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

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SCREEN PRINTING PROJECT BULLETIN 4

SCREEN PRINTING

SMARTER, SAFER SCREEN RECLAMATION
Alternative System Chi

The chemicals used for screen reclamation can be some of the most hazardous products in a screen printing facility. Typically, highly volatile solvents are used. These cleaners may contain chemicals that are harmful to the health of employees if inhaled, ingested, or absorbed through the skin. If they are not disposed of properly, these products may also harm the environment.

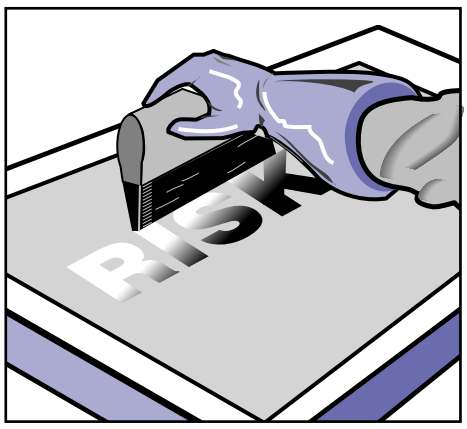
To reduce the hazards of screen reclamation to workers and to the environment, screen printers using solvents for screen reclamation should consider switching to one of the safer substitute products currently on the market. These substitutes often contain less harmful chemicals and have a lower volatile organic compound (VOC) content. With a lower VOC content, the chemical is less likely to be inhaled by employees or released to the air

This bulletin highlights the characteristics of one type of substitute product system and compares it to a traditional (solvent-based) screen reclamation system. Specifically, this bulletin describes:

- Performance of the alternative screen reclamation system as demonstrated in laboratory tests and the two volunteer printing facilities;
- The health and environmental risks of the alternative system;
- The cost of the alternative system.

Background

Initiated by industry, the DfE Screen Printing Project was entirely voluntary and involved almost all sectors of the screen printing industry: manufacturers donated their products for evaluation, staff from Screenprinting and Graphic Imaging Association International (SGIA) coordinated the field demonstrations, the Screen Printing Technical Foundation (SPTF) performed initial product testing, printers nationwide evaluated the products in their print shops, and EPA staff conducted a risk assessment of the products. One advantage of this coordinated effort is that all product systems were evaluated using the same methods. The consistency of the evaluations allows you to compare the results to determine which of the alternatives may be a viable substitute for your current reclamation products.



This bulletin highlights one alternative system referred to as Alternative System "Chi." This system, as with all systems demonstrated in this project, is a real, commercially available screen reclamation system; however, "Chi" is a masked name. The actual trade name for this alternative system (or for any of the alternative systems demonstrated) is not used in this case study or in the final project report. Trade names were masked for several reasons:

- One of the goals of the DfE project is to illustrate the process of searching for and evaluating cleaner alternatives. DfE hopes to encourage you to incorporate environmental concerns in your facility's decision-making processes and into your discussions with suppliers. By masking trade names, DfE encourages you to discuss the characteristics of the products you use, or are considering using, with your suppliers. This case study and the DfE project help you to know what characteristics to look for in the screen reclamation products you purchase.
- Since every screen printing shop is different, manufacturers recognize that their product's performance may vary greatly depending on the operating conditions and, moreover, printers' opinions of products will vary. In order to get their full cooperation before the results were available, the Project complied with the requests by some manufacturers that product names be masked.

To compare the cost and risk of Alternative System Chi to a known system, a baseline was established using a traditional solvent-based screen reclamation system consisting of: lacquer thinner as the ink remover, a sodium periodate solution as the emulsion remover, and a xylene/acetone/mineral spirits/cyclohexanone blend as the haze remover. These chemicals were selected because screen printers indicated they were commonly used in screen reclamation.

It should be noted the alternative reclamation systems were evaluated using a case study approach; rigorous scientific testing was not conducted. Instead, much of the information presented here is based on printers' experiences with these products as used at their facilities.

Promising Performance

Performance was evaluated in two phases: 1) performance demonstrations at SPTF's laboratory under controlled conditions; and 2) field demonstrations at volunteer printers' facilities under the variable conditions of production. Since conditions vary greatly from one facility to the next, printers felt it would be most valuable to evaluate performance based on the experiences and opinions of the experts: the printers who used the alternative products in their print shops during the month-long demonstrations. Each product system was demonstrated in two or three facilities to get a more complete evaluation of performance under a variety of operating conditions.

