

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

# design FOR THE ENVIRONMENT

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SCREEN PRINTING PROJECT CASE STUDY 2

## SCREEN PRINTING



### Changing Equipment and Reducing Solvent Use In Screen Reclamation

The Design for the Environment (DfE) Screen Printing Project is a unique, cooperative effort between the screen printing industry and the U.S. Environmental Protection Agency (EPA). The voluntary project helps screen printers improve their efforts to reduce risks to their workers and the environment in cost-effective ways.

EPA and the screen printing industry are developing a series of case studies to illustrate how screen printers can improve their environmental performance. This case study describes a successful pollution prevention program at Action Graphics, a commercial printer in Louisville, Kentucky, that took the initiative to minimize risks to workers and the environment. In doing so, the company purchased equipment that reduced solvent use and chose safer alternatives for the solvents it could not eliminate.

Specifically, this case study shows:

- How the need for ink remover can be eliminated by:
  - Reclaiming screens immediately after a print run.
  - Using a high-pressure water system.
  - Switching to more effective, safer emulsion and haze remover products.
- How the quantity of solvent used during the printing process can be greatly reduced by finding more efficient solvents and reusing rags.

### Background

Action Graphics produces point-of-purchase display products, such as shelving signs, banners, and window signs used in retail stores and fast-food restaurants. Traditional solvent-based inks are used in about 60 percent of the company's printing, and ultraviolet (UV) curable inks are used in 40 percent. Action Graphics opened for business in 1979 and currently has 30 employees, half of which are directly involved in printing processes.

Over the past five years, Action Graphics has developed a creative and comprehensive approach to pollution prevention. Although a small shop with limited resources, it has greatly reduced solvent use through many innovative changes. **The primary change was the introduction of a high-pressure water system, which eliminated the need for ink remover solvent. In addition, the company substituted safer screen reclamation chemicals, purchased a distiller, switched to a slower-evaporating solvent for screen cleaning during press runs, changed to a safer ink thinner, and developed a rag reuse policy.** These changes lowered the company's level of volatile organic compounds (VOCs) and decreased its generation of hazardous waste.

## A Change in Screen Reclamation Equipment and Chemicals

Action Graphics' owner, Joe Miller, began thinking about the unintended effects of the solvents the company used when representatives from the Occupational Safety and Health Administration (OSHA) visited the shop in 1991. While the company was not exceeding OSHA levels for contaminants in the air, the visit made Miller more aware of the possible respiratory health issues associated with solvents used in the screen reclamation process.

At that time, Action Graphics was using a traditional three-step screen reclamation process: first, workers applied an ink remover; second, they applied an emulsion remover; and third, they applied a haze remover to eliminate any remaining ink and emulsion. Each chemical product was washed off the screen with a low-pressure water sprayer at 400 to 500 pounds per square inch (psi). When needed, a degreaser also was used.

The ink remover consisted of diacetonealcohol (75 percent), methylchloroform (10 percent), and 2-butoxyethanol (15 percent). Exposure to these ingredients can cause adverse health effects.



Screen reclamation with a high-pressure water system

Methylchloroform exposure, for example, can cause dizziness, lightheadedness, and mild eye and skin irritation, and may have more serious effects with long-term exposure. The emulsion remover's ingredients included phosphoric acid, which can cause burns after prolonged exposure. The haze remover contained sodium hydroxide, which can also cause burns, and cyclohexanol, which can irritate the eyes, nose, and throat and possibly cause more serious effects at high concentrations. The degreaser did not present health concerns.

Indeed, some workers found vapors from the solvents to be overpowering at times, making breathing difficult in certain areas of the plant and causing eye irritation. In addition, operators occasionally received burns when they used some of the cleaning chemicals improperly.

To reduce these health risks, Action Graphics completely overhauled its screen reclamation process at the end of 1991. The key component of the new process was a high-pressure water system that met Miller's need to improve worker health and the environment by reducing solvent use. The system also promised to pay for itself in a reasonable amount of time. Miller also considered but ruled out enclosed booths in which solvents are reused. These were economically infeasible for the relatively low volume of screens reclaimed at Action Graphics.

