A Cooperative Project between the U.S. Environmental Protection Agency and the Printing Trade Associations Nationwide

design FOR THE ENVIRONMENT

September 1996

EPA744-F-96-012

SCREEN PRINTING PROJECT CASE STUDY 3

Innovations in Adhesives, Screen Cleaning, and Screen Reclamation

SCREEN PRINTING

This case study describes how T.S. Designs, a textile screen printer in Burlington, North Carolina, used initiative and creativity to prevent pollution at its facility. In doing so, the company minimized risk to workers and the environment, greatly reduced its solvent use, and increased its cost efficiency.

This case study shows how:

- **Water-based adhesives can effectively replace solvent-based adhesives in the textile printing process.**
- **Solvent use can be drastically reduced by reusing chemicals in enclosed screen cleaning and reclamation tanks.**

Background

T.S. Designs began textile screen printing in 1977 and today processes 4.5 million articles of clothing per year. The company employs 55 people, about a third of whom are directly involved in production. T.S. Designs mainly uses plastisol inks, which are polyvinyl chloride-based, although it does occasionally use water-based inks when requested by customers. Currently, T.S. Designs produces mostly T-shirts, but also prints sweatshirts, piece goods, and hosiery products. The materials include both synthetic and natural fibers. The firm's primary market is contract screen printing for large sportswear companies. The company also prints for local schools, restaurants, clubs, and other organizations.

Automated Adhesive Application Process

T.S. Designs began reducing its solvent use in 1991 as a quality control issue, not for environmental reasons. At that time, the company used a solvent-based spray adhesive to hold T-shirts in place on a platen while the image was applied. The adhesive came in 12- and 16-ounce aerosol cans, and workers manually sprayed it onto the platen. The process was imprecise, and if a worker sprayed too much or too little adhesive, the printed image would often be defective.

The company wanted to lower the number of products rejected due to incorrect adhesive application. It contacted several chemical companies to discuss automating the adhesive application process. Several partially automated systems did exist, but given the large quantity of textiles the company prints and its quality control requirements, the firm decided to design and build a totally new, fully automated system. The new system would be tied electronically to the printing machine, and could precisely control when and how much adhesive is applied.

Water-Based Adhesives

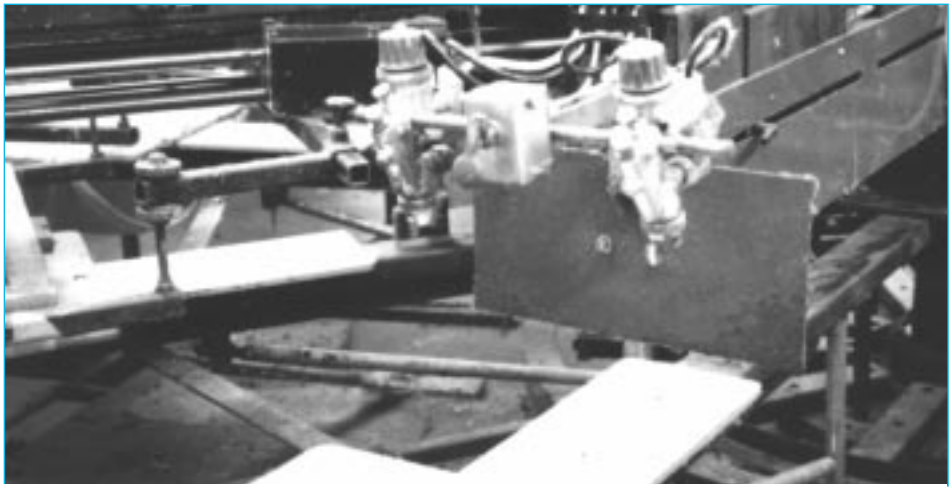
As T.S. Designs began researching the application options, the company also considered the cost, waste, health, and safety issues related to the adhesive itself. It found many disadvantages to continuing to use the solvent-based adhesive. Because it was flammable, and countless adhesive-filled aerosol cans were used throughout the plant, the company faced the risk of a can accidentally being dropped onto a conveyor belt and being carried into a dryer, causing a small explosion or fire. The company also determined that if it switched to an automated system that used air pressure to apply the solvent-based adhesive, there could be performance problems. Moreover, the solvent-based adhesive had possible adverse health effects—it contained 1,1,1-trichloroethane, which can cause dizziness or light-headedness or more serious effects from longer exposures.

Replacing the solvent-based adhesive with a water-based adhesive—a type commonly used before the invention of solvent-based adhesives—was considered. The company realized, however, that by today's standards, the thicker water-based adhesive would take too long to dry and would clog the spray nozzles of an automated system. Thus, the company began looking for a thinner water-based adhesive that would be more compatible with modern automation.

