



Project Summary

Powder Coat Applications

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Abstract

Powder coating is an organic finishing technology that offers users the potential to reduce volatile organic compound (VOC) emissions to zero. Due to ever-increasing VOC emission restrictions placed on manufacturers, powder coating production and use has been growing dramatically over the past few years. Powder coating has been accepted by such manufacturing communities as automotive, appliance, furniture, and equipment. However, small business manufacturers have difficulty investigating new technologies due to size and budget restrictions. Through the Environmental Protection Agency's (EPA) Environmental Technology Initiative, the National Defense Center for Environmental Excellence (NDCEE), operated by Concurrent Technologies Corporation (CTC), has worked with a small business representative to demonstrate the applicability of powder coating for small business. During the project, critical factors that affect the environment, cost, quality, and production were investigated. The investigation demonstrated that powder has the potential to provide unique and valuable benefits when considering each of these areas.

This Project Summary was developed by the National Risk Management Research Laboratory's Air Pollution Prevention and Control Division, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

New environmental regulations are placing tighter and tighter restrictions on how manufacturers can coat parts. A nominal

reduction in VOCs can be achieved by such equipment technologies as higher-efficiency spray equipment like High-Vol-ume, Low-Pressure (HVLP) and electrostatic equipment. In addition, a process material change can reduce VOC emissions by eliminating them from formulations. Coatings manufacturers offer a range of low-VOC technologies to lower emissions such as high-solids paint, water-borne, and powder coating materials.

Powder coating, invented in the early 1950s, is an environmental technology with zero-VOC emissions. Although powder coatings have been in existence for over 40 years, they have not gained widespread acceptance until recently with the introduction of strict VOC emission regulations. Powder coating manufacturers have continually refined their formulations and offer coatings that match or exceed performance characteristics of previously used liquid spray coatings.

Although powder coating has been adopted by such large industries as automotive, appliance, and furniture manufacturing, small businesses often do not have the resources to investigate new technologies. In order to successfully transition a new technology, a company must be able to investigate all aspects of the new process that affect:

- cost,
- environmental impact,
- part quality, and
- production.

Once these areas are evaluated, an informed decision can be made regarding the implementation of new technology.

The EPA, through its Environmental Technology Initiative, has funded the NDCEE to work with small businesses to demonstrate powder coating and identify opportunities for its use by these busi-

nesses. Ideally, the project would result in powder coating's being implemented by a small business manufacturer.

The project focused on commercially available powder coating materials that could potentially be implemented into small business manufacturing. These powder coatings have been developed for and used by larger manufacturers and the Department of Defense (DOD), but also have similar performance characteristics to those required by smaller businesses.

Procedure

Collaboration with the EPA, the DOD, the Small Business Association (SBA), and the Powder Coatings Institute (PCI) identified candidate small businesses for direct participation in the Powder Coating Applications project. The basic requirement was that small business candidates had to be using solvent-based liquid finishing technologies as a major component of their manufacturing process with an interest in transitioning to powder coating technology. One such small business representative, The Bilco Company, uses a solvent-based primer to coat its products.

To establish a baseline for the process economics, technical requirements and environmental aspects for The Bilco Company's current parts finishing operation, an on-site facility survey was conducted. This was followed by a detailed questionnaire which was used by Bilco representatives to assess current operations, and follow-up telephone conversations with Bilco personnel. This information was used to prepare the final life-cycle cost, environmental, and technical performance comparative analyses of the present finishing process to the powder coating alternative process.

Prior to full-scale powder coating technology demonstrations and formal economic and product performance data collection, it was necessary to perform initial feasibility testing to determine if powder coating technology was appropriate for the parts manufactured by The Bilco Company. The primary objective was to demonstrate that powder-based coatings show promise in terms of coating performance data for meeting Bilco's existing primer requirements.

To accomplish the feasibility assessment, various Bilco parts and sample coupons were pretreated and powder coated. Initial powder coating conditions were established through best engineering judgments, lessons learned from short duration pretreatment/powder coating runs, and

performance requirements/information obtained from The Bilco Company and the suppliers of the pretreatment chemicals and powder coatings.

Following pretreatment and powder coating, various laboratory coatings tests were performed on the powder-coated Bilco parts and sample coupons to determine the degree of compliance to Bilco's current coating performance specifications. Parallel laboratory tests were also performed on sample coupons coated at The Bilco Company using their current liquid coating process to establish the actual product quality of this coating system. This comparison indicated that a substantial increase in performance could be gained by using powder coating.

Following the successful feasibility demonstration of powder coating applied to Bilco parts, an optimization trial was performed. The optimization phase was intended to:

- focus on those aspects of the powder coating process that demonstrated a need for further refinement based on process engineering lessons learned and/or laboratory testing results from the feasibility trial,
- demonstrate that Bilco's coating requirements could be maintained after optimization process changes were made, and
- serve as a technical preparation phase for the final technology validation demonstration trials.

To accomplish the optimization testing phase of the project, powder coating runs were performed on Bilco parts and sample coupons. Following the coating of these specimens, a series of laboratory coatings tests were performed.

Following completion of the optimization testing, a final powder coating validation demonstration was conducted. The goals of the validation testing were to:

- use the process parameters and lessons learned from prior trials, and prove-out the ability of powder coating technology to successfully coat Bilco parts under simulated production conditions,
- to make any final process engineering observations which would translate into powder coating process transition recommendations, and
- to collect "on-line" technical, economic, and quality data for the powder coating of Bilco parts.

The validation demonstration was achieved by performing a simulated pow-

der coating work day specific to the powder coating of Bilco parts. Laboratory product performance testing was used to verify continued compliance to Bilco's coating specifications.

Results and Discussion

Environmental analysis of the alternative powder coating, demonstrated the potential to eliminate VOC emissions. Currently, approximately 39 tons (35 metric tons) per year of VOCs are produced by the current system. These VOCs are sent to a catalytic incinerator destruction system that is nearing the end of its useful life and will need to be replaced in order to meet regulations if the current coating system is kept. This VOC destruction system reduces the amount of VOCs emitted into the atmosphere to 2.5 tons (2.3 metric tons) per year.

During quality analysis, powder coating demonstrated the potential to dramatically improve upon performance of the current coating system. Performance characteristics such as salt spray corrosion resistance, impact resistance, and hardness were improved with the use of powder coating. With increased coating performance, Bilco could investigate the possibility of offering an extended warranty on its products.

Powder coating systems can be designed to meet Bilco's present and future production requirements. Automatic and manual powder equipment presently exists that can be configured to meet Bilco's present 235 door/day production level.

Using the National Institute of Standards and Technology (NIST) Building Life Cycle Cost program with a study period of 15 years, it was calculated that, through powder coating, Bilco can save over \$142,000 each year in operating costs when compared to using the current coating system with increased VOC controls. In addition, a Life Cycle Cost savings of over \$280,000 can be obtained with powder.

Bilco's current finishing system, flow coating, is a high-transfer efficiency coating process resulting in a low cost per part. As a result, it is estimated that an investment in powder coating equipment will not realize payback until year 7 after investment. This payback period is much longer than observed when powder systems have replaced liquid spray coating technologies in industry. However, benefits such as increased part quality and reduced use of hazardous materials are difficult to quantify. Powder coating, while offering a payback period of 7 years, has the potential to increase product quality and provide a cleaner, healthier workplace.

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The complete report, entitled "Powder Coat Applications," (Order No. PB98-108624; Cost: \$21.50, subject to change) will be available only from:

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