

**ALTERNATIVE LOW-VOC, LOW TOXICITY CLEANUP SOLVENTS FOR
THE SCREEN PRINTING INDUSTRY**

Prepared for:
Cal/EPA's Department of Toxic Substances Control
and the U.S. Environmental Protection Agency

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DISCLAIMER

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EXECUTIVE SUMMARY

There are more than 16,000 screen printers in the U.S. and almost 2,000 of them are in California. The vast majority of screen printers are small businesses with fewer than 20 employees. Screen printers use various types of inks to print on a variety of substrates including fabric, paper, metal, glass, wood, ceramics and plastics. Some small screen printers print by hand but most commercial screen printers use automated presses.

During printing, some screen printers use cleanup solvents to clean the excess ink from the screens. All screen printers remove the ink from the screens after printing when the screens are saved for the next run or recycled for reuse. The cleaners that are used today may contain toxic materials that pose a risk to workers and community members and virtually all of them are classified as VOCs that contribute to smog.

The South Coast Air Quality Management District (SCAQMD) regulates VOC emissions in four counties in southern California. One of the SCAQMD regulations specifies VOC limits for cleanup solvents used in screen printing. The VOC limit is presently set at 750 grams per liter. The regulation was recently modified to reduce the VOC limit to 500 grams per liter on July 1, 2005 and to 100 grams per liter on July 1, 2006. Companies in southern California must find alternatives that meet the much lower VOC level.

Cal/EPA's Department of Toxic Substances Control (DTSC), with DTSC and U.S. EPA funding, contracted with the Institute for Research and Technical Assistance (IRTA) to work with screen printers to identify, test, develop and demonstrate alternative low toxicity, low-VOC cleanup materials. IRTA is a nonprofit organization that assists companies and whole industries in finding safer alternatives in cleaning, adhesive, coating, dry cleaning and paint stripping applications.

During the project, IRTA worked with nine screen printers in southern California to find alternatives that performed effectively and were cost effective. The printers that participated in the project used a range of different inks and printed on a variety of different substrates.

The low toxicity, low-VOC alternatives that were tested were of three types. First, water-based cleaners were tested in several facilities and found to be effective. Second, vegetable based cleaners composed of soy performed well for cleaning certain types of inks. Third, acetone, a chemical not classified as a VOC and low in toxicity, was blended with other materials and found to effectively clean traditional solventborne inks.

Table E-1 shows the nine facilities that participated in the project. It also presents a description of the type of printing the facility does and the type(s) of inks used by each facility. Finally, it summarizes the alternative(s) that performed effectively in each of the participating facilities. Two of the companies, Owens-Illinois and Texollini, elected to convert to the alternatives that were tested in the course of the project.

**Table E-1
Participating Company Description and
Successful Safer and Low-VOC Alternatives**

Company	Printing Description	Ink Type	Successful Alternatives
Owens-Illinois	Prints on plastic cosmetic Bottles	UV	Soy Based Cleaner
Southern California Screen Printing	Prints on paper and plastic	UV	Water-Based Cleaner, Soy Based Cleaner
Com-Graf	Prints on variety of different substrates	Solventborne	Soy/Acetone/Mineral Spirits Blend
Serendipity	Prints on variety of different substrates	Solvent and Waterborne	Acetone/Mineral Spirits Blend
Oberthur	Prints on plastic credit cards	Solvent and Waterborne	Acetone/EEP Blend
Texollini	Prints on fabric	Waterborne	Water-Based Cleaner
Hino Designs	Prints on textiles	Plastisol	Water-Based Cleaner, Soy Based Cleaner
Quickdraw	Prints on textiles	Plastisol	Soy Based Cleaner, White Oil/Acetone/Mineral Spirits Blend
LCA Promotions	Prints on textiles	Plastisol	Soy Based Cleaner, Water-Based Cleaner, White Oil/Acetone/Mineral Spirits Blend

IRTA analyzed and compared the costs of the alternatives and the cleaners that are currently used by the facilities. In seven cases, the cost of using an alternative was lower or about the same as the cost of using the current cleaner. In two cases, the cost of using the alternative cleaner was higher than the cost of using the current cleaner.

The results of the project indicate that alternatives are available and cost effective for screen printing facilities in California. Water-based cleaner, soy based cleaners and acetone blends which are lower in toxicity and low in VOC content perform well in removing the different types of ink used by the screen printing industry today.

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I. INTRODUCTION AND BACKGROUND

The printing industry is one of the largest manufacturing industries in the United States. The industry is dominated by small and medium-sized businesses, most of them with fewer than 20 employees. In 2002, according to the Bureau of Census, approximately 83 percent of the screen printing industry was comprised of small businesses. The Info USA Power Business Database estimates the number of screen printers in 2002 in the U.S. at 16,341. California has 1,886 screen printing establishments.

The South Coast Air Quality Management District in southern California regulates VOC emissions from businesses located in the four county area including Los Angeles County, Orange County, San Bernardino County and Riverside County. One of the SCAQMD rules, Rule 1171 "Solvent Cleaning Operations," regulates the VOC content of screen printing cleanup solvents. The VOC content of screen printing cleanup solvents is currently set at 750 grams per liter. The District plans to reduce the allowed VOC content to 500 grams per liter on July 1, 2005 and to 100 grams per liter on July 1, 2006. Lowering the VOC content to 100 grams per liter would reduce emissions of these solvents by about 1.3 tons per day. By July 1, 2006, screen printers in southern California must convert to alternative low-VOC cleanup materials.

The Institute for Research and Technical Assistance (IRTA), a nonprofit organization, was established in 1989 to assist industry in adopting safer alternatives to ozone depleting, chlorinated, other toxic and VOC solvents. IRTA staff have worked with hundreds of facilities in the South Coast Basin to identify, test and develop alternatives. IRTA runs and operates the Pollution Prevention Center (PPC), a loose affiliation of local, state and federal governmental organizations and a large electric utility.

Cal/EPA's Department of Toxic Substances Control (DTSC), with DTSC and U.S. EPA Region IX funding, contracted with IRTA to work with screen printers to identify, test, develop and demonstrate alternative low-VOC, low toxicity cleanup solvents. IRTA had worked with some screen printers in two earlier projects, one sponsored by U.S. EPA headquarters and the other sponsored by SCAQMD. Both of these projects involved working with several different categories of cleaning and the resources for the screen printing alternatives were limited.

IRTA undertook the current DTSC/U.S. EPA project to work with a variety of screen printers of different types. IRTA worked with a total of nine screen printing facilities that handled different types of printing. The focus was on finding suitable alternatives that would be safer and would meet the final SCAQMD Rule 1171 VOC limit of 100 grams per liter.

Screen Printing

Screen printing is a short-run process that prints on almost any substrate including fabric, paper, leather, metal, glass, wood, ceramic and plastics. It is used for printing art prints, posters, greeting cards, labels, menus, program covers, wallpaper and textiles such as tablecloths, shower curtains and draperies. Some screen printing is done by hand with very simple equipment consisting of a table, screen frame and squeegee. Most commercial printing is performed on automated presses. One type of automated press uses flat screens that move in an indexed manner so that ink of different colors can be applied. Another type uses rotary cylindrical screens with the squeegee mounted inside the cylinder. The ink is pumped in automatically.

Screens are prepared before printing by the screen printers. The screens can be various sizes and they are generally made of polyester material with a wood or metal frame. A light sensitive emulsion is put onto the screen and it is cured with light. The emulsion forms a so-called stencil which serves as the pattern for printing. During printing, ink is forced through the screen and a pattern is printed on the substrate. The emulsion masks the part of the screen so that ink cannot pass through. Some companies also use a material called blackout to touch up the emulsion.

Most companies save the screens after a printing run so they can be used next time the customer orders a job. The emulsion is not removed from these screens and the screens are stored for future use. Some companies remove the emulsion each time the screen is used for printing.

Four types of inks are commonly encountered in screen printing. One type of ink is solventborne ink which is used by many printers. Another type of ink, called Plastisol ink, is used in textile printing applications; this ink is also solventborne. Textile printers account for about two-thirds of the screen printers. Some screen printers use ultraviolet (UV) curable ink which contains photoinitiators that are cured using light. Finally, a few screen printers use waterborne inks.

There are two places in the process where solvents are used to clean ink from the screens. During printing, many companies clean the screens periodically when the ink builds up. After printing when the screens are recycled or completely cleaned, solvents are used to remove the ink from the screens. Plain water or water-based cleaners are used to clean waterborne ink from the screens. Other materials are used to remove the emulsion, blackout and ghost image.

Participating Facilities

Nine facilities that have screen printing operations participated in the project. Table 1-1 shows a list of these facilities together with a description of the type of printing they perform and the type of ink they use. In three cases, Owens Illinois, Southern California Screen Printing, and Quick Draw, IRTA had worked with the facility to some extent in the earlier SCAQMD and U.S. EPA projects.

**Table 1-1
Facilities Participating in Project**

<u>Company</u>	<u>Printing Description</u>	<u>Ink Type</u>
Owens-Illinois	Prints on plastic cosmetic bottles	UV
Southern California Screen Printing	Prints on paper and plastic	UV
Com-Graf	Prints on variety of different substrates	Solventborne
Serendipity	Prints on variety of different substrates	Solvent and waterborne
Oberthur	Prints on plastic credit cards	Solvent and waterborne
Texollini	Prints on fabric	Waterborne
Hino Designs	Prints on textiles	Plastisol
Quickdraw	Prints on textiles	Plastisol
LCA Promotions	Prints on textiles	Plastisol

The facilities have a variety of different processes. Some, like Oberthur and Texollini manufacture goods and perform screen printing as part of their operations. Three of the facilities, Hino Designs, Quick Draw and LCA Promotions, are small textile printers who primarily print on T-shirts. Com-Graf prints on a variety of different products including glass and ceramics. Serendipity is a small one-person shop that does various printing jobs. Owens-Illinois prints on a range of different plastic cosmetic bottles. Southern California Screen Printing prints very large plastic and paper banners. Plastisol ink is used by the three T-shirt printers. UV curable ink is used by two of the participating facilities. Three facilities use waterborne ink and four facilities use more traditional solventborne ink.

Project Approach

The first step in the project was to visit each of the participating facilities. During these visits, IRTA toured the facility and focused particularly on the screen printing process. IRTA discussed the substrates and ink types used by each facilities. IRTA also discussed the types of emulsions and blockouts used by the facilities. These are the parameters that affect the type of cleaner that can be used. IRTA requested a sample of ink or inks from the facilities.

The second step in the project was to perform preliminary tests at the IRTA office using the ink and several alternative cleaning agents. At this stage, IRTA wanted to screen alternative cleaning materials to see if they could clean the ink. IRTA obtained a typical screen from a screen printer and this screen was used in the preliminary testing. The ink was applied to the screen and different cleaning agents were rubbed on the screen with a wipe cloth to determine if they could effectively remove the ink. This test procedure allowed IRTA to determine which alternatives might be effective in cleaning ink at each facility.

The third step in the project was to visit the facilities and conduct initial tests with the alternatives that appeared effective in the preliminary testing to clean the ink in the screen printing process. The initial testing generally involved limited testing by hand cleaning screens that did not need to be saved for a future job. Some of the alternative cleaners can remove emulsion or blockout, depending on the type of emulsion or blockout used by the facility. Most facilities do not want the emulsion or the blockout to be removed so they can save the screens for the same customer with future jobs.

The initial facility testing generally involved testing two to 15 cleaning alternatives that have low-VOC and are relatively low in toxicity. If a cleaning agent cleaned the ink effectively but removed the emulsion or the blockout in cases where the facilities wanted to preserve the screen, it was eliminated from consideration. In almost all cases, IRTA tested the alternatives in the same manner the facility used the current cleaning agent. In some cases, however, it was necessary to modify the conditions. Water-based cleaners work much more effectively when they are heated and the initial facility testing was generally performed with a heated cleaner.

The fourth step in the project was to perform more extensive or scaled-up testing of the alternative cleaning agents that appeared to effectively remove the ink. IRTA provided the facilities with a week's supply or more of the cleaning agents so they could test them under production conditions. In some cases, IRTA provided equipment to the facility for the scaled-up testing.

The fifth step in the project was to analyze and compare the cost and performance of the alternative and currently used cleaners. Section II of this document presents this analysis for the nine facilities participating in the project.

Current Cleanup Solvents

Solvents used by the screen printing industry for cleanup in the U.S. include mineral spirits, methyl ethyl ketone, toluene, xylene, glycol ethers, terpenes, heptane and hexane. All of these solvents are classified as VOCs and many of them are toxic. Mineral spirits contain trace quantities of benzene, toluene and xylene. Benzene is an established human carcinogen; toluene and xylene are listed on California's Proposition 65. Hexane causes peripheral neuropathy, a nervous system disease.

The project sponsors are concerned about the VOC emissions from the solvents and the exposure of the workers and community members to the solvents. The aim of the project was to identify, develop, test and demonstrate low-VOC, low toxicity alternative cleanup materials.

Alternative Cleanup Materials

The alternative low-VOC, low toxicity cleanup materials IRTA tested during this project can be classified into three categories. The first category is water-based cleaners. The second category is solvents that are exempt from VOC regulations. The third category is methyl esters which are vegetable based cleaners with a very low VOC content. Each of these categories of cleaners is discussed in more detail below.

Water-Based Cleaners. These cleaners generally contain a certain amount of water. They are sometimes diluted further with water when they are used for cleaning. Some water-based cleaners are based on surfactants; others contain a small amount of solvent. Water-based cleaners are most applicable for cleaning the plastisol ink used by the textile printers or ultraviolet (UV) curable ink used by some printers.

IRTA tested one water-based cleaner, called Ardrex 405-V and made by Chemetall Oakite, at two textile printing facilities. Both Hino Designs and LCA Promotions tested the water-based cleaner in a parts cleaner at 50 percent concentration. This water-based cleaner cleaned the ink effectively when the screens were being recycled.

IRTA tested another water-based cleaner, called Experimental Commercial Printing Cleaner NP 2520, which is made by Mirachem. This cleaner was tested at Southern California Screen Printing in a recirculating brush application system at full concentration. It worked very effectively in cleaning the UV curable ink when the screens were being recycled.

IRTA tested a third water-based cleaner, called GD 1990 and made by Brulin, during the project. The cleaner worked effectively for cleaning the semi-cured water-based ink at Texollini. The company converted to the cleaner and it is used in a high pressure spray process at about one-third concentration.

Exempt Solvents. There are a number of solvents that have been specifically deemed exempt from VOC regulations by U.S. EPA and local California air districts. Some of these contribute to ozone depletion and their production has been banned. The use of others, perchloroethylene and methylene chloride, is severely restricted because they are classified as carcinogens. Still others, one of the volatile methyl siloxanes and perchlorobenzotrifluoride, have potential toxicity problems.

One solvent that is exempt from VOC regulations was tested during the project. Acetone is an aggressive solvent that is very low in toxicity compared to other organic solvents. It evaporates readily and its disadvantage is its low flash point. IRTA tested acetone extensively during this project and it is a very effective ink cleaner.

Acetone evaporates too quickly to effectively remove ink from the screens when it is used by itself. When IRTA tested acetone during this project, it was combined with small quantities of other VOC solvents to prevent such rapid evaporation. A blend of acetone was tested for on-press cleaning at three textile printers, Hino Designs, Quick

Draw and LCA Promotions. It effectively cleaned the ink at two of these facilities. An acetone blend was also tested at Com-Graf, Oberthur and Serendipity and it worked effectively on the ink at those facilities.

Methyl Esters. This class of chemical generally contains methyl esters that have a 16 to 18 carbon chain length. Materials like soy, canola oil, rapeseed oil and coconut oil are composed of methyl esters. These materials clean most types of inks very effectively. During this project, IRTA relied heavily on soy based cleaners and soy was selected because it is more widely available and lower cost than some of the other methyl esters. Several different formulations were tested for VOC content by SCAQMD and the VOC content ranged from five to 25 grams per liter.

A soy based cleaner was tested with all three of the textile printers, Quick Draw, LCA Promotions and Hino Designs. The cleaner, called Soy Gold 2000 and made by Ag Environmental, effectively cleaned the plastisol ink. Use of the soy cleaner did, however, require an additional rinsing step for the textile printers. Soy cleaners are oily and they must be rinsed before the screens are ready for printing. Soy Gold 2000 was also effective for cleaning the UV curable ink at Owens-Illinois and the company converted their operation to use the vegetable based cleaner. Another soy based cleaner, called Autowash #3 and made by Seibert, was tested for cleaning the UV curable ink at Southern California Screen Printing. This cleaner worked almost as effectively as the current cleaner at that facility.

Cleaner Performance

Performance of the alternative cleaning agents at each facility was evaluated on a case-by-case basis. In each instance, the plant personnel provided information on their requirements for the cleaning process. In all cases, it was important for the cleaning agent to effectively clean the ink from the screens in a reasonable period of time. The facility personnel were the judges of which cleaners cleaned effectively. In addition, when cleaners were tested during printing, IRTA insisted that the facility print after cleaning to make sure the print quality was acceptable.

Cost Analysis

IRTA performed cost analysis for each of the alternatives that was successfully tested at each of the facilities participating in the DTSC/EPA project. The types of costs that were evaluated included:

- capital cost
- cleaner cost
- labor cost
- utilities cost
- disposal cost

These costs were evaluated and compared when the costs were different for the current solvent and the alternative cleaners.

In some of the cases, it was assumed that there would be a capital equipment requirement. In these instances, the cost of the capital equipment was spread over a 10 year period, which was assumed to be the life of the equipment. The interest rate for the cost of capital was assumed to be four percent.

In virtually all cases, there was a difference in the cost of the current solvent and the cost of the alternative cleaner. In some cases, there was a difference in labor costs and, in these instances, the different costs were compared. In a few cases, there was a difference in electricity costs and these were noted and compared. Finally, in some instances, there was a difference in disposal costs and these were analyzed where appropriate.