T.S Designs used all the resources available to determine the right combination of adhesive and automation for its application process. It brought together teams of employees and also spoke to representatives from other industries, such as the automobile industry, who had experience with similar spray systems. In addition, the company worked with the Screenprinting and Graphic Imaging Association International (SGIA) and participated in an EPA study that tested several water-based adhesives.

The New Adhesive Application Process

Ultimately, through testing, T.S. Designs found that a very fine spray of a water-based adhesive would dry quickly and not clog its system of nozzles. Automated systems using this adhesive were then installed on six of the company's seven presses. The adhesive is stored in one place in 55-gallon drums and pumped to the presses where the amount of adhesive applied to the T-shirts is controlled by computer. The system has reduced T.S. Designs' use of solvent-based adhesive by 91 percent, from 4,800 to 430 aerosol cans a year. This, in turn, has greatly decreased the release of potentially health-threatening chemicals into the environment.



T.S. Designs' automatic glue sprayer effectively reduces costs.

Not long after implementing this change, T.S. Designs encountered an obstacle. Over time, the thinner adhesive coated and eventually clogged the nozzles. A contact in the automobile industry recommended more advanced nozzles. Though they were more expensive, the cost was offset by better performance. The more advanced nozzles allowed the machines to operate longer and more smoothly.

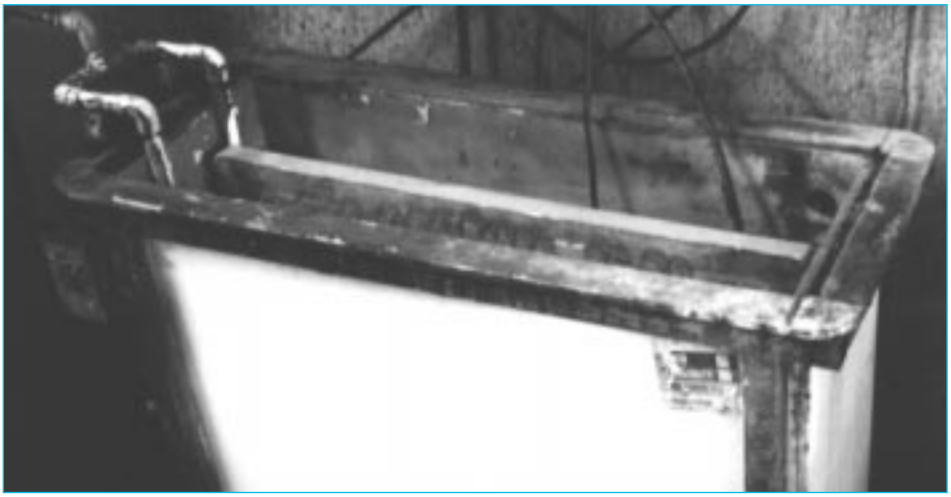
The new automated adhesive process required total equipment purchases of about $12,000 ($2,000 per press), but the water-based adhesive is considerably less expensive than the solvent-based one. The new system paid for itself through reduced adhesive costs in about 2 years, and now saves T.S. Designs roughly $6,000 a year. Quality also has been greatly improved by the much higher level of control afforded by the automated process.

Automated Ink Removal and Enclosed Emulsion Removal Systems

T.S. Designs also found that its ink removal and emulsion removal processes had room for improvement in efficiency, health, and environmental considerations.

In 1992, the company used traditional ink removal and emulsion removal processes that required the use of several hazardous chemicals. The first part of the ink removal process, carding out the screens, required workers to remove excess ink with cardboard cards. Next, workers applied a diluted ink remover detergent to the screens. The detergent contained glycol ethers (less than 30 percent), petroleum distillate (less than 5 percent), and d-limonene (less than 20 percent). For the emulsion removal process, workers applied an emulsion remover consisting partially of peracetic acid (25 to 30 percent). Occasionally, if a stain still remained on the screens, workers used a haze remover containing alkylphenoxypolyethoxyethanol (less than 18 percent). To complete the process, they used a degreaser with a small amount of propylene glycol ether (3 percent). After each step in the ink removal and emulsion removal processes, the chemicals were washed through the screens with a very low-pressure water stream. The resulting mixture was then washed down the drain in compliance with local, state, and federal regulations.

Even though the old system was in compliance, T.S. Designs knew that the fewer chemicals it sent down the drain, the lower their impact on the environment. The company also stood less chance of avoiding future compliance problems if regulations became more stringent. In addition, the old system used large amounts of water and was very labor intensive.



T.S. Designs' enclosed reclaim tank has cut the company's use of water in half.

