

SOLVENT SUBSTITUTION TO REDUCE AIR EMISSIONS FOR THE FRP INDUSTRY

**A WASTE REDUCTION STUDY
FUNDED THROUGH A NORTH CAROLINA
POLLUTION PREVENTION PAYS CHALLENGE GRANT**

**REPORT SUBMITTED BY DOUGLAS J. HOFFMAN
GRADY WHITE BOATS INC.
GREENVILLE, NORTH CAROLINA**

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OVERVIEW

Grady-White Boats builds fiberglass sportfishing boats ranging from 17¹ to 28¹ in length in its facility located in Greenville, North Carolina. This facility, covering 300,000 square feet, was designed specifically to build open molded fiberglass boats. During the building process of these fiberglass parts workers use numerous hand tools to spread the glass and resin smoothly in the laminate structure. These tools must be cleaned periodically to keep the resin from curing on the tool and making the tool ineffective. Acetone has been widely used in this industry for cleaning tools, and has been used at Grady-White for many years. Current air toxics emissions regulations and the problems concerning worker exposure to health hazards, cost of disposal of hazardous waste and flammability have caused Grady-White to look for an alternative to the use of acetone.

Acetone usage at this facility seemed to be excessive to management personnel. Quantities in excess of 250 gallons per day were being used on the average during 1990. This quantity of acetone not only contributed to the fire hazards within the plant but also contributes significantly to the total VOC emissions from this facility due to evaporation. The acetone, that does not evaporate is recovered and distilled and is recycled through the facility, but the acetone still bottoms become a hazardous waste, the only hazardous waste produced by this facility. After having looked at water-based resin emulsifiers as a substitute for acetone and found them to be very cumbersome, a different solution to this problem was needed. DBE, manufactured by Du Pont, was one of the first cleaning substances marketed as a substitute for acetone which was brought to the attention of Grady-White Management. Grady-White applied to the North Carolina Pollution Prevention Pays Program for a challenge grant to study DBE as an acetone substitute. During the time that this study concerning DBE and acetone was taking place, a number of other possible acetone substi-

tute solvents became available to the FRP industry. Some test results for these other solvents have been included in this study, although the emphasis of the information provided will be on the DBE solvent. Other products that were tested included Shipshape Resin Cleaner made by GAF Corporation, Propylene Carbonate, which was manufactured by ARCO Chemical, Tipsolve II, which is manufactured by Prillaman Chemical Corporation, SVC-12 manufactured by Silicon Valley Chem Labs, inc. and Butyl Cellusolve manufactured by Union Carbide. Butyl Cellusolve, although it works, could not be distilled on site and was discounted from further testing. SVC-12 works, but does not work well and was subsequently eliminated. All of these solvents have similar characteristics and they dissolve more resin than acetone does before they become sticky and unusable. Due to the low volatility, they leave a liquid film on hands and tools, which must be shaken off before returning to work on the parts. More information on this is included later in other sections of this report.

The purpose of this report is to supply information to users of acetone or other volatile organic solvents so that they may decide for themselves the replacement solvent that is suitable for their use. This report in no way favors one solvent manufacturer or another, it only points to which solvent would be best suited in our particular application. All users of these or any other solvents must test their solvents under their own specific conditions to see if they are usable, cost-effective and practical for their use.

SOURCE OF THESE SOLVENTS

Acetone has always been the premier solvent for polyester resin cleanup. However, due to environmental and safety reasons, the need arose for new solvent systems that could replace acetone on a better cost and performance basis, and certainly better overall safety as relating to low toxicity, flash point and environmental concerns.

Du Pont's Dibasic Ester (DBE) is a blend of the refined dimethyl esters of succinic, glutaric, and adipic acids (all naturally occurring acids). In the production of Nylon, an intermediate product is produced called adipic acid, it is from the production of adipic acid that DBE has its genesis. A stream is split off in this production referred to as the DBA (dibasic acid) stream. DBE is manufactured to tight specifications controlling water, methanol and acid content at low levels. This material is then esterified with methanol producing the methyl ester analogs of the diacids.

Du Pont produces DBE in three locations within North America; Orange and Victoria, Texas, and Maitland, Canada. DBE is sold on a global basis with sales to all the major countries in the world at present. There is sufficient production capacity presently in place to supply the total needs of this industry several times over. Since DBE comes out of the production of Nylon, in order for the production of DBE to be negatively affected the demand for Nylon would have to disappear.

DBE was first introduced in the mid-1970's and saw rapid commercial acceptance in three functional areas:

* as a solvent, plasticizer, or reaction medium for

automotive
refinish
OEM acrylic enamels

textile lubricants
magnetic memory disc coatings
pesticide carriers

Pyrrolidone-based chemicals, such as GAF's "ShipShape and Prillaman's "Tipsolve II" can perform many of the tasks of solvents being phased out. M-Pyrol-based chemicals have been widely used for many years as solvents by producers of petrochemicals, gases, chemicals and agricultural chemical adjuvants. They have also long been in use as cleaning solvents in many industries.

Pyrrolidone derivatives are widely used in treatment of animal illnesses, personal care products, surgery and preparation of alcoholic beverages. During its 30-year history, this chemistry has been fully analyzed and proven to have minimal environmental impact. M-Pyrol solvents have a low order of toxicity and are neither carcinogenic, mutagenic or teratogenic. Being 95% reclaimable, they impose no heavy economic burdens.

GAP Chemicals Corporation has invested millions of dollars in an on-going research program to examine the use of pyrrolidone-based solvents as alternative cleaners for industries now facing the replacement of CFC's, acetones, ketones, chlorinated hydrocarbons and other cleaners. The studies show that by treating each industry as a unique chemical and marketing situation, many viable replacement cleaners can be developed and offered. Potential applications exist in paint removing, precision cleaning of electronic parts, metal degreasing, cleaning fiberglass and polymer resin fabrication tools, cleaning equipment and many others.

Prillaman Chemical has developed Tipsolve II, a new M-Pyrol-based solvent system available to the fiberglass industry. Tipsolve II also has a low order of toxicity, high flash point and the ability to hold two to three times as much resin before becoming sticky and unusable. it is distillable and can be reused.

Propylene Carbonate has been used as an additive for clay gellants that are widely used as bases for anti-perspirant, lip-sticks, skin cleansers, eye shadow, mascara, hair conditioners and other cosmetic products for many years. Cosmetic products containing up to 20% propylene carbonate were essentially non-sensitizing and at most, moderately irritating to human skin, non-phototoxic and non-photosensitizing. It has been determined that propylene carbonate is safe as a cosmetic ingredient and consequently, if proper precautions are taken, would be safe as a solvent for use in the fiberglass industry.