Report Organization

Section II of this report provides detailed information on the analysis that was performed for each of the companies participating in the project. The cost of the current and alternative process was evaluated and compared. Section III summarizes the results of the tests and demonstrations at the facilities. Appendix A includes MSDSs for the alternative products that were tested or adopted by the participating facilities. Appendix B provides the stand alone case studies for two of the facilities that opted to convert to alternatives.

II. ANALYSIS OF THE ALTERNATIVE CLEANING AGENTS

This section presents analysis of the performance and cost of the alternative cleaning agents that were tested during the project. It provides a description of each of the facilities where the testing was conducted, the cleaning agents that are used currently, the alternatives that were tested and the alternatives that were most effective. It also provides a cost comparison of the current and alternative cleaners. The alternative cleaners were tested for a few weeks in most of the facilities so it is unknown whether other problems would arise if they were tested for a longer period. The alternative cleaners have been used for a much longer period, more than a year, at two facilities, Owens-Illinois and Texollini. These two facilities elected to convert to the alternatives.

Owens-Illinois

The Owens-Illinois Plastics Group operates a manufacturing facility in La Mirada, California. The company manufactures plastic cosmetic bottles for various types of products like shampoo and other personal products for a number of customers. Owens-Illinois has several extrusion and blow molding machines that are used to make the bottles. The company uses a range of plastic materials including HDPE, PET, LDPE, PVC and polypropylene. The bottles have various shapes including cylinders and ovals.

Owens-Illinois has several automated in-line decorating machines that are used to screen print on the plastic bottles. For a number of years, the company has exclusively used ultraviolet (UV) curable inks. The machines apply one color of ink to the bottle as it passes through the ink delivery system. Some of the bottles require five colors so they pass through five screens in the machine, each with one color. The bottles pass under a screen and squeegees applied to the top of the screen force the ink through the screen to color the pattern on the bottles. After the ink is applied, the bottles pass through an ultraviolet light which cures the ink. A picture of the process is shown in Figure 2-1.

Owens-Illinois performs two types of cleaning. Workers monitor the screens at the machines. Periodically, when the screens are contaminated, the worker uses a cleaner on a rag to wipe the excess ink from the lower part of the screen; this is in-process cleaning. After the run, the screens are removed from the machine, workers remove the ink from the top and bottom of the screens and they are processed further so they can be reused.

IRTA began working with Owens-Illinois on a project sponsored by the South Coast Air Quality Management District (SCAQMD). One of the SCAQMD regulations, Rule 1171, specifies that the VOC content of the cleaners used for screen printing cleanup have a VOC content of 100 grams per liter or less beginning in July of 2006. Owens-Illinois was using a high VOC cleaner and IRTA worked with the company to test alternatives that met the 100 gram per liter future VOC limit.

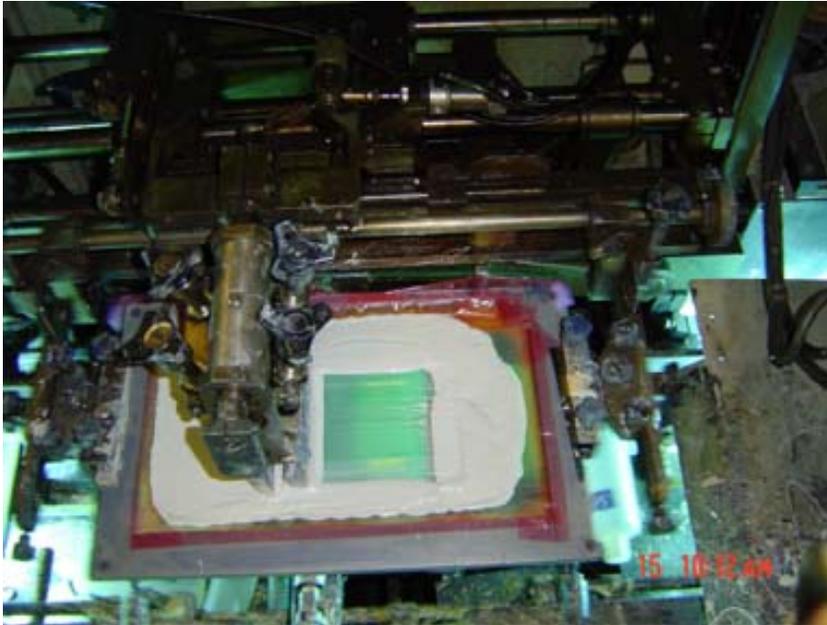


Figure 2-1. Printing Process at Owens-Illinois

In preliminary tests, IRTA found that high soy content cleaners cleaned Owens-Illinois' ink very well. IRTA performed scaled-up testing of one of the cleaners, Soy Gold 2000, at the facility. SCAQMD tests determined that the VOC content of this cleaner is less than 20 grams per liter which easily meets the future effective VOC limit. This product can be rinsed with water which is necessary for recycling the screens. After successful on-site testing, IRTA provided five gallons of the alternative cleaner to the facility for further testing. The results indicated that the cleaner performed well for both the in-process cleaning and the cleaning at the end of the process. An MSDS for the cleaner is provided in Appendix A.

IRTA followed up with Owens-Illinois in the current project and the company had converted to the alternative soy based cleaner. The cleaner has been successfully used for about a year. One advantage of the alternative cleaner is that it protects the emulsion which forms the pattern on the screen better than the high VOC cleanup solvent used in the past.

The only element in the cost that has changed with the adoption of the new cleaner is the price of the cleaner. Owens-Illinois uses about 15 gallons of cleaner per week under normal production conditions. The cost of the high VOC solvent is \$13 per gallon. On this basis, the annual cost of using the high VOC solvent was \$10,140. The cost of the soy alternative cleaner is less, at \$10.90 per gallon. The same amount of the new cleaner is used so the annual cost for cleaning now amounts to \$8,502.

Table 2-1 shows the annualized cost comparison for cleaning with the high VOC cleaner and the soy based cleaner for Owens-Illinois. The company reduced their costs by about 16 percent through the conversion.

**Table 2-1
Annualized Cost Comparison for Owens-Illinois**

	High VOC Cleaner	Soy Cleaner
Cleaner Cost	\$10,140	\$8,502
Total Cost	\$10,140	\$8,502

A stand alone case study for Owens-Illinois is shown in Appendix B.

Southern California Screen Printing

Southern California Screen Printing (SCSP) is located in Fontana, California. SCSP has six-color presses that provide in-line printing capability. The company prints high quality, high volume, large format work and their customers include the movie and advertising industries. Products printed by SCSP include very large banners, posters and bus advertising. SCSP uses UV curable ink for all of their operations. The screens used by the company for printing are very large, perhaps 15 feet long and seven feet high.

At the end of the screen printing process, SCSP must remove the ink from the screens. Currently the company has a large bay where the ink removal and other screen recycling operations occur. A picture of the cleaning bay is shown in Figure 2-2. SCSP, for several years, has used a high VOC glycol ether cleaner. The VOC cleaner is applied using a pump attached to a brush for scrubbing the screens. The cleaner is applied to only one side of the screen except in the case of black ink. When black ink is used, both sides of the screen must be cleaned to remove the ink. After the ink is cleaned, the stencil on the screen is removed and rinsed. The ghost image on the screen is then removed, the screen is rinsed again and then is vacuum dried.



Figure 2-2. Cleaning Bay at Southern California Screen Printing

IRTA conducted screening tests on SCSP's ink and found several alternatives that might be suitable. IRTA tested these alternatives by hand cleaning screens at SCSP. The results of this testing indicated that only one cleaner, Seibert Autowash #3, was effective in cleaning the ink. The cleaner is a blend of soy methyl esters and surfactants. An MSDS for the cleaner is shown in Appendix A. At a later time, IRTA identified a new water-based cleaner that cleaned the ink very well. This cleaner was also tested by hand on the screens at SCSP and it was effective in cleaning the ink. An MSDS for the water-based cleaner, called Mirachem Experimental Commercial Printing Cleaner NP 2520, is also shown in Appendix A.

IRTA arranged for scaled-up testing at SCSP of the soy based product and the water-based product. IRTA provided the company with 10 gallons of each formulation. The soy based cleaner worked acceptably but more labor was required. The water-based cleaner worked well and no additional labor was required.

IRTA analyzed the costs of the alternatives and compared them to the costs of the current cleaner. SCSP uses 55 gallons per month of solvent and the cost of the solvent is \$12.60 per gallon. The annual solvent usage is 660 gallons and, on this basis, the annual cost of the cleaning solvent is \$8,316. The cost of the soy based alternative is \$7 per gallon. The cost of the water-based cleaner, which is not yet commercialized, is estimated by the supplier at \$12.50 per gallon. Assuming the same amount of the alternative cleaners would be required, the annual cost of the soy product would be \$4,620 and the annual cost of the water-based alternative would be \$8,250.

SCSP has one worker who spends seven hours per day cleaning screens. The worker's labor rate is \$20 per hour. Assuming there are 260 working days per year, the annual labor cost for the cleaning process amounts to \$36,400.

SCSP provided estimates of the labor breakdown for the cleaning process. The worker spends 20 percent of his time on ink removal, 20 percent of his time on stencil removal and rinsing, 20 percent of his time on ghost image removal, 13 percent of his time on final rinsing and seven percent of his time on the vacuum drying operation. For the cost analysis, it was assumed that the worker would spend twice the time when the alternative soy based cleaner was used on the ink removal part of his job. On this basis, use of the soy based cleaner would add 1.4 hours of work per day to the cleaning process. The annual labor cost would amount to \$43,680. In the case of the water-based cleaner, the labor would be the same as with the current cleaner.

Table 2-2 shows the annualized cost comparison for the current high VOC cleaner, the soy based alternative and the water-based alternative. The lowest cost option is use of the water-based cleaner. It is slightly less costly than use of the current VOC solvent. The cost of using the soy based cleaner is eight percent higher than the cost of using the VOC solvent. The soy based cleaner is lower in cost than the VOC solvent but the labor cost increase raises the total cost of using the alternative above the cost of using the VOC solvent.

**Table 2-2
Annualized Cost Comparison for Southern California Screen Printing**

	Current VOC Cleaner	Soy Based Cleaner	Water-Based Cleaner
Cleaner Cost	\$8,316	\$4,620	\$8,250
Labor Cost	\$36,400	\$43,680	\$36,400
Total Cost	\$44,716	\$48,300	\$44,650

Com-Graf, Inc.

Com-Graf is located in Torrance, California. The company uses a variety of inks to print with fine mesh screens on various items including bottles and cups. The company specializes in printing on very difficult items like the surface of a walnut to a multi-angled chassis. Most of the ink used by Com-Graf is vinyl but the company also uses enamel and epoxy inks for printing. The cleaner currently used by the company is a high VOC material.

IRTA conducted preliminary testing with the owner of Com-Graf. A variety of alternatives were tested including a soy based cleaner, a white oil and a blend of acetone an mineral spirits. IRTA also performed testing with the Com-Graf workers during production. IRTA tested various blends of soy, acetone and mineral spirits. The blend that worked best was composed of 80 percent acetone, 10 percent Soy Gold 2000 and 10 percent mineral spirits. IRTA provided the company with larger quantities of the blend and it was tested for a longer period. The workers indicated that it performed well and that no additional labor was required to use the alternative. MSDSs for acetone, Soy Gold 2000 and the mineral spirit, called VM&P, are shown in Appendix A.

Com-Graf uses 55 gallons per month or 660 gallons per year of the high VOC solvent. The cost of the cleaner is \$486 per drum or \$5,832 per year. IRTA estimated the cost of the low VOC alternative from the cost of the individual components in the blend. The cost of Soy Gold 2000 is \$9 per gallon. The cost of acetone is also \$9 per gallon and the cost of mineral spirits is \$6 per gallon. The cost of the blend, based on these costs, is \$8.70 per gallon. Assuming the same usage rate for the alternative as for the high VOC cleaner, the annual cost of the alternative is \$5,742.

Table 2-3 shows the annualized cost comparison for Com-Graf. The cost of using the alternative cleaner is slightly lower than the cost of using the high VOC cleaner.

**Table 2-3
Annualized Cost Comparison for Com-Graf**

	High VOC Solvent	Soy/Acetone/Mineral Spirits Blend
Cleaner Cost	\$5,832	\$5,742
Total Cost	\$5,832	\$5,742

Serendipity

Serendipity is a small specialty screen printing facility located in Santa Fe Springs, California. The company prints on a range of substrates including wood and metal items and skate boards with solventborne ink including epoxy and flat fabrics with water-based ink. The owner performs all of the operations.

Each time a screen is used, it is recycled. The ink and the stencil are removed. The owner uses a glycol ether followed by lacquer thinner to clean the screens.

IRTA conducted preliminary testing and identified various alternatives that might be suitable for cleaning the screens. IRTA tested the most promising alternatives at Serendipity on a clear solventborne ink, an epoxy ink and an ink designed to print on plastic. The alternative that worked best was a blend of 92 percent acetone and eight percent mineral spirits. IRTA provided Serendipity with larger quantities of the cleaner and it was tested for a few months. The owner indicated that it turned the emulsion white but this had no effect on the screen when it was recycled and reused. The cleaner effectively cleaned the ink. MSDSs for acetone and VM&P mineral spirits are shown in Appendix A.

Serendipity uses one gallon of cleaner every two months or six gallons per year. The cost of glycol ether is about \$10 per gallon and the cost of lacquer thinner is about \$6 per gallon. Assuming half the cleaner used currently is glycol ether and half is lacquer thinner, the cost of the VOC cleaners is \$48 per year. The cost of the alternative low VOC cleaner is \$54 per year based on a cost of \$9 for acetone and \$6 for mineral spirits. The owner indicated there are no labor differences in using the alternative cleaner.

Table 2-4 shows the annualized cost comparison for the high and low VOC cleaning formulations. The cost of using the low VOC cleaner is 13 percent higher than the cost of using the glycol ether and lacquer thinner.

Table 2-4
Annualized Cost Comparison for Serendipity

	Glycol Ether/ Lacquer Thinner	Acetone/Mineral Spirits Blend
Cleaner Cost	\$48	\$54
Total Cost	\$48	\$54

Oberthur Card Systems

Oberthur Card Systems is located in Rancho Dominguez, California. The company has several lithographic presses and two automated screen printing presses for printing on plastic used to make credit cards of all types. A picture of one of the screen printing presses is shown in Figure 2-3.



Figure 2-3. Automated Printing Press at Oberthur

In the screen printing operation, Oberthur uses both waterborne inks and solventborne inks. The company uses plain water to clean the water-based inks and has historically used a VOC solvent for cleaning the solventborne inks. As part of a project sponsored by U.S. EPA and Cal/EPA's Department of Toxic Substances Control, IRTA worked with Oberthur to identify, develop and test alternative low-VOC cleaners. SCAQMD Rule 1171 requires cleanup materials used in screen printing to have a VOC content of 100 grams per liter by July 1, 2006 and IRTA tested materials that would meet this level.

IRTA obtained samples of Oberthur's solventborne screen ink for preliminary testing. The tests indicated that soy based cleaners and acetone performed well. Over a several month period, IRTA worked with Oberthur to test a variety of cleaners. The soy based cleaners cleaned the ink effectively. They left an oily residue on the screens that was not absorbed by the plastic substrate, however, and the printing was not acceptable. It became clear that soy based cleaners even in low concentrations in the formulation could not be used. IRTA then tested a number of different formulations based on acetone. The best performing acetone formulation was composed of about 88 percent acetone and 12 percent ethyl 3-ethoxy propionate (EEP) by weight. This cleaner has a VOC content less than 100 grams per liter. MSDSs for acetone and EEP are shown in Appendix A.

IRTA conducted testing with the blend with Oberthur and it appeared to perform well. More of the alternative cleaner was required. IRTA provided five gallons of the blend to

Oberthur for scaled-up testing and the company tested the cleaner. It performed effectively but the workers found that more of the alternative cleaner was necessary.

Oberthur uses 150 gallons of the VOC cleaner annually in the screen printing cleanup. The cost of the cleaner is \$20.50 per gallon. On this basis, the cost of the cleanup solvent is \$3,075 annually. For the alternative cleaner, IRTA assumed that 50 percent more would be required. This indicates that Oberthur would use 225 gallons of the acetone/EEP blend annually. Although this blend is not yet a commercial product, the blender estimates that the cost of the cleaner would be \$7.28 per gallon. The annual cost of the alternative cleaner, taking into account the higher use level, is \$1,638.

Table 2-5 shows the annualized cost comparison for the current VOC cleaner and the alternative cleaner for Oberthur. The values show that conversion to the alternative would reduce Oberthur's cleaning cost substantially, by 47%. Even if Oberthur required twice as much of the alternative cleaner as the current cleaner, the annual cleaning cost would still be much lower at \$2,184 than the current cleaning cost.

Table 2-5
Annualized Cost Comparison for Oberthur

	Current VOC Cleaner	Alternative Cleaner
Cleaner Cost	\$3,075	\$1,638
Total Cost	\$3,075	\$1,638

Texollini

Texollini is a knitting mill located in Long Beach, California. The company provides fabric development, knitting, dyeing, finishing, fabric print design and printing capabilities. Part of Texollini's operations involve screen printing on fabrics the company makes for their customers. A picture of the company's screen printing system is shown in Figure 2-4.

Texollini uses water-based inks exclusively for their screen printing operations. The water-based inks are applied on a conveyor line and the ink is cured in an oven. The screens are on a cylinder on the conveyor line. They are removed and cleaned using cold water in an automated system. In certain cases, the ink dries on the screen and cannot be removed with water. The company cleaned these screens with a VOC solvent using a hand-held spray wand.

IRTA conducted preliminary testing with Texollini's ink and identified several water-based cleaners that cleaned the ink effectively. Three of the water-based cleaners were tested in the hand-held spray cleaner. All three cleaners were more effective in cleaning the ink than the VOC solvent. IRTA provided larger quantities of the cleaner that



Figure 2-4. Printing Operation at Texollini

performed the best for scaled-up testing. After three months of testing, Texollini decided to convert to the alternative cleaner. An MSDS for the cleaner, called Brulin GD 1990, is shown in Appendix A.

