NEWMOA
Northeast Waste Management Officials' Association

NESCAUM
Northeast States for Coordinated Air Use Management

Pollution Prevention Case Study

Wood Furniture Finishing

Ultraviolet Radiation Cured Coatings and Aqueous-Based Coatings

Hussey Seating Company of North Berwick, Maine

In an effort to improve the work environment at the plant, and to prepare for the impending Clean Air Act standards for wood furniture, Hussey Seating Company (Hussey) decided to make changes to dramatically reduce the air emissions from their wood finishing operation. Through their pollution prevention (P2) efforts, Hussey has reduced total volatile organic compound (VOC) and hazardous air pollutant (HAP) emissions from their facility to where they are no longer considered a major source of VOCs or HAPs. Therefore, Hussey is no longer subject to the requirements of the wood furniture National Emission Standards for Hazardous Air Pollutants (NESHAP) or the VOC control technique guidance (CTG). This case study describes the main P2 projects Hussey has implemented and the benefits and challenges associated with their efforts.

Background

Hussey is located in southern Maine, close to the border with New Hampshire. The plant employs approximately 400 persons, making it a major employer in southern Maine. Hussey is the world leader in the manufacture of bleacher seating - the seating in many high school and college gymnasiums. They also manufacture stadium and theater seating. Hussey's bleacher seating is constructed primarily of wood that is finished at the North Berwick facility. Retractable bleachers are constructed on metal frames that are fabricated and finished in North Berwick as well. Stadium and theater seating is constructed from wood, plastic, or a combination of the two. Plastic components are molded at a separate facility located in Massachusetts. Upholstered seats and backs are made on wood frames; however since the wood is covered with fabric, it is not finished. Some seating has wood arm rests, wood seats, and/or wood backs. These wood components are finished at the North Berwick facility. All seating is assembled at the North Berwick facility and all metal parts are fabricated and finished there as well.

Air emissions from Hussey are mainly from the wood and metal finishing processes. This case study concentrates on Hussey's efforts to reduce emissions from their wood finishing operations. In 1993, Hussey's total VOC and HAP emissions from the wood finishing operations were approximately 50 and 10 tons per year, respectively. By 1995 total VOC and HAP emissions were less than one ton per year, reductions of 98 and 90 percent, respectively. Hussey is a growing company and was able to reduce emissions while expanding production.

To produce these significant emission reductions, while expanding production, Hussey implemented two major P2 projects: switching to an automated UV cured coating system for the bleacher seating, and switching to aqueous-based coatings for finishing the wood components of the stadium and theater seating. In addition, Hussey has implemented several other P2 projects not directly related to wood finishing, including switching to aqueous-based adhesives for seating upholstery, switching to high solids and powder coatings for metal finishing, and implementing various employee involvement programs. All of these P2 projects are discussed in the following sections.

Primary P2 Effort: UV Coatings for Bleacher Seating

Bleacher Seating consists mainly of flat, long, relatively narrow boards. In the past these were finished with two coats of polyurethane varnish on each side that was brushed on by hand. In 1993, at the suggestion of an employee, Hussey began investigating the applicability of UV cured coatings. After analysis and pilot studies, Hussey Seating switched to an automated UV coating system in 1994. Hussey purchased their UV equipment from Blackburn Associates of Elizabeth, New Jersey. Their UV coating supplier is Valspar of Dover, Delaware. With the new automated system the boards are placed on a conveyor, and rollers apply one coat of sealer to each side that is immediately cured by exposure to UV light. This is followed by the application of one topcoat to each side using a vacuum coater. This coat is also immediately cured by exposure to UV light. The two coating and UV light exposure steps all occur within a protective enclosure. There are important benefits of the new system and a few challenges as described below.

Benefits

- To Hussey Seating 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 needed to construct additional storage space just to accommodate the drying boards. With the UV cured 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 now no regulated emissions from the UV coating system. 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 old system required 8 employees to finish 9,000 units each week. The new finishing system is automated, and only 4 employees are needed at the finishing operation, despite the increase in production to 14,000 units each week. Assuming that increasing production by 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 system is fully automated, and all coating that does not adhere to the boards is collected and filtered for reuse, creating a transfer efficiency of nearly 100 percent. In addition, UV coatings are essentially 100 percent solids. Therefore, despite a 55 percent increase in production, coating usage has only increased by 20 percent. The cost of the UV coatings is approximately 8 percent higher than the polyurethane coatings.