USE OF THESE SOLVENTS IN THE FRP SHOP

One very important advantage is using these solvents in your fiberglass shop is the fact that they are solvents, not detergents or surfactants as are water-based emulsifiers. These solvents, since they handle the cleanup of resin like acetone does, by dissolving it, can be used in most areas where cleanup is necessary.

DBE BENEFITS

Compared to acetone, DBE is safer to handle and is an environmentally acceptable alternative.

DBE does not evaporate as quickly as acetone. In fact, the amount of acetone that is lost in 80 sets. to evaporation would take 57,600 sets. with DBE. This fact has several advantages to you in your shop:

- * larger buckets of material can be used at one time in your operation
- * with the DBE staying around to do the work, you can dissolve more resin per unit volume of solvent than was possible with acetone
- * so little DBE is vaporizing during use that there is a vast reduction in your VOC number for your operation
- * cost-effectiveness of DBE is high because it can be recycled
- * state air and water quality agencies recognize the value of diminished VOC's

DBE is extremely compatible with the basic resin polyester resin system. As was seen earlier, DBE has been used for years as an intermediate for resins. This fact has several advantages to you in your shop:

- * DBE film remaining on your rollers and brushes will not be detrimental to your laminate

- * it is not necessary to remove 100% of the DBE material from rollers and brushes
- * if there is a local region in the bed that has a high concentration of DBE, it will not tend to form blistering
- * DBE will not prevent the cure process from your laminate bed
- * DBE can be used in a multitude of operations - in gun, on tools, and some general cleaning applications

SHIPSHAPE RESIN CLEANER BENEFITS

Shipshape evaporates 200 times slower than acetone which lowers VOC emissions. it is easily reclaimable using a vacuum distillation with at least 90% yield of material which was distilled. This lowers make-up solvent cost by allowing you to use it over and over again. No heating is required as with water-based emulsifiers. This saves time and energy. Shipshape is non-flammable, treating a safer work environment and possibly lowering insurance premiums.

"TIPSOLVE II" BENEFITS

"Tipsolve II" is a new blend of products that are user-friendly and environmentally safe offering the end user the following benefits:

- i. Low order of toxicity - 5 g/kg (rat); practically non-toxic
2. High flash point - 275 deg. F. (P. M. C. C.)
3. Recyclable
4. Lower VOC emissions

5. Less expensive than acetone solvents
 - a. less solvent lost to evaporation
 - b. greater percentage of solvent retained for recycling
 - c. lower overall cost on equipment for VOC reduction
 - d. less governmental red tape
 - e. save by reducing insurance cost
6. Safer
 - a. higher flash point than acetone (less of a fire hazard)
7. Several sources
8. Manufactured to a specification - it is not a by-product stream
9. Requires less equipment/tools than water-based systems
10. is resin compatible - will not inhibit polymerization

"Tipsolve II" has been formulated to function primarily as a cleanup solvent for the removal of polyester, polystyrene and vinyl-ester resins from equipment such as brush, rollers and gloves used in the manufacture of fiberglass products.

Due to the innocuous nature of the product and the high flash point, "Tipsolve II" may be used in spray, curtain, dip or wipe applications. The material may be heated before use to increase evaporation rate or it may be facilitated by the use of a hot air spray or by steam if desired. However, it is not required. "Tipsolve II" will not inhibit polymerization reactions and can be used as a coalescing aid in paint formulations to improve color, gloss and adhesion. However, do not overload the resin as "Tipsolve II" evaporation will appear to retard the cure time.

Due to the low order of toxicity associated with "Tipsolve II", it is easy to forget it is an organic solvent. As with all organic solvents safety glasses, gloves and proper ventilation is required when using this product.

"Tipsolve II" must be kept clean. As residue builds up in the solvent, drippage will appear as spots on the work.

TOOL CLEANUP

DBE is effective in its cleaning of rollers and brushes in the lay-up area of the plant. Several facts should be known about DBE:

- * it will leave a film on rollers and brushes since it does not evaporate like acetone does. However, this actually is not a problem due to DBE's basic compatibility with the FE resin laminate. A study has been done that shows if less than 1% (by weight) of DBE contaminates the laminate bed the physical properties will actually slightly improve. There are ways to handle this film -
 - you may allow the brushes and rollers to drain into a bucket while a second set is being used
 - you can tap off the rollers over a collection bucket and "wring" out the brushes in the same bucket
 - you could wipe down the handles of both with rags
 - you can blow off the residual DBE with an OSHA approved air nozzle (30 psi) and collect in a bucket for reuse
- * because of the film, the roller and brush handles will feel slipperier than with acetone. Only a short period of time is necessary to get the "feel" of working with DBE. Companies that have been using DBE say that it is not difficult to learn to deal with.

Tips for effective use:

- k Because there is a reduced evaporation, larger mouth containers can be used. This allows easier access to the solvent and in the long run improves housekeeping. However, this **container** should have a lid

system for non-use periods. DBE will evaporate slowly, but it will still evaporate some, a lid system will prevent this loss.

- * Drill small holes along the metal base of the brushes to allow the DBE to drain freely after use.
- * install a collection sink (a fiberglass one from the local hardware is fine) and drop a 30 psi air line/nozzle to it. You can then blow off the rollers and brushes and collect the residual DBE for reuse.
- * While it is not theoretically necessary, installing a brush in the bottom or side of the solvent tank does tend to speed up the resin removal process.
- * Watch for sticky rollers - this will be one sign when the DBE solvent is getting too loaded with resin to effectively clean further.

PROCESS EQUIPMENT

CHOPPER GUNS

DBE can be used to clean chopper guns, both internally and externally. Clean the resin out of the gun just like the procedure used with acetone; the solvent should be purged into a reservoir. DBE is not detrimental to any of the metals used by the gun manufacturers of today. In addition, the DBE will not be harmful to the large rubber roller used to cut against. This external cleaning of the gun with DBE actually serves to protect the surface with the film that is left behind. In addition, the hoses can be cleaned with DBE safely.

-- Check the section on material compatibility --

GEL COAT GUNS

DBE can be used to clean out gel coat gun systems; internal and external. DBE is just as effective in dissolving most gel coats as it is with resins. It is easier to clean pressure-up systems than it is to clean hot pot systems.

Tips with gel systems:

- * Use a two container collection system. In the first container shoot the first gallon of solvent and gel. In a second container collect the next 1-2 gallons. This second container will be mostly solvent. This, in many plants, is being used as the initial one gallon flush next time. The two container system also allows more effective recover of the DBE solvent.
- * With a hot pot system a slightly different cleaning technique is required. Here it will depend on how much hose length is being used. For effective cleaning, the hose should be segmentable in no longer than 10 ft. sections. For instance, if you were using 30 ft. of hose, there would be three 10 ft.

sections of hose connected by quick disconnect connectors. This will allow short enough lengths to be cleaned effectively.

