.

Condensed Parameter List

Although all of the above parameters will result from the insulation fiberglass process, only a few need be monitored to insure that pollutants are not discharged:

Phenols
COD
Total Dissolved Solids
Total Suspended Solids
pH
Color
Temperature
Specific Conductance

The remaining five parameters will always appear in combination with one or more of the above parameters. To further pursue this point an absolute minimum of only three parameters, specific conductance, temperature, and total suspended solids need be monitored to insure that the recycle systems are operating. A deviance in any one of these parameters will signal that something is amiss and that analysis of the remaining parameters is necessary. These particular parameters need only be considered because any waste stream in an insulation fiberglass plant will significantly contain one to all three of these parameters.

SECTION VII

CONTROL AND TREATMENT TECHNOLOGY

Historical Treatment

In only one insulation fiberglass plant has other than primary treatment to an effluent been applied. Plants have historically discharged their waste streams to municipal sewage treatments rather than install secondary or more advanced treatment systems. Use of biological treatment as an end-of-pipe treatment for phenolic waste waters was attempted at one insulation fiberglass plant (Plant A). The treatment scheme (Figure VII) consisted of equalization, alum coagulation, nutrient addition, temperature control, extended aeration, post chlorination, aerobic sludge digestion, and vacuum filtration. It is noteworthy that the recirculation system was installed some thirteen years ago and that only the blowdown received biological treatment. Table XI summarizes the performance of the system. However, despite the percent removal efficiencies of the treatment system, objectionable concentrations of phenol and COD were still being discharged.

One parameter that received no treatment other than dilution was color. A bright pink dye is applied to many of the products in the binder solution. The company researched use of activated carbon absorption in an effort to remove the dye and the remaining phenol and COD in the effluent However, this approach proved too costly when compared to a total recycle system.

The only parameter that may interfer with an ill conditioned publicly owned treatment works is phenol. Only certain strains of microorganisms effectively remove phenols from waste waters and their effectiveness are confined to narrow concentration ranges. Therefore, if sufficient dilution water is not present, wide variations of phenol in the raw waste load may adversely affect the populations of these organisms.

State of the Art Treatment Technology

The industry already has long realized that recirculation of chain wash water is feasible and that a blowdown is necessary to control the buildup of solids in the system. The industry also recognizes that suitable treatment of the blowdown for reuse as overspray or binder dilution water is less costly than performing advanced treatment to a final effluent. In the former treatment scheme the wastes essentially go into the product and the water is evaporated. As an alternate method of blowdown disposal, some plants because of climatic conditions or space availability have employed evaporation ponds or spray irrigation.

FIGURE VII
BIOLOGICAL TREATMENT AT PLANT A

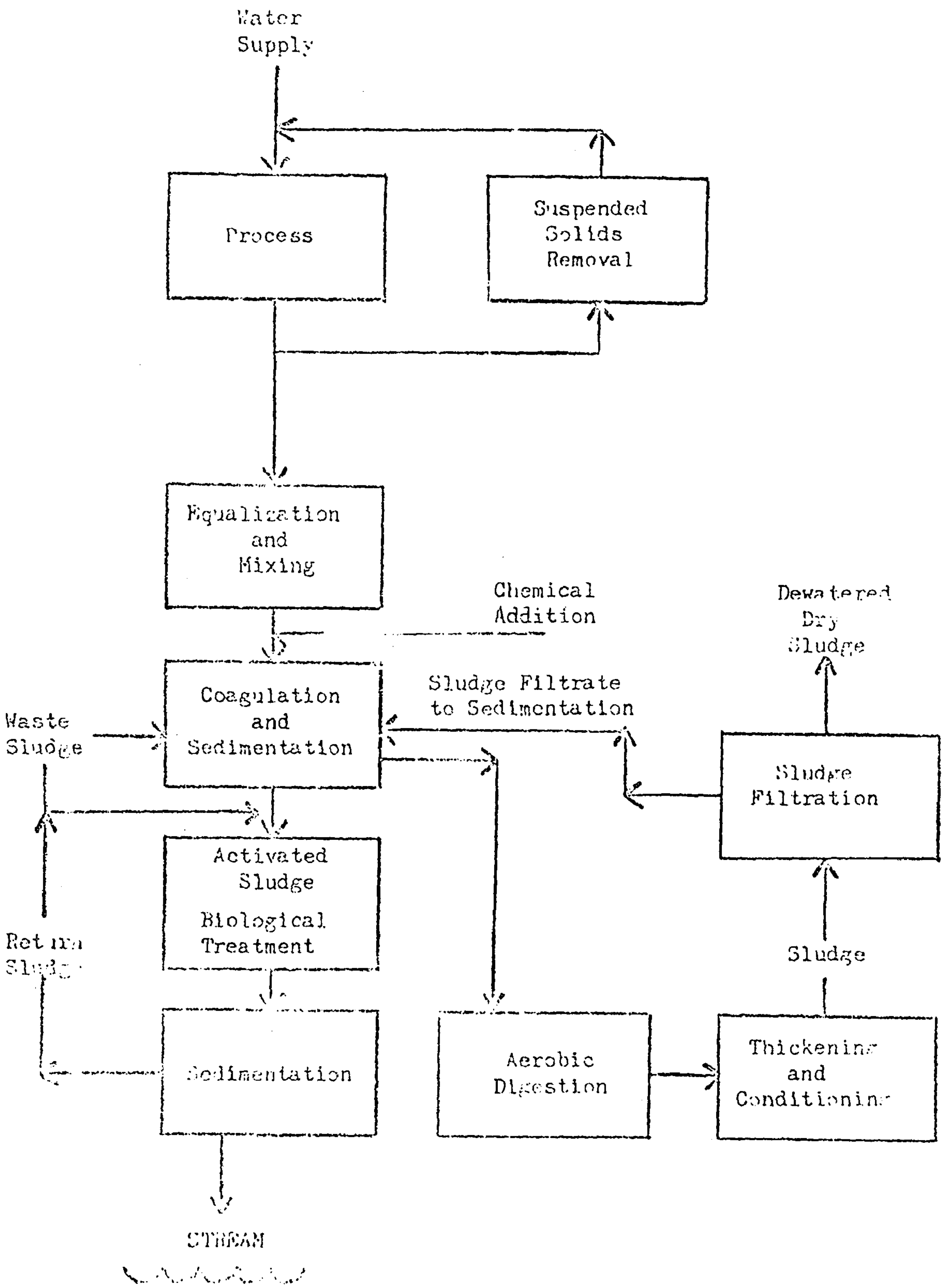

Table XI

Biological Treatment System
at
Plant A

Parameter	Raw Waste mg/l	Final Effluent mg/l	Percent Removal
Phenol	212	1.48	99.3
Suspended Solids	769	27	92.0
COD	6532	298	94.4
BOD_5	991	19.8	97.7

The two parameters in the recycled water that limit the pressure that can be used in the spray equipment are suspended solids and dissolved solids. Since the latter is determined by the blowdown rate and degree of resin polymerization it is the more difficult of the two to control.

The above methods constitute the current "state of the art treatment technology" employed by the industry. Table XII lists the water pollution abatement status of all existing primary plants. In summary the table shows that 3 plants completely recycle all process waters. One more does likewise except for cullet cooling water. Four plants recycle with three blowing down to evaporation ponds and the fourth to a spray field. Four plants recycle and discharge blowdown to publicly owned treatment works. Five discharge once through waters to such works. Six plants have plans for complete recirculation of process or all wastes streams.

All four insulation fiberglass producers operate or will shortly have complete process water recirculation plants. Three companies now operate total recirculation plants. Thus the entire industry has the technology to apply the "state of the art treatment technology".

Detailed descriptions of those plants that are currently practicing this technology follow. The plants described cover the entire range of types of plants: new and old; small, medium and large; flame attenuation and rotary spinning processes. The examples also illustrate how air pollution abatement methods can affect the water system.

Table XII

WATER POLLUTION ABATEMENT STATUS OF EXISTING PRIMARY INSULATION FIBERGLASS PLANTS

Plant	Status
A	Complete recirculation of process waters. Some indirect cooling water discharge to stream
B	Complete recirculation
C	Discharge once-through waters to POTW.[1] Plans for recirculation
D	Complete recirculation except for discharge of cullet cooling water
E	Complete recirculation of phenolic wastes by 5-1-73. Other wastes to POTW
F	Complete recirculation
G	Discharge once-through water to POTW. Plans for recirculation
H	Recycle with blowdown to POTW, cooling waters to river. Plans for complete recirculation
I	Discharge once-through waters to POTW. Recycles cullet water plans for complete recirculation (1975)
J	Recycle on 1 line. Other lines discharge to river
K	Recycle with blowdown to evaporation pond
L	Evaporate wastes in pond
M	Discharge once-through water to POTW. Plans for recirculation
N	Wastes used for spray irrigation
O	Discharge to POTW
P	Recycle with blowdown to evaporation ponds
Q	Discharge once-through waters to POTW. Plans for recirculation
R	Completely recycle phenolic waters. Caustics and other waters to POTW
S	Recycle with blowdown to POTW

[1] POTW - Publicly Owned Treatment Works

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Plant A

This plant was built in 1956 and currently has a production capacity of 120,000 metric tons (270 million pounds) per year. The four rotary spinning lines in operation are fed by direct melt, gas fueled furnaces and employ flight conveyors in the forming area. The plant produces standard two inch insulation, acoustical ceiling tile, pipe insulation, and blow mold.

As previously mentioned, efforts to close the water system have been undertaken for the past thirteen years. The plant has been operating a complete closed circuit process water loop for the past three years, but is continuing to research more effective and economic ways of internally treating the waste waters for reuse. Figure VIII depicts the present system.

The company considers the crucial point in this water system to be the huge amounts of heated air, that are drawn through the forming area and that leave the stack saturated with water from the chain wash system. The plant has a 1.5 percent blowdown of dirty water which stabilizes the total solids concentration within the system to between one and two percent. Phenol cencentrations range between 200 to 500 mg/l within the system.

The plant is currently operating stationary chain sprays at 20.4 atmospheres pressure using recycled water. Clean water is used at between 135 and 204 atmospheres when the resin buildup is particularly bad. This flow is estimated to average 0.6 l/sec (10 gpm) and to occur over a period of 10 minutes each shift. The dirty water sprays use 19 l/sec (300 gpm) per machine. This plant operates its water systems at a higher total solids concentration than other plants and must therefore use less powerful pumps in order to protect them.

As seen from Figure VIII, the system consists of directly recycling screened chain wash water, periodic blowdown for binder dilution water, and chemical treatment of additional blowdown before being returned to the recycle water system. Since a very low blowdown ratio exists, the plant must thoroughly treat a large portion of the process water before recycling it. The company originally employed flocculation and clarification to remove dissolved organics and suspended solids, but has recently discontinued flocculation without harmful effects. Sludge from the treatment systems is landfilled at an approved state site.

Like the rest of the industry this plant is dissatisfied with the performance and large maintenance requirements of the diatomaceous earth filters and is investigating alternate methods such as paper filters and cyclones.

