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Group II

Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the

OIL BASE SOLVENT WASH SUBCATEGORIES OF THE PAINT FORMULATING AND THE INK FORMULATING

Point Source Category

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

JULY 1975

DEVELOPMENT DOCUMENT

for

EFFLUENT LIMITATIONS GUIDELINES

and

NEW SOURCE PERFORMANCE STANDARDS

for the

OIL BASE SOLVENT WASH SUBCATEGORIES of the

PAINT FORMULATING and the INK FORMULATING
POINT SOURCE CATEGORIES

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ABSTRACT

This document presents the findings of a study of the paint and ink formulation industries for the purpose of developing effluent limitations guidelines, Federal standards of performance, and pretreatment standards for the industry to implement Sections 301, 304 and 306 of the Federal Water Pollution Control Act Amendments of 1972 (the "Act").

Effluent limitations guidelines are set forth for the degree of effluent reduction attainable through the application of the "Best Practicable Control Technology Currently Available," and 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" 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 require that, for both the oil base solvent wash subcategories of both the paint and ink formulation industries, no discharge of process wastewater pollutants to navigable waters be achieved by July 1, 1977.

For the same subcategories of the paint and ink formulation industries, the 1983 requirements and new source standards are the same as the 1977 requirements.

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

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SECTION I

CONCLUSIONS

For the purposes of establishing Effluent Limitation Guidelines and Standards of Performance for New Sources, the "Paint and Ink Formulation Industry" point source categories were divided into two categories (paint and ink) and six subcategories. The subcategories are: (1) Oil-Base Solvent Wash Paint Manufacture; (2) Oil-Base Caustic Wash Paint Manufacture; (3) Water-Base Paint Manufacture; (4) Oil-Base Solvent Wash Ink Manufacture; (5) Oil-Base Caustic Wash Ink Manufacture; and (6) Water-Base Ink Manufacture. The Paint and Ink Manufacturing industries were found to use similar raw materials and manufacturing processes but were separated principally on the basis of the end use of the product and on treatment technology employed. The major conclusions in each of these categories are discussed in the following paragraphs.

PAINT FORMULATING

The major conclusion for this industry was that the vast majority of paint formulating plants discharge their process wastewaters to municipal systems. The initial survey turned up seven manufacturers discharging process wastewaters to surface streams. A more recent check of the NPDS permit files shows twenty-seven company locations direct discharging wastewater to surface streams. A more detailed check of these companies show only one company location direct discharging process wastewater. There may be several other plants that were not detected but the magnitude of the problem, as far as direct pollution of surface streams is concerned, is essentially negligible.

Many of the paint manufacturing plants located on municipal sewer systems have elected to dispose of their process waste by shipping it to a landfill or by recycling and reusing it within the plant.

It was anticipated that mercury, lead, and other metals would be a significant problem in the industry, but this has not proven to be the case. Many of the manufacturers have, in recent years, switched to non-mercury-containing preservatives because of the mercury pollution problem a few years ago. The "Lead-Based Paint Poisoning Prevention Act of 1973," which reduces the allowable concentration of lead in a dry paint film to 0.5 percent, has significantly decreased the magnitude of the lead problem. Chromium and other heavy metals used in tinting agents during paint manufacture have also been significantly reduced because of the current trend in tinting paints at the retail store. The heavy metal-containing tinting agents are, for the most part, manufactured by the pigment industry and shipped directly to the retail stores. Their manufacture is not covered in this document.

The major pollutant parameters for the paint manufacturing industry are BOD_5, TSS, pH and selected metals. The volumes of wastewater discharged are, from a pollution control standpoint, very small.

INK FORMULATING

The ink formulating industry bears many resemblances to the paint formulating industry, although it is considerably smaller. A check of the NPDS Permit applications and consultation with industrial representatives led to the conclusion that there are less than 8 manufacturing plants in the country discharging process wastes directly to surface streams.

Again, as in the paint industry, many of the plants that are on municipal systems practice no discharge of wastewater pollutants. Ink process wastewaters are either sent to sanitary landfills for disposal or the wastewaters are recycled and reused within the plant. A limitation of "no discharge of wastewater pollutants" directly to surface streams would have little, if any, effect on the industry.

The major pollutant parameters for the ink manufacturing industry are BOD_5, TSS, pH, and selected metals. As with the paint industry, the volumes of wastewater discharged are very small.

SECTION II
RECOMMENDATIONS

PAINT FORMULATING

The effluent limitations for process wastes for the paint formulating industry oil base solvent wash have been set as no discharge of process wastewater pollutants to surface waters. The other categories will have effluent limitations and standards set at a later date. This limitation has been defined as (1) Best Practicable Control Technology Currently Available to be achieved no later than July 1, 1977; (2) Best Available Treatment Economically Achievable to be achieved no later than July 1, 1983; and (3) New Source Performance Standards to be achieved upon start-up of the new source. Pretreatment before discharge to publicly-owned treatment works for new sources has been set as that treatment necessary to meet the conditions of EPA Federal Regulation 40 CFR 128.

INK FORMULATING

The recommendations for the ink formulating industry are identical to those for the paint formulating industry set forth above.

SECTION III

INTRODUCTION

PURPOSE AND AUTHORITY

Legal Authority

Existing Point Sources -- 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 require 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 require 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) of the Act.

Section 304(b) of the Act requires the Adminstrator to publish 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 reducton attainable through the application of the best control measures and practices achievable including treatment techniques, process and procedure innovations, operating methods and other alternatives. The regulations proposed herein set forth effluent limitations guidelines, pursuant to section 304(b) of the Act, for the paint and ink formulation industries. The specific industries for which limitations are proposed are listed in Table III-1 by Standard Industrial Classification (SIC) Code number (1).

TABLE III-1

INDUSTRIES IN PAINT AND INK FORMULATION CATEGORY
BY SIC NUMBER

PAINT FORMULATION

2851 - Paints, Varnishes, Lacquers, Enamels, and Allied Products

INK FORMULATION

2893 - Printing Ink

New Sources -- Section 306 of the Act requires the achievement from 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 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 307(c) of the Act requires the Administrator to promulgate pretreatment standards for new sources at the same time that standards of performance for new sources are promulgated pursuant to section 306.

Section 304(c) of the Act requires the Administrator to issue to the States and appropriate water pollution control agencies information on the processes, procedures or operating methods which result in the elimination or reduction of the discharge of pollutants to implement standards of performance under section 306 of the Act. This Development Document provides, pursuant to section 304(c) of the Act, information on such processes, procedures or operating methods.

Basis of Proposed Effluent Limitations Guidelines for Existing Sources and Standards of Performance and Pretreatment Standards for New Sources

General Methodology -- The effluent limitations guidelines and standards of performance proposed herein were developed in the following manner. The point source category was first studied for the purpose of determining whether separate limitations and standards are appropriate for different segments within the category. This analysis included a determination of whether differences in raw material used, product produced, manufacturing process employed, age, size, wastewater constituents and other factors require development of separate limitations and standards for different segments of the point source category. The raw waste characteristics for each such segment were then identified. This included an analysis of (1) the source, flow and volume of water used in the process employed and the sources of waste and wastewaters in the operation, and (2) the constituents of all wastewaters. The constituents of the wastewaters which should be subject to effluent limitations guidelines and standards of performance were identified.

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

The information, as outlined above, was then evaluated in order to determine what levels of technology constitute the "best practicable control technology currently available", the "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 upon which the above analysis was performed was derived from a number of sources. These sources are listed as references and/or are included in Supplement B. The

Refuse Act Permit Program Applications were of limited value because they were too few in number and provided incomplete information. The Southern Research Institute (1) report on the paint industry and the materials provided by the National Association of Printing Ink Manufacturers, the National Paint and Coatings Association and the Federation of Societies for Paint Technology were quite helpful. Detailed telephone and personal conversations with representatives of the trade and technical associations and with individual members of the industries were invaluable. The cooperation of the East Bay Municipal Utilities District (Oakland, California) in opening their files and in assisting in the sampling of waste streams from paint and ink manufacturers in the areas is appreciated, as is the cooperation of all of those industries visited and sampled. The Metropolitan Sanitary District of Greater Chicago also supplied information from their files. Twelve paint manufacturing plants and six ink manufacturing plants were visited. Composite 3-day sampling was conducted at four paint plants and one ink plant. A record of all visits and conversations is included in Supplement B.

The pretreatment standards for new sources proposed herein are intended to be complementary to the pretreatment standards proposed for existing sources under 40 CFR Part 128. The bases for such standards are set forth in the Federal Register of July 19, 1973, 38 FR 19236.

GENERAL DESCRIPTION OF THE INDUSTRY

Division of these industries into six subcategories (water-base, oil-base caustic wash, and oil-base solvent wash paint, water-base, oil-base caustic wash, and oil base solvent wash ink) was made. The paint manufacturing and ink manufacturing industries share many of the same characteristics. The raw materials, processes and wastewater charcteristics are quite similar. The two industries are distinct, however, both because of the product manufactured and the end use of that product. For these reasons, and the fact that the paint and ink manufacturing industries utilize distinct and separate trade and technical associations, the decision was made to treat them separately in this document.

The rationale for further subdivision within each of the subcategories discussed above is given in Section IV of each subcategory.

Paint Formulating Industry

Paint manufacturing is essentially a product formulation industry; that is, few, if any, of the raw materials are manufactured on site. In practice, several of the larger manufacturers make resins on the site for their own use and for sale, but resin manufacture is not included in this document. Effluent limitations for resin manufacturing are covered in the proposed guidelines for the Plastics and Synthetics Industry.(4)

The paint industry (SIC Group 2851) consists of about 1,500 companies operating almost 1,700 plants. In 1971, total industry employment was nearly 63,000. Because of the relatively simple technology and low capital investment required, the industry contains many small companies. About 42 percent of the companies have fewer than 10 employees. These small companies accounted for less than 5 percent of the industry sales in 1967, whereas the four largest companies (Sherwin-Williams, DuPont, PPG Industries, Glidden-Durkee) accounted for about 22 pecent of sales and the largest 50 accounted for 61 percent. A distribution of plants by size is given in Table III-2.

TABLE III-2

DISTRIBUTION OF PAINT PLANTS BY SIZE(3)

Size of plant (total number of employees)	Number of plants	Total number of production workers
Fewer than 10	710	1,700
10 to 19	311	2,500
20 to 49	350	6,100
50 to 99	171	6,700
100 to 249	133	9,200
250 to more	46	10,100

Although the industry is spread over a wide geographical area, it is concentrated in heavily industrialized areas. Ten states accounted for about 80 percent of the value of shipments in 1967. A map illustrating the economic concentration of the industry is given in Figure III-1.

The major products of the industry consist of trade-sale paints, which are primarily off-the-shelf exterior and interior paints for houses and buildings, and industrial finishes sold to manufacturers of such products as automobiles, aircraft, appliances, furniture, machinery, and metal containers.

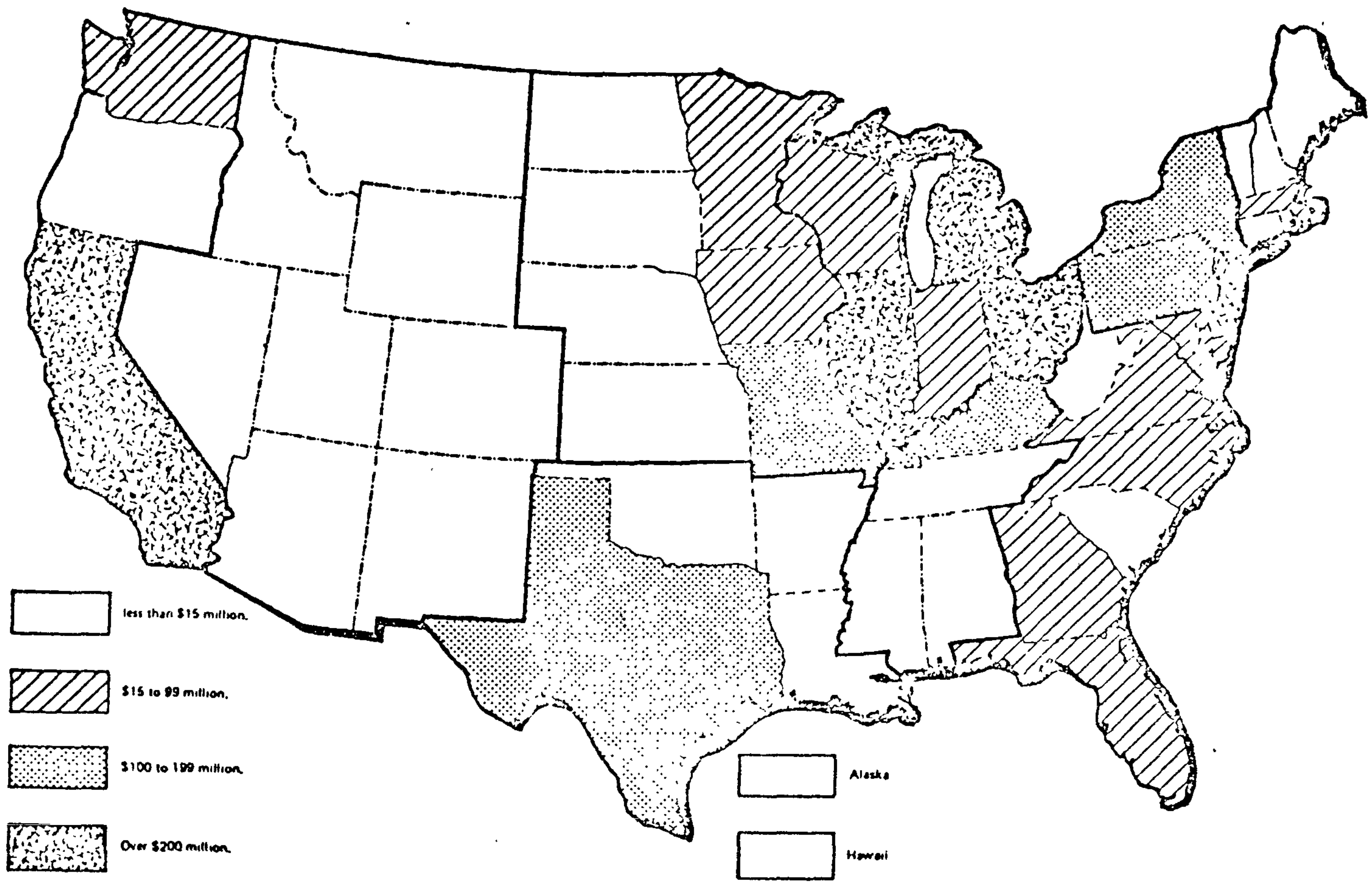

Figure III-1. U. S. Shipments of Paints and Allied Products by State 1967[2/]

In 1971, the value of trade-sale paints amounted to $1.56 billion and that of industrial finshes was $1.27 billion. The volume of these products is expected to increase at an annual rate of 7.5 percent until 1980. The historical and projected growth of these products is illustrated in Figure III-2.