- * Some manufacturers soak the gun tips in a small dish of DBE in between uses.
- * Clogged tips can be cleaned by soaking overnight in DBE (covered container) and then mechanically cleaned with brushes and probes.

PRESSURE ROLLER SYSTEMS

DBE has proven to be very effective in flushing out pressure roller systems. DBE has shown to be safe with the felt roller material and the plastic backing. the following procedure can be followed for effective cleaning:

- * after rolling the resin, disconnect the resin line and connect the DBE solvent line.
- * flush DBE through the line and resin delivery roller. When felt to be clean, hand squeegee out the felt roller into the collection bucket.
- * reconnect the resin line and begin to flow resin to the roller.
- * roll out the roller onto cardboard just as you did with acetone. Until you are used to the effect of DBE, roll out as many times as you would have with acetone and then roll it once or twice more before going to the laminate.
- * one manufacturer found that with acetone, it took him 5 gallons to do this job. To get the same degree of cleanliness with DBE it took him 1.5 qts., a dramatic reduction in the solvent volume.

MISCELLANEOUS CLEANING SOLUTIONS

DBE is an extremely effective general cleaning solvent for the fiberglass shop. Many of Du Pont's customers have identified additional uses for the DBE. These applications include:

FLOOR CLEANER

One manufacturer has found that the tar paper that is used to protect and cover the floor during processing gets soaked with DBE as the day goes on. While this is a potential source of VOC emissions and every effort should be used to minimize this, it is effective in removing some of the resin and general dirt that has built up on the floors with time.

PUMP CLEANER

DBE has slight lubricity characteristics. This means that greater service life can be obtained from pump diaphragms and seals. Many shops are finding that they can get many more weeks before tear down and this reduced the work load on the plant's maintenance workers.

Even though DBE is not designed to remove cured fiberglass, one company is using DBE to soak torn down pumps in and then using it to flush in the mechanical cleaning process.

IN-LINE FILTER CLEANER

Several companies are using DBE to clean the in-line filter located between the process molds and the storage tanks. DBE effectively cleans them and keeps them well coated, preventing corrosion. The film that is left behind is compatible with the resin so only minor care needs to be taken in removing it.

SURFACE WIPE DOWN CLEANER

Several boat manufacturers are using DEE as a surface wipe down agent just before the product is released for sale. While DBE does leave a slippery film, there is enough water solubility with DBE to allow the following procedure:

- * wipe down dirty surface with DBE on rags
- * spray the cleaned surface with water from a spray bottle
- * vacuum up the water with a shop-n-vac. The water sprayed on the surface will carry the residual DBE with it.
- * wipe the surface with a clean, dry rag

SAFETY SECTION

TWO POTENTIAL HAZARDS WITH DBE

- * CONTACT INDUSTRIAL DERMATITIS
- * POTENTIAL FOR BLURRED VISION

CONTACT INDUSTRIAL DERMATITIS

DBE is comprised of dimethyl esters. This material obeys the chemistry of the ester family. This means that if there is prolonged contact with the liquid, it is possible to develop a reversible condition of slight inflammation and swelling. it is believed that this is caused by the water on the skin reacting with esters to hydrolyze it to the half-acid format. in doing this, the proper environment is set up to create the condition. In all cases that have been observed, this condition has been only temporary and completely reversible.

There may be some long term operators in this industry who have become sensitized to chemicals. These operators may be especially sensitive and gloves will need to be worn.

There are some precautions to follow to eliminate this condition:

- * use gloves when using DBE. Gloves should have been worn with acetone too.
However, it seems that some people in this industry did not wear gloves with acetone and many cases of skin defatting have occurred.
- * use a hand care program for the employees. While the wearing of gloves will prevent direct contact with the liquid, this can also leave the hands clammy and a good hand treatment program will go a long way to help the employees.

* pay close attention to the type of glove that is being worn. An improper glove will give the illusion of protection, but in reality allow migration of DBE across the membrane barrier. When this occurs, it is one of the worst possible conditions - DBE will be trapped against the skin for prolonged periods.

| | |
|----------------|--|
| gloves to use: | Butyl rubber PVA (Polyvinyl alcohol) Nitrile rubber (for a limited period of time only; <45 min.) |
|----------------|--|

| | |
|------------------|-------|
| gloves to avoid: | Latex |
|------------------|-------|

* if DBE has come into full contact with the skin for only a short duration there may not be any problems with the average person. However, if this happens then you must wash your hands with soap and water as soon as possible after the contact.

POTENTIAL FOR BLURRED VISION

it was only recently seen that if DEE stays around long enough in a confined space, enough DBE could evaporate to allow the levels to exceed the AEL (1.5 ppm, or 10 mg/m³). This is a possibility which does not have to dramatically concern you unless you plan on using DBE in conditions described in this section.

Du Pont has investigated every one of the cases of temporary blurred vision, and have found a relationship between the DBE level and the styrene concentrations. That is, when the styrene concentrations were within limits (<150 ppm) the concentration of DBE was below the AEL for DBE. When general area conditions are poorly maintained then DBE concentrations can reach levels many times the AEL. Here are some general recommendations to follow to eliminate this condition:

* Read and familiarize yourself with the MSDS. Temporary blurred vision is a symptom of overexposure.

- * Check your ventilation in the production environment where DBE is being used.
- * Make a periodic check of the styrene levels to be certain that there is sufficient air movement in the production facility. it is difficult to predict exactly what the proper air flow necessary to keep DBE from exceeding the AEL is, however, there should be at least 6,000 CFM for each large open container of DEE to achieve a safety factor of 4.
- * For an average production area of 20 ft. by 10 ft. high, that would make the velocity of air flow in the immediate vicinity to be around 20 fpm. For this area then, this would be adequate for small surface evaporation of about 1 ft.²; about a 1 gallon open bucket. For an operation using greater than 1 ft.² evaporating surface it would be necessary to run 50 to 100 fpm
- * While air circulation helps, the more fresh air brought in the better.
- * While DBE is an effective acetone substitute it cannot be used like you did acetone - any spilled DBE will not evaporate.
- * Do not allow DBE soaked rags to lie around the production area. These are sources of DBE evaporation.
- * Avoid spillage of DBE. Make plans to prevent it and to clean up safely if it occurs.
- * Personal exposure monitoring is the most definitive way to determine whether there is a potential for DBE overexposure. Du Pont can help you to implement the proper procedures to insure good monitoring of DBE.
- * DBE air samples should be taken on charcoal tube containing 100/50 mg charcoal at 100-200 cc/minute for 2-3 hours. The Acceptance Exposure limit (AEL) is 10 mg/m³.
- * An organic vapor cartridge respirator will very effectively remove DBE vapor.

