Case Study No. 12 Waterborne and UV-Cured Coatings
Hussey Seating Company
North Berwick, ME

Background

Hussey Seating Company (Hussey) is a major manufacturer of roll-out bleachers, stadium, and theater seating. Hussey's North Berwick facility is located in southern Maine, close to the border with New Hampshire. The plant employs approximately 600 people, making it a major employer in southern Maine. All wood components are finished at the North Berwick facility. The bleacher seating is constructed of wood and plastic. The stadium and theater seating has wood arm rests, wood seats, and/or wood backs. North Berwick also fabricates and finishes metal frame retractable bleachers. All seating, regardless of substrate, is assembled at the North Berwick facility.

In an effort to improve the work environment at the plant, and to prevent becoming subject to the Wood Furniture NESHAP, Hussey decided to make changes to dramatically reduce the air emissions from their wood finishing operations. Hussey implemented two major pollution prevention projects: switching to an automated UV-cured coating system for the bleacher seating, and switching to waterborne coatings for finishing the wood components of the stadium and theater seating. Through these pollution prevention efforts, Hussey has reduced total VOC and HAP emissions to levels at which they are no longer considered a major source of VOCs or HAPs. Hussey is not subject to the Wood Furniture NESHAP.

Manufacturing and Coating Operations

UV-Cured Bleacher Seating

The new UV-curable coatings are applied on an automated flat line. At the front of the line, the boards are placed on a conveyor. The first step is the application of the sealer by a roll coater machine. One coat of sealer is applied to each side of the board. The boards then are cured by exposure to UV light in a UV oven. After the UV oven, one coat of topcoat is applied to each side using a vacuum coater. The topcoat also is cured by exposure to UV light. The entire UV process occurs within a protective enclosure.

Waterborne Coatings for Stadium and Theater Seating

Hussey uses a three-coat finishing process on the wood stadium and theater seating components: stain, sealer, and topcoat. All three coatings are waterborne. The coatings all are sprayed manually using HVLP guns.

Conversion to UV-Curable and Waterborne Coatings

Air emissions from Hussey primarily are from the wood and metal finishing processes. Hussey implemented two major pollution prevention projects: switching to an automated UV-cured coating system for the bleacher seating, and switching to waterborne coatings for finishing the wood components of the stadium and theater seating. In addition, Hussey has implemented several other pollution prevention

projects not directly related to wood finishing, including switching to waterborne adhesives for seating upholstery, switching to high-solids and powder coatings for metal finishing, and implementing various employee involvement programs. All of these pollution prevention projects are discussed in the following sections.

UV-Cured Coatings for Bleacher Seating

Bleacher seating consists mainly of flat, long, relatively narrow boards. In the past, these boards were finished with two coats of polyurethane varnish brushed on each side by hand. In 1993, at the suggestion of an employee, Hussey began investigating the applicability of UV-curable coatings. After analyses and pilot studies, Hussey switched to an automated UV coating system in 1994. There are important benefits of the new system and a few challenges as described below.

To Hussey, the primary benefit has been increased productivity and improved on-time delivery to customers. In the past, boards that were finished had to be placed on racks to dry. These drying boards required a significant amount of space, approximately 800 square feet. In order to expand production to meet increased demand, Hussey would have had to construct additional storage space just to accommodate the drying boards. With the UV-cured coating system, the boards exit the second UV light exposure completely cured and ready for immediate stacking. This has allowed Hussey to meet or beat delivery deadlines, an important improvement over their previous system and an important advantage over their competition.

Another major benefit is that there are very low emissions from the UV-cured coating system and the facility is not subject to the Wood Furniture NESHAP. Their VOC and HAP emissions were reduced from nearly 50 tons per year to only 219 pounds per year. This reduction occurred as production increased by over 55 percent, from 9,000 units per week to over 14,000.

The labor requirements also have been reduced. The old system required eight employees to finish 9,000 units each week. The new finishing system is automated, and only four employees are needed at the finishing operations, despite the increase in production to 14,000 units each week. Assuming that increasing production of 55 percent using the old finishing system would have required a 50 percent increase in labor, or 12 employees total, the new system represents a 67 percent reduction in labor requirements.