Laboratory Testing

During laboratory testing, three imaged screens were reclaimed using Alternative System Chi: one where a solvent-based ink was applied, the second with an ultraviolet-curable (UV) ink, and the third with a water-based ink. In the lab, two applications of the Chi ink remover were required to remove the solvent-based ink. The UV-curable ink and water-

	Chemical Composition		
	Ink Remover	**Emulsion Remover**	**Haze Remover**
Alternative System Chi	Diethylene glycol series ethers Propylene glycol series ethers N-methyl pyrrolidone Ethoxylated nonylphenol	Sodium periodate Water	Diethylene glycol series ethers Propylene glycol series ethers N-methyl pyrrolidone Ethoxylated nonylphenol
Traditional System	Lacquer thinner, consisting of: 30% Methyl ethyl ketone 20% Naphtha light aliphatic 20% Toluene 15% n-butyl acetate 10% Isobutyl isobutyrate 5% Methanol	1% Sodium periodate 99% Water	10% Xylene 30% Acetone 30% Mineral spirits 30% Cyclohexanone

[1] Clear concerns>Marginal concerns>Negligible concerns. Concerns were identified because exact risks were not calculated. The information in this table is based on the September 1994 draft *Cleaner Technologies Substitutes Assessment: Screen Printing Technical Report.*

based inks dissolved more easily, however an ink residue or haze remained on all of the screens after applying the ink remover. The emulsion remover easily dissolved the stencil with only light scrubbing, leaving no emulsion residue behind. When additional ink remover was applied (used instead of a haze remover), it removed the ink residue and lightened the stain on all three screens.

On-site Demonstrations

Two different facilities (referred to as Facility C and Facility D) used System Chi for a month to evaluate how well it performed in an actual production situation. The participating facilities recorded the amount of product used, the length of time needed, and their opinion of how well the product reclaimed the screen.

Ink Remover Performance: At Facility C, the Chi ink remover worked well, although in some cases, it acted more slowly than their standard solvent blend. Facility D found the ink remover worked well, especially on metallic inks.

Emulsion Remover Performance: The emulsion remover worked very well at both facilities, dissolving the stencil quickly and easily.

Haze Remover Performance: Alternative System Chi did not include a separate haze remover; instead the manufacturer recommended applying the ink remover again to remove any remaining haze. Facility D found their screens were completely clean after using just the ink and emulsion removers; a haze remover was not needed. At Facility C, the haze remover lightened the haze; however, when the haze was heavy, a ghost image remained on the screen.

Overall Evaluation: At both facilities, the performance of Alternative System Chi was as good as the performance of the facilities' standard screen reclamation products. The consistent performance of the product at SPTF and in the two facilities demonstrates that System Chi can work under different operating conditions.

Health Risks[1]	Performance			Cost
	Ink Remover	Emulsion Remover	Haze Remover	
• Inhalation risks of the ink and haze removers are negligible. • If you use the ink or haze remover on a daily basis without wearing gloves, there is a clear concern for harmful effects from diethylene glycol series ethers absorbed through your skin. If gloves are worn, the risk is negligible. • If your skin regularly contacts the ink or haze removers, there is a concern for reproductive toxicity risk from absorbing N-methyl pyrrolidone. If gloves and safety goggles are worn, the risk is negligible. • There is a clear concern that regular, unprotected contact with the emulsion remover will cause skin and eye irritation and tissue damage. If gloves and safety goggles are worn, the risk is negligible.	In on-site demonstrations, removed the ink well. One of the facilities found it worked very well on metallic inks. In lab testing, dissolved UV-curable and water-based ink well. Two applications were needed to remove the solvent-based ink.	Quickly and easily removed the stencil during facility demonstrations and lab tests.	At Facility C, the haze remove lightened moderate stains, but was not effective on heavy stains. At Facility D, haze remover was not needed. In lab testing, the haze remover lightened the ink stain.	Facility C: $3.89/screen or $5,829/year Facility D: $3.25/screen or $4,879/year
• If you use the ink or haze remover on a regular basis, there is a clear concern for harmful health effects from inhaling the chemicals (specifically toluene, methyl ethyl ketone, and acetone). • There is also a clear concern for adverse health effects if your skin contacts the ink or haze remover on a daily basis (from toluene, methyl ethyl ketone, and acetone). The concern is marginal for contact with cyclohexanone in the haze remover. If gloves and safety goggles are worn, these risks are negligible. • There is a clear concern that regular, unprotected contact with the emulsion remover will cause skin and eye irritation and tissue damage. If gloves and safety goggles are worn, the risk is negligible.	Removed solvent and UV inks with moderate scrubbing effort. A gray haze remained on the entire screen. With water-based ink, the ink solidified.	Not demonstrated[2]	Not demonstrated[2]	$6.27/screen or $9,399/year

2 The ink remover was demonstrated during laboratory tests as a component of a different reclamation system.

Reduced Risk

Occupational risks and environmental releases associated with using Alternative System Chi and the traditional system for screen reclamation are summarized in the table.

