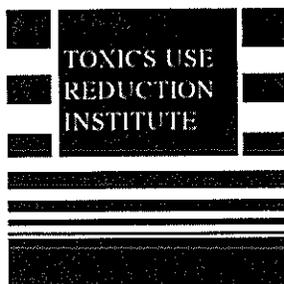


BLANKET WASH TECHNOLOGY STUDY:
AN EVALUATION OF COMMERCIALY AVAILABLE
BLANKET WASHES

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1.0 INTRODUCTION

This Blanket Wash Technology Study (BWTS) provides comparative information on a group of commercially available blanket washes commonly used in sheetfed offset lithography. The study was conducted by the Toxics Use Reduction Institute (TURI) at the University of Massachusetts Lowell, in cooperation with the Printing Industries of New England (PINE) and the Graphic Arts Technical Foundation (GATF).

The BWTS is designed to evaluate functional performance as well as environmental, health, and safety characteristics of selected blanket washes and to make this information available to printers. The Institute's primary objective in conducting this study is to provide information to printers that will assist them in their toxics use reduction (TUR) efforts. Toxics use reduction gives printers the opportunity to reduce occupational hazards and environmental pollution without compromising competitive advantage.

There is tremendous variability among printers in work practices and production requirements associated with blanket washes. Therefore, the Institute has limited the scope of this study and suggests that the information be used as only one part of a comprehensive product evaluation by printers. The study also lays out a testing protocol that may be useful to printers or other organizations in conducting similar research.

1.1 Background

Most commercial printers in the U.S. are small businesses with less than twenty employees. Although many printers do not have the luxury of employing dedicated environmental personnel, a number have expressed a strong interest in high quality, unbiased information on environmental issues. In focus groups conducted by the Institute with commercial printers, participants' environmental interests included: staying ahead of new and potential environmental regulations; working toward a cleaner environment; improving worker health and safety; and developing the emerging "green market" as a way to improve the bottom line.

New environmental regulations are likely to directly regulate cleaning solvents used in the commercial printing industry. A Control Technique Guideline (CTG) under the Clean Air Act (CAA) may recommend regulations that limit the concentration of Volatile Organic Compounds (VOC's) in blanket washes. In its draft form, this CTG contained a VOC limit of thirty percent. Conventional washes often contain VOC concentrations of more than 60 percent. Whether this limit will remain in the final CTG is subject to further review. There is some discussion between industry groups and the EPA about including a standard for vapor pressure in the final CTG as well.

Another Clean Air Act provision requires EPA to develop Maximum Available Control Techniques (MACT) standards for a list of one hundred eighty-nine chemical substances classified

as Hazardous Air Pollutants (HAPs). A number of washes evaluated in this study contain one or more of these listed HAPs.

In addition to the Clean Air Act, special provisions under RCRA are expected to impact the generation, storage, and disposal/recycling of contaminated wipers used by printers that may be classified as a RCRA hazardous waste. Several washes evaluated in this study contain one or more RCRA listed hazardous substances.

Printers are faced with the challenge of identifying from a vast array of commercially available products, those that offer appropriate environmental improvements. As the brief regulatory discussion above points out, this task has become quite complicated in recent years. While certain products may indeed offer environmental benefits, there are no standards for environmental marketing claims that are applicable to blanket washes. To further complicate matters, printers have certain performance and cost requirements that any new product must satisfy. This report is intended to give printers one more piece of information to assist them in meeting these challenges.

1.2 Project Scope

A blanket wash is a specific type of cleaning solvent used to clean ink from lithographic printing presses. Blanket washes clean ink from blanket rollers. A blanket roller is a cylinder covered by a rubber or paper "blanket" which is used to transfer ink from the plate to the paper.

This study evaluates fourteen commercially available lithographic blanket washes according to eleven criteria, four in the environmental, health, and safety category, and seven in the functional performance category. Environmental, health, and safety criteria include: Volatile Organic Compound (VOC) content, potential regulatory impact, health hazard, and safety hazard. Performance criteria include: ability to cut ink; ease of application (lubricity); ease of drying; adequacy of a standard volume; odor; tendency to swell a blanket; and tendency to increase blanket roughness. Observations are also made regarding impact on press latitude and roll-up. Performance testing was conducted at both the GATF testing facility in Pittsburgh, Pennsylvania and on the shop floor at the Waldorf Corporation in Chicopee, Massachusetts. Performance evaluations in this study are based on the use of rubber blankets.

This report describes the methodology that the Institute developed to evaluate blanket washes tested in our study, and reports the results of product evaluations. In order to meet time and budget constraints, the number of products tested was limited by only including products from suppliers that already have a significant market share in Massachusetts. Many other products are available and should be considered by printers. The Institute makes no inferred comment about products not included in the report.

The scope of our evaluation is limited by available time and resources and is not represented as comprehensive or exhaustive (see Appendix A for a detailed description of project limitations). Printers may find that additional research is required before proper chemical

purchase decisions can be made. Valuable information on chemicals and environmental impacts is available to printers from trade associations, vendors, US EPA, Massachusetts OTA, other state agencies, Universities and a number of other sources. More comprehensive and exhaustive research might include additional environmental, health, and safety evaluations, additional performance evaluations, or additional products not included in this study.

2.0 TECHNICAL APPROACH

This section provides a detailed description of the testing and scoring methodologies for each of eleven categories used to evaluate products. In each category, products are scored on a scale of one to three, where one is good, two-fair, and three-poor.

Product Scores

1 = GOOD

2 = FAIR

3 = POOR

By using a three point rating system in all categories, printers have access to information that is straightforward and easy to understand.

2.1 Environmental, Health, and Safety Characteristics of Tested Products

Four categories were used to evaluate the environmental, health, and safety characteristics of the products tested. De minimis concentrations of chemical ingredients contained in products are established in accordance with OSHA's Hazard Communication Standard (e.g., non-carcinogenic chemical ingredients present at less than one percent concentration and/or carcinogenic chemical ingredients present at less than one tenth of one percent were not considered in product evaluations). Specific scoring details for each of the four categories are provided in sections 2.1.1 through 2.1.4.

2.1.1 Potential Regulatory Impact

Many environmental regulations include a list of chemical substances which are subject to regulation. Using a computer program, a determination was made regarding whether chemical substances reported in products evaluated are included in any of nineteen regulated chemical lists (Microreg, Inc., 1992). For a description of each regulatory list, see Appendix B, Section B.1.

For each blanket wash product, one "hit" is recorded each time a reported chemical constituent is included on a regulatory list (see footnote for exceptions).¹ The total number of hits for each product is used to score products on a scale of 1 to 3. A summary of the scoring methodology is as follows:

- Score 1 (Good) Products with six hits or less.
- Score 2 (Fair) Products with between six and twelve hits.
- Score 3 (Poor) Products with twelve hits or greater.

This type of evaluation provides a review of regulations that may have an impact on a printer, but does not determine actual regulatory burden of products tested. Products are scored based on how they compare to one another, and scores are not reflective of how products evaluated in this study may compare to other products used in the graphic arts industry. For a unique printing situation, one may use this review as the first of a number of possible steps in determining actual regulatory burden of the products evaluated.

2.1.2 Health Hazard

The health hazard assessment used in this project is based on a toxicological profile of each chemical and should not be confused with a health risk assessment. A health risk assessment requires collecting data on both the health hazard of a chemical and the exposure to workers in a particular occupational setting. A health risk assessment provides a more complete picture of actual risks associated with chemical usage in the workplace.

Occupational exposure of a given chemical may be affected by the volume of chemical used, work practices, operating conditions, and many other factors. Since site-specific factors will vary from one shop to the next, this project does not attempt to develop the occupational exposure data necessary for a health risk assessment.

Exposure data can be estimated in a variety of ways, the most accurate of which involves an air sampling and monitoring program. Printers may wish to collect this information individually and use it in conjunction with the health hazard information provided in this report.

¹ Although there are six possible RCRA hits, only one hit is counted for a given product regardless of whether more than one exists. Once a waste is classified as hazardous, additional reasons for classifying the waste as hazardous do not increase the burden of waste disposal.

2.1.2.a Scoring Methodology

Each product was scored for health hazard based on toxicological data for its reported chemical ingredients using a methodology developed specifically for this project. Unfortunately, there is no definitive health hazard evaluation protocol that could simply be adopted for our purposes. The methodology used was developed after extensive research of current health hazard literature and with input from the project technical review team. It is our intention that it represent a reasonable approach to health hazard evaluation given the scope and limitations of this project.

Experts often disagree over the role of ingredient concentrations in health evaluation of chemical mixtures. In the toxicological database called REPROTEXT component concentrations are handled as follows: "complex mixtures are given the highest ranking of any ingredient (for reproductive hazard), regardless of percent composition," (Dabney, 1992). Several technical experts who have reviewed this report disagree with the REPROTEXT position, arguing that a mixture containing ninety percent of a particular hazardous component is certainly more problematic than a mixture containing only five percent of that same component.

An extensive literature and computer database search was conducted for each chemical ingredient reported in the products tested. The toxicological database called REPROTEXT was used to calculate the final scores for health hazard, the other databases that were consulted are listed in Appendix C. This research, combined with a careful review of the concentrations of the ingredients led to the decision to consider concentration only regarding petroleum distillates and not other ingredients in developing the health hazard scores for the products. The following facts support this decision: 1) all petroleum distillates reported in this study were identified in the literature search as a class 3 health hazard; 2) none of the remaining reported ingredients were identified in the literature search as a class 3 health hazard; 3) eleven of the fourteen products evaluated contain at least one petroleum distillate; and 4) the concentration of petroleum distillates reported in products ranged from about 5 percent to about 96 percent (see Appendix C for supporting information).

Products reporting 100 percent petroleum distillates receive a health hazard score of 3; products reporting less than 100 percent petroleum distillates receive a score between 2.0 to 2.9 depending on petroleum distillate concentrations. Products that do not report petroleum distillates are given a hazard score equal to the score of the ingredient with the highest hazard score, regardless of the concentration of that ingredient.

In summary, the scoring methodology for the health hazard of products is as follows:

- | | |
|----------------|--|
| Score 1 (Good) | No reported petroleum distillates; no other reported ingredients of Class 2 or 3 Hazard. |
| Score 2 (Fair) | Reported total concentration of petroleum distillates is less than 10 percent; of the remaining reported ingredients, at least one is a Class 2 Hazard, and none are a Class 3 Hazard. |
| 2.1 | Reported concentration of petroleum distillates is 10 to 20 percent. |
| 2.2 | Reported concentration of petroleum distillates is 20 to 30 percent. |
| 2.3 | Reported concentration of petroleum distillates is 30 to 40 percent. |
| . | |
| . | |
| . | |
| 2.9 | Reported concentration of petroleum distillates is 90 to 100 percent. |
| Score 3 (Poor) | Reported concentration of petroleum distillates is 100%. |

It is important to understand that products with even the highest health hazard score in this study may represent a lower health hazard than other products currently used in the marketplace. The range of scores is reflective of the health hazards represented by products submitted. For a detailed description of the health hazard scoring methodology and supporting information, see Appendix C.

2.1.3 Volatile Organic Compounds (VOC's)

The percent of VOC's by weight contained in each product was measured by an independent laboratory according to EPA Method 24², an established testing procedure for measuring the percent of VOC's by weight. A summary of the scoring methodology is as follows:

- | | |
|----------------|--|
| Score 1 (Good) | Measured VOC content of thirty percent or less. |
| Score 2 (Fair) | Measured VOC content between thirty and sixty percent. |
| Score 3 (Poor) | Measured VOC content of sixty percent or greater. |

² EPA Method 24 - ASTM D2854 for density measurement and D2369 for volatile content of coating. EPA Method E203-75 was used to determine the Karl Fisher water content.

2.1.4 Safety Hazard

Safety hazard ratings are based on the flash point of blanket washes. The higher the flash point, the lower the risk of product ignition during use and storage and therefore, the lower the safety hazard. Flash point measurements of each product were determined by an independent laboratory according to the Tag Closed Cup testing procedure.³ The scoring methodology is as follows:

- | | |
|----------------|--|
| Score 1 (Good) | Products with a measured flash point of 140°F or higher |
| Score 2 (Fair) | Products with a measured flash point between 100°F and 140°F |
| Score 3 (Poor) | Products with a measured flash point less than or equal to 100°F |

2.2 Performance Testing

Performance data was gathered from two isolated studies, one at the Graphic Arts Technical Foundation (GATF) in Pittsburgh Pennsylvania, and the other at the Waldorf Corporation in Chicopee, Massachusetts. A summary of the performance testing procedures and their role in the scoring methodology is summarized in the below sections.

2.2.1 Performance Testing, Graphic Arts Technical Foundation (GATF)

In order to ensure the highest level of technical expertise, GATF was hired to develop a performance testing protocol and to conduct the first phase of performance testing. GATF developed a performance protocol that included three principle evaluations: 1) blanket swell testing; 2) blanket smoothness testing; and 3) press testing. The protocol was then used to test each product at GATF's research facility in Pittsburgh.

The Komori press was set to manufacturer's specifications. The ink form rollers were set to 1/8 to 3/16-in stripe. The blanket to plate squeeze was between + 0.005-0.006-in. The recirculation system was used and set at a temperature of 50-55°F. The pH of the dampening solution was 4.0-4.5 with a conductivity between 1000-1200 μ mhos (see Appendix D, Table D.1 for a summary of materials and equipment used).

To minimize variability in the characteristics of process inputs, all plates and blankets used in the study were of the exact same type and came from the same lot number; all ink used was petroleum based lithographic cyan and came from the same batch; and all VM&P Naphtha came from the same product container. VM&P Naphtha was used as the control solvent in the performance tests.

³ Tag Closed Cup - ASTM D56.

For each product evaluation, including the Naphtha control solution, the following steps were executed:

- 1) measure Roughness average (Ra) of fresh blanket
- 2) install blanket on press
- 3) condition blanket with naphtha control solution
- 4) test press for latitude
- 5) clean blanket with wash under evaluation
- 6) test press for latitude
- 7) wipe blanket clean with naphtha control solution
- 8) remove blanket from press
- 9) measure Roughness average (Ra) of blanket
- 10) measure effect on blanket thickness (swell)

Roughness tests were obtained on a fresh blanket (x) and then the blanket was installed on the roller. The blanket was wiped with a naphtha control solution to condition the blanket and then inked. The press was started up at normal ink and water settings. Targeted cyan print density was 1.25-1.35. After ink density was established, the press was tested for latitude. Press latitude was measured by first lowering dampening settings slowly until prints began to plug and scum, and then returning settings to normal and slowly increasing them until prints began to wash-out. Dampening settings were recorded and prints generated during press latitude tests were retained for measurement of ink density and dot gain.

Once press latitude was determined, the blanket roller was cleaned with the blanket wash under evaluation. The cleaning procedure was standardized so that each product was evaluated under the same circumstances. A description of this procedure is provided in section 2.2.1.c.

