

II. ANALYSIS AND TESTING OF THE ALTERNATIVE CLEANING AGENTS

This section presents analysis of the performance, cost and toxicity of the alternative cleaning agents. It first presents the test results for the alternative blanket and roller washes tested at the individual facilities. It then addresses the test results for the alternative cleaners for the other on-press components. It summarizes the results of the extended testing in terms of performance and compatibility. Finally, it compares the toxicity of some of the current and alternative cleaners based on the MSDSs for the materials or products.

TESTS OF ALTERNATIVE BLANKET AND ROLLER WASHES AT INDIVIDUAL FACILITIES

This subsection provides a description of each of the facilities where the testing was conducted, the cleaning agents that are used currently, the blanket and roller cleaning 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 only a week in some of the facilities so it is unknown whether other problems would arise if they were tested for a longer period. In seven of the facilities, extended testing for at least three months was conducted. In these cases, the problems that were encountered are described and factored into the cost analysis.

Los Angeles Times

The Los Angeles Times San Fernando Valley Plant is located in Chatsworth, California. The company has two other plants in Southern California. The L.A. Times is a large newspaper with four presses at the Chatsworth location. A picture of one of the presses is shown in Figure 2-1. The company prints on newsprint with soy based ink and runs three shifts per day.



Figure 2-1. Press at Los Angeles Times

IRTA began working with the L.A. Times in 2001 as part of a project sponsored by Cal/EPA's Department of Toxic Substances Control, the South Coast Air Quality Management District and U.S. EPA to test, demonstrate and evaluate cleaning alternatives. At that time, the company was already using a water-based cleaner that had a very low VOC content. An MSDS for this cleaner, called Superclean BW, is shown in Appendix A. The company had converted from a VOC solvent some years before and no longer has records of the solvent use. The Pressroom Manager believes that the cost of using the water-based cleaner is lower than the cost of using the solvent cleaner. This analysis does not include a cost comparison of use of the solvent cleaner and the water-based cleaner used today.

IRTA worked with the L.A. Times to test other low-VOC water-based cleaners and a soy based cleaner. One of the alternative cleaners that was tested is Mirachem Pressroom Cleaner; an MSDS for this cleaner is shown in Appendix A. This cleaner is used by other newspapers. The second cleaner that was tested is a water-based cleaner called Daraclean 236. This cleaner is used by industrial facilities for metal cleaning; an MSDS is shown in Appendix A. The third cleaner that was tested is an emulsion of soy and water; an MSDS for this cleaner is shown in Appendix A.

The L.A. Times currently purchases 2,700 gallons of the Superclean BW. It is diluted with water in a five parts water, one part Superclean BW blend. Taking this into account, the amount of diluted cleaner used is 16,200 gallons per year. The cost of the cleaner is \$10.81 per gallon. On this basis, the cost of using the cleaner is \$29,187 per year. The Mirachem Pressroom cleaner worked effectively at a 50 percent concentration in water. The cost of this cleaner is \$9 per gallon. Assuming that 16,200 gallons at 50 percent concentration are required, the cost of using the Mirachem cleaner would amount to \$72,900 annually. The Daraclean 236 was determined to be effective at one-third concentration in water. The cost of this cleaner is \$11 per gallon. On this basis and assuming that 16,200 gallons are required, the annual cost of using the Daraclean cleaner would amount to \$59,400. The soy based cleaner was found to perform well and the press people thought it was the most effective cleaner. The cost of the cleaner is \$3.75 per gallon. Again assuming 16,200 gallons are used, the cost of using the soy based cleaner would be \$60,750.

Table 2-1 shows the cost comparison for the current cleaner and the alternative cleaners that were tested. The cost of all of the alternative cleaners is higher than the cost of the Superclean BW. The L.A. Times decided to continue using the Superclean BW because it is very low cost.

Table 2-1
Annualized Cost Comparison for the Los Angeles Times

Cleaner	Concentration Used	Annual Cost
Superclean BW	16.7 percent	\$29,187
Mirachem Pressroom Cleaner	50 percent	\$72,900
Daraclean 236	33.3 percent	\$59,400
ES-219	100 percent	\$60,750

San Bernardino Sun

The San Bernardino Sun is a large lithographic newspaper printer located in San Bernardino, California. The company prints the San Bernardino Sun and USA Today. The Sun prints on newsprint and, like many other newspapers, uses soy based ink.

IRTA began work with the San Bernardino Sun in 2001 as part of a project sponsored by Cal/EPA's Department of Toxic Substances Control, the South Coast Air Quality Management District and U.S. EPA to test, demonstrate and evaluate cleaning alternatives. A picture of one of the presses in the pressroom is shown in Figure 2-2. The San Bernardino Sun previously used a cleaner purchased from Pressroom Solutions for all cleaning tasks including blanket cleaning, pipe roller cleaning and ink tray cleaning. An MSDS for this cleaner is shown in Appendix A.



Figure 2-2. Press at San Bernardino Sun

When IRTA began testing with the San Bernardino Sun, the company had already converted to an alternative cleaner for their blanket cleaning. This cleaner, called Mirachem Pressroom Cleaner, is a water-based cleaner. An MSDS for the product is shown in Appendix A. The Sun uses this cleaner in a 50 percent blend with water for blanket cleaning. The Mirachem product cannot be used for the pipe roller cleaning because the paper web is in when the pipe rollers are cleaned. Water-based cleaners can dissolve the web. The Mirachem was not used for cleaning the ink trays because it cleaned too slowly.

IRTA tested alternatives with the Sun for blanket cleaning and for pipe roller and ink tray cleaning. IRTA tested a soy based cleaner called Soy Gold 2000 and in various dilutions with water as a blanket wash. This cleaner, even when diluted in a 50 percent blend with water, cleaned the blankets well. The Sun was not interested in switching to an alternative cleaner for the blanket cleaning, however. IRTA tested several alternatives including a variety of different water-based cleaners for cleaning the pipe rollers and ink trays. The most effective cleaner was a cleaner called Soy Gold 1000. This cleaner is similar to Soy Gold 2000 but it does not contain a surfactant for rinsing. An MSDS for Soy Gold 1000 is shown in Appendix A.

The Sun used five drums per month of the original solvent based cleaner for all of their cleaning. About 80 percent of the solvent was used for blanket cleaning, five gallons per month was used for ink tray cleaning and the remaining solvent was used for pipe roller cleaning. On this basis, of the 3,300 gallons of solvent used annually, 2,640 gallons were used for blanket cleaning, 600 gallons were used for pipe roller cleaning and 60 gallons were used for ink tray cleaning. Eliminating the ink tray cleaning, which is off-press cleaning, the Sun used 3,240 gallons of solvent per year. The cost of the solvent is \$5 per gallon. On this basis, the annual cost of on-press cleaning was \$16,200. The annual cost of ink tray off-press cleaning was \$300.

The Sun substituted the Mirachem water-based cleaner for the solvent in blanket cleaning. The price of the Mirachem cleaner is \$9.09 per gallon. Assuming the Mirachem is diluted 50 percent with water and that the same amount of cleaner is required, the cost of the cleaner for blanket cleaning now is \$11,999 per year. After IRTA conducted the testing, the Sun switched from the solvent cleaner to the soy based cleaner for pipe roller cleaning. The cost of the soy cleaner is \$8.90 per gallon. The annual cost of the pipe roller cleaner is now \$5,340. The company also adopted the soy based cleaner for cleaning the ink trays. The annual cost of ink tray cleaning is now \$534.

Table 2-2 shows the cost comparison for the on-press cleaning. The cost of using the alternative cleaners is seven percent higher than the cost of using the original cleaner. The blanket cleaner has a lower cost but this is more than offset by the higher cost of the pipe roller cleaner.

Table 2-2
Annualized Cost Comparison for On-Press Cleaning for the San Bernardino Sun

	Original Cleaner	Alternative Cleaners
Blanket Cleaner Cost	\$13,200	\$11,999
Pipe Roller Cleaner Cost	\$3,000	\$5,340
Total Cost	\$16,200	\$17,339

Table 2-3 shows the cost comparison for the off-press ink tray cleaning. The company increased their cost by 78 percent in converting to the alternative soy based cleaner.

Table 2-3
Annualized Cost Comparison for Off-Press Cleaning for the San Bernardino Sun

	Original Cleaner	Alternative Cleaner
Ink Tray Cleaner Cost	\$300	\$534
Total Cost	\$300	\$534

J.S. Paluch Co., Inc.

J.S. Paluch is located in Santa Fe Springs, California. The company exclusively prints church newsletters and prints on an uncoated book paper with soy based inks. J.S. Paluch has four narrow web presses that can print four colors. A picture of one of the presses is shown in Figure 2-3.



Figure 2-3. Press at J.S. Paluch Co.

IRTA started working with J.S. Paluch in 2003 as part of a project sponsored by Cal/EPA's Department of Toxic Substances Control, the South Coast Air Quality Management District and U.S. EPA to test, demonstrate and evaluate cleaning alternatives. The company presently uses a cleaner that serves as both a blanket and roller wash called Allied Hydrowash. An MSDS for this cleaner is shown in Appendix A.

IRTA conducted testing at J.S. Paluch to try to identify a suitable alternative cleaning agent. IRTA tested Mirachem Pressroom Cleaner, a cleaner used by some newspapers. This water-based cleaner did clean the ink and cleaned about as effectively as the current

cleaner. IRTA also tested blends of acetone and the Mirachem cleaner and these cleaners performed reasonably well. IRTA tested a soy based cleaner called Soy Gold 2000 and this cleaner was the most effective cleaner. An MSDS for this cleaner is shown in Appendix A. IRTA provided several week's supply of this cleaner to J.S. Paluch and the operator who used the cleaner indicated that it performed very well and that it cut through the ink more quickly than the current cleaner.

J.S. Paluch uses 80 gallons per year of the current cleaner. The cost of the cleaner is \$16 per gallon. On this basis, the annual cost of the current cleaner amounts to \$1,280.

The cost of the alternative soy based cleaner is \$8 per gallon. Assuming the same amount of the soy cleaner would be required, the annual cost of the alternative cleaner would be \$640.

Table 2-4 shows the annual cost comparison for J.S. Paluch. The figures show that the company could cut their cost in half by converting to the alternative soy based cleaner.

Table 2-4
Annualized Cost Comparison for J.S. Paluch

	Current Cleaner	Alternative Cleaner
Cleaner Cost	\$1,280	\$640
Total Cost	\$1,280	\$640

Nelson Nameplate

Nelson Nameplate is located in Los Angeles, California. The company manufactures membrane switches and nameplates made of aluminum, stainless steel and brass. As part of the manufacturing process, Nelson has a lithographic printing operation.

IRTA started working with Nelson several years ago as part of a project sponsored by Cal/EPA's Department of Toxic Substances Control, the South Coast Air Quality Management District and U.S. EPA to test, demonstrate and evaluate cleaning alternatives. Nelson has two manual presses that print on metal and plastic, one sheet at a time. A picture of one of the presses is shown in Figure 2-4.

Nelson historically used a roller wash called Hydro Clean which is an emulsion of water and mineral spirits. An MSDS for the product is shown in Appendix A. The Hydro Clean was used in a 50 percent blend with water. Nelson purchased 65 gallons of the Hydro Clean annually. The cost of the product is \$10 per gallon. On this basis, the annual cost of using the Hydro Clean roller wash was \$650.