DBE exposure level monitoring was done at Grady-White Boats on two different days with two different employees while they were laminating using DBE solvent for clean-up purposes. Air flow monitoring was done in the areas in which they were working to determine the air flow through the area in feet per minute. The air flow in the areas these employees were working ranged between 60 and 600 feet per minute during the time they were exposed to DEE depending on the workers proximity in relation to ventilation fans. The Time Weighted Average exposures for these employees ranged between .2 and .8 parts per million. The purpose of this test was to determine whether the ventilation that was required to Tower styrene levels was sufficient to to also lower DBE exposures. Adequate ventilation maintained while workers are using DBE should totally eliminate any problems concerning blurred vision or overexposure, if other safety practices are also followed.

SAFETY AND MATERIALS OF CONSTRUCTION
CONSIDERATIONS FOR USING SHIPSHAPE RESIN CLEANER

When a change from acetone to Shipshape is being considered wither for a major plant trial or total conversion, the foilowing items should be in place:

SAFETY

I. Recommended Gloves:

These should be 18mm thick and made of natural rubber. These are resistant to Shipshape and to a good degree, against styrene. Source of supply:

- i. Edmont Corp., Coshoctonk, Ohio 43812
Model #26-675
2. Magid Corp., Chicago, Illinois
Model #620
Phone: 800-444-8010

II. Recommended Shop Clothing

Disposable work suits impervious in the front and breathable in the back.

Materials of good resistance in front should be of:

1. High density polyethylene
2. Polypropylene
3. Tyvec

Boots made of these materials can also be used for foot protection. This will also eliminate high cost of taping presently performed in most lay-up facilities.

Iii. Emergency Showers and Eye Wash Stations

if not already in place, put at work stations so that Shipshape and/or resin can be thoroughly flushed if a spill or a line break should occur.

MATERIALS OF CONSTRUCTION FOR USE WITH SHIPSHAPE

I. Recommended materials to use for O-rings, gaskets, hoses, pump packings:

1. Kalrez - Du Pont Perfluoroelastomer
Call: 302-774-6880
2. Teflon
3. Buna - S: Butadiene-Styrene Copolymer
4. Butyl Rubber
5. EP: Ethylene-Propylene Copolymer

II. For Storage:

Ordinary 1020 carbon steel (0550) is satisfactory for storing Shipshape Resin Cleaner. Stainless steel 304 and 316, nickel and aluminum are also suitable.

Shipshape is a stable compound but it is hygroscopic. Therefore, shipping and storage containers should be stored in a dry area; sheltered from the weather.

MATERIALS & CONSTRUCTION FOR USE WITH "TIPSOLVE II"

Tipsolve II is stable under normal storage conditions. Carbon steel or stainless steel tanks, drums, transfer lines and pumps may be used. Preferred gasket material is Teflon(R), but EPR, neoprene, polyethylene, cork and natural rubber are satisfactory. Buna N, Hypalon and Viton are not suitable gasket materials. Air and moisture should be excluded from all storage vessels. Tipsolve II may assume a slight yellow coloration on prolonged storage, but the color does not have effect on its efficiency.

In the presence of an acid, base or salt, Tipsolve II may decompose. Protect from sources of ignition even though flash point is high. Tanks, lines and pumps may be cleaned with steam or water, however, they should be air dried before reuse.

DU PONT DE NEMOURS

SUMMARY OF DBE TOXICITY TESTING

ACUTE

DBE shows low to moderate toxicity by oral, inhalation and skin absorption.

EYE

include

Causes eye irritation; effects are moderate and reversible. Eye contact may initially irritate, tearing or blurring of vision.

SKIN

Causes mild to severe skin irritation after prolonged direct skin contact.

MUTAGENICITY

Negative were:

The Ames Test (i.e., not mutagenic).

Mouse micronucleus assay (in vitro).

Salmonella suspension assay (w and w/o activation).

Micro-forward mutation assaying using enzymatic activation from rat nasal olfactory mucosa.

Positive was:

Human lymphocyte chromosomal aberration damage only at high concentrations - such damage is not uncommon at high concentrations of even innocuous compounds and is unlikely

SUBCHRONIC

to reflect potential genetic toxicity of DBE.
(14 day exposure)

There were no compound-related clinical or pathological changes observed by oral or inhalation.

(90 day exposure)

All major organs and tissues were normal except mild lesions in olfactory tissue. It was determined that was caused by the hydrolysis to the monoacid and not by the DBE.

AQUATIC

DBE is slightly toxic to Daphnia (invertebrates) and moderately toxic to Minnows.

REPRODUCTIVE

No treatment related differences were observed in:

- * Male fertility index (number of male rats impregnating females/number of females mated)
- * Female fertility index (number of female rats impregnated/number of females mated)
- * Viability index (number of pups alive 4 days post-partum/number of pups at birth)
- * Lactation index (number of pups alive at 21 days post-partum/number of pups alive at 4 days)

An inferior weight gain rate in pups whose parents were exposed to the high doses were observed. This was expected due to maternal toxicity. No other reproduction parameters were affected by the test treatment.

DEVELOPMENTAL

GEE was not uniquely toxic to the rat conceptus. The only fetal effects occurred at a dose level that was maternally toxic.

CARCINOGENICITY

No tests have been conducted.

ODOR THRESHOLD

0.01 ppm **50%** of test panel detected DBE's odor
0.1 ppm 100% of test panel detected DBE's odor
(0.1 ppm is 15 times lower than the current exposure limit).

MONITORING METHOD

A method has been developed and is available for monitoring DBE concentrations in the workplace.

COMPARATIVE EXPOSURE TO DBE AND METHYLENE CHLORIDE

SUMMARY

A comparative test was conducted in which exposures to both methylene chloride (MeC12) and Du Pont's DBE (a mixture of the methyl esters of succinic, glutaric and adipic acids) were monitored during simulated work situations. The results show that work practices which result in control of methylene chloride within its recommended exposure limit will also prevent overexposure to DBE.