After cleaning, print roll-up was measured by counting printed sheets required to achieve color. The press was tested once again for latitude. By testing press latitude pre and post cleaning, cleaning solvent effect on press latitude could be determined. Since the blanket roller must be inked to test press latitude, it had to receive one additional cleaning prior to removing it from the press. Once removed, Roughness average of the blanket was measured and recorded. The final step in GATF's performance evaluation was to determine the extent to which products cause blanket swelling. A description of this procedure is provided in section 2.2.1.d.

2.2.1.a Blind testing methodology

A requirement of the performance testing study was that all products be tested in generic containers so product identities could not be determined by those conducting tests. By concealing product identities during testing, the opportunity to bias testing results, based on some prejudice from prior experience, was eliminated. Blanket washes were repackaged by a TURI representative to assure confidentiality.

Each product was transferred from its original container into a one quart plastic bottle. Since these containers were translucent, an opaque sheet of paper was taped around the circumference of each bottle to prevent possible product associations based on color. Products were coded by numbering the containers randomly from one to fifteen.

2.2.1.b Evaluation of blanket roughness

The effect solvent products have on blanket roughness was measured by measuring the roughness of a blanket prior to cleaning and after cleaning using a Surtronic 3 Profilometer. The difference in roughness measurements is an indication of the solvent effect.

The Surtronic 3 Profilometer measures roughness by pulling a stylus across the surface of a sheetfed lithographic blanket over a predetermined length. As the stylus is pulled across the blanket, the Profilometer records the height of peaks and depth of valleys and computes a center line. The center line is defined as an artificial line where the sum of the areas measured above the line are equal to the sum of the areas below. The Roughness average (Ra) is defined as the average value of the departures from the center line.

On each blanket, two Ra values were obtained in each of five specific points. Two Ra values were necessary for each point to account for variance in roughness across grains as compared to with grains. These Ra values were obtained by running the stylus lengthwise and then 90 degrees from that position. Five points on the blanket were selected. The locations of the points were the same on all blankets for both pre- and post- clean measurements.

2.2.1.c Evaluation of blanket wash effectiveness

The objective of this evaluation is to capture the wide range of factors that may pertain to blanket wash performance. These factors consist of eight principal components as shown below:

- 1) effect on press latitude
- 2) ability to cut ink
- 3) ease of application (function of lubrication)
- 4) ease of drying
- 5) whether a standard volume (120 mL) of product was sufficient
- 6) time required to clean
- 7) effect on roll-up
- 8) odor

For each product evaluated, 120 mL of product was measured in a graduated cylinder and poured over a folded rag. The press operator applied this rag to the blanket roller by wiping across the blanket while slowly rotating the blanket roller. Two rotations of the blanket roller were executed while wiping with solvent and one rotation while wiping with a dry rag. Time required to clean blankets was measured and recorded, and the press operator scored solvent performance on a scale

of 1 to 10 in five areas: ability to cut the ink; ease of application; ease of drying; whether 120 mL was a sufficient volume to clean the blanket; and odor. When appropriate, the press operator made additional comments.

2.2.1.d Evaluation of blanket swelling

The purpose of the swell test is to determine the extent to which washes cause blankets to swell. This is accomplished by measuring change in blanket thickness resulting from the use of a cleaning solvent (see Appendix D, Table D.2 for a summary of materials and equipment used).

Change in blanket thickness was measured after a fresh blanket was exposed to each solvent product for a one hour period, and again after an additional four hour period. The procedure for measuring swelling effect in this study was as follows:

- 1) Measure the thickness of a 2 X 2 inch blanket sample
- 2) Add 10 mL of blanket wash to a crystallization dish
- 3) Secure the blanket sample over the mouth of the crystallization dish
- 4) Expose the blanket sample for one hour
- 5) Remove the blanket sample and measure its thickness
- 6) Expose the blanket sample for an additional four hours
- 7) Remove the blanket sample and measure its thickness
- 8) Calculate percent swell after one hour and four exposures

2.2.2 Performance Testing at the Waldorf Corporation

The Waldorf Corp. is a paperboard packaging printer. Prior to the BWTS, this company had conducted evaluations regarding functional performance and environmental, health, and safety characteristics of blanket washes. When informed about the BWTS and that the research team was looking for a printing facility to test commercially available blanket washes, the Waldorf Corporation agreed to make its printing facility in Chicopee, Massachusetts available for product testing.

The printing press used to test products is a Planeta 55 inch, seven unit press. The inks used were petroleum based offset lithographic inks including process yellow, magenta, cyan, and black, and one custom. The ink form roller was set at 5/16 inch to vibrator and 1/4 inch to plate. The paper was 20 to 22 caliper, 78 pounds per thousand square feet, and 70 percent recycled. Maximum sheet size was 39.75 by 55 inches. The dampening solution was diluted to 3 ounces per gallon of tap water (see Appendix E, Table E.1 for a summary of equipment and materials used).

All product tests took place during production. One large job was selected (295,000 impressions) so all product tests could be accomplished without changing process materials. For each product evaluation, the number of printing impressions prior to cleaning blankets was

established at 5,000 impressions. Each time the press was shut down for cleaning, one product was evaluated at five printing units (four process inks and one custom) resulting in five trials for each product. Each product was evaluated by three to four press operators who would clean the blankets simultaneously until all were cleaned.

Immediately after cleaning a blanket, the press operator completed a questionnaire which asked them to score the product on a scale of 1 to 3 in each of the following categories:

- 1) ability to cut ink
- 2) ease of application
- 3) ease in drying
- 4) adequacy of the standard volume (6 ounces)
- 5) odor

Records were also logged regarding the number of sheets required to achieve required print density (e.g., rollup) and the number of blanket cylinder rotations required to clean the blanket and the number required to dry.

Performance tests were conducted in accordance with the blind testing methodology described in section 2.2.1.a of this report. In each product evaluation, a standard volume of solvent was used, equivalent to the amount required to barely saturate a dry rag, or six ounces. All testing was observed for TURI by BWTS Principal Investigator, John Tillotson and/or Massachusetts Office of Technical Assistance Engineer, Roland Beaudette to monitor consistency of testing methodology.⁴

An average score and standard deviation is computed for each product in each performance category based on five trials. Standard deviation is provided to indicate the variability of testing results, however, the data is not statistically significant. This performance testing is therefore classified as a case study.

3.0 RESULTS

This section reviews the results of all evaluations conducted in the BWTS. Table 3.2 provides an index to commercial product identities. In many cases results include extensive data which is provided in appendices and is appropriately referenced in this section. Below is a summary of the project findings.

The regulatory and health evaluations in this report rely heavily on information reported on MSDS sheets by manufacturers. The results of these evaluations are therefore only as accurate as the information provided.

⁴ Mass. OTA is a non-regulatory state agency that provides technical assistance for toxics use reduction to Massachusetts manufacturers.

As shown in Table 3.1 below, the most common ingredients reported on MSDSs of products evaluated are aromatic and aliphatic petroleum distillates, many of which are of the naphtha family.

Table 3.1 - Ingredients Disclosed on MSDSs

CAS No.	Chemical Name	Mixture	Product No.
53-60-5	Aliphatic Dibasic Ester	Y	6
763-69-9	Ethyl 3-Ethoxypropionate	N	6
34590-94-8	Dipropylene Glycol Mono Methyl Ether	N	9
64742-47-8	Kerosene, Hydrotreated	Y	15
64742-48-9	Heavy Naphtha, Hydrotreated	Y	4,7,8,11,12
64742-88-7	Medium Aliphatic Naphtha	Y	2,5,13,14
64742-94-5	Heavy Aromatic Naphtha	Y	1,2,5,13,15
64742-95-6	Light Aromatic Naphtha	Y	4,7,8,11,12,14
68584-24-7	Isopropylamine Dodecylbenzene Sulfonate	Y	8,11
NJTSR-649218-5510	Fatty Acid Ester	N	3,8,11

Light aromatic naphtha (CAS# 64742-95-6) is reported on MSDSs for six chemical products; heavy aromatic naphtha (CAS# 64742-94-5) and heavy naphtha, hydrotreated (CAS# 64742-48-9) are reported on MSDSs for five products; and medium aliphatic naphtha (CAS# 64742-88-7) is reported on MSDSs for four products. One of the two aromatic petroleum distillates is reported on MSDSs for all but three products. None of the products are reported to contain both aromatic blends.

Components of the two aromatic petroleum distillates include regulated substances that play a critical role in regulatory scores of products evaluated in this report.⁵ Regulated substances contained in light aromatic naphtha (CAS# 64742-95-6) include 1,2,4-trimethylbenzene (maximum concentration of 27 percent), xylene (maximum concentration of 5 percent), and cumene (maximum concentration of 4 percent). Regulated substances contained in heavy aromatic naphtha (CAS# 64742-94-5) include naphthalene (maximum concentration of 10 percent) and 1,2,4-trimethylbenzene (maximum concentration of 2 percent). No other regulated substances were reported or otherwise identified in products evaluated.

Aliphatic petroleum distillates reported in this project are naphtha blends characterized primarily by aliphatic hydrocarbons, although they may contain from 2 to 16 percent aromatic hydrocarbons. These components could be from isomers of hexane (C₆H₁₄), to isomers of decane

⁵ A regulated substance is defined in this report as a substance that is included on one or more of the nineteen regulatory lists considered.

(C₁₀H₂₂) or undecane (C₁₁H₂₄) (Brady, 1993). A determination of the presence and/or concentration of components contained in these aliphatic blends is not possible without going beyond the CAS number level of detail, which is beyond the scope of this project. Therefore, these components are not factored in product evaluations or scores.

3.1 Potential Regulatory Impact

Although eleven products contain regulated substances, only seven products contain a regulated substance(s) above de minimis concentrations. None of the products contain an ozone depleting substance (ODS) or SARA 302 Extremely Hazardous Substance. Nine products either contain a RCRA listed hazardous substance or are a characteristic hazardous waste. Seven of these products contain one or more SARA 313 chemicals. Six of these products contain one or more HAPs and one or more CERCLA hazardous substances.

Printers should consider a full regulatory review to develop a more comprehensive understanding of potential regulatory impact. Table 3.3 summarizes total regulatory hits for each product along with corresponding product scores (see Appendix B for a more detailed regulatory review and supporting information).

3.2 Health Hazard

Of the chemical ingredients evaluated, three were not identified in the literature search for this study. These substances include: aliphatic dibasic ester (CAS# 53-60-5); isopropylamine dodecylbenzene sulfonate (CAS# 68584-24-7); and fatty acid ester (NJTSR-649218-5510). Products containing one or more of these substances are marked with an asterisk in Table 3.4.

None of the products evaluated in this report receive a health hazard score of 3. Two products receive a health hazard score of 1. Petroleum distillates were not reported to be included in the chemical make-up of these two products. The remaining products scored between 2.0 and 2.9, which depended on the total concentration of petroleum distillates contained in the products. Table 3.3 summarizes health hazard scores for the products evaluated in this report. Appendix C, Section C.2 provides documentation supporting product scores.

3.3 VOC Content and Safety Hazard

Table 3.5 lists the results of VOC content measurements and corresponding product scores. As shown in this table, test results indicate that four products contain less than 30 percent VOCs, seven products contain between 30 and 60 percent VOCs, and three products contain greater than 60 percent VOCs.

Table 3.6 provides flash point data and corresponding product scores. Test data indicates that four products have a flash point between 100°F and 140°F, and that the remaining products have a flash point equal to or above 140°F.

It should be noted that VOC content and flash point measurements were made after samples had been stored for approximately one month. Although all product samples were stored in the original sealed containers, it is possible that some volatiles escaped during product repackaging and sampling. If this occurred, the actual VOC content upon delivery may be slightly higher than what is reported in Table 3.5, and the actual flash point upon delivery may be slightly lower than what is reported in Table 3.6.

3.4 GATF Performance Testing

Using the Surtronic 3 profilometer, smoothness testing was performed on blankets before and after use. Surface roughness on the average only changed 0.2 units (see Appendix D, Table D.3 for GATF blanket roughness test data). Changes in surface roughness of more than 0.5 units is considered significant (Evans, 1993).

Approximately 100 or less sheets were printed prior to cleaning each blanket. Press latitude measurement was then repeated. The normal ink setting was 2.5, which achieved between a 1.25 - 1.35 cyan ink density. Run number 13 start up density was around 1.38.

There was little difference in reaching the targeted density after the blankets were cleaned with the various solvents, which usually occurred after 10-20 sheets of paper. All runs showed scumming and plugging between water settings of 1.5 and 1.0. Slight scumming occurred at water setting 2.0 on runs 12 and 13. The prints did not completely wash out at a high water setting on any of the runs, but there was significant loss of ink density. Dot gain was measured on the 50% patch of the UGRA test target using the X-Rite 418 densitometer. The dot gain ranged between 18-23% with dot gains as high as 30% at low water settings. A 20-22% dot gain is normal. Microscopic examination on the UGRA microlines showed no difference in print fidelity after washing with each solvent (see Appendix D, Table D.4 for GATF press latitude test data, and Table D.5 for GATF cleaning effectiveness test data).

The results of swell tests show that none of the solutions attacked or caused significant swell of the blanket after the first hour of exposure. Solutions #6 and #7 indicated more than a 3% swell after four hours exposure. Less than 3% swell is recommended. Significant swell of this blanket could only occur after multiple cleanings with solution #6 or #7 in a short period of time. Except for the blanket used with solution #6, blankets returned close to the initial caliper (see Appendix D, Table D.6 for GATF swell test data).

3.5 Waldorf Corporation Performance Testing

The results of product evaluations conducted at the Waldorf Corporation are compiled in tables 3.7 through 3.13. Data contained in each of these tables is identical. The distinction between each table is the criteria used to organize data. For example, in table 3.7 products and corresponding performance scores are sorted according to the BWTS product number beginning with Product No. 1 at the top of the table. In table 3.8 products and corresponding performance scores are sorted according to average overall performance score beginning with the best scores

in this category at the top of the table. Table 3.9 sorts products according to the next performance category which is ability to cut ink. This type of sorting is accomplished for each performance category ending with the odor performance category in Table 3.13. For a summary of Waldorf Corp. performance test data see Appendix E, Table E.2. The questionnaire used to score the products is listed in this appendix as Table E.3.

Standard deviation is included with average performance scores to provide an indication of scoring variability. As indicated in Appendix A, however, scoring variability may indeed be attributable to differences in operator opinions and not random statistical variance.

4.0 CONCLUSIONS

Printers may find that substitute blanket washes offer significant environmental benefits. For example, this study found that six of the fourteen washes evaluated avoid all nineteen regulatory categories considered. This includes RCRA hazardous waste, Clean Air Act Hazardous Air Pollutants, and SARA 313 listed substances to name a few. There also appears to be quite a range in VOC concentrations, ranging from about 6 to 98 percent among products evaluated in this study. Although a product's flash point is an important safety consideration, all products evaluated in this study have a flash point above 100°F, which is considered within the industry to be the threshold for reasonably safe products.

Although strong environmental performance correlated with weaker functional performance for several products, some products performed well in both categories pointing out that it is possible to formulate products with both characteristics. The most problematic chemical substances in the environmental, health, and safety evaluations were naphthalene, trimethylbenzene, cumene, and xylene. These chemical substances were only found as sub-components of two aromatic petroleum distillates, both of which are of the naphtha type. A generally accepted methodology for evaluating the health hazard of chemical mixtures was found to be lacking in the literature search conducted for this study. More research in this area is needed.

