Paint-Waste Management Trends in the Manufacturing Industries

Paint-Waste Minimization Rolls On — but Coverage is Streaky

Editor's Note: Last month's EI Digest *reviewed the waste management issues of paint producers. This follow-up report examines waste management trends among some of the biggest users of paint — the manufacturers of motor vehicles, furniture, machinery and other painted products.*

by Alan J. Duff

More than 1 billion gallons of liquid paint were produced by U.S. paint makers in 1993, along with 194 million pounds of powder coatings — enough paint to cover the entire state of West Virginia. While most of that volume consisted of architectural coatings (see Figure 1), 334 million gallons were used by original equipment manufacturers, or OEMs — the makers of everything from forklifts to folding chairs.

Of course, not all the paint sold to OEMs in 1993 reached its intended surface. Transfer efficiencies among manufacturers vary considerably, but it's not uncommon for 30 to 40 percent of paint to miss its mark and wind up in a spray bath or filter. The top six paint-using OEM industries — motor vehicles, containers, finished wood products, metal furniture, metal sheets and coils, and machinery — waste an estimated total of about 75 million gallons of paint each year.

This report examines the paint usage patterns and paint-waste management trends for each of these six industry groups, which together account for most paint used in manufacturing (see Figure 2).

Original equipment manufacturers lose tens of millions of gallons of paint each year to overspray and other operating inefficiencies. Despite recent improvements in paint-line technology, transfer efficiencies for most industries remain surprisingly low. Meanwhile, efforts to adopt less hazardous water-based paints have proven problematic, and wide-scale use of powder coatings appears to be many years away. This report examines the paint usage patterns and paint-waste management trends for the six largest paint-using industries: motor vehicles, containers, finished wood products, metal furniture, metal sheet and coil products, and machinery and equipment.

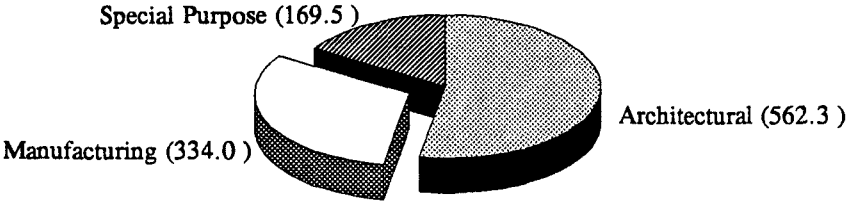
Motor Vehicles

With 60 plants scattered across the U.S., the auto industry is by far the largest OEM user of paint, and makers of trucks, buses, rail cars and other transportation equipment are also important paint users (see Figure 3). For many vehicle assembly plants, spraybooth sludge and other paint wastes rank among the three highest-volume waste streams.

The typical painting process for vehicles is more elaborate than for other products and usually involves three steps. First, a primer is applied to give metal surfaces better adhesion; automobiles typically require about half a gallon. Next comes the top coat, which gives the vehicle its color; some cars need three-quarters of a gallon of this coat, while others require twice as much. The final step is the application of a clear coat, which protects the surface and imparts a glossy appearance; half a gallon per car is the general rule of thumb for this coat.

Many auto companies invested heavily in their paint-application equipment during the 1980s (see

1993 Paint Usage, By Group



Figures represent millions of gallons. *Source: U.S. Census Bureau, 1994*

Figure 1

"Waste Management Trends in the Automotive Industry," *EI Digest*, April 1994). Today, electrostatic application tools and robotics are common, and at plants with state-of-the-art equipment, transfer efficiencies reportedly have improved dramatically.

While organic solvent-based paints are still the norm at auto plants, the use of alternative coatings is on the rise. Hazardous paint sludge disposal costs have driven the search for alternatives, but an even bigger impetus has been the need to reduce emissions of volatile organic compounds (VOCs) in order to meet stringent new Clean Air Act requirements. To achieve this objective, some automakers — including Chrysler and Saturn — are installing equipment at new plants that will allow the use of water-based top coats.

