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

design FOR THE ENVIRONMENT

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FLEXOGRAPHY PROJECT CASE STUDY 1

Case Study Highlights

- Using Water-Based Inks
- Reducing VOC Emissions
- Eliminating Hazardous Waste

Also in This Case Study

- Facility Profile
- Eliminating Solvents in Other Areas of the Facility
- Commitment from Management

A CASE STUDY

Reducing VOCs in Flexography

This case study highlights the experience of one wide-web flexographic printer that successfully reduced volatile organic compound (VOC) emissions and hazardous waste by switching inks. While every facility is unique, it is hoped that the information provided can help even very different flexographic printers. In particular, this case study shows:

- **how a water-based ink system and water-based cleaning procedure can reduce VOC emissions, hazardous waste, operating costs, and worker health risks**
- **how the printer overcame challenges to print successfully with water-based inks**

Company Background

Highland Supply Corporation (HSC), at its Highland, Illinois facilities, manufactures decorative packaging products for the floral industry. Its product line includes printed and laminated films, foils, and paper. In 1988, HSC made it company policy to reduce or eliminate air emissions and hazardous waste generation. HSC focused on reducing one of its primary emissions, VOCs, for two reasons. First, HSC was aware that VOCs can be harmful to worker health and the environment. Second, HSC predicted that federal and state environmental regulations for VOCs would become more stringent in the future.

The company found that its solvent-based inks (50% VOCs by weight) were the primary source of its VOC emissions. To reduce these emissions, the company initially looked into installing air pollution control equipment such as solvent recovery or oxidizers. But if future regulations were to require further VOC reduction, these units could not be easily adapted. In addition, the electricity and natural gas required to run them would be expensive. HSC decided instead to reduce its VOC emissions by replacing its solvent-based ink system with a water-based system.

Facility Profile

Highland Supply Corporation

Highland, Illinois

Number of Employees:

150 to 250 (depending on the season)

Output:

125 to 150 million linear feet annually from flexographic presses

Main Product:

Decorative packaging for the floral industry

Plant Size:

50,000 square feet

Printing Presses:

Five flexographic and ten rotogravure presses

Primary Ink:

Water-based ink (100% of product sales)

Primary Substrate:

Polypropylene (85% of product sales)

Type of Printing:

Reverse and surface Line and process work

Water-Based Ink System

In 1989, HSC began using a new water-based ink on two rotogravure presses. The following year, water-based inks were tested on the flexographic presses. By 1991, HSC was using the water-based ink on all its presses. Water-based inks now account for 100% of the total ink used in the facility.

When HSC first used the water-based ink system, the company encountered a number of new challenges, including some adverse customer response to the print quality of the inks. However, HSC was dedicated to the system and conducted many hours of research and testing. The company modified presses and changed internal color standards. Some other challenges HSC encountered, and the corresponding solutions, are listed below:

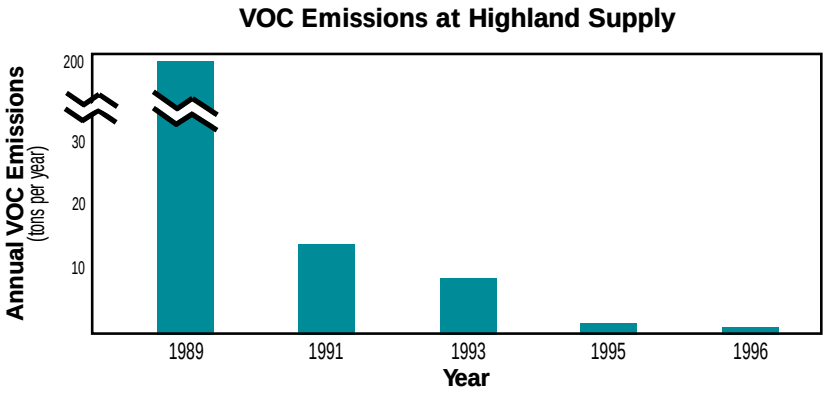
Challenges encountered with the water-based ink	HSC's solutions
1 **Drying of the ink was incomplete**	➢ **Improved drying systems by lowering temperatures and increasing air flow rates**
2 **Water fastness was insufficient**	➢ **Continuously improved ink formulations and additives**
3 **Print quality was variable**	➢ **Monitored the pH and viscosity of the inks**
4 **Ink adhesion was insufficient**	➢ **Installed a corona treater**
5 **Printing metallic inks was difficult**	➢ **Continuously improved ink formulations and additives**
6 **Printing UPC symbols was difficult**	➢ **Printed the white UPC symbol background with a water-based, high density ink**
7 **Cleaning the anilox rolls and plates was difficult because the water-based inks would not resolubilize**	➢ **Installed an ultrasonic cleaner; switched to a citrus-based cleaner; allowed more time for cleaning**

Environmental Benefits

VOC Emissions Were Dramatically Reduced

In 1989, HSC's water-based ink contained 10% to 12% VOCs by weight. By 1996, the average VOC content for water-based ink formulas was down to 0.71% VOCs by weight, according to HSC. The few VOCs remaining in the water-based inks are from dispersions and surfactants. HSC recently bought new equipment to use in creating its own VOC-free dispersions.