The methodology used in this study to field test products is highly subjective and dependant on the unique printing conditions at the particular shop where testing was conducted. Therefore, printers are encouraged to conduct actual product trials in their own shops prior to making significant changes in blanket washes. This report should be used as one of many resources available to guide printers toward an appropriate purchase decision based on their best professional judgement.

Table 3.2 - Index to the Commercial Identity of Products Tested

BWTS Product No.	Commercial Product Name	Supplier
1	Ecolo-Wash, Step A	Varn Products, Inc.
2	Lo-Vo Wash HF	Tower Products, Inc.
3	Enviroklene N 0.1	Prisco/Printers' Service, Inc.
4	Posco Ecolo Pro 2.2	Posco, Inc.
5	Envirowash 220 HF	Anchor Lithkemko, Inc.
6	Envirowash 3000	Anchor Lithkemko, Inc.
7	Posco PWM Wash	Posco, Inc.
8	Aspen B	Prisco/Printers' Service, Inc.
9	Lo-Vo Wash Ultimate	Tower Products, Inc.
10	Control for Waldorf Testing	N/A
11	Aspen C	Prisco/Printers' Service, Inc.
12	Posco Ecolo Pro 4.4	Posco, Inc.
13	Envirowash 350 HF	Anchor Lithkemko, Inc.
14	Lo-Vo Wash WM	Tower Products, Inc.
15	Ecolo-Clean 35	Varn Products, Inc.

Table 3.3 - Regulatory Scoring

Score	Product No.	Hits
1	1	1
	3	0
	5	0
	6	0
	8	3
	9	0
	13	0
	15	0
2	2	9
	14	10
3	4	15
	7	15
	11	15
	12	15

Table 3.4 - Health Hazard Scoring

Score	Product Number	Limiting Factor		
		Ingredient	Concentration	
1	3*	Fatty Acid Ester	100	
	6*	Aliphatic Dibasic Ester Ethyl-3 Ethoxypropionate	25 15	
2	2.0	1	Heavy Aromatic Naphtha	5
		9	Dipropylene Glycol Mono Methyl Ether	30
	2.1	na	na	na
	2.2	na	na	na
	2.3	5	Medium Aliphatic Naphtha	25
			Heavy Aromatic Naphtha	8
	2.4	4	Heavy Naphtha, Hydrotreated	8
			Light Aromatic Naphtha	37
		8*	Heavy Naphtha, Hydrotreated Light Aromatic Naphtha	25 15
	2.5	13	Kerosene, Hydrotreated	40
			Heavy Aromatic Naphtha	5
	2.6	11*	Medium Aliphatic Naphtha	45
			Heavy Aromatic Naphtha	8
	2.7	na	Medium Aliphatic Naphtha	30
			Light Aromatic Naphtha	20
	2.8	2	Heavy Naphtha, Hydrotreated	30
Light Aromatic Naphtha			30	
2.9	7	Heavy Naphtha, Hydrotreated	50	
		Light Aromatic Naphtha	44	
2.9	12	Heavy Naphtha, Hydrotreated	22	
		Light Aromatic Naphtha	74	

* - Product contains an ingredient that was not identified in the BWTS literature search

Table 3.5 - VOC Content Scoring

Score	Product No.	Percent VOCs (by weight)
1	3	6
	1	9
	9	25
	8	28
2	14	32
	6	35
	5	36
	2	48
	13	52
	4	55
	11	56
3	12	82
	15	93
	7	98

Table 3.6 - Safety Hazard Scoring

Score	Product No.	Flash Point (°F)
1	1	> 212
	3	> 212
	6	> 212
	9	201
	5	185
	2	169
	15	169
	13	158
	4	142
	8	140
2	14	135
	11	122
	12	117
	7	108

Table 3.7 - Performance Data, Waldorf Corp., Sorted by Product Number

Product No.	Avg. Overall Score	Ability to Cut Ink		Lubricity		Ease in Drying		Adequacy of Std. Vol.		Odor	
		Avg. Score	Std.D ev.	Avg. Score	Std.D ev.	Avg. Score	Std.D ev.	Avg. Score	Std.D ev.	Avg. Score	Std. Dev.
1	2.6	2.6	0.6	2.6	0.6	2.4	0.5	2.6	0.6	2.6	0.6
2	1.4	1.2	0.5	1.0	0.0	1.6	0.6	1.8	0.5	1.4	0.6
3	1.7	1.6	0.6	1.8	0.8	1.8	1.0	1.8	0.5	1.6	0.6
4	1.8	1.2	0.5	2.4	0.6	2.6	0.6	1.4	0.6	1.2	0.5
5	1.8	2.2	1.1	1.8	1.1	1.6	0.6	2.2	0.5	1.2	0.5
6	2.0	2.6	0.6	2.0	1.0	1.7	0.6	2.3	0.6	1.6	0.6
7	1.2	1.0	0.0	1.4	0.6	1.0	0.0	1.6	0.6	1.0	0.0
8	1.6	2.6	0.6	1.2	0.5	1.4	0.5	1.8	0.5	1.2	0.5
9	2.0	2.4	0.6	1.0	0.0	2.6	0.6	1.8	0.8	2.2	1.1
10	1.9	1.0	0.0	2.8	0.5	2.0	1.0	1.4	0.5	2.4	0.6
11	1.2	1.0	0.0	1.0	0.0	1.2	0.5	1.6	0.6	1.2	0.5
12	1.6	1.0	0.0	1.2	0.5	1.2	0.5	1.8	0.5	2.6	0.6
13	1.6	1.2	0.5	2.0	0.0	1.4	0.6	1.6	0.6	1.6	0.6
14	1.6	1.2	0.5	1.2	0.5	1.4	0.6	2.2	0.5	1.8	0.8
15	1.5	1.4	0.9	1.2	0.5	1.0	0.0	1.6	0.6	2.4	0.6

Note: Average scores were calculated using data collected from stations 2 - 6, standard deviation is based only on those 5 trials. Standard deviation indicates the variability among scores as follows: Std. Dev. of 0.0, Low Variability (all scores were the same); Std. Dev. of 0.5 - 0.6, Medium Variability; and Std. Dev. of 0.8 - 1.1, High Variability.

Table 3.8 - Performance Data, Waldorf Corp., Sorted by Avg. Overall Score

Product No.	Avg. Overall Score	Ability to Cut Ink		Lubricity		Ease in Drying		Adequacy of Std. Vol.		Odor	
		Avg. Score	Std.D ev.	Avg. Score	Std.D ev.	Avg. Score	Std.D ev.	Avg. Score	Std.D ev.	Avg. Score	Std. Dev.
7	1.2	1.0	0.0	1.4	0.6	1.0	0.0	1.6	0.6	1.0	0.0
11	1.2	1.0	0.0	1.0	0.0	1.2	0.5	1.6	0.6	1.2	0.5
2	1.4	1.2	0.5	1.0	0.0	1.6	0.6	1.8	0.5	1.4	0.6
15	1.5	1.4	0.9	1.2	0.5	1.0	0.0	1.6	0.6	2.4	0.6
8	1.6	2.6	0.6	1.2	0.5	1.4	0.5	1.8	0.5	1.2	0.5
12	1.6	1.0	0.0	1.2	0.5	1.2	0.5	1.8	0.5	2.6	0.6
13	1.6	1.2	0.5	2.0	0.0	1.4	0.6	1.6	0.6	1.6	0.6
14	1.6	1.2	0.5	1.2	0.5	1.4	0.6	2.2	0.5	1.8	0.8
3	1.7	1.6	0.6	1.8	0.8	1.8	1.0	1.8	0.5	1.6	0.6
4	1.8	1.2	0.5	2.4	0.6	2.6	0.6	1.4	0.6	1.2	0.5
5	1.8	2.2	1.1	1.8	1.1	1.6	0.6	2.2	0.5	1.2	0.5
10	1.9	1.0	0.0	2.8	0.5	2.0	1.0	1.4	0.5	2.4	0.6
6	2.0	2.6	0.6	2.0	1.0	1.7	0.6	2.3	0.6	1.6	0.6
9	2.0	2.4	0.6	1.0	0.0	2.6	0.6	1.8	0.8	2.2	1.1
1	2.6	2.6	0.6	2.6	0.6	2.4	0.5	2.6	0.6	2.6	0.6

Note: Average scores were calculated using data collected from stations 2 - 6, standard deviation is based only on those 5 trials. Standard deviation indicates the variability among scores as follows: Std. Dev. of 0.0, Low Variability (all scores were the same); Std. Dev. of 0.5 - 0.6, Medium Variability; and Std. Dev. of 0.8 - 1.1, High Variability.

Table 3.9 - Performance Data, Waldorf Corp., Sorted by Ability to Cut Ink

Product No.	Avg. Overall Score	Ability to Cut Ink		Lubricity		Ease in Drying		Adequacy of Std. Vol.		Odor	
		Avg. Score	Std. D ev.	Avg. Score	Std. D ev.	Avg. Score	Std. D ev.	Avg. Score	Std. D ev.	Avg. Score	Std. Dev.
7	1.2	1.0	0.0	1.4	0.6	1.0	0.0	1.6	0.6	1.0	0.0
10	1.9	1.0	0.0	2.8	0.5	2.0	1.0	1.4	0.5	2.4	0.6
11	1.2	1.0	0.0	1.0	0.0	1.2	0.5	1.6	0.6	1.2	0.5
12	1.6	1.0	0.0	1.2	0.5	1.2	0.5	1.8	0.5	2.6	0.6
2	1.4	1.2	0.5	1.0	0.0	1.6	0.6	1.8	0.5	1.4	0.6
4	1.76	1.2	0.5	2.4	0.6	2.6	0.6	1.4	0.6	1.2	0.5
13	1.6	1.2	0.5	2.0	0.0	1.4	0.6	1.6	0.6	1.6	0.6
14	1.6	1.2	0.5	1.2	0.5	1.4	0.6	2.2	0.5	1.8	0.8
15	1.5	1.4	0.9	1.2	0.5	1.0	0.0	1.6	0.6	2.4	0.6
3	1.68	1.6	0.6	1.8	0.8	1.8	1.0	1.8	0.5	1.6	0.6
5	1.8	2.2	1.1	1.8	1.1	1.6	0.6	2.2	0.5	1.2	0.5
9	2	2.4	0.6	1.0	0.0	2.6	0.6	1.8	0.8	2.2	1.1
1	2.6	2.6	0.6	2.6	0.6	2.4	0.5	2.6	0.6	2.6	0.6
6	2.04	2.6	0.6	2.0	1.0	1.7	0.6	2.3	0.6	1.6	0.6
8	1.64	2.6	0.6	1.2	0.5	1.4	0.5	1.8	0.5	1.2	0.5

Note: Average scores were calculated using data collected from stations 2 - 6, standard deviation is based only on those 5 trials. Standard deviation indicates the variability among scores as follows: Std. Dev. of 0.0, Low Variability (all scores were the same); Std. Dev. of 0.5 - 0.6, Medium Variability; and Std. Dev. of 0.8 - 1.1, High Variability.

Table 3.10 - Performance Data, Waldorf Corp., Sorted by Lubricity

Product No.	Avg. Overall Score	Ability to Cut Ink		Lubricity		Ease in Drying		Adequacy of Std. Vol.		Odor	
		Avg. Score	Std.D ev.	Avg. Score	Std.D ev.	Avg. Score	Std.D ev.	Avg. Score	Std.D ev.	Avg. Score	Std. Dev.
2	1.4	1.2	0.5	1.0	0.0	1.6	0.6	1.8	0.5	1.4	0.6
9	2.0	2.4	0.6	1.0	0.0	2.6	0.6	1.8	0.8	2.2	1.1
11	1.2	1.0	0.0	1.0	0.0	1.2	0.5	1.6	0.6	1.2	0.5
8	1.6	2.6	0.6	1.2	0.5	1.4	0.5	1.8	0.5	1.2	0.5
12	1.6	1.0	0.0	1.2	0.5	1.2	0.5	1.8	0.5	2.6	0.6
14	1.6	1.2	0.5	1.2	0.5	1.4	0.6	2.2	0.5	1.8	0.8
15	1.5	1.4	0.9	1.2	0.5	1.0	0.0	1.6	0.6	2.4	0.6
7	1.2	1.0	0.0	1.4	0.6	1.0	0.0	1.6	0.6	1.0	0.0
3	1.7	1.6	0.6	1.8	0.8	1.8	1.0	1.8	0.5	1.6	0.6
5	1.8	2.2	1.1	1.8	1.1	1.6	0.6	2.2	0.5	1.2	0.5
6	2.0	2.6	0.6	2.0	1.0	1.7	0.6	2.3	0.6	1.6	0.6
13	1.6	1.2	0.5	2.0	0.0	1.4	0.6	1.6	0.6	1.6	0.6
4	1.8	1.2	0.5	2.4	0.6	2.6	0.6	1.4	0.6	1.2	0.5
1	2.6	2.6	0.6	2.6	0.6	2.4	0.5	2.6	0.6	2.6	0.6
10	1.9	1.0	0.0	2.8	0.5	2.0	1.0	1.4	0.5	2.4	0.6

Note: Average scores were calculated using data collected from stations 2 - 6, standard deviation is based only on those 5 trials. Standard deviation indicates the variability among scores as follows:
 Std. Dev. of 0.0, Low Variability (all scores were the same); Std. Dev. of 0.5 - 0.6, Medium Variability;
 and Std. Dev. of 0.8 - 1.1, High Variability.

Table 3.11 - Performance Data, Waldorf Corp., Sorted by Ease in Drying

Product No.	Avg. Overall Score	Ability to Cut Ink		Lubricity		Ease in Drying		Adequacy of Std. Vol.		Odor	
		Avg. Score	Std. D ev.	Avg. Score	Std. D ev.	Avg. Score	Std. D ev.	Avg. Score	Std. D ev.	Avg. Score	Std. Dev.
7	1.2	1.0	0.0	1.4	0.6	1.0	0.0	1.6	0.6	1.0	0.0
15	1.5	1.4	0.9	1.2	0.5	1.0	0.0	1.6	0.6	2.4	0.6
11	1.2	1.0	0.0	1.0	0.0	1.2	0.5	1.6	0.6	1.2	0.5
12	1.6	1.0	0.0	1.2	0.5	1.2	0.5	1.8	0.5	2.6	0.6
8	1.6	2.6	0.6	1.2	0.5	1.4	0.5	1.8	0.5	1.2	0.5
13	1.6	1.2	0.5	2.0	0.0	1.4	0.6	1.6	0.6	1.6	0.6
14	1.6	1.2	0.5	1.2	0.5	1.4	0.6	2.2	0.5	1.8	0.8
2	1.4	1.2	0.5	1.0	0.0	1.6	0.6	1.8	0.5	1.4	0.6
5	1.8	2.2	1.1	1.8	1.1	1.6	0.6	2.2	0.5	1.2	0.5
6	2.0	2.6	0.6	2.0	1.0	1.7	0.6	2.3	0.6	1.6	0.6
3	1.7	1.6	0.6	1.8	0.8	1.8	1.0	1.8	0.5	1.6	0.6
10	1.9	1.0	0.0	2.8	0.5	2.0	1.0	1.4	0.5	2.4	0.6
1	2.6	2.6	0.6	2.6	0.6	2.4	0.5	2.6	0.6	2.6	0.6
4	1.8	1.2	0.5	2.4	0.6	2.6	0.6	1.4	0.6	1.2	0.5
9	2.0	2.4	0.6	1.0	0.0	2.6	0.6	1.8	0.8	2.2	1.1

Note: Average scores were calculated using data collected from stations 2 - 6, standard deviation is based only on those 5 trials. Standard deviation indicates the variability among scores as follows:
 Std. Dev. of 0.0, Low Variability (all scores were the same); Std. Dev. of 0.5 - 0.6, Medium Variability;
 and Std. Dev. of 0.8 - 1.1, High Variability.