Meanwhile, automakers are working with the paint-manufacturing industry to come up with a powder coating substitute for oil-based clear coats. In June, the big three domestic auto manufacturers — Ford, General Motors and Chrysler — announced plans to construct a $20 million facility in Michigan to test powder paints. According to the U.S. Council for Automotive Research, the cooperative R&D facility could shave more than two years off the development time for powder coatings.

Nevertheless, it will be several years before powder-based clear and top coats are ready for wide-scale use on auto bodies. In spite of this, plants are already making progress toward using powder coatings for other, non-visible automotive components.

Most automakers say their plants have already maximized transfer efficiencies for organic solvent-borne paints. However, they are finding that the switch to water-based top coats is often accompanied by a drop in transfer efficiency. The resulting increase in waste volumes is mitigated somewhat by the fact that the waste generated by water-based paint lines is less hazardous than organic solvent-borne paint waste.

Ironically, the trend toward lighter, more fuel-efficient vehicles may cause automotive paint waste volumes to increase. In order to meet government-mandated efficiency guidelines, some auto industry experts foresee an acceleration of the trend toward replacing steel parts with aluminum and plastic. And because transfer efficiencies for aluminum primers are generally lower than those for other types of metal, more waste is generated. What's more, while traditional paint wastes are classified as hazardous only if they exhibit hazardous characteristics, the waste from aluminum-applied paint is a listed RCRA hazardous waste.

Containers

Each year, nearly 70 million gallons of paint are applied to new metal storage containers, ranging in size from 12-ounce soda cans to 55-gallon industrial drums.

- **Food and Beverage Cans**

Food and beverage cans, four-fifths of which are now made from aluminum, roll off U.S. fabrication lines at the mind-boggling clip of about 140 billion units per year. About 20 different companies operate the 50 or so can-making plants in the U.S.

Two different types of coatings are applied to aluminum beverage cans, one for the outside and another for the inside. The outside of the can is typically dressed in a four-color pattern of acrylic polyester, while the inside is coated with an acrylic. The industry switched to these water-based coatings from solvent-based epoxies and vinyls in the early 1980s for environmental reasons. Powder coatings have been shunned because of application problems presented by the aluminum can's unique interior shape.

The inner and outer coatings are applied to the aluminum via a printing and baking process that resembles roller coating. This process is so exacting, according to industry contacts, that most plants generate only an occasional drum of waste — usually from accidental paint spills.

- **Larger Containers**

While the volume of paint used for food and beverage cans is considerable, it "pails" in comparison to the amount used on larger metal containers. Industry contacts estimate that about 40 million gallons of paint are applied annually to 55-gallon drums, while an additional 10 million gallons are used for smaller drums, pails and other metal containers.

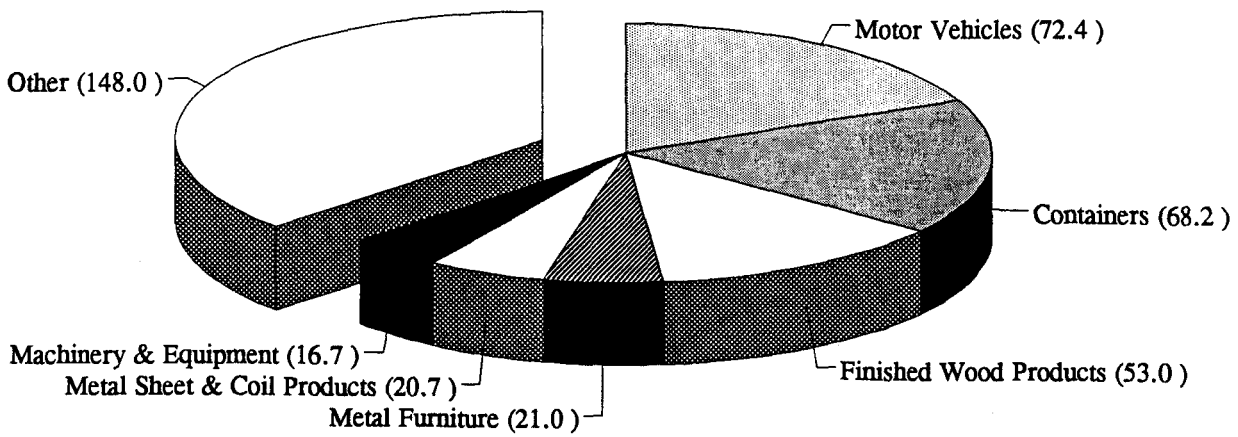
About 30 companies make 55-gallon drums at 45 plant sites across the U.S. Many additional companies make drums in 16- and 30-gallon sizes. Although some powder coatings are used, manufacturers in this sector typically use spray guns to apply two thick coats of oil-based paint to their drums. This low-tech approach indicates that many of the new paint-line efficiencies have bypassed this sector;