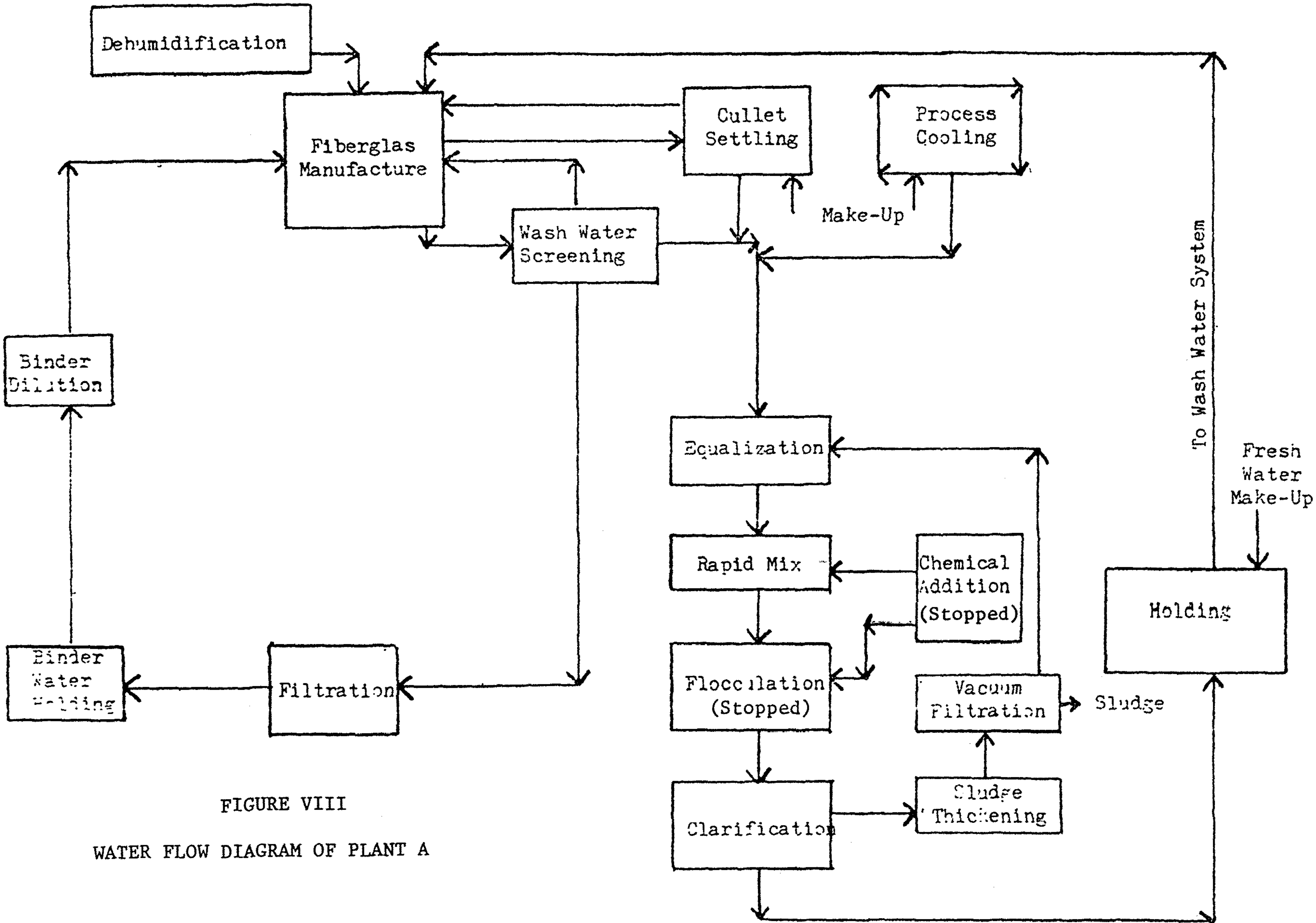


FIGURE VIII

WATER FLOW DIAGRAM OF PLANT A

A considerable amount of cullet is produced here. The cullet quench water system is a separate recirculation system with blowdown to the flocculation treatment system. The indirect furnace cooling water system is also closed with blowdown likewise going to the flocculation treatment system. Chromates are used for corrosion control in the system.

Caustic mandrel cleaning is performed at this plant. However, the volumes of caustic blowdown are such that they can be put into the wash water recirculation system without causing obvious problems.

Air has replaced steam in the forming process thus reducing the demand for softened waters. The only water required in this system is for indirect cooling of the air compressors.

The majority of water used in the plant is for particulate air pollution control at the forming area. This water is also used as chain wash water. The company is concerned that any change in the air pollution control equipment may also effect the wash water system, particularly in the case of where dry air pollution equipment is used and more blowdown may be required to maintain the low solids concentration.

An air scrubber is used at the end of the curing oven to lessen the odor problems. The system requires continual fresh water make-up due to water evaporation and has no blowdown. A dehumidification system is used on the forming air in a further effort to control odor problems. Contact cooling water from this system is recycled with the blowdown going to the chain wash water system. Noncontact once through cooling water for the dehumidification system is discharged to a small stream behind the plant. Unless a leak occurs in the shell and tube heat exchanger the only contaminant in this discharge is thermal, the temperature estimated to range between 31 and 40 degrees Centigrade. At present this is the only plant within the industry employing a dehumidification system.

One of the more effective techniques to curb odor problems at this plant has been to change binder compositions to inhibit phenol volatilization in the hot forming area. However, whenever this is done the wash water quality must be re-evaluated to insure its compatability with the new binder. The company expressed concern that future air pollution abatement requirements will further complicate the wash water system, but at this time they see no reasons why the system cannot remain a total recirculation system.

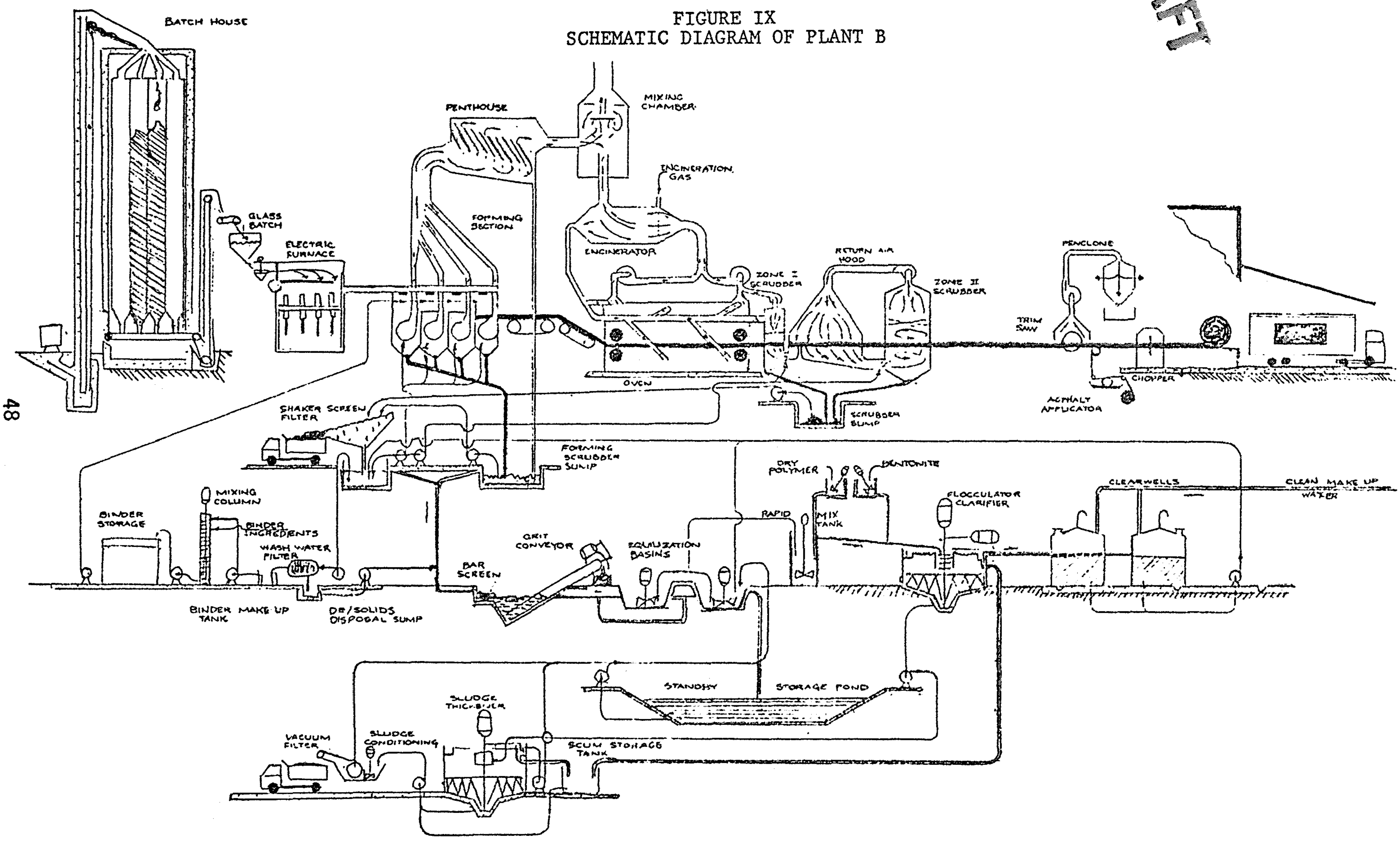
No treatment problems can be foreseen at this and all the other exemplary plants cited due to start-up, shut down, or process upsets.

Plant B

This plant best represents how a new plant can avoid air and water treatment problems through proper design before the plant is built. The plant was completed in June of 1971, and with only two lines has a capacity of 34,800 metric tons (75 million pounds) per year. The plant employs rotary spinners that are fed by cold, top feed electric melt furnaces. This technique has the advantage of virtually eliminating the air pollution problems encountered by conventional gas fired furnaces. The electricity is three times as expensive as the equivalent energy derived from gas. However, the total costs are about the same since the electrodes are positioned at the bottom of the furnace and require but one-third the energy to melt the same amount of raw materials. Gas fired furnaces have their burners less efficiently positioned in the furnace walls. Only standard two inch residential insulation is produced at this plant.

Figure IX is a schematic diagram of the plant operations, and Figure X is a detailed water flow diagram. As it can be seen the process is identical to that at Plant A. However flocculation, using Benonite clay and a polymer, and diatomite filtration is still employed, and since the air and water treatment systems operate both efficiently and economically, the plant has no plans to alter the system. The plant feels that as long as the total solids concentration can be held below two percent, the system will function properly.