Whether using traditional screen reclamation techniques or an alternative system, chemicals can get into your body either through your skin when you contact the product or through your lungs when you inhale chemical vapors. Some chemicals have a lower tendency to evaporate or to enter the body through the skin; and different chemicals have different effects, some more harmful than others, once in your body. The risks associated with inhalation of the chemicals in Alternative System Chi were found to be negligible, while there is a clear concern for chemical inhalation risk with the traditional system. With the traditional system, daily inhalation of toluene and methyl ethyl ketone in the ink remover, and acetone in the haze remover could lead to eye, nose, and throat irritation, headaches, or fatigue. With Alternative System Chi, the adverse effects from inhalation are negligible.

Applying either the Alternative System Chi or the traditional system products regularly without wearing gloves can be harmful to your health. In the traditional system, these effects are from the toluene and methyl ethyl ketone in the ink remover, the sodium perio-

date in the emulsion remover, and the acetone in the haze remover. In the alternative system, potential for these harmful effects through skin contact are attributed to diethylene glycol series ethers in the ink/haze remover, and sodium periodate in the emulsion remover. If gloves and safety goggles are worn regularly, however, the dermal risks from either system are negligible.

Minimal Environmental Releases

Based on the EPA assessment, none of the chemicals in either the traditional system or Alternative System Chi were found to be hazardous to the environment in the quantities used for screen reclamation. However, reducing the use of the traditional chemicals could cut a facility's air releases. Traditional screen-cleaning solvents often have a high volitile organic compound (VOC) content, contain Hazardous Air Pollutants regulated under the Clean Air Act, or contain a RCRA listed or characteristic waste. Substituting an alternative product for these screen reclamation chemicals could reduce your facility's regulatory burden. Contact your state and local regulatory authorities for information specific to your location.

Cost Savings

The performance demonstrations showed that both of the participating facilities could reduce their costs for screen reclamation by switching from the traditional system to Alternative System Chi. As with the risk comparisons, costs of Alternative System Chi were compared to the costs of using the traditional system. It was assumed 6 screens were reclaimed daily and that all screens were 2,127 in^2 (approximately 15 ft^2) in size for both the traditional and the alternative systems. The cost estimate for each reclamation system included labor time spent to reclaim the screen, the cost of an average quantity of reclamation products, and the cost of hazardous waste disposal for RCRA-listed waste or RCRA-characteristic waste (ignitable based on flashpoint). For the alternative system and the traditional system, RCRA issues apply only to the traditional system ink remover.

For Facility C, their reclamation cost per screen would drop by 38% from $6.27/screen to $3.89/screen for annual savings of $3,560. At Facility D, the reclamation cost of $6.27/screen using the traditional system would decrease 48% to $3.25/screen at Facility D for the alternative system. Over a year, the savings would amount to $4,520. The difference in costs between the facilities is due to differences in the quantity of product used and the labor time required per screen as recorded by each facility's employees.

For More Information...

Although the alternative system described in this case study proved to be a viable alternative in the two printing facilities where performance demonstrations were conducted, it may not be the solution for all types of screen printing operations. If you find that Alternative System Chi does not seem like a feasible substitute for your facility, refer to the summary booklet, *Designing Solutions for Screen Printers: An Evaluation of Screen Reclamation Systems,* which includes information on all the alternative product systems and alternative technologies evaluated. When you identify a product system that seems like a potential substitute, contact your supplier, identify the alternative system by its chemical composition, and discuss the characteristics of the products you are looking for.

This bulletin is part of a series of bulletins and case studies that provide screen printers with information on products and techniques that can help them to prevent pollution in their facilities. Information in these bulletins is largely based on the work done by the Design for the Environment Screen Printing Project. For copies of this bulletin, other DfE Screen Printing Project materials, or more information about the project, contact :

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