Table 1 **Major Customer Groups for Metal Sheet and Coil Products**

Customer Group (by industry)	Material Tons	Annual Paint Usage (millions of gallons)
Building Products	1,682,000	12.0
Containers	377,000	2.7
Appliances	283,000	2.0
Transportation Goods	240,000	1.7
Other	318,000	2.3
Total	2,900,000	20.7

Source: Coil Coatings Association, 1992

Annual OEM Paint Usage, by Industry



Figures represent millions of gallons.

Source: Rauch & Associates, 1990

Figure 2

typically more than a gallon of paint is expended on each 55-gallon drum.

Finished Wood Products

Of the thousands of companies with SIC codes 2511 (non-upholstered household furniture) and 2521 (office furniture), only a handful have payrolls of 10 employees or more. This universe of mainly small manufacturers uses more than 45 million gallons of paint annually, while an additional 8 million gallons is used by makers of wooden board products such as windows and picture frames.

Due to wood's unique characteristics, most surfaces require three layers of coating: a preliminary "dip" or "flood" coat, an intermediary primer coat and a finishing top coat. The industry has been working with paint manufacturers to develop water-based alternatives to oil-based urethane coatings, the industry standard. However, problems with water-based products — such as relatively slow drying times and greater susceptibility to weathering — remain unsolved. Those familiar with the industry say they doubt that there will be any major move toward water-based or powder coatings for wood in the near future.

While some finishers of board and fabricated wood products can use roller-coating equipment that generates very little paint waste, most wood-painting operations involve unsophisticated spraying techniques with very low transfer efficiencies — in some cases, as low as 35 percent.

Metal Furniture

Metal furniture manufacturers with SIC codes 2514 (household furniture) and 2522 (office furniture) number at around 275. Many of these companies specialize in painting metal furniture, leaving the tasks of assembly, packaging and distribution to other companies.

Each year, makers of metal fixtures and furnishings use about 21 million gallons of paint, which encompass just about every color of the spectrum. However, because commercial customers generally seek uniformity in their furnishings, demand for identical colors can span many years' worth of product lines.

These color-specific demands have slowed the movement toward new coatings and transfer technologies and have stifled the industry's paint-waste minimization efforts. Spray guns are typically used, and overspray captured in spraybooth baths is sometimes reused in lower-quality coatings of a different color. The type of paint used varies a great deal, depending on the components being painted.