Nelson also used 125 gallons of a blanket wash cleaner each year. An MSDS for the blanket wash is shown in Appendix A. The price of the blanket wash, a blend of mineral spirits and acetone, is \$8.25 per gallon. The annual cost of purchasing the blanket wash is \$1,031. The total cost of on-press cleanup amounts to \$1,681 per year.



Figure 2-4. Press at Nelson Nameplate

IRTA tested a variety of roller wash alternatives at Nelson. IRTA tested Mirachem, a water based cleaner used by a few newspapers but this cleaner was not effective. Nelson uses a soy based ink so IRTA tested a variety of different soy based cleaners. Although the soy based cleaners cleaned the ink effectively, a residue that could not be removed with even several water rinses remained. IRTA also tested blends of the soy based products with other components that might aid in the rinsing but, in all cases, there was a residue that did not allow the quality printing Nelson requires. IRTA then began testing a series of blends of acetone with Hydro Clean, the cleaner used by Nelson for many years. The roller wash that was most effective is a blend of 25 percent acetone, 12.5 percent Hydro Clean and 62.5 percent water.

Nelson participated in the extended testing and longer term testing of the alternative low-VOC cleaners was conducted for 13 weeks. The roller wash provided to Nelson also had to be modified during the extended testing. The blend that was tested was composed of 37.5 percent acetone, 12.5 percent Hydro Clean and 50 percent water. During that period, Nelson used 60 percent more of the alternative than the original roller wash. This indicates the company would use 200 gallons of the alternative roller wash per year. The price of the Hydro Clean is \$8.25 per gallon and the price of the acetone is \$6.43 per gallon. On this basis, the annual cost of the alternative roller wash is \$689.

IRTA also tested a variety of different formulations that might serve as an alternative blanket wash. Because Nelson used a blend of mineral spirits and acetone, IRTA focused on similar blends that had a lower VOC content. The blanket wash that appeared to be effective is a blend of 89 percent acetone and 11 percent mineral spirits. The price of this blend is \$5.84 per gallon. On this basis, assuming the same usage as the original blanket wash, the cost of using the alternative blanket wash is \$730 per year.

Table 2-5 shows the annualized cost comparison of using the original blanket and roller wash and the new blanket and roller wash. The figures show that the cost of using the alternative cleaners is 16 percent lower than the cost of using the original higher VOC cleaners.

**Table 2-5
Annualized Cost Comparison for Nelson Nameplate**

	<u>Original Cleaners</u>	<u>Alternative Cleaners</u>
Blanket Wash Cost	\$1,031	\$730
Roller Wash Cost	\$650	\$689
Total Cost	\$1,681	\$1,419

PIP Printing

PIP Printing is located in Santa Monica, California. The shop provides a service as a commercial lithographic printer. Among the products printed by PIP are flyers and newsletters.

IRTA began working with PIP in 2004 as part of a project sponsored by Cal/EPA’s Department of Toxic Substances Control, the South Coast Air Quality Management District and U.S. EPA to test, demonstrate and evaluate cleaning alternatives. The company has a small A.B. Dick printing press. A picture of the press is shown in Figure 2-5. PIP generally cleans the rollers four or five times a day. An MSDS for PIP’s current cleaning agent is shown in Appendix A.



Figure 2-5. Press at PIP Printing

During the cleaning process, the operator replaces the plate with paper cleanup mats. The cleaning agent is applied to the rollers with a squeeze bottle while the press is running. The cleaner is circulated down through the roller train and the excess ink is taken up by

the cleanup mat. As the rollers are cleaned, the cleanup mats contain less and less ink. With the current cleaner, the operator uses about five cleanup mats per cleaning cycle.

IRTA conducted testing of a variety of alternatives with PIP. IRTA tested Mirachem Pressroom Cleaner, a water-based cleaner that is used by some newspapers to clean their presses. This cleaner did not clean fast enough. IRTA tested a blend of 50 percent acetone and a water/mineral spirits emulsion and this cleaner was not effective. IRTA then tried the same cleaner with 75 percent acetone. Although this formulation did clean, it was not effective enough. IRTA tried cleaning with a white oil but this cleaner did not clean effectively.

The cleaning alternative that did work on PIP's press was a soy based cleaner. An MSDS for the cleaner is shown in Appendix A. The soy cleaner contains a surfactant so it can be rinsed with water. This cleaner effectively cleaned the ink with five cleanup mats. Two additional mats were required to rinse the rollers with tap water.

PIP uses five gallons per month of their current cleaner which is priced at \$12 per gallon. The annual cost of the cleanup solvent is \$720. The price of the cleanup mats is 16 cents per sheet. Assuming PIP cleans up 4.5 times per day and uses five cleanup mats, the daily cost of cleanup sheets is \$3.60. The annual cost of the cleanup mats amounts to \$936. The total cost of cleanup currently is \$1,656 annually.

The cost of the alternative soy cleaner in five gallon quantities is about \$8 per gallon. Assuming the same amount of usage of the soy as the current cleaner, the annual cleaner cost would amount to \$480. With the soy cleaner, more cleanup mats were required because of the rinsing step. Assuming 4.5 cleanups per day and use of seven cleanup mats each time, the annual cost of cleanup mats would amount to \$1,310. The total cost of cleaning the press with the alternative would be \$1,790.

Table 2-6 shows the cost comparison of using the current cleaner and the alternative cleaner. The figures show that the cost of using the alternative cleaner would increase the cleaning cost by about eight percent.

Table 2-6
Annualized Cost Comparison for PIP Printing

	Current Cleaner	Alternative Soy Cleaner
Cleaner Cost	\$720	\$480
Cleanup Mat Cost	\$936	\$1,310
Total Cost	\$1,656	\$1,790

South Coast Air Quality Management District Print Shop

The South Coast Air Quality Management District (SCAQMD) print shop has a small press which is shown in Figure 2-6. The print shop provides printing services to the SCAQMD in its rule development, enforcement and outreach activities. The shop prints flyers and reports in support of SCAQMD activities.



Figure 2-6. Press at SCAQMD Print Shop

For several years, the print shop used a high VOC cleaner for cleaning the rollers and the blanket on the press. The head of the print shop estimates that the shop used seven gallons per year. Three-fourths of the cleaner or 5 gallons were used for cleaning the rollers and one-fourth was used for cleaning the blankets. The cost of the cleaner is \$11.15 per gallon. On this basis, the annual cost of the cleaner amounted to \$78.

The rollers on the small press shown in Figure 2-6 are cleaned using cleanup mats. The mats are placed on the machine and the cleanup solvent is applied several times. The cleanup mats absorb the ink that is put into solution by the cleanup solvent. When the mats no longer absorb ink, the rollers are clean. The print shop historically used about five cleanup mats per cleanup and cleanup is performed on average four days each week. Each cleanup mat costs 39.5 cents. The annual cost of the cleanup mats was \$411.

The pressman spent about 15 minutes four days a week in the cleanup activities. Assuming the SCAQMD labor rate of \$21 per hour, the annual labor cost was \$1,092.

IRTA tested alternatives with the SCAQMD print shop for more than a year and the print shop has adopted the lower VOC cleaners. Alternatives that were tested included soy, water-based and acetone based cleaners. The cleaner that worked best as an alternative for roller wash cleaning was a blend of 62.5 percent acetone, 25 percent water and 12.5 percent of a mineral spirits cleaner called Hydro Clean. An MSDS for this cleaner, called Rho-Wash 100, is shown in Appendix A. The blanket wash that worked most effectively was 90 percent acetone and 10 percent mineral spirits. An MSDS for the product adopted by the print shop for blanket wash, called Rhosolv 7248, is shown in Appendix A. SCAQMD performed extended testing on their press for about six months during the project.

During the extended testing, the print shop used about the same amount of the alternative roller and blanket wash as the high VOC wash. The cost of both of the alternative cleaners amounts to \$19 per gallon including a delivery fee. Assuming the same usage, the annual cost of the new cleaners is \$133.

During the extended testing for the alternative roller wash, the pressman indicated that he used two extra cleanup mats during the cleaning. Assuming the cleaning frequency of four days per week, use of seven cleanup mats per job and a cost of 39.5 cents per cleanup mat, the cost of cleanup mats with the alternative cleaner is \$575 per year.

The pressman reported that, during the extended testing, the cleanup time was increased from 15 minutes to 20 minutes per day with the alternative cleaners. Assuming the labor rate of \$21 per hour, the annual cleanup labor cost with the alternatives amounts to \$1,456.

Table 2-7 shows the annualized cost comparison for the SCAQMD print shop. The cost of cleanup using the alternative low-VOC cleaners increased by about 37 percent.

**Table 2-7
Annualized Cost Comparison for SCAQMD Print Shop**

	High VOC Cleaner	Alternative Cleaners
Cleaner Cost	\$78	\$133
Cleanup Mat Cost	\$411	\$575
Labor Cost	\$1,092	\$1,456
Total Cost	\$1,581	\$2,164

City of Santa Monica Print Shop

The City of Santa Monica Print Shop provides support to the city for various printing activities. One of their operations involves printing on envelopes and stationary with a small lithographic printing press. The press is used twice a month and it is cleaned after each print session.

In the past, the city used two high VOC cleaners, one for cleaning the rollers and the other for cleaning the cylinder plate. The city used one gallon of the roller cleaner each year. At a cost of \$40 per gallon, the total cost of purchasing the roller cleaner was \$40 per year. The city used one quart of the cylinder cleaner each year. At a cost of \$15 per gallon, the total cost of purchasing the cylinder cleaner was about \$4 annually. Cleanup mats are used to collect the ink when the solvent is applied to the rollers. The city used 120 cleanup mats per year. At a cost of 28 cents per cleanup mat, the total annual cost was \$34. The cost of purchasing cleaning materials was about \$78 annually.

IRTA worked with the city to test alternatives. After testing several formulations, the city decided to convert to a soy based cleaner called Soy Gold 2000 for roller cleaning and a water-based cleaner called Mirachem Pressroom Cleaner for the cylinder cleaning. Both the soy cleaner and the water-based cleaner are lower in toxicity than the VOC cleanup solvents used by the city previously. About one gallon per year of the soy cleaner is required. At a price of \$8 per gallon, the annual cost of purchasing the roller cleaner is now \$8. For cleaning the cylinder, the city uses one quart per year of the water-based cleaner. At a cost of \$10 per gallon, the annual cost of the formulation is \$3. The city uses more cleanup mats with the new cleaner because the soy cleaner needs to be rinsed with water so it does not leave a residue; about nine cleanup mats per job or 216 cleanup mats per year are required. The annual cost of the cleanup mats is now about \$60. The yearly total cost of cleaning materials is now \$71.

The labor cost for cleaning has increased. When the city used the VOC cleaners, it took about one-half hour to clean the press twice a month. At a labor rate of \$17.50 per hour, the annual labor cost for cleaning amounted to \$210. The cleanup now takes one hour twice a month. The labor cost is twice what it was in the past, at \$420.

The annual cost comparison of the VOC solvents and the low VOC cleaners is shown in Table 2-8. The values of Table 2-8 show that the cost for cleaning at the city increased by 70 percent when the city substituted the low VOC alternatives.

Table 2-8
Annualized Cost Comparison for City of Santa Monica

	VOC solvents	Soy and Water-Based Cleaner
Cleaner and Cleanup Mat Cost	\$78	\$71
Labor Cost	\$210	\$420
Total Cost	\$288	\$491

Presslink

Presslink is located in Anaheim, California. The company is a commercial lithographic printer with two sheet fed presses. One of the presses is a small Ryobi and the other is a larger four color press. Pictures of the small and larger presses are shown in Figure 2-7 and Figure 2-8 respectively. Presslink prints flyers and brochures.



