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# ECONOMIC IMPACT AND REGULATORY FLEXIBILITY ANALYSES OF THE FINAL ARCHITECTURAL COATINGS VOC RULE

Office of Air Quality
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This report contains portions of the economic impact analysis report that are related to the industry profile.

# SECTION 1
# INTRODUCTION, REGULATORY BACKGROUND, AND INDUSTRY PROFILE

## 1.1 INTRODUCTION

Under Title I of the Clean Air Act of 1990, the U.S. Environmental Protection Agency (EPA) is developing regulations to reduce volatile organic compound (VOC) emissions from various consumer and commercial products. One of the first categories of consumer and commercial products to be regulated is architectural coatings.

This report analyzes the economic impacts of the final architectural coating regulation. Section 183(e)(1)(B) of the Clean Air Act Amendments of 1990 defines a consumer or commercial product asany substance, product (including paints, consumer and commercial products, and solvents), or article (including any container or packaging) held by any person, the use, consumption, storage, disposal, destruction, or decomposition of which may result in the release of volatile organic compounds.

Thus, the general purpose of the regulation is to reduce the flow of VOCs into the atmosphere from consumption and disposal of products that contain VOCs. Figure 1-1 shows the dissipative emissions and the disposal emissions into the air that are the target of this regulation.[1] These emissions are

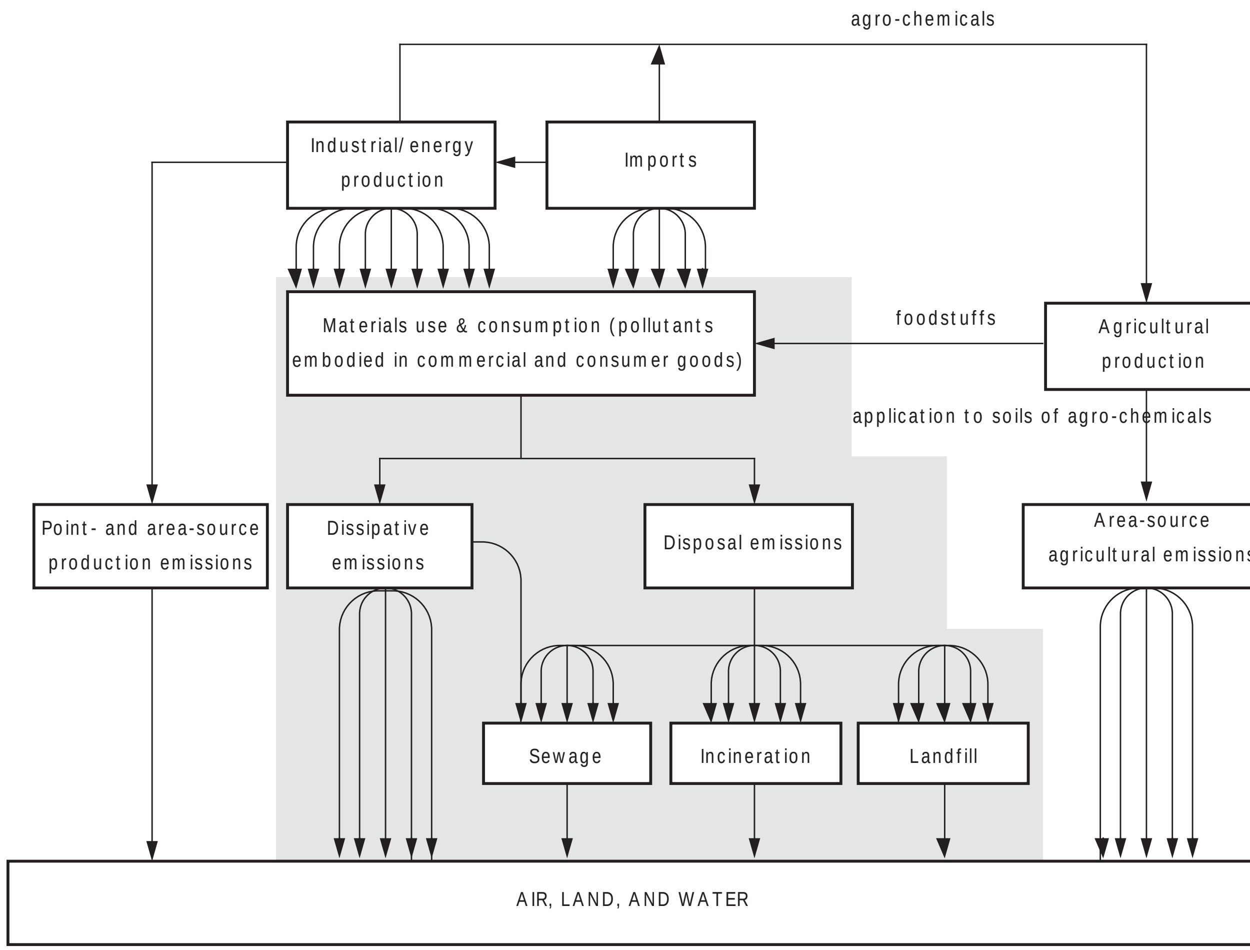


Figure 1-1. Comprehensive classification of emissions from consumer and commercial products.

Source: Adapted from Stigliani, William M. Chemical Emissions from the Processing and Use of Materials: The Need for an Integrated Emissions Accounting System. Ecological Economics 2(4):325-341. 1990. (Figure 2).

distinguished from the manufacturing-related emissions that are controlled by other forms of regulation. The regulatory structure is presented here followed by an overview of the architectural coatings industry.

## 1.2 REGULATORY BACKGROUND

Section 183(e)(3)(A) directs the EPA to list categories of consumer or commercial products that account for at least

80 percent of VOC emissions on a reactivity-adjusted basis in ozone nonattainment areas. The EPA divided this category list into four groups and established priorities for regulation. Architectural coatings is in the first group of categories to be regulated.

The design of regulatory strategies to reduce VOCs emitted by architectural coatings is shaped in specific ways by the Clean Air Act as amended. Two components of the legislation are of particular importance:

- determining regulated entities and
- establishing best available controls.

Regulations developed under Section 183(e) may be imposed only with respect to "manufacturers, processors, wholesale distributors, or importers of consumer or commercial products for sale or distribution in interstate commerce in the United States" or certain entities that supply such products to the former Sections 183(e)(1)(C) and 183(e)(3)(B). The definition of regulated entities excludes retailers and users.