**With the new high-pressure water system, workers transfer screens to the reclamation area immediately after a press run. Speed is essential because it prevents the ink from drying on the screens. Operators apply the emulsion remover with a brush, then rinse the screens by shooting water**

through them at a pressure of 3,000 psi. The combination of not allowing the ink to dry and using the high-pressure water stream allows workers to flush out both ink and emulsion without the use of ink remover. Eliminating the need for ink remover decreased the company's annual solvent use by approximately 770 gallons, reduced worker exposure to potentially harmful chemicals, and saved over \$13,000 per year in purchasing costs.



Action Graphics also changed its emulsion remover to sodium metaperiodate, which, unlike the company's original emulsion remover, does not cause burns. Although the new emulsion remover is slightly more expensive, it is also more highly concentrated, so Action Graphics uses less (see chart for cost savings). Workers complete the process by applying a new, less corrosive haze remover and rinsing it out with water at 3,000 psi.

Another advantage to the new high-pressure water system is that it includes filtration equipment that reduces the amount of waste from the reclamation process discharged into the sewer system. The filtration system removes all particles 5 microns or larger and keeps the wastewater in compliance with local sewer district requirements.

**Besides the environmental and health benefits, the new equipment and chemicals actually do a better job of keeping the screens clean.** In addition, the old caustic chemicals tended to slowly eat away at the screens. The new system causes less wear and tear on the screens, so they need to be replaced less often.

One of the benefits of solvent reduction is that it almost always saves money. All told, Action Graphics' new system saves \$9,400 a year in operating costs. Since the one-time capital cost for the system was only \$13,300, it paid for itself in less than 16 months.



## Comparison of Yearly Operating Costs\*

	Old System	New System
Ink Remover	\$13,100	\$0
Emulsion Remover	\$5,000	\$2,600
Haze Remover	\$7,800	\$10,900
Filter Media	\$0	\$3,000
Total	\$25,900	\$16,500

**Yearly Operating Cost Savings: \$9,400**

\*Although Action Graphics believes labor costs also were reduced under the new system, specific data are not available.

## A Change in Solvents Used During Press Operation

About a year after Action Graphics overhauled its screen reclamation system, another one of its solvents surfaced as a problem. Like many printers, Action Graphics used a solvent during the printing process to remove dried ink left on screens overnight or during lunch breaks. The quickly evaporating solvent, called a press wash, consisted of n-butyl acetate, toluene, n-butanol, and isopropanol.

In 1989, Action Graphics purchased a distiller to reclaim its press wash solvent and consequently reduce its hazardous waste disposal and solvent costs. As a result, the company was able to reuse roughly 100 gallons of solvent over the course of a year, for a savings of about \$500 annually. Although this early change was a step in the right direction, when Action Graphics' management applied for a permit with the local Air Pollution Control Board in 1992, they realized that more had to be done. During the application process, the shop discovered that much of its VOC emissions were coming from the quickly evaporating press solvent. The board found that the level of VOCs on the application triggered ordinances that required Action Graphics to perform a best achievable control technology test to find ways to decrease its VOC emissions. These ordinances help protect both the environment and worker health, since VOCs can contribute to air pollution and exposure to VOCs can lead to adverse health effects.

Some of the changes Action Graphics explored to reduce these environmental and health effects included using thermal incineration, catalytic incineration, or carbon absorption. Thermal and catalytic incineration involve burning VOCs that are captured in a dryer. Carbon absorption removes VOCs through activated carbon, which periodically must be sent out for reactivation.

Through a cost-benefit analysis, Action Graphics found that these processes required a large capital investment. Since Action Graphics is a small shop, a large financial investment was out of the question. The company decided that chemical reformulation of its press wash was a more affordable alternative. In addition, chemical reformulation promised to stop VOCs from being generated in the first place, a true pollution prevention alternative, instead of trying to capture the VOCs after generation.

Finding a new solvent was no easy task, however. The company spoke with other screen printers, distributors of national brands that are marketed as environmentally friendly, and local chemical suppliers. Action Graphics found that formulations from local chemical suppliers were much less expensive than national brands and through trial and error found one that met its needs. Action Graphics switched to a solvent that contains aromatic solvent naphtha (60 percent), 1-methoxy-2-propanol (30 percent), and oxybispropanolmethylether (10 percent). This mixture evaporates much more slowly than the company's traditional solvent, thereby decreasing Action Graphics' total VOC emissions.