Figure 2-7. Small Press at Presslink



Figure 2-8. Larger Press at Presslink

IRTA began working with Presslink as part of a project sponsored by Cal/EPA's Department of Toxic Substances Control, the South Coast Air Quality Management District and U.S. EPA to test, demonstrate and evaluate alternative on-press cleaning agents. Presslink uses an air dry solventborne ink on their small press and a heat set ink on their larger press. On the small press, the company uses a blanket wash and a two step roller wash for cleaning. An MSDS for the blanket wash is shown in Appendix A. MSDSs for the two roller washes are also shown in Appendix A. On the larger press, which has an automated roller wash system, Presslink uses the same blanket wash and the step 2 roller wash.

IRTA tested a variety of alternatives at Presslink. IRTA tested Mirachem Pressroom Cleaner, a cleaner used by some newspapers but it did not clean effectively. IRTA tested a few different blends of the Mirachem cleaner and acetone but they did not work well. IRTA tested a soy based cleaner called Soy Gold 2000 which did clean effectively.

IRTA provided Presslink with a week’s supply of the soy based cleaner and it was tested as a blanket and roller wash on both presses. During the time period, it cleaned both presses well. An MSDS for the soy based cleaner is shown in Appendix A.

Presslink uses 20 gallons per month or 240 gallons per year of blanket wash. The price of the blanket wash is \$3.66 per gallon, so the annual cost of using the blanket wash is \$878. The company uses 2.5 gallons per month or 30 gallons per year of the two roller washes. The price of the roller washes is \$10 per gallon. The annual cost of the roller wash is \$300. The total annual cost of the current cleaners is \$1,178.

The cost of the alternative soy based cleaner is \$8 per gallon. Assuming the cleaner is used as both a blanket and roller wash and assuming that the same amount of cleaner is required, the annual cost of the alternative cleaner is \$2,160.

Table 2-9 shows the annualized cost comparison for Presslink. The values show that the cleaning cost with the soy based alternative cleaner is 83 percent higher than the cleaning cost with the current cleaners.

**Table 2-9
Annualized Cost Comparison for Presslink**

	Current Cleaners	Alternative Cleaners
Blanket Wash Cost	\$878	\$1,920
Roller Wash Cost	\$300	\$240
Total Cost	\$1,178	\$2,160

Vertis, Inc.

Vertis’ headquarters are in Baltimore, Maryland. The company has nearly 7,000 professional employees in approximately 120 locations. Vertis provides lithographic printing services for advertising and other commercial printing venues. The company is one of the largest producers of newspaper advertising and editorial special sections in the U.S.

As part of projects sponsored by U.S. EPA, Cal/EPA’s DTSC and the SCAQMD, IRTA worked with one of the Vertis printing facilities in Riverside, California to test alternative low-VOC cleaners on its web offset presses.

Historically, Vertis used two different cleaners. The first was used in the automated blanket wash system. This cleaner has a VOC content of 264 grams per liter. The second was used as a manual blanket wash cleaner. This cleaner has a VOC content of 192 grams per liter. Although both cleaners have a low VOC content, the VOC content exceeds the SCAQMD Rule 1171 100 gram per liter limit that becomes effective in July of 2006.

IRTA tested several alternatives with Vertis. The alternatives included water-based and soy based cleaners. The water-based cleaners could not be used on the web presses, even in more dilute concentration, because cleaning was performed when the paper web was in the press and water has a tendency to shred the paper. IRTA then supplied Vertis with 10 gallons of one of the soy cleaners, called Soy Gold 2000, and it was tested for a week or so in the automatic blanket wash system on one of Vertis' presses. An MSDS for this cleaner is shown in Appendix A.

As a result of the testing, Vertis decided to convert to a lower VOC content cleaner, and contacted their solvent supplier. The supplier provided the facility with a methyl ester cleaner similar to the soy based cleaner IRTA had provided. The company has been using the cleaner, which has a VOC content of 72 grams per liter, for both automatic and manual cleaning for more than a year and a half. Discussions with the press operators indicated that they prefer the new, low-VOC cleaner because of reduced cleaning time.

Table 2-10 shows the annualized cost comparison for Vertis at its Riverside facility. Because of the reduction in labor, the cost of cleaning with the new low-VOC cleaner is about 19 percent lower than the cost of cleaning with the higher VOC cleaners.

Table 2-10
Annualized Cost Comparison for Vertis

	High VOC Cleaners	Low VOC Cleaner
Cleaner Cost	\$45,396	\$48,300
Labor Cost	\$175,200	\$131,400
Total Cost	\$220,596	\$179,700

R.R. Donnelley & Sons Co.

R.R. Donnelley & Sons is a large lithographic printer. One of the company's facilities is located in Torrance, California. Donnelley prints newspaper inserts and high quality magazines. The company has several large four-color presses at the Torrance location.

IRTA began working with Donnelley in 2001 as part of a project sponsored by Cal/EPA's Department of Toxic Substances Control, the South Coast Air Quality Management District and U.S. EPA to test, demonstrate and evaluate cleaning alternatives. IRTA assisted the company in converting their off-press cleaning operations to alternative low-VOC materials. IRTA also tested alternatives with Donnelley for on-press cleaning.

Donnelley has an automated roller wash system on their presses. The company uses a roller cleaner based on mineral spirits and a methyl ester. An MSDS for this product is shown in Appendix A. The operators clean the blankets by hand "on the run." They apply the cleaning solvent in spray bottles directly onto the blankets while the press is operating during printing. The blanket wash is a mineral spirit and an MSDS for the material is shown in Appendix A.

IRTA conducted testing of alternatives with Donnelley. The company tested a soy based product containing a surfactant for both blanket and roller cleaning for more than three months. An MSDS for this product is shown in Appendix A. Donnelley had blanket failures and the testing was stopped. It is unknown whether the blanket failures were attributable to use of the new cleaner. The press operators indicated that it took slightly longer to get the press back to color but did not provide details. The press operators also indicated that the residue from the new cleaner made the floor slippery and that the excess cleaner occasionally dripped onto the web. A possible explanation for these two problems is the operator practice of applying the blanket wash to the blanket in squeeze bottles in the “on the run” cleaning. The new cleaner does not evaporate readily and an alternative application method might solve these problems.

Donnelley uses 3,675 gallons of their roller wash annually. The price of this product is \$10.50 per gallon. The cost of the roller wash is \$38,588 per year. Donnelley uses 13,950 gallons of the other mineral spirits product in their plant and two-thirds or 9,300 gallons per year are used to clean the blankets. The price of this product is \$2.60. On this basis, the annual cost of the blanket wash is \$24,180. The current cost of roller and blanket wash is \$62,768 per year.

The cost of the alternative Soy Gold 2000 product is \$8 per gallon. Assuming the product is used for cleaning rollers and blankets and assuming the same amount is required, Donnelley would use 12,975 gallons of the alternative cleaner per year. On this basis, the cost of the alternative product would be \$103,800 annually.

Table 2-11 shows the annualized cost comparison for Donnelley. The alternative soy cleaner is less costly than the current roller wash and more costly than the current blanket wash. The figures show that the cost to Donnelley would increase by 66 percent if the company adopted the alternative.

Table 2-11
Annualized Cost Comparison for R.R. Donnelley & Sons

	Current Cleaners	Alternative Soy Cleaner
Blanket Wash Cost	\$24,180	\$74,400
Roller Wash Cost	\$38,588	\$29,400
Total Cost	\$62,688	\$103,800

Fanfare Media Works

Fanfare Media Works is located in Valencia, California. The company has three sheet fed presses where they print posters and other material for a variety of different customers in the advertising industry. A picture of one of the sheet fed presses is shown in Figure 2-9. Fanfare also has two web fed presses that print cash register tape and car wash and dry cleaning coupons. A picture of one of the web presses is shown in Figure 2-10.



Figure 2-9. Conventional Ink Press at Fanfare Media Works



Figure 2-10. UV Curable Ink Press at Fanfare Media Works

The sheet fed presses use coated paper whereas the web presses use uncoated paper. IRTA began work with Fanfare as part of an SCAQMD project to test alternative low-VOC, low toxicity cleaners. The ink used on both types of presses, at that stage, was a solventborne air dry ink. At a later date, Fanfare switched the ink on one of the web presses to UV curable ink.

IRTA worked with Fanfare to test alternatives on the sheet fed presses. Alternatives that were tested included Mirachem, a water-based cleaner, acetone and various types of soy based products. The product that worked best was Soy Gold 2500, a product that was

designed to rinse well. IRTA provided larger quantities to Fanfare and the company participated in the extended testing. Fanfare tested the cleaner as both a roller and blanket wash for about three months. The cleaner worked very well over the period. An MSDS for the Soy Gold 2500 is provided in Appendix A.

When Fanfare switched to UV curable ink on the web presses, IRTA tested alternatives to identify cleaners that would perform well in cleaning the new ink. The two alternatives that were tested were Mirachem and Soy Gold 2500. The Mirachem cleaned well but dissolved the paper since cleaning was conducted with the web in. Fanfare tested the Soy Gold 2500 on one of the web presses for several months and the pressman indicated it worked well.

Fanfare estimates that the company uses about one drum of their high VOC roller and blanket wash every six weeks or about 477 gallons per year. This cleaner is used on all of the presses. The cost of the solvent is \$8.72 per gallon. The annual cost of using the high VOC cleaner is \$4,159. During the extended testing, the pressmen used the about the same amount of Soy Gold 2500 as the high VOC solvent. The Soy Gold 2500 vendor agreed to provide the product at the same cost as the high VOC solvent. This implies that the annual cost of the Soy Gold 2500 would also be \$4,159.

Table 2-12 shows the annualized cost comparison for Fanfare. The cost of using the alternative low-VOC cleaner is the same as the cost of using the higher VOC cleaner.

Table 2-12
Annualized Cost Comparison for Fanfare Media Works

	High VOC Cleaner	Soy Gold 2500
Cleaner Cost	\$4,159	\$4,159
Total Cost	\$4,159	\$4,159

The Castle Press

The Castle Press is located in Pasadena, California. The company is a commercial lithographic printer with five sheet fed presses. A picture of one of Castle’s presses is shown in Figure 2-11. The company prints items like newsletters and brochures.

IRTA began working with Castle as part of a project sponsored by Cal/EPA’s Department of Toxic Substances Control, the South Coast Air Quality Management District and U.S. EPA to test, demonstrate and evaluate alternative on-press cleaning agents. Castle cleans their sheet fed presses with two blanket washes, one for cleaning with the automated system and one for cleaning by hand. The company uses a two step roller wash. Appendix A includes MSDSs for the hand blanket wash, the automated blanket wash, the step 1 roller wash and the step 2 roller wash.

IRTA conducted testing of a variety of alternatives at Castle. During blanket wash testing, one of the alternatives that was tested was Mirachem Pressroom Cleaner, a water-



Figure 2-11. Press at The Castle Press

based cleaner used by some newspapers. This cleaner did not clean aggressively enough. IRTA also tested a soy based cleaner as a blanket wash. Although it cleaned the ink well, the operator indicated that it did not evaporate quickly enough. IRTA also tested acetone but the operator thought it was too strong. IRTA tested a blend of 25 percent acetone and 75 percent Mirachem which was not aggressive enough. Finally, IRTA tested a blend of 50 percent acetone and 50 percent of a soy based cleaner and, according to the operator, this cleaner worked well. An MSDS for the soy based cleaner, called Soy Gold 2000, and for acetone are shown in Appendix A.