FIGURE IX
SCHEMATIC DIAGRAM OF PLANT B



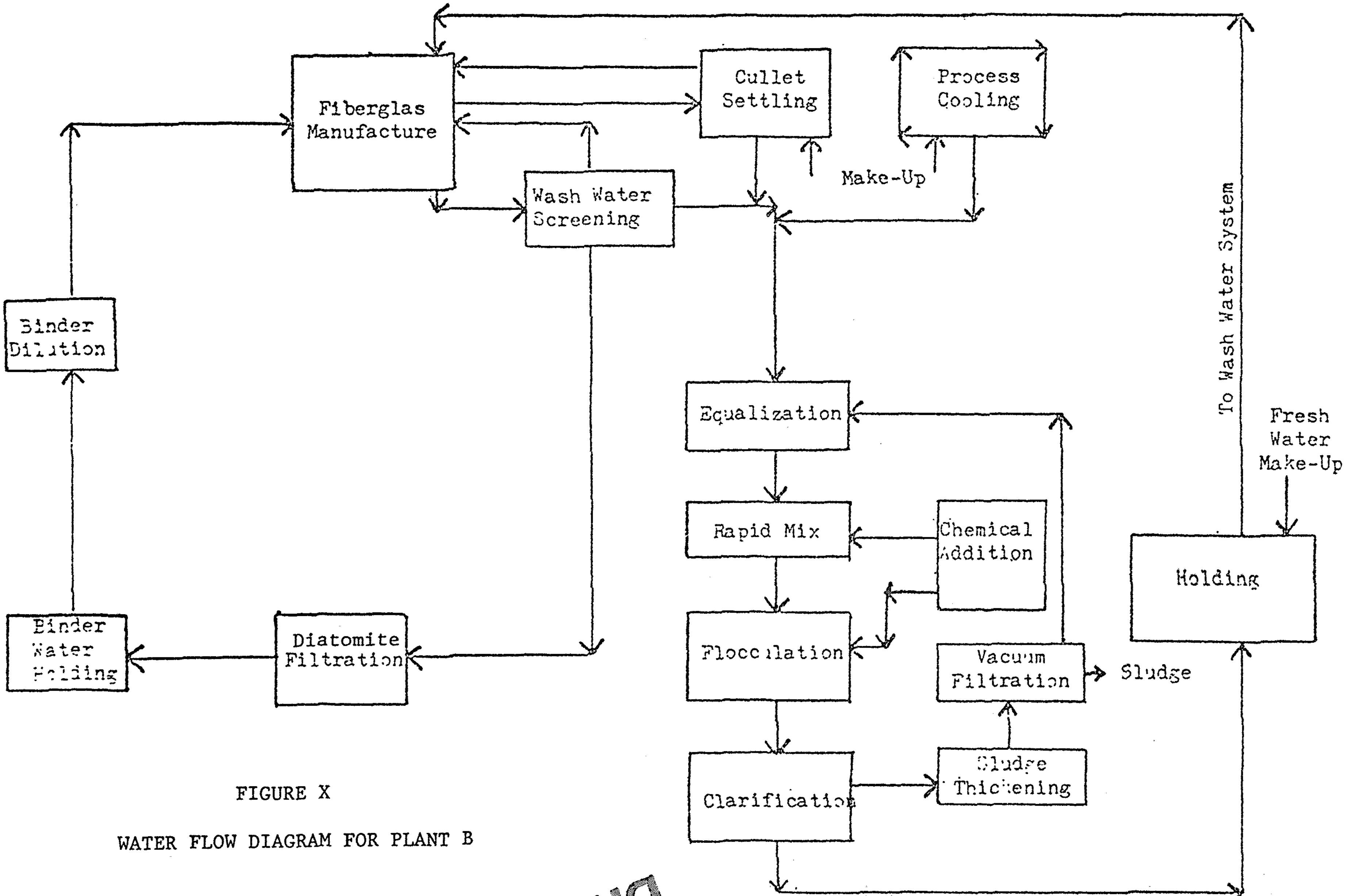


FIGURE X

WATER FLOW DIAGRAM FOR PLANT B

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Plant E

This plant is in the midst of installing a recirculation system with completion expected by May 1, 1973. It is medium sized having a capacity of 15,900 metric tons (35 million pounds) per year. There are four flame attenuated lines, one rotary spun line, and one line which uses textile fiberglass wastes as a raw material. Standard residential insulation is produced by five primary lines that are fed by gas fueled, direct melt furnaces. The plant was bought in 1952, but the original structure is considerably older.

The water flow diagram for this plant appears as Figure XI. Except for the blowdown treatment system, the recirculation system has been successfully in operation since May 1972. The process, however, differs considerably from those at Plants A and B.

Wire mesh chains are used in the forming area of the flame attenuated lines. The plant employs a combination of both hot caustic washing and 13 atmospheres pressure water spray washing of the wire mesh chains (refer to Figure XII). The only blowdown from the caustic bath occurs as carry-over water on the chain which is then washed by the spray wash water system. Attempts to get away from using caustic have so far not succeeded, but the amount of caustic entering the system does not interfer with the binder because of the sizable dilution of wash water. The rotary spinning line employs a flight conveyor cleaned only by a rotating water spray. The waste textile line is a dry process.

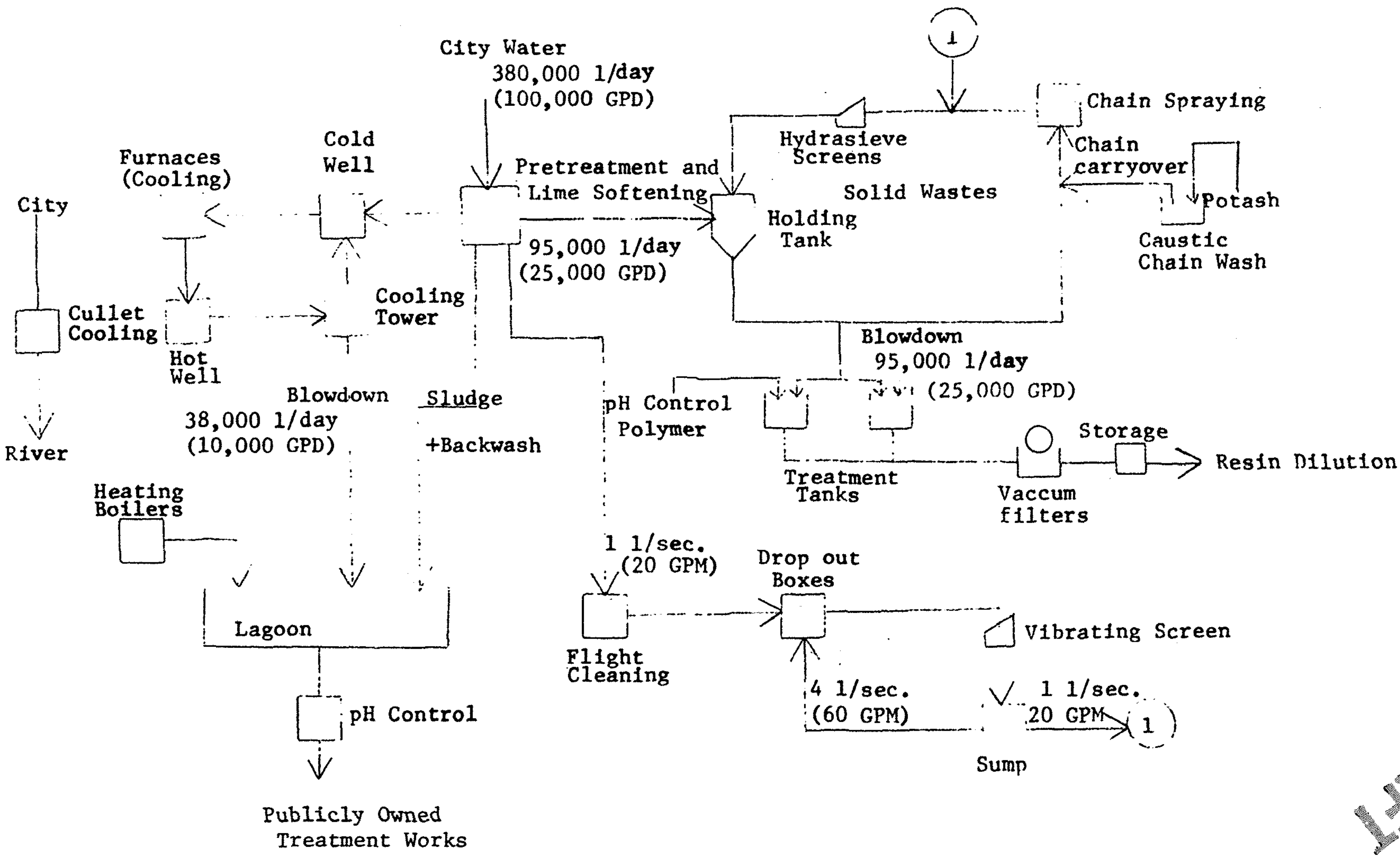
Although drop out boxes are used with water sprays for the exiting forming air, considerably less water is used than for plants A and B. Sufficient suspended solids are removed by the Hydrasieves and sufficient blowdown occurs that this plant does not need to treat the recycled water by floccualtion and coagulation as do Plants A and B.

The blowdown system that is currently being installed consists of pH adjustment, coagulation, settling and vacuum filtration. The treated water will then be used as resin dilution water.

Sludge and backwash from lime softening, cooling tower blowdown and boiler blowdown is directed to a lagoon for settling. Overflow is neutralized with sulfuric acid and discharged to a municipal sanitary sewer. Cullet cooling water is presently discharged to the river after large glass particles are removed in a sump.