Texollini used 132 pounds of the VOC cleaner per year at a cost of 89 cents per pound. The annual cost of the cleaner amounted to \$117. Texollini uses the water-based cleaner in a 25 percent concentration with water. Total annual usage is 41 pounds per year. Assuming a density for the cleaner of nine pounds per gallon and a price of \$12.75, the annual cost of the alternative water-based cleaner is \$58.

When the VOC solvent was used, Texollini had one employee who spent 1.5 hours per week cleaning ink from the screens. Assuming a labor rate of \$10 per hour, the labor cost for cleaning with the VOC solvent was \$780 per year. Less labor is required with the water-based cleaner. One employee now spends about one-half hour per week in cleaning. This amounts to an annual labor cost of \$260.

The spray applicator requires 120 volts and two amps which translates into 0.24 kW per hour. With the VOC solvent, the spray wand was used for 78 hours a year. Assuming an electricity cost of 15 cents per kWh, the annual electricity cost was about \$3 per year. With the water-based cleaner, the spray wand was used for less time, 26 hours per year.

Again, assuming an electricity rate of 15 cents per kWh, the annual electricity cost is now \$1 per year.

Table 2-6 shows the annualized cost comparison for Texollini. The company reduced their cleaning cost by 65 percent by converting to the water-based cleaner.

Table 2-6
Annualized Cost Comparison for Texollini

	VOC Solvent	Water-Based Cleaner
Cleaner Cost	\$117	\$58
Labor Cost	\$780	\$260
Electricity Cost	\$3	\$1
Total Cost	\$900	\$319

A stand alone case study for Texollini is presented in Appendix B.

Hino Designs

Hino Designs is located in Gardena, California. The company is a textile printer that develops and prints custom designs, primarily on T-shirts. Hino has one manual press and one automated press.

The company uses a VOC solvent for cleaning the screens during printing and after printing when the screens are recycled. During in-process cleaning, the cleaner is applied by hand with wipes. During final cleaning, Hino uses a recirculating cleaning system with a pump and brush to clean the screens. Between 30 and 40 screens are cleaned each week.

IRTA conducted preliminary testing with Hino by hand cleaning screens with various cleaners to decide which ones should be tested. The cleaners had to clean the ink well and they also had to leave the emulsion intact so Hino could save the screens for printing in the future. One of the cleaners, Mirachem Pressroom Cleaner, removed the emulsion when it was heated. Three other cleaners that did not remove the emulsion were also tested.

The best alternative cleaner in the screening tests was Soy Gold 2000, a vegetable based cleaner. An MSDS for this cleaner is shown in Appendix A. IRTA provided Hino with a parts cleaner containing the soy and it was tested for several weeks for cleaning the screens after printing. The soy cleaned the ink very well but it caused a problem with the screen tape. This tape is pulled off after printing and it leaves a residue. With Hino's VOC cleaner, the residue is simply left in place. The soy liquified the tape adhesive residue and Hino was concerned that this would cause a problem when the company tried to reapply the emulsion. Hino did apply emulsions to about 60 screens with no problem but the company was concerned that there could be a problem in the future. The residue

from the tape could be cleaned off with the soy but this would require increased labor. The soy also needed to be rinsed which was an additional step in the process.

IRTA tested another cleaner, a water-based cleaner called Super Scrub, in the parts cleaner at a concentration of one-third. This cleaner did not clean the ink effectively enough. IRTA increased the concentration to 50 percent but the cleaner did not perform as well as the current VOC cleaner.

IRTA tested a third cleaner, a water-based cleaner called Ardrox 405-V, at one-third concentration in the parts cleaner. An MSDS for this cleaner is provided in Appendix A. It did not clean aggressively enough so IRTA increased the concentration to 50 percent. This cleaner cleaned the ink as effectively as the VOC solvent. The operator, however, did not like the smell. IRTA added a fragrance to the cleaner and this improved the situation somewhat.

For the in-process cleaning, IRTA tested several alternatives. Hino is using an emulsion that is removed by many solvents. IRTA identified another emulsion that was solvent and water resistant. IRTA provided Hino with a sample but Hino did not test it during the project. IRTA did not identify an alternative for in-process cleaning at Hino.

IRTA analyzed and compared the cost of using the VOC solvent with the cost of using the soy and the Ardrox 405-V at the end of the printing process. Hino purchases about 60 gallons per year of the VOC cleaning solvent. The owner estimates that 60 percent of the solvent is used for in-process cleaning and 40 percent is used at the end of the printing cycle. The cost for five gallons of the cleaning solvent is \$62.50. The in-process solvent cost is \$450 annually. The cost of the solvent for cleaning after printing is \$300 annually.

The operator that performs the cleaning at the end of the printing process spends about eight hours per week cleaning. Assuming the cleaning is performed 52 weeks per year and assuming Hino's labor rate of \$7.50 per hour, the labor cost with the VOC solvent amounts to \$3,120 annually.

Hino pays an electricity cost for using the pump on the cleaning system. IRTA estimates that the annual electricity cost related to the pump is \$10. This is based on the electricity cost of a parts cleaner operating 1.6 hours per day.

Hino could use the soy cleaner in the current cleaning system. Assuming the use of the soy would be the same as the use of the VOC solvent, Hino would require 24 gallons of soy annually. At a cost of \$9 per gallon for the soy, the annual cleaner cost would amount to \$216. Use of the soy would require an additional one-half hour each week for the rinsing. On this basis, the labor cost with the soy would be \$3,315. The electricity cost for using the soy is the same as the cost with the VOC solvent.

The Ardrox 405-V, like other water-based cleaners, needs to be heated to clean more effectively. Hino would need to purchase a heater for use with their cleaning system to

use this cleaner. Assuming a heater cost of \$400, a cost of capital of four percent and a useful life of 10 years for the heater, the annualized cost of purchasing the heater would be \$42. The cost of the Ardrox 405-V is \$12.13 per gallon when purchased in small quantities. Assuming the cleaner is used at 50 percent dilution and that 24 gallons of cleaner would be required, the cost of the cleaner is \$146 annually. No additional labor would be required for use of the Ardrox 405-V. Because the water-based cleaner is heated, the electricity cost for the pump and heater in the cleaning system would increase. IRTA estimates the cost at \$85 per year.

Table 2-7 shows the annualized cost comparison for the cleaning after printing for Hino. The cost of the three options, the VOC solvent, the soy based cleaner and the water-based cleaner is comparable. The cost of using the soy based cleaner is about three percent higher than the cost of using the VOC solvent. The cost of using the water-based cleaner is about one percent lower than the cost of using the VOC solvent.

**Table 2-7
Annualized Cost Comparison for Hino**

	Current VOC Cleaner	Soy Based Cleaner	Water-based Cleaner
Capital Cost	-	-	\$42
Cleaner Cost	\$300	\$216	\$146
Labor Cost	\$3,120	\$3,315	\$3,120
Electricity Cost	\$10	\$10	\$85
Total Cost	\$3,430	\$3,541	\$3,393

Quickdraw

Quickdraw is located in West Los Angeles, California. The company is a textile printer and most of the work involves printing on T-shirts. Quickdraw has three presses. A picture of one of the presses is shown in Figure 2-5.

Quickdraw removes ink from the screens during the printing process. The company, like many other screen printers, also removes the ink from the screens at the end of the printing process so the screens can be recycled. Quickdraw uses one VOC solvent for the in-process cleaning, a blend of terpenes and mineral spirits, and a second VOC solvent for the end of process cleaning, an aerosol screen opener. All of the cleaning is performed by hand with wipes. After the wipes are used, they are sent off-site to an industrial laundry.

IRTA conducted preliminary testing of several alternatives for cleaning after the printing process. The operator decided that a soy based cleaner called Soy Gold 2000 performed best. An MSDS for this cleaner is shown in Appendix A. IRTA provided Quickdraw



Figure 2-5. Automated Press at Quickdraw

with the soy cleaner and the operator used it for several months. He indicated that it performed well. The soy is oily and must be rinsed with water before the screen can be reused.

Quickdraw uses 14 gallons per year of the VOC solvent for cleaning the screens after printing. The cost of the cleaner is \$11.40 per gallon. The annual cost of purchasing the cleaner is \$160. The cost of the alternative, the soy based product, is \$9 per gallon. Assuming the same amount of soy and the VOC solvent would be used, the annual cost of using the soy would amount to \$126.

Quickdraw spends about four hours per day cleaning screens after printing. Assuming the company operates five days per week and 52 weeks per year and that Quickdraw's labor rate is \$10 per hour, the annual labor cost is \$10,400. Quickdraw estimates that an extra hour of labor a day would be required to rinse the screens after cleaning with the soy. The labor cost for cleaning after printing with the soy would amount to \$13,000 per year.

For the in-process cleaning, Quickdraw uses an aerosol screen opening cleaner. The company uses about one can every two weeks and the cost of the cleaner is \$7 per can. On this basis, the cost of using the screen opener for in-process cleaning amounts to \$182.

IRTA tested one alternative for in-process cleaning. The cleaner is a blend of 60 percent white oil, 30 percent acetone and 10 percent mineral spirits. An MSDS for the white oil, acetone and VM&P mineral spirits are shown in Appendix A. Although the operator did not like the odor, the blend did clean effectively. The cost of the white oil is \$16.50 per gallon. The cost of acetone is \$9 per gallon and the cost of the mineral spirits is \$6 per gallon. Taking these prices into account, the cost of the blend amounts to \$13.20 per gallon. One aerosol can generally contains between 12 ounces and one pound of product. Using this assumption, and using a density for the cleaner of about seven pounds per gallon, Quickdraw uses about three gallons of screen opener a year for in-process cleaning. Assuming the same amount of the alternative blend would be required, the cost of using the alternative in-process cleaner would amount to \$40 annually.

Table 2-8 shows the annualized cost comparison for Quickdraw. The cost of using the alternative low-VOC cleaners is 23 percent higher than the cost of using the VOC cleaners.

**Table 2-8
Annualized Cost Comparison for Quickdraw**

	High VOC Cleaners	Soy and White Oil Cleaners
Cleaner Cost	\$342	\$166
Labor Cost	\$10,400	\$13,000
Total Cost	\$10,742	\$13,166

LCA Promotions Inc.

LCA Promotions is a textile printer located in Chatsworth, California. Much of the work involves printing on T-shirts but the company also prints on woven shirts, sweaters, activewear, headwear, outer wear and accessories like backpacks and aprons.

Until recently, LCA used lacquer thinner purchased from Home Depot for in-process cleaning during printing and after printing. During and after printing, the cleaner was applied by hand with wipes that are shipped off-site to an industrial laundry. The owner of LCA purchased a parts cleaner and is now using a different VOC cleaner. A picture of the new parts cleaner is shown in Figure 2-6.

IRTA performed preliminary screening tests with several alternative cleaners with the owner of LCA. Three cleaners worked well and left the emulsion intact. The first cleaner, an emulsion of water and mineral spirits, is called Hydroclean. IRTA provided LCA with a parts cleaner containing a concentration of Hydroclean of 12.5 percent. The cleaner was tested at the end of the printing process and it did not perform well.

The second cleaner tested at LCA in the parts cleaner was Soy Gold 2000, a vegetable based cleaner. An MSDS for this cleaner is shown in Appendix A. LCA tested the soy cleaner for several weeks in the parts cleaner. IRTA also provided the facility with the



Figure 2-6. Parts Cleaner at LCA Promotions

soy based cleaner so it could be tested for hand cleaning as well. The cleaner performed as well as their current cleaner. An extra step was required to rinse the soy.

The third cleaner tested at LCA was a water-based cleaner called Ardrex 405-V. An MSDS for this cleaner is shown in Appendix A. IRTA tested this cleaner in the parts cleaner at a 50 percent concentration. It was heated to about 105 degrees F and it performed well.

For the in-process cleaning, IRTA tested a blend of 60 percent white oil, 30 percent acetone and 10 percent mineral spirits. MSDSs for the white oil, the acetone and the VM&P mineral spirits are shown in Appendix A; like soy, the white oil has very low VOC content. The operator indicated that the lacquer thinner worked a little better but that the alternative did perform acceptably. The evaporation rate of the alternative in-process cleaner was judged by the operator to be just right.

IRTA analyzed and compared the cost of using the lacquer thinner, the new VOC cleaner and the alternative for cleaning during printing and the two alternatives for cleaning after printing. LCA used about 30 gallons per month or 360 gallons per year of the lacquer thinner. The owner estimates that 95 percent of the cleaner was used at the end of the cleaning process and five percent was used for in-process cleaning. On this basis, 342 gallons of the cleaner were used after printing and 18 gallons were used during printing each year. The cost of the cleaner, which was purchased in one-gallon quantities at hardware stores, is \$6 per gallon. The annual cost of purchasing the cleaner was \$2,052 for cleaning after printing and \$108 for in-process cleaning.

The new VOC cleaner is used in a parts cleaner with a 30 gallon capacity for cleaning after printing. LCA recently purchased a parts cleaner which is used with the new VOC cleaner. The cost of the parts cleaner was \$1,500. Assuming a useful life for the parts cleaner of 10 years and a cost of capital of four percent, the annualized cost of the parts cleaner amounts to \$156. IRTA estimates that the new VOC cleaner would require changeout every three months. LCA would also need 18 gallons of the cleaner each year for in-process cleaning. The cost of the cleaner is \$10.50 per gallon. The cost of purchasing the cleaner for in-process and after printing cleaning is \$1,449 annually. The unheated parts cleaner would use electricity for the pump and IRTA estimates this cost at \$50 per year.

LCA workers spend eight hours per day cleaning. Assuming a five day week and 52 weeks per year and adopting LCA's labor rate of \$8 per hour, the labor involved in cleaning activities amounts to \$16,640 annually.

For the in-process cleaning, IRTA estimated the cost of the alternative based on the raw material cost of the components purchased in small quantities. The cost of the white oil is \$16.50 per gallon. The cost of acetone is \$9 per gallon and the cost of the mineral spirits is \$6 per gallon. On this basis, the cost of the blend is \$13.20 per gallon. Assuming LCA purchases 18 gallons for in-process cleaning, the annual cost of the cleaner would amount to \$238. The labor would remain the same for the alternative in the in-process cleaning.

For cleaning after printing, it was assumed that the soy based cleaner would be used for hand cleaning in the same manner as the lacquer thinner. The cost of the soy is \$9 per gallon. Assuming 342 gallons would be required, the annual cost of purchasing the soy for hand cleaning is \$3,078. In this scenario, the labor would increase because the screens would require rinsing to remove the soy.

For cleaning after printing, IRTA also analyzed the cost of using the soy cleaner or the water-based cleaner in the parts cleaner. The water-based cleaner, to be effective, needs to be heated. If LCA purchased a heater for the parts cleaner, it would cost \$400. Making the same assumptions as for the parts cleaner, the annualized cost for the heater would be \$42. The parts cleaner with the added heater would use more electricity at a cost of \$466 annually based on a usage rate of eight hours per day.

Based on the cleaning tests with the parts cleaner, the soy and the water-based cleaner would require changeout every three months. Assuming a capacity of 30 gallons for the parts cleaner and a cost of \$9 per gallon for soy, the annual cost of soy for the parts cleaner would amount to \$1,080 per year. The cost of the water-based cleaner is \$7.50 per gallon for drum quantities and the cleaner is used at 50 percent concentration. On this basis, the annual cost of purchasing the water-based cleaner for the parts cleaner would be \$450.

No additional labor would be required for using the water-based cleaner. Because the screens need to be rinsed after cleaning with the soy based cleaner, there would be an

additional labor cost for the hand cleaning and for cleaning in the parts cleaner. The increased labor is estimated at one-half hour per day. On this basis, the increase in the labor cost would be \$1,040 annually.

LCA pays \$45 per week for sending the soiled rags to an industrial laundry and receiving fresh rags. The annual cost of this service amounts to \$2,340. Use of the soy cleaner for hand cleaning would lead to the same cost. Use of the cleaners in the parts cleaner would require disposal every three months when the parts cleaner is changed out. For all three cleaners, disposal of two drums of waste per year would be required. The cost of disposal is estimated at \$200 per drum for an annual cost of \$400. Use of the parts cleaner would reduce the cost of the service for the rags. Assuming that five percent of the cleaning, the in-process cleaning, would still need to be done with rags, the cost of the rag service with the parts cleaner would be \$117 annually.

Table 2-9 compares the cost of five scenarios. The first case is the use of lacquer thinner for hand cleaning. The second case is the case of the high VOC solvent used in the parts cleaner. The third case is the use of soy for hand cleaning. The fourth case is the use of soy in the parts cleaner. The fifth case is the use of the water-based cleaner in the parts cleaner. The cleaner used after printing is referred to as Cleaner A in the table and the in-process cleaner is called Cleaner B. The scenarios assume that the alternative in-process cleaner is used for the last three cases.

**Table 2-9
Annualized Cost Comparison for LCA Promotions**

	Lacquer Thinner Hand	VOC Solvent Parts Cleaner	Soy Hand	Soy Parts Cleaner	Water-Based Parts Cleaner
Capital Cost	-	\$156	-	\$156	\$198
Cleaner A Cost	\$2,052	\$1,260	\$3,078	\$1,080	\$450
Cleaner B Cost	\$108	\$189	\$238	\$238	\$238
Labor Cost	\$16,640	\$16,640	\$17,680	\$17,680	\$16,640
Electricity Cost	-	\$50	-	\$50	\$466
Disposal Cost	\$2,340	\$517	\$2,340	\$517	\$517
Total Cost	\$21,140	\$18,812	\$23,336	\$19,721	\$18,509

The lowest cost option in Table 2-9 is use of the water-based cleaner in a parts cleaner. The cost of this option is about 12 percent lower than the baseline option of the lacquer thinner cleaning by hand. Using the VOC solvent in a parts cleaner is also lower cost than using the lacquer thinner for hand cleaning by about 11 percent. The cost of using the soy based cleaner in a parts cleaner is also lower in cost by seven percent than cleaning with the lacquer thinner by hand. Cleaning with the soy by hand is 10 percent higher in cost than cleaning with the lacquer thinner by hand.