The UV coating line is fully automated, and all coating that does not adhere to the boards is collected and filtered for reuse, resulting in a transfer efficiency of nearly 100 percent. The cost of the UV-curable coatings is approximately 8 percent higher than the polyurethane coatings. However, because the UV-curable coatings are 100 percent solids, there has been a 23 percent reduction in the volume of material needed to coat each item. Therefore, the coating material costs per unit have decreased by approximately 17 percent.

The UV-curable coatings remain liquid until they are exposed to UV light. Therefore, as long as coating reservoirs are protected from incident light, little equipment cleanup is necessary. Coatings can be left in the system at the end of one day and used as-is the next day. This practice is a substantial improvement over the cleaning requirements of the previous finishing process. Under the old system, significant air emissions occurred because solvents were used on a daily basis to clean brushes and spills.

Finally, the last major benefit enjoyed by Hussey is that UV-cured coatings are more durable than solvent-borne coatings. This increase in durability is most noticeable under exposure to sunlight, heavy use, and/or water, attributes particularly important for outdoor seating. This improvement should enhance long-term customer satisfaction.

There also are several disadvantages to using UV-curable coatings. There are some potential adverse human health effects associated with the use of UV-curable coatings. Exposure to the UV lights can cause damage similar to exposure to the sun. To protect workers, the process is fully enclosed and cannot be inadvertently opened while the UV lamps are activated. The UV-curable coatings also can contain hazardous compounds and unreacted UV-curable coatings are associated with potentially severe skin irritation. Once cured, the coatings are nonhazardous, and there is no skin irritation. Empty coating containers and rags containing coating are sent through the system so they are exposed to the UV light and the coating residue cures. The resulting materials are considered a solid waste. There has been no increase in solid waste generation associated with the new UV system.

Worker training is essential to prevent direct exposure to the uncured coatings and the UV light. Therefore, Hussey had to initiate a new worker safety training program. In addition, the new automated system is much different from the previous manual application system, requiring extensive retraining of the finishing room employees.

Waterborne Coatings for Chair Arms and Backs

Hussey replaced the nitrocellulose solvent-based coatings used on wood chair arms and backs with waterborne polyester coatings. Hussey uses a three-coat finishing process on the wood components: stain, sealer, and topcoat. All three coatings were reformulated as waterborne. Hussey used HVLP guns for the nitrocellulose coating application, and they did not require any new equipment to switch to the waterborne coatings. There was no change in the number of operators required to apply the new coatings.

The main benefit associated with the switch to waterborne coatings is that the VOC emissions now are less than 2 pounds per gallon, in contrast to the 6 pounds per gallon with the nitrocellulose coatings. This represents an emissions reduction of over 65 percent. Another benefit is that the waterborne coatings do not require solvents for clean-up. Therefore, Hussey has reduced hazardous waste generation from wood component finishing from 165 gallons per year to zero.

In addition, the work environment for the spray gun operators has improved substantially, and they have not had problems adjusting to the new coatings. The quantity of coating used is the same with the waterborne coatings as it was with the nitrocellulose coatings.

The waterborne coatings cost approximately 10 percent more than the nitrocellulose coatings on a per gallon basis, but Hussey believes that the worker health and safety and environmental benefits are worth this extra cost. The only other additional start-up costs were to conduct performance tests to evaluate and select the waterborne coatings and to retrain the operators to adjust to the characteristics of the new coatings.

Other Pollution Prevention and Recycling Efforts

Waterborne Adhesives

Hussey uses adhesives to attach fabric to chair seats and backs during the upholstery operation. Hussey also makes all of the wooden seats and backs at the North Berwick facility in a process that includes gluing several thin pieces of wood together. These processes contributed to Hussey's VOC and HAP emissions as well as potential air quality problems within the plant. In 1995, Hussey switched all of the adhesives used at the plant to waterborne glues similar to Elmer's™ glue. There are no air emission or safety concerns associated with the new adhesives. In addition, the glue manufacturer takes back all of the waste glue and clean-up rinse water to use in their production process. Therefore, Hussey no longer has any glue or rinse wastewater disposal issues or costs.