FIGURE XI

WATER FLOW DIAGRAM OF PLANT E



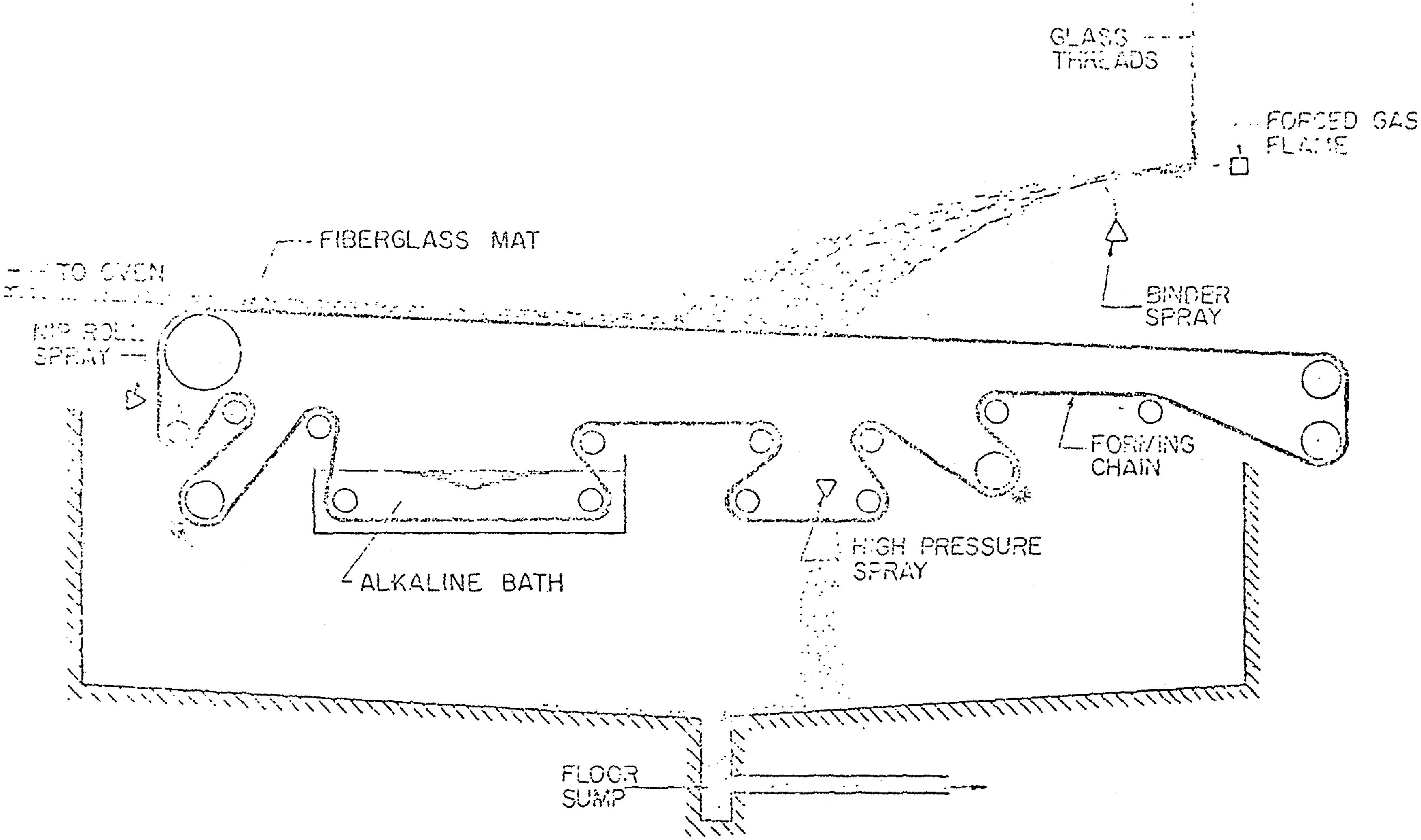


FIGURE XII

CHAIN CLEANING AT PLANT E

Plant F

This plant best illustrates how with minimization of water usage, most problems of the general recirculation model can be avoided. The plant was built in 1969 with two standard insulation lines employing marble fed, flame attenuation processes. The addition of two similar lines in 1972 has boosted the plant from small to medium size. Current production is 15,900 metric tons (35 million pounds) per year. The plant has successfully maintained a complete recycle system depicted in Figure XIII since it was built.

The principal reason for the system's reliability is that approximately eight percent of the process water flow is continually blown down. This condition is able to be attained by use of low volume, high pressure (68 atmospheres), rotating, chain (wire mesh) water sprays. The only other water usage within the system is to flush out the dirty water pit. The blowdown, 2 l/sec (30 gpm), is consumed in the process as overspray.

In order to protect the pumps and spray nozzles, suspended solids are removed from the recycled water by vibrating screens, diatomaceous earth filters, and fiberglass filters operated in series. With the combination of water treatment and high blowdown rate, the total solids concentration ranges between 0.3 and 0.5 percent. This then allows high pressure pumps to be used, which in turn minimizes water usage and makes the system possible. The addition of anhydrous ammonia aids the filters in that the ammonia inhibits polymerization of the phenols and thereby keeps the filters free. Although this practice will raise the dissolved solids concentration, this problem is adequately handled by the high blowdown percentage. Even though it is used in the binder, additional ammonia is automatically added to the recycled water to obtain an optimal pH of about 9.0.

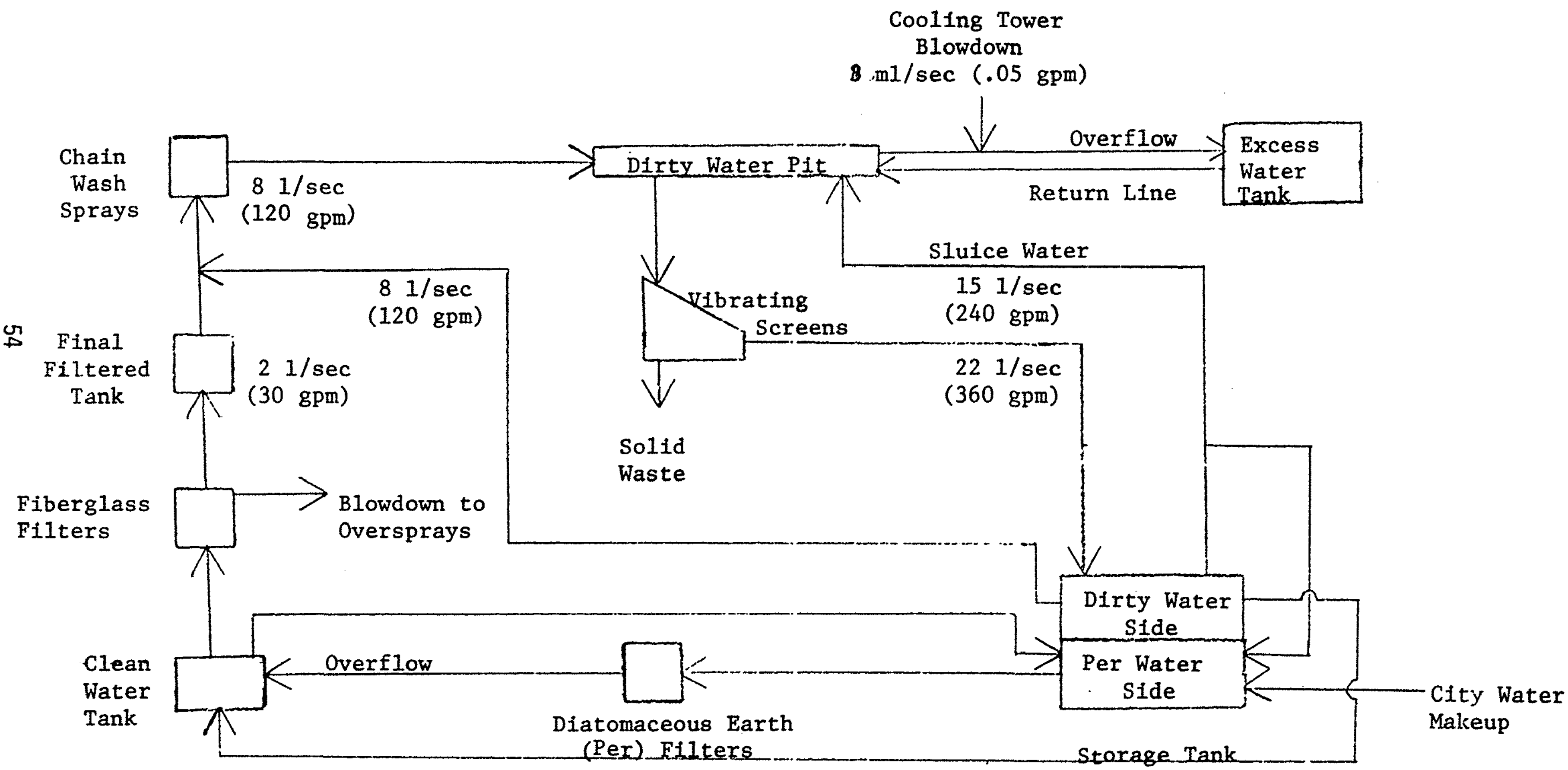
The plant also minimizes water usage by using dry air pollution control equipment. Drop out boxes (without water sprays) are used for the exiting forming air. High energy fiberglass filters are used for the curing oven gases.

Maintenance of the diatomaceous earth (Per) filters has proven to be a major cost of the system, and the plant is researching alternate treatment schemes that need less attention. Flocculation is so far the most promising technique.

Cooling tower blowdown is bled into the recycle system. No water softening is required for this plant.

Figure XIII

WATER FLOW DIAGRAM OF PLANT F



Plant G

This plant was the recipient of government research funds in 1968 in an effort to demonstrate the feasibility of complete recirculation of chain washing waters. The project was based upon three principles. First, the caustic baths used to clean the forming chains could be replaced by high pressure water sprays. Secondary diatomite filtration would prevent spray nozzle plugging. Last, the entire blowdown from the system could be used as overspray. Figure XIV illustrates the process water system.

The plant is an older, small sized plant producing pipe insulation. As such a simpler binder mixture is used than for standard two inch insulation, and fewer problems are encountered in recyling the waters. The recycle system operates between 0.1 and 0.5 percent total solids.

Several items have changed since the research grant. The diatomite filters have not proven to be as successful as originally thought, since excessive maintenance is required. The company has subsequently decided to replace these filters with a screening and clarification system. The research report also included anticipated resin savings into the systems costs. Although the recycled phenols do display some binding properties, they are not as significant as first assumed.

Additional pipes discharging process waters have been discovered since the research project, and have been subsequently incorporated into the treatment system. The remaining discharges have been diverted to a sanitary sewer.

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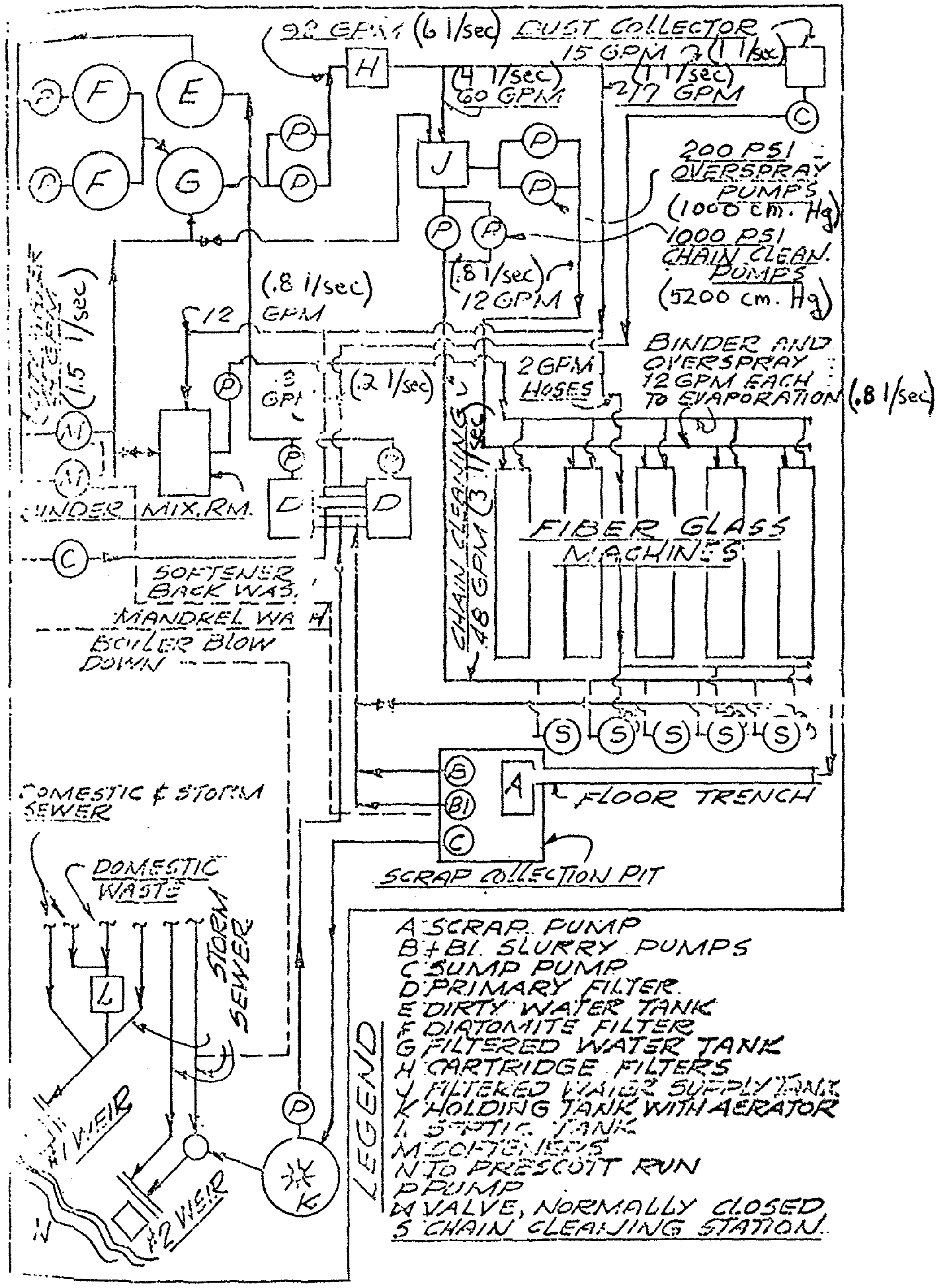