III. PROJECT RESULTS AND CONCLUSIONS

During this project, IRTA staff worked with nine screen printers to test alternative safer, low-VOC cleanup materials. SCAQMD Rule 1171 currently allows screen printers to use cleaners with 750 grams per liter VOC. In July 2005, the allowed VOC level will decline to 500 grams per liter and, a year later, it will be set at 100 grams per liter.

IRTA staff tested alternatives with the nine participating facilities for in-process cleaning and screen recycling. All of the alternatives that were tested had a VOC content of 100 grams per liter or less. The alternatives that were tested fall into three categories including water-based cleaners, soy based cleaners and exempt solvent blends. In general, these alternatives are lower in toxicity than the higher VOC cleaners used by the industry.

Table 3-1 summarizes the alternatives that were tested successfully at each of the facilities that participated in the project. The table also specifies the type of ink used by each facility.

**Table 3-1
Successful Safer and Low-VOC Alternatives**

<u>Company</u>	<u>Ink Type</u>	<u>Successful Alternative(s)</u>
Owens-Illinois	UV	Soy Based Cleaner
Southern California Screen Printing	UV	Water-Based Cleaner, Soy Based Cleaner
Com-Graf	Solventborne	Soy/Acetone/Mineral Spirits Blend
Serendipity	Solvent and waterborne	Acetone/Mineral Spirits Blend
Oberthur	Solvent and waterborne	Acetone/EEP Blend
Texollini	Waterborne	Water-Based Cleaner
Hino Designs	Plastisol	Water-Based Cleaner, Soy Based Cleaner
Quickdraw	Plastisol	Soy Based Cleaner, White Oil/ Acetone/Mineral Spirits Blend
LCA Promotions	Plastisol	Soy Based Cleaner, Water-Based Cleaner, White Oil/Acetone/ Mineral Spirits Blend

Table 3-1 indicates that UV curable ink can be cleaned with soy and water-based cleaners at Owens-Illinois and Southern California Screen Printing. Com-Graf, Serendipity and Oberthur can clean their solventborne ink with acetone blends. The cured waterborne ink at Texollini was cleaned successfully with a water-based cleaner. The three textile printers, Hino Designs, Quickdraw and LCA Promotions, cleaned their plastisol ink successfully with water-based cleaners and soy based cleaners during screen recycling. For in-process cleaning, the textile printers can clean with a white oil/acetone blend.

The cost analysis indicated that the alternatives were lower cost in some cases and higher cost in other cases. Owens-Illinois converted to the soy based cleaner and reduced their cost. Southern California Screen Printing would increase their cost if they converted to the soy based cleaner; their cost would remain about the same if they converted to the water-based cleaner. Com-Graf and Oberthur would both reduce their cost by converting to the alternative acetone blends. Serendipity would increase their cost by converting to the acetone blend. Texollini converted to the water-based cleaner alternative and reduced their cost substantially in the process. The cost at Hino Designs would remain about the same if the company converted to the soy based or water-based alternative. Quickdraw would increase their cost by converting to the alternatives. LCA Promotions would reduce their cost by converting to the water-based cleaner but would increase their cost by converting to the soy based cleaner.

The results of the project indicate that screen printers using a variety of different ink types and printing on different substrates can find safer alternatives. The alternatives tested here were generally lower in toxicity than the cleaners used by the facilities today. The alternatives were also low in VOC content; all the alternative cleaners that were tested had a VOC content of 100 grams per liter or less. In some cases, use of the alternatives would increase costs but in most cases, the cost of using the alternative would be less or about the same.

Appendix A
Material Safety Data Sheets for Safer Alternative Products

MSDS for Soy Gold 2000



MATERIAL SAFETY DATA SHEET

EMERGENCY PHONE: 913-599-6911

CHEMTREC: 800-424-9300

SECTION I-IDENTIFICATION

PRODUCT: SOYGOLD® 2000
CAS No.: 67784-80-9
CHEMICAL: Fatty acid methyl esters
SYNONYMS: Methyl esters of soybean oil

SECTION II-INGREDIENTS AND HAZARD CLASSIFICATION

TYPICAL COMPOSITION	CAS	%
Alkyl C ₁₆ -C ₁₈ -Methyl Esters	67784-80-9	97-99
Surfactant	9016-45-9	1-3

SARA HAZARD: TITLE III SECTION 313: Not listed FIRE (Section 311/312): None noted

SECTION III-HEALTH INFORMATION

EFFECTS OF OVEREXPOSURE

INHALATION: No known problems
INGESTION: LD₅₀:>50ml/kg (albino rats)(similar products)
EYE CONTACT: Not classified as eye irritants
SKIN CONTACT: Not classified as a skin irritant or corrosive material

SECTION IV-OCCUPATIONAL EXPOSURE LIMITS

PEL: NO OSHA PEL TLV: NO ACCIH TLV

SECTION V-EMERGENCY FIRST AID PROCEDURE

FOLLOW STANDARD FIRST AID PROCEDURES

SWALLOWING: Call physician or poison control center.
SKIN CONTACT: Wash affected area.
EYE CONTACT: Flush eyes with cool water for at least 15 minutes. Do not let victim rub eyes.
INHALATION: Immediately remove victim to fresh air. Get medical attention immediately.

SECTION VI-PHYSICAL DATA

BOILING POINT: Over 600° F (315° C) at 760 mm Hg pressure
MELTING POINT: -1° C
VAPOR PRESSURE: 0.882 mm Hg at 25° C
SPECIFIC GRAVITY: 0.882 g/mL at 25° C
DIELECTRIC STRENGTH: >56.9
SOLUBILITY IN WATER: Negligible at room temperature
APPEARANCE AND COLOR: Light yellow to clear and liquid at room temperature
ODOR: Light vegetable oil odor

SECTION VII-FIRE AND EXPLOSION HAZARDS

FLASH POINT & METHOD USED: 425° F (218° C)(PMCC)
FLAMMABLE LIMITS: Not applicable
NFPA RATING: No NFPA rating
HMIS RATING: HEALTH: 0 FIRE: 1 REACTIVITY: 0

AEF 12001

SPECIAL FIRE FIGHTING PROCEDURES & PRECAUTIONS

Treat as oil fire. Use water spray, dry chemical, foam or carbon dioxide.

UNUSUAL FIRE & EXPLOSION HAZARDS

Rags soaked with any solvent present a fire hazard and should always be stored in UL listed or Factory Mutual approved, covered containers. Improperly stored rags can create conditions that lead to oxidation. Oxidation, under certain conditions can lead to spontaneous combustion. This product contains antioxidants to retard oxidation.

SECTION VIII-REACTIVITY

STABILITY:	Stable
HAZARDOUS POLYMERIZATION:	None likely
MATERIALS TO AVOID:	Strong oxidizing agents
HAZARDOUS DECOMPOSITION PRODUCTS:	CO ₂ , CO
CONDITIONS TO AVOID:	None known

SECTION IX-EMPLOYEE PROTECTION

CONTROL MEASURES:	Adequate ventilation
RESPIRATORY PROTECTION:	None required
PROTECTIVE CLOTHING:	No need anticipated
EYE PROTECTION:	None required

SECTION X-ENVIRONMENTAL PROTECTION

ENVIRONMENTAL PRECAUTIONS:	Avoid uncontrolled releases of this material into environment.
SPILL OR LEAK PRECAUTIONS:	Contain spilled material. Transfer to secure containers. Where necessary, collect using absorbent media.
WASTE DISPOSAL:	Dispose of according to federal, state and/or local requirements.

SECTION XI-REGULATORY CONTROLS

DOT CLASSIFICATION:	Class 55
DOT PROPER SHIPPING NAME:	Cleaning Compound, N.O.S.
OTHER REGULATORY REQUIREMENTS:	Listed in TSCA inventory

SECTION XII-PRECAUTIONS: HANDLING, STORAGE AND USAGE

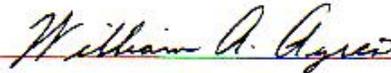
No special precautions necessary.

SECTION XIII-DATE AND SIGNATURE

This information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any other process. The stated MSDS is reliable to the best of the company's knowledge and believed accurate as of the date indicated. However, no representation, warranty or guarantee of any kind, expressed or implied, is made as to its accuracy, reliability or completeness and we assume no responsibility for any loss, damage or expense, direct or consequential, arising out of use. It is the user's responsibility to satisfy himself as to the suitability and completeness of such information for his own particular use.

AG ENVIRONMENTAL PRODUCTS, L.L.C.
9804 PFLUMM
LENEXA, KS 66215

SIGNATURE: _____



PREPARED BY: WILLIAM A. AYRES REVISION DATE: 5-01-01

MSDS for Autowash #3

MATERIAL SAFETY DATA SHEET

I. PRODUCT IDENTIFICATION

Trade Name: SIEBERT AUTOWASH #3
Generic Name: Blanket Wash

CAS #: Proprietary Blend

Manufacturer: Siebert, Inc.
Address: 8134 West 47th Street
City: Lyons State: IL Zip: 60534

Emergency phone#: (800) 535-5053
Technical phone#: (708) 442-2010

DOT Hazard Classification: Not Regu
NFPA Codes: Health - 0 Flammability - 0 Reactivity - 0
HMIS Codes: Health - 1 Flammability - 0 Reactivity - 0 Personal Protection - B

II. HAZARDOUS INGREDIENTS

If present, IARC, NTP, and OSHA carcinogens and chemicals subject to the reporting requirements of SARA Title III Section 313 are identified in this section.

Ingredient Name	CAS Number	%wt	TLV	STEL	SARA TITLE III
Fatty esters	Various	70 to 90	None established	None established	No
Surfactants	Various	15 to 30	None established	None established	No

References: 29CFR 1910.1000, ACGIH "Threshold Limit Values for Chemicals in the Workplace", National Toxicology Program Annual Report, International Agency for Research on Cancer Monographs, and 40CFR Part 372. All components of this product are in compliance with TSCA.

III. PHYSICAL DATA

Boiling Point @ 760 mm Hg:	308 - 335°F
Vapor Pressure @ 80°F:	<0.1 mm Hg
Specific Gravity @ 68°F:	0.92
Water Solubility (%):	Insoluble
Specific Vapor Density (air=1):	<1.0
% Volatile by Volume:	<1.0
% Volatile Organic Compound(s):	<1.0
Appearance:	Clear golden liquid
Odor:	Typical organic odor

IV. FIRE AND EXPLOSION DATA

Flash Point (Method): >300°F (TCC)
Explosive Limit: LEL - N/E UEL - N/E
Extinguishing Media: Water fog, carbon dioxide, or dry chemical.
Special Fire Fighting Procedures: Wear self-contained breathing apparatus when fighting chemical fires.
Unusual Fire and Explosion Hazards: Fine sprays/mists may be combustible at temperatures below normal flash point. Rags soaked with material, stored for a long period while mixed with strong alkali or acidic materials, may smolder, then smoke, and may even ignite.

V. HEALTH HAZARD DATA

Eyes - May cause temporary irritation, redness, tearing, blurred vision. Contact lenses must not be worn when possibility exists for eye contact due to spraying liquid or airborne particles.
Skin - Prolonged or repeated contact may cause irritation.

SIEBERT AUTOWASH #3

Breathing - Excessive inhalation of vapors may cause nasal and respiratory irritation, central nervous system effects including dizziness, weakness, fatigue, nausea, headache and possible unconsciousness.

Swallowing - Can cause gastrointestinal irritation, nausea, vomiting, and diarrhea.

First Aid/Emergency Procedures

Inhalation: Remove to fresh air. If breathing is difficult, administer oxygen. If breathing has stopped, give artificial respiration. Keep person warm, quiet and get medical attention.

Skin Contact: Wash thoroughly with soap and water. Remove contaminated clothing. Launder contaminated clothing before re-use.

Eyes: Flush with copious amounts of water. Get medical attention.

Ingestion: Do not induce vomiting. If large quantity is swallowed, give lukewarm water (pint). NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON. Get medical attention immediately. Risk of damage to lungs exceeds poisoning risk.

Primary Entry Route(s): Inhalation, skin contact.

Chronic Health Effects: Chronic overexposure may aggravate existing skin, eye and lung conditions.

VI. REACTIVITY DATA

Stability: Stable.

Hazardous Polymerization: Cannot occur.

Incompatibilities: Avoid contact with strong oxidizing materials, strong alkalies, strong mineral acids.

Hazardous Decomposition Products: Carbon mono/di oxides.

Conditions to Avoid: None

VII. SPILL OR LEAK PROCEDURES

Procedures for Spill/Leak:

Eliminate all ignition sources (flares, flames including pilot lights, electrical sparks, etc.).

Small Spill - Absorb liquid on paper, vermiculite, floor absorbent, or other absorbent material and transfer to a recovery drum.

Large Spill - Persons not wearing protective equipment should be excluded from area of spill until clean-up has been completed. Stop spill at source, dike area of spill to prevent spreading, pump liquid to salvage tank. Remaining liquid may be taken up on sand, clay, earth, floor absorbent, or other absorbent material and shoveled into recovery drums. Prevent run-off to sewers, streams or other bodies of water. Notify proper authorities, as required, that a spill has occurred.

Waste Management:

Landfill solids at permitted sites. Use registered transporters. Burn concentrated liquids at permitted sites. Avoid flameouts. Assure emissions comply with applicable regulations. Dilute aqueous waste may biodegrade. Avoid overloading/poisoning plant biomass. Assure effluent complies with applicable regulations.

VIII. SPECIAL PROTECTION INFORMATION

Respiratory Protection:

If workplace exposure limit(s) of product is exceeded, a NIOSH/MSHA approved air supplied respirator is advised in the absence of proper environmental control. OSHA regulations also permit other NIOSH/MSHA respirators (negative pressure type) under specified conditions. Engineering or administrative controls should be implemented to reduce exposure.

Ventilation: Provide sufficient mechanical (general and/or local exhaust) ventilation to maintain minimum exposure.

Eye Protection: Chemical Splash Proof Goggles and full face shield are advised for operations where eye or face contact can occur.

Gloves: Wear impervious gloves.

Other Protective Equipment: To prevent repeated or prolonged skin contact, wear impervious clothing and boots.

IX. SPECIAL PRECAUTIONS

SIEBERT AUTOWASH #3

Special Handling/Storage:

To avoid skin contact and ingestion, wash hands and face well before eating or smoking. Do not permit food in work area. Avoid breathing mists if generated. Store at room temperature. Reseal container when not in use. Do not store near acids, bases or flammable liquids. Containers of this material should be rinsed when emptied, since emptied containers retain product residues (vapor, liquid, and/or solid). All hazard precautions given in this data sheet must be observed.

As of the date of preparation of this document, the foregoing information is believed to be accurate and is provided in good faith to comply with applicable federal and state law(s). However, no warranty or representation with respect to such information is intended or given.

Date revised: 04/01/2001

jpm

MSDS for Mirachem NP-2520



Material Safety Data Sheet

Experimental Commercial Printing Cleaner NP 2520

(Formulation No. 2520)

Section I - Chemical Product and Company Identification

Manufacturer Name: Mirachem Corporation
P.O. Box 14059
Phoenix, Arizona 85063-4059
Date Prepared: 8/31/04
Revision Date: New
Emergency Phone: 1-(800) 847-3527

Section II - Composition/Information on Ingredients

<u>Hazardous Component (CAS #)</u>	<u>OSHA PEL</u>	<u>ACGIH TLV</u>	<u>Other Limits</u>	<u>% (Optional)</u>
None				

Section III - Hazards Identification

Emergency Overview: Clear, non-flammable, water based cleaner with a light citrus odor.

Potential Health Effects:

Eye Contact: May cause mild temporary irritation.

Skin Contact: Prolonged or repeated exposure may cause mild irritation.

Inhalation: No adverse effects expected.

Ingestion: No adverse health effects are anticipated to occur as a result of acute ingestion. Chronic effects are not known.

Carcinogenicity: None of the components in this material are listed by IARC, NTP, OSHA, or ACGIH as a carcinogen.

Signs/Symptoms of Overexposure: Prolonged contact may cause mild irritation or dryness to sensitive skin.

Medical Conditions Generally Aggravated by Exposure: None known.

Section IV - First Aid Measures

Eyes: Immediately flush with clean water. Consult physician if necessary.

Skin: Rinse with water.

Ingestion: If swallowed, treat symptomatically and supportively. Do not induce vomiting. If victim conscious and alert, give two glasses of water or milk to drink. If vomiting occurs, keep head below hips to prevent aspiration. Contact Physician.

Inhalation: No adverse effects anticipated.

Section V - Fire and Explosion Hazard

Flash Point (Method Used): >212°F (PMCC, nonflammable) Explosive Limits: N/A
Extinguishing Media: N/A
Special Fire Fighting Procedures: N/A Unusual Fire Fighting and Explosion Hazards: N/A

Section VI - Accidental Release

Small Spills: Flush with water into containing area or to sewer where applicable within Federal, State or Local disposal requirements.
Large Spills: Dike and pump into suitable containers, clean up residual with absorbent material and wash with water. Dispose of in accordance with Federal, State or Local disposal requirements.

Section VII - Handling & Storage

Handling & Storage: Wear protective goggles or face shield if splashing or spraying liquid. Protect from freezing.
Precautions:
Other Precautions: Keep container tightly closed. Keep out of reach of children.

Section VIII - Exposure Controls, Personal Protection

Respiratory Protection: No respiratory protection is necessary.
Ventilation: Good general ventilation is sufficient.
Protective Clothing: When prolonged skin contact is expected, wear protective gloves.
Eye Protection: Wear safety glasses.
Work/Hygienic Practices: Use good personal hygiene practices, wash hands before eating, drinking, smoking, or using toilet facilities.