For the rollers, IRTA tested Mirachem Pressroom Cleaner which did not work well. IRTA also tested a soy based cleaner, called Soy Gold 2000, followed by a water rinse. This cleaner worked effectively. With further testing, however, the soy product did not rinse adequately. IRTA tested a blend of acetone with a mineral spirits/water emulsion but it did not clean adequately. Finally, IRTA tested another soy based cleaner, called Magic Wash 522C. With rinsing, this product cleaned well. An MSDS for this product is shown in Appendix A.

IRTA provided Castle with a week's supply of the blanket and roller wash that worked best for scaled up testing. After testing for that time frame, the blend of 50 percent acetone and 50 percent Soy Gold 2000 worked effectively as a blanket wash and the Magic Wash 522C worked effectively as a roller wash.

Castle uses 80 gallons per month of their current blanket wash. The cost of the blanket wash is \$7.62 per gallon. On this basis, the annual blanket wash cost is \$7,315. The company uses 12 gallons per month of each of the two roller washes. The cost of the two roller washes is \$10.32 per gallon and \$9.22 per gallon. The annual cost of the roller washes is \$2,814. The total annual cost of the current cleaning materials is \$10,129.

The cost of the alternative blanket wash, consisting of 50 percent acetone and 50 percent Soy Gold 2000 is estimated at \$6 per gallon. Assuming the company would use the same amount of the new blanket wash as the current blanket wash, the annual cost of the alternative blanket wash would be \$5,760. The cost of the Magic Wash 522C is about \$20 per gallon. Again assuming the use would be the same as for the current roller washes, the annual cost of the alternative roller wash would be \$5,760. The total cost for the new blanket and roller washes would amount to \$11,520.

Table 2-13 shows the cost comparison for the current and alternative blanket and roller washes. The alternative blanket wash is lower cost than the current blanket wash but the cost of the alternative roller wash is higher than the cost of the current products. Conversion to the alternatives would increase the cleaning cost by 14 percent.

Table 2-13
Annualized Cost Comparison for The Castle Press

	Current Cleaners	Alternative Cleaners
Blanket Wash Cost	\$7,315	\$5,760
Roller Wash Cost	\$2,814	\$5,760
Total Cost	\$10,129	\$11,520

Print 2000

Print 2000 is located in Monterey Park, California. The company has four sheet fed presses and a picture of one of these is shown in Figure 2-12. Print 2000 prints high quality posters and flyers; 90 percent of the paper for the products is coated and 10 percent is uncoated.



Figure 2-12. Press at Print 2000

IRTA began work with Print 2000 as part of a project sponsored by U.S. EPA, Cal/EPA's Department of Toxic Substances Control and SCAQMD. The purpose of the project was to identify, test and demonstrate low-VOC alternatives for cleaning blankets and rollers.

Print 2000, like other printers, uses high VOC cleaners for cleaning the blankets and rollers. An MSDS for the roller wash used by the company, called Step #2 Roller Wash, is shown in Appendix A. IRTA tested a variety of alternatives with the company including water-based cleaners, soy based cleaners and acetone. Print 2000 participated in the extended testing program where IRTA provided cleaners at no cost to the company. The extended testing required about three months.

After testing several alternatives, IRTA provided Print 2000 with larger quantities of two cleaners. The roller wash that worked best was a soy based product called Soy Gold 2500. This product was designed to rinse easily and it can be rinsed with one water rinse. During the extended testing, Print 2000 tested this cleaner as a roller wash. IRTA also provided the company with a blend of 80 percent Soy Gold 2500 and 20 percent acetone for blanket cleaning. Although this blend cleaned the ink effectively, Print 2000 had to rinse the blankets with a wet wipe cloth after cleaning. The pressroom employees did not want to take this extra step. IRTA conducted additional testing with the company to find a blanket wash that would not require rinsing. The alternative that worked best is a blend of acetone and mineral spirits called Rhosolv 7248. IRTA provided larger quantities of this cleaner and Print 2000 used it for the extended testing. MSDSs for Soy Gold 2500 and Rhosolv 7248 are shown in Appendix A.

Print 2000 uses one drum per month or 12 drums per year of the high VOC cleanup solvent. On this basis, the company uses 660 gallons per year. Print 2000 estimates that about one-third of the solvent or 220 gallons is used for roller wash and two-thirds or 440 gallons is used for blanket wash. The cost of the cleaner is between \$450 and \$600 per drum. Assuming the midpoint of \$525 per drum or \$9.55 per gallon, the annual cost of the roller wash is \$2,101 and the annual cost of the blanket wash is \$4,202. The total annual cost of the high VOC cleaner is \$6,303.

During the extended testing, the pressroom employees indicated that they used about the same amount of the low-VOC roller and blanket wash. The cost of the Soy Gold 2500 roller wash is \$8.93 per gallon based on purchases of drum quantities. Assuming 220 gallons are used annually, the cost of the new low-VOC roller wash is \$1,965 per year. The cost of the Rhosolv 7248 blanket cleaner, again based on purchases of drum quantities, is \$5.96 per gallon. Assuming 440 gallons are used per year, the annual cost of the low-VOC blanket wash is \$2,622.

Table 2-14 shows the annualized cost comparison for Print 2000. The figures show that Print 2000 would reduce their cost of cleaning by 27 percent by converting to the low-VOC cleaning alternatives.

Table 2-14
Annualized Cost Comparison for Print 2000

	High VOC Cleaner	Low-VOC Cleaners
Blanket Cleaner Cost	\$4,202	\$2,622
Roller Cleaner Cost	\$2,101	\$1,965
Total Cost	\$6,303	\$4,587

Western Metal Decorating

Western Metal Decorating is located in Rancho Cucamonga, California. The company has been in business for more than 45 years decorating sheet and coil stock with operations for coating, laminating and lithographic printing. Western Metal Decorating has two lithographic printing presses. The company prints on a range of products ranging from metal can stock to vintage posters and serving trays.

IRTA worked with Western Metal Decorating as part of a project sponsored by U.S. EPA, Cal/EPA's Department of Toxic Substances Control and SCAQMD. The company uses epoxy and alkyd based inks for printing on metal. These inks are very difficult to clean.

Western Metal Decorating uses a solvent consisting of a blend of high VOC solvents that is used as thinner for the coatings. The solvent is recycled on-site and is used as a blanket and roller wash for the lithographic presses. Western Metal Decorating uses about 35 gallons of the recycled material per month or 420 gallons per year. There is no cost for the blanket and roller cleaner because it is generated by the plant.

IRTA investigated several alternative blanket and roller cleaners. The alternatives generally contained acetone and soy based cleaners. The alternative that worked most effectively was a blend of 68 percent acetone, 23 percent of a soy product called Soy Gold 2500 and nine percent of the company's recycled solvent. IRTA provided larger quantities of this cleaner for scaled-up testing. MSDSs for acetone and Soy Gold 2500 are shown in Appendix A.

Western Metal Decorating would blend the new low-VOC cleaner at the facility. The company would use their recycled solvent and purchase acetone and Soy Gold 2500 in drum quantities. The cost of the acetone, in drum quantities, is \$7.02 per gallon. Assuming the same amount of the alternative cleaners would be required, 286 gallons of acetone would be required for the blend. The cost of the acetone is \$2,008 annually. About 96 gallons of Soy Gold 2500 would be required. At a cost of \$8.93 per gallon for drum quantities, the cost of the soy for the blend would amount to \$857 per year. Western Metal Decorating would also use 38 gallons of recycled solvent at no cost in the blend. The total cost of the alternative cleaner would be \$2,865 annually.

The facility is currently using 420 gallons of recycled solvent as a cleanup material on the lithographic press. If Western Metal Decorating converted to the alternative low-VOC cleaner, the blend would only require 38 gallons of recycled solvent. The company indicates that the additional recycled solvent could be used as a thinner in the coatings. Thus, the facility would not have to dispose of it as hazardous waste.

Table 2-15 presents the annualized cost comparison for Western Metal Decorating. The company would have to begin paying about \$2,900 per year to use the alternative low-VOC cleaner.

Table 2-15
Annualized Cost Comparison for Western Metal Decorating

	High VOC Cleaner	Low-VOC Alternative
Cleaner Cost	\$0	\$2,865
Total Cost	\$0	\$2,865

The Dot Printer

The Dot Printer is located in Irvine, California. The company is a commercial lithographic printer that prints high quality posters and the Thomas Guide. Dot has three six-color sheet fed presses that use an air dry ink and two web presses that use a heat set ink.

IRTA began working with Dot in 2003 as part of a project sponsored by Cal/EPA’s Department of Toxic Substances Control, the South Coast Air Quality Management District and U.S. EPA to test, demonstrate and evaluate cleaning alternatives. IRTA worked with Dot to test alternative cleaners for the sheet fed presses. A picture of one of the sheet fed presses is shown in Figure 2-13.



Figure 2-13. Press at The Dot Printer

Dot uses the same cleaner for both blanket and roller cleaning on the sheet fed presses. An MSDS for this cleaner, from Day International, is shown in Appendix A. IRTA tested a number of alternative blanket and roller washes with Dot. IRTA tested Mirachem Pressroom Cleaner, a water-based cleaner used by some newspapers but it did not effectively clean the ink. IRTA tested a number of soy based cleaners and blends of soy based cleaners with other components as a roller wash. Rinsing with water did not remove the residue sufficiently. IRTA did find a soy based cleaner, called Magic Wash 522C, that could be rinsed and it cleaned the ink well. An MSDS for this cleaner is shown in Appendix A. IRTA tested a variety of different cleaners and blends consisting of soy based cleaners, acetone and other solvents with the operator to find a blanket wash that suited his needs. The operator indicated that a blend of 92 percent acetone and eight percent of a cleaner called Soy Gold 2000 worked best. An MSDS for the Soy Gold 2000 is shown in Appendix A.

IRTA provided Dot with larger quantities of the alternative roller and blanket wash and Dot tested them for a week. The cleaners performed well but the operator did not like the smell of the blanket wash. The company also thought it was inconvenient that the roller wash could not be used to clean the plate because it leaves a residue and it removed the image from the plate.

The company cleans the blankets 10 of 15 times a day and cleans the rollers when a job is completed and a color change is necessary. Dot uses 50 gallons per week or 2,600 gallons per year of the cleaner on the three sheet fed presses. Three-fourths of the cleaner is used as a blanket wash and one-fourth is used as a roller wash. The cost of the cleaner is \$4.25 per gallon. The annual cost of the cleaner amounts to \$11,050.

The alternative blanket wash is composed of 92 percent acetone which has a price of \$4 per gallon and eight percent Soy Gold 2000 which has a price of \$8 per gallon. The cost of the blend is \$4.32 per gallon. Assuming Dot uses 1,950 gallons of blanket wash per year and assuming the same amount of the alternative blanket wash would be used, the annual cost of the alternative blanket wash would amount to \$8,424. The alternative roller wash is priced at \$20 per gallon. Assuming 650 gallons of roller wash are used each year and assuming that the new soy based roller wash would be used in the same quantity, the annual cost of roller wash would be \$13,000. The total annual cost of the alternative cleanup materials would be \$21,424.