Figure XIV - FLOW CHART - FOR PLANT G

Plant D

This plant is currently experiencing the most difficult problems within the industry in maintaining a completely closed cycle water system, and as such serves as an example that, with even minimal internal waste water treatment, a closed water loop can be operated. In 1965 the plant was bought from a company who also produced fiberglass. The structure was originally built in 1961. In September 1970 the company was given a cease and desist order by the State Water Pollution Control Board and since that time the plant in order to comply has operated the system shown in Figure XV. The plant is medium sized and produces no specialty products. There are two lines employing rotary spinners and direct melt, gas fueled furnaces.

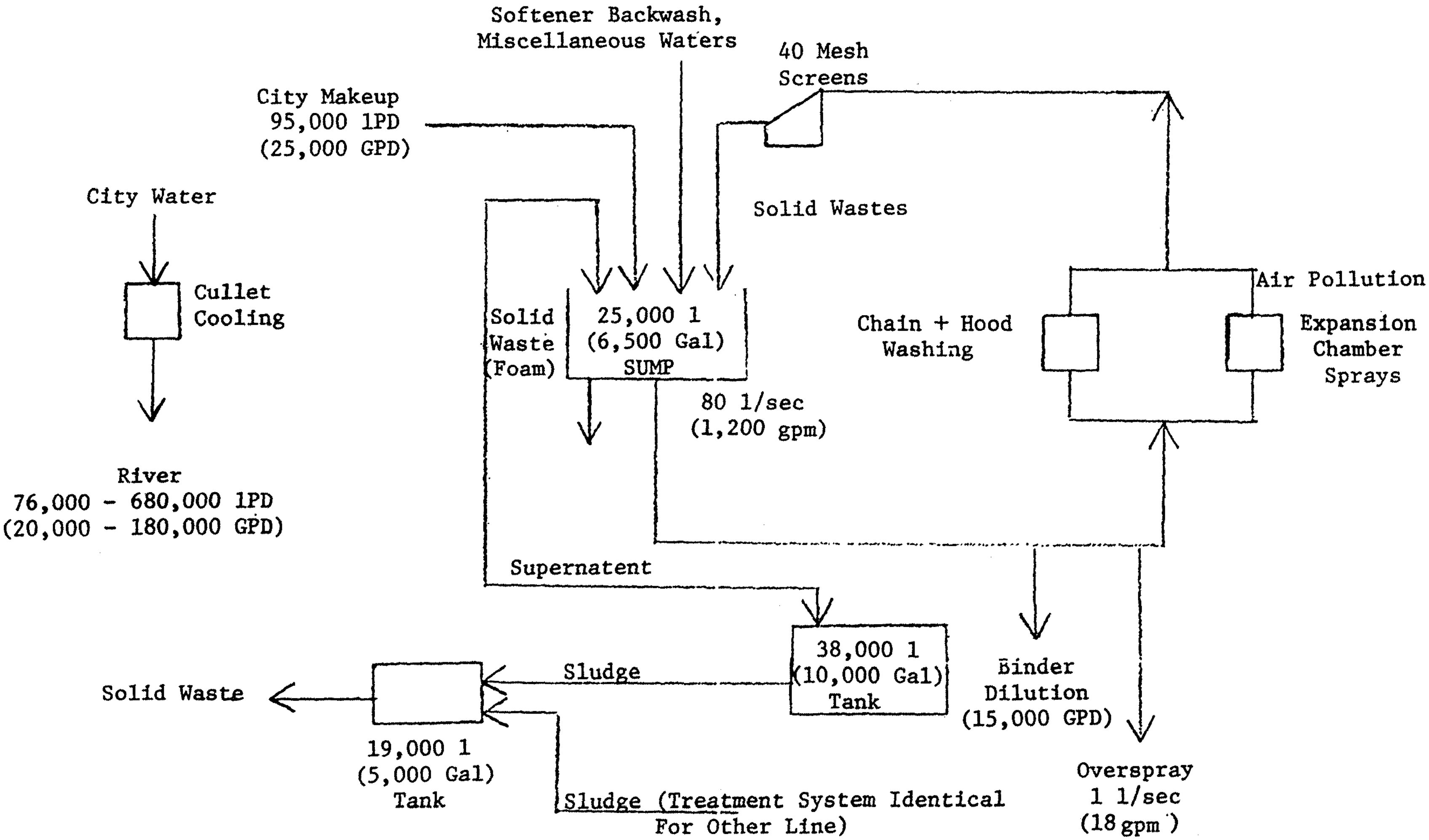
At the heart of the treatment system there are two 25,000 liter (6500 gallon) sumps, one for each line. Wash water passes through 40 mesh screens and receives approximately five minutes retention time in the sumps before the water is again used to clean the fight conveyor. Relatively low pressures are used to clean the flight conveyors, 5.8 atmospheres.

A small amount of water is pumped from the sumps to two 38,000 liter (10,000 gallon) tanks for additional settling. Sludge is then pumped to a 19,000 liter (5,000 gallon) tank to hold until it is hauled away to a landfill. The plant is able to keep the total solids in as little control that exists by blowing down 98,000 and 57,000 liters (26,000 and 15,000 gallons) per day respectively as overspray and binder dilution water.

Because the preliminary screening is inadequate and the water in the sump is constantly stirred up due to the short retention time, quite a bit of foaming occurs. So much foaming occurs that it eventually floats and hardens to a depth of about two feet, necessitating "digging out" the sumps once a week. The foam is about one-half resin and one-half glass fibers. While this is being done, both lines must be shut down for a period of 10 to 12 hours. In addition the flight conveyors must also be blasted with crushed walnut shells to free them of polymerized resin. Walnut shells are used to minimize chain wear. Despite the lost time in production and high maintenance costs, the plant is still able to make some profit.

The company will by the autumn of 1973 install automatic, chain driven scrappers in both sumps and reposition the existing screens for easier access to the sumps. In addition the plant will treat a portion of the recycled water by flocculation much like plants A and B. However,

FIGURE XV
WATER FLOW DIAGRAM OF PLANT D



it is not known at this time what percentage of the recycled water flow will be so treated, and it is conceivable that this will be as high as 100 percent. The plant expects to profit from the installation of treatment facilities since more than enough increased production will result as to pay for the treatment.

Because the recycled water currently has a total solids concentration of 4 percent (ninety percent of which are dissolved organics) the air pollution control equipment employing water sprays is ineffective. Like other plants, it is estimated that the total solids should be less than two percent in order to keep these water and air systems in control.

Except for cullet cooling water all waste waters are sent to the sumps. The former is discharged to a stream without adequate treatment.

Summary

In summary the preceeding examples illustrate the following points.

1. The type of fiberizing process has no appreciable effect upon the treatability of the wastes in a recycle system.

2. High pressure sprays (67 atmospheres) can effectively clean the forming chain if sufficient treatment of the recycled water is provided as to avoid damage to the pumps, pipes, and spray nozzles.

3. Smaller volumes of water can be used at the higher pressures.

4. The size of the plant has no effect upon the treatability of the wastes in a recycle system.

5. The age of a plant does affect the efficiency of a recycle system in that in the design of a new plant minor changes in the process will significantly improve the treatability of the waste waters.

6. Although recycled phenols do have some binding capabilities they are not such as to cause a significant reduction in the amount of new binder made up.

7. The treatment systems described operate within critical limits of total solids concentrations. New binder formulations and additional wet air pollution control equipment may necessitate significant changes in the recycle system requiring external blowdown as an interim measure.

8. Using properly treated blowdown for overspray or binder dilution water will not affect the quality of the product.

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SECTION VIII

COST, ENERGY AND NON-WATER QUALITY ASPECTS

Cost Reduction Benefits of Alternate Treatment and Control Technologies

The three alternate treatment and control technologies considered are biological treatment, biological treatment and carbon adsorption, and complete recycle. All three treatment schemes consist of recycling chain wash water and treatment of only the blowdown. Consideration of treatment of once through process water has long since been abandoned by the industry because of the large volumes involved and the amenability of chain wash water to treatment for recycle.

Table XIII compares the costs and effluent qualities for the three alternate treatment schemes as they are estimated for Plant A. The table clearly indicates that total recycle is the best alternative of the three treatment schemes for best practicable control technology currently available, best available technology economically achievable, and best available demonstrated control technology. It is here assumed that the relationship between the costs of the three alternatives will hold for different plant sizes. Even if this were not true, it is quite significant that no discharge of pollutants can be achieved at costs comparable to end of pipe treatment technology.

Furthermore best available technology economically achievable specifies application of technology "which will result in reasonable further progress toward the national goal of eliminating the discharge of all pollutants". Total recycle both is economically achievable and meets the no discharge of pollutants goal. Any end-of-pipe treatment that is installed to meet best practicable control technology currently avialable may not be readily convertable to meet best available technology economically achievable requirements. This and the fact that total recycle is practicable and currently available constitute the reasons for the proposed treatment and control technology recommendations.