The regulations affecting architectural coatings will require best available controls. The EPA Administrator, on the basis of "technological and economic feasibility, health, environmental, and energy impacts," will determine the desired degree of emissions reduction that is achievable through the application of the most effective equipment, measures, processes, methods, systems or techniques, including chemical reformulation, product or feedstock substitution, repackaging, and directions for use, consumption, storage, or disposal. (Section 183[e][1]).

### 1.2.1 Regulatory Structure

One hundred sixteen architectural coatings manufacturers responded to a survey conducted by the National Paint and Coatings Association for products manufactured and their VOC contents.[2] The Architectural and Industrial Maintenance Surface Coatings VOC Emissions Inventory Survey (the survey) provides VOC content information and 1990 sales quantities by product. Based in part on these data, EPA is promulgating VOC content limit standards, which manufacturers and importers will be required to meet in 1999. Once the regulation becomes law, manufacturers and importers of architectural coatings subject to the regulation must limit the VOC content per liter of coating to the standards specified for each coating product they manufacture. The EPA has included an option of allowing manufacturers and importers to choose to pay an exceedance fee instead of meeting the limit for a particular product category. Another option manufacturers and importers have is to use a tonnage exemption to claim a set amount of product as exempt from VOC limits. The VOC content limits are presented in the Table of Standards (TOS) for 1999 in Section 2 (Table 2-1). The limits specified in this table were used in this economic impact analysis. They cover all the major architectural coatings categories as well as certain special purpose coating products for which a less stringent limit is granted in order for the coating to adequately perform its designed purpose (e.g., high-temperature coatings).

Architectural coatings manufacturers who choose to pay a fee on their products that do not meet the standards will pay the fee on the VOC content of the product that is in excess of the limit.[a] The fee rate is $2,500 (1996 dollars, adjusted to $2,200 in 1991 dollars) per metric ton (Mg) of excess VOCs. Fees will be paid semi-annually and will be placed in a "special fund" specified under Section 183(e). If EPA is able to obtain these funds through a subsequent Congressional appropriation they may be used by the Administrator to support the administration of the regulation or to promote additional VOC emission reductions from architectural coatings through technological development grants, award programs, or other means.

This report includes an overview of the architectural coatings industry, products, and technologies and an analysis of the economic impacts on the affected entities and the industry as a result of the TOS VOC content limits, exceedance fees, and tonnage exemption. An economic model of the architectural coatings industry is developed to obtain estimates of the potential price and quantity changes associated with the regulation. In addition, a Regulatory Flexibility Analysis is conducted, which estimates the impacts of the regulation on small businesses and presents alternatives that may be implemented to mitigate those impacts.

## 1.3 INDUSTRY PROFILE

This profile of the architectural coatings industry describes commodities and VOC content, demand for architectural coatings, production of architectural coatings, and industry conditions.

### 1.3.1 Commodities and VOC Content

The "architectural coatings" regulation applies primarily to products that the U.S. Census Bureau also categorizes as architectural coatings, but some products in the Census categories of special purpose coatings and miscellaneous allied paint products are affected as well.[3] Unless otherwise indicated, the term "architectural coatings" is used

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[a]Excess VOCs are defined as the maximum VOC content of the coating, as applied, in grams per liter of coating, less water and exempt compounds, minus the applicable VOC standard.

throughout this report to indicate the entire group of regulated products. Product categories covered under the regulation are listed in Table 1-1.[4] The products are grouped into the three Census categories in which they are found.[b] As indicated, the largest quantity of regulated coatings is included in the architectural coatings category, but some coatings are classified with the special purpose and allied paint products categories, which also include other products not covered by this regulation such as marine paints and putty.

Examples of Census-defined architectural coatings, all of which are represented in Table 1-1, include exterior and interior organic solventborne and waterborne tints, enamels, undercoats, clear finishes, stains, and architectural lacquers. These coatings are used for general purpose on-site application to residential, commercial, institutional, and industrial structures. They are intended for ordinary use and exposure and provide protection and decoration.

Special purpose coatings are similar to architectural coatings in that they can be classified as stock or shelf goods, rather than formulated to customer specifications, as are OEM coatings. The difference is that they are formulated for special applications or environmental conditions such as extreme temperatures, chemicals, fumes, fungi, or corrosive conditions.

VOC content varies substantially between specific types of coating products. Most of this variety is due to the type of solvent used in the coating and the ratio of the solvent to other ingredients in the formulation. Based on the 1990

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[b]See Appendix A for a detailed explanation of products for regulation and their corresponding Census classification.

TABLE 1-1. AVERAGE VOC CONTENT FOR ARCHITECTURAL COATINGS TO BE COVERED BY REGULATION

| Product Category | Sales-Weighted Average VOC Content (g/L) Organic Solvent | Waterborne |
|---|---|---|
| Architectural coatings | | |
| Exterior flat architectural coatings | 336 | 68 |
| Exterior nonflat architectural coatings | 404 | 76 |
| Interior flat architectural coatings | 315 | 48 |
| Interior nonflat architectural coatings | 413 | 74 |
| Semitransparent stains | 527 | 85 |
| Opaque stains | 429 | 56 |
| Undercoaters | 379 | 41 |
| Primers | 374 | 48 |
| Sealers | 607 | 41 |
| Waterproofing sealers, clear | 659 | 200 |
| Waterproofing sealers, opaque | 242 | a |
| Quick dry undercoaters, primers, and sealers | 441 | 31 |
| Bituminous coatings | 290 | 4 |
| High performance architectural coatings | 431 | 113 |
| Roof coatings | 269 | 28 |
| Lacquer | 667 | 300 |
| Varnish | 481 | 143 |
| Special purpose/industrial maintenance Coatings | | |
| Swimming pool coatings | 554 | a |
| Dry fog coatings | 365 | 149 |
| Mastic texture coatings | 278 | 107 |
| Metallic pigmented coatings | 461 | a |
| Fire retardant coatings | a | 23 |
| Antigraffiti | 577 | 131 |
| Concrete curing compounds | 717 | 71 |
| Form release compounds | 601 | a |
| Graphic arts coatings | 386 | 42 |
| High-temperature coatings | 560 | a |
| Industrial maintenance coatings | 392 | 112 |
| Multicolored coatings | 321 | a |
| Pretreatment wash primers | 718 | a |
| Sanding sealers | 531 | 192 |
| Shellacs | 539 | a |
| Traffic marking paints | 398 | 85 |
| Allied paint products | | |
| Below ground wood preservatives | 541 | a |
| Semitransparent wood preservatives | 591 | 67 |
| Clear wood preservatives | 493 | 419 |
| Opaque wood preservatives | 446 | a |

[a] Sales-weighted average VOC content not available.