Section IX - Physical/Chemical Characteristics

Boiling Point:	>210°F	Specific Gravity (H ₂ O = 1):	0.963
Vapor Pressure (mm Hg.) @ 20°C	Composite = 0.006	pH:	9.5 – 10.0
Vapor Density (AIR =1):	> 1	Evaporation Rate (Butyl Acetate = 1):	> 1
Solubility in Water:	Complete	Melting Point:	N/A
Appearance and Odor:	Clear liquid with a mild citrus odor		

N/A = Not Applicable N. E. = Not Established

Section X - Stability & Reactivity

Stability:	Unstable Stable X	Incompatibility (Materials to Avoid):	Strong Acids and Alkalies demulsify product.
Hazardous Decomposition or By-products:	Thermal decomposition may produce CO ₂		
Hazardous Polymerization:	May Occur	Will Not Occur	X

Section XI - Toxicological Information

No data currently available

Section XII - Ecological Information

No data currently available

Section XIII - Disposal Considerations

Waste Disposal: Flush uncontaminated material to sewer where applicable within Federal, State or Local
(Unused Material) disposal requirements.

Note: Chemical additions to, processing of, or otherwise altering this material may make this waste management information incomplete, inaccurate, or otherwise inappropriate. Furthermore, State and local waste disposal requirements may be more restrictive or otherwise different from Federal laws and regulations.

Section XIV - Transportation Information

D.O.T Shipping Name:	Not Regulated	D.O.T Hazard Class:	None
UN Shipping Name:	N/A	UN/NA Number:	N/A
UN Class or Division:	N/A	UN Packing Group:	None
NMFC Freight Class:	Compound, Cleaning Fluid, NOI 48580 Sub 3		

Section XV - US Regulatory Information

Notice: The information herein is presented in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied is given. Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with federal, state, and local laws. The following specific information is made for the purpose of complying with numerous federal, state, and local laws and regulations.

Federal Regulations:

Workplace Classification This product is considered non-hazardous under the OSHA Hazard Communication Standard (29CFR 1910.1200)

SARA Title III

Section 311/312 This product is not a hazardous chemical under 29CFR 1910.1200, and therefore is not covered by Title III of SARA.

Section 313 This product does not contain a chemical, which is listed in Section 313 at or above de minimis concentrations.

CERCLA Information (40CFR 302.4) Releases of this product to air, land, or water are not reportable to the National Response Center under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or to state and local emergency planning committees under the Superfund Amendments and Reauthorization Act (SARA) Title III Section 304.

Waste Classification When a decision is made to discard unused portions of this product, it does not meet RCRA's characteristic definition of ignitability, corrosivity, or reactivity, and none of the materials used in this product are listed in 40 CFR 261.33. The toxicity characteristic (TC), however, has not been evaluated by the Toxicity Characteristic Leaching Procedure (TCLP).

Note: Chemical additions to, processing of, or otherwise altering this material may make this waste management information incomplete, inaccurate, or otherwise inappropriate. Furthermore, State and local waste disposal requirements may be more restrictive or otherwise different from Federal laws and regulations.

TSCA All components of this product are in compliance with the inventory listing requirements of the U.S. Toxic Substances Control Act.

NFPA Ratings	Health = 1	Flammability = 0	Reactivity = 0	Special = 0
NPCA-HMIS Ratings	Health = 1	Flammability = 0	Reactivity = 0	Protective Equipment = None

State Regulations:

Arizona

Maricopa County Under the definitions of Rule 331, this product is considered a Low-VOC Cleaner.

California

California Safe Drinking Water and Toxic Enforcement - Prop. 65 This product does not contain any materials currently listed by California as chemicals known to cause cancer or known to have reproductive toxicity under Proposition 65.

Volatile Organic Compounds (VOC) The VOC content of this product is 97 grams/liter (0.81 pounds/gallon) with a composite partial pressure at 20°C of less than 1mm Hg.

BAAQMD This product meets the requirements of the Bay Area Air Quality Management District Regulation 8, Rule 16 when used at a 1:1 dilution with water. The VOC content at this dilution is 48 grams/Liter (0.40 pounds/gallon) with a composite partial pressure at 20°C of less than 1 mm Hg.

SCAQMD This product, when used at normal use dilutions of 3:1 or greater meets the requirements of South Coast Air Quality Management District Rules 1122 and 1171. The VOC content at this dilution is 24 g/L (0.20 lbs./gal.) with a composite partial pressure at 20°C of less than 1 mm Hg.

Section XVI - International Regulatory Information

Notice: The information herein is presented in good faith and believed to be accurate as of the effective date shown above. However, no warrantee, express or implied is given. Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with their federal, state/province, and local laws. The following specific information is made for the purpose of complying with numerous specific foreign regulations.

Australia This product is not classified as hazardous according to criteria of Worksafe Australia. Mirachem has reviewed Australia's List of Hazardous Substances and Australia's Standard of the Uniform Scheduling of Drugs and Poisons and determined that no ingredient in this product is listed in either listing. We have also verified with NICNAS at the Australian National Occupational Health & Safety Commission (NOHSC) that all of the components in this formulation are listed in the Australian Inventory of Chemical Substances (AICS) and that no notification will be necessary under the Industrial Chemicals (Notification and Assessment) Act 1989.

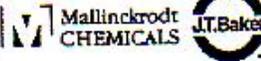
Canada Non-controlled under WHMIS.

European Union All materials in this formulation are EINECS listed. Not a hazardous preparation according to the EC-Directive 68/379/EEC.

MSDS for Acetone

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865



24 Hour Emergency Telephone: 908-899-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 619-896-6555

Outside U.S. and Canada
Chemtrec: 709-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

ACETONE

MSDS Number: A0446 --- Effective Date: 04/10/01

1. Product Identification

Synonyms: Dimethylketone; 2-propanone; dimethylketal

CAS No.: 67-64-1

Molecular Weight: 58.08

Chemical Formula: (CH₃)₂CO

Product Codes:

J.T. Baker: 5356, 5580, 5805, 9001, 9002, 9003, 9004, 9005, 9006, 9007, 9008, 9009, 9010, 9015, 9036, 9125, 9254, 9271, A134, V655

Mallinckrodt: 0018, 2432, 2435, 2437, 2438, 2440, 2443, 2445, 2850, H451, H580, H981

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Acetone	67-64-1	99 - 100%	Yes

3. Hazards Identification**Emergency Overview**

DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM.

J.T. Baker SAF-T-DATA^(tm) Ratings (Provided here for your convenience)

Health Rating: 1 - Slight

<http://www.jtbaker.com/msds/A0446.htm>

8/15/02

Flammability Rating: 4 - Extreme (Flammable)
Reactivity Rating: 2 - Moderate
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

Inhalation:

Inhalation of vapors irritates the respiratory tract. May cause coughing, dizziness, dullness, and headache. Higher concentrations can produce central nervous system depression, narcosis, and unconsciousness.

Ingestion:

Swallowing small amounts is not likely to produce harmful effects. Ingestion of larger amounts may produce abdominal pain, nausea and vomiting. Aspiration into lungs can produce severe lung damage and is a medical emergency. Other symptoms are expected to parallel inhalation.

Skin Contact:

Irritating due to defatting action on skin. Causes redness, pain, drying and cracking of the skin.

Eye Contact:

Vapors are irritating to the eyes. Splashes may cause severe irritation, with stinging, tearing, redness and pain.

Chronic Exposure:

Prolonged or repeated skin contact may produce severe irritation or dermatitis.

Aggravation of Pre-existing Conditions:

Use of alcoholic beverages enhances toxic effects. Exposure may increase the toxic potential of chlorinated hydrocarbons, such as chloroform, trichloroethane.

4. First Aid Measures

Inhalation:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Ingestion:

Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately.

Skin Contact:

Immediately flush skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting upper and lower eyelids occasionally. Get medical attention.

5. Fire Fighting Measures

Fire:

Flash point: -20C (-4F) CC

Autoignition temperature: 465C (869F)

Flammable limits in air % by volume:

lcl: 2.5; ucl: 12.8

Extremely Flammable Liquid and Vapor! Vapor may cause flash fire.

Explosion:

Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Vapors can flow along surfaces to distant ignition source and flash back. Contact with strong oxidizers may cause fire. Sealed containers may rupture when heated. This material may produce a floating fire hazard. Sensitive to static discharge.

Fire Extinguishing Media:

Dry chemical, alcohol foam or carbon dioxide. Water may be ineffective. Water spray may be used to keep fire exposed containers cool, dilute spills to nonflammable mixtures, protect personnel attempting to stop leak and disperse vapors.

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB(R) solvent adsorbent is recommended for spills of this product.

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:

Acetone:

-OSHA Permissible Exposure Limit (PEL):

1000 ppm (TWA)

-ACGIH Threshold Limit Value (TLV):

500 ppm (TWA), 750 ppm (STEL) A4 - not classifiable as a human carcinogen

Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):

If the exposure limit is exceeded, a half-face organic vapor respirator may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest.

A full-face piece organic vapor respirator may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-face piece positive-pressure, air-supplied respirator.

WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin

contact.

Eye Protection:

Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:

Clear, colorless, volatile liquid.

Odor:

Fragrant, mint-like

Solubility:

Miscible in all proportions in water.

Specific Gravity:

0.79 @ 20C/4C

pH:

No information found.

% Volatiles by volume @ 21C (70F):

100

Boiling Point:

56.5C (133F) @ 760 mm Hg

Melting Point:

-95C (-139F)

Vapor Density (Air=1):

2.0

Vapor Pressure (mm Hg):

400 @ 39.5C (104F)

Evaporation Rate (BuAc=1):

ca. 7.7

10. Stability and Reactivity

Stability:

Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:

Carbon dioxide and carbon monoxide may form when heated to decomposition.

Hazardous Polymerization:

Will not occur.

Incompatibilities:

Concentrated nitric and sulfuric acid mixtures, oxidizing materials, chloroform, alkalis, chlorine compounds, acids, potassium t-butoxide.

Conditions to Avoid:

Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

Oral rat LD50: 5800 mg/kg; Inhalation rat LC50: 50,100mg/m3; Irritation eye rabbit, Standard Draize, 20 mg severe; investigated as a tumorigen, mutagen, reproductive effector.

-----\Cancer Lists\-----

Ingredient	---NF? Carcinogen---		IARC Category
	Known	Anticipated	
Acetone (67-64-1)	No	No	None

12. Ecological Information

Environmental Fate:

When released into the soil, this material is expected to readily biodegrade. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material is expected to readily biodegrade. When released to water, this material is expected to quickly evaporate. This material has a log octanol-water partition coefficient of less than 3.0. This material is not expected to significantly bioaccumulate. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material may be moderately degraded by photolysis. When released into the air, this material is expected to be readily removed from the atmosphere by wet deposition.

Environmental Toxicity:

This material is not expected to be toxic to aquatic life. The LC50/96-hour values for fish are over 100 mg/l.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: ACETONE
 Hazard Class: 3
 UN/NA: UN1090
 Packing Group: II
 Information reported for product/size: 350LB

International (Water, I.M.O.)

Proper Shipping Name: ACETONE
 Hazard Class: 3
 UN/NA: UN1090
 Packing Group: II
 Information reported for product/size: 350LB

15. Regulatory Information

Ingredient	-----\Chemical Inventory Status - Part 1\-----			
	TSCA	EC	Japan	Australia

-----\Chemical Inventory Status - Part 2\-----				
Ingredient	Korea	Canada	DSL	NDSL Phil.
Acetone (67-64-1)	Yes	Yes	Yes	Yes
-----\Federal, State & International Regulations - Part 1\-----				
Ingredient	-SARA 302-		-SARA 313-	
	RQ	TPQ	List	Chemical Catg.
Acetone (67-64-1)	No	No	Yes	No
-----\Federal, State & International Regulations - Part 2\-----				
Ingredient	CERCLA	-RCRA-	-TSCA-	
		261.33	8(d)	
Acetone (67-64-1)	5000	0002	No	

Chemical Weapons Convention: No TSCA 12(b): Yes CDTA: Yes
 SARA 311/312: Acute: Yes Chronic: No Fire: Yes Pressure: No
 Reactivity: No (Pure / Liquid)

Australian Hazchem Code: 2[Y]E
Poison Schedule: No information found.

WHMIS:
 This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 1 Flammability: 3 Reactivity: 0

Label Hazard Warning:
 DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM.

Label Precautions:
 Keep away from heat, sparks and flame.
 Keep container closed.
 Use only with adequate ventilation.
 Wash thoroughly after handling.
 Avoid breathing vapor.
 Avoid contact with eyes, skin and clothing.

Label First Aid:
 Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.

Product Use:
 Laboratory Reagent.
Revision Information:
 No changes.
Disclaimer:

MSDS for VM&P

MATERIAL SAFETY DATA SHEET

DATE PRINTED: 9/16/1999 PAGE 1
 00000000 ARPIL MILLER MSDS NO. 1650

SECTION 1. CHEMICAL PRODUCT AND COMPANY INFORMATION

MANUFACTURERS NAME ADDRESS
 W.M. BARR & COMPANY, INC. 2105 Channel Ave.
 Memphis, TN 38113 USA
 EMERGENCY TELEPHONE #1 EMERGENCY CONTACT
 901-775-0100 W.M. Barr Technical Serv.
 EMERGENCY INFORMATION
 See Section 5 for additional Emergency Information
 INVENTORY ITEM # CHEMICAL FORMULA
 G22701 1650
 PRODUCT NAME
 ALLPRO VM&P NAPHTHA
 REVISED BY REVISION DATE
 W.M. Barr Technical Services 7/20/1992

SECTION 2. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE DESCRIPTION	PERCENT	CAS#	CARCINOGENICITY			
			NTP	ACGIH	OSHA	IARC
ALIPHATIC PETROLEUM DISTILLATE	95-100	64742-89-8	N	N	N	N
** ABOVE INGREDIENT CONSISTS OF THE FOLLOWING **						
VM&P NAPHTHA	95-100	8032-32-4	N	N	N	N

SECTION 3. REGULATORY INFORMATION

SUBSTANCE DESCRIPTION	EXPOSURE LIMITS/REGULATORY INFORMATION						
	REG.AGCY	U/M	TWA	STEL	CELL	SKIN	PEL
ALIPHATIC PETROLEUM DISTILLATE							
	ACGIH	PPM	N/E	N/E	N/E	N	N/E
	OSHA	PPM	N/E	N/E	N/E	N	N/E
VM&P NAPHTHA	ACGIH	PPM	300.00	N/E	N/E	N	N/E
	OSHA	PPM	300.00	400.00	N/E	N	N/E

ADDITIONAL REGULATORY INFO
 The time weighted average (TWA) value described herein is a threshold limit value (TLV) as established by ACGIH. The permissible exposure limit (PEL) is a value established by OSHA. CALIFORNIA (PROPOSITION #65):
 Ingredients in this product are not listed on California's Prop 65 list: "Chemicals known to the State to Cause Cancer or Reproductive Toxicity."
 SEC. 313 SUPPLIER NOTIFICATION
 The following information must be included in all MSDS that are copied and distributed for this material.
 This product contains no chemicals subject to the reporting requirements of SARA III: Section 313.

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 MSDS NO. 1650

SECTION 3. REGULATORY INFORMATION
 (CONTINUED)

CLEAN AIR ACT

This formula contains no known ozone depleting chemicals.

HAZARD COMMUNICATION STANDARD

This document is prepared in accordance with the OSHA Hazard Communication Standard (29 CFR 1910.1200). This MSDS contains thirteen (13) sections.

The following effects and/or symptoms are not expected to be experienced by persons who use this product properly and according to ALL instructions, precautions, and warnings; however, should the product user experience ANY questionable effects or symptoms, the product user should immediately seek medical attention.

SECTION 4. HAZARDS IDENTIFICATION

INHALATION ACUTE EXPOSURE EFFECTS

May cause dizziness, headache, watering of eyes, irritation of respiratory tract, drowsiness, nausea, and light headedness. Severe overexposure may cause unconsciousness.

SKIN CONTACT ACUTE EXPOSURE EFFECTS

None known.

EYE CONTACT ACUTE EXPOSURE EFFECTS

May cause irritation.

INGESTION ACUTE EXPOSURE EFFECTS

Harmful or fatal if swallowed. May cause nausea, vomiting, gastrointestinal irritation, and diarrhea.

CHRONIC EXPOSURE EFFECTS

Reports have associated repeated and prolonged overexposure to solvents with neurological and other physiological damage. May cause skin irritation.

MEDICAL CONDITIONS AGGRAVATED

None known.

PRIMARY ROUTE OF EXPOSURE

Inhalation, ingestion, and dermal.

SECTION 5. FIRST AID MEASURES

INHALATION

If user experiences breathing difficulty, move to air free of vapors. Administer oxygen or artificial respiration until medical assistance can be rendered.

SKIN CONTACT

Wash with soap and water.

EYE CONTACT

Flush with large quantities of water for at least 15 minutes. If irritation from contact persists, get medical attention.

INGESTION

DO NOT induce vomiting. Call your poison control center, hospital.

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MSDS NO. 1650

SECTION 5. FIRST AID MEASURES
(CONTINUED)

emergency room, or physician immediately.

NOTE TO PHYSICIAN

This formula is registered with POISINDEX.

Call your local poison control center for further information.

SECTION 6. FIRE FIGHTING MEASURES

HAZARD RATING SOURCE	HMIS	NFPA
HEALTH	2	1
FLAMMABILITY	3	3
REACTIVITY	0	0
OTHER	G	NA

FLASH METHOD
TCC
FLASH POINT
50.00 F 10.00 C
LOWER EXPLOSION LIMIT
C.9

GENERAL COMMENTS

CSHA FLAMMABILITY: Class IH

EXTINGUISHING METHOD

Use carbon dioxide, dry powder, or foam.