The industry produces paints, varnishes, and lacquers, which consist of film-forming binders (resins or drying oils) dissolved in volatile solvents or dispersed in water. In addition, all paints and most lacquers contain pigments and extenders (calcium carbonate, clays and silicates). The industry also produces such products as putty, caulking compounds, sealants, paint and varnish removers, and thinners. The quantity and value of shipments of trade sale products in 1971 are shown in Table III-3. Table III-4 shows similar information for industrial finishes.

The principal raw materials consumed by the industry are oils, resins, pigments, and solvents. Drying oils, such as linseed oil, are used as the film-forming binder in some oil-base paints. Semi-drying oils, such as soybean oil, are used in the manufacture of alkyd resins, which are the principal binders in other oil-base paints. Acylic resins are used in the manufacture of water-base (latex) paints. Some industrial water-base paints contain a third type of resin, the water-soluble alkyd resins.

Pigments are used to impart opacity and color to the coatings. The pigment particles are finely divided to provide good dispersion in the oil or water medium and to provide good coverage. The four basic types of pigments are: 1) prime white pigments, such as titanium dioxide and zinc oxide, 2) colored inorganic and organic pigments, 3) filler and extender pigments, and 4) metallic powders. The paint industry is the largest consumer of titanium dioxide and inorganic pigments.

The paint industry is also a large consumer of solvents, which are used as the volatile vehicles in all coatings except water-base paints. The major solvents used are mineral spirits, toluene, xylene, naphtha, ketones, esters, alcohols, and glycols.

Consumption of the principal raw materials used by the industry is shown in Table III-5. In addition, the industry consumes a wide variety of other additives such as driers, bactericides and fungicides, defoamers, antisettling agents and thickeners.

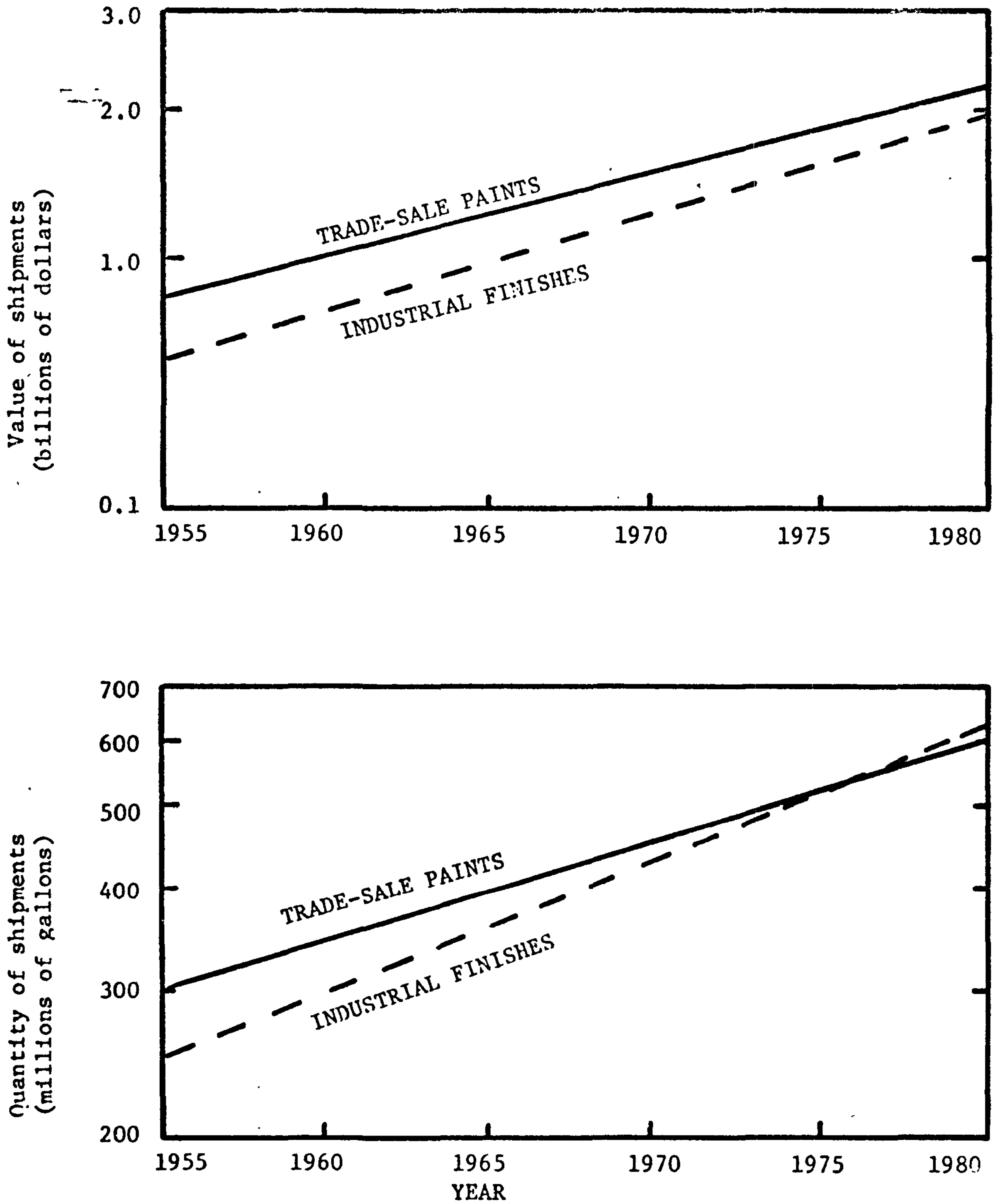

Figure III-2. Historical and Projected Growth of Coating Products, 1955 to 1980[3]

TABLE III-3

U.S. SHIPMENTS OF TRADE SALES PAINTS, VARNISHES, AND LACQUERS BY END USE 1971[2]

	Million Liters	Million Gallons	Million Dollars
Interior finishes			
House paints			
Water emulsion			
Flat	492	130	$ 420
Semigloss	76	20	70
Oil and Alkyd			
Flat	57	15	55
Semigloss	76	20	80
High-gloss	57	15	75
Primers, sealers, other	38	10	30
Miscellaneous[a]	95	25	95
Total, interior	891	235	825
Exterior finishes			
House paints			
Water emulsion	265	70	240
Oil and alkyd paints	114	30	130
Enamels	57	15	60
Primers, sealers, other	38	10	35
Miscellaneous[b]	38	10	50
Total, exterior	512	135	515
Other trade sales products			
Automotive refinishes	132	35	160
Traffic paints	76	20	40
Other[c]	22	6	23
Total, other	230	61	223
TOTAL	1633	431	$1,563

a/ Includes stains, varnishes, seamless flooring, and ceramic-like tiles

b/ Includes barn, roof, and fence coatings, bituminous products, metallic pigmented paints, stains, and varnishes

c/ Mostly marine shelf goods

TABLE III-4

U.S. SHIPMENTS OF INDUSTRIAL FINISHES BY END USE 1971[2]

	Million Liters	Million Gallons	Million Dollars
Transportation equipment			
Motor vehicles	246	65	$ 190
Marine	76	20	65
Railroad, aircraft, and other	57	15	45
	379	100	300
Industrial maintenance	189	50	170
Furniture			
Wood	189	50	90
Metal	95	25	65
	284	75	155
Prefinished stock			
Metal	95	25	100
Wood	95	25	55
	190	50	155
Metal decorating			
Packaging	151	40	100
Other	38	10	30
	189	50	130
Machinery and equipment[a]	132	35	100
Appliances	76	20	85
Packaging, exc. metal	38	10	30
Miscellaneous	201	53	143
TOTAL	1678	443	$1,268

a/ Includes data for insulating varnishes and magnet wire enamels

TABLE III-5
PRINCIPAL RAW MATERIALS USED IN THE
MANUFACTURE OF PAINTS, 1970 (3)

	Thousands of tons	Thousands of metric tons
Pigments		
Prime white		
Titanium dioxide	360.8	327.4
Zinc oxide	27.0	24.5
White lead	4.0	3.6
Extenders and fillers	333.0	302.0
Red lead	8.0	7.3
Carbon black	7.1	6.4
Oils in paint	133.9	121.5
Oils in paint resins	76.5	69.4
Natural resins	21.0	19.0
Total Selected solvents*	482.2	437.6

* Includes glycol esters, alcohols, ketones, and esters

The trend in the industry is to assist the customer in reducing air pollution in the application of industrial finishes. This is resulting in the development of water-base paints for industrial finishes and the production of high-solids and even dry powder paints. These are applied by new techniques such as electrocoating (electrophoretic deposition of charged particles of water-base paint), fluidized bed coating and electrostatic spraying (both of the latter use dry powder coatings). This trend will result in a decrease in the water pollution potential of the paint manufacturing industry.

Ink Formulating Industry

The ink manufacturing industry is similar to the paint industry in that it is essentially a formulation industry. Resins are made by some of the major manufacturers but, again, resin manufacture will not be covered in this document.

Printing ink production in the United States now exceeds one billion pounds per year. The major components include drying oils, resins, varnish, shellac, pigments and many specialty additives. The industry comprises over 250 printing ink producers. However, seven companies share over 50 percent of the market: Inmont, Sinclair and Valentine, Sun Chemical, Cities Service (F. H. Levey), Tenneco Chemicals (California Ink), Borden, and Flint Ink. Many large-volume users are captive producers as, for example, American Can, Reuben H. Donnelly, Bemis Bag and others.(5)

Printing inks can be either water- or oil-base. Many of the raw materials are the same regardless of the vehicle. The inks are made with the same type of equipment as in the paint industry and by the same processes. The waste charactristics are similar to the paint counterpart.

The largest volume single type of ink is, as one would expect, that used in the printing of newspapers. This black ink is produced by mixing finely divided carbon black and mineral oil. The value of "newsblack" however is overshadowed by the value of the great number of colored inks used largely by publishers of newspapers, books and magazines and by package manufacturers. Most of these colored inks are mixed on order but many of the pigments used in them are staple quantity products such as lithol reds, eosin reds, chrome yellows and peacock and iron blues. A large number of more specialized inks, which in the aggregate make up a considerable volume, are also used. They include vat colors and even fluorscent colors. The general trend is toward greater use of color in printing.(5)

DISCUSSION OF DOCUMENT

Each section of this document is divided into two parts, paint formulation and ink formulation. References for each industry are separated and presented in section XIII. It is believed that this arrangement will provide clarity and enhance the report's usefulness.

In all cases, limitations proposed in this document apply only to process wastewaters - that is, wastewater that has come in direct contact with raw materials or intermediate or finished products. The limitations do not apply to once-through cooling water, cooling tower blow-down, boiler blow-down or other non-contact wastewaters.

SECTION IV.
INDUSTRY CATEGORIZATION

Paint Formulating Industry

PROFILE OF PRODUCTION PROCESSES

The paint manufacturing industry is very unique in the fact that an entrepreneur can hire a few men, buy a minimum of equipment and start producing a respectable quantity of paint, providing, of course, that he has a good paint formula. A small plant with less than 30 employees can produce between 7,600 and 11,400 liters (2,000 and 3,000 gal.) of paint per day.

Paints can be either oil-base or water-base but there is little difference in the production processes used. The major production difference is in the carrying agent -- oil-base paints are dispersed in an oil mixture, while water-base paints are dispersed in water with a biodegradable surfactant used as the dispersing agent. The next significant difference is in the cleanup procedures. As the water-base paints contain surfactants, it is much easier to clean up the tubs with water. The tubs used to make oil-base paint are generally cleaned with an organic solvent, but cleaning with a strong caustic solution is also a common practice (1,2).

All paints are generally made in batches. The major difference in the size of a paint plant is in the size of the batches. A small paint plant will make up batches of from 400 to 1,900 liters (100 to 500 gal.) while a large plant will manufacture batches of up to 23,000 liters (6,000 gal.). There are generally too many color formulations to make a continuous process feasible.

There are three major steps in the oil-base paint manufacturing process: (1) mixing and grinding of raw materials, (2) tinting and thinning, and (3) filling operations. The flow diagram in Figure IV-1 illustrates these steps.

At most plants, the mixing and grinding of raw materials for oil-base paints are accomplished in one production step. For high gloss paints, the pigments and a portion of the binder and vehicle are mixed into a paste of a specified consistency. This paste is fed to a grinder, which disperses the pigments by breaking down particle aggregates rather than by reducing the particle size. Two types of grinders are ordinarily used for this purpose: pebble or

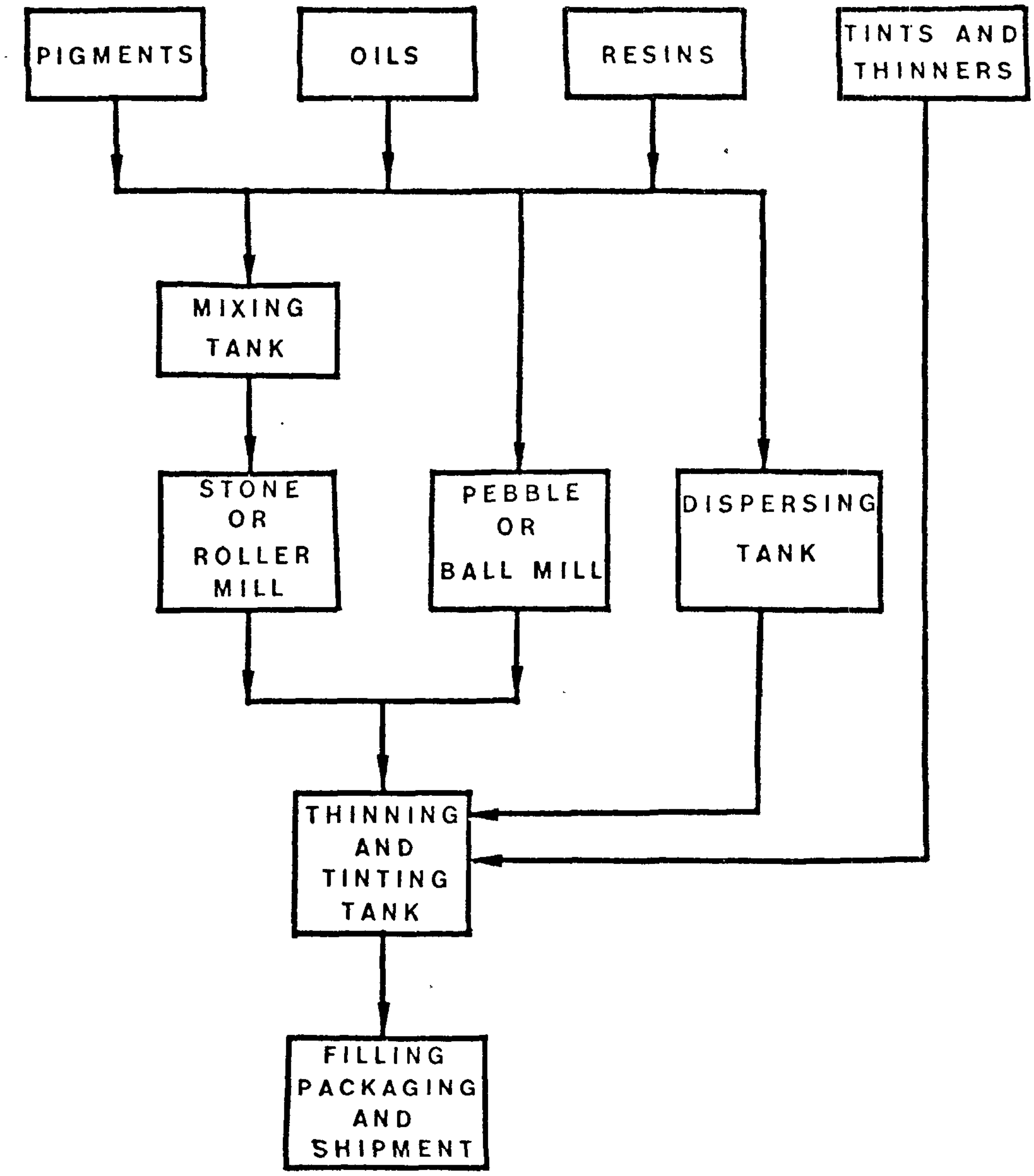

Figure IV-1. Flow Diagram of Manufacturing Process for Oil-Base Paints steel ball mills, or roll-type mills. Other paints are mixed and dispersed in a mixer using a saw-toothed dispersing blade.