Table 3.12 - Performance Data, Waldorf Corp., Sorted by Adequacy of Std. Volume

Product No.	Avg. Overall Score	Ability to Cut Ink		Lubricity		Ease in Drying		Adequacy of Std. Vol.		Odor	
		Avg. Score	Std.D ev.	Avg. Score	Std.D ev.	Avg. Score	Std.D ev.	Avg. Score	Std.D ev.	Avg. Score	Std. Dev.
4	1.8	1.2	0.5	2.4	0.6	2.6	0.6	1.4	0.6	1.2	0.5
10	1.9	1.0	0.0	2.8	0.5	2.0	1.0	1.4	0.5	2.4	0.6
7	1.2	1.0	0.0	1.4	0.6	1.0	0.0	1.6	0.6	1.0	0.0
11	1.2	1.0	0.0	1.0	0.0	1.2	0.5	1.6	0.6	1.2	0.5
13	1.6	1.2	0.5	2.0	0.0	1.4	0.6	1.6	0.6	1.6	0.6
15	1.5	1.4	0.9	1.2	0.5	1.0	0.0	1.6	0.6	2.4	0.6
2	1.4	1.2	0.5	1.0	0.0	1.6	0.6	1.8	0.5	1.4	0.6
3	1.7	1.6	0.6	1.8	0.8	1.8	1.0	1.8	0.5	1.6	0.6
8	1.6	2.6	0.6	1.2	0.5	1.4	0.5	1.8	0.5	1.2	0.5
9	2.0	2.4	0.6	1.0	0.0	2.6	0.6	1.8	0.8	2.2	1.1
12	1.6	1.0	0.0	1.2	0.5	1.2	0.5	1.8	0.5	2.6	0.6
5	1.8	2.2	1.1	1.8	1.1	1.6	0.6	2.2	0.5	1.2	0.5
14	1.6	1.2	0.5	1.2	0.5	1.4	0.6	2.2	0.5	1.8	0.8
6	2.0	2.6	0.6	2.0	1.0	1.7	0.6	2.3	0.6	1.6	0.6
1	2.6	2.6	0.6	2.6	0.6	2.4	0.5	2.6	0.6	2.6	0.6

Note: Average scores were calculated using data collected from stations 2 - 6, standard deviation is based only on those 5 trials. Standard deviation indicates the variability among scores as follows: Std. Dev. of 0.0, Low Variability (all scores were the same); Std. Dev. of 0.5 - 0.6, Medium Variability; and Std. Dev. of 0.8 - 1.1, High Variability.

Table 3.13 - Performance Data, Waldorf Corp., Sorted by Odor

Product No.	Avg. Overall Score	Ability to Cut Ink		Lubricity		Ease in Drying		Adequacy of Std. Vol.		Odor	
		Avg. Score	Std.D ev.	Avg. Score	Std.D ev.	Avg. Score	Std.D ev.	Avg. Score	Std.D ev.	Avg. Score	Std. Dev.
7	1.2	1.0	0.0	1.4	0.6	1.0	0.0	1.6	0.6	1.0	0.0
4	1.8	1.2	0.5	2.4	0.6	2.6	0.6	1.4	0.6	1.2	0.5
5	1.8	2.2	1.1	1.8	1.1	1.6	0.6	2.2	0.5	1.2	0.5
8	1.6	2.6	0.6	1.2	0.5	1.4	0.5	1.8	0.5	1.2	0.5
11	1.2	1.0	0.0	1.0	0.0	1.2	0.5	1.6	0.6	1.2	0.5
2	1.4	1.2	0.5	1.0	0.0	1.6	0.6	1.8	0.5	1.4	0.6
3	1.7	1.6	0.6	1.8	0.8	1.8	1.0	1.8	0.5	1.6	0.6
6	2.0	2.6	0.6	2.0	1.0	1.7	0.6	2.3	0.6	1.6	0.6
13	1.6	1.2	0.5	2.0	0.0	1.4	0.6	1.6	0.6	1.6	0.6
14	1.6	1.2	0.5	1.2	0.5	1.4	0.6	2.2	0.5	1.8	0.8
9	2.0	2.4	0.6	1.0	0.0	2.6	0.6	1.8	0.8	2.2	1.1
10	1.9	1.0	0.0	2.8	0.5	2.0	1.0	1.4	0.5	2.4	0.6
15	1.5	1.4	0.9	1.2	0.5	1.0	0.0	1.6	0.6	2.4	0.6
1	2.6	2.6	0.6	2.6	0.6	2.4	0.5	2.6	0.6	2.6	0.6
12	1.6	1.0	0.0	1.2	0.5	1.2	0.5	1.8	0.5	2.6	0.6

Note: Average scores were calculated using data collected from stations 2 - 6, standard deviation is based only on those 5 trials. Standard deviation indicates the variability among scores as follows:
 Std. Dev. of 0.0, Low Variability (all scores were the same); Std. Dev. of 0.5 - 0.6, Medium Variability;
 and Std. Dev. of 0.8 - 1.1, High Variability.

BIBLIOGRAPHY

Below is a list of references used throughout the text of this report. Some references are also applicable to this report's Appendices, and in such cases this is appropriately indicated.

- 1) Brady, R., Anchor/Lithkemco, telephone communication, Aug. 31, 1993.
- 2) Dabney PhD, B. J., Hall MD, A. H., REPROTEXT, Micromedex, Inc., 1992.
- 3) Evans, B., Graphic Arts Technical Foundation, Performance Testing Summary Report, July 29, 1993.
- 4) "General Electric - Raytheon - AT&T Joint Meeting, CFC Elimination, Industrial Hygiene Evaluation, Alternative Solvent Selection Process," conference proceedings, February 1992.
- 5) Hlavacek, D., Statistical Support Manager, 3M Corporation, "Technical review memorandum regarding the PWTS draft report," October 1993.
- 6) Micromedex, Inc., New Jersey Hazardous Substance Fact Sheets, 1993.
- 7) MicroReg, Inc., ECLIPSsm Version 1.5 (EPA's Register of Lists), 1992.
- 8) Placanico, J., Shift Supervisor, Waldorf Corporation, personal communication, August 1993.

APPENDIX A

PROJECT LIMITATIONS

SECTION A.1 - PROJECT LIMITATIONS

Limitations to VOC Content Scoring Methodology

- 1) One supplier provided TURI with data indicating the EPA Method 24 testing procedure does not provide consistent results for the same chemical ingredient or chemical product. This supplier suggested to TURI that based on the data provided, EPA Method 24 does not appear to be an appropriate testing procedure for blanket washes. An evaluation of the applicability of EPA Method 24 to blanket washes is beyond the scope of this paper, however, these concerns are worth noting.

Limitations to the Regulatory Screen Methodology

- 1) The methodology applies equal weight to each regulatory list and printers may find it useful to apply different weights to different lists. For example, a printer may find that RCRA hazardous waste classifications are more significant in evaluating products than the other lists included in the report. This weighting system should be developed to fit specific circumstances.
- 2) The methodology does not determine actual regulatory burden. Plant specific regulatory burden can be developed using appropriate legal and technical professionals.
- 3) The scoring methodology is based on chemicals identified on MSDSs, therefore an inaccuracy of MSDS reporting could result in inaccurate potential regulatory impact scores.

Limitations to the Health Hazard Methodology

- 1) The methodology does not consider exposure.
- 2) A lack of data on a chemical substance could artificially improve the score a product receives in this study.
- 3) The scoring methodology is based on chemicals identified on MSDSs, therefore an inaccuracy of MSDS reporting could result in inaccurate health hazard scores.

Limitations of the Safety Hazard Methodology

- 1) This methodology does not consider the fact that lower VOC products were reported to be more slippery than higher VOC products. Press operators at the Waldorf Corporation suggested that if low VOC products are spilled on the shop floor, people could slip and fall.

Limitations to the Blanket Roughness Evaluation

- 1) Blankets were exposed to only one cleaning prior to determining the increase in blanket roughness. In production, a blanket may receive greater exposures.

Limitations to Performance Data Obtained at GATE

- 1) Only 50 to 100 impressions were printed prior to evaluating each product. Blanket ink density has a tendency to increase as the number of printing impressions increase prior to cleaning (Placanico, 1993). As ink density increases, blanket cleaning becomes more difficult, other factors being the same. Therefore, the data does not provide an indication of how well products will clean on jobs larger than 100 impressions.

- 2) Cleaning effectiveness ratings are based on the opinion of one press operator and should not be taken as an absolute rating. It has been well documented that if the same product is given to the same person on several different occasions (blind, coded, randomized), repeated ratings are likely to vary from one to the next. Differences in the individual ratings could be the result of actual product differences, or simply differences in how the individual used the rating scale from one trial to the next (Hlavacek, 1993).
- 3) Ratings of cleaning effectiveness were based on a ten point scale. In evaluating the cleaning effectiveness of blanket washes, it is difficult to determine the practical importance of a two point difference when using a ten point rating scale (Hlavacek, 1993).
- 4) Products were evaluated in only one printing situation (i.e., type of press, ink, paper, etc.) and controls were imposed in the study (i.e., one lot of plates, one lot of ink, etc.). Although it makes sense from an experimental standpoint, these facts may limit how well the results translate to all printing conditions (Hlavacek, 1993).

Limitations to Performance Data Obtained at the Waldorf Corporation.

- 1) Products were evaluated in only one printing situation (i.e., type of press, ink, paper, etc.), which may limit how well the results translate to all printing conditions.
- 2) Although seven press operators participated in the study, not every operator had the opportunity to evaluate every blanket wash. Press operators may have used the rating scale differently. Differences in average blanket wash ratings may be attributed to which press operator evaluated the product and not actual product differences (Hlavacek, 1993).
- 3) Five trials were conducted for each product, but since testing was conducted on different shifts, the press operators were not the same for each product. The variability of data across the five trials for each product is probably not due to random statistical variance. More statistically consistent results are generally obtained when fewer individuals (i.e., two press operators instead of four) are involved in a study (Hlavacek, 1993).

APPENDIX B

SUPPORTING DATA FOR REGULATORY REVIEW

SECTION B.1 - DESCRIPTION OF REGULATORY LISTS (Microreg, Inc., 1992).

LIST CODE: CAA 111
CITE: 40 CFR 60.489
LIST NAME: STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES OF AIR POLLUTANTS - EQUIPMENT LEAKS CHEMICAL LIST
STATUTE NAME: Clean Air Act, Section 111
DESCRIPTION: Clean Air Act Section 111 is a list of chemicals covered by the SOCM I Equipment Leaks NSPS.
CONTACT NAME: DOUG BELL PHONE: (919) 541-5568
CONTACT NAME: ROBERT E. ROSENSTEEL PHONE: (919) 541-5608
UPDATED: 02/09/93

LIST CODE: CAA 112
CITE: 40 CFR 63.60
LIST NAME: NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS
STATUTE NAME: Clean Air Act, Section 112
DESCRIPTION: Clean Air Section 112 contains a list of pollutants that are judged to be hazardous for which emission standards will be developed for source categories that emit one or more of these pollutants.
CONTACT NAME: NANCY PATE PHONE: (919) 541-5347
UPDATED: 06/14/93

LIST CODE: NSDWR

CITE: SDWA SEC.1412

LIST NAME: NATIONAL SECONDARY DRINKING WATER REGULATIONS

STATUTE NAME: Safe Drinking Water Act

DESCRIPTION: The SDWA of 1974 required EPA to develop regulations to control contaminants in drinking water that primarily affect the aesthetic qualities relating to the public acceptance of drinking water. These regulations are not federally enforceable but are intended as guidelines to the States.

CONTACT NAME: ELIZABETH C. SHAW PHONE: (202) 260-5555

UPDATED: 02/18/93

LIST CODE: PARA-4C

CITE: NA

LIST NAME: PRE-TREATMENT POLLUTANTS

STATUTE NAME: NA

DESCRIPTION: List of 423 compounds identified by EPA ERL Athens in the paragraph 4(c) Consent Decree Study [NRDC et al v. Train, 8 ERC 2120 (DDC 1976)].

CONTACT NAME: WILLIAM TELLIARD PHONE: (202) 260-5131

UPDATED: 04/03/92

LIST CODE: PRIO POLL

CITE: 40 CFR 423

LIST NAME: PRIORITY POLLUTANTS

STATUTE NAME: Clean Water Act (Federal Water Pollution Control Act - 1987)

DESCRIPTION: List is composed of 126 compounds found in 40 CFR part 423, Appendix A - 126 Priority Pollutants. The list of 126 (originally 129, 3 delisted in 1981) unambiguous analytes were developed by EPA and negotiated w/NRDC to define a specific list of analytes to be monitored as "priority pollutants".

CONTACT NAME: WILLIAM TELLIARD PHONE: (202) 260-5131

UPDATED: 02/09/93

LIST CODE: RCRA 3 CHR

CITE: 40 CFR 261.20 - 261.23

LIST NAME: CHARACTERISTICS OF HAZARDOUS WASTES: IGNITABILITY, REACTIVITY, AND CORROSIVITY

STATUTE NAME: Resource Conservation and Recovery Act

DESCRIPTION: The Resource Conservation and Recovery Act (RCRA) list of characteristics of hazardous waste not quantified by levels of a particular chemical in the waste. If a solid waste were to exhibit at least one of these characteristics (determined by a standard test method) the waste would be considered hazardous pursuant to RCRA 3001.