PURPOSE

DBE has excellent solvent characteristics and has been recommended as a replacement for methylene chloride. The Threshold Limit Value for methylene chloride is currently at 100 ppm, while Du Pont recommended exposure limit for DBE is 10 mg/m³ (~1.5 ppm). Although the exposure limit for DBE is much lower in parts per million than that of methylene chloride, the concentration in air under similar conditions should also be much lower for DBE because of the great difference in vapor pressures (0.2 mm Hg for DBE vs. 340 mm Hg for MeC12, both at 20 degrees C). The purpose of the test described below was to determine what the actual exposures were to DBE and methylene chloride under comparable simulated work tasks.

TEST SET-UP

The location of the test was in a non-air conditioned storage building approximately 24' x 38' x 20' high. Doors were opened on each end of the room, resulting in a gentle cross breeze. A vent was located in the ceiling above the work area.

A 3' x 4' piece of stainless steel sheet was the simulated work piece. It was supported on two 55-gallon drums, resulting in a working height about waist high. A 2-liter bucket containing about 1/2 liter of the test chemical was placed near one end of and slightly below the work piece. A cotton dishwashing "mop" was used

as a swab. Two test of about one hour each were conducted. During the first test, methylene chloride was wiped across the test piece twenty times in about one minute and then the test subject stepped back for about one minute or until a total cycle time of about two minutes had elapsed. The cycle was repeated thirty times. The methylene chloride evaporated immediately during wiping operation. The test subject wore three pump/carbon tube monitoring devices during the test. In addition, area monitors consisting of similar devices were placed in front of and to the left and right of the test subject. Therefore, a total of six air samples were taken during each test.

The second test was similar to the first except that DBE solvent was used instead of methylene chloride. During this test, the DBE did not evaporate. However, the same motions of wiping and then standing back were used so that an equal chance for exposure to the test chemical resulted.

ANALYSIS AND RESULTS

The carbon tubes used during the tests were sent to Analytics, inc. of Richmond, VA, for analysis. A standard NIOSH method was used for methylene chloride and a method developed and validated by Analytics was used for DBE.

The personal samples in the breathing zone for the test subject during the two tests showed 44, 49 and 35 ppm (avg. 43 ppm) for methylene chloride. One analysis for methylene chloride showed more than 25% of the front tube section amount in the back section, so that sample may have been slightly higher than indicated. Analysis of the DBE showed undetectable amounts (<.2 ppm) of the adipate and succinate components of DBE and .21, .23 and .33 ppm (avg. .29 ppm) of the glutarate. All values represent i-hour time-weighted averages (TWA). The ratio of methylene chloride to the only detectable ester averaged 43 ppm to 0.29 ppm or about 148:1.

CONCLUSION

Although a worker would do other things besides the particular tasks monitored during an 8-hour workday (breaks, set-up, clean-up, etc.), the values shown would be fairly representative of an 8-hour TWA.

The results of this test indicate that work practices used to control exposure to methylene chloride to less than 100 ppm should be more than adequate to control exposure to DBE solvent to less than 1 ppm in comparable work situations.

"TIPSOLVE II" COMPARED TO OTHER CLEANERS

"Tipsolve II" vs. Water

Many companies are switching from organic solvents to water-based emulsifiers to clean tools and equipment. There are several disadvantages.

First is the fact that the tool must be taken out of service, cleaned and completely dried before reusing. Therefore, the manufacturer must have 2 - 3 times the number of tools on hand to keep production going. On the other hand, cleaning the tools with "Tipsolve II" requires only a quick dip and shake in the solvent and the tools are cleaned and ready to be used.

Another disadvantage of water-based systems is that the manufacturer must purchase and maintain a separate cleaning unit since most water-based systems cannot be used in the same equipment as with solvent type cleaners.

Disposal of used material is another disadvantage. A water-based system may be highly regarded as "biodegradable", but that does not mean that the waste is biodegradable. Consequently, water-based systems should never be flushed to the sanitary sewer unless permitted, they should be handled like other waste, in accordance to all Federal, State and local laws. Quite often, this means deep well injection or other special treatment with cost well above that for solvent borne waste.

"Tipsolve II" can be recycled.

"Tipsolve II" has no known impairing affects on workers.

"Tipsolve II" does not deplete ozone, is not found on any governmental toxicity list (SARA Extremely Toxic Substances, etc.) and is not a carcinogen.

ENVIRONMENTAL AND DISPOSAL

DBE is Classified as a Non-Regulated Material

This non-regulated category allows certain advantages in storage and handling procedures. In addition, it's presence will not contribute to a "hazard" rating of waste materials, as will the presence of acetone. This is not to say that the waste DBE will be classified as non-hazardous, it does mean that by adding DBE alone it will not force the classification to be hazardous.

Evaporation is Extremely Slow

The evaporation rate of DBE is over 500 times slower than acetone. This fact significantly reduces VOC discharge and odors in the working environment. In fact, most plants will be able to defend a reduction of 70% to 80% or more in the VOC's emitted.

Biodegradability

DBE was tested by Du Pont for biodegradability in both a batch aerated reactor and an electrolytic respirometer. In addition, DBE successfully passed the European OECD test for Biodegradability.

The batch aerated reactor is used to develop an acclimated culture for BOD testing and compare degradability to easily oxidized materials. Acclimation, using sewage sludge from the Wilmington, Delaware municipal waste water treatment plant, was

conducted for three weeks. During this time, the concentration of the DBE was increased by increments from 20% as COD in the feed to 100% (approximately 1000 ppm). This test concluded that the biochemical oxygen demand (BOD₅) increased approximately 0.9 g/g DBE after 23 days of seed acclimation. This value represents a moderately high biodegradability with about half of the COD being oxidized by the bacteria in five days. BOD, TOC and COD removals all exceeded 97%.

The electrolytic respirometer is used to ascertain biodegradability and/or inhibition by the rate of oxygen uptake by microorganisms at various concentrations and test conditions. DBE was tested at three concentrations for a period of ten days with sewage and sludge seed from a small municipal treatment system which normally receives little or no industrial contribution. Oxygen uptake was not affected and DBE was degraded up to approximately 300 ppm when tested alone and when combined with the domestic sewage. It was concluded from the respirometer testing that even an unacclimated biotreatment system (POTW) can handle at least 300 ppm without significantly affecting the health of the biomass. The only impact at these levels was the increased aeration necessary for the bacteria to degrade the DBE. The implications of these results, subject to the approval of your local regulatory authorities, are:

- * if an operation has only an intermittent flow to a waste water treatment system, the DBE, in smaller quantities should still be acceptable for treatment
- * If there is a spill of DBE, one could flush any remaining residual (after clean-up) to a municipal waste water treatment system.
- * If an operation results in a constant flow to a biological waste water treatment facility (resulting in an acclimated sludge), successful treatment of the operation's discharge would be anticipated (up to 1000 ppm DBE).