FIRE FIGHTING PROCEDURES

Self-contained respiratory protection should be provided for fire fighters fighting fires in buildings or confined areas. Storage containers exposed to fire should be kept cool with water spray to prevent pressure build-up. Stay away from heads of containers that have been exposed to intense heat or flames.

FIRE AND EXPLOSION HAZARDS

DANGER! FLAMMABLE. KEEP AWAY FROM HEAT, SPARKS, FLAME, AND ALL OTHER SOURCES OF IGNITION. Do not smoke.

Extinguish all flames and pilot lights, and turn off stoves, heaters, electric motors and all other sources of ignition during use and until all vapors are gone. Beware of static electricity that may be generated by synthetic clothing and other sources.

SECTION 7. ACCIDENTAL RELEASE MEASURES

CLEAN-UP

Keep unnecessary people away; isolate hazard area and deny entry. Stay upwind, out of low areas, and ventilate closed spaces before entering. Shut off ignition sources; keep flames, smoking or flames out of hazard area. SMALL SPILLS: take up liquid with sand, earth or other noncombustible absorbent material and place in a plastic container where applicable. LARGE SPILLS: dike far ahead of spill for later disposal.

For transportation related spills contact Chemtrec at 1-800-424-9300 for emergency assistance.

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SECTION 7. ACCIDENTAL RELEASE MEASURES
(CONTINUED)

WASTE DISPOSAL

Dispose in accordance with applicable local, state and federal regulations.

SECTION 8. HANDLING AND STORAGE

STORAGE

Keep container tightly closed when not in use. Store in a cool, dry place. Do not store near flames or at elevated temperatures.

HANDLING

Read carefully all cautions and directions on product label before use. Since empty container retains residue, follow all label warnings even after container is empty. Dispose of empty container

according to all regulations. Do not reuse this container.

SECTION 9. TRANSPORT INFORMATION

TRANSPORTATION

For D.O.T. information, contact W.M. Barr Technical Services Department.

SECTION 10. EXPOSURE CONTROLS/PERSONAL PROTECTION

VENTILATION PROTECTION

Use only with adequate ventilation to prevent build-up of vapors. Open all windows and doors. Use only with a cross ventilation of moving fresh air across the work area. If strong odor is noticed or you experience slight dizziness, headache, nausea, or eye-watering - STOP - ventilation is inadequate. Leave area immediately.

RESPIRATORY PROTECTION

For OSHA controlled work place and other regular users - Use only with adequate ventilation under engineered air control systems designed to prevent exceeding appropriate TLV. For occasional use, where engineered air control is not feasible, use properly maintained and properly fitted NIOSH approved respirator for organic solvent vapors. A dust mask does not provide protection against vapors.

SKIN PROTECTION

Wear impermeable gloves. Gloves contaminated with product should be discarded. Promptly remove clothing that becomes soiled with product.

EYE PROTECTION

Safety glasses, chemical goggles or face shields are recommended to safeguard against potential eye contact, irritation, or injury. Contact lenses should not be worn while working with chemicals.

OTHER PROTECTION

Various application methods can dictate use of additional protective safety equipment, such as impermeable aprons, etc., to minimize exposure. A source of clean water should be available in the work

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MSDS NO. 1650

SECTION 10. EXPOSURE CONTROLS/PERSONAL PROTECTION
(CONTINUED)

area for flushing eyes and skin. Do not eat, drink, or smoke in the work area. Wash hands thoroughly after use. Before reuse, thoroughly clean any clothing or protective equipment that has been contaminated by prior use. Discard any clothing or other protective equipment that cannot be decontaminated, such as gloves or shoes.

SECTION 11. PHYSICAL AND CHEMICAL PROPERTIES

VOLATILE %: 100.000 by weight
BOILING POINT: GT 242.00 F 116.66 C
BOILING RANGE: 242 F - 300 F
VAPOR DENSITY (Air = 1.0):
Heavier than air
EVAPORATION RATE
Slower than ether
BULK DENSITY: 6.250
lbs/gal at 75 F
PHOTOCHEMICALLY REACTIVE: NO

MAX V.O.C.
749 grams per liter (excluding exempt solvents & water)
MAX VAPOR PRESSURE
(of the V.O.C.) 13mm Hg at 20 degrees C

SECTION 12. STABILITY AND REACTIVITY

INCOMPATIBILITIES

Incompatible with strong oxidizing agents.

DECOMPOSITION

Decomposition may produce carbon monoxide and carbon dioxide.

POLYMERIZATION: Will not occur.

STABILITY: Stable.

SECTION 13. ADDITIONAL INFORMATION

IMPORTANT NOTE

The information contained herein is presented in good faith and believed to be accurate as of the effective date shown above. This information is furnished without warranty of any kind. Employers should use this information only as a supplement to other information gathered by them and must make independent determination of suitability and completeness of information from all sources to assure proper use of these materials and the safety and health of employees. Any use of this data and information must be determined by the user to be in accordance with applicable federal, state and local laws and regulations.

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SECTION 13. ADDITIONAL INFORMATION

LEGEND:

PPM - parts per million

MG/M3 - milligrams per cubic meter

N/E or NE - none established

GT - greater than

N/A or NA - not applicable

TCC = tag closed cup

TOC = tag open cup

PMCC - Pensky-Martens closed cup

IDLH - Immediately Dangerous to Life and Health

MSDS for EEP

EASTMAN

MATERIAL SAFETY DATA SHEET

Revision Date: 07/15/2004

MSDSANSI/ANSI/EN/150000001149/Version 12.0

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name	Eastman(TM) EEP Solvent
Product Identification Number(s)	12470-00, P1247000, P1247001, P1247002, P1247003, P1247004, P1247005, P1247006, P1247007, P1247008, P1247010, P1247009, P12470M2, P12470M4, P1247011
Manufacturer/Supplier	Eastman Chemical Company Eastman Road Kingsport, TN 37662 US
MSDS Prepared by	Eastman Product Safety and Health
Chemical Name	3-ethoxypropanoic acid, ethyl ester
Synonym(s)	12470-00 970309
Molecular Formula	C7H14O3
Molecular Weight	146.19
Product Use	solvent
OSHA Status	hazardous

For emergency health, safety & environmental information, call 800-EASTMAN.

For emergency transportation information, call CHEMTREC at 800-424-9300 or call 800-EASTMAN.

2. COMPOSITION INFORMATION ON INGREDIENTS

(Typical composition is given, and it may vary. A certificate of analysis can be provided, if available.)

Weight %	Component	CAS Registry No.
>99.5%	ethyl 3-ethoxypropionate	763-69-9
<0.02%	formaldehyde	50-00-0
<0.02%	butylated hydroxytoluene (as inhibitor)	128-37-0

3. HAZARDS IDENTIFICATION

CAUTION!
COMBUSTIBLE LIQUID AND VAPOR
FORMS PEROXIDES IF MATERIAL BECOMES UNINHIBITED
HIGH VAPOR CONCENTRATIONS MAY CAUSE DROWSINESS

HMIS® Hazard Ratings: Health - 1, Flammability -2, Chemical Reactivity - 1

HMIS® rating involves data interpretations that may vary from company to company. They are intended only for rapid, general identification of the magnitude of the specific hazard. To deal adequately with the safe handling of this material, all the information contained in this MSDS must be considered.

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MATERIAL SAFETY DATA SHEET

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4. FIRST-AID MEASURES

Inhalation: Move to fresh air. Treat symptomatically. Get medical attention if symptoms persist.

Eyes: Any material that contacts the eye should be washed out immediately with water. If easy to do, remove contact lenses. Get medical attention if symptoms persist.

Skin: Wash with soap and water. Get medical attention if symptoms occur.

Ingestion: Seek medical advice.

5. FIRE FIGHTING MEASURES

Extinguishing Media: water spray, carbon dioxide, dry chemical, foam

Special Fire-Fighting Procedures: Wear self-contained breathing apparatus and protective clothing. Use water spray to keep fire-exposed containers cool. USE WATER WITH CAUTION. Material will float and may ignite on surface of water. Water may be ineffective in fighting the fire. The fire could easily be spread by the use of water in an area where the water could not be contained.

Hazardous Combustion Products: carbon dioxide, carbon monoxide

Unusual Fire and Explosion Hazards: Forms peroxides of unknown stability if material becomes uninhibited. Combustible.

6. ACCIDENTAL RELEASE MEASURES

Use personal protective equipment. Eliminate all ignition sources. Absorb spill with vermiculite or other inert material, then place in a container for chemical waste.

For Large Spills: Flush spill area with water spray. Prevent runoff from entering drains, sewers, or streams. Dike for later disposal.

7. HANDLING AND STORAGE

Personal Precautionary Measures: Avoid breathing high vapor concentrations. Use only with adequate ventilation. Wash thoroughly after handling.

Prevention of Fire and Explosion: Keep away from heat and flame. Keep from contact with oxidizing materials. Keep inhibited. Minimize exposure to air. After opening, purge container with nitrogen before reclosing. Periodically test for peroxide formation on long-term storage. If peroxide formation is suspected, do not open or move container. Do not allow to evaporate to near dryness. Do not distill to near dryness.

Storage: Keep container closed.

Additional Information: Store away from heat and light.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Country specific exposure limits have not been established or are not applicable unless listed below.

ETHYL 3-ETHOXYPROPIONATE

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MATERIAL SAFETY DATA SHEET

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Eastman Chemical Company occupational exposure limit:

Time Weighted Average (TWA): 50 ppm,

Eastman Chemical Company occupational exposure limit:

Short Term Exposure Limit (STEL): 100 ppm,

Ventilation: Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level.

Respiratory Protection: If engineering controls do not maintain airborne concentrations below recommended exposure limits (where applicable) or to an acceptable level (in countries where exposure limits have not been established), an approved respirator must be worn. In the United States of America, if respirators are used, a program should be instituted to assure compliance with OSHA Standard 63 FR 1152, January 8, 1998. Respirator type: Air-purifying respirator with an appropriate, government approved (where applicable), air-purifying filter, cartridge or canister. Contact health and safety professional or manufacturer for specific information.

Eye Protection: It is a good industrial hygiene practice to minimize eye contact.

Recommended Decontamination Facilities: eye bath, washing facilities

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical Form: liquid

Color: colorless

Odor: ester, pungent

Odor Threshold: 0.02 ppm

Specific Gravity: 0.95 (20 °C)

Vapor Pressure: 25 °C; 2.0 mbar

Vapor Density: 5.0

Freezing Point: <-50 °C

Boiling Point: 165 °C

Evaporation Rate: 0.12 (n-butyl acetate = 1)

Viscosity: 1.20 mPa.s (25 °C),

Solubility in Water: 29 g/l

Octanol/Water Partition Coefficient: P: 22.4; log P: 1.35

Flash Point: 59 °C (Setaflash closed cup)

Autoignition Temperature: 377 °C (ASTM E659)

Thermal Decomposition Temperature: (HPDTA) No exotherm to 400°C

10. STABILITY AND REACTIVITY

Stability: Stable. Forms peroxides if material becomes uninhibited.

Incompatibility: Material reacts with strong oxidizing agents.

Hazardous Polymerization: Will not occur.

11. TOXICOLOGICAL INFORMATION

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MATERIAL SAFETY DATA SHEET

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Acute toxicity data, if available, are listed below. Additional toxicity data may be available on request.

Oral LD-50:(male rat)	>5,000 mg/kg(highest dose tested)
Oral LD-50:(female rat)	4,300 mg/kg
Inhalation LC-50: (rat)	6 hours: > 1000 ppm (highest concentration tested)
Dermal LD-50: (guinea pig)	> 20 ml/kg (highest dose tested)
Skin Irritation (guinea pig)	slight
Eye Irritation (rabbit)	slight
Skin Sensitization: (guinea pig)	none

12. ECOLOGICAL INFORMATION

Acute toxicity data, if available, are listed below. Additional toxicity data may be available on request.

This material is readily biodegraded and is not likely to bioconcentrate.

Oxygen Demand Data:

BOD-5: 370 mg/g
BOD-20: 560 mg/g

COD: 1,920 mg/g
ThBOD: 1,970 mg/g

Acute Aquatic Effects Data:

96 h LC-50 (fathead minnow): 50 mg/l NOEC: 25 mg/l
48 h EC-50 (Daphnia magna): > 480 mg/l NOEC: 470 mg/l
72 h EC-50 (Selenastrum capricornutum): > 115 mg/l

13. DISPOSAL CONSIDERATIONS

Discharge, treatment, or disposal may be subject to national, state, or local laws. Incinerate. Since emptied containers retain product residue, follow label warnings even after container is emptied.

14. TRANSPORT INFORMATION

Important Note: Shipping descriptions may vary based on mode of transport, quantities, package size, and/or origin and destination. Consult your company's Hazardous Materials/Dangerous Goods expert for information specific to your situation.

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DOT (USA)

Class combustible liquid, Packing group III for quantities of 450 liters (119 gallons) or more; not regulated for smaller quantities
0

Marine pollutant:

Possible Shipping Description(s):

not regulated

Esters, n.o.s. (ethyl 3-ethoxypropionate)
combustible liquid UN III

Esters, n.o.s. (ethyl 3-ethoxypropionate)
combustible liquid UN 3272 III

Sea - IMDG (International Maritime Dangerous Goods)

Possible Shipping Description(s):

ESTERS, N.O.S. (ethyl 3-ethoxypropionate)
3 UN 3272 III

Air - ICAO (International Civil Aviation Organization)

Possible Shipping Description(s):

Esters, n.o.s. (ethyl 3-ethoxypropionate)
3 UN 3272 III

15. REGULATORY INFORMATION

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

WHMIS (Canada) Status: controlled

WHMIS (Canada) Hazard Classification: B/3

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MATERIAL SAFETY DATA SHEET

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SARA 311-312 Hazard Classification(s):

fire hazard
reactive hazard

SARA 313: none, unless listed below

Carcinogenicity Classification (components present at 0.1% or more): none, unless listed below

TSCA (US Toxic Substances Control Act): This product is listed on the TSCA inventory. Any impurities present in this product are exempt from listing.

DSL (Canadian Domestic Substances List) and CEPA (Canadian Environmental Protection Act): This product is listed on the DSL. Any impurities present in this product are exempt from listing.

EINECS (European Inventory of Existing Commercial Chemical Substances): This product is listed on EINECS or otherwise complies with EINECS requirements.

AICS / NICNAS (Australian Inventory of Chemical Substances and National Industrial Chemicals Notification and Assessment Scheme): This product is listed on AICS or otherwise complies with NICNAS.

MITI (Japanese Handbook of Existing and New Chemical Substances): This product is listed in the Handbook or has been approved in Japan by new substance notification.

ECL (Korean Toxic Substances Control Act): This product is listed on the Korean inventory or otherwise complies with the Korean Toxic Substances Control Act.

16. OTHER INFORMATION

Visit our website at www.EASTMAN.com or call 001-423-229-2000.

The information contained herein is based on current knowledge and experience; no responsibility is accepted that the information is sufficient or correct in all cases. Users should consider these data only as a supplement to other information. Users should make independent determinations of suitability and completeness of information from all sources to assure proper use and disposal of these materials, the safety and health of employees and customers, and the protection of the environment.

Highlighted areas indicate new or changed information.

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MSDS for Brulin GD 1990

PRODUCT NAME: BRULIN 1990 GD
PRODUCT NUMBER: 301008

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MATERIAL SAFETY DATA SHEET

Per 29 CFR 1910.1200

DATE PREPARED : 10/24/02

SECTION I.

BRULIN & COMPANY, INC. P.O. BOX 270, INDIANAPOLIS, IN 46206-0270 (317) 923-3211

WEST COAST FACTORY
Richmond, California

24 HOUR EMERGENCY NUMBER

CHEMTREC 1-800-424-9300

IDENTITY (As listed on label):
BRULIN 1990 GD

Health: 1
HMIS HAZARD RATINGS: Flammability: 0
Reactivity: 0

SECTION II - HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

Hazardous Components (Specific Chemical Identity, Common Name(s))	CAS #	OSHA PEL	ACGIH TLV-TWA	OTHER LIMITS RECOMMENDED	PERCENT
--	-------	----------	------------------	-----------------------------	---------

This product contains no hazardous chemical substances at 1.0% or more listed in 29 CFR 1910.1203 or ACGIH Threshold Limit Values. Also, this product contains no carcinogens at 0.1% or more listed in NTP Annual Report on Carcinogens, IARC Monographs, or 29 CFR 1910.1203. No components of this product are subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-To-Know Act of 1986.

SECTION III - PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point:	212 F	Specific Gravity (H ₂ O=1):	1.067
Vapor Pressure (mm Hg):	Approx. 17 @ 68 F.	Melting Point:	Approx. 30 F
Vapor Density (Air=1):	Approx. 0.6	Evaporation Rate (water=1):	1.0
Solubility in Water:	Complete		
Appearance and Odor:	Water white, mild odor.		

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point (Method Used): None
Flammable Limits LEL NA UEL NA
Extinguishing Media: None
Special Fire Fighting Procedures:

Full protective equipment including self-contained breathing apparatus should be used. During emergency conditions, overexposure to decomposition products may cause a health hazard. Symptoms may not be immediately apparent. Get medical attention. Water may be used to cool and protect closed containers exposed to extreme heat.

Unusual Fire and Explosion Hazards: None known. Closed containers may explode (due to build-up of pressure) when exposed to extreme heat.

SECTION V - REACTIVITY DATA

Stability Unstable Stable
Conditions to Avoid: Freezing
Incompatibility (Materials to Avoid): Strong acids and oxidizers.
Hazardous Decomposition or Byproducts: Carbon monoxide, Carbon dioxide, and oxides of sulfur.
Hazardous Polymerization: May Occur May Not Occur
Conditions to Avoid: None

SECTION VI - HEALTH HAZARD DATA

Route(s) of Entry: Ingestion? No Skin? Yes Inhalation? No Eyes? Yes
Health Hazards (Acute and Chronic): Direct eye contact and prolonged or repeated skin contact may cause irritation seen as redness.
Carcinogenicity: NTP? No IARC Monographs? No OSHA Regulated? No
Signs and Symptoms of Exposure: Irritation as noted above.
Medical Conditions Generally Aggravated by Exposure: None Known
Emergency & First Aid Procedures:
Eye Contact: Flush with large amounts of water for 15 min. lifting upper & lower lids occasionally. Get medical attention.
Inhalation: Remove to fresh air.
Skin Contact: Wash with mild soap and water. Remove contaminated clothing and launder before reuse. If irritation persists, consult a physician.
Ingestion: If conscious, dilute by giving 2 glasses of water. Get immediate medical attention.