In the next stage of production, the paint is transferred to tinting and thinning tanks, occasionally by means of portable transfer tanks but more commonly by gravity feed or pumping. Here, the remaining binder and liquid, as well as various additives and tinting colors, are incorporated. The paint is then analyzed and the composition is adjusted as necessary to obtain the correct formulation for the type of paint being produced. The finished product is then transferred to a filling operation where it is filtered, packaged and labeled (1,2). In a large plant, these operations are usually mechanized. In a small plant, the operation may entail the use of an overhead crane to lift the tub onto a platform where an employee fills various-sized cans from a spigot on the bottom of the tub while other employees hammer lids on the can and paste on labels.

The paint remaining on the sides of the tubs or tanks may be allowed to drain naturally and the "cleavage", as it is called, wasted or the sides may be cleaned with a squeegee during the filling operation until only a small quantity of paint remains. The final cleanup of the tubs generally consists of flushing with an oil-base solvent until clean. The dirty solvent is treated in one of three ways: (1) it is used in the next paint batch as a part of the formulation; (2) it is placed in drums that are sold to a company where it is redistilled and resold; or (3) it is collected in drums with the cleaner solvent being decanted for subsequent tank cleaning and returned to the drums until only sludge remains in the drum. The drum of sludge is then sent to a landfill for disposal (1,2,3). Cleanup of tanks by use of a strong caustic solution is also practiced. The caustic is used to remove wastes which may have hardened in the tanks and would not be amenable to cleanup with solvent; wastewater from the caustic wash can be (1) collected in holding tanks and treated before discharge; (2) collected in drums and taken to a landfill; (3) discharged directly to a sewer or receiving stream; or (4) reused in the washing operation.

Water-base paints are produced in a slightly different method than oil-base paints. The pigments and extending agents are usually received in proper particle size, and the dispersion of the pigment, surfactant and binder into the vehicle is accomplished with a saw-toothed disperser. In small plants, the paint is thinned and tinted in the same tub, while in larger plants the paint is transferred to special tanks for final thinning and tinting. Once the formulation is correct, the paint is transferred to a filling operation where it is filtered, packaged and labeled in the same manner as for oil-base paints.

The production process for water-base paints is diagrammed in Figure IV-2. The average composition of common water-base paints is shown in Table IV-1. This table does not include small quantities of preservatives or driers that may contain trace quantities of heavy metals nor does it include the organic biocides.

TABLE IV-1.

COMPOSITION OF COMMON WATER-BASE PAINTS(4)

	Type of Paint	
Ingredient	Polyvinyl Acetate Percent	Acrylic Percent
Titanium Dioxide	10.2	20.0
Calcium Carbonate	3.4	-
Zinc Oxide	-	4.1
Silicates	20.4	13.0
Synthetic Latex Solids	11.2	-
Acrylic Resin	-	15.7
Plasticizer	2.6	-
Soy Alkyd Resin	-	2.5
Water	52.2	44.7
Total Percent by Weight	100.0	100.0

As in the oil-base paint operation, as much product as possible may be removed from the sides of the tub or tank before final cleanup starts. Cleanup of the water-base paint tubs is done simply by washing the sides with a garden hose or a more sophisticated washing device. The washwater may be: (1) collected in holding tanks treated before discharge; (2) collected in drums and taken to a landfill; (3) discharged directly to a sewer or receiving stream; (4) reused in the next paint batch; or (5) reused in the washing operation.

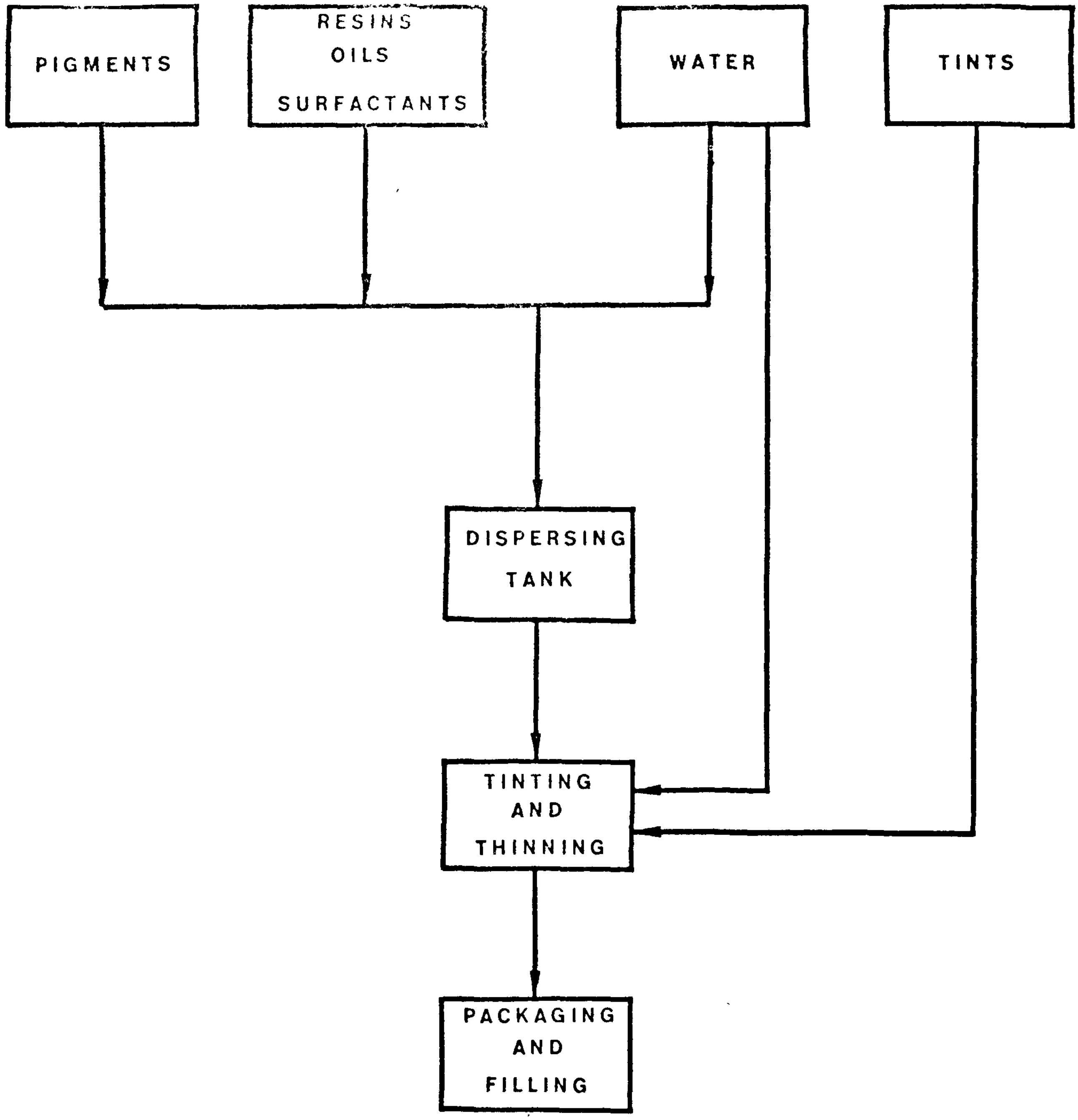

Figure IV-2. Flow Diagram of Manufacturing Process for Water-Base Paints

Some of the larger paint plants manufacture the synthetic resins used; either the usual alkyd resin, a water-soluble alkyd resin or an acrylic resin. The manufacture of either type involves an esterification process in which polybasic acids and polyhydric alcohols react with various oils or fatty acids. The raw materials are fed into a large reactor (kettle) equipped with an agitator. The kettle is then heated to the specified reaction temperature. Most alkyd resins are manufactured at around 200°C (392°F). The heated resins are cooled, filtered, and stored for use in paint production or for sale (1). Although resin manufacturing may be associated with a paint formulation facility, the guidelines being developed in this document are only for paint formulation. The production of resins is covered in the proposed Effluent Limitations Guidelines and Standards of Performance and Pretreatment for the Plastics and Synthetics Industries (5). Discharge permits for plants producing resins as well as paints will have to be based on two or more separate effluent limitations guidelines.

Varnish orginally was manufactured by the slow cooking and polymerization of natural oils and resins. This process is rapidly being replaced by the manufacture of synthetic resins (often called varnishes) as described above. The only water pollution loads possible from these processes would be from air pollution equipment and from the caustic cleaning of the cook tubs. Lacquer is produced by dissolving certain resins in a non-water solvent base with the desired pigment. No water is used in these processes and no liquid wastes are discharged.

Allied products manufactured by the paint industry include putty, caulking compounds, paint and varnish removers, shellacs, stains, wood fillers and wood sealers. The manufacturing process for these products does not generally utilize water, except for some water-base stains and paint removers. The types of wastes generated in cleanup of equipment do not greatly differ from those generated in paint formulation. As these categories are generally low in water use and are very similar to paints, they will be considered as being in the same category.

CATEGORIZATION

The following factors were considered in determining if the paint industry should be divided into subcategories for the purpose of application of effluent limitations guidelines and standards of performance:

1. Raw materials

2. Products
3. Production methods
4. Size and age of production facilities
5. Wastewater constituents
6. Treatability of wastes

Raw Materials and Products

The use of various oils and resins, extenders (calcium carbonate, silicates, clays), pigments and dispersing agents are generally the same for all paints and enamels, except for the use of oil or water as the dispersing medium. Water- and oil-base paints are interchangeable in many applications except that industrial finishes are primarily oil-base. Even this is changing, however, because of the air pollution problems generated in the industrial use of oil-base paints.

Production Methods

As previously mentioned, both oil- and water-base paints are made in the same factory, use many of the same raw materials and are produced with, generally, the same equipment. Some oil-base pigments may be dispersed in roll or ball mills before blending into the dispersed calcium carbonate, talcs and clays. The cleanup procedure varies. For oil-base paints both caustic washing and solvent washing systems are used. For water base paints caustic washing and water rinsing are the major cleanout methods.

Size and Age of Production Facilities

This study showed that the size of a production facility affects only the quantity of wastes - the characteristics of the wastes are similar regardless of plant size. Because the paint manufacturing process equipment has not changed appreciably over the years, the age of the plant has little bearing on the waste characteristics.

Wastewater Constituents and Treatability of Wastes

Oil-base paint waste solvent discharges contain flammable substances whose entry into most municipal sewer systems or surface waters is controlled by EPA Regulation 40 CFR 128. Most cities have waste ordinances that have attempted to deal with the release of these obviously deleterious substances. In most paint plants, it would be very difficult for these substances to get into the sewer system because there is usually no direct connection. Due to the highly volatile nature and the odor of these materials, the source of any substances that do find their way into the sewer system through accidental spills could quickly be located. The general practice of the paint industry is to practice no discharge of oil-base paint solvent wastes to waterways or sewers (4).

Latex is a substance that is forbidden from the sewer system by some municipal ordinances and not by others. Some plants may find that the municipality, while not prohibiting discharge of latex wastes to the sewer system, may place the waste under a surcharge. It has been found that the latex wastes can build up on the sides of the sewer laterals and cause blockages. The degree of control and enforcement has often depended on the problems that the paint plants have created for the municipality. (4)

Latex materials generally enter the sewer system as a result of the washing down of batch equipment. When there is no change of formulation from one batch to the next, as is found often with small paint manufacturers, little or no latex enters the sewer system. Generally, the small manufacturer can recycle most of his washwater into the next batch, if he is engaged in the manufacture of only one or two base colors (2). This is both a desirable water conservation practice and an economic advantage because the valuable solid materials are thus recovered.

The wastes from latex paint production contain only biodegradable oils and surfactants mixed with insoluble inorganic extenders and pigments. The concentration of preservatives is diluted well below levels of significance during washing operations. Thus, there is no problem in treating the wastes using physical and biological treatment methods.

Although the equipment and raw materials used to make oil-based and water-based paints are quite similar and could be classified as one category, the problem of pretreatment standards and the requirements to control fire and explosive hazards would dictate that oil- and water-based paints be treated as separate categories.

CONCLUSION

On the basis of the raw materials used, the products produced, the production methods, the cleanup methods, the size and age of facilities, the wastewater constituents and the treatability of wastes, it is concluded that the paint formulation category be subcategorized into (1) oil-based solvent wash paints, (2) oil-base caustic wash paints and (3) water-based paints.

Ink Formulating Industry

PROFILE OF PRODUCTION PROCESSES

The ink formulation industry differs only slightly from the paint industry. Many of the raw materials are the same and the methods of producing ink are nearly identical to those for producing paint. Milling is used more frequently in the ink industry than in the paint industry as a method of dispersing pigments. There are both large and small ink formulators, and again, the size of the plant appears to offer no economic advantage.

As the processes and equipment used by the ink industry are very similar to the paint industry, there is no need to discuss the methods of production. The profile of the paint industry is applicable to inks also. Although resin manufacturing may be associated with an ink formulation facility, the guidelines being developed in this document are only for ink formulation. The production of resins is covered in the Effluent Limitations Guidelines and Standards of Performance and Pretreatment for the Plastics and Synthetics Industries (1). Discharge permits for plants producing resins as well as inks will have to be based on two or more separate effluent limitation guidelines.