Workers did not like switching to this new solvent, however. Since it evaporates more slowly, press operators were concerned that they would have to check more carefully to see if it was completely



Screen cleaning with a slowly evaporating press wash

evaporated before continuing a press run. To address this issue, company management wrote a letter to the press operators. The letter explained that the new solvent really did not require any additional effort and that the switch was not only necessary to comply with regulations, but also helped create a healthier work environment. Employees gradually adjusted to the new procedure.

The company not only reduced its VOCs by using the new solvent, but also reduced the total quantity of solvent used, since press operators needed less of the slower-evaporating solvent to do the same job. **This switch cut solvent usage from approximately 1,200 gallons per year to 300 gallons. Although the new solvent costs a little more per gallon, the company saves about \$2,300 a year in purchasing costs because it uses so much less of the new product.**



At the same time that the Air Pollution Control Board suggested that Action Graphics reduce its VOC emissions from its press wash solvent, the board also noted that the company was close to the emissions limit for ethylene-based glycol ether compounds. If the company exceeded the limit, it would move to a higher emissions category under Title V



of the Clean Air Act and be subjected to a costly permit application process. Many of the company's inks and thinners contained these compounds. Action Graphics followed the same steps it took to locate a new press wash and found a new ink thinner that consisted of safer chemicals, 1-methoxy-2 propanol (85 percent) and oxybispropanolmethyl-ether (15 percent), which are not listed as hazardous air pollutants. Although the company saw no reduction in solvent usage, these safer chemicals cost less than the glycol ether ink thinner, saving the company approximately \$900 a year.

## Rag Reuse

Another proposed solution for reducing solvents from Action Graphics' best achievable control technology test was to purchase a centrifuge to reclaim solvent from used rags. The company found in its cost-benefit analysis, however, that for its low volume of rags, a centrifuge was not the best option. Instead, the company instituted a policy to reuse the rags as many times as possible before disposal. Now, instead of press operators always reaching for a new rag each time they clean a screen, they are asked to reuse a rag as long as they are running the same color ink. When they change inks, they also change their rags.

Eventually the heavily soiled rags are sent to an industrial laundry. Action Graphics does not reuse rags from the laundry, however, because the laundry washes rags that are used for many purposes, including rags from metal shops. These rags often retain minute metal pieces, which would destroy Action Graphics' screens. Instead, the laundry provides the rags to other companies that do not need to use them on fragile equipment.

The participation rate for rag reuse has not been as high as the company's management would like, because clean rags do a better job cleaning screens. Action Graphics hopes increased education will help employees understand the benefit of generating fewer solvent-soaked rags.

## Continued Improvements

While your print shop may use different inks or create different products than Action Graphics, you may still be able to learn from Action Graphics' decisions. When problems were identified, the company actively sought out creative solutions.

**Company management weighed all their options carefully, spoke to other printers, and when appropriate conducted cost-benefit analyses before making changes.**

Purchasing the high-pressure water system, switching press wash solvents and ink thinner, and instituting a rag reuse policy resulted in win-win situations. These changes enhanced screen reclamation performance, benefitted worker health and the environment, and saved the company money. If you are interested in these improvements, you can learn from Action Graphics' success.

Action Graphics' progress probably will not stop there, however. One of the key factors behind Action Graphics' success has been the company's continued self-evaluation and openness to new ideas. Action Graphics' management is always on the lookout for new ways to improve working conditions and minimize the company's impact on the environment. One future improvement the company is considering is switching over completely to UV curable inks, eliminating its use of solvent-based inks.

## For More Information

For more information on the technologies in this case study, contact your equipment suppliers. For more information on other technological and chemical alternatives, refer to the summary booklet *Designing Solutions for Screen Printers—An Evaluation of Screen Reclamation Systems*. For more information on EPA's DfE Program or to obtain additional 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

For more information on this case study and trade association information, contact:

Screenprinting and Graphic Imaging  
Association International (SGIA)  
10015 Main Street  
Fairfax, VA 22031  
Phone: 703-385-1335

Alternatively, you can visit the DfE home page on the World Wide Web at <http://www.epa.gov/dfe> or the SGIA home page at <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.

## What Is the Design for the Environment Screen Printing Project?

The U.S. Environmental Protection Agency's (EPA) 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.