Table 2-16 shows the annual cost comparison for the current and alternative cleaners assuming they are used on Dot's three sheet fed presses. The cost of using the alternative cleaners is slightly less than double the cost of using the current cleaner.

Table 2-16
Annualized Cost Comparison for The Dot Printer

	Current Cleaner	Alternative Cleaners
Blanket Wash Cost	\$8,288	\$8,424
Roller Wash Cost	\$2,762	\$13,000
Total Cost	\$11,050	\$21,424

Lithographix

Lithographix is a large, high quality independently owned printer. The company has three facilities in California: a corporate office and printing plant in Hawthorne; a plant in Carlsbad; and a plant in San Mateo. At the Hawthorne plant, Lithographix operates five sheet fed eight color presses and three full web presses.

IRTA began work with Lithographix with the help of the Printing Industries Association of Southern California as part of a project sponsored by U.S. EPA, DTSC and the SCAQMD to test alternative low-VOC, low toxicity cleanup materials. The testing was conducted at Lithographix's Los Angeles facility before it was moved to Hawthorne.

At various times during the testing, IRTA worked with Lithographix on alternatives for a conventional ink sheet fed press, a UV curable ink sheet fed press and a heat set ink web press. This report focuses on the results of the testing on the sheet fed press that used UV curable ink.

Historically, Lithographix used a glycol ether based cleaner for their off-press, blanket and roller cleaning. An MSDS for this cleaner, called 396 U.V. Wash, is shown in Appendix A. The company purchased two drums of the cleaner per month and the cost of the cleaner was \$500 per drum or \$9.09 per gallon. One drum of the solvent per month was used for off-press cleaning, three-fourths of a drum or 41 gallons per month was used for blanket cleaning and one fourth of a drum or 14 gallons per month was used for roller cleaning. The annual cost of the blanket cleaner amounts to \$4,472 and the annual cost of the roller cleaner is \$1,527.

Lithographix provided UV ink samples to IRTA and IRTA performed screening tests with acetone, various water-based cleaners, certain VOC solvents and blends. IRTA and Lithographix conducted preliminary testing of the cleaners that worked the best on the UV press. Cleaners that were tested included Mirachem Pressroom Cleaner, a water-based cleaner called Magic UV, acetone and blends of various VOC solvents with these cleaners. The cleaner that worked most effectively as a roller wash was Magic UV and the cleaner that worked most effectively as a blanket wash was a blend of 92 percent acetone and eight percent of a glycol ether called DPM. MSDSs for Magic UV, acetone and DPM are shown in Appendix A.

IRTA provided larger quantities of the alternative cleaners to Lithographix and the press people tested it for a few weeks. The pressman indicated that the blanket wash was as effective as the higher VOC blanket wash and the same amount of cleaner was required. He also indicated that the low-VOC roller wash cleaned effectively but that more was required. He estimated that the low-VOC cleaner would be used up in 5.5 days whereas the high VOC cleaner would last seven days. This indicates that about 27 percent more of the Magic UV alternative was required for roller cleaning.

The cost of the low-VOC blanket wash is \$6.85 per gallon if purchased in drum quantities. Assuming the company would use 41 gallons of the cleaner per month, the

annual cost of the alternative blanket wash would be \$3,370. The cost of the Magic UV alternative roller wash is \$20 per gallon. Assuming 18 gallons per month or 216 gallons per year of the roller wash would be required, the annual cost of roller cleaning would be \$4,320.

Table 2-17 shows the annual cleaning cost comparison for Lithographix. The figures in Table 2-17 indicate that the annualized cost of cleaning with the low-VOC alternatives is 28 percent higher than the cost of cleaning with the higher VOC solvents. The cost of the alternative blanket wash is lower but the cost of the roller wash is substantially higher.

Table 2-17
Annualized Cost Comparison for Lithographix

	High VOC Cleaner	Low-VOC Cleaners
Blanket Wash Cost	\$4,472	\$3,370
Roller Wash Cost	\$1,527	\$4,320
Total Cost	\$5,999	\$7,690

Anderson Lithograph

Anderson Lithograph, one of the largest lithographic printers in the country, has one printing facility that is located in Commerce, California. This plant has several sheet fed and web presses that use both conventional solventborne and UV curable ink.

As part of the SCAQMD and DTSC projects, IRTA worked with Anderson to test alternatives for more than two and a half years. IRTA tested alternatives on a sheet fed conventional ink press, a sheet fed UV curable ink press and a web press. Anderson originally agreed to conduct extended testing but dropped out of the testing project before it occurred. This section presents the incomplete results of the testing at Anderson.

On the web press, IRTA and Anderson tested a variety of soy based formulations. The company was already using a methyl ester formulation with relatively low VOC content when IRTA began the work. An MSDS for this cleaner, called Envirowash 220, is shown in Appendix A.

The web presses at Anderson are cleaned with an automated blanket wash system and they are also cleaned periodically by hand with a blanket wash. Because the alternative would be used in the automated system, IRTA focused on cleaners that would have a flash point of about 140 degrees F or higher. The three alternatives that worked best included blends of about 90 percent Soy Gold 2000 with 10 percent of a glycol ether called DPM, 10 percent of 1-butanol or 10 percent of EEP. MSDSs for these three components are shown in Appendix A. All of these alternatives had a VOC content of about 100 grams per liter. As mentioned above, Anderson dropped out of the program before the alternatives could undergo extended testing.

IRTA and Anderson also worked extensively on alternatives for the sheet fed conventional and UV curable ink presses. The high VOC cleaner used by Anderson for cleaning these presses is CP-580 Hybrid Wash. An MSDS for this product is shown in Appendix A. A roller wash composed of 100 percent Soy Gold 2000 and a blanket wash composed of 50 percent Soy Gold 2000 and 50 percent acetone were tested on one press using UV curable ink for a six week period. The results of the testing were positive but qualified. A letter from Frank Barnett, Director, Environmental, Health & Safety at Anderson, summarizing the results of the testing is included in Appendix B. As indicated in the letter, compatibility and flash point issues were not resolved. The blanket wash could only be used by hand since the flash point is too low for the cleaner to be used in the automated blanket wash system.

IRTA and Anderson performed additional work on the sheet fed presses taking into account that the cleaners must have high flash points. By then, IRTA had obtained a new soy formulation, called Soy Gold 2500, which was much more easily rinsed than the Soy Gold 2000. An MSDS for Soy Gold 2500 is shown in Appendix A. Several of the same formulations that were tested on the web press were tested on the sheet fed presses. The formulation that performed best, both on the conventional and UV curable ink, was a blend of 90 percent Soy Gold 2500 and 10 percent DPM. Although Anderson may have conducted some independent testing, the company dropped out of the program before the formulation could be tested in the automated blanket wash system.

The Printery

The Printery is located in Irvine, California. The company has four sheet fed presses for printing posters and other material for a variety of different customers. Two of the presses are small duplicating Crestline presses, one is a larger two color press and one is a large six color press with an automated blanket wash system. Figures 2-14, 2-15 and 2-16 show pictures of one of the Crestline presses, the two color press and the six color press.



Figure 2-14. Six Color Press at The Printery



Figure 2-15. Two Color Press at The Printery

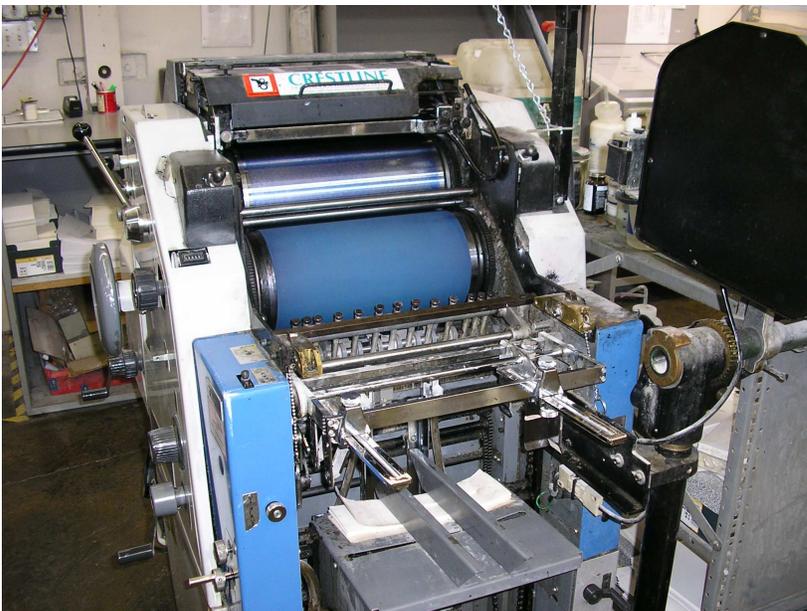


Figure 2-16. Small Crestline Press at The Printery

IRTA began work with The Printery as part of a project sponsored by SCAQMD to test alternative, low-VOC cleanup solvent alternatives. IRTA particularly wanted to work with a company that had an automated blanket wash system on a sheet fed press. When IRTA began work with The Printery, the company had already converted to 500 gram per liter VOC cleaners.

IRTA tested alternatives with The Printery. The alternative roller wash that was most effective was a soy based cleaner called Soy Gold 2500. An MSDS for this cleaner is shown in Appendix A. This cleaner was also effective as a blanket wash for the sheet fed

press with the automated blanket wash system. This system allows use of a water rinse and The Printery routinely used the rinse feature during the extended testing. The company also cleans all of its presses, including the sheet fed press with the automated blanket wash system, with a hand blanket wash. The hand blanket wash that performed best was a blend of a glycol ether and acetone. An MSDS for this product, called Rhosolv Blanket Wash 7150, is shown in Appendix A.

The Printery participated in extended testing of the low-VOC alternatives. The alternatives were tested on one of the Crestline presses, the two color press and the six color press for more than three months. The two problems the company experienced were that the fountain solution required more frequent changeout and that the soy cleaner used in the automated blanket wash system “dripped” onto the product periodically during the day. A picture of the drip on the paper substrate is shown in Figure 2-17. The press people learned to control the dripping to some extent, but use of the blanket wash did lead to an increase in paper waste. As discussed below, when the company used the 500 gram per liter VOC cleaners, these same two problems were evident.



Figure 2-17. Drip (Circled) at The Printery

When the VOC limit for cleaners was 800 grams per liter, The Printery used a two step automated blanket wash, a roller wash and a hand blanket wash. The company used 260 gallons per year of each of the solvents comprising the two step automated blanket wash. The price of one of the components was \$10.25 per gallon and the price of the other component was \$9.75 per gallon. The annual cost of the two step automated blanket wash was \$5,200. The Printery used 52 gallons per year of the roller wash. At a price of \$9.45 per gallon, the annual cost of the roller wash amounted to \$491. The company used 156 gallons per year of the hand blanket wash. At a price of \$9.95 per gallon, the

annual cost of the hand blanket wash was \$1,552. The total annual cost of purchasing the high VOC solvents was \$7,243.

When the 800 gram per liter VOC cleaners were used, The Printery used 12 ounces of fountain solution per week. At a cost of \$22 per gallon, the annual cost of purchasing the fountain solution amounted to \$107. The amount of paper waste that is generated depends on many factors. The Printery estimates that the cost of the paper waste averaged about \$100 per day. Assuming a five day week, the annual cost of paper waste was \$26,000.