CATEGORIZATION

With respect to identifying discrete categories, the following factors were considered in determining whether or not the ink industry should be divided into subcategories for the purpose of application of effluent limitations guidelines and standards of performance:

1. Raw materials
2. Products
3. Production methods
4. Size and age of production facilities
5. Wastewater constituents
6. Treatability of wastes

Raw Materials and Products

The use of various oils and resins, lacquers, clays, pigments and dispersing agents are generally the same except for the use of oil or water as the dispersing medium.

Production Methods

Both oil- and water-base inks can be made in the same factory. Many of the same raw materials are used and the inks are produced with, generally, the same equipment. Some oil-base pigments may be blended into the extenders and carriers before being dispersed by roll or ball mills.

The equipment methods vary. For oil-base inks a caustic or solvent washout system is used. For water base inks a caustic washout or water rinse methods of cleanout.

Size and Age of Production Facilities

Only the quantity of wastes is affected by the plant size. The chemical composition is generally the same. Some plants recycle and conserve water and have a negligible discharge, while other plants use water lavishly with no regard for conservation. The age of the plant has no effect on the quantity or composition of the wastes generated.

Wastewater Constituents and Treatability of Wastes

Oil-base ink discharges contain substances whose entry into most municipal sewer systems or surface waters is controlled by EPA Regulation 40 CFR 128. As previously mentioned in the section on paint, most cities have waste ordinances which have attempted to deal with the release of these substances.

The wastes from water-base ink formulation have generally been accepted by municipalities as nearly all ink plants are connected to municipal sewers. As with paint, the metals in inks are generally part of the suspended solids. The organics in water-base inks are generally considered to be biodegradable as they are basically the same as in paints.

CONCLUSIONS

It is concluded that, based on the constituents, wash procedures and treatability, the ink manufacturing industry must be considered as three subcategories -- water-base inks, oil-base solvent wash and oil-base caustic wash inks.

SECTION V.

WATER USES AND WASTE CHARACTERISTICS

Paint Formulating Industry

SPECIFIC WATER USES

On the basis of data from the Southern Research Institute (SRI) report (1) on plants representing 26 percent of the total industry paint production and 38 percent of the total industry production employees, the water usage for the entire industry is estimated at 284 to 310 million liters (75 to 82 million gal.) per day. Cooling is the largest single use of water, accounting for about 79 percent of the total usage. Of the other uses for water, all are less than that used for sanitary purposes, which is about 6 percent (1). The total process water use for the 1,700 plants is from 42 to 45 million liters per day (11 to 12 mgd).

A major source of water is municipal or public supply, which accounts for about 43 percent of the total intake. Well water and surface water account for about 21 and 32 percent, respectively. Only about 4 percent of the total water used is recycled; however, the reported figures are probably somewhat low because some plants responding to the SRI survey did not include the water used in recirculating cooling systems. In smaller plants, a greater proportion of the water is used for purposes other than cooling. Very large plants--those with more than 250 employees--account for nearly 70 percent of the total industry water usage while plants with fewer than 100 employees account for about 10 percent (1).

Disposition of wastewater from the various uses in the paint industry is shown in Table V-1. Since cooling water normally does not contact the product or raw material, it should not become contaminated if properly handled. On the other hand, water used for cleanup and air pollution control, which accounts for 4 percent of the total discharge, necessarily becomes contaminated in use and can result in the discharge of pollutants. Water used for air pollution control (wet scrubbers) is associated almost exclusively with the production of resins and is therfore not of concern in this document. Dusts and powders removed from paint production areas are recovered by dry methods. Table V-1 shows that about 70 percent of the wastewater is discharged untreated. However, only 0.5 percent is likely to be contaminated directly from the paint manufacturing operation. It is worth noting that approximately 25 percent

TABLE V-1

DISPOSITION OF WASTEWATER IN PAINT PLANTS[1/]

Use	Total use, as % of total wastewater	Disposition, percent of use						
		Discharged				Not discharged		
		Untreated		Treated				
		To sanitary sewer	To surface receiving body	To sanitary sewer	Other	Evaporated	Recycled	Other[a/]
Boiler feed	3.4	34.2	39.4	0.8	0	8.6	14.2	2.8
Cooling	79.0	20.5	56.7	0.1	0.4	0.3	4.1	17.9
Sanitary	6.5	95.0	0	0	0	2.9	0	2.1
Cleanup	1.5	47.2	0.3	30.7	0.3	12.3	2.5	6.7
Air pollution control	2.5	39.1	3.7	19.2	0	0.6	14.4	23.1
Other	1.4	0.3	2.3	17.0	0	2.6	0	77.7
Unaccounted for	5.7	0.7	0	0	0	1.3	3.2	-2.8
Total disposition, as % of total wastewater	100.0	26.9	46.1	1.3	0.3	4.2	11.8	9.4

a/ Includes landfill, hauling, incineration, septic tanks, etc.

of the industry's wastewater is not discharged, but is disposed of by evaporation, recycling, or by some other method. Only larger plants show other wastewater sources, such as air pollution control or process water from resin manufacturing (1).

Most cleanup waste results from cleaning the equipment used to manufacture water-base paints. The types of equipment most frequently cleaned are filling machines, tinting and thinning tanks, and mixers. The average quantity of water used in cleanup of equipment ranges from 0.02 liters per liter (gal./gal.) of paint produced for filling machines to 0.8 liters per liter (gal./gal.) of paint produced for tinting and thinning tanks (1,2).

Other sources of wastewater generated in cleanup operations include the caustic washing of equipment used in the preparation of solvent-base paints, resins, and other products. However, the equipment used to prepare these products is frequently cleaned with solvent which is not discharged.

The average volume of cleanup water discharged for plants of various sizes is shown in Table V-2. For small plants--those with fewer than 50 employees--the volume discharged is relatively small, less than 1,000 liters (260 gal.) per day. At plants with more than 250 employees, the average volume of cleanup water is about 40 times this value, still an extremely small volume when considering pollution potential.

TABLE V-2
AVERAGE VOLUME OF CLEANUP WATER
DISCHARGED FROM PLANTS OF VARIOUS SIZES(1)

Size of plant (total number of employees)	Number of plants reporting	Cleanup water discharged liter/day	gal./day
Fewer than 10	24	292	77
10 to 19	30	769	200
20 to 49	34	983	260
50 to 99	21	4,679	1,200
100 to 249	22	11,957	3,200
250 or more	20	40,490	11,000

In addition to routine equipment cleanup, wastewater is generated through general plant cleanup and spills. It is not possible to estimate accurately the volumes of wastewater arising from these operations. Settling tanks and other kinds of treatment are used for treating wastewaters from floor drains and spills, while off-specification batches are recovered and reused or sold (1).

WASTE CHARACTERISTICS

As determined by the Southern Research Institute survey, the major contaminants of wastewater reported by paint plants are listed in Table V-3. As would be expected, these contaminants, except for caustics used in cleaning, are components of paint. The materials listed most frequently by plants as major contaminants are pigments and latex. The presence of one or both of these materials in the wastewater was reported by about 90 percent of the 71 plants. Over half of the plants also reported the presence of such materials as oils, resins, driers, and dispersing agents. Only four plants reported the presence of solvents as a major contaminant of the wastewater, five plants reported metals and six reported fungicides (1).

TABLE V-3

MAJOR CONTAMINANTS IN WASTEWATER DISCHARGE(1)

	Number of plants			
Number of Employees	19 or less	20 to 99	Greater than 100	Totals
Number of plants reporting	26	23	22	71
Major Contaminants				
Pigments	15	10	11	36
Latex	12	8	6	26
Driers and wetting agents	3	4	8	15
Oils	3	3	6	12
Resins	7	3	1	11
Caustics	1	0	7	8
Fungicides (including mercury)	2	2	2	6
Metals (excluding mercury)	0	1	4	5
Solvents	0	3	1	4

Table V-4 summarizes raw waste loadings calculated from analyses of 22 parameters reported by nine plants. Although 91 plants (of 153) reported that routine effluent analyses were conducted by either plant staff or outside laboratories, only 29 reported data on results of those analyses. Of the 29, 20 reported data on treated effluent. No meaningful conclusions could be drawn from the analyses of treated effluents reported in the survey since too few plants used the same treatment methods. Almost all of the nine plants providing information on raw waste characteristics gave data on the combined plant effluent; therefore, calculation of the loading in relation to production of particular products was not possible. The loadings are therefore, expressed in kg/day rather than the preferred units of weight per unit of product. The data show the average, minimum and maximum daily loadings, and the number of plants reporting (1). The NFIC-D survey of selected paint plants was made to supplement this data.

As indicated in Table V-4, suspended solids, primarily from pigments and resin particles, is the most significant parameter. The high loading of dissolved solids is not readily explainable in terms of the ingredients used in paint or the soluble constituents shown in the Table that would constitute the dissolved solids. Loadings of BOD_5 and COD, principally from biodegradable oils and resins, are not as high as those of suspended and dissolved solids. While oil and grease content appears high, it should be noted that the standard test gives high results for oil and grease in the effluents from this industry because resin particles that are present are, at least partially, extracted by the solvent used in the test. However, the major components making up these high concentrations are easily biodegradable and thus are amenable to biological treatment. The relatively high loadings of zinc, iron and titanium are due principally to the pigments, drying agents, and preservatives. Mercury is present in some preservatives, however, these are rapidly being phased out. The ultimate fate of the use of mercury by the industry is unknown pending court appeals. In addition to lead and zinc, shown in the table, some drying agents also contain cobalt and manganese. All of the metals shown in the table, and a number of others, are commonly present in at least trace quantities in inorganic pigments (1,6,7,8,9).

The information needed to supplement the raw waste data obtained from the Southern Research Institute report was developed through a study of the files of the East Bay Municipal Utilities District (EBMUD) in Oakland, California, and files of the Greater Chicago Metropolitan Sanitary

TABLE V-4.

DAILY RAW WASTE LOADING FROM PAINT PLANTS[1/]

	Waste Loadings						
	Average		Minimum		Maximum		Number of plants reporting
Parameter	kg/day	(lb/day)	kg/day	(lb/day)	kg/day	(lb/day)	
Total dissolved solids	220	485	9	20	483	1,065	7
Total suspended solids	377	832	3	7	3,233	7,132	9
Volatile suspended solids	40	88	15	33	61	135	3
Acidity/Alkalinity	17	38	2	4	47	104	5
BOD (acclimated seed)	20	44	4	9	77	170	9
Chemical oxygen demand	28	62	13	29	44	97	6
Total organic carbon	15	33	6	13	23	51	2
Chloride	43	95	0.4	0.9	125	276	3
Oil and Grease	224	494	0.8	1.8	1,327	2,927	6
Sulfate	14	31	0.4	0.9	40	88	3
Sulfide	0.12	0.26	<0.02	<0.04	0.4	0.9	3
Organic nitrogen	0.4	0.9	-	-	-	-	1
Nitrogen, as N	6	13	0.4	0.9	18	40	4
Ammonia	2	4	0.02	0.04	10	22	5
Phosphorus	0.2	0.4	<0.02	<0.04	0.5	1.1	4
Mercury	0.0002	0.0004	<0.0002	<0.0004	0.0004	0.0009	5
Lead	0.077	0.170	0.024	0.05	0.120	0.265	7
Cadmium	0.008	0.018	0.002	0.004	0.120	0.265	6
Chromium	0.112	0.247	0.010	0.022	0.217	0.479	3
Zinc	4.7	10.4	0.028	0.062	10.8	23.8	5
Iron	2.9	6.4	0.426	0.940	9.6	21.2	4
Titanium	0.933	2.06	0.052	0.115	1.2	2.6	4

District, and by a plant sampling survey in the Oakland-Berkeley, California area by National Field Investigations Center-Denver (NFIC-D) (2).

The results of a waste discharge survey of paint plants by the EBMUD are presented in Table V-5. All data were developed by State certified laboratories.

The typical waste characteristics of effluents from a large plant are shown in Table V-6. As can be seen, the concentrations of the pollutants are relatively large. This data is slightly in error as there is an employee washroom that drains into the sewer ahead of the EBMUD sampling point. Subsequent data taken from the NFIC-D survey for this plant in late 1973 was collected upstream of the employee washroom. The data, presented in Table V-7, generally supports the range of data presented by Barrett et al (1). The wastewater characteristics of two small plants are shown in Table V-8 and V-9. Table V-8 shows the effects of reducing pollutant load by removing as much product as possible from the paint tubs before washing and by using minimum washwater volume as opposed to a more normal tub-cleaning process shown by Table V-9.

TABLE V-5

CONSTITUENTS OF PAINT MANUFACTURING PLANT (SIC 2851) WASTES IN EAST BAY MUNICIPAL UTILITIES DISTRICT[a]

Constituent	No. of Entries	Values (mg/l) Min.	Max.	Mean	Std. Dev.	Median
pH	28	3.4	13.2	8.8	3.2	6.7
BOD	12	60	1,740	481	474	450
Total COD	31	53	99,999[b]	5,428	17,649	5,145
Dissolved COD	31	19	78,000	4,103	13,787	4,466
Total Solids	1	-	-	6,887	-	-
Settleable Solids	3	0[c]	2	1	-	-
Total Suspended Solids	32	38	8,180	1,039	1,759	612
Ammonia	3	0	1.7	0.5	-	1.7
Total Kjeldahl Nitrogen	3	0	189	64	-	-
Oil & Grease	26	4	999	103	232	7
Total Phosphorus	3	0.3	26.4	14	-	26
Aluminum	3	2.6	74.6	29.5	-	11.4
Antimony	1	1.1	1.1	1.1	-	-
Barium	3	0.77	5.7	2.8	-	5.7
Cobalt	2	0.05	0.23	0.14	-	-
Chromium	3	0.4	7.5	2.8	-	0.4
Copper	3	0.11	0.22	0.17	-	0.11
Iron	3	3.8	37.3	15.2	-	4.6
Lead	3	1.14	9.99	4.99	-	1.1
Manganese	3	0.06	9.99	3.5	-	0.06
Nickel	3	0.02	0.07	0.03	-	0.02
Silver	2	0	0	0	-	-
Tin	3	0	0.07	0.02	-	-
Zinc	3	0.31	9.3	3.8	-	1.7
Phenols	3	0	0.1	0.0	-	-
Surfactants	3	0.2	7.5	2.8	-	7.5

a/ All data from East Bay Municipal Utilities District files.
b/ Series of 9's indicate number higher then allocated space in computer program.
c/ A zero indicates a value below detectable limits of analytical test.