Source: Industry Insights. Architectural and Industrial Maintenance Surface Coatings VOC Emissions Inventory Survey. Prepared for the National Paint and Coatings Association in Cooperation with the AIM Regulatory Negotiation Industry Caucus. Final Draft Report. 1993.

survey data collected, the sales-weighted average VOC contents for surveyed coating products are listed in Table 1-1.[c,5]

### 1.3.2 Demand for Architectural Coatings

1.3.2.1 Conceptual View of Coating Decision. The demand for architectural coatings derives from the demand for the treatment of architectural surfaces. Surface treatment services include not only coating treatment, but also noncoating treatment alternatives such as wallpaper or exterior siding. While the choice among coating alternatives is emphasized below, it is implicitly recognized that the substitution between coating and noncoating surface treatments is possible as well.

The coatings themselves are an input into the production of surface treatment services, the final product of interest. Each surface possesses certain attributes that affect the demand for surface treatment. These include surface material (substrate), age, exposure (e.g., weather, chemicals), and other physical factors that intrinsically affect the relative performance of treatment alternatives.

In an economic decisionmaking context, we think of the owner of the surface as seeking to maximize the utility derived from the services provided by the surface (i.e., shelter, decoration, etc.). Let process i indicate the activity of treating a surface defined by the attributes above. Through this process, labor, capital, and materials are employed to treat the surface. Thus we can characterize the production of a unit of surface treatment through process i as follows:

$$Q_i = Q(L,K,X_i)$$

where $Q_i$ is the surface area unit (e.g., 1,000 $ft^2$) treated using process i and L, K, and $X_i$ are the quantities of labor, capital, and material (e.g., coatings) used to produce $Q_i$.

For the processes that include coatings application, assume there is a fixed proportions relationship between each input and output, determined by the type of coating being used. For example, process A requires 1 gallon of coating A, 40 hours of labor, and 10 units of capital to cover a unit area of a given surface type. Therefore, for

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[c]Sales-weighted average VOC content is

[illegible]

where VOC content is equal to the percentage by weight, sales are measured in pounds per year, and n equals the number of product categories.

a given set of input prices, there is a (constant) per-unit cost of treatment. Costs of noncoating alternatives can be similarly computed. Considering all n possible treatment alternative for a given surface generates an array of costs ($C_1, C_2, ..., C_n$). Each owner/consumer places a subjective value on the outcome of each treatment alternative. This value derives from such factors as innate preferences for the visual appeal of treatment alternatives and perceptions of the structural quality and durability. For example, consumer A may prefer the look of glossy solvent-based coatings to flat water-based coatings and/or may perceive other differences in product quality. The consumer explicitly or implicitly monetizes these preferences, and the associated monetary values for each of the n alternatives comprise the array of perceived benefits for ($B_1, B_2, ..., B_n$).

In evaluating the choice among treatment alternatives, the consumer weighs each alternative's monetized benefit, $B_i$, against the cost of treatment, $C_i$. The subjective payoff from each alternative can be expressed as

$$\Pi_i = B_i - C_i.$$

The consumer maximizes utility with respect to the surface treatment choice by selecting the alternative with the highest payoff. This of course presumes that at least one of the payoffs is not negative. If all potential payoffs are negative, the consumer is better off by choosing no surface treatment at all.

#### 1.3.2.2 Substitution Effects.

The purpose of this discussion is to describe how consumption choices may change in response to any price effects of the regulations. If the regulations induce a change in the price schedule of various architectural coatings, the unit costs of treatment alternatives will be directly affected. Furthermore, the regulations may induce a change in the structural characteristics of the coating that alters the application technology. For example, a different VOC content may change the volume of the coating that must be applied and the amount of labor and capital necessary to achieve the same surface area treatment; consequently, the technological parameters may change with the new VOC requirements. Therefore, treatment costs will be affected jointly by what we call the factor price effect and the technology effect. If, for example, the VOC-content regulations would raise the price of the affected coatings and reduce the technological efficiency of the treatment process (e.g., more coats necessary), then both the factor price effect and technology effect would combine to increase the cost of the affected treatment alternatives, generating a new set of treatment costs ($C_1', ..., C_n'$). Alternatively the new formulas could improve technical efficiency, but at a higher cost and the net effect on price would be unknown.

VOC-content regulations may also affect consumer valuation of the treatment alternatives through a change in visual characteristics and altered perceptions of quality or durability. These changes generate a new set of subjective values for the treatment alternatives of $(B_1',...,B_n')$. As a result, evaluating the new arrays of benefits and costs produces a new array of treatment payoffs, $(\Pi_1'...,\Pi_n')$. The consumer can again be expected to select the treatment alternative with the highest payoff. This situation may produce a different optimal selection than the no-regulation case. The consumer may in fact choose a noncoating alternative or no-treatment alternative, where coating treatment would be selected without the regulation.

1.3.2.3 Aggregate Demand.

If all consumers' preferences were identical and all surfaces to be treated possessed the same characteristics, the consumer choice model above would predict only one optimal type of surface treatment throughout the economy. A wide array of treatments and coatings are actually applied, however, indicating a variety of surfaces with different characteristics as well as individual preferences that vary across consumers.

Aggregating over all consumers and all surfaces, we can see how the regulatory changes can induce substitution among treatment alternatives and changes in aggregate demand for the affected coatings. These aggregate changes in demand and the associated effect on consumer welfare are the focus of this study.

1.3.2.4 Coating Users. Users of coatings can be divided into two groups: professionals and nonprofessionals. The nonprofessional is typically a "do-it-yourselfer" who purchases only a small amount of coatings each year. The application of coatings by nonprofessionals is limited primarily to residential architectural coatings. Professional users of coatings may be professional painters or contractor/builders. These professionals apply coatings to a broad array of surfaces in residential, commercial, institutional, and industrial settings. Table 1-2 shows that in 1991 do-it-yourselfers purchased two-thirds of all residential architectural coatings.[6] It seems reasonable to assume that contractors purchased all of the nonresidential architectural coatings and thus accounted for 60 percent of the use of all architectural coatings.

TABLE 1-2. CONSUMERS OF ARCHITECTURAL COATINGS

| | Percentage of Total Gallons in 1991 (%) |
|---|---|
| Residential | |
| Do-it-yourselfers | 41 |
| Contractors | 19 |
| Nonresidential[a] | 40 |
| Total | 100 |

[a] Commercial, institutional, light industrial.

Source: National Paint and Coatings Association. U.S. Paint Industry Data Base. Menlo Park, CA, SRI International. 1992.