This reduction in the VOC content of the inks, along with the elimination of solvents in other areas of the facility, had a dramatic effect on HSC's total VOC emissions. The following graph shows the company's annual VOC emissions for 1989, 1991, 1993, 1995, and 1996, as reported to the Illinois Environmental Protection Agency.



Hazardous Waste Was Eliminated

The water-based ink system contributed to another important benefit. HSC reports that it completely eliminated hazardous waste from waste ink and cleaning operations in 1994, 1995, and 1996. HSC generates a small amount of nonhazardous solid waste from disposable cleaning wipes.

Recycling Waste Ink

HSC also reduced the amount of total waste generated by recycling its water-based ink. When the company first used water-based inks, the waste ink was solidified and sent to a landfill under a nonhazardous waste permit. Recycling of the water-based inks began in 1992. By 1995, HSC recycled 99% of its waste water-based inks. Press return ink is stored in a separate container labeled with the formula ID number until it can be blended back into virgin ink of the same color. New colors can also be made, and hard-to-match waste ink can be made into dark green and black inks. HSC also added a computer with a colorimeter and scanner to facilitate better blending of the recycled inks.

Economic Benefits

Reduced Ink Costs

HSC's new water-based inks cost less per unit area printed. This is because HSC's water-based inks have a higher ink mileage than the previously-used solvent-based inks.

Hazardous Waste Disposal Costs Eliminated

Since hazardous waste is no longer generated, HSC spends very little on disposal costs. Solid nonhazardous waste disposal costs totaled less than $1,000 in 1996.

Labor Hours Saved

When HSC switched to water-based inks, some permitting requirements were eliminated. HSC avoided the labor costs needed to meet these requirements. If HSC was still using solvent-based inks today, more than 100 tons of VOCs would be emitted each year, making HSC a "major source" under Title V of the 1990 Clean Air Act Amendments. Since HSC is not a "major source," it has avoided spending significant labor hours to prepare and file initial permit applications, and will save additional labor hours every year in years to come.

In addition, HSC reduced flammable liquid usage below Occupational Safety and HealthAdministration (OSHA) reporting thresholds (Process Safety Management, OSHA 1910:119). Being exempt from this regulation saves HSC significant labor hours in the first year and additional labor hours in subsequent years.

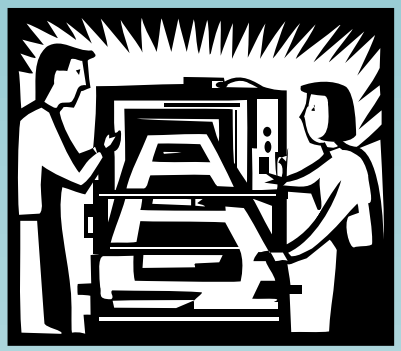
VOC emissions decreased 99% in seven years. The only VOC emitted in 1996 was dipropylene glycol methyl ether, which is not a hazardous air pollutant (HAP) and is not a reportable VOC under the Clean Air Act Amendments.

The reduction in VOC emissions and hazardous waste occurred even as HSC's production more than doubled from 1988 to 1995.

Eliminating Solvents In Other Areas

Highland Supply Corporation has stopped using traditional solvents in adhesives, cleaning, and maintenance. For example:

- **In 1992, HSC installed an ultrasonic cleaner to clean anilox and plate cylinders.**
- **In 1993, HSC replaced other traditional solvent-based cleaners (methyl ethyl ketone, methyl isobutyl ketone, and toluene) with a mixture of water and d-limonene (a citrus-based cleaner).**



If you would like more information about Highland Supply Corporation and their experience with water-based inks, contact:

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Partners in the DfE Flexography Project include: California Film Extruders and Converters Association (CFECA), Flexible Packaging Association (FPA), Flexographic Technical Association (FTA), Industrial Technology Institute (ITI), National Association of Printing Ink Manufacturers (NAPIM), Plastic Bag Association (PBA), RadTech International, N.A., National Institute of Standards and Technology (NIST), Tag and Label Manufacturers Institute, Inc. (TLMI), University of Tennessee (UT), Western Michigan University (WMU), and individual printers and suppliers.

Other Benefits

Additional benefits that improve HSC's safety, working conditions, marketing, and public image include:

- **eliminated health risks related to VOC exposure**
- **reduced fire hazard**
- **eliminated need for expensive explosion-proof storage**
- **improved public image and community relations**

Commitment From Management and Employees

Company-wide commitment was essential to the success of HSC's switch to water-based inks. To strengthen this commitment, management integrated recycling and pollution prevention standards into the job descriptions for each employee, implemented aggressive health and safety programs, and conducted an internal pollution prevention assessment.

With a commitment from management and continuous improvement in the printing process, your company can also realize the benefits of reducing VOC emissions and hazardous waste.

About the Design for the Environment Flexography Project

The goal of the Design for the Environment (DfE) Flexography Project is to provide flexographers with information that can help them design an operation which is more environmentally sound, safer for workers, and more cost effective.

The partners of the DfE Flexography Project, in a voluntary cooperative effort, are evaluating three different ink technologies: solvent, water-based, and UV-cured. Information is being gathered on the performance, cost, and health and environmental risk trade-offs of several inks within each technology.

In addition to the Flexography Project, similar DfE projects are currently underway with both the screen printing and lithography industries.

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.

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