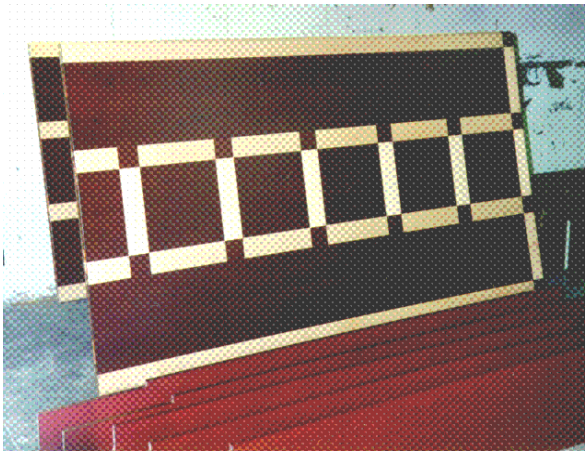
Case Study No. 9 High-Solids Coatings
Design Fabricators
Lafayette, CO

Background

Design Fabricators produces custom store fixtures and entertainment/ornamental items. Most of their production consists of coated wood products made from sheet goods; 60 to 70 percent of the coatings are clear sealers or topcoats. A small percentage of the coatings, five to ten percent of total sales, are used to coat metal or fiberglass. The plant operates five days a week with two shifts. The number of hours worked and number of employees vary seasonally, but averages close to 200 employees on two 8-hour shifts. Approximately 25 of those employees are in the finishing department.


Product sample

In October 1994, Design Fabricators moved into their current location. Prior to the move, the local community raised concerns over emissions and the odor of the solvent-borne coatings. The company was interested in pursuing new finishing techniques and lowering emissions, but they found that information about low-VOC/HAP coatings was not readily available. By November 1995, alternative coatings were under serious consideration and were being tested for quality, durability, and cost effectiveness. The new coating system was fully implemented in early 1996.

Manufacturing and Coating Operations

Most commonly, raw material is purchased in sheet form. The sheet goods are then cut to size and edged with laminate or wood tape if necessary. Both processes are automated. Some solid woods, which need to be ripped, planed, and milled, also are used for products such as tables and benches.


Finishing department

The components are then taken directly to either the assembly area or the finishing department. Depending on the product, it may be finished before or after assembly. In the assembly area, there are specified areas for different jobs. Products are assembled and sanded by hand. In the finishing department, the product is taken into one of the two spray booths and placed on hangers (the larger items are


Product assembly

rolled in on trolleys). The hangers are moved manually throughout the finishing area, with the operators taking care not to touch the product until the finish is cured. Most of the coatings are applied using air-assisted airless guns, although a small number of custom jobs require conventional spray guns. The coatings are pumped from 55-gallon drums in the paint kitchen directly to the spray guns in the booths. The only exception is the catalyzed conversion varnish, which is mixed in 5-gallon batches and put into smaller pumps located in the spray booth. The stain is applied first and is hand wiped for some products. The product then is sprayed with a sealer and sanded. Finally, a topcoat is applied and the product is allowed to air dry. After the finish has cured, the product is packaged and shipped to the customer.

Conversion to High-Solids, Low-HAP Finishes

Design Fabricators tested several different coatings and suppliers before settling on their current finishing system. First, waterborne coatings were used on some of the smaller orders, but they caused several problems. The biggest problem was grain raise. When a waterborne product is applied to wood, especially the softer species, the grain of the wood absorbs the water and stands up, or raises. Grain raise results in a rougher finish that lacks the smoothness that is typically achieved using solvent-borne coatings. In an attempt to rectify this problem and smooth the grain, additional sanding was required. However, the operators often sanded through the seal coat. This would cause the grain to raise again when the topcoat was applied because the wood was re-exposed to a waterborne coating.

Another problem encountered with the waterborne coatings was drying time. To prevent the parts from sticking together, waterborne products generally require a much longer drying time before they can be stacked or shipped. This problem can be helped by adding drying ovens to speed the curing process. However, additional equipment would not only be expensive, but would also require more space than the facility can devote to finishing. A third problem Design Fabricators encountered with their waterborne coatings was a softer finish that was not as durable. Because of these difficulties, waterborne coatings were not chosen for the new system.

Design Fabricators next considered UV-cured coatings. Ultraviolet-cured coatings have the low-VOC/HAP advantage of waterborne products while producing a durable, high-quality finish. Grain raise is avoided because UV-cured coatings can have up to 100 percent solids and no water. The very-high solids content prevents the VOC and HAP emissions associated with traditional solvent-borne coatings. The curing time also

is very short, only a few seconds. However, UV-cured coatings are most feasible for flatline finishing, making UV finishing impractical for Design Fabricators because of the wide variety of shaped pieces that they finish.

The final coating system tested by Design Fabricators included a high-solids catalyzed conversion varnish and low-HAP sealers and stains. The VOC and HAP content of these coatings is still low due to the high solids content, and the problems experienced with the waterborne coatings tested by the facility were avoided because the coating is acetone based. The acetone-based coatings are applied using spray guns, allowing easy finishing of shaped pieces. The main problem with acetone-based finishes is that they tend to dry too quickly. However, drying time may be adjusted by adding other solvents. Acetone also is very flammable, and fire risks are an important issue. However, because of the high-quality finish and compatibility with the existing finishing line, the high-solids, low-VOC/HAP system was selected. The new topcoat has around 40 percent solids, where the old topcoat had about 18 percent solids. Gradually, the old precatalyzed topcoats are being phased out and replaced with the high-solids catalyzed conversion varnishes. Catalyzed finishes have a higher solids content and result in a more durable finish. The harder finish is achieved because the coating is not only dried, but is cured by a polymerization reaction controlled by the amount of catalyst in the coating.

The transition to high-solids coatings was fairly smooth for Design Fabricators. There was a learning-curve period of six to eight months during which the operators became familiar with the new coatings and different coatings combinations were tried to achieve the best finish possible. Because the new system is compatible with the original solvent-borne system, the operators were able to make the minor adjustment rapidly. The coating process did not undergo much change when the coatings were changed. The new coatings are applied manually using spray guns, as were the old coatings.

Costs

Although the new finishes cost more per gallon ($18 per gallon versus $11 per gallon for the topcoat), the overall costs are approximately the same because of the higher coverage associated with high-solids coatings. Design Fabricators feels any slight increase in cost is worthwhile; the high-solids finishes are not only lower-emitting, they also produce a quality finish equal to, if not better than, the original solvent-borne system.

Emissions

According to data provided by the facility, the switch to high-solids coatings resulted in a considerable decrease in the annual VOC and HAP emissions for the plant. The coatings changes also served to address the local community's concerns about their emissions. The new coatings typically average around 1 pound of VOC per pound of solids. In 1995, before beginning the switch to the lower-emitting coatings, around 44 tons of VOCs were emitted. After the complete conversion to the new system, only about 36 tons of VOCs were emitted over a 12-month period. Although the difference seems small, the company's sales increased during that two year period ($10.1 million

in 1995 versus $13.7 million in 1997). Design Fabricators was able to increase production and still lower their total mass emissions and their emissions per dollar of sales.

The reduction in HAP emissions was even greater. In 1995, approximately 20 tons of HAPs were emitted. By 1998, HAP emissions were almost eliminated, while production nearly doubled. The new coatings contain from 0.04 to 0.46 pound HAP per pound of solids. In addition, the glues, cleaning solvent, and stain base contain no HAPs.