### 1.3.3 Production of Architectural Coatings

1.3.3.1 Raw Material Inputs. Coatings comprise four basic types of materials: pigment, resin (binder), solvent, and additives. Pigment is the solid component consisting of uniform particles of a controlled size that are insoluble in the vehicle (the liquid portion of the coating). Pigments are used in coatings to decorate and protect and as fillers.[7] Pigmentation, although it varies depending on desired properties, is similar in both waterborne and solventborne formulations.

Film-forming binders surround and hold together the elements of the coating film and make up the nonvolatile portion of the vehicle. Resins aid in adhesion; determine the cohesiveness of the dried film; affect gloss; and provide resistance to chemicals, water, and acids. Natural and synthetic resins and oils, along with certain additives such as driers and plasticizers, serve as binders in coatings and are one of three types: multiuse resins (acrylics, vinyls, urethanes, polyesters); thermoset resins (alkyds, epoxies); and oils (drying oils, bodied oils).

The vehicles in organic solventborne and waterborne paints differ not only by the type of resin used, but also in the way they form a film and dry (or cure). Alkyd paints are oxidizing film formers in which the drying oils react with the oxygen in the air when the paint dries. The chemical reaction binds the molecules of the vehicle into a hard, dry film. Alkyd coatings continue to oxidize long after they dry and eventually provide a rock hard surface. Latexes consist of tiny, heat-sensitive plastic particles (latex) that are dispersed but not dissolved in water along with the pigment. As the water evaporates, a layer of closely packed plastic particles and pigment is left behind. The softened plastic particles then lose their shape and molecules diffuse and reattach to form a binding film.[8] The chemical characteristics of latex and alkyd paint influence some of their characteristics, such as gloss and resistance to blocking and water. Heat-sensitive plasticizers in latex paint cause the residual tackiness called blocking, which is more of a problem in glossy latex paints where the ratio of resin to pigment is higher. Precise control of particle shape and size in the film former is necessary to increase gloss. The plastic mesh also breathes better, allowing water and air to pass through it. The oxidizing process of alkyds forms a smooth (thus glossier), watertight skin of hardened resin that provides durability and water resistance.

Petroleum distillates in alkyd paints and water in latex paint function as the carrier, or volatile vehicle, that disperses the pigment and resin and provides the necessary fluidity for applying the coating. Basically there are two types of solvents: water and organic. In alkyd paints organic solvents dissolve the components of the film former, keeping them in solution. In latex paints, water separates and suspends the droplets of film former. Following application, the evaporation rate of the particular solvent controls the rate at which the film forms, leaving the pigment and resin bonded to the surface. Latent solvents, which dissolve the film former when combined with true solvents, and diluents may be added to the true solvent.[9] Diluents can be blended with the dissolved solution to extend the true and latent solvents. Water is the true solvent used in latex paints but may function as a diluent in alkyd formulations. Three types of organic solvents are used in coatings: hydrocarbons (aliphatic, aromatic); oxygenated solvents (alcohols, esters, ketones, glycol ethers); and chlorinated solvents (1,1,1-trichloroethane, methyl chloroform).[10] Architectural solventborne paints are mainly formulated with aliphatic hydrocarbons.

Additives are used in relatively small amounts in both organic solventborne and waterborne formulations to provide additional necessary properties or augment the properties of other inputs. They may be added to the film former, solvent, or pigment. Waterborne paints in particular may use additives such as agents to reduce foaming or bubbling of paint when it is shaken and applied; wetting agents, which can improve pigment dispersion or adhesion; freeze-thaw agents, which reduce the temperature at which the paint will freeze to prevent coagulation; and coalescing agents, which aid the flow of the latex particles to form a more continuous film.[11] VOC contents in latex paints (4 to 10 percent, or 50 to 200 g/L) are due to the additives used.[12] Solvents such as alcohols and ethylene glycols are added as co-solvents to waterborne formulations. They are often necessary to allow the plastic particles to soften and be mobile enough to bind into a continuous film.[13]

The additives used in the largest volume are thickeners, fungicides and preservatives, plasticizers, and defoamers.[14] Figures 1-2 and 1-3 show the principal raw material ingredients discussed above as they are used in organic solventborne and waterborne coating formulations.

1.3.3.2 Formulations. One of the distinguishing characteristics of each coating is the relative amount of the three main material inputs contained in the coating: pigment, binder, and solvent. Different formulations, particularly different ratios of pigmentation in the dried film to total volume of the dried film (pigment-volume concentration), will lead to correspondingly different protective and decorative functions.[15] For example, a coating designed to hide surface irregularities (like a mastic texture coating) has a higher pigment-volume concentration than a gloss varnish whose decorative function is to impart a shiny transparent or semitransparent coating. Low pigment-volume concentrations have an increased resin content and in general have high durability, gloss, and washability. The ratio of solvent to nonvolatile components ("solids") also characterizes types

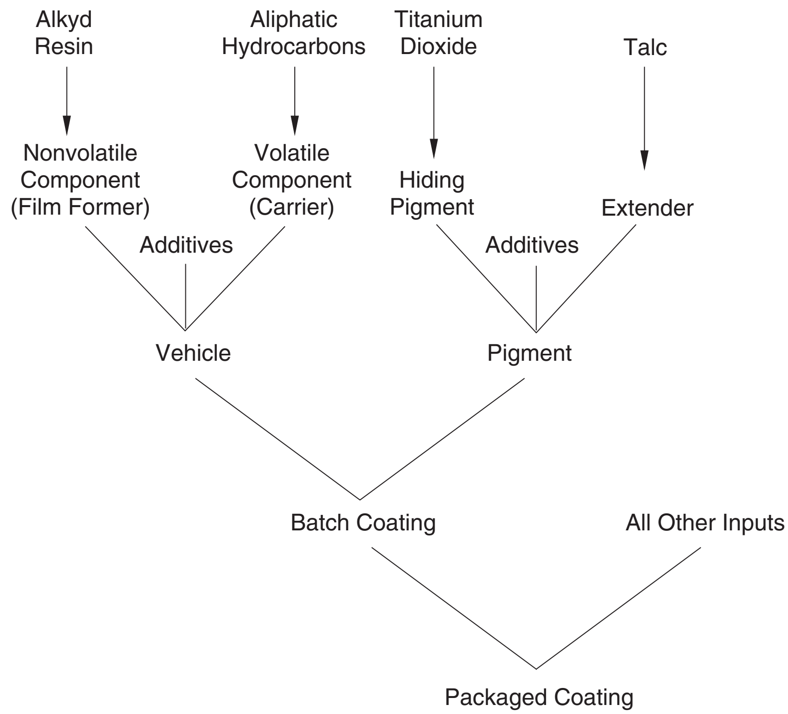


Figure 1-2. Inputs generally used in the manufacture of a solventborne coating.