After the interim SCAQMD Rule 1171 VOC limit of 500 grams per liter became effective, The Printery converted to alternative cleaners. At this stage, the company used two cleaners, LV 33 and LV flush. The usage of each cleaner amounted to 260 gallons per year. At a price for LV 33 of \$17.88 per gallon and a price for LV Flush of \$19.10 per gallon, the annual cost of purchasing the cleaners amounted to \$9,615.

After conversion to the 500 gram per liter VOC cleaners, The Printery had to change out the fountain solution more often and the paper waste increased because the lower vapor pressure cleaners “dripped” on the substrate. The press people estimate that the company used an additional 12 ounces of fountain solution per week. At a price of approximately \$22 per gallon, the annual cost of the fountain solution increased by \$107 to \$214. The press people estimate that there was an increase in waste paper generation of about \$30 per week. This amounts to a cost increase of \$7,800 per year. The total annual cost of the paper waste was \$33,800.

The 100 gram per liter VOC alternatives that were tested included Soy Gold 2500 which was used for cleaning the rollers and as an automated blanket wash and the acetone/glycol ether blend which was used as a hand blanket wash. The soy was rinsed with water during its use as a roller wash and an automated blanket wash. The Printery estimated the use of the soy product at 2.5 gallons per week or 130 gallons per year. Assuming a per drum price of \$10 per gallon, the annual cost of using the soy is \$1,300. The Printery used 7.5 gallons per week of the hand blanket wash. At a price of \$8.60 per gallon assuming the wash is purchased in a 30 gallon drum, the annual cost of purchasing the material is \$3,354. The total cost of purchasing the low-VOC cleaners is \$4,654 per year.

When The Printery tested the low-VOC alternatives, the company experienced the higher fountain solution use in the large press and also the “dripping” problem that had been observed during use of the 500 gram per liter VOC cleaners. On this basis, the annual cost of the fountain solution and the waste paper is \$214 and \$33,800 respectively.

Table 2-18 shows the annualized cost of the 800, 500 and 100 gram per liter cleaners for The Printery. The figures show that the cost of using the 800 gram per liter VOC cleaners is the lowest of the three scenarios. The cost of using the 500 gram per liter VOC cleaners is 31 percent higher than the baseline. The cost of using the 100 gram per

liter VOC cleaners is lower than the cost of using the 500 gram per liter VOC cleaners but it is 16 percent higher than the baseline cost.

Table 2-18
Annualized Cost Comparison for The Printery

	800 Gram/Liter Cleaners	500 Gram/Liter Cleaners	100 Gram/Liter Cleaners
Cleaner Cost	\$7,243	\$9,615	\$4,654
Fountain Solution Cost	\$107	\$214	\$214
Waste Paper Cost	\$26,000	\$33,800	\$33,800
Total Cost	\$33,350	\$43,629	\$38,668

Tedco

Tedco was located in Los Angeles for many years; the company recently relocated to Paramount, California. Tedco provides lithographic printing services for a variety of customers including other printers. About half of the company’s printing is on plastic substrates and half is on paper and paperboard. Tedco exclusively uses UV curable ink. The company has two six color sheet fed presses. A picture of one of the presses is shown in Figure 2-18.



Figure 2-18. Press at Tedco

IRTA began working with Tedco as part of a project sponsored by U.S. EPA, Cal/EPA’s Department of Toxic Substances Control and SCAQMD. The aim of the project was to identify, test and demonstrate alternative low-VOC, low toxicity alternative cleaning solvents.

Tedco used a high VOC cleaner that contained aromatic hydrocarbons and a glycol ether for cleanup of the ink on both presses. An MSDS for this cleaner, called LC-97, is shown

in Appendix A. The material functioned as a blanket and a roller wash. IRTA tested a variety of alternatives with Tedco and the formulation that performed most effectively was a blend of 61 percent acetone, 30 percent of a water-based cleaner called Magic UV and nine percent isopropyl alcohol (IPA). MSDSs for acetone, Magic UV and IPA are shown in Appendix A. This cleaner met the 100 gram per liter low VOC target limit. IRTA was not able to clean Tedco’s white ink with this formulation. The white ink used by Tedco has been formulated to be especially durable. Another formulation, composed of 20 percent of a glycol ether called DPM and 80 percent of a soy based material called Soy Gold 2500, was effective on the white ink. MSDSs for DPM and Soy Gold 2500 are shown in Appendix A. This formulation has a VOC content of 200 grams per liter.

Tedco used three gallons per week or 156 gallons per year of the high VOC solvent. The company pays \$620.95 for a 55 gallon drum of the solvent. This translates into \$11.29 per gallon. The annual cost of cleaning with the high VOC solvent was \$1,761.

IRTA provided two weeks worth of the 100 gram per liter acetone/Magic UV/IPA blend to Tedco for scaled-up testing. The cleaner performed acceptably and IRTA provided larger quantities of the cleaner for three months of extended testing. The pressmen indicated that the cleaner performed adequately but that they used about 20 percent more cleaner than the high VOC material. Assuming that 20 percent more of the cleaner would be required, the annual use of the low VOC cleaner would amount to 187 gallons per year. The cost of the low VOC cleaner is \$11.08 per gallon. On this basis, the cost of using the alternative cleaner would be \$2,072 annually.

Table 2-19 shows the annualized cost comparison for the high- and low VOC cleaners. The figures indicate that the cost of using the alternative low VOC cleaner would be 18 percent higher than the cost of using the high-VOC cleaner.

Table 2-19
Annualized Cost Comparison for Tedco

	High-VOC Cleaner	Low VOC Cleaner
Cleaner Cost	\$1,761	\$2,072
Total Cost	\$1,761	\$2,072

Oberthur Card Systems

Oberthur is located in Rancho Dominguez, California. The company uses both lithographic and screen printing to print on plastic credit cards. Oberthur has five sheet fed lithographic presses and prints with both air dry conventional ink and UV curable ink. Two of the presses print two colors and three print six colors. A picture of one of Oberthur’s two-color conventional ink presses is shown in Figure 2-19.

IRTA began working with Oberthur as part of a project sponsored by U.S. EPA, Cal/EPA’s Department of Toxic Substances Control and SCAQMD. The aim of the

project was to identify, test and demonstrate alternative low-VOC, low toxicity alternative cleanup solvents.



Figure 2-19. Press at Oberthur Card Systems

Oberthur used high VOC cleaners for cleaning the blanket and rollers on their presses. IRTA tested a variety of alternatives with Oberthur for both the UV and conventional presses. For the conventional press, IRTA tested a number of different soy based cleaners. The soy cleaners cleaned the ink effectively but the print quality could not be achieved. When paper substrates are used, the residual oily soy is picked up by the paper and the print quality recovers quickly. In contrast, with a plastic substrate, the plastic does not pick up the residual soy and the print quality is not acceptable.

After extensive testing, IRTA identified a blanket and roller wash that cleaned effectively on the conventional press and maintained print quality. The blanket wash is a blend of 75 percent acetone, 12.5 percent Hydro Clean, a mineral spirits cleaner, and 12.5 percent water. MSDSs for acetone and Hydro Clean are provided in Appendix A. This cleaner met the 100 gram per liter VOC target. The roller wash is a blend of 25 percent acetone, 25 percent Hydro Clean and 50 percent water. This material has a 200 gram per liter VOC content. IRTA provided larger quantities of the blanket and roller wash to Oberthur for scaled-up testing on the conventional press.

IRTA also tested extensively with Oberthur on the UV press. Soy cleaners were not considered for the UV presses because of the EPDM rubber used for the rollers and blankets. The alternative that was found to be most effective for the rollers was a blend of 75 percent of a water-based cleaner called Magic UV and 25 percent acetone. For cleaning the blanket, a blend of 90 percent acetone and 10 percent DPM, a glycol ether, was found to be effective. IRTA provided larger quantities of the blanket and roller wash for scaled-up testing. These two formulations met the 100 gram per liter VOC target limit. MSDSs for acetone, Magic UV and DPM are shown in Appendix A.

Oberthur uses 440 gallons per year of a high VOC cleaner for the conventional presses. This cleaner is used for both the blanket and roller cleaning. The company indicates that about 60 percent of the cleaner or 264 gallons is used for roller cleaning and 40 percent or 176 gallons is used for blanket cleaning. The cost of the cleaner is \$9.05 per gallon. On this basis, the annual cost of the high VOC blanket wash is \$1,600 and the annual cost of the roller wash is \$2,400.

The cost of the low-VOC alternative blanket wash is \$4.65 per gallon. Because this cleaner is 75% acetone, it was assumed that twice as much or 352 gallons would be required for cleaning the blankets. On this basis, the annual cost of the alternative blanket wash would be \$1,637. The cost of the roller wash is \$5.30 per gallon. Assuming that the same amount of the low-VOC roller wash would be required, the annual cost of the roller wash is \$1,399.

Table 2-20 shows the annualized cost comparison for the conventional press. The figures show that a conversion to the low-VOC alternatives would result in a 24 percent decrease in costs.

Table 2-20
Annualized Cost Comparison for Conventional Presses for Oberthur

	High VOC Cleaner	Alternative Low-VOC Cleaners
Blanket Cleaner Cost	\$1,600	\$1,637
Roller Cleaner Cost	\$2,400	\$1,399
Total Cost	\$4,000	\$3,036

Oberthur uses 350 gallons per year of a high VOC cleaner for the UV presses. Again, this cleaner is used for both roller and blanket cleaning. The company indicates that about two-thirds of the cleaner or 233 gallons per year is used for blanket wash and one-third of the cleaner or 117 gallons per year is used for roller wash. The cost of the UV ink cleaner is \$16.35 per gallon. On this basis, the cost of the blanket wash is \$3,810 annually and the cost of the roller wash is \$1,913 annually.

The alternative cleaner that worked best as a blanket wash was a blend of 90 percent acetone and 10 percent DPM, a glycol ether. The cost of this cleaner is \$7.88 per gallon. It was assumed that the company would use twice as much of the alternative low-VOC blanket wash because it evaporates more readily. On this basis, Oberthur would use 466 gallons a year and the annual cost of the alternative blanket wash would be \$3,672. The alternative cleaner that worked effectively for roller wash on the UV press was 75 percent Magic UV and 25 percent acetone. The cost of this cleaner is \$21.35 per gallon. Assuming that 117 gallons would be required, the annual cost of this cleaner would be \$2,498.

Table 2-21 shows the annualized cost comparison of the high VOC cleaners and the alternative low-VOC cleaners. The values show that the cost of using the alternative

low-VOC cleaners would be about eight percent higher than the cost of using the high VOC cleaners.

Table 2-21
Annualized Cost Comparison for UV Presses for Oberthur

	High VOC Cleaner	Alternative Low-VOC Cleaners
Blanket Cleaner Cost	\$3,810	\$3,672
Roller Cleaner Cost	\$1,913	\$2,498
Total Cost	\$5,723	\$6,170

Huhtamaki

Huhtamaki is located in Los Angeles, California. The company is international and the business entity in Los Angeles makes consumer packaging, primarily for ice cream cartons. Huhtamaki has an eight stage web press with seven color stations and a clear coating station. A picture of the press is shown in Figure 2-20. Huhtamaki is one of the few companies in the U.S. to use electron beam curable ink.



Figure 2-20. Press at Huhtamaki

IRTA began work with Huhtamaki as part of a project sponsored by U.S. EPA, Cal/EPA's Department of Toxic Substances Control and SCAQMD. The focus of the project was to identify, test and demonstrate alternative low-VOC, low toxicity alternative cleanup materials.

