Case Study No. 4 Waterborne Coatings
Automated Building Components
Chanhassen, MN

Background

Automated Building Components (ABC) finishes and distributes a variety of millwork, including exterior/interior doors, windows, fireplace mantels, stair components, and moldings. The majority of their products are oak, although some are maple. About half of the annual production is interior trim packages and 40 percent of them are finished on-site. These "prefinished" parts provide 3 percent of total revenue and are sold to residential building contractors. ABC uses 12 different finishes with an annual production of 3 million feet per year. Two shifts are run daily, with five or six people per shift in the finishing department. The finishing department consists of two finishing lines, one manual and one automatic. In 1993, ABC began investigating the use of a waterborne finishing system to allow expansion within the current permit restraints.

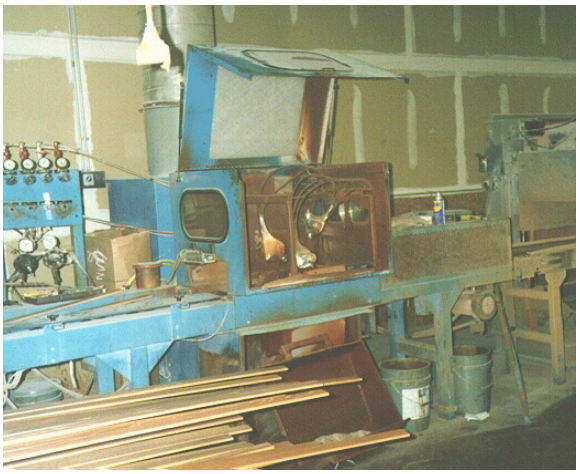
Product sample

Manufacturing and Coating Operations

The manual finishing line consists of one spray booth in which operators apply stain, sealer, and topcoat. Stains are applied using HVLP guns and the sealer and topcoat are applied using airless guns. The spray booth has four coating supply lines for stains. Three are dedicated lines for the most popular colors (to reduce necessary line flushing and gun cleaning) and the fourth line is used for the remaining colors. Parts are laid flat on a cart in the spray booth, the stain is applied, and the parts are hung on an overhead line and moved out of the booth to be hand wiped and to dry. The rags used for wiping are sent to a laundry service for cleaning and then are reused. The hanging parts again are moved into the spray booth, sealer is applied, and the parts again are moved out of the spray booth to dry and are hand sanded. The topcoat is applied in the same manner as the sealer.

Spray booth

The automatic line finishes smaller flat products such as moldings. The product is loaded onto a conveyor belt at the beginning of the process. First, the stain is applied by an automated HVLP gun. Overspray is collected, filtered, and reused. The conveyor then carries the product through a wiping machine which dries the stain enough that the sealer can be applied by an automated airless gun. The product is racked and allowed to air dry. Once the product is dry, it is run through the same line again, but this time only the airless gun is active, applying a topcoat. The parts again are racked and allowed to air dry before being packaged and shipped. For products that only receive a clearcoat, the staining step is omitted and only the airless gun is used.


Automatic line

The sealer and topcoat are received in 55-gallon drums, which require a minimal fee to be removed. The stains are received in 5-gallon buckets, which can be recycled at no cost if the handles are removed.

Cleaning Operations

All of the guns are soaked nightly and cleaned throughly once a week. A toluene-based lacquer thinner is used for the majority of the cleaning. Where possible, the coating is allowed to dry completely and is chipped off of the equipment to reduce the amount of cleaning solvent used. All parts that come in contact with the coatings have been covered in plastic to reduce the amount of coating that will stick to them.

Conversion to Waterborne Coatings

ABC was finishing with traditional solvent-borne coatings when permit constraints threatened to impede expansion of their operations. Because expansion was necessary to continue to meet increasing customer demand, alternative coatings that would not cause them to exceed current permit limits were researched. ABC was outsourcing some finishing work to a company that was using no-HAP, low-VOC waterborne finishes with little problem and producing a high-quality product. This contact prompted the move to waterborne finishing at ABC.