TABLE V-6

WASTEWATER CHARACTERISTICS OF A
WATER-BASE PAINT PLANT, BERKELEY, CALIFORNIA[a/]

Pollutant	No. of Samples	Avg. mg/1	Quantity gm/day	Quantity lb/day	kg of Pollutant per 1,000 1 of Product	lb of Pollutant per 1,000 gal. of Product
COD	33	2,339	33,642	71.1	1.87	14.97
BOD	24	536	7,709	17.0	0.43	3.58
Total Suspended Solids	51	1,394	20,050	44.2	1.11	9.30
Oil & Grease	22	90	1,294	2.8	0.07	0.59
pH (No. of Occurances)		3-4.9 (6)	5-6.9 (19)	7-8.9 (8)	9-10.9 (6)	11 (10)
Barium	1	1.0	14.4	0.03	8.0×10^{-4}	6.3×10^{-3}
Chromium	2	<0.08	--	--	neglible	neglible
Titanium	1	1.2	17.3	0.04	9.6×10^{-4}	8.4×10^{-3}
Cadmium	1	0.01	0.1	3×10^{-4}	5.6×10^{-6}	6.3×10^{-5}
Iron	1	5.9	85.0	0.19	4.7×10^{-3}	4×10^{-2}
Lead	2	0.4	5.8	0.01	3.2×10^{-4}	2.1×10^{-3}
Mercury	3	0.3	4.3	9.5×10^{-3}	2.4×10^{-4}	2×10^{-3}
Zinc	3	14.2	204.5	0.45	0.01	9×10^{-2}
Copper	1	0.04	0.58	1.1×10^{-3}	3.2×10^{-5}	2.3×10^{-4}

a/ All data taken from EBMUD records. Average sewer flow from paint plant 3,800 gpd (14,383 l/day), average paint production 4,750 gpd (17,978 l/day), 100 employees.

TABLE V-7

AVERAGE POLLUTANT LOAD FROM LARGE LATEX PAINT PLANT BASED ON 3-DAY COMPOSITE SAMPLING (OCTOBER 15-18, 1973)[a/]

Pollutant	Concentration mg/l	Quantity gm/day	Quantity lb/day	Pollutant Load Per Production Unit kg/1,000 l	Pollutant Load Per Production Unit lb/1,000 gal.
pH	11.5[b/]				
COD	8,100	176,000	387	6.64	55.0
TOC	1,200	26,900	59.2	1.01	8.46
Total Suspended Solids	11,300	247,000	544	9.32	77.7
Metals					
Barium	1.67	36.4	0.08	14×10^{-4}	114×10^{-4}
Total Chromium	0.93	20.3	0.04	7.6×10^{-4}	57×10^{-4}
Cadmium	<0.01	<0.22	$<5 \times 10^{-4}$	$<8 \times 10^{-6}$	7.1×10^{-5}
Iron	41.70	908	2.01	343×10^{-4}	0.28
Lead	0.62	13.5	0.03	5.1×10^{-4}	42.8×10^{-4}
Zinc	52.7	1,150	2.53	433×10^{-4}	0.36
Copper	0.40	8.72	0.02	3.3×10^{-4}	28.5×10^{-4}
Titanium	223	4,870	10.7	$1,840 \times 10^{-4}$	1.53

Mercury - Analysis not possible because of interferences.

Average wastewater flows as gaged 21,800 l/day (5,760 gpd.).
Average Paint Production 26,500 l/day (7,000 gpd.).
Average of 100 employees

a/ Survey conducted by NFIC-D.
b/ Value reported as standard units.

TABLE V-8

AVERAGE POLLUTANT LOAD FROM SMALL LATEX PAINT PLANT WITH LOW WATER USE BASED ON 3-DAY SAMPLING PROGRAM (OCTOBER 15-18, 1973)a/

Pollutant	Concentration mg/l	Quantity gm/day	Quantity lb/day	Pollutant Load Per Production Unit kg/1,000 l	Pollutant Load Per Production Unit lb/1,000 gal.
pH	8.2b/				
COD	14,800	843	1.86	0.30	2.48
TOC	1,890	107	0.24	0.04	0.23
Total Suspended Solids	31,500	1,790	3.94	0.63	5.25
Metals					
Barium	1.0	0.06	1.3×10^{-4}	2.1×10^{-5}	1.7×10^{-5}
Total Chromium	0.59	0.03	7.4×10^{-5}	1.0×10^{-5}	9.9×10^{-5}
Cadmium	<0.01	$<6 \times 10^{-4}$	1.3×10^{-6}	Negligible	1.7×10^{-6}
Iron	139	7.90	1.7×10^{-2}	2.8×10^{-3}	2.3×10^{-2}
Lead	1.02	0.06	1.3×10^{-4}	2.1×10^{-5}	1.7×10^{-4}
Zinc	2.64	0.15	3.3×10^{-4}	5.3×10^{-5}	4.4×10^{-4}
Copper	0.14	7.9×10^{-3}	1.7×10^{-5}	2.7×10^{-6}	2.3×10^{-5}
Titanium	743	42.2	9.3×10^{-2}	1.5×10^{-2}	0.12
Mercury - Analyses not possible because of interferences.					

Notes: Small plant made paint in batches. Samples represented washwater from 5 batches.

Average wastewater flow as gaged 56.8 l/day (15 gpd).
Average Paint Production 2840 l/day (750 gpd).
Average of 15-20 employees

a/ Survey conducted by NFIC-D.
b/ Value reported as standard units.

TABLE V-9

AVERAGE POLLUTANT LOAD FROM SMALL LATEX PAINT PLANT BASED ON
3-DAY SAMPLING PROGRAM,
(OCTOBER 15-18, 1973)[a]

Pollutant	Concentration mg/l	Quantity gm/day	Quantity lb/day	Pollutant Load Per Production Unit kg/1,000 l	Pollutant Load Per Production Unit lb/1,000 gal.
pH	7.7[b]				
COD	16,200	7,500	16.5	1.56	13.0
TOC	3,100	1,390	3.1	0.29	2.44
Total Suspended Solids	19,800	8,890	19.6	1.8	15.44
Metals					
Barium	<1	<0.5	$<1 \times 10^{-3}$	$<1 \times 10^{-4}$	7.8×10^{-4}
Total Chromium	0.77	0.35	7.7×10^{-4}	7.2×10^{-5}	6.0×10^{-4}
Cadmium	<0.001	4×10^{-4}	9.9×10^{-7}	$<8.2 \times 10^{-8}$	7.8×10^{-7}
Iron	523[c]	235	0.52	4.9×10^{-2}	0.41
Lead	2.5	1.12	2.4×10^{-3}	2.3×10^{-4}	1.9×10^{-3}
Zinc	77.4	34.8	7.6×10^{-2}	7.2×10^{-3}	6×10^{-2}
Copper	0.09	0.04	8.8×10^{-5}	8.2×10^{-6}	6.9×10^{-5}
Titanium	248	111	0.24	2.3×10^{-2}	0.19
Mercury - Analyses not possible because of interferences.					

Note: Small plant making paint in batches. Sample represented 5 grab samples before dumping.

Average wastewater flow as gaged 449 l/day (119 gpd).
Average paint production 4820 l/day (1270 gpd).
Average of 25 employees
a/ Survey conducted by NFIC-D.
b/ Value reported as standard units.
c/ One value, 2,600 mg/l iron, from iron pigment.

Ink Formulating Industry

The predominant water use in ink formulation is for non-contact cooling water for ball or roller mills. The only process wastewater from ink formulation is the water used for tub washing and plant cleanup. Some water is used in water-base ink product formulation but this water is not discharged except during tub washing.

Because these tubs are identical to those used by paint formulators, the type of cleanup and quantities of water used are identical. Reference is made to Section V of the discussion on paints. Limited information is currently available on the actual composition of ink wastes. The composition of wastes from a tub washer that recycles the cleaning water is shown in Table V-10. These wastewaters are not discharged. Table V-11 gives the constituents of several ink manufacturing plant wastes in the Oakland, California area. There is no information available to determine the number of plants the data in Table V-11 covers.

The quantities of water used were very difficult to determine as data was limited. For systems with no water reuse, the range was from 4,400 to 8,900 liters/1,000 kg (500 to 1,000 gals./1,000 lb) of ink including cooling, boiler and process waters. In the recycle system of Table V-10, the sludge was produced at a rate of 113 liters/1,000 kg (13.6 gals./1,000 lb) of ink. If the sludge were 3 percent solids as indicated in the table, the washwater discharged would be 110 liters/1,000 kg (13.2 gals./1,000 lb) of ink.

TABLE V-10

WASTE CHARACTERIZATION FROM AN INK TUB WASHER THAT RECYCLES THE WASH WATER[a/]
(October 15-18, 1973)

Pollutant	Concentration (mg/l)
COD	59,500
TOC	32,000
Total Suspended Solids	31,600
pH	12.5[b/]
Metals	
Barium	6.7
Total Chromium	150
Cadmium	0.29
Iron	134
Lead	760
Zinc	4.9
Copper	6.4
Titanium	<1

a/ Survey conducted by NFIC-D; daily production 18,400 lb/day (average of data from two grab samples).
b/ Value reported as standard units.

TABLE V- 11

CONSTITUENTS OF INK MANUFACTURING PLANT (SIC 2893) WASTES IN EAST BAY MUNICIPAL UTILITIES DISTRICT[a/]

Constituent	No. of Entries	Values (mg/l)				
		Min.	Max.	Mean	Std. Dev.	Median
PH[b/]	16	5.6	11.6	9.4	1.9	11.1
BOD	12	55	2,160	412	563	490
Total COD	16	310	3,270	926	693	935
Dissolved COD	16	170	2,980	742	643	876
Total Solids	2	338	385	361		-
Total Suspended Solids	16	13	1,230	156	292	78
Oil & Grease	14	7	183	57	49	97
Aluminum	2	0.5	1.8	1.1		-
Boron	2	0.18	0.21	0.19		-
Cobalt	1	0	0	0	0	0
Chromium	2	0.1	0.1	0.1	0	-
Copper	1	0.06	0.06	0.06	0	0.06
Iron	2	0.6	2.2	1.4		-
Lead	2	0.26	0.32	0.29		-
Manganese	2	0.02	0.10	0.06		-
Nickel	2	0.01	0.01	0.01	0	0
Silver	2	0	0	0	0	0
Tin	2	0	0	0	0	0

a/ All data from East Bay Municipal Utilities District files.
b/ Value reported as standard units.

SECTION VI.

SELECTION OF POLLUTANT PARAMETERS

Paint Formulating Industry

The major wastewater parameters of significance for the paint formulation industry are BOD_5 (5-day 20°C Biochemical Oxygen Demand), TSS (Total Suspended Solids), pH, and selected metals. Chemical Oxygen Demand (COD) may be used as a substitute for BOD_5 if a relatively constant COD/BOD_5 ratio can be developed for a given plant. On the basis of the evidence reviewed, there appear to be very small quantities of potentially hazardous or toxic pollutants released by the paint formulation inustry. Recycling washwater and water conservation practices will reduce the quantity of paint wastes discharged to the sewers or receiving waters.

Ink Formulating Industry

As most ink formulators do not discharge wastes to water courses and their wastes are generally considered to be compatible with municipal treatment, there is little data available on the waste characteristics. The practices of recycling wastewater and water conservation can reduce the quantity of ink waste discharged to the sewers.

The significant parameters for measuring the pollution potential of ink wastes are BOD_5 (5-day), pH, and Total Suspended Solids. Chemial Oxygen Demand (COD) may be used as a substitute for BOD_5 if a relatively constant BOD_5/COD ratio can be developed for a given plant.

RATIONALE FOR SELECTION OF POLLUTANT PARAMETERS

Biochemical Oxygen Demand (BOD5, 20°C)

Biochemical oxygen demand (BOD) is a measure of the oxygen consuming capabilities of organic matter. The BOD does not in itself cause direct harm to a water system, but it does exert an indirect effect by depressing the oxygen content of the water. Sewage and other organic effluents during their processes of decomposition exert a BOD, which can have a catastrophic effect on the ecosystem by depleting the oxygen supply. Conditions are reached frequently where all of the oxygen is used and the continuing decay process causes the production of noxious gases such as hydrogen sulfide and methane. Water with a high BOD indicates the presence of decomposing organic matter and subsequent high bacterial counts that degrade its quality and potential uses.

Dissolved oxygen (DO) is a water quality constituent that, in appropriate concentrations, is essential not only to keep organisms living but also to sustain species reproduction, vigor, and the development of populations. Organisms undergo stress at reduced DO concentrations that make them less competitive and able to sustain their species within the aquatic environment. For example, reduced DO concentrations have been shown to interfere with fish population through delayed hatching of eggs, reduced size and vigor of embryos, production of deformities in young, interference with food digestion, acceleration of blood clotting, decreased tolerance to certain toxicants, reduced food efficiency and growth rate, and reduced maximum sustained swimming speed. Fish food organisms are likewise affected adversely in conditions with suppressed DO. Since all aerobic aquatic organisms need a certain amount of oxygen, the consequences of total lack of dissolved oxygen due to a high BOD can kill all inhabitants of the affected area.

If a high BOD is present, the quality of the water is usually visually degraded by the presence of decomposing materials and algae blooms due to the uptake of degraded materials that form the foodstuffs of the algal populations.

It was thought at first that the BOD_5 test would be meaningless because of the action of the biological inhibitors and heavy metals. However, this does not appear to be the case as the majority of the water-base paints are not tinted before packaging and the tinting materials contain most of the troublesome heavy metals. Also the inhibitor is diluted to the point of ineffectiveness by the washwater. The oils used in water-base paint production are generally easily oxidized (9). Thus, control of this parameter will also control oil and grease concentrations.

Chemical Oxygen Demand (COD)

Chemical oxygen demand (COD) provides a measure of the equivalent oxygen required to oxidize the materials present in a waste water sample under acid conditions with the aid of a strong chemical oxidant, such as potassium dischromate, and a catalyst (silver sulfate). One major advantage of the COD test is that the results are available normally in less than three hours. Thus, the COD test is a faster test by which to estimate the maximum oxygen exertion demand a waste can make on a stream. However, one major disadvantage is that the COD rest does not differentiate between biodegradable and nonbiodegradable organic material. In addition, the presence of inorganic reducing chemical (sulfides, reduciable metallic ions, etc.) and chlorides may interfere with the COD test. As a rough generalization, it may be said that pollutants which would be measured by the BOD_5 test will also show up under the COD test, but that additional pollutants which are more resistant to biological oxidation (refractory) will also be measured as COD.

pH

Acidity and alkalinity are reciprocal terms. Acidity is produced by substances that yield hydrogen ions upon hydrolysis and alkalinity is produced by substances that yield hydroxyl ions. The terms "total acidity" and "total alkalinity" are often used to express the buffering capacity of a solution. Acidity in natural waters is caused by carbon dioxide, mineral acids, weakly dissociated acids, and the salts of strong acids and weak bases. Alkalinity is caused by strong bases and the salts of strong alkalies and weak acids.

The term pH is a logarithmic expression of the concentration of hydrogen ions. At a pH of 7, the hydrogen and hydroxyl ion concentrations are essentially equal and the water is neutral. Lower pH values indicate acidity while higher values indicate alkalinity. The relationship between pH and acidity or alkalinity is not necessarily linear or direct.