ECOLOGICAL AFFECTS OF "TIPSOLVE II"

This product should not be allowed to enter water courses without prior treatment.

Degradability in water:

| <u>Degree</u> | <u>Evaluation</u> |
|---------------|-----------------------|
| 60% | Readily Degradable |

This product is biodegradable -

By careful addition to adapted biological effluent treatment plants, no adverse effects on the degradative activity of the activated sludge are expected. However, this is not an implication to flush this product to surface waters or into a sanitary sewage system.

Treatment, storage, transportation and disposal must be in accordance with applicable Federal, State/Provincial and Local regulations.

DBE is Recyclable

DEE can be more fully utilized by being able to recycle the spent-DEE solvent from your clean-up operation. Because of the physical properties of DBE, vacuum distillation is necessary to effect this cleanup. This can be done in a variety of different ways:

- * on-site distillation through use of a small, easy to use distillation unit.
- * off-site distillation by one of many reputable recyclers.
- * by the use of a mobile distillation unit. This unit comes to your plant, uses your water and after processing the spent-DBE, gives you all the materials back for disposal and handling.

ON-SITE DISTILLATION

There are quite a few very competent producers of distillation equipment that can handle the distillation of spent-DBE. While vacuum is necessary to accomplish this, the distillation of DEE is neither unusual or complicated. There are no azeotropes formed in this procedure. However, there are some tips that will allow you to more effectively perform this on your plant.

- * 26 in. Hg vacuum and about ,280 deg. F (140 deg. C) is necessary to distill off the DBE.
- k use a nylon bag liner in the reservoir. This will allow you to more easily remove the solids after the distillation is finished.
- k instead of changing the bag after every distillation, because of the low solids in the spent-DDE, you should be able to get two or three batches before emptying.
- k if you have a distillation unit that is in current use for acetone, contact the manufacturer to see if it can be retrofitted for vacuum. Many systems were originally designed to allow the reservoir to be under vacuum. if

this is possible, then a relatively inexpensive (\$2-5M) kit can be installed.

* Du Pont can identify people who can provide a suitable on-site recovery unit.

OFF-SITE DISTILLATION

There are some recyclers that have the capability of handling the distillation of high boiling solvents. If you are not aware of who in your district may be able to handle vacuum distillation, check with your Du Pont Representative. Most fiberglass distributors are very aware of the reputable recyclers in an area.

In addition to these sources, Du Pont has identified a national recycler who is knowledgeable in recycling DBE - SAFETY KLEEN CORP (SK). SK is a strong national firm with vast experience on the chemistry of DBE distillation.

DBE Has Good Heating Value

DEE has about 9,000 BTU/lb heating value. In addition, DBE burns cleanly with no residue. DEE can be used in a fuels burning program as another means of disposal.

DBE is Not on Any Known List

DBE has a non-regulated Freight Classification, not on RCRA, Prop 65 or any other hazardous substance list. Because of its physical properties, we have confidence that DBE will not find its way onto any type of regulatory list such as listed above. DBE is not reportable under SARA Title iii.

RECYCLING "TIPSOLVE II"

Prillaman Chemical has been in the Solvent Recovery business for over forty years. During that forty years, as solvents, markets and regulations have changed, so has Frillaman Chemical. With the introduction of "Tipsolve II", Prillaman has purchased new recovery equipment that will allow them to recover the material regardless of the vapor pressure.

With this new equipment they offer a service to users of this product. Prillaman will pick up bulk quantities of spent solvent and distill it and return the solvent to your facility. This is done at approximately 75% of the cost of virgin solvent and could help the small generator reclaim waste without large initial capital expenditure.

TYPICAL ANALYSIS OF SHIPSHAPE
RESIN CLEANER AFTER DISTILLATION

Data was generated on-site at a boat manufacturer. An 8 gallon per hour vacuum distillation unit was used to distill Shipshape after it was spent. The major use area was in tool cleaning in lamination.

PER CENT BY WEIGHT

| | |
|------------------|------|
| % H2O | 2.7 |
| % (1) NVR | .22 |
| % Active Solvent | 96.0 |
| Styrene | .23 |
| Peroxides | .003 |
| Lights | .85 |

(i) Non-Volatile Residue

Recommended procedure would be to take off a pre-cut which would remove the vast majority of both water and styrene giving a higher reading for per cent solvent returned.

PHYSICAL PROPERTIES TESTING

DBE, Propylene Carbonate, Acetone and Shipshape Resin Cleaner were all used in a strength of 1% in solution to form test panels using standard resin and catalyst ratios. The results on the following page show that in some cases the strength factors, including flexural strength, flexural modulus, tensile strength, tensile modulus and percent elongation are actually improved when adding a small amount of solvent in the laminate. These tests were all done in controlled environment conditions and could vary depending on the type of resin and catalyst that are used. Acetone seemed to have a more detrimental effect on the laminates in some cases than other solvents. The control panel was only marginally better than the test panels created using 1% solutions of DBE, Propylene Carbonate and Shipshape. (Tisolve II was not available for testing.)

DBE, Propylene Carbonate, Acetone and Shipshape Resin Cleaner were all used in a secondary bonding test. The test consisted of hand laying and rolling out one layer of fiberglass mat on a test panel. These test panels were allowed to cure for four days and then were covered with these solvents listed above. Using a paint brush, solvent was applied to the cured laminate and allowed to stand for 10 minutes. The acetone evaporated off of the laminate leaving no visible residue, and the DBE, Propylene Carbonate and Shipshape Resin Cleaner all did not evaporate. Next, another layer of fiberglass laminate was applied to this laminate and allowed to cure for four days. When these two layers of laminate were separated using wooden wedges, the physical bond visible by the amount of broken fiberglass on the laminate sides was as good or greater using these solvents than it was on a control panel which was done using no solvents whatsoever. Secondary bonding is not affected these solvents in any significant way.