CONTACT NAME: RON JOSEPHSON PHONE: (202) 260-6715

UPDATED: 04/07/92

LIST CODE: RCRA F
CITE: 40 CFR 261.31
LIST NAME: HAZARDOUS WASTES FROM NON-SPECIFIC SOURCES
STATUTE NAME: Resource Conservation and Recovery Act
DESCRIPTION: The Resource Conservation and Recovery Act (RCRA) list of hazardous wastes from non-specific sources (i.e., not defined by a specific industry) pursuant to RCRA 3001. These wastes are subject to regulation under CERCLA (40 CFR 302.4).
CONTACT NAME: RON JOSEPHSON PHONE: (202) 260-6715
UPDATED: 04/07/92

LIST CODE: RCRA K
CITE: 40 CFR 261.32
LIST NAME: HAZARDOUS WASTES FROM SPECIFIC SOURCES
STATUTE NAME: Resource Conservation and Recovery Act
DESCRIPTION: The Resource Conservation and Recovery Act (RCRA) list of hazardous wastes from specific sources is a categorized (by industry or process) list of industrial wastes pursuant to RCRA 3001. These wastes are subject to regulation under CERCLA (40 CFR 302.4).
CONTACT NAME: RON JOSEPHSON PHONE: (202) 260-6715
UPDATED: 04/07/92

LIST CODE: RCRA P

CITE: 40 CFR 261.33(E)

LIST NAME: ACUTELY HAZARDOUS DISCARDED COMMERCIAL CHEMICAL PRODUCTS

STATUTE NAME: Resource Conservation and Recovery Act

DESCRIPTION: A Resource Conservation and Recovery Act (RCRA) list of acutely hazardous commercial chemical products that, when disposed unused (or when formulations containing any one of these as a sole active ingredient are disposed unused), become hazardous wastes pursuant to RCRA 3001. These wastes are subject to regulation under CERCLA (40 CFR 302.4).

CONTACT NAME: RON JOSEPHSON PHONE: (202) 260-6715

UPDATED: 04/07/92

LIST CODE: RCRA TC

CITE: 40 CFR 261.24

LIST NAME: CHARACTERISTICS OF HAZARDOUS WASTE: TOXICITY CHARACTERISTIC

STATUTE NAME: Resource Conservation and Recovery Act

DESCRIPTION: The Resource Conservation and Recovery Act (RCRA) list of compounds that, if detected in a waste extract from a toxicity characteristic leaching procedure (TCLP) above levels of regulatory concern, would cause the waste to be considered hazardous pursuant to RCRA 3001. These wastes are subject to regulation under CERCLA (40 CFR 302.4).

CONTACT NAME: RON JOSEPHSON PHONE: (202) 260-6715

UPDATED: 04/07/92

LIST CODE: RCRA U
CITE: 40 CFR 261.33(F)
LIST NAME: OTHER DISCARDED COMMERCIAL CHEMICAL PRODUCTS
STATUTE NAME: Resource Conservation and Recovery Act

DESCRIPTION: A Resource Conservation and Recovery Act (RCRA) list of commercial chemical products that, when disposed (or when formulations containing anyone of these as a sole active ingredient are disposed) unused, become hazardous wastes pursuant to RCRA 3001. These wastes are subject to regulation under CERCLA (40 CFR 302.4).

CONTACT NAME: RON JOSEPHSON PHONE: (202) 260-6715

UPDATED: 04/07/92

LIST CODE: SARA 110

CITE: PL 99-499

LIST NAME: SUPERFUND SITE PRIORITY CONTAMINANT LIST

STATUTE NAME: CERCLA 104 Priority List

DESCRIPTION: Chemical substances found at Superfund sites are prioritized based on their frequency of occurrence, toxicity rating, and potential human exposure. Once a substance has been listed, the Agency for Toxic Substances and Disease Registry (ATSDR) is mandated to develop a toxicological profile which contains general health/hazard assessments with effect levels, potential exposures, uses, regulatory actions, and further research needs. This list contains the 275 highest ranking substances of the approximately 700 prioritizes substances.

CONTACT NAME: DAVID A. BROOKS PHONE: (202) 260-1501
CONTACT NAME: BILL HENRIQUES PHONE: (404) 639-6308

UPDATED: 02/10/93

LIST CODE: SARA 302(A)

CITE: 40 CFR 355 APPENDICES A AND B

LIST NAME: EXTREMELY HAZARDOUS SUBSTANCES

STATUTE NAME: Sec 302(a) Emergency Planning and Community Right-to-Know Act

DESCRIPTION: List of chemicals which if present at a facility in quantities greater than their threshold planning quantity must be reported to State Emergency Response Commissions and Local Emergency Planning Committees for addressing community emergency plans. Also subject to regulation under SARA 304, which requires releases in excess of reportable quantities to be reported to these State and local authorities.

CONTACT NAME: KATHLEEN BISHOP

PHONE: (202) 260-5338

CONTACT NAME: JOHN FERRIS

PHONE: (202) 260-4043

UPDATED: 08/24/92

LIST CODE: SARA 313

CITE: NA

LIST NAME: EPCRA SECTION 313 LIST OF TOXIC SUBSTANCES

STATUTE NAME: Superfund Amendments & Reauthorization Act, Title III

DESCRIPTION: Facilities that exceed a manufacturing threshold of 25,000 pounds or processing or use threshold of 10,000 pounds for any chemical or category on the list must report to EPA any releases of the chemical (or category chemical) to air, land, water, POTW, underground injection, and offsite transfer.

CONTACT NAME: MARIA J. DOA

PHONE: (202) 260-9592

CONTACT NAME: SAM SASNETT

PHONE: (202) 260-1821

UPDATED: 05/01/92

SECTION B.2 - SUBSTANCES INCLUDED ON REGULATORY LISTS CONSIDERED

Lists which contain the Chemical: 98-82-8 CUMENE (Count of Records = 6)

Code	List
> CAA 111	STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES OF
> CAA 112	NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS
> CERCLA	CERCLA HAZARDOUS SUBSTANCES
> PARA-4C	PRE-TREATMENT POLLUTANTS
> RCRA U LIST	OTHER DISCARDED COMMERCIAL CHEMICAL PRODUCTS
> SARA 313	EPCRA SECTION 313 LIST OF TOXIC SUBSTANCES

Lists which contain the Chemical: 91-20-3 NAPHTHALENE (Count Of Records = 9)

Code	List
> CAA 112	NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS
> CERCLA	CERCLA HAZARDOUS SUBSTANCES
> CWA 307(A)	TOXIC POLLUTANTS
> CWA 311	CLEAN WATER ACT SECTION 311 HAZARDOUS SUBSTANCES
> PARA-4C	PRE-TREATMENT POLLUTANTS
> PRIO POLL	PRIORITY POLLUTANTS
> RCRA U LIST	OTHER DISCARDED COMMERCIAL CHEMICAL PRODUCTS
> SARA 110	SUPERFUND SITE PRIORITY CONTAMINANT LIST
> SARA 313	EPCRA SECTION 313 LIST OF TOXIC SUBSTANCES

Lists which contain the Chemical: 95-63-6 1,2,4 TRIMETHYLBENZENE (Count Of Records = 2)

Code	List
> PARA-4C	PRE-TREATMENT POLLUTANTS
> SARA 313	EPCRA SECTION 313 LIST OF TOXIC SUBSTANCES

Lists which contain the Chemical: 1330-20-7 XYLENE (Count Of Records = 8)

Code	List
> CAA 111	STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES OF
> CAA 112	NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS
> CERCLA	CERCLA HAZARDOUS SUBSTANCES
> CWA 311	CLEAN WATER ACT SECTION 311 HAZARDOUS SUBSTANCES
> NPDWR	NATIONAL PRIMARY DRINKING WATER REGULATIONS
> RCRA U LIST	OTHER DISCARDED COMMERCIAL CHEMICAL PRODUCTS
> SARA 110	SUPERFUND SITE PRIORITY CONTAMINANT LIST
> SARA 313	EPCRA SECTION 313 LIST OF TOXIC SUBSTANCES

Table B.1 - Concentrations of Regulated Substances

Product No.	Maximum Percent Concentration of Substances (by volume)			
	1,2,4-Trimethylbenzene	Cumene	Naphthalene	Xylene
1	0.1	NA	0.5	NA
2	0.6	NA	3.0	NA
3	NA	NA	NA	NA
4	10.0	1.5	NA	1.9
5	0.2	NA	0.8	NA
6	NA	NA	NA	NA
7	11.9	1.8	NA	2.2
8	4.1	0.6	NA	0.8
9	NA	NA	NA	NA
11	8.1	1.2	NA	1.5
12	20.0	3.0	NA	3.7
13	0.2	NA	0.8	NA
14	5.4	0.8	NA	1.0
15	0.1	NA	0.5	NA

Table B.2 - Regulated Substances Above De Minimis Concentrations

Product No.	Maximum Percent Concentration of Substances (by volume)			
	1,2,4-Trimethylbenzene	Cumene	Naphthalene	Xylene
2	NA	NA	3.0	NA
4	10.0	1.5	NA	1.9
7	11.9	1.8	NA	2.2
8	4.1	NA	NA	NA
11	8.1	1.2	NA	1.5
12	20.0	3.0	NA	3.7
14	5.4	NA	NA	1.0

Table B.3 - Regulatory Hits

Regulatory List	Product Numbers													
	1	2	3	4	5	6	7	8	9	11	12	13	14	15
CAA 111				XX			XX			XX	XX		X	
CAA 112		X		XX			XX			XX	XX		X	
ODS														
CERCLA		X		XX			XX			XX	XX		X	
CWA 307(A)		X												
CWA 311		X		X			X			X	X		X	
NPDWR				X			X			X	X		X	
NSDWR														
PARA-4C		X		XX			XX	X		XX	XX		X	
PRIO POLL		X												
RCRA 3 CHR	X			X			X	X		X	X		X	
RCRA F														
RCRA K														
RCRA P														
RCRA TC														
RCRA U		X		XX			XX			XX	XX		X	
SARA 110		X		X			X			X	X		X	
SARA 302(A)														
SARA 313		X		XXX			XXX	X		XXX	XXX		XX	
Total Hits	1	9	0	17	0	0	17	3	0	17	17	0	11	0
Total Hits Minus RCRA extra counts	1	9	0	15	0	0	15	3	0	15	15	0	10	0

APPENDIX C

SUPPORTING DATA FOR HEALTH HAZARD REVIEW

SECTION C.1 - SUMMARY OF HEALTH HAZARD RATING METHODOLOGIES

C.1.a Ingredient Health Hazard Rating Methodologies

REPROTEXT provides general toxicity and reproductive toxicity hazard ratings on chemical substances/mixtures reported in this study (Dabney, 1992). Below is a description of this rating system followed by an itemized list of rating categories.

"Ratings are based on information from literature reviews, original studies, and material safety data sheets. Complex mixtures are given the highest ranking of any ingredient for reproductive hazard, regardless of percentage composition. General toxicity rankings for mixtures are based on actual test data, or where data are lacking, are estimates based on knowledge of the composition and toxicity of the ingredients. These rankings are subject to change if new information substantially changes the understanding of the toxic effects of any substance. All classifications are guidelines not rigid rules. Certain individuals may be more or less sensitive to any chemical, or may react in ways not previously known."

Other databases consulted for health hazard data included the following:

- 1) MEDITEXT;
- 2) HAZARDTEXT;
- 3) INFOTEXT;
- 4) SARATEXT;
- 5) RTECS from NIOSH (Registry of Toxic Effects of Chemical Substances Database from the National Institute for Occupational Safety and Health);
- 6) HSDB from NLM (Hazardous Substances Data Bank from the National Library of Medicine);
- 7) OHM/TADS from EPA (Oil and Hazardous Materials/Technical Assistance Data System from the U.S. EPA);
- 8) CHRIS from Coast Guard (Chemical Hazard Response Information System developed by the U.S. Coast Guard);
- 9) DOT Emergency Response Guides;
- 10) IRIS from EPA (Integrated Risk Information System from the U.S. EPA); and
- 11) REPROTEXT (Toxicity and Reproductive Hazards of industrial chemicals from Micromedex).

These databases are updated on a quarterly basis and provide extensive toxicological data on thousands of chemical substances.

REPROTEXT HEALTH HAZARD RATING METHODOLOGY:

General Toxicity Hazard Ratings

- 0 - No appreciable hazard
- 1 - May cause reversible effects generally not life threatening
- 2 - May cause irreversible effects generally not life threatening
- 3 - May cause irreversible effects which can be life threatening
- U - Unknown or insufficient information to identify
- X - Simple asphyxiant

REPROTEXT Reproductive Hazard Ratings

- A+ Human reproductive hazard with no known no-effect dose
- A Human reproductive hazard with known no-effect dose
- A- Unconfirmed human reproductive hazard
- B+ Multiple reproductive effects in animals but no human data
- B Mixed reproductive effects in animals but no human data
- B- Few reproductive effects in animals but no human data
- C No reproductive data found
- D Insufficient information to identify
- E Known not to affect animal reproduction but no human data
- F Known not to affect human reproduction

REPROTEXT was selected as one of two health hazard rating methodologies to score the health hazard of reported chemical ingredients. For REPROTEXT'S General Toxicity Hazard Ratings, scores of 1, 2, and 3 are directly transferrable to this study. That is, chemical ingredients rated as a 3 in REPROTEXT score a 3 in the BWTS report (Class 3 Hazard). Ingredients with a rating of 0 or X in REPROTEXT score a 1 in this report (Class 1 Hazard) and ingredients with a rating of U trigger use of an alternate hazard rating methodology. REPROTEXT Reproductive Toxicity Hazard Ratings in the A range score a 3 in this report; ratings in the B range score a 2; and ratings of C trigger use of an alternate hazard rating methodology.

For comparison, a second rating methodology was used. This methodology is referred to as the Alternate Health Hazard Rating Methodology and was created based on an industrial hygiene evaluation of substitute solvents developed and implemented by the General Electric Corporation at its Lynn, Massachusetts manufacturing facility (General Electric, 1992).

ALTERNATIVE HEALTH HAZARD RATING METHODOLOGY:

Class 3 Hazard - Substances that have any of the following characteristics:

- 1) Are known or suspect (animal) human carcinogens;
- 2) Result in mutagenesis, teratogenesis, or fertility impairment in humans;
- 3) Result in irreversible central nervous system disturbances;
- 4) Are fast acting and can produce major injury;
- 5) Result in respiratory or skin sensitization; or
- 6) Have OSHA or ACGIH standards (whichever is lower) less than 25 ppm.

Class 2 Hazard - Substances that have any of the following characteristics:

- 1) Produce severe irritation of the skin, eyes, or respiratory system; and/or
- 2) Have OSHA or ACGIH exposure standards (whichever is lower) between 25 ppm and 199 ppm inclusive.

Class 1 Hazard - Substances that have any of the following characteristics:

- 1) Are classified as simple asphyxiants or nuisances;
- 2) Have generally low risk effects; and/or
- 3) Have OSHA or ACGIH exposure standards (whichever is lower) of 200 ppm or greater.

Each reported chemical ingredient is evaluated using both health hazard rating methodologies. In cases where the two ranking methodologies do not produce the same hazard score, the higher score is used. In cases where necessary data is lacking for one ranking methodology, the score computed using the other methodology is used. In cases where there is insufficient data to compute a score using either ranking methodology, the chemical

ingredient is marked with an asterisk, and the ingredient does not negatively impact the products health hazard score.

C.1.b Product Health Hazard Rating Methodology

All petroleum distillates reported in products evaluated receive a health hazard score of 3. No other reported ingredients receive this hazard score. Therefore, products reporting a concentration of 100 percent petroleum distillates receive a health hazard score of 3; products reporting less than 100 percent petroleum distillates receive a score between 2.0 to 2.9 depending on petroleum distillate concentrations. Products that do not report petroleum distillates are given a hazard score equal to the score of the ingredient with the highest hazard score, regardless of the concentration of that ingredient. A summary of the scoring methodology for the health hazard of products is included in the text of section 2.1.2.a.