Waters with a pH below 6.0 are corrosive to water works structures, distribution lines, and household plumbing fixtures and can thus add such constituents to drinking water as iron, copper, zinc, cadmium and lead. The hydrogen ion concentration can affect the "taste" of the water. At a low pH water tastes "sour". The bactericidal effect of chlorine is weakened as the pH increases, and it is advantageous to keep the pH close to 7. This is very significant for providing safe drinking water.

Extremes of pH or rapid pH changes can exert stress conditions or kill aquatic life outright. Dead fish, associated algal blooms, and foul stenches are aesthetic liabilities of any waterway. Even moderate changes from "acceptable" criteria limits of pH are deleterious to some species. The relative toxicity to aquatic life of many materials is increased by changes in the water pH. Metalocyanide complexes can increase a thousand-fold in toxicity with a drop of 1.5 pH units. The availability of many nutrient substances varies with the alkalinity and acidity. Ammonia is more lethal with a higher pH.

The lacrimal fluid of the human eye has a pH of approximately 7.0 and a deviation of 0.1 pH unit from the norm may result in eye irritation for the swimmer. Appreciable irritation will cause severe pain.

Total Suspended Solids (TSS)

The bulk of the materials used in paint formulations are nearly insoluble inorganic compounds -- titanium dioxide, clays, calcium carbonate, and silicates -- which could occlude the bottom of the receiving body of waters. The parameter of suspended solids would measure the efficiency of removal of these inorganic solids.

The bulk of the materials used in ink formulations are insoluble inorganic compounds--clays and pigments--which could occlude the bottom of the receiving body of water. The parameter of suspended solids would measure the efficiency of removal of these inorganic solids.

Suspended solids include both organic and inorganic materials. The inorganic components include sand, silt, and clay. The organic fraction includes such materials as grease, oil, tar, animal and vegetable fats, various fibers, sawdust, hair, and various materials from sewers. These solids may settle out rapidly and bottom deposits are often a mixture of both organic and inorganic solids. They adversely affect fisheries by covering the bottom of the stream or lake with a blanket of material that destroys the fish-food bottom fauna or the spawning ground of fish. Deposits containing organic materials may deplete bottom oxygen supplies and produce hydrogen sulfide, carbon dioxide, methane, and other noxious gases.

In raw water sources for domestic use, state and regional agencies generally specify that suspended solids in streams shall not be present in sufficient concentration to be objectionable or to interfere with normal treatment processes. Suspended solids in water may interfere with many industrial processes, and cause foaming in boilers, or encrustations on equipment exposed to water, especially as the temperature rises. Suspended solids are undesirable in water for textile industries; paper and pulp; beverages; dairy products; laundries; dyeing; photography; cooling systems, and power plants. Suspended particles also serve as a transport mechanism for pesticides and other substances which are readily sorbed into or onto clay particles.

Solids may be suspended in water for a time, and then settle to the bed of the stream or lake. These settleable solids discharged with man's wastes may be inert, slowly biodegradable materials, or rapidly decomposable substances. While in suspension, they increase the turbidity of the water, reduce light penetration and impair the photosynthetic activity of aquatic plants.

Solids in suspension are aesthetically displeasing. When they settle to form sludge deposits on the stream or lake bed, they are often much more damaging to the life in water, and they retain the capacity to displease the senses. Solids, when transformed to sludge deposits, may do a variety of damaging things, including blanketing the stream or lake bed and thereby destroying the living spaces for those benthic organisms that would otherwise occupy the habitat. When of an organic and therefore decomposable nature, solids use a portion or all of the dissolved oxygen available in the area. Organic materials also serve as a seemingly inexhaustible food source for sludgeworms and associated organisms.

Turbidity is principally a measure of the light absorbing properties of suspended solids. It is frequently used as a substitute method of quickly estimating the total suspended solids when the concentration is relatively low.

Oil and Grease

Oil and grease exhibit an oxygen demand. Oil emulsions may adhere to the gills of fish or coat and destroy algae or other plankton. Deposition of oil in the bottom sediments can serve to exhibit normal benthic growths, thus interrupting the aquatic food chain. Soluble and emulsified material ingested by fish may taint the flavor of the fish flesh. Water soluble components may exert toxic action on fish. Floating oil may reduce the re-aeration of the water surface and in conjunction with emulsified oil may interfere with photosynthesis. Water insoluble components damage the plumage and costs of water animals and fowls. Oil and grease in a water can result in the formation of objectionable surface slicks preventing the full aesthetic enjoyment of the water.

Oil spills can damage the surface of boats and can destroy the aesthetic characteristics of beaches and shorelines.

Metals

Metals are used in paint formulations as biological inhibitors, driers, and as pigments (10).

Mercury - Mercury compounds were the predominant biocides used in the past but recent State and Federal restrictions on their use have been forcing industry to find other biocides that are subject to environmental degradation. Mercury use can be expected to decrease, but until such time as it ceases to be used, it should be limited.

Lead - Lead compounds have been among the cheapest, most stable and brightest tinting agents used in yellow and red paints. Lead is also used in drying agents. However, recent legislation (Lead-Based Paint Poisoning Prevention Act of 1973) to reduce lead in paints has forced the search for suitable replacements. As with mercury, lead usage is decreasing, but, as it inhibits biological life, it should be limited.

Zinc - Occurring abundantly in rocks and ores, zinc is readily refined into a stable pure metal and is used extensively for galvanizing, in alloys, for electrical purposes, in printing plates, for dye-manufacture and for dyeing processes, and for many other industrial purposes. Zinc salts are used in paint pigments, cosmetics, pharmaceuticals, dyes, insecticides, and other products too numerous to list herein. Many of these salts (e.g., zinc chloride and zinc sulfate) are highly soluble in water; hence it is to be expected that zinc might occur in many industrial wastes. On the other hand, some zinc salts (zinc carbonate, zinc oxide, zinc sulfide) are insoluble in water and consequently it is to be expected that some zinc will precipitate and be removed readily in most natural waters.

In zinc-mining areas, zinc has been found in waters in concentrations as high as 50 mg/1 and in effluents from metal-plating works and small-arms ammunition plants it may occur in significant concentrations. In most surface and ground waters, it is present only in trace amounts. There is some evidence that zinc ions are adsorbed strongly and permanently on silt, resulting in inactivation of the zinc.

Concentrations of zinc in excess of 5 mg/1 in raw water used for drinking water supplies cause an undesirable taste which persists through conventional treatment. Zinc can have an adverse effect on man and animals at high concentrations.

In soft water, concentrations of zinc ranging from 0.1 to 1.0 mg/1 have been reported to be lethal to fish. Zinc is thought to exert its toxic action by forming insoluble compounds with the mucous that covers the gills, by damage to the gill epithelium, or possibly by acting as an internal poison. The sensitivity of fish to zinc varies with species, age and condition, as well as with the physical and chemical characteristics of the water. Some acclimatization to the presence of zinc is possible. It has also been observed that the effects of zinc poisoning may not become apparent immediately, so that fish removed from zinc-contaminated to zinc-free water (after 4-6 hours of exposure to zinc) may die 48 hours later. The presence of copper in water may increase the toxicity of zinc to aquatic organisms, but the presence of calcium or hardness may decrease the relative toxicity.

Observed values for the distribution of zinc in ocean waters vary widely. The major concern with zinc compounds in marine waters is not one of acute toxicity, but rather of the long-term sub-lethal effects of the metallic compounds and complexes. From an acute toxicity point of view, invertebrate marine animals seem to be the most sensitive organisms tested. The growth of the sea urchin, for example, has been retarded by as little as 30 ug/l of zinc.

Zinc sulfate has also been found to be lethal to many plants, and it could impair agricultural uses.

With the exception of mercury, the metals used in paint production are generally insoluble and the control of suspended solids concentrations will give adequate control of these metals.

There are many different metals used in paints and inks depending on the color desired. These metals, such as boron, chromium, cadmium, copper, iron, and titanium should be considered for control on a case-by-case basis when the application for a discharge permit is considered. The plants should be asked for a list of the metals they expect to discharge.

There are possibly trace quantities of other organic and metallic compounds as the carriers are polymerized oils and the pigments and extenders in many cases are processed natural minerals. These are not in sufficient or controllable quantities so they are not considered at this time. This does not preclude reopening the issue if, at a later time, they are identified as problem compounds.

SECTION VII.

CONTROL AND TREATMENT TECHNOLOGY

Paint Formulating industry

The paint industry consists of about 1,500 companies with about 1,700 plants. In 1971, total industry employment was about 63,000. Because of the relatively simple technology and low capital investment required, the industry contains many small companies. About 42 percent of the companies have fewer than 10 employees. These small companies accounted for less than 5 percent of the industry sales in 1967, whereas the four largest companies accounted for about 22 percent of sales and the largest 50 accounted for 61 percent (1).

Although the industry is spread over a large geographical area, paint plants are, in general, located close to the point of use because of transportation costs. This, then, places most plants in metropolitan areas; and, as such, most of the plants discharge to municipal systems. A check of the Refuse Act Permit Program (RAPP) applications in the ten EPA regions turned up only one plant that had process wastes going to surface water courses in 1971. The findings of the NFIC-D survey of plants for degree-of-treatment technology are presented in Table VII-1.

As the vast majority of the paint manufacturing plants discharge to municipal systems, the degree of sophistication of treatment is solely a function of the restrictions applied by the municipal system. In areas where high surcharges are placed on BOD_5 and TSS, there is a trend toward strict water conservation and reuse and the disposal of paint wastes to landfills. In areas where no restrictions are imposed, water use is lavish and there is little or no treatment before discharge (11,12).

The extent of control and treatment technology reported by plants of various sizes is shown in Table VII-2. About 20 percent of all plants generate no wastewater on a routine, daily basis, except for sanitary, non-contact cooling, and boiler blowdown water. An additional 22 percent of the plants, while generating some wastewater, do not discharge wastewater, but control or dispose of it by some non-discharge method (1).

Of the remaining 58 percent of the plants that discharge wastewater, 30 percent treat all wastewater, 15 percent control or treat some of their wastewater, and 13 percent

TABLE VII-1

TREATMENT TECHNOLOGY IDENTIFIED IN THE PAINT FORMULATION INDUSTRY (SIC2851)

Plant	No. of Employees	Treatment Technology: Solvents (Oil Based)	Treatment Technology: Water Based (Washwater)
A*	140	Redistilled by commercial plant	Settled, sludge landfilled, liquid reused
B*	60	Redistilled by commercial plant	All wastes drummed and landfilled
C*	80	Redistilled by commercial plant	No water based production
D*	<25	Reused in subsequent paint batches	Washwater reused in industrial coatings
E	13	Unknown	Caustic wash & reuse system. Sludge is landfilled
F*	>100	Redistilled	Caustic reuse and total recycle system. There are 16 other plants in the company using total recycle of washwater. Sludge is landfilled
G	45	Sent to scavenger	---
H	15	--	Reused, sludge to landfill
I	250	--	Used in product
J	Unknown (20,000 gpd production)	--	Sent to scavenger
K	100	--	Reused or sent to scavenger
L	65	--	Sent to scavenger
M	230	--	Sent to scavenger
N*	15-20	Redistilled	Sewer
O*	15-20	Decanted and reused sludge to landfill	Settling, then to sewer. Sludge sent to landfill
P*	25	Reused in shingle stain	Settling, then to sewer. Sludge sent to landfill
Q	25	Unknown	Lagoon
R	>100	Redistilled commercially	Flow equalization to sewers, some washwaters reused in product

* Plants visited - other plants contacted by phone.

TABLE VII-2

EXTENT OF CONTROL AND TREATMENT PRACTICED IN PAINT PLANTS[1/]

	Number and percentage of plants (Categorized by number of employees)												Total	
	Fewer than 10		10 to 19		20 to 49		50 to 99		100 to 249		250 or more			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Plants generating no wastewater	7	28	5	17	11	33	5	23	2	9	1	5	31	20
Plants not discharging wastewater	6	24	9	30	12	35	4	18	1	5	1	5	33	22
Plants treating all wastewater	5	20	10	33	5	15	5	23	10	45	10	50	45	30
Plants partially treating or not discharging wastewater	2	8	2	7	4	11	5	18	6	27	4	20	23	15
Plants without treatment	5	20	3	10	2	6	3	14	3	14	4	20	20	13
Total plants in group	25	16	29	19	34	22	22	15	22	15	20	13	152	100

discharge without using any control or treatment. Thus, about 87 percent of the plants either do not generate any wastewater or are treating or controlling at least some of it.

About a third of the plants report reduction of wastewater by reycling or by conservation of water through the use of high-pressure nozzles for cleaning, self-contained tub washers or other conservation methods. In several small plants (less than 50 employees) the quantity of cleanup wastewater was found to range from 0.02 to 0.23 liters/liters (gal./gal.) of paint. Within these plants, production equipment and cleaning facilities are nearly identical. The ten-fold differences in washwater volume generated shows the effect of water conservation practices. There was no detectable difference in the cleanliness of the tubs. A comparison of two large plants of nearly equal capacity showed that one discharges 0.86 liter of waste per liter (gal./gal.) of product and the second discharges 0.08 liter of waste per liter (gal./gal.) of product (2). Required conservation of water can be attained by modification of washing methods, as evidenced by the above examples.

Another method for water reduction is the reuse of washwater in products (2). This practice is possible under some conditions. If the paint formulation for the next batch is the same or of a darker color, then the tub may be reused without washing or a minimum of water can be used to remove the residue from the walls of the tub. Because bacterial contamination of paint causes reduction of shelf life, some producers are hesitant to reuse the washwater as they feel this water would contaminate subsequent batches. In other words, some manufacturers feel that the replacements for mercury-based biocides are not dependable. There is not a consensus by industry members on this point. One manufacturer has recently installed equipment to flocculate, settle and filter washwater. The filtered water is exposed to ultraviolet radiation to disinfect the water which is then reused for paint manufacture. Tests are currently being conducted on a similar system in another paint plant.

One promising method for reducing water usage is the use of dry pick-up procedures for handling spills of the raw material and of the product. Several plants have plugged all floor drains and use vacuums to clean the floor area. This procedure also cuts down on the accident potential as the floors are always dry. Spills of oils and paints are handled by cleaning up with shovels or squeegees followed by the use of a dry absorbent to pick up the residue.

CONTROL AND TREATMENT TECHNOLOGY

A general overview of the methods of treatment and disposal employed by plants of various sizes is presented in Table VII-3. Sedimentation is the most common treatment method employed. This is to be expected in view of the fact that most plants discharge to municipal systems where some pretreatment is required. In about half of the plants employing sedimentation, flocculaticn is also used to increase the effectiveness of removing suspended solids. Neutralization, principally of caustic cleaning solutions, is employed in at least eight plants. Of the remaining treatment methods, no one method is widely employed. Off-site disposal, such as landfill, is the most common disposal method and is practiced in at least 32 plants. Reuse of cleanup water in products is practiced in at least 26 plants. At least ten plants evaporate wastewater and three more plants use incineration to dispose of wastewater (1).