4/9/91

FLEX. STR.

| TEST # | PC | DBE | ACE | SS | CON |
|--------|----------|----------|----------|----------|----------|
| 1 | 32597.00 | 38425.00 | 31494.00 | 35909.00 | 30945.00 |
| 2 | 30992.00 | 28964.00 | 27225.00 | 31306.00 | 35668.00 |
| 3 | 30575.00 | 29322.00 | 30058.00 | 39980.00 | 37180.00 |
| 4 | 28316.00 | 32310.00 | 33373.00 | 36830.00 | 37523.00 |
| 5 | 37835.00 | 30752.00 | 32683.00 | 33514.00 | 41473.00 |
| 6 | 32142.00 | 27373.00 | 24311.00 | 44130.00 | 28637.00 |
| AVG. | 32076.17 | 31191.00 | 29857.33 | 36944.83 | 35237.67 |

FLEX. MOD.

| TEST # | PC | DBE | ACE | SS | CON |
|--------|-------|-------|-------|-------|-------|
| 1 | 9.35 | 11.30 | 9.54 | 10.90 | 11.00 |
| 2 | 9.43 | 10.40 | 9.09 | 9.88 | 11.00 |
| 3 | 8.76 | 11.00 | 9.77 | 11.20 | 11.40 |
| 4 | 8.64 | 10.20 | 10.50 | 12.30 | 10.50 |
| 5 | 10.80 | 10.80 | 11.30 | 9.90 | 11.80 |
| 6 | 9.28 | 10.20 | 8.48 | 13.40 | 9.60 |
| AVG. | 9.38 | 10.65 | 9.78 | 11.26 | 10.88 |

TENS. STR.

| TEST # | PC | DBE | ACE | SS | CON |
|--------|----------|----------|----------|----------|----------|
| 1 | 17372.00 | 16526.00 | 12402.00 | 17557.00 | 16610.00 |
| 2 | 15071.00 | 16074.00 | 13645.00 | 16243.00 | 20764.00 |
| 3 | 16418.00 | 18806.00 | 15258.00 | 17922.00 | 15031.00 |
| 4 | 17042.00 | 14739.00 | 13256.00 | 16238.00 | 19779.00 |
| 5 | 18344.00 | 18916.00 | 15443.00 | 15271.00 | 16757.00 |
| AVG. | 16849.40 | 17012.20 | 14000.80 | 16646.20 | 17788.20 |

TENS. MOD.

| TEST # | PC | DBE | ACE | SS | CON |
|--------|-------|-------|-------|-------|-------|
| 1 | 13.50 | 12.60 | 10.50 | 13.10 | 12.40 |
| 2 | 12.60 | 10.40 | 11.20 | 12.00 | 13.50 |
| 3 | 12.40 | 13.20 | 11.30 | 12.40 | 12.00 |
| 4 | 12.90 | 10.90 | 12.50 | 11.10 | 13.30 |
| 5 | 13.10 | 12.40 | 12.80 | 11.70 | 12.40 |
| AVG. | 12.90 | 11.90 | 11.66 | 12.06 | 12.72 |

% ELONG.

| TEST # | PC | DBE | ACE | SS | CON |
|--------|------|------|------|------|------|
| 1 | 1.80 | 1.70 | 1.80 | 1.80 | 1.80 |
| 2 | 1.50 | 1.70 | 1.80 | 1.90 | 1.80 |
| 3 | 2.10 | 1.80 | 1.80 | 1.80 | 1.50 |
| 4 | 2.00 | 1.50 | 1.50 | 2.00 | 2.10 |
| 5 | 1.80 | 1.60 | 1.60 | 1.60 | 1.50 |
| AVG. | 1.84 | 1.66 | 1.70 | 1.82 | 1.74 |

COST ANALYSIS

These solvents were tested in standard production conditions by multiple workers. The solvent loss due to evaporation, or spillage is included in these numbers. The waste disposal cost is based on the amount of waste left in the bottom of the still during the recycling process. The cost is assuming that this waste is hazardous and would be shipped to a properly licensed hazardous waste facility for a fuels blending program. (Each user of these solvents must test their own waste stream to determine whether it is hazardous or not. The chemical solvents are not listed as hazardous alone but the contaminants contained in the spent solvent could possible be.)

As you can see by looking at the cost analysis, the quantity of solvents used was one half or less than the amount of acetone used during the same time. Even though the unit cost of these replacement solvents is significantly greater than the cost of acetone, the fact that only 50% or less of the solvent is used in a day's time represents a savings of approximately \$300 per year per person.

Solvent cost analysis is based on per person usage per day

| Item | Qty. Gals. | Unit Cost | Total Cost | Annual Cost @ 242 days/yr | Residual value of reclaimed solvent | Cost of waste disposal | Labor cost of reclaim inc. burden | Total annual cost per person |
|-------------------|---------------|--------------|---------------|------------------------------|---|------------------------------|---|------------------------------------|
| Daily acetone use | 3 | 2.42 | 7.26 | 1756.92 | 556.36 | 58.52 | 50.58 | 1309.66 |
| Daily DBE use | 1.55 | 4.79 | 7.42 | 1796.73 | 869.39 | 46.20 | 39.93 | 1013.47 |
| Daily PC usage | 1.25 | 5.8 | 7.25 | 1754.50 | 842.16 | 36.96 | 31.94 | 981.24 |
| Daily SS usage * | 1.2 | 15.49 | 18.59 | 4498.30 | 0.00 | 0.00 | -31.94 | 4466.36 |
| Daily SS usage ** | 1.2 | 15.49 | 18.59 | 4498.30 | 2549.03 | 41.89 | 31.94 | 2023.09 |
| Daily TS II usage | 1.3 | 5.611 | 7.29 | 1765.22 | 814.72 | 36.96 | 31.94 | 1019.40 |

SUMMARY EVALUATION

Based on the findings of this study, DBE, Propylene Carbonate, Shipshape Resin Cleaner and Tipsolve II are all valid usable solvents for the replacement of acetone. All four clean resin from the tools with great effectiveness and when used properly, do not affect the physical properties of the laminate structure or interfere with secondary bonding. in cleaning brushes or heavy nap mop rollers, you must work the solvents into the bristles of the brush or into the nap of the roller slightly to enhance the cleaning process.

When converting from acetone to DBE, Shipshape, Propylene Carbonate or Tipsolve ii there are some slight modifications which must be made concerning tools, clothing and worker habits. As noted in the earlier description of safety suggestions, workers should wear gloves, chemical resistant suits and possibly rubber boots to protect themselves from these solvents. This is due to the fact that when spilled these solvents do not evaporate quickly as does acetone. Worker habits must change in order to prevent as much as possible the transfer of solvent from the bucket it is stored in during use to the floor and to the parts they are laminating. Due to the higher viscosity of these solvents as compared to acetone, more tends to stick to the tool upon removal of the solvent and must be shaken or blown off before removing the tool from the bucket. This solvent, when dripped on the floor, will dissolve some of the surface overspray on the floor and can become very slippery. Holes must be drilled in the bases of any brushes that are used in order to facilitate drainage. Any mop rollers that are used for smoothing large areas of mat can be replaced using the standard roller frame, removing the part of the frame which holds the absorbent roller and replacing it with one and one half inch diameter polyethylene rod. This rod can be chucked in a lathe and a hole may be drilled through the length of the one and a half inch polyethylene rod so that it fits

directly in place of the mop roller. This polyethylene will not be affected by the solvent and will not soak up the solvent but will still allow the smoothing of large areas of mat and removing the excess resin that is contained in that mat. Any tools such as rollers or brushes that have hollow handles must be filled so that the solvent does not stay in the handle and drip on to the fiberglass part. This can be accomplished easily with silicone rubber sealer. The use of a metal screen in the bottom of the bucket which contains the solvent will allow the resin and heavier particles to settle to the bottom of the bucket and keep the tools suspended in the clean portion of the solvent. By allowing this used solvent to stand over night, the heavier particles and contaminants will tend to settle to the bottom allowing the removal of the clean portion from the top and by adding additional clean solvent this material can be reused on a daily basis until it become totally loaded. This settling and decanting process can extend the life of these solvents significantly.