Historically, Huhtamaki used two 55 gallon drums per month of a VOC solvent EB. An MSDS for this cleaner is shown in Appendix A. Half of the EB was used for off-press

cleaning and half was used for on-press cleaning. The facility estimates that three-fourths of a drum or 41 gallons per month was used for blanket cleaning and one-fourth of a drum or 14 gallons per month was used for roller cleaning. The cost of the solvent is \$9.09 per gallon. On this basis, the cost of blanket wash amounted to \$4,472 per year and the cost of roller wash amounted to \$1,527 per year.

IRTA tested a variety of alternatives with Huhtamaki for both off-press and on-press cleaning. The company converted to a soy based cleaner for off-press cleaning. Because Huhtamaki's roller supplier indicates that the soy cleaner is incompatible with the EPDM rubber used to make the rollers, soy was not tested for on-press cleaning. IRTA conducted on-press testing with the company and found alternatives to use in the scaled up testing. In the meantime, however, Huhtamaki changed their ink formulation. IRTA again tested alternatives on the new ink and found different alternatives to used in the scaled up testing.

The alternative that was most effective on the rollers was a water-based cleaner called Magic UV. An MSDS for this product is shown in Appendix A. In the testing conducted by IRTA, the cleaner was slower than the current cleaner. The company also tested blends of the Magic UV with acetone and adding the acetone did speed up the cleaning. IRTA spent about six hours in the plant during a normal set of printing jobs and observed how the cleaning was performed. The pressman applied the roller wash and immediately left to perform other tasks during the downtime between jobs. Huhtamaki does not want to use acetone because of the flammability. Because the roller wash does not have to clean quickly, the company could use the Magic UV alone.

For the scaled up testing, Huhtamaki indicated they would use the Magic UV alone and would blend in acetone as required. IRTA examined two alternative cost scenarios for the roller wash. For both scenarios, IRTA assumed the company would use 1.5 times as much cleaner or 252 gallons of the low-VOC roller wash per month. The cost of the Magic UV is \$20 per gallon and the cost of acetone purchased in drum quantities is \$7.02 per gallon. Assuming the roller wash is 100 percent Magic UV, the annual cost of using the alternative roller wash is \$5,040. Assuming the roller wash is 50 percent Magic UV and 50 percent acetone, the annual cost of using the alternative roller wash is \$3,405.

The alternative low-VOC blanket wash was tailored to clean as well as the EB. The cleaner that worked best was a blend of 67 percent acetone and 33 percent Kyzen M6521, a water-based cleaner. MSDSs for acetone and the Kyzen M6521 are shown in Appendix B. The cost of acetone is \$7.02 per gallon and the cost of the Kyzen water-based cleaner is \$16.20 per gallon. Assuming the same amount of blanket cleaner, the annual cost of the alternative low-VOC blanket wash is \$4,944.

The labor for using the alternative low-VOC roller wash could increase because the roller wash may require a rinse. During the time IRTA spent while the pressroom operators ran jobs, IRTA provided the water-based cleaner as a roller wash and the operators did not rinse the rollers with plain water. The need for rinsing was to be investigated during the scaled up testing. Huhtamaki has not yet conducted the scaled up testing so it is not

known whether rinsing would be required. For purposes of analysis, IRTA assumed that rinsing would be required. In a four hour period, when IRTA observed the cleaning, the operator cleaned two rollers. In 24 hours, or three shifts, the operator would clean 12 rollers. Assuming it takes one minute to clean each roller (the operator applies the roller wash and leaves to perform other tasks), that the company operates three shifts 5.5 days per week and that Huhtamaki's labor rate is \$23 per hour, the annual labor cost for roller cleaning is \$1,316. If it is assumed that rinsing is required, the labor cost would double to \$2,632 per year.

The labor for cleaning the blankets would stay the same since the low-VOC alternative cleans in a similar manner to the EB. For the blanket labor, it was assumed that the operators clean four sets of blankets thirty times per day or 120 blankets per day. Assuming it requires two minutes to clean a blanket, that the press operates 5.5 hours per day and again that the labor rate is \$23 per hour, the annual labor cost for blanket cleaning amounts to \$26,312.

Table 2-22 presents the annualized cost comparison for cleaning for Huhtamaki assuming the roller cleaner is 100 percent Magic UV. The figures show that Huhtamaki's cost of cleaning would increase by about 16 percent with use of the low-VOC alternatives.

Table 2-22
Annualized Cost Comparison for Huhtamaki
Magic UV Roller Cleaner

	High VOC EB	Low-VOC Cleaners
Blanket Cleaner Cost	\$4,472	\$4,944
Roller Cleaner Cost	\$1,527	\$5,040
Blanket Cleaning Labor Cost	\$26,312	\$26,312
Roller Cleaning Labor Cost	\$1,316	\$2,632
Total Cost	\$33,627	\$38,928

Table 2-23 presents the annualized cost comparison for cleaning for Huhtamaki assuming the roller cleaner is a blend of acetone and Magic UV. The values show that Huhtamaki's cleaning cost would increase by about 11 percent if the company adopted the low-VOC alternative cleaners.

Table 2-23
Annualized Cost Comparison for Huhtamaki
Magic UV/Acetone Roller Cleaner

	High VOC EB	Low-VOC Cleaners
Blanket Cleaner Cost	\$4,472	\$4,944
Roller Cleaner Cost	\$1,527	\$3,405
Blanket Cleaning Labor Cost	\$26,312	\$26,312
Roller Cleaning Labor Cost	\$1,316	\$2,632
Total Cost	\$33,627	\$37,293

CLEANING OF OTHER ON-PRESS COMPONENTS

As part of this project, IRTA investigated, in a limited way, whether or not alternative low-VOC cleaners could be used to clean plates, dampening rollers and metering rollers. This subsection summarizes the results of that investigation.

IRTA talked with several industry sources to determine the emissions inventory and current practices for cleaning the other on-press components. There was general agreement among suppliers that the VOC emissions from cleaning plates, dampening rollers and metering rollers accounts for about 10 percent of total VOC emissions from cleaning these components and cleaning rollers and blankets. The emissions may be as low as five percent of the total on-press sector emissions and they may be as high as 15 percent of these emissions.

Plates are cleaned periodically with abrasive cleaners that do not contain solvents. IRTA did not evaluate alternatives to these cleaners. The non-abrasive cleaners that have been designed specifically as plate cleaners may contain water, surfactants and solvents of various kinds like terpenes, glycol ethers, mineral spirits, heptane and IPA. Plates are regularly cleaned as part of the roller cleaning process at the end of the day or when there is a color change on the press. The plate is generally engaged during roller cleaning so the roller cleaner most often serves as the plate cleaner. The alternative low-VOC cleaners that IRTA tested for plate cleaning generally were the roller cleaners that contained 100 grams per liter or less VOC.

Metering rollers and dampening rollers most often contact one another so they are generally cleaned with the same material. Metering roller cleaners (called MRCs) are most often fast evaporating cleaners. The cleaners contain solvents of various kinds including glycol ethers, acetone, mineral spirits, heptane, methylene chloride and IPA. During this project, IRTA developed and tested two low-VOC MRCs and one of these was tested at several facilities.

Nelson Nameplate has two small automated presses. The presses have plates that are cleaned regularly and a dampening roller but no metering roller. IRTA developed and tested a low-VOC product for cleaning the plate and dampening roller. An MSDS for this product, called Rhosolv 7248, is shown in Appendix A. It contains acetone and is fast evaporating. Nelson tested this cleaner for a week and it performed acceptably.

At Print 2000, IRTA tested an alternative plate and MRC for a three month period. Print 2000, as described earlier, participated in the extended testing. The plate was engaged while the rollers were cleaned so the plate cleaner that worked effectively was the alternative roller wash, Soy Gold 2500. An MSDS for this cleaner is shown in Appendix A. The MRC that was used for cleaning the metering and dampening roller is Rhosolv 7248 which was also used for general blanket cleaning at Print 2000. This MRC worked well.

IRTA also tested the Rhosolv 7248 product at Anderson Lithograph for cleaning the metering rollers. On the sheet fed press, the press people reported that the odor was high but that the cleaner worked similarly to their current cleaner. On the web press, the Rhosolv 7248 reportedly was slower than their cleaner in cutting the ink but the press people liked it better because it eliminated the streaking that resulted from the use of their current product.

IRTA tested alternative plate and MRC cleaners at Tedco. Tedco uses UV curable ink and the company participated in the extended testing. The plate was engaged when the company cleaned the rollers so the roller wash, a blend of 61 percent acetone, 30 percent Magic UV and nine percent IPA, was used to clean the plate for several months. IRTA also tested the MRC, called Rhosolv 7248, at Tedco for metering/dampening roller cleaning. The press people indicated that it worked effectively.

IRTA tested alternative plate and metering/dampening roller cleaners at The Printery. This company participated in the extended testing. The materials were tested on three presses, a small crestline duplicating press, a two color press and a six color press. The plate was engaged during roller cleaning and the roller cleaner for the three month period on all three presses was Soy Gold 2500. An MSDS for this material is shown in Appendix A. IRTA developed an acetone based hand blanket wash for The Printery and the company used this cleaner as an MRC for the extended testing period of three months. It worked effectively for this purpose.

The limited testing IRTA conducted indicates that a range of facilities can meet the 100 gram per liter VOC limit for plate, dampening and metering roller cleaners. In most cases, if the company converts to a 100 gram per liter roller wash, this material will serve as a plate cleaner. Fast evaporating MRCs that are suitable for cleaning metering and dampening rollers can be formulated with a high concentration of acetone and these cleaners can meet the 100 gram per liter limit as well.

EXTENDED TESTING RESULTS

Extended testing of the alternatives that performed best was conducted with seven facilities. The alternatives were tested for at least three months. The facilities that participated in the extended testing included:

- Nelson Nameplate
- SCAQMD Print Shop
- Print 2000
- Fanfare Media Works
- Vertis
- Tedco
- The Printery

Performance Evaluation

More information was available for the cost analysis from the facilities involved in the extended testing. In a few cases, the company used more of the alternative and the long testing timeframe allowed that to be noted. Two companies that used acetone based alternatives, Nelson Nameplate and Tedco, used more cleaner in the extended testing. This is probably because of the high vapor pressure of acetone. Some of the other facilities that used acetone formulations, however, did not notice a difference in use.

Two of the facilities using soy based cleaners, Print 2000 and The Printery, had to change out their fountain solution more often. Tedco used a water-based cleaner and had to change out their fountain solution more often as well. The soy based cleaner and the water-based cleaner are very low vapor pressure materials and they may have contaminated the fountain solution and affected it more readily than the higher vapor pressure original cleaners.

When the 500 gram per liter VOC limit became effective in July of 2005, the industry indicated that there was a buildup over time of the vegetable based cleaners used in automated blanket wash systems on sheet fed presses. The Printery has this type of operation and no buildup was observed during the more than three months of extended testing. The pressmen at The Printery did experience a few random drips over a day that resulted in an increase in paper waste.. The increase in paper waste was taken into account in the cost analysis.

Compatibility

As discussed earlier, as part of the SCAQMD project, UT worked with the roller and blanket manufacturers to develop a protocol for compatibility testing. UT conducted extensive testing and the report summarizing the results of the testing is available from UT.

Blankets used by lithographic printers are relatively low cost when compared with the cost of rollers. Blankets are changed out frequently, generally on a periodic basis. Rollers, in contrast, are generally changed out over much longer periods ranging from six months to several years.