The effectiveness of the treatment methods employed by the paint industry is difficult to judge on the basis of available data. However, the most significant constituents of paint wastes are amenable to treatment by physical-chemical (P-C) methods combined with biological treatment for removal of biodegradable organics. As in other industries, dissolved solids are not treated.

Physical-chemical methods are used by some plants to meet the pretreatment limitations set by state and local agencies. Briefly, the plants using P-C treatment collect the flows in a holding tank until sufficient quantity is obtained to warrant treatment. If necessary, pH adjustment is made before a coagulant (lime, alum or iron salts) and/or a coagulant aid (polymer) is added to the batch which is then flocculated and settled. The settled sludge is sent to a landfill and the clarified water goes to the municipal treatment plant. Another variation of this procedure utilizes a settling pond to obtain clarification before discharge. One plant follows the addition of the chemicals by pressurization followed by atmospheric release into a combination settling-flotation basin where the oil froth is skimmed and the solids are settled before the effluent is discharged. Physical-chemical treatment methods can be expected to produce an effluent with the following ranges of characteristics: TSS = 1-150 mg/l; BOD_5 = 5-60 mg/l; COD = 18-1,400 mg/l. Metals can be expected to range from 0.01 to 0.1 mg/l in the treated effluent (13).

Several plants now practice no discharge by utilization of solids separation and washwater reuse. The washwater is

TABLE VII-3

WASTEWATER TREATMENT METHODS
EMPLOYED IN THE PAINT INDUSTRY1/

Treatment method	Number of Plants (Categorized by number of employees) Fewer than 10	10 to 19	20 to 49	50 to 99	100 to 249	250 or more	Total
Sedimentation	5	9	5	3	9	8	39
Flocculation	0	3	3	1	5	5	17
Neutralization	0	1	0	2	3	2	8
Flotation	0	1	0	1	1	0	3
Aerated lagoon	1	0	0	0	0	1	2
Filtration	0	1	0	0	1	0	2
Equalization	0	0	0	1	0	0	1
Odor control	0	0	1	0	0	0	1
Activated sludge	0	0	0	0	0	1	1
Chemical treatment	0	1	0	0	0	0	1
Unspecified or other	0	1	1	3	2	2	9
Off-site disposal	3	5	7	9	5	3	32
Reused in product	1	8	4	6	1	6	26
Evaporation	4	3	2	0	1	0	10
Incineration	0	0	2	0	0	1	3

greatly minimized and collected in a tank where the solids are settled. The partially clarified water is used as a first wash of the tubs. This is followed with a clean rinse at the end to remove any residual solids. The solids are sent to a landfill operation. Several other plants collect all washwater and send it to landfill operations in drums. One plant manufacturing water-base industrial coatings has no discharge as it reuses all waters in subsequent paint batches (14).

The current trend by several water-base paint manufacturers is to give the purchaser of paints for home use a wide range of paint colors that are mixed in the retail store. It was estimated by several medium to large sized manufacturers that they now produce as high as 90 percent of their trade sale paint in the tint base form, with the tinting added in the store at the time of sale. This trend is expected to continue throughout the water-base paint industry. One of the most impressive water reuse systems seen during the NFIC-D survey was used by one large paint manufacturing company with a vertical flow plant. It was an application of a commerical caustic tub washer that allowed the cleaning of either separate paint tubs or the cleaning in-place of the piping and equipment on that floor. The caustic was reused until spent, then more caustic was added. The only output from the system was a thick sludge with a consistency of peanut butter. The cleaned tubs and mix tanks had a light powder (spent caustic) on the surfaces but this caused no product contamination. The company had plugged all floor drains and slop sinks within the plant. Also they collected any excess water, 380-760 liters (100-200 gal.) per week, and reused it in product. They reported no product contamination.

Oil-base paint manufacturers practice two basic methods of equipment cleanup. They are solvent washing and caustic washing. For solvent wash plants there is no contact of water with the process. The waste solvents are reclaimed, reused or incinerated. Reclaiming is accomplished by distillation either by the plant or a solvent reclaiming company. The use of caustic wash is similar to the description above for water base paints. There are no known dischargers of oil base solvent wash paint wastes to any receiving streams or municipal systems.

IDENTIFICATION OF WATER-POLLUTION RELATED MAINTENANCE AND OPERATIONAL PROBLEMS

There are several maintenance and operational problems that are associated with wastewater treatment. One of the most visible sources of pollution is leaking pumps. As the material being pumped in the paint industry is abrasive, pump seals wear rapidly. In plants where maintenance is adequate, the quantity of paint lost is minimal.

Spill cleanup techniques can greatly affect the quality and quantity of the wastewater. Some plants hose the spills into the floor drains while others use squeegees and shovels to pick up the waste and place it into containers for discharge to landfills. Any residual materials left on the floor are picked up by an absorbing agent. Although for convenicence some plants wash down dry spills, a vacuum type of pickup would keep the materials out of the sewer.

The general plant cleanup can be accomplished by the use of vacuums and minimum-water-use floor scrubbers. Several plants have covered all floor drains and use dry cleanup techniques to keep from increasing the wastewater load.

There are some plants that conserve water and discharge either no water or very little water per unit of production. Generally speaking, the plants using water conservation methods were as clean as those with lavish uses of water (15).

Ink Formulating Industry

In recent years, there has been a proliferation of inks for rather specific end uses, such as carbon paper, typewriter ribbons, textiles, magnetic applications as in bank check processing, and conductive coatings. Improved pigments including reactive mixtures and fluorescent dyes have also been developed. Specialty inks likely account for some 20 percent of the 1971 U.S. market.

However, large volume markets continue to be concentrated in the four basic classifications: letterpress, lithographic, rotogravure and flexographic. Newsprint (letterpress) is, of course, largest in volume, but its low selling price significantly offsets its dollar volume. These inks, largely comprised of carbon black and mineral oil, have undergone very little change over the years.

Lithographic inks used in publications, packaging and commercial printing now have a substantially larger dollar volume than letterpress inks. The use of web-offset equipment in printing newspapers and general publications has accelerated this growth.

In the solvent-base inks, flexographic inks are increasing their market share at the expense of letterpress. The inks dry rapidly, affording efficient operation using continuous webs. Flexographic inks are used on corrugated boxes, transparent films, foils and flexible laminates.

Gravure inks, historically used to print the newspapers' Sunday supplements, are now used to print many decorative consumer packages such as cereal cartons, frozen food packaging and soap wrappers. The printing ink industry is a large consumer of pigments due to the increasing demand for color over the past few years (2).

The industry is almost exclusively located in metropolitan areas, where the market exists. Because of the proximity to metropolitan areas, the wastes are generally discharged to municipal sewers. A check of the RAPP applications in the ten EPA regions failed to produce any ink manufacturing plants that discharge other than cooling water to surface waters. Contacts with the industry have supported this finding.

As the ink manufacturing plants discharge only to municipal systems, there is little sophistication in the treatment methods. The complexity of the treatment process is a function of the restrictions applied by the municipality.

In areas where high surcharges are placed on BOD_5 and TSS, there is a trend toward strict water conservation, reuse and disposal of ink solids to landfills. In other areas where no restrictions are imposed, water use is lavish and there is little or no treatment before discharge. Treatment consists of sedimentation or coagulation-sedimentation to remove solids before discharge to sewers. Where the municipality is very restrictive, plants have gone to no discharge of process wastewaters. Washwater is recycled and the solids are sent to landfills. Restrictions on landfilling are forcing the industry to examine incineration as a method of reducing the organic content of the sludge. The installation of a tub washer with reuse of the washwater is practiced in several plants, and results in no discharge of process wastewaters (3,4).

Another method of water reduction is in the reuse of washwater as a raw material. This practice is possible if the ink formulation for the new batch is the same or of a darker color. The tub can be reused without washing or with a minimum of washing, or the washwater can be used to disperse the raw materials in the new batch. Some plants have plugged all floor drains and use dry pickup methods to dispose of spilled ink.

CONTROL AND TREATMENT TECHNOLOGY

Sedimentation is a common treatment method employed due to the large numbers of plants discharging into municipal sewers with pretreatment requirements. Flocculation is also used to increase the effectiveness of removing suspended solids. Neutralization, principally of caustic cleaning solutions, is employed to some degree. Of the ten plants shown in Table VII-4, all except two have achieved zero discharge of process wastewater pollutants. Solvent cleaning wastes are reclaimed either on site or by a solvent reclaimer. Scavenger pickup and disposal was the predominant method found. The most promising as far as water conservation is concerned is the recycling caustic tub washer where only sludge is wasted.

TABLE VII- 4

TREATMENT TECHNOLOGY DETERMINED IN
THE INK FORMULATING INDUSTRY (SIC2893)

Plant[a/]	Number of Employees	Treatment Technology Solvent Based	Water Based
A		Drummed and redistilled	To Sewer
B		Drummed and redistilled	Recycling caustic tub-washer
C		Drummed and recycled	Drummed and landfilled
D		Redistilled	Recycling caustic washer, rinse water to sewer, sludge to landfill
E		Redistilled	Total recycling caustic washer, excess water from rinses. Evaporated with steam. Sludge to landfill.
F		Scavenger and redistilled	Scavenger picked up
G		Scavenger and redistilled	Scavenger picked up
H		Scavenger and redistilled	Scavenger picked up
I		Scavenger and redistilled	Scavenger picked up
J		Scavenger and redistilled	Scavenger picked up

a/ Plants A, B. C, D, and E visited. Others verified by phone or from Chicago Metropolitan Sanitary District Board.

One small ink manufacturer redistills all washwater from his ink process and uses it as boiler feed water. In one plant the volume of scrub water is greatly minimized and collected in a tank where the solids are settled. The partially clarified water is used to initially wash the tubs and a final clean rinse is used to remove any residual solids. The sludge (3 percent solids) is sent to a landfill operation. Several other small plants actually collect all washwater in drums and send it to landfill operations (3,4,5).

SECTION VIII

COST, ENERGY, AND OTHER NON-WATER QUALITY ASPECTS

Paint Formulating Industry

OIL-BASE PAINT PRODUCTION

Cleanup of oil-base manufacturing paint equipment is accomplished by the use of solvents or by the use of caustic solutions. The solvents typically are flammable and disposal to navigable waters or municipal sewers is usually prohibited. In addition, the cleaning solvents are costly and are usually either recovered or sold to a scavenger for recovery. Caustic solutions are reused until spent.

For those waste materials considered to be non-hazardous where land disposal is the choice for disposal, practices similar to proper sanitary land fill technology may be followed. The principles set forth in the EPA's Land Disposal of Solid Wastes Guidelines (CFR Title 40, Chapter 1; Part 241) may be used as guidance for acceptable land disposal techniques.

For those waste materials considered to be hazardous disposal will require special precautions. In order to ensure long-term protection of public health and the environment, special preparation and pretreatment may be required prior to disposal. If land disposal is to be practiced, these sites must not allow movement of pollutants to either ground or surface waters. Sites should be selected that have natural soil and geological conditions to prevent such contamination or, if such conditions do not exist, artidicial means (e.g., liners) must be provided to ensure long-term protection of the environment from hazardous materials. Where appropriate, the location of solid hazardous materials disposal sites should be permanently recorded in the appropriate office of the legal jurisdiction in which the site in located.

Best practicable control technology currently available in oil-base solvent wash paint manufacturing is no discharge of wastewater pollutants. If the waste solutions are recovered on site, the residual sludge must be adequately disposed of in a landfill.

Treatment levels for Best Practicable Control Technology Currently Available (BPCTCA), Best Available Technology Economically Achievable (BATEA), New Source Performance Standards (NSPS), and Pretreatment of New and Existing

Sources (NESPS) for the control of process wastes from oil-base solvent wash paint production are all defined as no discharge of wastewater pollutants to surface waters. Good housekeeping, with control of spills and leaks, will allow all such waste materials to be collected in sumps, placed in drums, and periodically disposed of in a landfill. Since the best practicable level of treatment is already no discharge of process waste liquids, the added costs of achieving BPCTCA, BATEA and NSPS are zero. The amount of plant modification and maintenance required to insure good housekeeping and prevent leaks and spills from entering drains and being discharged to surface waters can be achieved for a negligible cost. The costs of reclaiming solvents does not have an impact since a profit or savings is obtained. The costs for oil-base caustic wash paints will be developed in the Development Document for all the paint and ink subcategories.

WATER-BASE PAINT PRODUCTION

Costs for water-base piants will be developed in the Development Document for all the paint and ink subcategories.

Best Practicable Control Technology Currently Available (BPCTCA)

The BPCTCA for plants in the oil base solvent wash subcategory is no discharge of process water pollutants to navigable waters through solvent recovery, reclamation, incineration and landfill. The costs for three different size solvent recovery plants are summarized in Table VIII-1 (17). Reclaimed solvents sell for 10-30¢/1 (40¢-$1.00/gal). Compared to the cost of reclamation 1.0 - 3.8¢/1 (3.6 - 14.2¢/gal) (17) it is beneficial for the paint and ink industry ro practice this technology.

Best Available Technology Economically Achievable (BATEA) and New Source Performance Standards (NSPS)

Since BPCTCA for the oil-base solvent wash subcategory is no wastewater discharge, the same technology applies for BATEA and NSPS. The incremental cost of these technologies above BPCTCA is zero for that subcategory.

Non Water Quality Considerations

The study found no instance where the proposed guidelines would significantly increase the noise or radiation levels.

Table VIII-1

OPERATING COSTS FOR A SOLVENT RECLAIMING SYSTEM
IN A PAINT MANUFACTURING PLANT

BASIS:

Operation	-	230 eight-hour days per year
Operation Costs (steam, electricity)	-	1.2 cents per gallon recovered
Labor	-	1/3 to 1/2 operator
Overhead	-	100% of operating cost & labor
Maintenance	-	5% of installed cost
Depreciation	-	20% of installed cost

Solvent Recovery Rate	380 l/hr (100 gph)	1500 l/hr (400 gph)	6100 l/hr (1600 gph)
Installed Cost	$54,000	$71,000	$120,000
Solvent Recovered per year	760,000 l (200,000 gal.)	3,000,000 l (800,000 gal)	12,000,000 l (3,200,000 gal.)
Operating Cost	$2,400	$9,600	$38,400
Labor	$5,000	$5,000	$5,000
Overhead	$7,400	$14,600	$43,000
Maintenance	$2,700	$3,550	$6,000
Depreciation	$10,800	$14,200	$24,000
Annual Operating Cost	$28,300	$46,950	$116,800
Total Recovery Cost	3.8¢/l (14.2¢/gal.)	1.6¢/l (5.9¢/gal.)	1.0¢/l (3.6¢/gal.)