Cost of Total Recycle

Table XIV summarizes the water pollution abatement costs for a few insulation fiberglass plants. Investment costs have been interpolated to August 1971 dollars by using EPA tables of sewage treatment plant cost indexes. (14) Two depreciation periods are used in calculating

TABLE XIII

A COMPARISON BETWEEN THE ALTERNATE TREATMENT AND CONTROL TECHNOLOGIES

	Extended Aeration	Extended Aeration + Activated Carbon	Total Recycle
Capital Costs ($1000)	1100	1260	745
Annual Operating Costs ($100)[1]	540	556	508.5
Effluent Quality			
BOD_5 (mg/l)	20	> 10[2]	0[3]
COD (mg/l)	298	> 50[2]	0[3]
Phenol (mg/l)	1.48	> 0.05[2]	0[3]
Suspended Solids (mg/l)	27	> 5[2]	0[3]
Color	yes	no	no

1. Operating and maintenance costs and power costs for extended aeration and activated carbon are assumed to be the same for the total recycle system.

2. Estimated

3. No discharge hence no pollutants.

TABLE XIV
WATER POLLUTION ABATEMENT COSTS FOR TOTAL RECYCLE

	Plant E	Plant F	Plant F[3]	Plant G
Capacity (Thousand Metric Tons/Yr.)	16.9	9	16	9
(Million Pounds/yr.)	35	20	35	20
Investment[1] ($1000)	483	32.5	340.5	245.4
Annual Costs				
Capital Costs ($1000)	2			
Depreciation ($1000)	24	23.7		17.5
Years Amortization	20	14		14
Operating and Maintenance ($1000)	55	36.5	44.5	13.8
Energy and Power Costs ($1000)	8	1.7	2.3	4.6
Total Annual Cost ($1000)	89	62		36
Adjusted Annual Cost[2] ($1000)	113	71	81	43
Energy Consumption (1000 kilowatt-hours/yr.)	551	165.8	212	512

1 Adjusted to August 1971 dollars using sewage treatment plant cost index (14).
2 Total Annual Cost using a 10 year amortization period.
3 After 1972 expansion to 4 lines, includes original oversized treatment system.

total annual cost. The first is the true depreciation period as determined by the company. For the second, a 10 year depreciation is used for the purposes of comparison with the consultant study summarized later.

An economic study by one consultant (11) concluded that zero discharge is practical for the insulation fiberglass industry. The firm selected two basic forms of recycle systems. Treatment A, coarse filtration, fine filtration and water recycle is practiced at Plant F. Treatment B, coarse filtration, flocculation, settling and water recycle, is practiced at Plant B. Table XV lists the resultant fixed capital investment and annual operating costs for the two treatment schemes scaled to the four plant sizes considered by the consultant.

As a conservative estimate 80 percent production was used to calculate incremental capital and operating costs as shown in Table XVI. Assumed selling prices and estimated current fixed capital investments were used. Table XVI and Figure XVI both clearly show that the incremental operating costs for the treatment systems are not linealy related to plant size. Therefore, the smaller plants will spend more per unit of product in order to maintain a closed water system than larger plants.

The relative effects on company and plant pretax earnings, assuming no price increases as a result of the incremental operating costs, will be equal to the proportion of selling price represented by these costs. If incremental costs are passed on, the current rate of profitability will be maintained. As current returns on investment are unknown for individual plants, the relative effects on returns on investment can only be obtained by assuming a certian level of profits on sales before taxes, and measuring sensitivity at various levels of returns on investment.

For this analysis, average pretax earnings are assumed to be 12 percent on sales for wool glass fibers. The current returns on investments tested are 5, 10, and 15 percent in Table XVII. Thus for wool glass, a 1 percent increase in operating costs will reduce returns on investments by 8.3 percent of the current rate.

Plants of any size that currently have a return on investment no better than 5 percent will become marginal and could possibly cease production. However, no such facilities currently exist. Plants operating at over 5 percent return on investment will continue to enjoy reasonable returns.

It is estimated that $10 million is needed for the industry to achieve no discharge, assuming that there are presently no treatment facilities. The consultant concluded that the insulation fiberglass industry has the

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TABLE XV

ESTIMATED COST OF WASTE WATER TREATMENT FOR INSULATION FIBERGLASS MANUFACTURE (11)

Plant Capacity: Thousand metric tons/yr.	Plant Capacity: Million lb/yr		Type Treatment System (A) Coarse Filtration Fine Filtration Water Recycle	Type Treatment System (B) Coarse Filtration Flocculation Settling Water Recycle
200	400	Fixed Cap. Investment ($1000)	2000	1050
		Annual Operating Cost $1000)	610	680
41	90	Fixed Cap. Investment ($1000)	800	400[1,2]
		Annual Operating Cost ($1000)	200	200[3]
9	20	Fixed Cap. Investment ($1000)	325[1]	160
		Annual Operating Cost ($1000)	80	71
2.3	5	Fixed Cap. Investment ($1000)	150	70
		Annual Operating Cost ($1000)	46	37

1. Based on Costs reported by the Industry

2. Actual investment was closer to $600,000 but the existing system has more capacity than required.

3. Reported cost was closer to 0.3¢/lb., but reported treatment chemical cost seems high.

TABLE XVI

SUMMARY OF CAPITAL AND OPERATING COST EFFECTS: WOOL GLASS FIBER

Plant Capacity M metric ton	Plant Capacity (MM lb)	Type of Treatment Process	Plant Output* (MM lb)	Net Revenues ($MM)	Current Fixed Capital Investment ($MM)	Water Pollution Control Costs: Incremental Investment ($MM)	Incremental Investment as % of Current Investment	Incremental Operating Cost (¢/lb)	Incremental Operating Cost as % of Selling Price
200	440	(A) Coarse and Fine Filtration	352	98.5**	80	2.0	2.5	0.18	0.64
		(B) Flocculation and Settling	352	98.5	80	1.0	1.25	0.19	0.68
41.	90	(A)	72	18.7***	26	0.8	3.8	0.27	1.04
		(B)	72	18.7	26	0.4	1.9	0.29	1.11
9	20	(A)	16	4.4**	10	0.325	3.25	0.50	1.78
		(B)	16	4.4	10	0.16	1.6	0.44	1.57
2.3	5	(A)	4	1.2****	4	0.15	3.75	1.15	3.83
		(B)	4	1.2	4	0.07	1.75	0.93	3.10

* @ 80% Yield
** @ 28¢/lb
*** @ 26¢/lb
**** @ 30¢/lb

1 Table reproduced from "Initial Economic Impact Analysis of Water Pollution Control Costs Upon the Fiber Glass Industry" reference 11

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TABLE XVII

EFFECTS ON RETURNS ON INVESTMENT
WOOL GLASS FIBER (11)

Plant Size Capacity (M metric tons/yr)	Waste Water Treatment Type	Operating Cost as % of Selling Price	Predicted affect on return on investment if currently at 5%	10%	15%
200	A	.64	4.7	9.5	14.2
	B	.68	4.7	9.5	14.2
41	A	1.04	4.6	9.2	13.7
	B	1.11	4.5	9.1	13.6
9	A	1.78	4.3	8.5	12.8
	B	1.57	4.4	8.7	13.0
2.3	A	3.83	3.4	6.8	10.2
	B	3.10	3.7	7.4	11.1

financial capabilities to install total recycle facilities, and that this will have minimal effect on the selling price of its products.

The economic analysis of the consultant report was based upon treatment systems employed at only two plants of different companies. Figures XVII and XVIII compare the costs of water treatment for different sizes of plants as determined from actual industry calculations and the estimations by the consultant previously mentioned. As seen, actual costs lie within the limits estimated by the consultant report, and it can be assumed that the conclusions of the consultant study hold true for the entire insulation fiberglass industry.

FIGURE XVI

EFFECT OF PLANT SIZE ON COST OF WATER RECYCLING IN WOOL PLANTS (11)