Two general types of rubber are used to make blankets and rollers used in lithographic printing. Nitrile is generally used for presses that run conventional solventborne or soy based ink. EPDM is commonly used for presses that run UV and EB curable ink. Roller and blanket manufacturers have many different variations of rollers and blankets based on nitrile and EPDM.

Most of the roller manufacturers cautioned about using soy based products with EPDM and about using acetone with nitrile. Bottcher, one of the largest roller manufacturers, routinely evaluates compatibility of formulations their customers are using or planning to use. The company has four classifications regarding compatibility. They include:

- acceptable for automated systems without dilution
- recommend dilution--25 percent water or heavy after rinse
- must dilute with at least 25 percent water
- not compatible--too much swelling

Other roller suppliers have the same types of classifications.

IRTA provided the Bottcher lab with a sample of Soy Gold 2000, one of the soy based cleaners tested in the project. After evaluation, Bottcher indicated that for a nitrile compound, the product fell into the category “acceptable for automated systems without dilution.” Bottcher also indicated that the product fell into the category “recommend dilution--25 percent water or heavy after rinse” for an EPDM compound.

The UT results generally indicated that acetone formulations were not compatible with nitrile compounds above about 25 percent. Acetone formulations with less than 25 percent were compatible. The UT results and the roller manufacturers indicate that acetone is compatible with EPDM.

The short term testing of alternatives was not likely to reveal compatibility problems but the extended testing of at least three months should be long enough for problems to emerge. During the extended testing, the companies exclusively used the alternative blanket and roller washes on at least one press. IRTA generally followed the rules about compatibility when providing formulations to the facilities for extended testing with some exceptions.

At Fanfare Media Works, IRTA did test Soy Gold 2500 on the blankets on a small web press using UV curable ink with EPDM rubber. The press prints on grocery store tape which is very absorbent. There were no problems with the rubber during the three months of testing.

At several of the facilities participating in the extended testing, IRTA tested high acetone content formulations as roller washes or hand blanket washes. IRTA tested a high acetone content formulation at the SCAQMD Print Shop as a roller wash. The shop converted to the alternative and has been using it for over a year. There has been no observed effect on the rollers. At another facility, Nelson Nameplate, the company has been using a blanket wash containing more than about 80 percent acetone for at least six years and has observed no compatibility problems. At Print 2000, another company that participated in the three month testing, the blanket wash was more than 90 percent acetone. The company experienced no compatibility problems during the period. At The Printery, the hand blanket wash IRTA provided to the company was tested for more than three months on three presses and no compatibility problems were observed.

It is possible that some of the high acetone formulations could present problems if they were used for longer periods. At Nelson Nameplate, however, the company has been using a very high acetone content blanket wash for many years. As mentioned above, most companies replace their blankets on a periodic basis. It may be that the replacement schedule is simply shorter than the time frame for damage to be observed.

One of the soy based cleaners was used on a small press with EPDM blankets for more than three months and no compatibility problems were observed. The Bottcher evaluation for a similar soy based material indicated that it could be used with a heavy after rinse. In all cases where soy compounds are used, they must be rinsed thoroughly or the press does not come back up to color. The limited testing results described here suggest that soy based materials could be used on EPDM rubber as long as heavy rinsing is performed.

TOXICITY EVALUATION AND COMPARISON

The California Department of Health Services Hazard Evaluation System & Information Service (HESIS) conducted a toxicity assessment of the high VOC cleanup solvents and low-VOC alternatives for IRTA. The assessment was based on an evaluation of the MSDSs for some of the products used by the printers that participated in the project. A brief summary of the evaluation is presented here.

High VOC Products

Many of the high VOC products used by the facilities when the 800 gram per liter VOC content limit was in effect were composed of various fractions of mineral spirits like aromatic and aliphatic hydrocarbons. At least six products contain a component called aromatic hydrocarbon, petroleum naphtha or aromatic petro distillate (C8-C12) with the CAS # 64742-95-6. Some of the products used by the participating facilities that contain this fraction include:

- Pressroom Solutions Blanket & Roller Wash used by the San Bernardino Sun
- AQ 1301 Roller Wash No. 1 used by Presslink
- AQ 1302 Roller Wash No. 2 also used by Presslink
- PowerKlene VC Blanket and Roller Wash used by The Castle Press
- Bay International Products Div. Blanket Wash used by The Dot Printer
- Allied Hydrowash used by J.S. Paluch

Several of the MSDSs used by the participating facilities also contain CAS # 64742-88-7 referred to as aliphatic hydrocarbon or mineral spirits. Some of the products that contain this fraction include:

- Pressroom Solutions Blanket & Roller Wash used by the San Bernardino Sun
- IC ALL PRO used by PIP Printing
- Anchor Environwash 220 used by R.R. Donnelley & Sons
- Shell Mineral Spirits 146 HT used by R.R. Donnelley & Sons

Other components contained within some of the MSDSs for the high VOC products are 1,2,4-trimethyl benzene, 1,3,5-trimethylbenzene, xylene, cumene and various glycol ethers.

Most of the high VOC products exclusively contain organic solvents in concentrations ranging from 70 to 100 percent. The HESIS review indicates that overexposure to

solvent based cleaners affects the central nervous system (brain), causing nausea, dizziness, clumsiness, drowsiness and other effects like those of being drunk. Overexposure for months or years can cause long-lasting and possibly permanent damage to the nervous system. The symptoms of long-term health effects include fatigue, sleeplessness, poor coordination, difficulty in concentrating, loss of short-term memory and personality changes such as depression, anxiety and irritability. Solvent based products can also irritate the eyes, nose, throat and skin. Skin contact can cause dermatitis.

Glycol ethers in some of the products can affect the nervous system as a result of absorption through intact skin in addition to inhalation. Ethylene glycol monobutyl ether (also called 2-butoxy ethanol) and ethylene glycol monopropyl ether also can damage red blood cells and cause anemia. 1,2,4-Trimethylbenzene and 1,3,5-trimethylbenzene can pose additional risks of asthmatic bronchitis and blood dyscrasias and cancer due to benzene contamination; the Permissible Exposure Level of the isomers is 25 ppm. Xylene exhibits general solvent toxicity and has a Permissible Exposure Level of 100 ppm. Isopropylbenzene or cumene is a central nervous system toxicant and an irritant with a Permissible Exposure Level of 50 ppm.

Low-VOC Products

Alternatives that were tested by IRTA during the project generally included soy based materials, water-based materials, acetone and small amounts of VOC solvents including mineral spirits, IPA and propylene glycol ethers.

The soy based products tested in the project including Soy Gold 2000, Soy Gold 2500 and Magic Wash 522C contain fatty acid esters. HESIS reviewed the toxicity of these products. HESIS indicates that although there were no toxicity data on fatty acid esters in Toxnet, Scorecard and other chemical databases, they are not volatile, do not pose an inhalation hazard and are of low toxicity compared to organic solvents. The European Union, in conjunction with the US, is sponsoring research on vegetable oils and their fatty acid esters as substitutes for organic solvents in industrial processes.

The fatty acid ester products that are useful in this industry all contain surfactants. As discussed earlier in the document, soy based products must be rinsed so the press can come back up to color. Surfactants are generally used to allow the products to be rinsed. One of the products tested contains a surfactant called ethylphenoxypolyethoxy ethanol (a nonylphenol ethoxylate) that is an endocrine disruptor. The other two products that were tested contain unspecified surfactants so it is not clear whether they would be endocrine disruptors or not.

Water-based products were also tested during the project. Some of these include Mirachem Pressroom Cleaner and Magic UV. These products might also contain surfactants that are endocrine disruptors.

IRTA relied heavily on acetone based products during the project, particularly in fast evaporating hand blanket washes that some printers prefer. Consistent with general solvent toxicity, overexposure to acetone affects the nervous system and causes skin and respiratory irritation. In the case of acetone, however, the threshold for producing these health effects are higher (the Permissible Exposure Level of acetone is 750 ppm) than for the mineral spirit Stoddard Solvent (the Permissible Exposure Level of the chemical is 100 ppm) or xylene (the Permissible Exposure Level of xylene is 100 ppm). In one case, Tedco, IRTA formulated a cleaner that contained 10 percent isopropyl alcohol. Like acetone, it has general solvent toxicity but the threshold is higher (the Permissible Exposure Level is 400 ppm) than for many other solvents.

The HESIS review indicates that 2-butoxy ethanol, an ethylene based glycol ether, can damage red blood cells and cause anemia. This glycol ether is used mainly in the high VOC products. The propylene glycol ethers used in the low-VOC products do not cause this problem and are less volatile than the ethylene glycol ethers. However, they can produce neurotoxic effects through skin absorption as well as inhalation. This points up the importance of using appropriate gloves to minimize skin contact with the solvents.

IRTA used a product called Hydro Clean in dilute concentration for some of the low-VOC formulations. This material was originally used in a 50 percent concentration with water at Nelson Nameplate. For the low-VOC products, the concentration of this product was generally no more than about 10 percent since the low-VOC materials had to meet a 100 gram per liter VOC limit. The balance of the product was water and acetone. The Hydro Clean product contains a variety of mineral spirits components, various trimethylbenzene isomers and isopropylbenzene or cumene. The effects of these materials are discussed above under the high VOC cleaners. Because they are present here in more dilute concentration, their effects would be less for the low-VOC products.

Conclusions About Toxicity

The high VOC materials are generally more toxic than the low-VOC materials tested during the project. The low-VOC products contain fatty acid esters which are not volatile and lower in toxicity than other organic solvents. Formulators should take care, however, to blend the fatty acid esters with surfactants that are not endocrine disruptors. This also holds true for water-based cleaners. IRTA relied heavily on acetone in the low-VOC alternatives. Acetone is lower in toxicity than most other organic solvents. IRTA used some of the same VOC solvent components in the low-VOC formulations that were tested but these were generally used at about a 10 percent concentration. The toxicity effects of these formulations were correspondingly lower than for the high VOC formulations. When low volatility materials like propylene glycol ethers are used in low-VOC formulations, it is important that printers wear appropriate gloves to minimize the effects of solvent toxicity through skin exposure.

OTHER CONSIDERATIONS

IRTA relied heavily on acetone as an alternative in blends for cleaning UV/EB curable ink and as a component in blanket washes used to clean conventional and UVEB curable ink. One disadvantage of acetone is its low flash point. Printing shops that elect to use the chemical must comply with local fire department regulations. The Uniform Fire Code classifies acetone as a Class I-B liquid. Class I-B liquids have flash points less than 73 degrees F and a boiling point greater than or equal to 100 degrees F. Many local fire departments directly adopt the Uniform Fire Code and some have additional requirements. The Uniform Fire Code allows facilities to have 60 gallons of acetone in use in closed containers in each control area. It also allows facilities to have 15 gallons of acetone in use in the open, for dispensing and mixing. With these limitations in mind, companies could purchase about one 55 gallon drum of an acetone based formulation for storage and could use 15 gallons in open containers during printing.

In some cases, as noted in the individual case studies, personnel in the printing shops did not like the odor of the alternatives. In other cases, and this was not noted in the case studies, personnel indicated they liked the odor of the alternative better than the odor of the higher VOC cleaner they were using currently. The perception of odor is a very personal thing. There is generally not a consensus on whether a particular cleaner has a good or bad odor and there is no way to predict whether a particular worker will like or not like the odor of a cleaner.