Table C.1 - Concentrations of Petroleum Distillates

Product No.	Maximum Concentrations of Petroleum Distillates (by volume)					
	Kerosene, Hydrotreated (64742-47-8)	Heavy Naphtha, Hydrotreated (64742-48-9)	Medium Aliphatic Naphtha (64742-88-7)	Heavy Aromatic Naphtha (64742-94-5)	Light Aromatic Naphtha (64742-95-6)	Total Conc. of Petro. Dist.
12		22			74	96
7		50			44	94
2			50	30		80
11		30			30	60
13			45	8		53
14			30		20	50
4		8			37	45
15	40			5		45
8		25			15	40
5			25	8		33
1				5		5
3						0
6						0
9						0

SECTION C.2 - HEALTH HAZARD SUMMARIES OF REPORTED INGREDIENTS

1,2,4 - TRIMETHYL BENZENE (CAS# 95-63-6)

"Trimethylbenzene is a skin and respiratory irritant, and presumably would also be an eye irritant, in acute exposures. High levels in the air can cause CNS depression. It is an aspiration hazard and can presumably cause defatting dermatitis. It would appear that chronic exposures can produce signs of CNS effects at much lower levels than required in acute exposures. Chronic exposures may also affect the blood. Because of its effects on the nervous system and lungs, trimethylbenzene is in Class 3 (may cause irreversible effects which can be life-threatening) for general toxicity. It is in Class C (no data) for reproductive hazard. The human reproductive hazard is unknown. Note, however, that both BENZENE and XYLENE, with which it is structurally related, are unconfirmed human reproductive hazards. In general, substances which can cause neurological effects in adults have been linked with neurological defects in the unborn" (Dabney, 1992).

CUMENE (CAS# 98-82-8)

"Cumene is an irritant to the skin, eyes, nose, mouth, and throat. At higher acute exposures cumene can cause you to become dizzy, lightheaded, and to pass out. Chronic (long-term) health effects can occur at some time after exposure to Cumene and can last for months or years. According to the information presently available to the New Jersey Department of Health, Cumene has not been tested for its ability to cause cancer in animals nor for its ability to adversely affect reproduction. Long-term exposure can cause drying and cracking of the skin. Exposure may damage the lungs, liver, and kidneys. This chemical has not been adequately evaluated to determine whether brain or other nerve damage could occur with repeated exposure. However, many solvents and other petroleum-based chemicals have been shown to cause such damage. Effects may include reduced memory and concentration, personality changes (withdrawal, irritability), fatigue, sleep disturbances, reduced coordination, and/or effects on nerves supplying internal organs (autonomic nerves) and/or nerves to the arms and legs (weakness, "pins and needles") (Micromedex, Inc., 1993).

DIPROPYLENE GLYCOL METHYL ETHER (CAS# 34590-94-8)

"DPGME is relatively innocuous in humans except for irritation at exposures around or even below the TLV, with signs of CNS impairment becoming evident only at much higher levels. Because of the unconfirmed report that DPGME may be a sensitizer, it is in Class 2 (may cause irreversible effects generally not life-threatening) for general toxicity. It is in Class C (no data) for reproductive hazard. The actual human reproductive hazard is unknown. Persons who are sensitized should be excluded from further exposure" (Dabney, 1992).

ETHYL 3-ETHOXYPROPIONATE (CAS# 763-69-9)

"From its irritancy, ethyl-3-ethoxypropionate is in Class 1 (may cause reversible effects which are generally not life-threatening) for general toxicity and Class C (no data) for reproductive hazard. The human reproductive hazard is unknown. As with all chemicals, unnecessary exposure should be avoided" (Dabney, 1992).

KEROSENE, HYDROTREATED (CAS# 64742-47-8)

"Based on properties of similar substances, this product is in Class 3 (may cause irreversible effects which can be life-threatening) for general toxicity. It is in Class C (no data) for reproductive hazard. The human reproductive hazard is unknown" (Dabney, 1992).

NAPHTHA, HEAVY AROMATIC (CAS# 64742-94-5)

"Because this product probably contains some aromatic carcinogens, it is tentatively put in Class 3 (may cause irreversible effects which can be life-threatening) for general toxicity. It is in Class C (no data) for reproductive hazard. The human reproductive hazard is unknown. Naphtha in general has been linked with CNS defects from exposure during pregnancy. There seems to be a general association that substances which can cause CNS effects in adults have been associated with CNS defects in the unborn" (Dabney, 1992).

NAPHTHA, HEAVY, HYDROTREATED (CAS# 64742-48-9)

"Because of the hazard of aspiration, this product is in Class 3 (may cause irreversible effects which can be life-threatening) for general toxicity. It is in Class C (no data) for reproductive hazard. The actual human reproductive hazard is unknown" (Dabney, 1992).

NAPHTHA, LIGHT AROMATIC (CAS# 64742-95-6)

"Based on the properties of naphthas in general, this product is in Class 3 (may cause irreversible effects which can be life-threatening) for general toxicity. Because no reproductive data were found for this specific naphtha, it is in Class C (no data) for reproductive hazard. However, it should be functionally regarded as an A- (unconfirmed human reproductive hazard)" (Dabney, 1992).

NAPHTHA, MEDIUM ALIPHATIC SOLVENT (CAS# 64742-88-7)

"From the properties of naphtha in general, this product is in Class 3 (may cause irreversible effects which can be life-threatening) for general toxicity and Class C (no data) for reproductive hazard. Naphtha has been linked with CNS defects from exposure during pregnancy. There seems to be a general association that substances which can cause CNS effects in adults have been associated with CNS defects in the unborn" (Dabney, 1992).

NAPHTHALENE (CAS# 91-20-3)

"Naphthalene can affect you when breathed in and by passing through your skin. Exposure can irritate the eyes, nose and throat. Very high levels can cause headaches and nausea, damage the red blood cells, liver and kidneys and even cause death. Repeated exposure can cause clouding of the eye lens and damage vision. OSHA's legal airborne permissible exposure limit (PEL) is 10 ppm averaged over an 8-hour work shift. ACGIH's recommended airborne exposure limit is 10 ppm averaged over an 8-hour work shift and 15 ppm as a STEL (short term exposure limit). When skin contact also occurs, one may be overexposed, even though air levels are less than the limits listed above (Micromedex, Inc., 1993).

XYLENE (CAS# 1330-20-7)

"Xylene is an irritant and CNS depressant in acute exposures and can cause progressive and permanent effects on the nervous system from chronic exposures. It can also affect the heart and liver, and may have some activity by itself in causing anemia. Xylene is in Class 3 (may cause irreversible effects which may be life-threatening) for general toxicity because of its effects on the CNS. Because of the several reports of xylene being linked with birth defects and possibly menstrual disturbances, it is in Class A- (unconfirmed human reproductive hazard) for reproductive hazard. These effects cannot be attributed solely to xylene because of mixed or poorly documented exposures or failure to exclude genetic causes. In general there seems to be an association between neurological effects in adults and neurological defects in the unborn, but this has not been proven for xylene" (Dabney, 1992)

APPENDIX D

SUPPORTING DATA FOR GATE PERFORMANCE EVALUATIONS



Table D.1 - GATF - Equipment/Materials Used to Measure Blanket Wash Effectiveness

Press	Komori Two Color Press 20 x 26 inches equipped with a Komorimatic Continuous Dampening System (only one printing unit was used).
Blanket	Compressible
Ink	Process Cyan
Paper	70# Coated Stock
Dampening Solution	Signature Dampening Concentrate and Aquanol Alcohol Substitute both diluted to 4 ounces per gallon of tap water.
Various Blanket Washes	fourteen commercially available blanket washes
Control Solvent	VM&P Naphtha (Varnish Makers' and Painters' naphtha; petroleum fractions meeting ASTM specifications. Distillation range at 760mm Hg 5% at 130 degrees C; greater than 90% at 145 degrees C.)

Table D.2 - GATF - Equipment/Materials Used to Measure Blanket Swelling

Equipment and Materials	
1)	Crystallization Dish
2)	Cady Gauge +/- 0.0001 inch
3)	Swell Test Clamp
4)	2 x 2 inch squares of compressible blankets
5)	VM&P Naphtha (Varnish Makers' and Painters' naphtha; petroleum fractions meeting ASTM specifications. Distillation range at 760mm Hg 5% at 130 degrees C; greater than 90% at 145 degrees C.)
6)	Various Blanket Washes

TABLE D.3 - GATF Test Data, Effect on Blanket Roughness

Blanket #1 (control)				Blanket #2 (Prod. #1)			
Before Press Test		After Press Test		Before Press Test		After Press Test	
Grain #1	Grain #2	Grain #1	Grain #2	Grain #1	Grain #2	Grain #1	Grain #2
0.69	0.68	0.75	0.63	0.62	0.6	0.79	0.65
0.66	0.63	0.81	0.43	0.64	0.65	0.88	0.69
0.63	0.61	0.71	0.81	0.62	0.72	0.8	0.83
0.68	0.63	0.66	0.92	0.65	0.66	0.75	0.84
0.71	0.72	0.73	0.9	0.61	0.66	0.6	0.68

Blanket #3 (Prod. #2)				Blanket #4 (Prod. #3)			
Before Press Test		After Press Test		Before Press Test		After Press Test	
Grain #1	Grain #2	Grain #1	Grain #2	Grain #1	Grain #2	Grain #1	Grain #2
0.68	0.66	0.79	0.64	0.63	0.77	0.78	0.7
0.66	0.65	0.76	0.71	0.56	0.65	0.9	0.68
0.72	0.69	1.09	0.72	0.69	0.59	0.78	0.9
0.67	0.63	1.07	0.67	0.63	0.7	1.04	0.68
0.74	0.64	0.77	0.65	0.69	0.68	0.89	0.81

Blanket #5 (Prod. #4)				Blanket #6 (Prod. #5)			
Before Press Test		After Press Test		Before Press Test		After Press Test	
Grain #1	Grain #2	Grain #1	Grain #2	Grain #1	Grain #2	Grain #1	Grain #2
0.58	0.61	0.75	0.72	0.7	0.72	0.84	0.81
0.65	0.68	0.88	0.66	0.67	0.67	0.8	0.75
0.59	0.63	0.7	0.77	0.75	0.82	0.84	0.74
0.59	0.64	0.77	0.78	0.62	0.73	0.7	0.74
0.62	0.59	0.77	0.71	0.61	0.69	1.04	0.69

Blanket #7 (Prod. #6)				Blanket #8 (Prod. #7)			
Before Press Test		After Press Test		Before Press Test		After Press Test	
Grain #1	Grain #2	Grain #1	Grain #2	Grain #1	Grain #2	Grain #1	Grain #2
0.72	0.65	0.74	0.69	0.55	0.53	0.99	0.89
0.77	0.64	0.68	0.75	0.56	0.75	0.77	0.8
0.67	0.68	0.71	0.76	0.56	0.74	0.89	0.7
0.62	0.74	0.69	0.72	0.67	0.66	0.75	0.81
0.63	0.67	0.73	0.65	0.62	0.63	0.82	0.87

Blanket #9 (Prod. #8)				Blanket #10 (Prod. #9)			
Before Press Test		After Press Test		Before Press Test		After Press Test	
Grain #1	Grain #2	Grain #1	Grain #2	Grain #1	Grain #2	Grain #1	Grain #2
0.76	0.9	0.74	0.76	0.68	0.77	0.84	0.71
0.71	0.75	0.87	0.74	0.68	0.62	0.76	0.73
0.74	0.65	0.64	0.71	0.67	0.68	0.71	0.69
0.74	0.65	0.86	0.77	0.72	0.68	0.66	0.69
0.69	0.56	0.77	0.76	0.69	0.63	0.77	0.99

Blanket #11 (Prod. #10)				Blanket #12 (Prod. #11)			
Before Press Test		After Press Test		Before Press Test		After Press Test	
Grain #1	Grain #2	Grain #1	Grain #2	Grain #1	Grain #2	Grain #1	Grain #2
0.7	0.67	0.8	0.86	0.7	0.7	0.85	0.8
0.59	0.69	0.78	0.8	0.59	0.69	0.91	0.81
0.65	0.67	0.75	0.9	0.65	0.69	0.91	0.78
0.69	0.76	0.78	1.01	0.69	0.69	0.92	0.79
0.66	0.73	0.79	0.84	0.69	0.71	0.92	0.78

Blanket #13 (Prod. #12)				Blanket #14 (Prod. #13)			
Before Press Test		After Press Test		Before Press Test		After Press Test	
Grain #1	Grain #2	Grain #1	Grain #2	Grain #1	Grain #2	Grain #1	Grain #2
0.62	0.69	0.8	0.66	0.99	0.64	0.92	0.84
0.58	0.62	0.73	0.66	0.65	0.81	0.77	0.7
0.7	0.62	0.72	0.71	0.57	0.62	0.73	0.69
0.62	0.7	0.94	0.91	0.64	0.83	0.8	0.76
0.68	0.78	0.88	0.68	0.59	0.75	0.83	0.73

Blanket #15 (Prod. #14)				Blanket #16 (Prod. #15)			
Before Press Test		After Press Test		Before Press Test		After Press Test	
Grain #1	Grain #2	Grain #1	Grain #2	Grain #1	Grain #2	Grain #1	Grain #2
0.88	cnt read	0.7	0.84	0.73	0.71	0.77	0.84
0.69	cnt read	0.75	0.79	0.62	0.78	0.87	0.91
0.73	0.59	0.81	0.93	0.57	0.8	0.8	0.83
0.7	0.62	0.72	0.8	0.64	0.62	0.77	0.98
0.63	0.92	0.79	0.87	0.62	0.7	0.85	0.87

TABLE D.4 - GATF Test Data, Effect on Press Latitude

Control											
Water Setting	Ink Setting	Before Cleaning					After Cleaning				
		Solid Density			Dot Gain (%)	Comments	Solid Density			Dot Gain	Comments
2.5	2	1.33	1.3	1.33	21		1.31	1.36	1.22	21	
2	2	1.38	1.33	1.37	21		1.3	1.37	1.21	20	
1.5	2	1.39	1.44	1.42	19		1.37	1.42	1.27	21	slight scum
1	2	1.46	1.51	1.49	23		1.43	1.47	1.33	18	moderate scum
3	2	1.3	1.27	1.21	20		1.27	1.3	1.22	19	
4	2	1.38	1.41	1.33	22		1.23	1.22	1.22	20	
5	2	1.38	1.4	1.35	22		1.07	1.2	1.22	20	
6	2	1.32	1.36	1.3	21		1.05	1.19	1.24	20	
7	2	1.33	1.35	1.32	22		1.07	1.2	1.21	19	
8	2	1.3	1.3	1.28	21		1.05	1.15	1.2	23	
9	2	1.24	1.29	1.27	22		1.02	1.12	1.12	22	
10	2	1.28	1.31	1.28	21		0.98	1.12	1.13	19	