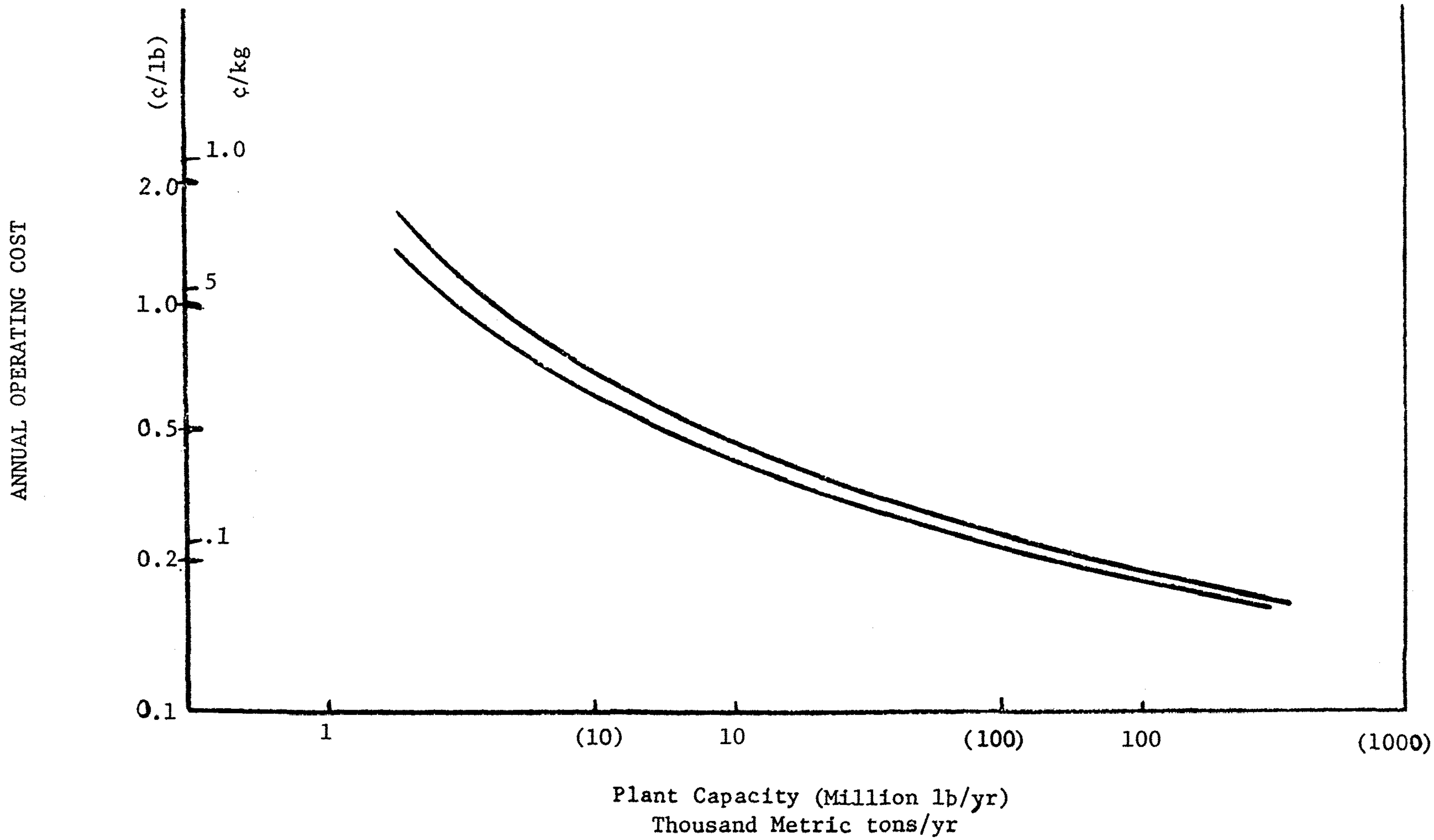


FIGURE XVII
INVESTMENT COSTS VERSUS PLANT SIZE

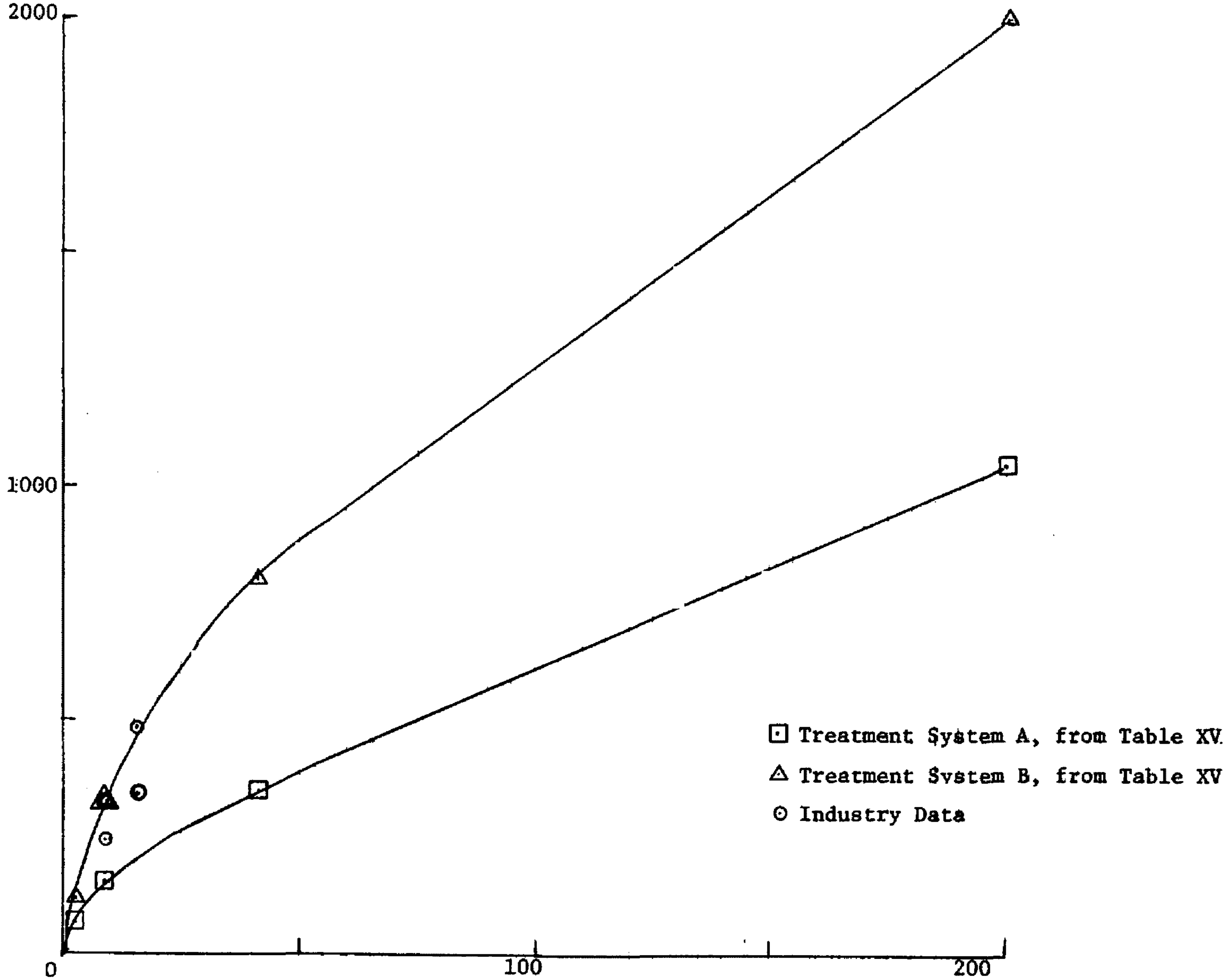
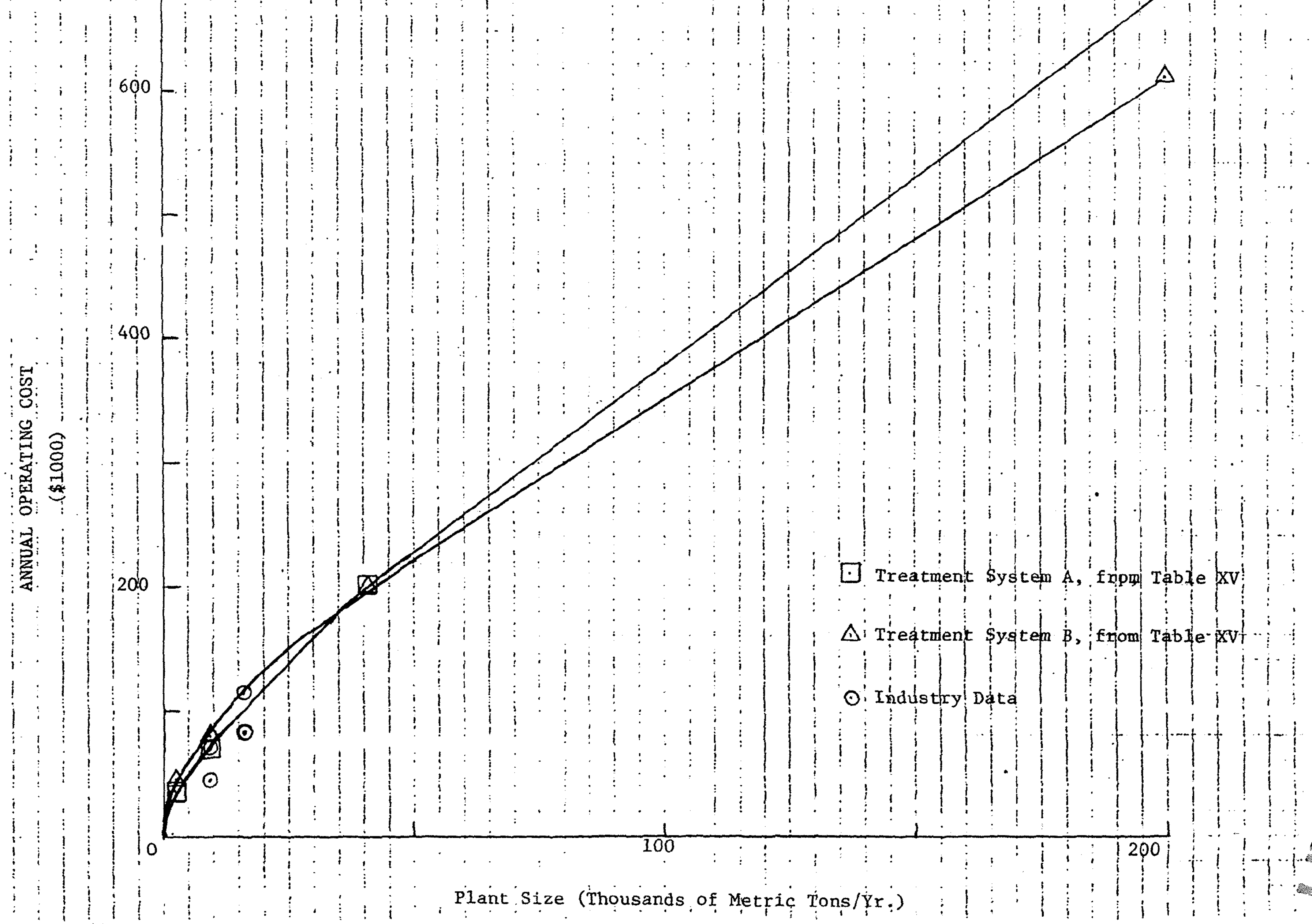


FIGURE XVIII

ANNUAL OPERATING COSTS VERSUS PLANT SIZE



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Non-Water Pollution Effects of the Closed Treatment System

The major non-water quality aspect that has resulted from existing closed water systems have been solid waste disposal. Sources of solid wastes include cullet, glass fiber - resin sludges, particulates removed from stack gases, and wasted product. Since all of these solids are in a form not currently usable, they are hauled to sanitary landfills. Restrictions at some sites prohibits burial of phenolic wastes because of the fear of ground water contamination. One company proposes to autoclave its sludges to insure complete polymerization of the phenols.

In only one case has use of recycled water affected air emissions (Plant D). In this case chain wash water is also used in the drop out boxes for the forming air. However, the plant will soon be installing additional water treatment equipment which will correct the problem.

The use of high pressure spray water pumps does produce objectionable levels of noise. However, a fiberglass plant is extremely noisy especially in the forming area. The small increment of additional noise introduced by pumps and other miscellaneous recycle equipment would not affect the hearing protection measures already practiced by the industry.

This type of treatment system does affect land requirements. The treatment systems employed at Plants A and B and proposed at Plant D require considerable space for flocculating and settling tanks, since low pressure, high volume wash systems are used. Although the high pressure low volume wash systems require space for overflow ponds it is not as great as in the previous case.

Power requirements of existing treatment systems are included in Table XIV. The industry considers the extra power needed to operate waster treatment systems to be negligible when compared to the power requirements of the fiberglass manufacturing equipment.

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SECTION IX

EFFLUENT REDUCTION ATTAINABLE THROUGH THE APPLICATION OF THE BEST PRACTICABLE CONTROL TECHNOLOGY CURRENTLY AVAILABLE -- EFFLUENT LIMITATIONS GUIDELINES

Introduction

The effluent limitations which must be achieved July 1, 1977 are to specify the degree of effluent reduction attainable through the application of the best practicable control technology currently available. This technology is generally based upon the average of the best existing performance by plants of various sizes, ages and unit processes within the industrial category and/or subcategory industry. This average is not based upon a broad range of plants within the insulation fiberglass manufacturing industry, but based upon performance levels achieved by exemplary plants. Consideration must also be given to:

a. The total cost of application of technology in relation to the effluent reduction benefits to be achieved from such application;

b. the size and age of equipment and facilities involved;

c. the processes employed;

d. the engineering aspects of the application of various types of control techniques;

e. process changes;

f. non-water quality environmental impact (including energy requirements).

Best practicable control technology currently available emphasizes treatment facilities at the end of a manufacturing process but includes the control technology within the process itself when the latter are considered to be normal practice within an industry.

A further consideration is the degree of economic and engineering reliability which must be established for the technology to be "currently available." As a result of demonstration projects, pilot plants and general use, there must exist a high degree of confidence in the engineering and economic practicability of the technology at the time of commencement of construction or installation of the control facilities.

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Effluent Reduction Attainable Through The Application of Best Practicable Control Technology Currently Available

Based upon the information contained in Sections III through VIII of this report, a determination has been made that the degree of effluent reduction attainable through the application of the best practicable control technology currently available is no discharge of process waste water to navigable waters.