The impact of the paint sludge on landfills would be minimal. The range is from 0.08 m^3 (0.1 yd^3) each week for a plant with 2,800 liters per day (750 gpd) paint to 0.8 m^3 (1 yd^3) for a plant with 26,000 liters per day (7,000 gpd) production. Based on the information in Figure III-2 the total sludge each year to landfills would be between 13,000 and 134,000 m^3 (17,000 and 175,000 yd^3) if all paint plants in the United States were to go to a total recycle system.

In reality the increase in sludge disposal to landfills would be the difference between the quantitiy produced by a total recycle wash system and that quantity currently removed in sewage treatment plants.

Ink Formulating Industry

The BPCTCA for plants in the oil-base solvent wash subcategory is no discharge of process water pollutants to navigable waters. Costs are the same as for the oil-base solvent wash paint subcategory.

The study found no instance where the proposed guidelines would significantly increase the noise or radiation levels.

The impact of ink sludge on landfills would be minimal as the range is from 1.0 to 3.2 kg of ink solids per 1,000 kg (lb/1,000 lb) of product. These quantities could be increased if flocculants were added. Assuming no use of flocculants, the weight of sludge produced would vary from 0.1 to 0.32 percent of the weight of ink produced.

SECTION IX.

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

INTRODUCTION

The effluent limitations which must be achieved by July 1, 1977 are those attainable through the application of the Best Practicable Control Technology Currently Available (BPCTCA). Best Practicable Control Technology Currently Available is 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. This average is not based on a broad range of plants within the paint processing industry, but 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; and

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

Also, Best Practicable Control Technology Currently Available emphasizes treatment facilities at the end of a manufacturing process but includes control technologies 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.

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

Paint Formulating Industry

Based on the information contained in Sections III through VIII of this document, a determination has been made of the degree of effluent reduction attainable through the application of the Best Practicabe Control Technology Currently Available for the oil-base solvent wash paint subcategory of the paint formulating industry. The effluent limitations are for no discharge of process wastewater pollutants to navigable waters.

Ink Formulating Industry

Based on the information contained in Sections III through VIII of this document, a determination has been made of the degree of effluent reduction attainable through the applicaion of the Best Practicable Control Technology Currently Available for the oil-base solvent wash ink subcategory of the ink manufacturing industry. The effluent limitations are for no discharge of process wastewater pollutants to navigable waters.

Identification of the Best Practicable Control Technology Currently Available

The Best Practicable Control Technology Currently Available for the oil-base solvent wash paint subcategory of the paint formulating industry and the oil-base solvent wash ink subcategory of the ink formulating industry is no discharge of process wastewater pollutants to receiving streams. This can be accomplished redistillation and reuse of solvents utilized in tub washing either captively or by contractor, with solids disposal to landfill or incineration.

Paint Formulating Industry

Total Cost of Application

There will be no cost to the paint manufacturing industry for oil-base solvent wash paints as it is profitable to recover.

Size and Age of Equipment

The size of the paint formulating plant would have little effect on the control technology applied. Since the equipment used in paint formulating has not changed appreciably over the years, the age of the equipment is not a basis for differentiation in the application of the control technology.

Process Employed

There is no essential difference in methods of making water- and oil-base paints. Larger plants may use gravity flow or pumping to transfer paints where the small operator mechanically moves the paint tub from station to station.

The main difference in the paint formulating process is the washout methods used. As discussed previously solvent wash, caustic wash and water rinse are the primary methods and have been utilized as a factor in the subcategorization of the industry.

Engineering Aspects

The technology required to meet BPCTCA has been demonstrated by most plants in the industry (15).

Process Changes

No major changes are expected in the formulation of paints. Any minor changes would reflect water conservation and possible reuse of wastewater in the product.

Non-Water Quality Environmental Impact

There is no evidence that application of this control technology will result in any unusual air pollution problems, either in kind or magnitude. The energy required to apply this control technology represents only a small increment of the present total energy requirements of the industry. In fact the relcamation of solvents reduces the demand for virgin solvents many of which as petroleum based and energy intensive to produce. Solid waste control must be considered. Solid residue and sludge are potential probelms because of the need for periodic disposal. Solid waste must be handled properly to assure that no landfill or associated problems develop. Best practicable control technology and best available control technology, as they are known today, require disposal of the pollutants removed from waste waters in this industry in the form of solid wastes and liquid concentrates. In most cases these are non-hazardous substances requiring only minimal custodial care. However, some constituents may be hazardous and may require special consideration. In order to ensure long term protection of the environment from these hazardous or harmful constituents, special consideration of disposal sites must be made. All landfill sites where such hazardous wastes are disposed should be selected so as to prevent horizontal and vertical migration of these contaminants to ground or surface waters. In cases where geologic conditions may not reasonably ensure this, adequate precautions (e.g., impervious liners) should be taken to ensure long term protection of the environment from hazardous materials. Where appropriate, the location of solid hazardous materials disposal sites should be permanently recorded in the appropriate office of the legal jurisdiction in which the site is located.

Ink Formulating Industry

Total Cost of Application

There will be no cost to the Ink Manufacturing Industry. It is profitable to reclaim solvents.

Size and Age of Equipment

The size of the ink manufacturing plants would have no effect on the control technology applied. The age of the equipment is not a basis for differentiation in the application of the control technology.

Process Employed

The main difference in the ink formulating process is the washout methods used. As discussed previously solvent wash, caustic wash and water rinse are the primary methods and have been utilized as a factor in the subcategorization of the industry.

Engineering Aspects

The technology required to meet BPCTCA has been demonstrated by most plants in the industry (3,4).

Process Changes

No major changes are expected in the manufacture of inks. Any minor changes would reflect water conservation and possible reuse in the product.

Non-Water Quality Environmental Impact

There is no evidence that application of this control technology will result in any unusual air pollution or solid waste disposal problems, either in kind or magnitude. The costs of avoiding problems in these areas are not excessive. The energy required to apply this control technology represents no significant increase of the present total energy requirements of the industry. In fact the reclamation of solvents reduces the demand for virgin solvents many of which are petroleum based and energy intensive to produce.

Best practicable control technology and best available control technology require disposal of the pollutants removed from wastewaters in the form of solids. In most cases, these are non-hazardous substances requiring only minimal custodial care. However, some constituents may be hazardous and may require special consideration. In order to ensure long-term protection of the environment from these hazardous or harmful constituents, special consideration of disposal sites must be made. All landfill sites where such hazardous wastes are disposed should be selected so as to prevent horizontal and vertical migration of these contaminants to ground or surface waters.

In cases where geologic conditions may not reasonably ensure this, adequate precaution (e.g. impervious liners) should be taken to ensure long-term protection to the environment from hazardous materials. Where appropriate, the location of hazardous materials disposal sites should be permanently recorded in the appropriate office of the legal jurisdiction in which the site is located.

SECTION X

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

INTRODUCTION

The effluent limitations which must be achieved no later than July 1, 1983 are not based on an average of the best performance within an industrial subcategory, but are determined by identifying the very best control and treatment technology employed by a specific point source within the industrial category or subcategory, or by one industry where it is readily transferable to another. A specific finding must be made as to the availability of control measures and practices to eliminate the discharge of pollutants, taking into account the cost of such elimination.

Consideration must also be given to:

a. The age of the equipment and facilities involved;

b. The process employed;

c. The engineering aspects of the application of various types of control techniques;

d. Process changes;

e. The cost of achieving the effluent reduction resulting from application of the technology;

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

In addition, Best Available Technology Economically Achievable emphasizes in-process controls as well as control or additional treatment techniques employed at the end of the production process.

This level of technology considers those plant processes and control technologies which, at the pilot plant, semi-works, or other level, have demonstrated both technological performance and economic viability at a level sufficient to reasonably justify investing in such facilities. It is the highest degree of control technology that has been achieved or has been demonstrated to be capable of being designed for plant scale operation up to and including "no discharge" of pollutants. Although economic factors are considered in this development, the costs for this level of control are intended to be the top-of-the-line of current technology, subject to limitations imposed by economic and engineering feasibility. However, there may be some technical risk with respect to performance and with respect to certainty of costs. Therefore, some industrially-sponsored development work may be needed prior to its application.

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

Paint Formulating Industry

The effluent reduction attainable for the oil-base solvent wash paint subcategory of the paint formulating industry through the application of the Best Available Technology Economically Achievable is the same as BPCTCA which is no discharge of process wastewater pollutants to navigable waters, as developed in Section IX. There is no incremental cost of BATEA over BPCTCA.

Ink Formulating Industry

The effluent reduction attainable for the oil-base solvent wash ink subcategory of the ink manufacturing industry through the application of the Best Available Technology Economically Achievable is the same as BPCTCA which is no discharge of process wastewater pollutants to navigable waters, as developed in Section IX. There is no incremental cost of BATEA over BPCTCA.

SECTION XI
NEW SOURCE PERFORMANCE STANDARDS

INTRODUCTION

The effluent limitations that must be achieved by new sources are termed performance standards. The New Source Performance Standards apply to any source for which construction starts after the publication of the proposed regulations for the Standards. The Standards become effective upon start-up of the new source. The Standards are determined by adding to the consideration underlying the identification of the Best Practicable Control Technology Currently Available a determination of what higher levels of pollution control are available through the use of improved production processes and/or treatment techniques. Thus, in addition to considering the best in-plant and end-of-process control technology, New Source Performance Standards are based on an analysis of how the level of effluent may be reduced by changing the production process itself. Alternative processes, operating methods or other alternatives are considered. However, the end result of the analysis is to identify effluent standards which reflect levels of control achievable through the use of improved production processes (as well as control technology), rather than prescribing a particular type of process or technology which must be employed. A further determination made is whether a standard permitting no discharge of pollutants is practicable.

Consideration must also be given to:

a. Operating methods;

b. Batch, as opposed to continuous, operations;

c. Use of alternative raw materials and mixes of raw materials;

d. Use of dry rather than wet processes (including substitution of recoverable solvents for water);

e. Recovery of pollutants as byproducts.

EFFLUENT REDUCTION ATTAINABLE FOR NEW SOURCES

Paint Formulating Industry

The effluent reduction attainable for new sources in the oil-base solvent wash paint subcategory of the paint formulation industry is the same as BPCTCA which is no discharge of process wastewater pollutants to navigable waters, as developed in Section IX.

Ink Formulating Industry

The effluent reduction attainable for new sources in the oil-base solvent wash ink subcategory of the ink formulation industry is the same as BPCTCA which is no discharge of process wastewater pollutants to navigable waters, as developed in Section IX.

SECTION XII

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SECTION XIII

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SECTION XIV

GLOSSARY

DEFINITIONS

Ball Mill -- A horizontal mounted cylindrical tank containing steel or ceramic balls that reduce particle size of materials when the tank is rotated.

Binder -- That component of a coating that contributes primarily to the adhesive and cohesive properties of the coating.

Biochemical Oxygen Demand (BOD_5) -- The amount of oxygen required by microorganisms while stabilizing decomposable organic matter under aerobic conditions. The level of BOD_5 is usually measured as the demand for oxygen over a standard five-day period. Generally expressed as mg/l.

Biocide -- Chemical toxic to biological life.

Biological Inhibitor -- Chemical that inhibits or disrupts biological processes.

Carbon Black -- Finely divided carbon obtained by burning a gas in an oxygen deficient combustion chamber. The carbon is mixed with oils to produce certain inks.

Chemical Oxygen Demand (COD) -- A measure of the amount of organic matter which can be oxidized to carbon dioxide and water by a strong oxidizing agent under acidic conditions. Generally expressed as mg/l.

Cleavage -- That quality of paint or ink left on the sides of production tanks after the product is removed.

Disperser -- Mixing machine that acts to disperse the components of paint or ink.

Dispersing Agent -- A reagent that is compatible with the solvent and holds finely divided matter dispersed in the solvent.

Esterification -- The formation of an ester by elimination of water between an acid and an alcohol.

Extender -- Clays and silicates used to give opacity to a coating.

Fungicide -- Chemical used to inhibit growth of fungus.

Lacquer -- A solution in an organic solvent of a natural or synthetic resin, a cellulose ester or a cellulose ester together with modifying agents, such as plasticizers, resins, waxes, and pigments.

Latex -- Aqueous colloidal disperson of rubber or rubber-like substances.

Oil-Base -- Paints or inks that use oils or resins as the prime vehicle.

pH -- The reciprocal logarithum of the hydrogen ion concentration in wastewater expressed as a standard unit.

Physical-Chemical -- The method of treating wastewaters using combinations of the processes of coagulation, sedimentation, carbon absorption, electrodialyses or reverse osmosis.

Pigment -- The colorant used to give paints and inks the desired hue and color.

Process Wastewater -- Any water subsequently discharged directly or indirectly, as through municipal sewers, to the environment in a liquid phase which (1) came in direct contact with raw materials, intermediates or final products or (2) was utilized in cleanups of the manufacturing equipment or area.

Resin -- Any class of solid or semi-solid organic products of natural or synthetic origin, generally of high molecular weight with no definite melting point.

Roll Mills -- Machines with close-tolerance adjustable metal rolls used to disperse and grind pigments to a certain consistency and size.

Total Suspended Solids (TSS) -- Solids that eigher float on the surface of, or are in suspension in, water and which are largely removable by filtering or sedimentation.

Varnish -- A fluid that dries in contact with air by evaporation of its volatile constituents by the oxidation of its oil and resin ingredients or by both methods to a continuous protective coating when spread upon a surface in a thin film.

Water-Base -- Paints or inks that use water as the prime vehicle.

SYMBOLS

gal.	--	volume in gallons = 3.785 liters
gm	--	weight in grams = 0.03527 ounces
gpd	--	flow rate in gallons per day = 3.785×10^{-3} cubic meters per day
gpm	--	flow rate in gallons per minute = 0.0631 liters per second or 3.785 liters per minute
kg	--	weight in kilograms = 2.205 pounds
kg/day	--	mass flow rate in kilograms per day
l	--	volume in liters = 0.2642 gallons
l/m	--	flow rate in liters per minute
lb/day	--	mass flow rate in pounds per day
m	--	length in meters = 3.281 feet or 1.094 yards
m^3/day	--	flow rate in cubic meters per day = 264.2 gallons per day
mgd	--	flow rate in million gallons per day = 3,785 cubic meters per day = 43.7 liters per second
mg/l	--	concentration in milligrams per liter
TOC	--	total organic carbon

TABLE XIV-1

METRIC TABLE

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)*	°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	killowatts
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)*	atm	atmospheres (absolute)
square feet	sq ft	0.0929	sq m	square meters
square inches	sq in	6.452	sq cm	square centimeters
ton (short)	ton	0.907	kkg	metric ton (1000 kilograms
yard	yd	0.9144	m	meter

* Actual conversion, not a multiplier

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