Product #1											
Water Setting	Ink Setting	Before Cleaning					After Cleaning				
		Solid Density			Dot Gain (%)	Comments	Solid Density			Dot Gain (%)	Comments
2.5	2	1.22	1.32	1.33	22		1.32	1.32	1.32	21	
2	2	1.38	1.43	1.41	24		1.37	1.38	1.31	22	
1.5	2	1.45	1.47	1.45	26		1.44	1.43	1.4	22	very slight scum
1	2	1.21	1.26	1.3	22		1.48	1.47	1.43	23	slight scum
3	2	1.22	1.26	1.31	23		1.39	1.38	1.34	22	
4	2	1.23	1.26	1.31	23		1.31	1.32	1.33	22	
5	2	1.24	1.28	1.3	23		1.29	1.33	1.31	23	
6	2	1.24	1.27	1.29	23		1.28	1.31	1.33	23	
7	2	1.28	1.31	1.3	21		1.27	1.29	1.29	20	
8	2	1.21	1.26	1.26	23		1.24	1.26	1.25	22	
9	2	1.17	1.21	1.22	23		1.23	1.25	1.24	22	
10	2	1.16	1.22	1.2	23		1.22	1.22	1.23	21	

Product #2												
Water Setting	Ink Setting	Before Cleaning					After Cleaning					
		Solid Density			Dot Gain (%)	Comments	Solid Density			Dot Gain	Comments	
2.5	2	1.34	1.35	1.33	24		1.3	1.28	1.33	22		
2	2	1.36	1.34	1.35	24		1.37	1.34	1.36	23		
1.5	2	1.46	1.41	1.39	23	very slight scumming	1.44	1.36	1.38	23	slight scumming	
1	2	1.49	1.42	1.45	27	moderate scumming	1.45	1.41	1.42	27	moderate scumming	
3	2	1.31	1.26	1.31	21		1.27	1.25	1.29	22		
4	2	1.3	1.23	1.32	23		1.26	1.22	1.3	23		
5	2	1.26	1.23	1.29	22		1.23	1.22	1.29	22		
6	2	1.27	1.2	1.29	23		1.25	1.21	1.28	20		
7	2	1.27	1.22	1.27	21		1.23	1.19	1.23	21		
8	2	1.16	1.13	1.21	23		1.21	1.17	1.25	22		
9	2	1.16	1.12	1.19	22		1.21	1.17	1.22	22		
10	2	1.14	1.13	1.2	23		1.14	1.11	1.11	19		

Product #3											
Water Setting	Ink Setting	Before Cleaning					After Cleaning				
		Solid Density			Dot Gain (%)	Comments	Solid Density			Dot Gain	Comments
2.5	2	1.34	1.31	1.32	20		1.32	1.28	1.3	21	
2	2	1.34	1.32	1.33	23		1.36	1.31	1.32	22	
1.5	2	1.42	1.39	1.36	24	slight scumming	1.43	1.38	1.37	23	slight scumming
1	2	1.4	1.41	1.37	22	moderate scumming	1.43	1.38	1.37	24	moderate scumming
3	2	1.29	1.27	1.27	21		1.28	1.24	1.26	19	
4	2	1.28	1.26	1.25	21		1.27	1.23	1.28	21	
5	2	1.23	1.2	1.22	19		1.26	1.23	1.26	21	
6	2	1.22	1.18	1.22	21		1.25	1.22	1.26	22	
7	2	1.22	1.2	1.22	22		1.26	1.21	1.24	20	
8	2	1.18	1.15	1.17	21		1.22	1.19	1.21	21	
9	2	1.16	1.12	1.14	22		1.15	1.14	1.17	19	
10	2	1.14	1.11	1.11	22		1.09	1.1	1.12	21	

Product #4											
Water Setting	Ink Setting	Before Cleaning					After Cleaning				
		Solid Density			Dot Gain (%)	Comments	Solid Density			Dot Gain	Comments
2.5	2	1.33	1.32	1.33	22		1.4	1.36	1.35	22	
2	2	1.41	1.37	1.36	22		1.4	1.37	1.34	23	
1.5	2	1.39	1.42	1.42	24	slight scumming	1.43	1.35	1.34	22	
1	2	1.42	1.39	1.39	34	severe scumming	1.5	1.44	1.43	23	slight scumming
3	2	1.23	1.22	1.25	22		1.32	1.31	1.32	22	
4	2	1.37	1.38	1.33	22		1.32	1.28	1.31	22	
5	2	1.28	1.28	1.31	23		1.28	1.29	1.3	22	
6	2	1.3	1.31	1.33	24		1.29	1.28	1.32	22	
7	2	1.31	1.29	1.33	21		1.36	1.35	1.34	22	
8	2	1.32	1.3	1.32	23		1.26	1.25	1.27	21	
9	2	1.37	1.37	1.34	23		1.19	1.19	1.18	21	
10	2	1.23	1.22	1.23	23		1.17	1.18	1.16	18	

Product #5											
Water Setting	Ink Setting	Before Cleaning					After Cleaning				
		Solid Density			Dot Gain (%)	Comments	Solid Density			Dot Gain	Comments
2.5	2	1.4	1.29	1.22	21		1.46	1.52	1.48	23	
2	2	1.42	1.37	1.31	21		1.49	1.56	1.54	24	
1.5	2	1.43	1.38	1.38	23	very slight scumming	1.52	1.6	1.59	23	slight scumming
1	2	1.44	1.4	1.37	28	moderate scumming	1.5	1.62	1.57	32	moderate scumming
3	2	1.33	1.25	1.21	22		1.38	1.44	1.39	24	
4	2	1.34	1.23	1.2	21		1.36	1.41	1.36	23	
5	2	1.34	1.27	1.21	23		1.32	1.37	1.33	23	
6	2	1.34	1.26	1.23	21		1.29	1.36	1.31	20	
7	2	1.3	1.28	1.23	22		1.28	1.37	1.33	21	
8	2	1.31	1.27	1.23	22		1.23	1.32	1.31	22	
9	2	1.26	1.21	1.16	22		1.17	1.26	1.24	19	
10	2	1.24	1.2	1.15	22		1.15	1.25	1.21	20	

Product #6											
Water Setting	Ink Setting	Before Cleaning					After Cleaning				
		Solid Density			Dot Gain (%)	Comments	Solid Density			Dot Gain (%)	Comments
2.5	2	1.4	1.36	1.3	22		1.3	1.31	1.23	20	
2	2	1.39	1.38	1.31	23		1.32	1.33	1.24	22	
1.5	2	1.45	1.42	1.36	24	slight scumming	1.41	1.41	1.3	23	slight scumming
1	2	1.45	1.44	1.37	25	moderate scumming	1.45	1.41	1.32	26	moderate scumming
3	2	1.28	1.29	1.24	20		1.29	1.29	1.23	21	
4	2	1.25	1.27	1.24	21		1.25	1.25	1.2	21	
5	2	1.27	1.28	1.25	23		1.22	1.21	1.21	22	
6	2	1.26	1.27	1.24	22		1.22	1.25	1.17	22	
7	2	1.26	1.26	1.21	22		1.21	1.23	1.2	20	
8	2	1.2	1.2	1.15	22		1.22	1.24	1.14	22	
9	2	1.19	1.2	1.14	22		1.21	1.22	1.18	21	
	2	1.2	1.18	1.15	21		1.17	1.18	1.13	20	

Product #7											
Water Setting	Ink Setting	Before Cleaning					After Cleaning				
		Solid Density			Dot Gain (%)	Comments	Solid Density			Dot Gain	Comments
2.5	2	1.31	1.33	1.22	20		1.32	1.35	1.27	23	
2	2	1.31	1.35	1.27	22		1.5	1.51	1.43	25	
1.5	2	1.37	1.4	1.32	23	slight scumming	1.55	1.57	1.49	26	slight scumming
1	2	1.38	1.4	1.34	28	moderate scumming	1.55	1.55	1.57	29	moderate scumming
3	2	1.27	1.29	1.25	22		1.34	1.37	1.32	20	
4	2	1.24	1.24	1.21	22		1.28	1.32	1.29	23	
5	2	1.22	1.24	1.22	22		1.28	1.3	1.29	23	
6	2	1.23	1.24	1.19	23		1.28	1.31	1.29	23	
7	2	1.23	1.25	1.22	22		1.3	1.31	1.28	23	
8	2	1.23	1.25	1.2	22		1.29	1.3	1.25	23	
9	2	1.2	1.21	1.16	20		1.24	1.26	1.21	22	
10	2	1.16	1.19	1.13	22		1.22	1.23	1.19	23	

Product #8											
Water Setting	Ink Setting	Before Cleaning					After Cleaning				
		Solid Density			Dot Gain (%)	Comments	Solid Density			Dot Gain	Comments
2.5	2	1.31	1.28	1.22	21		1.34	1.32	1.29	21	
2	2	1.32	1.32	1.25	22		1.4	1.33	1.31	23	
1.5	2	1.41	1.36	1.36	23	slight scumming	1.43	1.41	1.35	24	slight scumming
1	2	na	na	na	na	scumming/plugging	na	na	na	na	plugging/scumming
3	2	1.28	1.2	1.23	21		1.27	1.24	1.26	21	
4	2	1.24	1.19	1.2	22		1.27	1.22	1.25	22	
5	2	1.28	1.19	1.22	22		1.27	1.22	1.25	22	
6	2	1.27	1.2	1.23	22		1.27	1.21	1.27	22	
7	2	1.29	1.21	1.24	23		1.27	1.24	1.25	20	
8	2	1.25	1.18	1.2	22		1.3	1.24	1.23	21	
9	2	1.27	1.18	1.19	21		1.23	1.22	1.2	22	
10	2	1.22	1.14	1.12	21		1.2	1.19	1.15	22	

Product #9											
Water Setting	Ink Setting	Before Cleaning					After Cleaning				
		Solid Density			Dot Gain (%)	Comments	Solid Density			Dot Gain	Comments
2.5	2	1.34	1.3	1.27	21		1.35	1.32	1.3	20	
2	2	1.39	1.34	1.27	22		1.4	1.34	1.29	20	
1.5	2	1.39	1.34	1.27	22		1.41	1.36	1.32	24	
1	2	na	na	na	na	scumming/plugging	1.41	1.36	1.36	29	scumming/plugging
3	2	1.24	1.18	1.2	21		1.33	1.25	1.24	21	
4	2	1.22	1.18	1.21	19		1.28	1.22	1.24	21	
5	2	1.26	1.2	1.23	21		1.28	1.22	1.24	19	
6	2	1.22	1.17	1.2	20		1.27	1.21	1.24	21	
7	2	1.21	1.16	1.17	18		1.25	1.19	1.19	21	
8	2	1.21	1.16	1.18	18		1.23	1.16	1.17	21	
9	2	1.19	1.12	1.13	19		1.17	1.18	1.16	22	
10	2	1.17	1.09	1.1	20		1.16	1.11	1.1	21	

Product #10											
Water Setting	Ink Setting	Before Cleaning					After Cleaning				
		Solid Density			Dot Gain (%)	Comments	Solid Density			Dot Gain	Comments
2.5	2	1.32	1.32	1.27	22		1.31	1.27	1.21	21	
2	2	1.36	1.3	1.2	23		1.3	1.27	1.25	22	
1.5	2	1.44	1.36	1.32	23		1.4	1.35	1.3	23	slight scumming
1	2	na	na	na	na	scumming/plugging	na	na	na	na	severely plugged/scmd
3	2	1.24	1.2	1.2	21		1.22	1.2	1.18	22	
4	2	1.2	1.17	1.17	21		1.19	1.17	1.16	21	
5	2	1.17	1.16	1.16	21		1.18	1.19	1.18	22	
6	2	1.18	1.15	1.17	21		1.19	1.18	1.19	22	
7	2	1.2	1.16	1.17	21		1.18	1.17	1.21	22	
8	2	1.17	1.17	1.13	21		1.17	1.16	1.13	21	
9	2	1.14	1.12	1.1	20		1.15	1.12	1.12	21	
10	2	1.11	1.1	1.09	21		1.14	1.13	1.11	20	

Product #11											
Water Setting	Ink Setting	Before Cleaning					After Cleaning				
		Solid Density			Dot Gain (%)	Comments	Solid Density			Dot Gain	Comments
2.5	2	1.33	1.32	1.3	21		1.34	1.33	1.27	20	
2	2	1.33	1.36	1.29	22		1.34	1.35	1.3	21	slight scumming
1.5	2	1.45	1.39	1.36	22	slight scumming	1.34	1.35	1.35	22	slight scumming
1	2	na	na	na	na	scumming/plugging	na	na	na	na	scumming/plugging
3	2	1.3	1.28	1.28	21		1.17	1.19	1.17	20	
4	2	1.27	1.24	1.25	21		1.21	1.19	1.2	20	
5	2	1.26	1.26	1.26	21		1.2	1.19	1.19	20	
6	2	1.25	1.24	1.26	17		1.21	1.23	1.22	20	
7	2	1.27	1.24	1.24	21		1.24	1.2	1.2	21	
8	2	1.25	1.24	1.22	20		1.21	1.15	1.17	20	
9	2	1.2	1.18	1.17	21		1.14	1.11	1.13	20	
10	2	1.19	1.16	1.15	20		1.17	1.13	1.16	20	

Product #12											
Water Setting	Ink Setting	Before Cleaning					After Cleaning				
		Solid Density			Dot Gain (%)	Comments	Solid Density			Dot Gain	Comments
2.5	2	1.45	1.39	1.34	24		1.42	1.34	1.3	23	
2	2	1.49	1.43	1.38	24	very slight scumming	1.50	1.43	1.36	24	slight scumming
1.5	2	1.49	1.41	1.38	25	slight scumming	1.50	1.42	1.36	24	slight scumming
1	2	1.40	1.36	1.37	35	moderate scumming	completely scummed and plugged				
3	2	1.25	1.23	1.25	23		1.27	1.24	1.25	22	
4	2	1.26	1.21	1.23	22		1.33	1.31	1.29	23	
5	2	1.26	1.21	1.25	22		1.37	1.37	1.36	24	
6	2	1.24	1.19	1.19	22		1.35	1.33	1.31	23	
7	2	1.26	1.2	1.18	22		1.33	1.31	1.28	23	
8	2	1.21	1.17	1.14	22		1.31	1.28	1.25	21	
9	2	1.19	1.12	1.11	21		1.24	1.20	1.18	21	
10	2	1.16	1.12	1.11	20		1.21	1.18	1.16	22	