SECTION VII - PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken in Case Material is Released or Spilled: Absorb on solid absorbent and shovel into containers for disposal.
Waste Disposal Method: Dispose according to Federal, State and Local Laws and 40 CFR.
Precautions to be Taken in Handling and Storing: Store between 40 and 110 F.

SECTION VIII - CONTROL MEASURES

Respiratory Protection (Specify Type): Not normally required. However, if potential for overexposure exists, wear a NIOSH/MSHA approved respirator.
Ventilation: Mechanical (General): Sufficient
Protective Gloves: Recommended (Rubber)
Eye Protection: Safety glasses, safety goggles, or full face shield recommended.
Other Protective Clothing or Equipment: Sufficient to minimize skin contact.
Work/Hygienic Practices: Use only with adequate ventilation. Avoid breathing vapor and mist. Avoid contact with skin and eyes. Do not take internally. Wash thoroughly after handling.

MSDS for Ardrex 405-V

Chemetall Oakite

ARDROX 405-V
GENERAL PURPOSE CLEANER

OAKITE PRODUCTS, INC.
A MEMBER OF THE CHEMETALL GROUP
50 VALLEY ROAD, BERKELEY HEIGHTS, NJ 07922
(800) 526-4473 / (908) 464-6900

CHEMTREC EMERGENCY TELEPHONE: 800-424-9300

I. HAZARDOUS INGREDIENTS:

COMPONENT(S):	WT %	CAS NO.	EXPOSURE LIMITS TO AIR	
			ACGIH TLV	OSHA PEL
Propylene Glycol	<10	5131-66-8	ND	ND
n-Butyl Ether				
Tall Oil	3-5	8002-26-4	5 mg/m ³	5 mg/m ³
Alkyl Phenol Ethoxylate	4-6	9016-45-9	ND	ND
Monoethanolamine	1-2	141-43-5	3 ppm	3 ppm

*Subject to the reporting requirements of Section 313 of Title III of the Superfund Amendment and Reauthorization Act of 1986 and 40CFR Part 372.

II. PHYSICAL DATA:

MELTING POINT: Approx. 32^oF
BOILING Point: Approx. 212^oF
VAPOR PRESSURE (mm Hg): Similar to water
VAPOR DENSITY (Air=1): >1
ODOR: Mild solvent odor
VOC (GM/L): 76

SPECIFIC GRAVITY: 1.01
SOLUBILITY IN WATER: Complete
EVAPORATION RATE (BuAc=1): <1
PH: (50% SOLN): 12.6
APPEARANCE: Blue liquid
VAPOR PRESSURE OF VOC (MMHG): <1

III. FIRE AND EXPLOSION HAZARD DATA:

FLASH POINT: >200^oF
AUTOIGNITION TEMPERATURE: ND
FLAMMABLE LIMITS: UPPER: ND LOWER: ND
EXTINGUISHING MEDIA: Dry Chemical. CO₂.

FIRE AND EXPLOSION HAZARDS:
Moderate fire hazard when exposed to heat or flame.

SPECIAL FIRE FIGHTING PROCEDURES:
Wear self-contained breathing apparatus. Use water to keep fire-exposed containers cool and to flush spills away from fire. In the case of large fires also cool surrounding equipment and structures with water.

IV. REACTIVITY:

STABILITY: Stable
CONDITIONS TO AVOID: See Below

MATERIAL SAFETY DATA SHEET

-1-

ARDROX 405-V

GENERAL PURPOSE CLEANER

HAZARDOUS POLYMERIZATION: Will Not Occur

INCOMPATIBILITY:

Strong oxidizing and reducing agents. Strong acids. Strong alkalis (such as sodium hydroxide), and alkali metals. Reactive metals.

HAZARDOUS DECOMPOSITION PRODUCTS:

Acrid smoke. Toxic fumes of carbon oxides and nitrogen oxides on combustion. Organic compounds on combustion.

=====
V. ENVIRONMENTAL AND DISPOSAL INFORMATION:
=====

ACTION TO TAKE FOR SPILLS/LEAKS

CAUTION:

Use appropriate protective and safety equipment. See Section VIII of this Material Safety Data Sheet for handling precautions.

SMALL SPILL:

Mop up or soak up with non-combustible absorbent inorganic material. Transfer to DOT-approved container.

LARGE SPILL:

Evacuate spill area of unprotected personnel. Contain by diking with non-combustible absorbent inorganic material. Prevent runoff from entering sewers, storm drains, surface water, and soil. Transfer contaminated absorbent to a DOT-approved container.

WASTE DISPOSAL INFORMATION:

Consult appropriate federal, state and local regulatory agencies to ascertain proper disposal procedures.

NOTE:

Comply with all applicable government regulations on spill reporting and handling and disposal of waste. Empty containers can have residues, gases, and mists, and are subject to proper waste disposal.

=====
VI. HEALTH HAZARD DATA:
=====

ROUTES OF ENTRY:

BREATHED:

A single prolonged (hours) exposure of one component may cause respiratory irritation. High vapor concentrations are irritating to the nose, throat, mucous membrane, and lungs, may cause headaches, dizziness, sleep (anesthesia) and may have other CENTRAL NERVOUS SYSTEM effects.

SKIN CONTACT:

SKIN ABSORPTION:

Component(s) are readily absorbed through the skin and are moderately toxic. Effects may be similar to those described under other categories in this section.

ARDROX 405-V
GENERAL PURPOSE CLEANER

EYE CONTACT:

May cause severe irritation with corneal injury which may result in permanent impairment of vision or even blindness.

SWALLOWED:

A component(s) of this product is toxic. Swallowing a component(s) may cause burns of the mouth and throat and irritation or ulceration to the stomach and intestines. Swallowing a component(s) may cause headache, nausea, vomiting, weakness.

SYSTEMIC AND OTHER EFFECTS:

Repeated excessive exposure may injure the LIVER and KIDNEY.

MEDICAL CONDITIONS AGGRAVATED:

Component(s) of this product may aggravate pre-existing lung (pulmonary) disease. Persons with pre-existing skin conditions may be susceptible to the effects of a component(s) of this product.

SUSPECTED CANCER AGENT: No

FEDERAL OSHA	CA OSHA	NTP	IARC
No	No	No	No

TARGET ORGANS, OTHER THAN THOSE IMPLIED BY ROUTES OF ENTRY (I.E., BREATHED, INCLUDES RESPIRATORY TRACT AND LUNGS) ARE CAPITALIZED. CALIFORNIA ONLY: PROPOSITION 65

This product contains a chemical(s) known to the State of California to cause cancer or reproductive toxicity. These are trace amounts found in normal technical grade industrial materials and are not deliberately added to the product.

VII. FIRST AID:

BREATHED:

Remove victim to fresh air at once. If not breathing, give mouth-to-mouth resuscitation. If breathing is difficult, GET IMMEDIATE MEDICAL ATTENTION. Keep victim warm and at rest.

SKIN:

Wash skin immediately with lots of soap and water. If clothes and shoes are contaminated, remove and wash before reuse. Get medical attention if ill effect or irritation develops.

EYES:

Wash eyes immediately with running water for at least 20 minutes. Use fingers to assure that eyelids are separated and that eye is being washed. Lift the lower and upper lid occasionally. GET IMMEDIATE MEDICAL ATTENTION.

SWALLOWED:

ARDROX 405-V
GENERAL PURPOSE CLEANER

DO NOT INDUCE VOMITING. If vomiting spontaneously occurs, do not allow vomitus to be breathed into lungs. Keep victim's head below his hips. Call a physician and/or transport to emergency medical facility immediately. The decision of whether to induce vomiting or not should be made by a physician. If lavage is performed, suggest endotracheal and/or esophageal control. Danger from lung aspiration must be weighed against toxicity when considering emptying the stomach. Corrosive: May cause stricture. If victim is conscious, give large amounts of water. Do not attempt to give fluids to unconscious victim.

NOTE TO PHYSICIAN:

Supportive care: Treatment based on judgement of physician in response to reactions of patient. If burn is present, treat as thermal burn after decontamination. No specific antidote.

=====
VIII. HANDLING PRECAUTIONS:
=====

VENTILATION:

Control airborne concentrations below exposure guidelines (Section I) with MECHANICAL VENTILATION, if necessary. Local explosion-proof EXHAUST VENTILATION may be necessary for some operations.

RESPIRATORY PROTECTION:

Atmospheric levels should be maintained below exposure guidelines. When respiratory protection is required for certain operations, use a MSHA/NIOSH approved filter type respirator used in accordance with the requirements of 29 CFR 1910.134. In confined or poorly ventilated areas or for emergency and other conditions where the exposure guidelines may be greatly exceeded, use an approved positive-pressure, self-contained breathing apparatus or air line supplied respirator.

EYE PROTECTION:

Contact lenses should not be used. Suggested protection is safety glasses, but where contact with liquid is likely, chemical goggles and face shields are recommended.

SKIN PROTECTION:

Impermeable gloves are recommended. When prolonged or frequently repeated contact could occur, use protective clothing. Selection of specific items such as boots, apron, or full-body suit will depend on operation. Wash thoroughly after handling chemicals.

SPECIAL EQUIPMENT:

Suitable laboratory safety equipment includes safety showers, eye washes, and proper fire extinguishing media.

=====
IX. STORAGE AND HANDLING:
=====

ARDROX 405-V

GENERAL PURPOSE CLEANER

Train all employees on all special handling procedures in this section before they work with this product. Exercise reasonable care and caution. Personnel should avoid breathing vapors and/or mists and getting product in the eyes or on the skin. DO NOT CONSUME food, drink, or tobacco in areas where they may become contaminated with this material. Keep containers cool, dry, and away from sources of ignition. DO NOT STORE product in direct sunlight, high temperature, or below freezing areas. Keep product container tightly closed when not in use. Protect containers from physical damage. Use and store with adequate ventilation. DO NOT cut, grind, weld or drill on or near this container. Wash thoroughly after using. Concentrated vapors of this product are heavier than air and will collect in low areas such as pits, degreasers, storage tanks, and other confined areas. DO NOT ENTER these areas where vapors of this product are suspected unless special breathing apparatus is used and an observer similarly equipped is present for assistance.

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X. DOT INFORMATION

NON-REGULATED BY CFR 49 172.101

=====

XI. OTHER SAFETY AND REGULATORY INFORMATION

=====

HMIS CODES

2	HMIS HEALTH	0	HMIS FLAMMABILITY
0	REACTIVITY	C	HMIS PERSONAL PROTECTION

SARA TITLE III, SECT 302-304:

THRESHOLD PLANNING QUANTITY (TPQ) None
REPORTABLE QUANTITY (RQ): None

SARA TITLE III, SECTION 311-12: Chronic

=====

XII. NAME OF PREPARER-DATE FIRST PREPARED-DATE REVISED

=====

NAME OF PREPARER:	MICHAEL CHANG
DATE PREPARED	Oct 29, 1993
REVISED DATE	June 10, 1996

None Abbreviations: NA:Not Applicable; ND:Not Determined.
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EXPRESS OR IMPLIED, IS MADE. Since buyer's conditions of use are
beyond Oakite's control, Oakite does not warrant any recommendations
and information for the use of such products.

MSDS for White Oil



CITGO Duoprime® Oil 70

Material Safety Data Sheet

CITGO Petroleum Corporation
P.O. Box 3758
Tulsa, OK 74102-3758

MSDS No. 669347001

Revision Date 05/02/2002

IMPORTANT: Read this MSDS before handling or disposing of this product and pass this information on to employees, customers, and users of this product.

Emergency Overview			
Physical State	Liquid.		
Color	Colorless.	Odor	Odorless.
Not expected to present a hazard under anticipated conditions of use.			
If liquid material is swallowed, contact a physician.			
Do not induce vomiting.			
If liquid material enters the lungs, it can cause severe damage.			
Spills may create a slipping hazard.			

Hazard Rankings		
	HMIS	NFPA
Health Hazard	0	0
Fire Hazard	1	1
Reactivity	0	0
* = Chronic Health Hazard		
Protective Equipment		
Minimum Requirements See Section 8 for Details		

SECTION 1: IDENTIFICATION

Trade Name	CITGO Duoprime® Oil 70	Technical Contact	(800) 248-4564
Product Number	669347001	Medical Emergency	(918) 495-4700
CAS Number	8042-47-5	CHEMTREC Emergency (United States Only)	(800) 424-9300
Product Family	White Mineral Oil		
Synonyms	White Mineral Oil; CITGO SAP Product Code No.: 669347001 and 959347		

SECTION 2: COMPOSITION

Component Name(s)	CAS Registry No.	Concentration (%)
1) White Mineral Oil	8042-47-5	100
2) di alpha tocopherol (Vitamin E) (Stabilizer)	59-02-9	<0.1

SECTION 3: HAZARDS IDENTIFICATION

Also see Emergency Overview and Hazard Ratings on the top of Page 1 of this MSDS.

Major Route(s) of Entry Not applicable.

Signs and Symptoms of Acute Exposure

Inhalation	No significant adverse health effects are expected to occur upon short-term exposure.
Eye Contact	Minimal eye irritation may result from short-term contact with liquid, mist, and/or vapor.
Skin Contact	No significant irritation is expected to occur upon short-term exposure.
Ingestion	If swallowed, no significant adverse health effects are anticipated. Ingestion can cause a laxative effect. If liquid material enters into the lungs, it can cause severe damage.

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Continued on Next Page

Page Number: 1

CITGO Duoprime® Oil 70

Chronic Health Effects Summary No significant signs or symptoms indicative of any adverse health effects are expected to occur.

Conditions Aggravated by Exposure None known.

Target Organs No target organ effects are anticipated.

Carcinogenic Potential This product does not contain any components at concentrations above 0.1% which are considered carcinogenic by OSHA, IARC or NTP.

OSHA Hazard Classification is indicated by an "X" in the box adjacent to the hazard title. If no "X" is present, the product does not exhibit the hazard as defined in the OSHA Hazard Communication Standard (29 CFR 1910.1200).

OSHA Health Hazard Classification				OSHA Physical Hazard Classification					
Irritant	<input type="checkbox"/>	Toxic	<input type="checkbox"/>	Combustible	<input type="checkbox"/>	Explosive	<input type="checkbox"/>	Pyrophoric	<input type="checkbox"/>
Sensitizer	<input type="checkbox"/>	Highly Toxic	<input type="checkbox"/>	Flammable	<input type="checkbox"/>	Oxidizer	<input type="checkbox"/>	Water-reactive	<input type="checkbox"/>
Corrosive	<input type="checkbox"/>	Carcinogenic	<input type="checkbox"/>	Compressed Gas	<input type="checkbox"/>	Organic Peroxide	<input type="checkbox"/>	Unstable	<input type="checkbox"/>

SECTION 4: FIRST AID MEASURES

Take proper precautions to ensure your own health and safety before attempting rescue or providing first aid. For more specific information, refer to Exposure Controls and Personal Protection in Section 8 of this MSDS.

Inhalation Vaporization is not expected at ambient temperatures. This material is not expected to cause inhalation-related disorders under anticipated conditions of use. In case of overexposure, move the person to fresh air.

Eye Contact Check for and remove contact lenses. Flush eyes with cool, clean, low-pressure water while occasionally lifting and lowering eyelids. Seek medical attention if excessive tearing, redness, or pain persists.

Skin Contact Remove contaminated shoes and clothing. Wipe off excess material. Wash exposed skin with soap and water. Seek medical attention if tissue appears damaged or if irritation persists. Thoroughly clean contaminated clothing before reuse. Discard contaminated leather goods. If material is injected under the skin, into muscle, or into the bloodstream, seek medical attention immediately.

Ingestion Do not induce vomiting or give anything by mouth. If spontaneous vomiting is about to occur, place victim's head below knees. If victim is drowsy or unconscious, place on the left side with head down. Never give anything by mouth to a person who is not fully conscious. Do not leave victim unattended. Seek medical attention immediately.

Notes to Physician This material presents a significant aspiration hazard. Aspiration may produce chemical pneumonitis. Induction of emesis is not recommended because of the potential for aspiration. Treatment may involve careful gastric lavage if performed soon after ingestion or in patients who are comatose or at risk of convulsing. Protect airway by placement in Trendelenburg and left lateral decubitus position or by cuffed endotracheal intubation. Subcutaneous or intramuscular injection requires prompt surgical debridement.

SECTION 5: FIRE FIGHTING MEASURES

NFPA Flammability Classification NFPA Class-IIIB combustible material. Slightly combustible!

Flash Point Method OPEN CUP: 166°C (331°F) (Cleveland.)

Lower Flammable Limit No data. **Upper Flammable Limit** No data.

Autoignition Temperature AP 400°C (AP 752°F)

Hazardous Combustion Products Carbon dioxide, carbon monoxide, smoke, fumes, and unburned hydrocarbons.

CITGO Duoprime® Oil 70

Special Properties	This material can burn but will not readily ignite. This material will release vapors when heated above the flash point temperature that can ignite when exposed to a source of ignition. In enclosed spaces, heated vapor can ignite with explosive force. Mists or sprays may burn at temperatures below the flash point.
Extinguishing Media	Use dry chemical, foam, Carbon Dioxide or water fog.
Protection of Fire Fighters	Firefighters must use full bunker gear including NIOSH-approved positive pressure self-contained breathing apparatus to protect against potential hazardous combustion or decomposition products and oxygen deficiencies.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Take proper precautions to ensure your own health and safety before attempting spill control or clean-up. For more specific information, refer to the Emergency Overview on Page 1, Exposure Controls and Personal Protection in Section 8 and Disposal Considerations in Section 13 of this MSDS.