High-Solids and Powder Coatings for Metal Finishing

Hussey was able to reduce VOC and HAP emissions from their metal coating operations by 50 percent by implementing two changes. To coat metal components that will remain in an indoor environment, Hussey has installed an electrostatic liquid paint distribution system and switched to higher-solids paints. For metal components that will be installed outdoors, Hussey replaced a two-coat nitrocellulose coating system with a one-coat powder coating system. In addition to reducing emissions, the new system has reduced color change times and coating waste as well as improved product quality.

Employee Involvement Programs

Hussey is progressive in efforts to involve their employees in environmental initiatives. In November of 1994, Hussey employees began an effort to reduce, reuse, and recycle the facility's various waste streams. Voluntary employee committees for waste and for safety were established. These committees provided a forum for all employees to voice their concerns and present their ideas for improvements. The company's weekly newsletter often highlights waste committee initiatives. In addition, Hussey has structured their employee incentive pay programs to reward involvement in the waste reduction and productivity improvement efforts, such as presenting ideas to reduce waste and air emissions and cooperating with waste reduction initiatives.

As a result of the waste committee initiative, scrap metal sales have doubled, increasing income by over $50,000 in 1995. Recycling of office paper also has doubled in response to waste committee efforts. In the past, corrugated cardboard was discarded as trash. Now, over 60 tons of corrugated cardboard is recycled each year. Although the market and price for corrugated cardboard scrap fluctuates, Hussey still realizes savings by avoiding solid waste disposal fees. Hussey also generates a significant quantity of waste fabric that is now recycled. Previously, Hussey had to pay to dispose of this waste. Finally, Hussey makes its scrap wood available to a local hobbyist and to its employees for their personal use, eliminating the need for scrap wood management.

Costs

The following table shows the cost information for Hussey's conversion to UV-cured sealers and topcoats.

Item	Savings or (Cost)
Labor	$280,000 per year
Materials	$55,000 per year
Capital costs	($320,000)
Avoided construction cost	$200,000
Payback period	4½ months

Labor

Elimination of the need for eight finishing room workers (taking into account the increased production) results in an estimated annual savings of approximately $280,000.

Material

At current production levels (14,000 units per week), the savings in coating material is approximately $55,000 per year. Hussey has not determined the effect on electricity costs due to operation of the UV coating system. However, due to decreased ventilation and health requirements, Hussey believes the increase may not be substantial.

Capital Costs

The initial capital cost of the automated UV-curable coating application system was $190,000. Hussey estimates the labor cost to investigate and install the new system, and retrain workers was approximately $100,000. Other capital costs included $30,000 for an air handling system. Hussey was able to avoid the cost of constructing the additional storage space that would have been needed if the old finishing process had been continued. Hussey estimates the storage space construction would have required a $200,000 investment.

Emissions

In 1993, Hussey's total VOC emissions from the wood finishing operations were approximately 50 tons per year. Total HAP emissions from the wood finishing operations were approximately 10 tons per year. By 1995, combined VOC and HAP emissions were less than 1 ton per year, reductions of 98 and 90 percent, respectively. Hussey is a growing company and was able to achieve these emission reductions while expanding production by 55 percent.

Acknowledgment

This case study was based on a study prepared by the Northeast Waste Management Officials Association (NEWMOA) and the Northeast States for Coordinated Air Use Management (NESCAUM) under an Environmental Technology Initiative (ETI) grant from the U. S. Environmental Protection Agency. The purpose of this ETI project was to promote pollution prevention approaches to comply with the hazardous air pollution control requirements of the 1990 Clean Air Act Amendments. NESCAUM and NEWMOA are nonprofit, nonpartisan interstate associations established to address regional pollution issues: NEWMOA focuses on waste and pollution prevention, and NESCAUM on air pollution. For more information about NEWMOA, NESCAUM, the ETI project, or other pollution prevention opportunities for the wood furniture industry, please contact Jennifer Griffith at NEWMOA at (617) 367-8558, ext. 303.