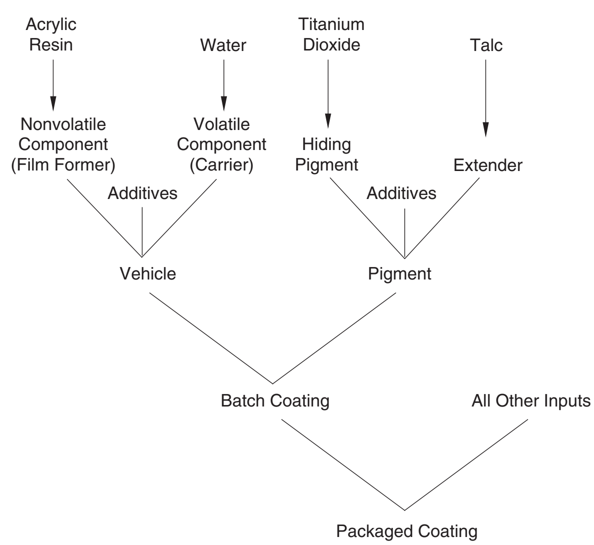


Figure 1-3. Inputs generally used in the manufacture of a waterborne coating.

of coatings.[d] Penetrating stains have a low solids-to-solvent ratio, and, when the solvent evaporates, virtually no film is left behind.

Figure 1-4 shows typical formulations and average VOC contents for a few architectural coatings.[16] The coatings in Figure 1-4 with higher solvent content also have higher VOC content. A low solids-to-solvent ratio, as with semi-transparent stain, is associated with high VOC content in coatings with organic solvents because VOCs are contained almost exclusively in the solvent portion of the coating. Two ways to reduce the amount of VOCs released from coatings are to increase the solids-to-solvent ratio and to substitute water for an organic solvent.

1.3.3.3 Manufacturers' Substitution Options and New Technologies. Manufacturers face two substitution possibilities to reduce VOC emissions from coatings. They may reformulate the coating to increase the solids-to-solvent ratio. Alternatively, manufacturers may reformulate the coating so that it contains the same amount of solvent but emits fewer VOCs during application (i.e., substitute water for an organic solvent). Certain coatings such as interior flat wall paint, interior semigloss, and exterior house and trim paint have been formulated using water for several years. Between 1950 and 1980, waterborne coatings replaced approximately 70 percent of solventborne coatings.[17] The performance of latex paints often meets and even exceeds alkyd counterparts; therefore, manufacturers may choose to discontinue organic solventborne paints in these product classes.

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[d]Nonvolatile components are often referred to as the "solids" portion of the coating, which includes pigments, resins, and other additives, although resins are not really solid until the film forms and are considered part of the nonvolatile vehicle, or liquid portion of the formulation.

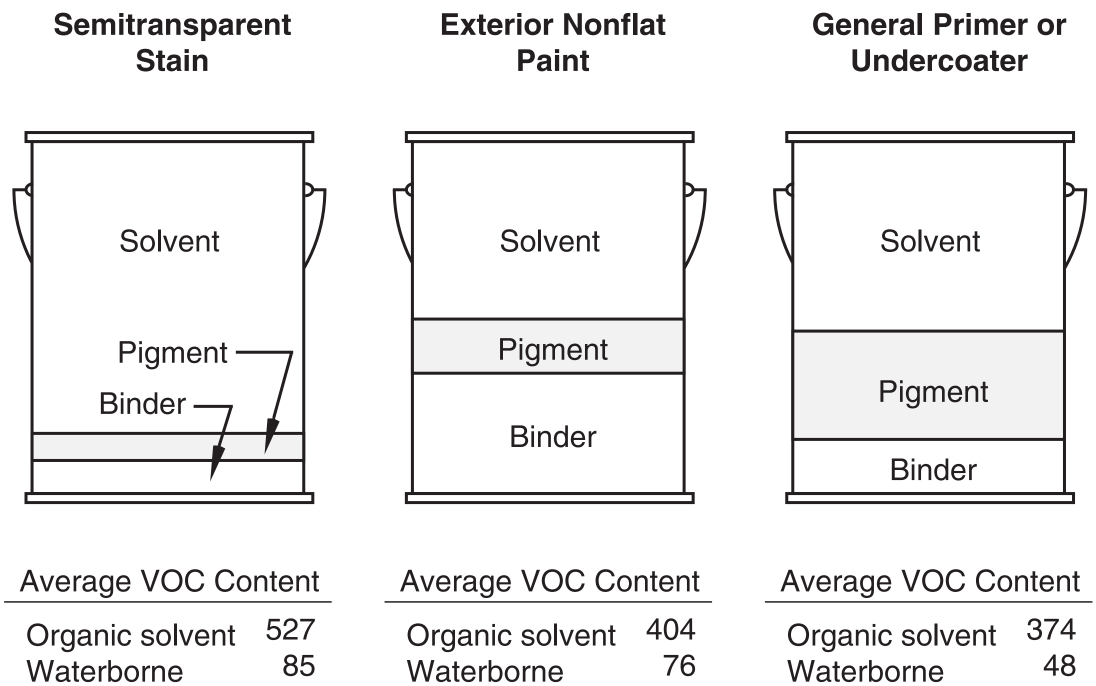


Figure 1-4. Approximate volume relationships of coating ingredients.

Note: VOC content in grams per liter from Table 1-1.

Source: Whittington, Trevellyan V. Paint Fundamentals. In Paint Handbook. Guy E. Weismantel (ed.). New York, McGraw-Hill. Pp. 1-1 to 1-23. 1981. (Adapted from Figure 1.4)

Other products, including stains, clears, high-gloss enamels, outdoor varnishes, and some special purpose coatings, are more difficult to reformulate. According to a 1990 article, clear coatings have two problems associated with them: waterbornes are transparent to UV radiation, whereas organic solventbornes absorb UV rays thus protecting the substrate; and waterborne acrylic polymers are not strong enough.[18] Quality performance in reformulated products is currently possible, but the cost may be very high.[19] As new technologies become more refined, new resin systems, such as alkyd systems once used only in solventbornes, will be used in more coatings, so prices will become more competitive.