Do not touch damaged containers or spilled material unless wearing appropriate protective equipment. Slipping hazard; do not walk through spilled material. Stop leak if you can do so without risk. For small spills, absorb or cover with dry earth, sand, or other inert non-combustible absorbent material and place into waste containers for later disposal. Contain large spills to maximize product recovery or disposal. Prevent entry into waterways or sewers. In urban area, cleanup spill as soon as possible. In natural environments, seek cleanup advice from specialists to minimize physical habitat damage. This material will float on water. Absorbent pads and similar materials can be used. Comply with all laws and regulations.

SECTION 7: HANDLING AND STORAGE

Handling	Avoid water contamination and extreme temperatures to minimize product degradation. Empty containers may contain product residues that can ignite with explosive force. Do not pressurize, cut, weld, braze solder, drill, grind or expose containers to flames, sparks, heat or other potential ignition sources. Consult appropriate federal, state and local authorities before reusing, reconditioning, reclaiming, recycling or disposing of empty containers and/or waste residues of this product.
Storage	Keep container closed. Do not store with strong oxidizing agents. Do not store at temperatures above 120° F or in direct sunlight for extended periods of time. Consult appropriate federal, state and local authorities before reusing, reconditioning, reclaiming, recycling or disposing of empty containers or waste residues of this product.

SECTION 8: EXPOSURE CONTROLS AND PERSONAL PROTECTION

Engineering Controls	Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of mists and/or vapors below the recommended exposure limits (see below). An eye wash station and safety shower should be located near the work-station.
Personal Protective Equipment	Personal protective equipment should be selected based upon the conditions under which this material is used. A hazard assessment of the work area for PPE requirements should be conducted by a qualified professional pursuant to OSHA regulations. The following pictograms represent the minimum requirements for personal protective equipment. For certain operations, additional PPE may be required.



Eye Protection	Safety glasses equipped with side shields should be adequate protection under most conditions of use. Wear goggles and/or face shield if splashing or spraying is anticipated. Wear goggles and face shield if material is heated above 125°F (51°C). Have suitable eye wash water available.
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CITGO Duoprime® Oil 70

Hand Protection	Use gloves constructed of chemical resistant materials such as neoprene or heavy nitrile rubber if frequent or prolonged contact is expected. Use heat-protective gloves when handling product at elevated temperatures.
Body Protection	Use clean and impervious protective clothing (e.g., neoprene or Tyvek®) if splashing or spraying conditions are present. Protective clothing may include long-sleeve outer garment, apron, or lab coat. If significant contact occurs, remove oil-contaminated clothing as soon as possible and promptly shower. Launder contaminated before reuse or discard. Wear heat protective boots and protective clothing when handling material at elevated temperatures.
Respiratory Protection	Vaporization is not expected at ambient temperatures. Therefore, the need for respiratory protection is not anticipated under normal use conditions and with adequate ventilation. If elevated airborne concentrations above applicable workplace exposure levels are anticipated, a NIOSH-approved organic vapor respirator equipped with a dust/mist prefilter should be used. Protection factors vary depending upon the type of respirator used. Respirators should be used in accordance with OSHA requirements (29 CFR 1910.134).
General Comments	Use good personal hygiene practices. Wash hands and other exposed skin areas with plenty of mild soap and water before eating, drinking, smoking, use of toilet facilities, or leaving work. DO NOT use gasoline, kerosene, solvents or harsh abrasives as skin cleaners. Since specific exposure standards/control limits have not been established for this product, the "Oil Mist, Mineral" exposure limits shown below are suggested as minimum control guidelines.

Occupational Exposure Guidelines

Substance	Applicable Workplace Exposure Levels
1) Oil Mist, Mineral	ACGIH (United States), TWA: 5 mg/m ³ STEL: 10 mg/m ³ OSHA (United States), TWA: 5 mg/m ³

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Physical State	Liquid.	Color Colorless.	Odor	Odorless.
Specific Gravity	0.84 (Water = 1)	pH Not Applicable.	Vapor Density	>1 (Air = 1)
Boiling Point/Range	Not available.		Melting/Freezing Point	Not available.
Vapor Pressure	<0.1 mm of Hg (@ 20°C)		Viscosity (cSt @ 40°C)	13
Solubility in Water	Insoluble in cold water.		Volatile Characteristics	Slightly volatile.
Additional Properties	Gravity, °API (ASTM D287) = AP 34.0 @ 60° F Density = AP 7.10 Lbs/gal. Viscosity (ASTM D2161) = AP 72 SUS @ 100° F			

SECTION 10: STABILITY AND REACTIVITY

Chemical Stability	Stable.	Hazardous Polymerization	Not expected to occur.
Conditions to Avoid	Keep away from extreme heat, sparks, open flame, and strongly oxidizing conditions.		
Materials Incompatibility	Strong oxidizers.		
Hazardous Decomposition Products	No additional hazardous decomposition products were identified other than the combustion products identified in Section 5 of this MSDS.		

CITGO Duoprime® Oil 70

SECTION 11: TOXICOLOGICAL INFORMATION

For other health-related information, refer to the Emergency Overview on Page 1 and the Hazards Identification in Section 3 of this MSDS.

Toxicity Data

White Mineral Oil:

ORAL (LD50): Acute: >5000 mg/kg [Rat].
DERMAL (LD50): Acute: >2000 mg/kg [Rabbit].

White Mineral Oil:

Low-viscosity and High-viscosity White Mineral Oils:

ORAL (LD50), Acute: >5000 mg/kg [Rat].
DERMAL (LD50), Acute: >2000 mg/kg [Rabbit].
DRAIZE EYE, Acute: Non-irritating [Rabbit].
DRAIZE DERMAL, Acute: Non-irritating [Rabbit].
BUEHLER, Acute: Non-sensitizing [Guinea Pig].
28-Day DERMAL, Sub-Chronic: Non-irritating [Rabbit].
104-Week DERMAL, Chronic: No skin tumors at site of application [Mouse].

MUTAGENICITY:

Modified Ames Assay: Negative [Salmonella typhimurium].
in-vitro Lymphoma Assay: Negative or no toxicity [Mouse].

Lifetime mouse skin painting studies indicated that white mineral oils are not mutagenic or carcinogenic. Mineral oil mists derived from highly refined oils are reported to have low acute and sub-acute toxicities in animals. Effects from single and short-term repeated exposures to high concentrations of mineral oil mists well above applicable workplace exposure levels include lung inflammatory reaction, lipid granuloma formation and lipid pneumonia. In acute and sub-acute studies involving exposures to lower concentrations of mineral oil mists at or near current work place exposure levels produced no significant toxicological effects. In long term studies (up to two years) no carcinogenic effects have been reported in any animal species tested.

SECTION 12: ECOLOGICAL INFORMATION

Ecotoxicity

Analysis for ecological effects has not been conducted on this product. However, if spilled, this product and any contaminated soil or water may be harmful to human, animal, and aquatic life. Also, the coating action associated with petroleum and petroleum products can be harmful or fatal to aquatic life and waterfowl.

Environmental Fate

An environmental fate analysis has not been conducted on this specific product. Plants and animals may experience harmful or fatal effects when coated with petroleum-based products. Petroleum-based (mineral) lube oils will normally float on water. In stagnant or slow-flowing waterways, an oil layer can cover a large surface area. As a result, this oil layer might limit or eliminate natural atmospheric oxygen transport into the water. With time, if not removed, oxygen depletion in the waterway might be enough to cause a fish kill or create an anaerobic environment.

SECTION 13: DISPOSAL CONSIDERATIONS

Hazard characteristic and regulatory waste stream classification can change with product use. Accordingly, it is the responsibility of the user to determine the proper storage, transportation, treatment and/or disposal methodologies for spent materials and residues at the time of disposition.

Conditions of use may cause this material to become a "hazardous waste", as defined by federal or state regulations. It is the responsibility of the user to determine if the material is a RCRA "hazardous waste" at the time of disposal. Transportation, treatment, storage and disposal of waste material must be conducted in accordance with RCRA regulations (see 40 CFR 260 through 40 CFR 271). State and/or local regulations may be more restrictive. Contact the RCRA/Superfund Hotline at (800) 424-9346 or your regional US EPA office for guidance concerning case specific disposal issues.

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CITGO Duoprime® Oil 70

SECTION 14: TRANSPORT INFORMATION

DOT Status	Not a U.S. Department of Transportation regulated material.		
Proper Shipping Name	Not regulated.		
Hazard Class	Not regulated.	Packing Group(s)	Not applicable.
		UN/NA ID	Not regulated.
Reportable Quantity	A Reportable Quantity (RQ) has not been established for this material.		
Placards		Emergency Response Guide No.	Not applicable.
		HAZMAT STCC No.	Not assigned.
		MARPOL III Status	Not a DOT "Marine Pollutant" per 49 CFR 171.8.

SECTION 15: REGULATORY INFORMATION

TSCA Inventory	This product and/or its components are listed on the Toxic Substance Control Act (TSCA) inventory.
SARA 302/304	The Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III requires facilities subject to Subparts 302 and 304 to submit emergency planning and notification information based on Threshold Planning Quantities (TPQs) and Reportable Quantities (RQs) for "Extremely Hazardous Substances" listed in 40 CFR 302.4 and 40 CFR 355. No components were identified.
SARA 311/312	The Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III requires facilities subject to this subpart to submit aggregate information on chemicals by "Hazard Category" as defined in 40 CFR 370.2. This material would be classified under the following hazard categories: No SARA 311/312 hazard categories identified.
SARA 313	This product contains the following components in concentrations above de minimis levels that are listed as toxic chemicals in 40 CFR Part 372 pursuant to the requirements of Section 313 of SARA: No components were identified.
CERCLA	The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) requires notification of the National Response Center concerning release of quantities of "hazardous substances" equal to or greater than the reportable quantities (RQ's) listed in 40 CFR 302.4. As defined by CERCLA, the term "hazardous substance" does not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically designated in 40 CFR 302.4. This product or refinery stream is not known to contain chemical substances subject to this statute. However, it is recommended that you contact state and local authorities to determine if there are any other reporting requirements in the event of a spill.
CWA	This material is classified as an oil under Section 311 of the Clean Water Act (CWA) and the Oil Pollution Act of 1990 (OPA). Discharges or spills which produce a visible sheen on waters of the United States, their adjoining shorelines, or into conduits leading to surface waters must be reported to the EPA's National Response Center at (800) 424-8802.
California Proposition 65	This product is not known to contain the any components for which the State of California has found to cause cancer, birth defects or other reproductive harm.
New Jersey Right-to-Know Label	Petroleum Oil
Additional Regulatory Remarks	Federal Hazardous Substances Act, related statutes, and Consumer Product Safety Commission regulations, as defined by 16 CFR 1500.14(b)(3) and 1500.83(a)(13): This product contains "Petroleum Distillates" which may require special labeling if distributed in a manner intended or packaged in a form suitable for use in the household or by children. Precautionary label dialogue should display the following: DANGER: Contains Petroleum Distillates! Harmful or fatal if swallowed! Call Physician immediately. KEEP OUT OF REACH OF CHILDREN!

CITGO Duoprime® Oil 70

SECTION 16: OTHER INFORMATION

Refer to the top of Page 1 for the HMIS and NFPA Hazard Ratings for this product.

REVISION INFORMATION

Version Number 1.2
Revision Date 05/02/2002
Print Date Printed on 05/02/2002.

ABBREVIATIONS

AP: Approximately EQ: Equal >: Greater Than <: Less Than NA: Not Applicable ND: No Data NE: Not Established
ACGIH: American Conference of Governmental Industrial Hygienists AIHA: American Industrial Hygiene Association
IARC: International Agency for Research on Cancer NTP: National Toxicology Program
NIOSH: National Institute of Occupational Safety and Health OSHA: Occupational Safety and Health Administration
NPCA: National Paint and Coating Manufacturers Association HMIS: Hazardous Materials Information System
NFPA: National Fire Protection Association EPA: US Environmental Protection Agency

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***** END OF MSDS *****

Appendix B
Stand Alone Case Studies for Owens-Illinois and Texollini

**LA MIRADA SCREEN PRINTER CONVERTS TO SAFER CLEANING
ALTERNATIVE**

The Owens-Illinois Plastics Group has a facility in La Mirada that manufactures cosmetics bottles for a number of customers. The company uses a variety of plastic types for the bottles which hold shampoo and other personal products.

Owens-Illinois has a number of conveyORIZED decorating machines for printing on the bottles. The company is very progressive and has exclusively used ultraviolet (UV) curable ink for several years. These inks are a benefit to the environment because they contain no solvents.

On the decorating machines, the bottles pass under the screens. Squeegees applied to the top of the screen force the ink through the screen and the ink is printed on the bottles. The bottles then pass through an ultraviolet light which cures the ink. Owens-Illinois performs two types of cleaning. The workers clean excess ink from the bottoms of the screens periodically with a solvent laden rag. After the run is completed, the screens are removed from the machine and the workers clean the ink from both sides, again using a rag containing solvent. The screens are then recycled for reuse. In the past, the company used a high VOC solvent for both cleaning activities.

The South Coast Air Quality Management District (SCAQMD) regulates the VOC content of the solvents that are used for cleanup in the screen printing industry. SCAQMD Rule 1171 specifies that cleanup solvents used in this industry must have a VOC content of 100 grams per liter or less beginning in July 2005. IRTA began working with Owens-Illinois during a project sponsored by SCAQMD to test alternatives that would meet the future 100 gram per liter VOC limit. The company decided to convert to one of the low VOC alternatives during another IRTA project sponsored by Cal/EPA's Department of Toxic Substances Control and two wastewater discharge agencies.

In preliminary screening tests, IRTA found that soy based cleaners were effective in cleaning the UV curable ink used by Owens-Illinois. In scaled-up testing with the company, one soy cleaner called Soy Gold 2000 performed well. The VOC content of this cleaner, at 20 grams per liter, is well below the Rule 1171 future limit.

Owens-Illinois likes the new cleaner. Freddy Osorio, Decorating Process Specialist at the company, says "the cleaner performs as well as our high VOC cleaner. The most important thing to me is that it is better than our other cleaner for health and the environment." Owens-Illinois is investigating the new low VOC cleaner for their other U.S. screen printing facilities.

Annualized Cost Comparison for Owens-Illinois

	High VOC Cleaner	Soy Cleaner
Cleaner Cost	\$10,140	\$8,502
Total Cost	\$10,140	\$8,502

SCREEN PRINTING COMPANY ADOPTS LOW-VOC ALTERNATIVE EARLY

Texollini, one of the most technologically advanced knitting mills in America, was founded in 1989. Located in Long Beach, California, the company is a vertically integrated knitting mill that provides fabric development, knitting, dyeing, finishing, fabric print design and printing capabilities to their customers. The product lines produced by Texollini include sportswear, bodywear, activewear, performance wear, intimate apparel and swimwear and the fabrics offered by the company are made of cotton, spandex and a variety of other knitted materials.

Part of Texollini's operations involve screen printing on the fabrics the company makes for their customers. For many years, the company has used water-based inks which they mix themselves on-site. The water-based inks are applied on a machine that conveys the fabrics; the inks are cured with heat in an oven. The screens, including the patterns, are on a cylinder on the conveyer.

The screens are cleaned using cold water in an automated system. Although much of the cleaning is accomplished with this water process, some of the screens are much more difficult to clean. In certain cases, the ink dries on the screen and cannot be removed with water. For these screens, the company's practice was to clean the screens with a VOC solvent using a hand-held high pressure spray device.

IRTA began working with Texollini as part of a project sponsored by Cal/EPA's Department of Toxic Substances Control, EPA Region IX, Los Angeles County Sanitation Districts, the City of Los Angeles Bureau of Sanitation and Southern California Edison. In this project, IRTA is working with several screen printing companies. South Coast Air Quality Management District (SCAQMD) Rule 1171 "Solvent Cleaning Operations" currently requires the cleaners used for cleaning ink from screens to have a VOC content of 750 grams per liter; in July of 2006, the VOC limit for these cleaners is much lower, 100 grams per liter. The purpose of IRTA's project is to identify, test and implement alternative cleaners for the participating screen printers that meet the lower VOC content limit, are low in toxicity and do not cause problems for hazardous waste disposal and sewer discharge.

In initial laboratory testing, IRTA identified several different water-based cleaners that appeared to work well for cleaning Texollini's screens. Three of the water-based cleaners that worked best were tested in the company's spray operation. All three cleaners worked better than the solvent used currently even when they were diluted. IRTA provided larger quantities of the cleaner that worked the best to Texollini for scaled up testing. After three months of testing, Texollini was pleased with the cleaner, GD 1990, which is made by Brulin. The operators used the cleaner at 25 percent concentration for most applications. In some cases, where a more rigorous cleaning is necessary, the operators increased the concentration to 50 percent. The GD 1990 is certified by SCAQMD as a Clean Air Solvent. The VOC content of the cleaner concentrate is less than 5 grams per liter.

The company is able to use much less of the water cleaner than the solvent. In addition, the labor for cleaning the screens has declined from 30 minutes per screen to 10 minutes per screen. Because the screen cleaning takes less time, Texollini has also reduced their electricity cost. Converting to the alternative water-based cleaner has reduced the company's cleaning cost by 65 percent.

Lana Farfan, Project Engineer at Texollini, is happy with the new cleaner. "We are continuously searching for ways to reduce our VOC emissions throughout the plant, she says. "Conversion to the new water-based cleaner is better for the workers and the environment and the added benefit is that it also saves us money."

Annualized Cost Comparison for Texollini

	VOC Solvent	Water-Based Cleaner
Cleaner Cost	\$117	\$58
Labor Cost	\$780	\$260
Electricity Cost	\$3	\$1
Total Cost	\$900	\$319