However, because the UV coatings are 100 percent solids, the facility operates with a 23 percent reduction in the volume of material needed to coat each item. Therefore, the coating material costs on a per unit basis have decreased by approximately 17 percent.

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

- Finally, UV cured coatings are more durable than polyurethane coatings when exposed to sunlight, heavy use, and/or water; attributes particularly important for outdoor seating. This improvement should enhance long-term customer satisfaction.

Challenges

- There are some potential adverse human health effects associated with the use of UV-cured coatings. Exposure to the UV lights can cause damage similar to exposure to the sun, such as skin darkening, dryness and/or burning, and potentially severe eye damage. To protect workers, the process is fully enclosed and cannot be inadvertently opened while the lights are activated. UV coatings contain hazardous compounds, and unreacted UV coatings are associated with potentially severe skin irritation. Once cured, the coatings are non-hazardous, and there is no skin irritation. The health effects studies on the carcinogencity of uncured UV coatings have not been conclusive. Empty UV 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. Nitrocellulose solvent-based coatings have potential adverse human health effects. On balance, the relative employee health risks from using nitrocellulose solvent-based coatings compared with the risks from using a UV coating system have not been determined.

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

Savings/Costs

	Savings or (Cost)
Labor	$280,000 per year
Materials	$55,000 per year
Capital Costs	($320,000)
Avoided Construction Cost	$200,000
Payback Period	4 ½ 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 heating requirments, Hussey believes the increase may not be substanital.

- Capital costs: The initial capital cost of the automated UV cured 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 were $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 was continued. Hussey estimates the storage space construction would have required a $200,000 investment.

- Payback period: 4 ½ months[1]

Secondary P2 Effort: Aqueous-based Coatings for Chair Arms and Backs

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

The main benefit associated with the switch to aqueous-based coatings is that VOC emissions are now less than two pounds per gallon, in contrast to the six pounds per gallon with the nitrocellulose coatings. This represents an emissions reduction of over 65 percent. Another benefit is that aqueous-based coatings do not require solvents for cleanup. Therefore, Hussey has reduced hazardous waste generation from the wood component finishing operation from 165 gallons per year to zero. In addition, the work environment for the spray gun operators has substantially improved, and they have not had problems adjusting to the new coatings. The aqueous-based coatings cost approximately 10 percent more than the nitrocellulose coatings on a per-gallon basis, but Hussey believes the worker health and safety and environmental benefits are worth this extra cost. The quantity of coatings used is the same with the aqueous-based coatings as it was with the nitrocellulose coatings. The only other additional start-up costs were to conduct performance tests to evaluate and choose the aqueous-based coatings and to retrain the operators to adjust to the characteristics of the new coatings.

Other P2 Efforts

Aqueous-based adhesives: Hussey uses adhesives to aid in attaching 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.

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[1] If production levels had not increased (labor savings of only four workers ($140,000), annual coating material savings of $36,786, and no avoided $200,000 construction cost), the UV coating system would still be economically viable, with a payback period of 22 months.

Traditionally, all of the adhesives used at the facility were solvent-based. These 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 polyvinyl alcohol-based glues, similar to the Elmer's glue used by children. There are no air emission or safety concerns associated with the new adhesives. In addition, the glue manufacturer takes back all the waste glue and cleanup 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 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 ensuring compliance with air emission regulations, the new system has reduced color change times and improved product quality.

Employee involvement programs: Hussey Seating is progressive in its 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 have 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 program to reward involvement in waste reduction and productivity improvement efforts, such as for presenting ideas to reduce waste and air emissions, and cooperating with waste reduction initiatives.

As a result of a waste committee initiative, scrap metal sales have doubled, increasing income by over $50,000 in 1995. Recycling of office paper has also doubled in response to waste committee efforts. Historically, 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 is volatile, Hussey still realizes savings by avoiding solid waste disposal fees. Hussey also generates a significant quantity of waste fabric that is now recycled. This was previously a waste that Hussey had to pay to dispose of. Finally, Hussey makes its scrap wood available to a local hobbyist and its employees for their personal use, eliminating the need for scrap wood management.

Summary

Through investing in pollution prevention, Hussey Seating reduced VOC and HAP emissions by over 90 percent, improved the work environment for its employees, and improved the efficiency of its production process; all while saving money. Under Hussey Seating's particular circumstances, the highly capital intensive UV coating system was extremely economically beneficial, paying for itself within less than five months of operation. Even if Hussey did not have increased production needs, the UV coating system would have paid for itself within two years.

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