High solids content formulation is an alternative technology to waterborne formulations that manufacturers have employed to reduce VOC emissions from coatings. A high solids coating is formulated with a high solids-to-solvent ratio.[e] Since a smaller percentage of solvent is contained in the coating, fewer VOCs are released during application. Table 1-3 shows example reduced solvent contents of three different types of reformulated organic solventborne products.[20]

TABLE 1-3. PERCENTAGE OF SOLVENT IN CONVENTIONAL AND REFORMULATED ORGANIC SOLVENTBORNE COATINGS

| Product | Conventional Solvent Content (%) | Reformulated Solvent Content (%) |
|---|---|---|
| Interior semigloss | 60 | 47 |
| Clear coatings | 55 - 62 | 35 - 37 |
| Stains | 72 - 85 | 30 - 35 |

Source: Bakke, Timothy O. Clean Air Paints. Popular Science. 237:85. August 1990.

Disadvantages noted in the past of higher solids organic solventborne paints include increased viscosity, longer drying time, reduced durability, and generally higher prices.[21] Reformulated organic solventbornes may be thicker, which would make them harder to apply and extend drying time, but they may offer greater protection. Durability may be compromised because of the reduced strength of shorter chain alkyd molecules substituted for longer chain molecules to improve flow.[22] Reformulated alkyd products can offer some advantages however. Durability may be traded for flexibility, which provides increased resistance to cracking and peeling. Presealers may not be necessary for wood substrates because the thicker coatings penetrate more evenly. Reduced VOC emissions, lower odor, and reduced toxicity and flammability are other benefits.

Raw material suppliers are expanding and improving upon existing technologies to meet demand for performance in new waterborne and high solids formulations. Solvents for use in waterborne formulations (i.e., glycol ethers) and high solids (keytones, esters) are replacing many of the hydrocarbon solvents used in solventborne formulations. Resins are being developed with a goal toward improved performance in new low-VOC formulations; similarly additives are being developed to improve flow and leveling characteristics of the new resins. Additional low-VOC technologies are reactive diluent technology, radiation curing technologies, and powder coatings, which currently are mainly used in manufacturing applications.

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[e]Note that the definition of high solids varies by coating type.

### 1.3.4 Industry Conditions

1.3.4.1 Shipments and Manufacturer Specialization. In 1991, the architectural coatings segment of the paint and allied products industry shipped $4,881.9 million in potentially regulated products (Table 1-4).[23,24,25,26,27,28,29,30,31,32] The value of shipments steadily increased by approximately 59 percent between 1981 and 1991, with a slight decrease between 1990 and 1991. The strong construction market throughout the 1980s helped contribute to this growth, but the industry as a whole was generally considered to be maturing in the early 1990s.[33] In 1991, the size of the architectural coatings component relative to the total coatings industry was 37.8 percent. New products are important to the paint and allied products industry, because growth for individual

TABLE 1-4. VALUE SHIPPED OF POTENTIALLY REGULATED PAINT AND ALLIED PRODUCTS: 1981 THROUGH 1991 ($$10^6$)

| 1987 Product Code | Product Class | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1991 | 1990 | 1989 | 1988 | 1987 | 1986 | 1985 | 1984 | 1983 | 1982 | 1981 |
| 28511 | Architectural coatings | 4,881.9 | 4,913.6 | 4,525.3 | 4,426.8 | 4,245.4 | 4,010.0 | 3,830.8 | 3,559.3 | 3,320.8 | 3,092.2 | 3,065.6 |
| | Exterior solventborne | 856.8 | 890.3 | 819.7 | 817.7 | 816.9 | 765.3 | 757.8 | 731.0 | 672.4 | 621.9 | 609.6 |
| | Exterior waterborne | 1,166.0 | 1,201.9 | 1,062.3 | 1,014.3 | 952.7 | 899.8 | 851.1 | 875.4 | 833.8 | 789.1 | 719.7 |
| | Interior solventborne | 647.2 | 644.1 | 655.1 | 621.4 | 603.0 | 553.5 | 544.7 | 512.6 | 490.2 | 473.1 | 445.5 |
| | Interior waterborne | 2,054.8 | 2,018.9 | 1,850.8 | 1,779.2 | 1,620.1 | 1,491.9 | 1,405.5 | 1,343.0 | 1,210.7 | 1,119.7 | 1,090.6 |
| 28511 93 | Architectural lacquers | 83.3 | 85.5 | 73.5 | 84.7 | 81.7 | 81.2 | 79.2 | 64.9 | 57.6 | 45.3 | 37.1 |
| 28511 00 | Architectural coatings, n.s.k.[a] | 73.7 | 72.9 | 63.9 | 109.6 | 170.9 | 218.2 | 192.4 | 32.9 | 35.9 | 42.9 | 163.2 |
| 28513 | Special purpose coatings | | | | | | | | | | | |
| 28513 0 | Industrial new construction and maintenance paints | | | | | | | | | | | |
| | Interior | 293.8 | 265.9 | 240.0 | 208.6 | 179.9 | 128.7 | 149.7 | 126.9 | 103.5 | 120.0 | 88.4 |
| | Exterior | 503.2 | 484.7 | 497.4 | 395.2 | 343.1 | 321.8 | 330.2 | 252.9 | 191.9 | 209.7 | 203.9 |
| 28513 11 | Traffic marking paints | 132.4 | 138.0 | 138.0 | 136.5 | 104.6 | 78.5 | 95.9 | N/A | N/A | N/A | N/A |

N/A = Not available.
[a] n.s.k. = Not specified by kind.

Sources: U.S. Department of Commerce. Current Industrial Reports: Paints and Allied Products, 1982. Washington, DC, Government Printing Office. 1983
U.S. Department of Commerce. Current Industrial Reports: Paints and Allied Products, 1983. Washington, DC, Government Printing Office. 1984.
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Note: Inflation factors used by the Census to produce estimates for the entire industry for aggregated data were applied to the disaggregated figures here. For architectural coatings: 1987-1991, 1.00; 1982-1986, 1.004; and 1981, 1.04. For special purpose coatings: 1987-1991, 1.06; 1982-1986, 1.00; and 1981, 1.08. The inflation factors for 1981 are based on 1977 Census relationships and for 1982-1986 on 1982 Census relationships.

producers is predicted to come from market share expansion, new product introductions, and improvements in established products.[34]

Sales in the architectural sector generally reflect activity in house redecoration, maintenance and repair, as well as sales of existing homes, new home building, and, to a lesser extent, commercial and industrial construction. Among interior and exterior architectural coatings, the waterborne coatings market dominates the sector and experienced a larger percentage increase in growth than did organic solventborne coatings. Interior waterbornes grew the most, 88.4 percent from 1981 through 1991. In 1991, 76 percent of interior coatings and 57.6 percent of exterior coatings were waterborne. Partly in response to environmental regulations aimed at the reduction of VOC emissions, the industry has shifted from manufacturing conventional organic solventborne paints in favor of paints with high solids-to-solvent ratios and waterborne and solventless paints.[35] However, much of this trend has also been driven by consumer demand.