Identification of Best Practicable Control Technology Currently Available

Best practicable control technology currently available for the insulation fiberglass manufacturing subcategory is recycle and reuse of process waters within the operation. To implement this require:

1. Replacement of caustic baths with pressurized water sprays in order to clean forming chains of glass fiber and resin. This has already been accomplished by the industry.

2. The higher the pressures are, the better the cleaning results. This results in minimizing the use of other cleaning methods and in the design of smaller treatment systems, since less water is used.

3. Reuse of chain wash water after suitable treatment.

4. Blowdown from the chain wash system to control dissolved solids disposed of in the process as overspray, binder dilution water, or extra - process by evaporation and/or spray irrigation.

5. Incorporation of hood wash water into the chain wash system.

6. Incorporation of other miscellaneous process waters, such as mandrel cleaning caustic, into the chain wash system.

7. Recirculation of cullet cooling water with blowdown to the chain wash recirculation system.

8. Incorporation of all non-process contaminated waste streams into the chain wash recirculation system. These streams include floor wash water and storm water that falls upon specific areas where phenol contamination occurs.

The amounts and concentrations of dissolved solids in water softener backwash and boiler blowdown and the extensive treatment required to remove dissolved solids from such do not justify the treatment of these wastes.

Rationale for the Selection of Best Practicable Control Technology Currently Available

Age and Size of Equipment and Facilities

As set forth in this report, industry competition and general improvements in production concepts have hastened modernization of plant facilities throughout the industry. This coupled with the similarities of waste water characteristics for plants of varying size substantiate that total recycle is practicable.

Total Cost of Application in Relation to Effluent Reduction Benefits

Based upon the information contained in Section VIII and Supplement A of this report, the industry as a whole would have to invest up to an estimated maximum of $10,000,000 to achieve the effluent limitations prescribed herein. This amounts to approximately a 1.0 to 4.0 percent increase in projected total capital investment, and an anticipated increase of 0.6 to 3.8 percent in the operating cost.

It is concluded that the ultimate reduction to zero discharge outweighs the costs. 37 percent of plants are achieving no discharge of pollutants. Only three plants (16 percent) still discharge process waters to surface waters, and to these plants no discharge of pollutants can be practically applied.

Processes Employed

All plants in the industry use the same or similar production methods, the discharges from which are also similar. There is no evidence that operation of any current process or subprocess will substantially affect capabilities to implement best practicable control technology currently available.

Engineering Aspects of Control Technique Applications

This level of technology is practicable because 37 percent of the plants in the industry are now achieving the effluent reductions set forth herein. The concepts are proved, available for implementation, enhance production and waste management methods may be readily adopted through adaptation or modification of existing production units.

Process Changes

This technology is as an integral part of the whole waste management program now being implemented within the industry. While it does require inprocess changes, they are practiced by many plants in the industry.

Non-Water Quality Environmental Impact

There is one essential impact upon major non-water elements of the environment: a potential effect on soil systems due to strong reliance upon the land for ultimate disposition of final effluents.

With respect to this, it is addressed only in a precautionary context since no evidence has been discovered which even intimates a direct impact--all evidence points to the contrary. Technology and knowledge are available to assure land disposal or irrigation systems are maintained commensurate with crop need or soil tolerance.

SECTION X

EFFLUENT REDUCTION ATTAINABLE THROUGH THE APPLICATION OF THE BEST AVAILABLE TECHNOLOGY ECONOMICALLY ACHIEVABLE -- EFFLUENT LIMITATIONS GUIDELINES

The effluents limitations reflecting this technology is no discharge of process waste waters to navigable waters as developed in Section IX.

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SECTION XI

NEW SOURCE PERFORMANCE STANDARDS

The effluents limitations for new sources in no discharge of process waste waters to navigable waters as developed in Section IX.

Section XIV

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SECTION XV

GLOSSARY

Act

The Federal Water Pollution Control Act Amendments of 1972.

Atmosphere

Unit of pressure. One atmosphere is normal atmosphere pressure.

Batt

Standard wool mat used for residential insulation.

Best Available Technology Economically Achievable (BATEA)

Treatment required by July 1, 1983 for industrial discharges to surface waters as defined by Section 301 (b)(2)(A) of the Act.

Best Practicable Control Technology Currently Available (BPCTCA)

Treatment required by July 1, 1977 for industrial discharges to surface waters as defined by Section 301(b)(1)(A) of the Act.

Best Available Demonstrated Control Technology (BADCT)

Treatment required for new sources as defined by Section 306 of the Act.

Binder

Chemical substance sprayed on the glass fibers in order to bond them together. Synonymous with the terms resin and phenolic resin.

BOD, 5 day, 20°C

Biochemical Oxygen Demand.

Borosilicate

A type of glass containing approximately five percent boric oxide.

Capital Costs

Financial charges which are computed as the cost of capital times the capital expenditures for pollution control. The cost of capital is based upon a weighed average of the separate costs of debt and equity.

Category and Subcategory

Divisions of a particular industry which possess different traits which affect water quality and treatability.

Caustic

Any strongly alkaline material. Usually sodium hydroxide.

Chain

A revolving metal belt upon which the newly formed glass fibers fall to form a thick mat. There are two general types of chains: wire mesh chains and flight conveyors. The latter are hinged metal plates with several holes to facilitate the passage of air.

cm

Centimeter

COD

Chemical Oxygen Demand

Cullet

Chunks of solid glass formed when molten glass bled from a furnace comes into contact with water.

Curing

The act of thermally polymerizing the resin onto the glass fibers in a controlled manner.

Depreciation

Accounting charges reflecting the deterioration of a capital asset over its useful life.

Diatomaceous Earth

A filter media used in this case to remove fine glass-resin particles. The process of filtration is referred to as diatomite filtration.

Dry Air Pollution Control

The technique of air pollution abatement without the use of water.

Fiberglass

Extremely fine fibers of corrosion resistant glass of diameters typically less than 0.015 mm. Also fiber glass.

Flame Attenuation

The glass fiber forming process in which thick threads of glass are forced through perforated bushings and then attenuated by burning gases or steam in order to further reduce the fiber diameters.

Forming Area

The physical area in which glass fibers are formed, sprayed with lubricant and/or binder, and fall to the chain. A downward forced air draft is maintained to insure proper binder dispersal and to force the fibers to the chain.

Glass Wool

The cured fiberglass - resin product. Also referred to as insulation fiberglass.

gpm

Gallons per minute

Industrial Waste

All wastes streams within a plant. Included are contact and non-contact waters. Not included are wastes typically considered to be sanitary wastes.

Investment Costs

The capital expenditures required to bring thee treatment or control technology into operation. These include the traditional expenditures such as design; purchase of land and materials; site preparation; construction and installation; etc.; plus any additional expenses required to bring the technology into operation including expenditures to establish related necessary solid waste disposal.

l

Liter

Lubricant

Usually a mineral oil added to the binder to inhibit fiber abrasion.

M

Thousand (e.g. thousand metric tons).

Mandrel

A pipe-like metal form with numerous holes. Serves as a form about which insulation is shaped to make pipe insulation.

Mat

The newly formed layer of fiberglass on the chain.

mg/l

Milligrams per liter. Nearly equivalent to parts per million concentration.

MM

Million (e.g. million pounds)

New Source

Any building, structure, facility, or installation from which there is or may be a discharge of pollutants and whose construction is commenced after the publication of the proposed regulations.

No Discharge of Pollutants

No net increase (or detectable gross concentration if the situation dictates) of any parameter designated as a pollutant to the accuracy that can be determined from the designated analytical methods.

Operations and Maintenance

Costs required to operate and maintain pollution abatement equipment. They include labor, material, insurance, taxes, solid waste disposal etc.

Overspray

Water spray applied to the newly formed glass fibers, the purpose of which is to both cool the hot glass and to decrease the rate of resin volatilization and polymerization.

Pack

A fiberglass product made from relatively thick fibers, as compared to glass wool insulation, that is used for special application (e.g. air filters and distillation column packing).

pH

A measure of the relative acidity or alkalinity of water. A pH of 7.0 indicates a neutral condition. A greater pH indicates alkalinty and a lower pH indicates acidity. A one unit change in pH indicates a 10 fold change in acidity and alkalinity.

Phenol

Class of cyclic organic derivatives with the basic formula C_6H_5OH

Pretreatment

Treatment proved prior to discharge to a publicly owned treatment works.

Process Water

(i) Any water which comes into contact with any glass, fiberglass, phenolic binder solutions or any other raw materials, intermediate or final material or product, used in or resulting from the manufacture of insulation fiberglass. (ii) Non-contact cooling water.

Resin

Synonymous to Binder

Rotary Spun

The glass fiber forming process in which glass is forced out of holes in the cylindrical wall of a spinner.

Sec

Second. Unit of time.

Secondary Treatment

Biological treatment provided beyond primary clarification.

Silicates

A chemical compound containing silicon, oxygen, and one or more metals.

Staple Fiber

Glass fibers with used short irregular lengths for insulation products in contrast to continuous filaments used for textile products.

Surface Waters

Navigable waters. The waters of the United States including the territorial seas.

Wet Air Pollution Control

The technique of air pollution abatement utilizing water as an absorptive media.

TABLE XVIII

CONVERSION TABLE

MULTIPLY (ENGLISH UNITS)		by		TO OBTAIN (METRIC UNITS)
ENGLISH UNIT	ABBREVIATION	CONVERSION	ABBREVIATION	METRIC UNIT
acre	ac	0.405	ha	hectares
acre - feet	ac ft	1233.5	cu m	cubic meters
British Thermal Unit	BTU	0.252	kg cal	kilogram - calories
British Thermal Unit/pound	BTU/lb	0.555	kg cal/kg	kilogram calories/kilogram
cubic feet/minute	cfm	0.028	cu m/min	cubic meters/minute
cubic feet/second	cfs	1.7	cu m/min	cubic meters/minute
cubic feet	cu ft	0.028	cu m	cubic meters
cubic feet	cu ft	28.32	l	liters
cubic inches	cu in	16.39	cu cm	cubic centimeters
degree Fahrenheit	°F	0.555(°F-32)[1]	°C	degree Centigrade
feet	ft	0.3048	m	meters
gallon	gal	3.785	l	liters
gallon/minute	gpm	0.0631	l/sec	liters/second
horsepower	hp	0.7457	kw	kilowatts
inches	in	2.54	cm	centimeters
inches of mercury	in Hg	0.03342	atm	atmospheres
pounds	lb	0.454	kg	kilograms
million gallons/day	mgd	3,785	cu m/day	cubic meters/day
mile	mi	1.609	km	kilometer
pound/square inch (gauge)	psig	(0.06805 psig +1)[1]	atm	atmospheres (absolute)
square feet	sq ft	0.0929	sq m	square meters
square inches	sq in	6.452	sq cm	square centimeters
tons (short)	t	0.907	kkg	metric tons (1000 kilograms)
yard	y	0.9144	m	meters

[1] Actual conversion, not a multiplier