Product #13											
Water Setting	Ink Setting	Before Cleaning					After Cleaning				
		Solid Density			Dot Gain (%)	Comments	Solid Density			Dot Gain	Comments
2.5	2	1.35	1.35	1.30	22		1.30	1.30	1.22	21	
2	2	1.41	1.36	1.37	23		1.39	1.32	1.28	21	
1.5	2	1.38	1.35	1.39	26	slightly scummed	1.38	1.31	1.24	22	slightly scummed
1	2	completely scummed and plugged					completely scummed and plugged				
3	2	1.14	1.18	1.16	22		1.24	1.21	1.20	21	
4	2	1.16	1.16	1.16	21		1.21	1.19	1.19	21	
5	2	1.18	1.16	1.14	20		1.21	1.18	1.16	21	
6	2	1.20	1.16	1.18	22		1.20	1.18	1.16	21	
7	2	1.19	1.19	1.20	22		1.21	1.19	1.17	21	
8	2	1.21	1.18	1.18	21		1.17	1.16	1.12	19	
9	2	1.22	1.18	1.16	21		1.15	1.10	1.09	21	
10	2	1.18	1.12	1.10	21		1.13	1.09	1.08	20	

Product #14											
Water Setting	Ink Setting	Before Cleaning					After Cleaning				
		Solid Density			Dot Gain (%)	Comments	Solid Density			Dot Gain	Comments
2.5	2	1.30	1.23	1.20	22		1.30	1.25	1.20	21	
2	2	1.31	1.31	1.21	22		1.34	1.28	1.22	22	
1.5	2	1.39	1.27	1.31	24	slight scumming	1.39	1.32	1.27	23	
1	2	completely scummed and plugged					completely scummed and plugged				
3	2	1.20	1.17	1.15	20		1.30	1.28	1.27	22	
4	2	1.18	1.16	1.15	21		1.35	1.34	1.31	23	
5	2	1.18	1.15	1.18	22		1.37	1.36	1.36	20	
6	2	1.20	1.15	1.18	22		1.37	1.33	1.33	24	
7	2	1.15	1.12	1.12	22		1.27	1.31	1.32	21	
8	2	1.21	1.15	1.14	22		1.21	1.26	1.26	22	
9	2	1.14	1.11	1.09	20		1.18	1.22	1.21	23	
10	2	1.19	1.14	1.10	20		1.21	1.16	1.16	23	

Product #15											
Water Setting	Ink Setting	Before Cleaning					After Cleaning				
		Solid Density			Dot Gain (%)	Comments	Solid Density			Dot Gain	Comments
2.5	2	1.41	1.30	1.26	22		1.40	1.37	1.34	24	
2	2	1.40	1.33	1.26	23		1.47	1.43	1.37	25	
1.5	2	1.43	1.35	1.31	23		1.45	1.40	1.35	25	slight scumming
1	2	completely scummed and plugged					1.45	1.39	1.34	24	moderate scumming
3	2	1.23	1.19	1.20	21		1.31	1.29	1.28	23	moderate scumming
4	2	1.22	1.18	1.19	23		1.27	1.26	1.27	22	
5	2	1.21	1.19	1.20	22		1.26	1.23	1.23	22	
6	2	1.22	1.19	1.22	22		1.26	1.22	1.22	21	
7	2	1.22	1.19	1.21	22		1.24	1.21	1.20	21	
8	2	1.22	1.18	1.14	21		1.23	1.18	1.18	21	
9	2	1.19	1.12	1.11	21		1.20	1.15	1.14	21	
10	2	1.14	1.11	1.09	20		1.19	1.14	1.14	17	

TABLE D.5 - GATF TEST DATA, CLEANING EFFECTIVENESS

Graphic Arts Technical Foundation Pressman Evaluation of Blanket Washes													
Ability to Cut Ink		Adequacy of Standard Volume		Lubricating Properties		Ease of Drying		Odor		Rollup		Clean Time	
Score	Product	Score	Product	Score	Product	Score	Product	Score	Product	Sheets	Product	Seconds	Product
10	2	10	naphtha	10	2	10	naphtha	1	15	9	15	29	2
10	5	9	5	9	1	10	1	1	5	11	6	30	5
10	13	9	7	9	5	10	2	1	2	11	12	34	13
10	14	9	12	9	7	10	7	2	12	11	13	35	14
9	3	8	2	9	8	9	3	2	8	12	3	35	3
9	7	8	8	9	9	9	6	2	4	13	11	35	7
9	8	8	13	8	4	9	8	2	1	14	4	35	8
8	1	8	14	8	11	9	12	2	naphtha	14	7	36	1
8	4	7	3	8	14	9	13	3	14	17	2	36	4
8	6	7	4	8	15	9	14	3	9	17	14	38	6
8	9	7	6	7	3	8	4	4	7	18	naphtha	38	9
8	12	7	9	7	6	8	5	5	13	18	1	38	12
8	15	7	11	7	12	8	11	6	3	18	5	44	15
7	11	6	15	7	13	8	15	8	11	18	9	60	11
6	naphtha	4	1	3	naphtha	5	9	9	6	19	8	60	naphtha

TABLE D.6 - GATF Test Data, Effect on Blanket Swelling

Product No.	Exposure Time/Percent Swell		
	One Hour	Four Hours	After 24 hours not exposed
1	0.0	0.3	0.0
2	0.9	1.8	0.9
3	0.1	0.6	0.6
4	0.6	1.1	0.0
5	0.6	1.1	0.3
6	2.6	4.0	2.3
7	2.2	3.5	0.0
8	0.9	0.9	0.9
9	2.0	2.3	1.1
VM&P NAPHTHA	0.3	0.5	0.0
11	0.6	1.9	0.0
12	1.9	3.1	0.8
13	0.7	1.9	0.6
14	0.6	2.6	1.3
15	1.3	1.3	0.0

APPENDIX E

**SUPPORTING DATA FOR WALDORF CORP.
PERFORMANCE EVALUATIONS**

Table E.1 - Waldorf Corp. - Equipment/Materials Used to Measure Blanket Wash Effectiveness

Press	Planeta 55 inch seven unit press
Blanket	Compressible; blanket to plate squeeze = .004
Ink	Process Yellow, Magenta, Cyan, and Black, and one custom offset; ink form roller setting - 5/16 in. to vibrator; 1/4 in. to plate.
Paper	20 to 22 caliper; 78 lbs/1000sf.; 70% recycled/30% SBS; max sheet size = 39.75 by 55 in.
Dampening Solution	dampening solution diluted to 3 ounces per gallon tap water;
Various Blanket Washes	fourteen commercially available blanket washes
Control Solvent	VM&P Naphtha (Varnish Makers' and Painters' naphtha; petroleum fractions meeting ASTM specifications. Distillation range at 760mm Hg 5% at 130 degrees C; greater than 90% at 145 degrees C.)

TABLE E.2 - Waldorf Test Data, Cleaning Effectiveness

Product #1							Product #2						
Performance Category	Station Number						Performance Category	Station Number					
	2(bp)	3(jr)	4(jr)	5(bp)	6(cc)	7(cc)		2(ba)	3(bd)	4(bd)	5(ba)	6(aj)	7(aj)
Ability to cut ink	2	3	3	2	3	3	Ability to cut ink	2	1	1	1	1	1
Lubricity	2	3	3	2	3	3	Lubricity	1	1	1	1	1	1
Ease of drying	2	2	2	2	3	3	Ease of drying	2	1	1	2	2	2
Adequacy of std vol	2	3	3	2	3	3	Adequacy of std vol	2	2	2	1	2	2
Odor	3	2	2	3	3	2	Odor	2	1	1	2	1	1
Revolutions to clean	2	3	3	2	5	4	Revolutions to clean	7	4	3	2	3	2
Revolutions to dry	2	2	2	2	2	2	Revolutions to dry	3	2	2	2	2	2
Comments	rollup = 35 sheets; 5,000 impressions;						Comments	rollup = 46 sheets; 5,000 impressions					
Product #3							Product #4						
Performance Category	Station Number						Performance Category	Station Number					
	2(ba)	3(ms)	4(ms)	5(bd)	6(bd)	7		2(ba)	3(bd)	4(ms)	5(ms)	6(aj)	7(aj)
Ability to cut ink	2	2	2	1	1	na	Ability to cut ink	1	1	1	1	2	2
Lubricity	3	2	2	1	1	na	Lubricity	2	3	2	2	3	3
Ease of drying	na	3	2	1	1	na	Ease of drying	2	2	3	3	3	3
Adequacy of std vol	1	2	2	2	2	na	Adequacy of std vol	1	2	1	1	2	2
Odor	2	2	2	1	1	na	Odor	1	1	1	1	2	2
Revolutions to clean	10	8	na	4	5	na	Revolutions to clean	6	4	7	7	3	2
Revolutions to dry	3	2	na	2	2	na	Revolutions to dry	3	3	2	2	2	2
Comments	rollup = 30 sheets; 5000 impressions						Comments	rollup = 65 sheets; 5000 impressions					

Product #5						
Performance Category	Station Number					
	2(mb)	3(mb)	4(jr)	5(mb)	6(cc)	7(cc)
Ability to cut ink	3	3	1	1	3	2
Lubricity	3	3	1	1	1	1
Ease of drying	2	2	1	1	2	2
Adequacy of standard volume	3	2	2	2	2	1
Odor	1	2	1	1	1	1
Revolutions to clean	4	3	2	2	4	2
Revolutions to dry	2	2	2	2	2	2
Comments	Rollup = 40 sheets; 5,000 impressions					

Product #6						
Performance Category	Station Number					
	2(jr)	3(jr)	4(mb)	5(mb)	6(cc)	7(cc)
Ability to cut ink	3	3	2	2	3	2
Lubricity	3	3	1	1	2	2
Ease of drying	na	na	2	2	1	1
Adequacy of standard volume	na	na	2	2	3	2
Odor	2	2	1	1	2	2
Revolutions to clean	4	3	3	2	4	2
Revolutions to dry	na	na	2	2	1	1
Comments	rollup = 50 sheets; 5,220 impressions					

Product #7						
Performance Category	Station Number					
	2(jr)	3(jr)	4(mb)	5(mb)	6(mb)	7(jr)
Ability to cut ink	1	1	1	1	1	1
Lubricity	1	1	2	2	1	1
Ease of drying	1	1	1	1	1	1
Adequacy of standard volume	1	1	2	2	2	1
Odor	1	1	1	1	1	1
Revolutions to clean	3	2	2	2	2	2
Revolutions to dry	1	1	2	2	2	1
Comments	rollup = 12 sheets; 5,000 impressions					

Product #8						
Performance Category	Station Number					
	2(jr)	3(jr)	4(mb)	5(mb)	6(cc)	7
Ability to cut ink	3	3	2	2	3	na
Lubricity	1	1	1	1	2	na
Ease of drying	2	2	2	2	1	na
Adequacy of standard volume	2	2	2	2	3	na
Odor	1	1	1	1	2	na
Revolutions to clean	3	3	3	3	4	na
Revolutions to dry	2	2	2	2	1	na
Comments	rollup = 35 sheets; 5,000 impressions					

Product #9							Product #10						
Performance Category	Station Number						Performance Category	Station Number					
	2(jr)	3(jr)	4(mb)	5(mb)	6(cc)	7(cc)		2(ba)	3(bd)	4(bd)	5(aj)	6(aj)	7
Ability to cut ink	3	3	2	2	2	1	Ability to cut ink	1	1	1	1	1	na
Lubricity	1	1	1	1	1	1	Lubricity	2	3	3	3	3	na
Ease of drying	2	2	3	3	3	3	Ease of drying	2	1	1	3	3	na
Adequacy of standard volume	3	2	1	1	2	2	Adequacy of standard volume	1	2	2	2	2	na
Odor	1	1	3	3	3	3	Odor	2	2	2	3	3	na
Revolutions to clean	3	3	3	3	4	2	Revolutions to clean	3	3	3	2	2	na
Revolutions to dry	2	2	3	3	2	3	Revolutions to dry	2	1	1	1	1	na
Comments	rollup = 23; 5,000 impressions						Comments	rollup = 15 sheets; not enough cleaner for station 7					

Product #11							Product #12						
Performance Category	Station Number						Performance Category	Station Number					
	2(ba)	3(ms)	4(ms)	5(bd)	6(bd)	7(bd)		2(ba)	3(ms)	4(ms)	5(ms)	6(aj)	7(aj)
Ability to cut ink	1	1	1	1	1	1	Ability to cut ink	1	1	1	1	1	1
Lubricity	1	1	1	1	1	1	Lubricity	1	1	1	1	2	2
Ease of drying	2	1	1	1	1	1	Ease of drying	1	1	1	1	2	2
Adequacy of standard volume	2	2	2	1	1	1	Adequacy of standard volume	1	2	2	2	2	2
Odor	2	1	1	1	1	1	Odor	2	3	3	3	2	2
Revolutions to clean	2	2	2	1	1	1	Revolutions to clean	2	3	3	3	2	2
Revolutions to dry	2	2	2	1	1	1	Revolutions to dry	2	2	2	2	2	2
Comments	rollup = 15 sheets; 5,000 impressions; bd really liked it!						Comments	rollup = 30 sheets; 5,000 impressions					

Product #13							Product #14						
Performance Category	Station Number						Performance Category	Station Number					
	2(ba)	3(bd)	4(bd)	5(ba)	6(aj)	7(aj)		2(bp)	3(jr)	4(jr)	5(mb)	6(mb)	7(cc)
Ability to cut ink	1	1	1	1	2	2	Ability to cut ink	2	1	1	1	1	2
Lubricity	2	2	2	2	2	2	Lubricity	2	1	1	1	1	2
Ease of drying	1	2	2	1	1	1	Ease of drying	2	2	1	1	1	2
Adequacy of standard volume	1	2	2	1	2	2	Adequacy of standard volume	3	2	2	2	2	2
Odor	2	1	1	2	2	2	Odor	3	2	2	1	1	2
Revolutions to clean	2	2	2	2	2	2	Revolutions to clean	2	2	2	2	2	2
Revolutions to dry	2	2	2	2	1	2	Revolutions to dry	1	2	2	2	2	1
Comments	no rollup; end of order						Comments	rollup = 21 sheets;					

Product #15						
Performance Category	Station Number					
	2(bp)	3(jr)	4(jr)	5(mb)	6(mb)	7(mb)
Ability to cut ink	1	1	1	1	3	2
Lubricity	1	1	1	1	2	2
Ease of drying	1	1	1	1	1	2
Adequacy of standard volume	2	2	2	1	1	1
Odor	2	2	2	3	3	3
Revolutions to clean	2	2	2	2	4	2
Revolutions to dry	1	2	1	2	2	2
Comments	rollup = 20 sheets;					

TABLE E.3 - Waldorf Corp. Blanket Wash Questionnaire

Note: Please indicate your rating of the product in each of the six categories below by placing an "X" next to the rating that most accurately reflects your judgement of the product's performance. For question 6, please record the time required to clean the blanket (seconds).

PRODUCT NUMBER _____ (1 - 15)

STATION NUMBER _____ (1 - 7)

1. How well did the product cut the ink?

Good _____

Fair _____

Poor _____

2. Ease of application (i.e., is the product sufficiently lubricated?)

Good _____

Fair _____

Poor _____

3. How would you characterize the products ability to dry?

Good _____

Fair _____

Poor _____

4. Did you have enough solvent to clean the blanket?

Yes, more than enough _____

Yes, just barely enough _____

No _____

5. What did you think of the odor?

Good _____

Fair _____

Poor _____

6. How many revolutions were required to clean the blanket? to dry the blanket?

Revolutions to clean _____

Revolutions to dry _____