Although the historical Census data do not identify value of shipments for paint products within the four product classes, other sources indicated that the majority of interior wall and exterior siding paint jobs use waterborne products.[36,37,38] Therefore, the exterior and interior solventborne shares probably account for mainly coatings used on exterior and interior trim, floors, decks, and high-gloss enamels.

Industrial new construction and maintenance paints and traffic marking paints are classified by the Census as special purpose coatings, which comprised 22 percent of the total coatings market in 1991. Market shares for industrial maintenance and traffic marking paints within the special purpose segment were 28 percent and 4.6 percent, respectively. Growth prospects for this segment are expected to be above average, especially for industrial and machinery maintenance coatings.

For all companies classified in the paints and allied products industry in 1987, 98 percent of their value of shipments was generated from the manufacture of paints and allied products (Table 1-5).[f,39] Only 3 percent of the value of paints and allied products shipped were manufactured by companies outside the industry. The top three secondary producers of paint and allied products account for about half the value produced as secondary products in other industries and are shown in Table 1-6: adhesives and sealants, plastics materials and resins, and printing ink.[40] Because coating products

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[f]Industry statistics, unless otherwise noted, include figures for all segments of the paint and allied products industry, not just those to be regulated.

often function as sealants, the adhesives and sealants industry is a logical secondary producing industry.

1.3.4.2 Company Size and Industry Structure. Information on industry structure is highly dependent on one's definition of the industry in question. The data used in this discussion apply to the entire Paint and Allied Products Industry (SIC 2851). As indicated above, architectural coatings account for just under 40 percent of industry shipments. Unfortunately, the industry structure data are not available for the architectural coatings component of the industry. Therefore, the information presented here may not always accurately reflect the structure of the architectural coatings sector.

In 1987, the paint and allied products industry comprised 1,121 companies owning a total of 1,428 establishments (Table 1-7).[41,42] Single establishments were held by approximately 77 percent of the companies, and they had an

TABLE 1-5. NUMBER OF COMPANIES, ESTABLISHMENTS, AND PRODUCER SPECIALIZATION—PAINT AND ALLIED PRODUCTS: 1987

| SIC Code | Industry/ Primary Product Class | Industry: Number of Companies | Industry: Number of Establish-ments | Industry: Primary Product Specialization Ratio (%)[a] | Industry: Coverage Ratio (%)[b] | Product Class Total Made in All Industries ($\$10^6$) |
|---|---|---|---|---|---|---|
| 2851 | Paints and allied products | 1,123 | 1,426 | 98 | 97 | 12,078.8 |
| 28511 | Architectural coatings | | 282 | | | |
| 28513 | Special purpose coatings | | 131 | | | |

[a] Value of primary products for the industry divided by the sum of the value of primary products produced by the industry and the value of secondary products produced by the industry.

[b] Value of primary products for the industry divided by the total value of products for that industry produced in any industry.

Source: U.S. Department of Commerce. 1987 Census of Manufactures, Industry Series: Paint and Allied Products. Washington, DC, Government Printing Office. 1990.

average value added of $1.1 million. The multiestablishment companies had an average value added of $20.4 million and produced almost 85 percent of the total value added for the industry. Also shown in Table 1-7, the 50 largest companies in 1987 produced 66 percent of the total value of shipments for the industry. Data from the Small Business Administration (SBA) indicate that in 1991 there were 1,152 companies and approximately 98 percent of those were classified as small businesses as defined by having fewer than 500 employees.[43] Figure 1-5 displays the location of manufacturing establishments in the paint and allied products industry by state.[44] California has the greatest number, 201, followed by Illinois with 118. Paint manufacturing is fairly well represented in most states east of the Mississippi River.

TABLE 1-6. COMMODITY PRODUCTION IN 1982: PAINT AND ALLIED PRODUCTS

| (SIC 2851) Product Examples | Producing Industries | Value[a] ($$10^6$) | Percentage Produced |
|---|---|---|---|
| Interior and exterior paint, lacquers, and varnishes; OEM coatings; industrial new construction and maintenance paints, traffic paints, automotive refinish paints, marine paints, aerosol coatings, paint and varnish removers, thinners, putty and glazing compounds, brush cleaners | Primary | 8,243.3 | 96.5 |
| | All secondary producers | 303.2 | 3.5 |
| | All producers | 8,546.5 | 100.0 |
| | Top three secondary: | 142.6 | 1.7 |
| | Adhesives and sealants | 68.8 | 0.8 |
| | Plastics materials and resins | 45.8 | 0.5 |
| | Printing ink | 28.0 | 0.3 |
| | All other secondary producers | 160.6 | 1.9 |

[a] Measured at producers' prices.

Source: U.S. Department of Commerce. The 1982 Benchmark Input-Output Accounts of the United States. Washington, DC, Government Printing Office. 1991.

In the 1980s, consolidation was a major trend in the paint and allied products industry. The maturity of the industry and increased technology requirements are factors contributing to the restructuring. A large number of mergers and acquisitions took place in response to pressure from the higher cost of paint ingredients, intense industry competition, compliance with government regulations, and low profit margins.[45] Other companies divested their paint and coating operations to focus on other businesses or as an alternative to making the capital and research and development (R&D) commitments required to remain competitive. The number of coating manufacturers and the number of establishments

TABLE 1-7. LARGE FIRM DOMINANCE AND NUMBERS OF COMPANIES AND ESTABLISHMENTS IN THE PAINT AND ALLIED PRODUCTS INDUSTRY: 1987

| Industry (SIC 2851) | Nu[illegible] Co[illegible] | | Value [illegible]hipments Percent[illegible]ccounted for by [a] | | | |
|---|---|---|---|---|---|---|
| | | | [illegible]rgest [illegible]nies | 8 [illegible] | 20 Largest C[illegible]panies | 50 Largest Companies |
| Paint and allied product producers | | | | | 53 | 66 |
| Multiestablishment companies | | | | | | |
| Single-establishment companies | 862 | | | | | |

[a] Percentages consist of the sum of value [illegible] companies (or 8, 20, or 50 companies), divided by the total [illegible] of [illegible]ustry.

[b] The total value added divided b[illegible]mber of c[illegible]anies.