Automated Ink Removal System

The firm sought out ways to improve its ink removal and emulsion removal processes at every level. Beginning with the carding out phase, it eliminated the thousands of cardboard cards and replaced them with reusable cards made from scrap Formica. Next, the company improved the application of its ink removal chemical. It identified and installed an automated closed loop system that did not need water and did not send ink down the drain. This system simply requires workers to put the screen inside an enclosed tank, and the equipment does the rest, much like an industrial dishwasher.

This new enclosed system allows chemicals to be applied in a much more controlled environment. They can be recycled many times and waste is greatly reduced.

This reuse process keeps approximately 1,000 gallons of solvent a year out of the wastewater system. The new system cost nearly $13,000 to install, but saves T.S. Designs over $20,000 in reduced labor and purchasing costs annually.

Enclosed Emulsion Removal System

The emulsion removal process presented many of the same concerns as the ink removal process. Too many hazardous chemicals were being washed down the drain, and workers were spending too much time applying the chemicals, waiting for them to loosen the emulsion, and washing off the screens. T.S. Designs started experimenting with its emulsion remover chemical. It found that much smaller amounts of the chemical, if left on the screen longer, were just as effective as the amount the company had been using. Although the chemical looked dirty after use, it could be reused many times and still successfully reclaim the screens.

T.S. Designs used this new information to design and build its own enclosed system. Similar to the ink removal system, workers place the screen in a tank where it is soaked in emulsion remover. This chemical softens the emulsion. Workers then remove the screen from the tank and wash out any remaining emulsion with gray water recycled from the degreasing process (described below) at a pressure of 200 pounds per square inch. Previously, T.S. Designs used roughly 90 gallons of emulsion remover a month, but now about 25 gallons are recirculated through the system each month. This recirculation reduces the amount of emulsion remover purchased and disposed of by about 780 gallons a year, saving over $900 in purchasing costs annually. These purchasing savings allowed the firm to recoup its labor and equipment costs for designing and implementing the new emulsion removal system in just over a year. In addition, the effectiveness of the ink removal and emulsion removal systems has allowed the firm to virtually

eliminate the haze remover step.

The final step in reclaiming a screen is the degreasing process, in which the screen is given a final rinse with fresh water. This process also takes place in an enclosed tank. The used water is stored and then pumped back to be used in the emulsion removal tank. This recycling step has cut the company's use of water in half, saving 630 gallons a week.

Taken together, new systems have substantially reduced the company's impact on the environment, decreasing the company's chemical use by 86 percent, and cutting water and energy consumption as well. By making the effort, the company discovered alternatives that are not only cost-effective, but that also reduce risks to workers and the environment.

For More Information

For more information on the technologies discussed in this case study, contact your equipment suppliers. For more detailed information on other technological and chemical alternatives, refer to the summary booklet *Designing Solutions for Screen Printers: An Evaluation of Screen Reclamation Systems*. Additional case studies and bulletins are also available. For more information on EPA's Design for the Environment Program or to obtain the case studies, bulletins, and other related materials, contact:

Pollution Prevention Information Clearinghouse (PPIC)
U.S. EPA
401 M Street, SW. (7409)
Washington, DC 20460
Phone: 202-260-1023
Fax: 202-260-4659
World Wide Web:
http://www.epa.gov/opptintr/p2home/ppicdist.htm

For more information on this case study, contact:

Eric Henry
President
T.S. Designs, Inc.
2035 Willow Springs Lane
Burlington, NC 27215-8854
Phone: 910-229-6426
Fax: 910-226-4418
E-mail: eric@netpath.net
World Wide Web:
http://www.tsdesigns.com

For trade association information, contact:

Screenprinting and Graphic Imaging Association International (SGIA)
10015 Main Street
Fairfax, VA 22031
Phone: 703-385-1335
World Wide Web:
http://www.sgia.org

Also be sure to investigate your local health and environmental regulations. Local agencies are familiar with priority issues in your area and can help you find the best ways to prevent pollution in your community.

Mention of trade names, companies, or commercial products does not constitute endorsement or recommendation for use by either the U.S. Environmental Protection Agency or other firms, organizations, or individuals who have participated in the preparation of this publication.

What Is the Design for the Environment Screen Printing Project?

The U.S. Environmental Protection Agency's (EPA's) Design for the Environment (DfE) Screen Printing Project is a voluntary project that encourages printers to consider environmental concerns along with cost and performance when purchasing products to use in their facilities. Replacing hazardous chemicals with environmentally safer substitutes is one way to reduce the impact of printing on the environment while maintaining product quality. Many printers, however, have limited time and resources and therefore need help identifying and testing environmentally safer substitutes.

DfE fills this information gap. EPA has teamed up with screen printing industry representatives (including trade associations, printers, and suppliers) in the DfE Screen Printing Project. The project's goal is to evaluate and publicize pollution prevention opportunities in screen printing, particularly in the screen reclamation process.