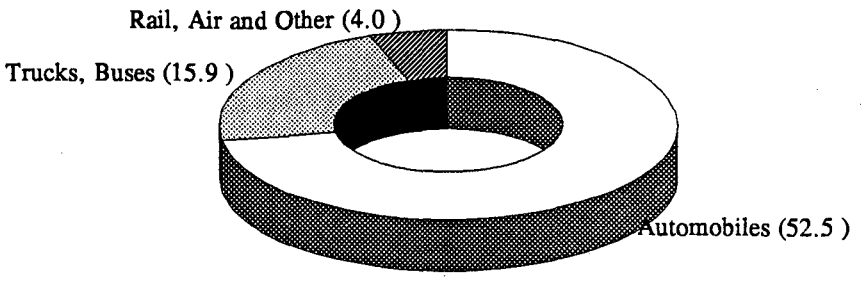
Metal Sheet and Coil Products

Domestic makers of coated metal sheet and coil products, who number between 50 and 60, deliver nearly 3 million tons of product annually for makers of metal buildings and a wide range of other goods (see Table 1). Diversity is the rule for sheet and coil manufacturers as well as their other customers, most of whom serve more than one market, according to Howard Grunwell of the Coil Coatings Association, a trade group that

represents about two-thirds of the industry.

The coated coil and sheet metal industry uses about 21 million gallons of paint per year. Oil-based paint is most commonly used. Paint usage and waste management trends among manufacturers of coated products for the transportation industry closely resemble those of automakers, who until recently were the industry's primary customer group. While the auto industry has taken on more of its own parts-painting duties in recent years, the trend may be reversing; two major auto companies recently have expressed a desire for more ready-painted parts from coil producers.

Annual Paint Usage by Vehicle Manufacturers



Figures represent millions of gallons. *Source: Rauch & Associates, 1990*

Figure 3

Machinery and Equipment

Dozens of companies manufacture tractors, lawn mowers, snowblowers and other motorized equipment for industrial, commercial and residential use. Together, the machinery and equipment industry uses about 17 million gallons of paint annually. The amounts and types of paint used by individual companies vary by product line; oil-based coatings are the most common.

One major maker of agricultural and industrial equipment is currently drawing up plans to convert the paint lines at one of its tractor and engine plants to water-based or powder coatings. However, engineers have had to overcome problems in the re-tooling effort. Water-based paints have tested satisfactorily, but only when applied in two coats to enhance corrosion protection. Meanwhile, powder coatings have been shown to require curing temperatures that are too high for many of the company's products.

Another major equipment manufacturer reports better luck with powder coatings, which it now uses on its household line of lawn mowers, snow blowers and other consumer products. However, the manufacturer continues to apply organic solvent-borne paints to its commercial products.

For each of the three largest equipment companies, the trend is moving away from traditional stand-alone spray guns and toward electrostatic spray-painting. Sophisticated spray-booth systems are allowing some plants to recover most of the overspray for re-use. For example, one plant in Wisconsin, reports that cathodic electrode spray equipment, used in conjunction with a $3 million overspray recovery system, achieves transfer efficiencies that approach 100 percent.

Conclusion

Wasted paint is a significant issue for all six of the manufacturing groups discussed above, and companies in each industry recognize the bottom-line significance that paint-waste disposal carries. Most OEMs contacted for this report say they shop around extensively for the best combination of service, expertise and price when choosing disposal service vendors. A majority of OEMs also pretreat their wastes to some extent. While many larger paint users prefer to receive full-service waste treatment and disposal from a single vendor, some smaller OEMs go so far as to segregate their paint waste streams and ship them to several different fuel blenders or landfill operators. It is fairly common for OEMs to ship their paint wastes halfway across the U.S. for disposal, and transportation expenses were cited as a significant part of the overall paint-waste disposal cost.

Some OEM industries have done much to switch from oil-based paints to water-based and powder coatings. In particular, the machinery and equipment industry has invested aggressively on this front. However, problems with paint application and durability have slowed the movement toward these alternatives.

Of course, as Soonie McDavid, waste minimization chair for the National Paints & Coatings Association, points out, the best way for paint-using OEMs to minimize paint waste is to improve transfer efficiencies. Led by the automotive industry, each of the major paint-using OEMs has reportedly improved its overall transfer efficiency by at least 10 percent over the past decade. This is due not only to equipment upgrades but also to closer monitoring of painting practices by line operators and managers.

While the future pace of paint-waste minimization will vary considerably by industry, it's a safe bet that each of the major paint-using OEMs is on the lookout for opportunity. Δ