Sources: U.S. Department of Commer[illegible] Cen[illegible]s of Manufactures, Subject Series: Type of Organization. Washington, DC, Government Printing Office, February 1991.

Source for Percentage Accounted for Data: U.S. Department of Commerce. 1987 Census of Manufactures, Concentration Ratios of Manufacturers. Washington, DC, Government Printing Office. 1992.

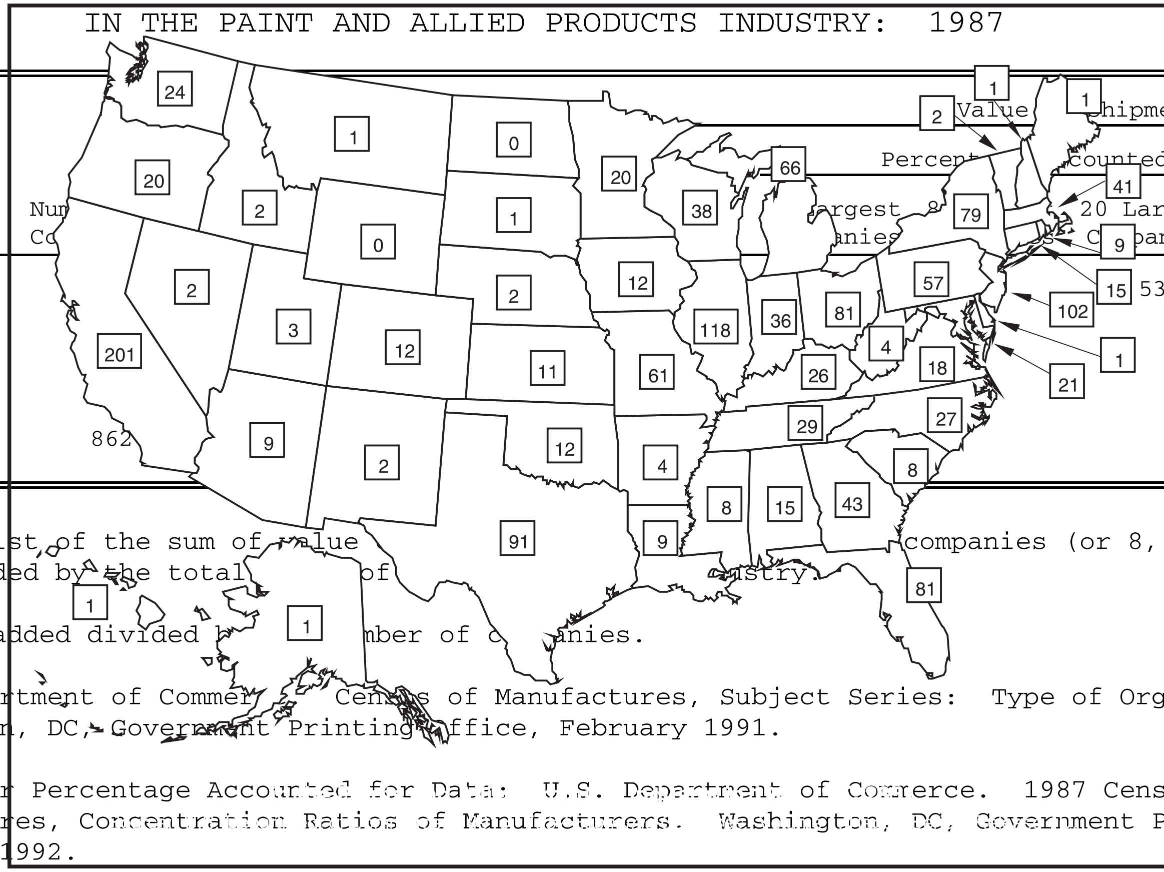


Figure 1-5. Location of manufacturing establishments in the paints and allied products industry in 1987: SIC 2851.

Source: U.S. Department of Commerce. 1987 Economic Censuses. Volume 1, Report Series, Release 1D. Census of Manufactures: Location of Manufacturing Plants. file MC87LMCO. 1991.

operated by these manufacturers has decreased. As indicated in Table 1-8, from 1972 to 1991, the number of companies decreased by 12 percent, and the number of manufacturing establishments decreased by over 20 percent.[46]

TABLE 1-8. NUMBER OF COMPANIES AND ESTABLISHMENTS IN THE COATINGS INDUSTRY, SELECTED YEARS, 1972-1991

| Year | Number of Establishments | Number of Companies |
|---|---|---|
| 1972 | 1,599 | 1,317 |
| 1977 | 1,579 | 1,288 |
| 1982 | 1,441 | 1,170 |
| 1987 | 1,426 | 1,123 |
| 1991 | 1,400[a] | 1,030[a] |
| % change 1972-1991 | -12.4% | -21.8% |

[a] 1991 figures are from Finishers' Management. The U.S. Paint and Coatings Industry. pp. 23-25. April 1991.

Source: U.S. Department of Commerce. 1987 Census of Manufactures, Industry Series: Paints and Allied Products. Washington, DC, Government Printing Office. 1990.

On average, 35 to 40 mergers or acquisitions took place each year in the coatings industry in the late 1980s and early 1990s.[47] A transaction involves the transfer of production capacity from one company to another but does not necessarily indicate the dissolution of the company making the transfer. The selling company could sell only a division or product line and remain in business. Some of the larger acquisitions reported in trade journals, by the press, and in companies' annual reports are listed in Table 1-9.[48]

TABLE 1-9. ACQUISITIONS IN THE COATINGS INDUSTRY: CIRCA 1990

| Selling Company | Acquiring Company | Division Sold |
|---|---|---|
| DeSoto | Sherwin Williams | Consumer Paint Operation |
| Whittaker Corp. | Morton International | Specialty Chemicals Operation |
| Azko Coatings Inc. | Reliance Universal Inc. | Buyout |
| DeSoto | Valspar | Coil Coatings Operation |
| Clorox Co. | PPG Industries, Inc. | Olympic and Lucite finishes |

Source: Loesel, Andrew. Coatings Industry Faces New Mix. In Chemical Marketing Reporter. 238(18):SR3-SR8. New York, Schnell Publishing Co. 1990.

Most of the larger companies produce architectural, original equipment manufacturer (OEM), and special purpose coatings. Several of the largest coatings producers are chemical corporations; however, paint manufacturing represents only a small part of their overall business.[49] In 1991, merger activity slowed down and left the industry basically divided into two groups: a few, well-financed and highly diversified multinationals and a large number of regional paint companies.[50]

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