The manual finishing line required little modification to apply waterborne coatings. Carbon steel parts on both the pumps and guns needed to be replaced with stainless steel, but entirely new equipment was not necessary. The coating supply lines also were updated to stainless steel to allow for installation of a recirculating system. However, this expense was not required; the coatings could have been pumped directly out of the barrel at the spray booth without any regulatory or fire safety violations.

When the waterborne coating system first was implemented, ABC experienced problems with the tips of the spray guns plugging. This problem was gradually

alleviated by adding a series of filters before the gun tip to catch any impurities. It also is probable that the amount of impurities was reduced as the coating supplier increased the quality of the coatings.

Another problem encountered with the waterborne coatings was color matching. This was quickly solved by the coating supplier making minor modifications to the stains. The coating supplier was very helpful throughout the entire conversion process, from helping to select the best equipment for ABC's waterborne finishes to making any necessary reformulation to improve the quality of the product.

Typically, increased drying time is an issue faced by companies that have switched to waterborne coatings. ABC has added a few fans to speed the drying time but has experienced few difficulties because of the way their production area is set up. All products off the automated flat line are racked, and by the time the end of the batch is finished, the beginning of the batch is dry enough either to apply the topcoat or be moved to the shipping area. Similarly, on the manual line, by the time a coating has been applied to all of the products on the line, the pieces at beginning of the line are dry enough for the next step.

An important benefit of the waterborne system is the quality of the product. The waterborne finish is more durable and resistant to yellowing than the original solvent-borne finish. The waterborne coatings also provide a larger selection of colors, eleven more than the four offered in the solvent-borne line.

The waterborne finishing system also has provided other benefits. The reductions in fire and health hazards are worth far more than the physical cost reduction enjoyed due to decreased permit and emission fees, increased coverage, and higher transfer efficiency (due to the new equipment).

Costs

The manual finishing line required little adjustment to be compatible with the waterborne coatings, and the adaptation was done at minimal cost. The total equipment renovation cost was $18,000. However, the entire cost was not due to the change to waterborne coatings. The switch to a stainless steel recirculation system was costly, but not necessary for a successful conversion. Although the automated flat line required new HVLP guns and pumps for the stain, these upgrades were not a direct cost of the conversion process because the equipment that was being used was old and needed to be replaced. The new guns have quickly paid for themselves because of their higher transfer efficiency. Any coating that would normally be considered waste is recovered by the overspray reclamation system and reused.

The waterborne coatings cost $20 per gallon, whereas the solvent-borne coatings were only $7 per gallon. This represents only a small increase in overall cost for two main reasons. First, the waterborne coatings contain a much higher percentage of solids and therefore cover twice the amount of wood per gallon. Secondly, the overspray

reclamation system installed with the waterborne equipment recovers what would have been waste coating under the old system.

The switch to waterborne coatings required 400 man-hours in lost productivity. However, while the switch was taking place, actual production volume and product quality never suffered. This is exemplified by the fact that the sales staff and customers never realized there was a change until after the fact. Now, they are very satisfied with the quality of the waterborne coatings, which are more durable than the original solvent-borne coatings.

Including the decreases in license and emission fees, the overall cost savings is estimated to be over $60,000 per year. This figure includes savings from the higher transfer efficiency of the new spray guns, increased coating coverage, and the overspray reclamation system.

Emissions

After implementation of the waterborne coating system, emissions were reduced while the production of coated product was simultaneously increased. According to ABC, toluene usage for cleaning was reduced by 3,800 pounds, or 22 percent, in the first year after waterborne coatings were implemented. In the same year, total VOC emissions were reduced by 13,880 pounds, or 26 percent. The following year, toluene usage was reduced by 90 percent and VOC emissions fell an additional 94 percent.

Currently, annual coating usage is 2,805 gallons each for topcoat and sealer and 2,325 gallons for stains. Facility personnel stated that total VOC emissions currently are under 2.5 tons per year, and that toluene usage for cleaning is down to 80 gallons per year, with emissions of 171 pounds per year.

ABC also noted that hazardous waste production has been nearly eliminated due to the overspray reclamation system; this is an annual reduction of almost 2,000 gallons. Because the waterborne coatings are no-HAP coatings, all HAP emissions from the finishing process also have been eliminated.