Distillation of these solvents can be accomplished in-house using stills with vacuum attachments and solvent recovery rate is quite high. The remaining material that is left in the still after distillation may or may not be listed as hazardous depending on the contaminants dissolved in the solvent when it was distilled. These solvents themselves are not listed as hazardous, but each user must determine the nature of the waste produced in their own operation. The initial cost for distillation equipment of this nature varies significantly. In the case of some distillation equipment, vacuum attachments may be retrofitted onto existing equipment that has been used for acetone and be a very cost effective way of reclaiming these solvents. New distillation equipment can be purchased from any number of sources and payback for this equipment will vary depending on the size of the distillation unit and the quantity of solvents used. (Contact the solvent manufacturer-j in the case of this study, payback for distillation equipment of the correct size would be approximately

2.5 years. This is based only on savings represented by the reduction in solvent use and the ability to reclaim and reuse spent solvent. Other factors which may or may not apply to each user of these solvents would be a reduction in insurance cost due to the non-hazardous nature of these solvents, and the reduction in flammable liquid stored throughout the facility. if, after distillation, the users still bottom waste is declared non-hazardous, a significant savings can be realized in waste disposal. Another aspect which may come into effect is the possible taxation of air emissions from a manufacturing facility. The use of these solvents, by reducing VOC emission significantly, could save a considerable amount of money should this legislation become law.

I would like to thank the corporations and people who have provided samples for test purposes, supplied me with much of the information contained in this report, performed laboratory testing and answered so many questions during this study.

E.I. Du Pont De Nemours & Co., David F. Lucas, Market Development Manager,
Petro Chemicals Department, 704 Highland View Place, Nashville, TN 37027-5524

Prillaman Chemical Corporation, Robert C. Cooke, Sales Representative, George
Quinlin, P.O. Box 4024, Martinsville, VA 24115

GAF Chemicals Corporation, Marshall G. Kamras, Senior Sales Engineer, Chemical
Sales, Two Fairview Plaza, 5950 Fairview Road, Suite 612, Charlotte, NC 28210

SouthChem, Incorporated, Woody Wright, P.O. Box 400, New Bern, NC 28560

Reichhold Chemical Corporation, Reactive Polymers Division, Tommy Bakis, Senior
Sales Representative, Chris Kirschling, Mark Callicutt, P.O. Box 19129,
Jacksonville, FL 32245

DBE SOLVENT

MATERIAL SAFETY DATA SHEET

17-May-90

Du Pont Material Safety Data Sheet

Page 1

MATERIAL IDENTIFICATION

NUMBER : 00000067
NAME : DBE-2

CHEMICAL FAMILY : Aliphatic Dibasic Acid Esters
TRADE NAMES / SYNONYMS :
Dibasic Ester-2
DBE-2 SPG
Carbonic Acid Gas

DUPONT REGISTRY NUMBER : 30-92-6
FORMULA : $\text{CH}_3\text{OOC}(\text{CH}_2)_n\text{COOCH}_3$, $n=3,4$
MOLECULAR WEIGHT : Avg. 163
NPCA-HMIS RATING : Health: 2 Flammability: 1 Reactivity: 0
Personal Protection rating to be supplied by
user depending on use conditions.

MANUFACTURER/DISTRIBUTOR: Du Pont
1007 Market Street
Wilmington, DE 19898

PRODUCT INFORMATION PHONE : 1-(800)441-7515
TRANSPORTATION EMERGENCY PHONE : 1-(800)424-9300
MEDICAL EMERGENCY PHONE : 1-(800)441-3637

COMPONENTS

| Material | CAS Number | % |
|--------------------|------------|-------|
| Dibasic Esters | | |
| Dimethyl Glutarate | 1119-40-0 | 76 |
| Dimethyl Adipate | 627-93-0 | 23 |
| Dimethyl Succinate | 106-65-0 | 0.5 |
| Methanol | 67-56-1 | <0.1 |
| Hydrogen Cyanide | 74-90-8 | ~5ppm |

PHYSICAL DATA

Boiling Point : 210 to 225 deg C
Vapor Pressure : 0.1 mm Hg at 20 deg C
Melting Point : ~-13 deg C
% Volatiles : 100 WT % at 20 deg C
Evaporation Rate : <.1 (Butyl Acetate = 1.0)
Solubility in Water : 4.2 WT % at 20 deg C
Odor : Sweet
Form : Liquid
Color : Colorless
Specific Gravity : 1.081 at 20 deg C



HAZARDOUS REACTIVITY

Instability : Stable.
Incompatibility : Incompatible with strong oxidants, acids, alkalies.
Decomposition : Decomposes with heat.
Polymerization : Polymerization will not occur.

FIRE AND EXPLOSION DATA

Flash Point : 104 deg C
Method : TCC
Autoignition Temperature : 375 deg C
Explosive Limits in Air, % by Vol.:
LEL: 1.2
UEL: 7.9

FIRE AND EXPLOSION HAZARDS

Vapor forms explosive mixture with air. Hazardous gases/vapors produced in fire are carbon monoxide.

EXTINGUISHING MEDIA

Water Spray. Foam. Dry Chemical. CO2.

SPECIAL FIRE FIGHTING INSTRUCTIONS

Keep personnel removed & upwind of fire. Wear self-contained breathing apparatus. Wear full protective equipment. Cool tank/container with water spray.

HEALTH HAZARD INFORMATION

The summary below is based on toxicity testing of DBE, a mixture of dimethyl glutarate (66%), dimethyl adipate (17%) and dimethyl succinate (17%). Toxicity of DBE-2 should be similar.

ANIMAL DATA:

Inhalation LC50: 1 hr. >10.7 mg/l in rats
Skin Absorption LD50: >2,250 mg/kg in rabbits
Oral LD50: 8,191 mg/kg in rats

DBE is an eye irritant in animal tests. DBE has been found to be a mild to severe skin irritant in rabbits. Dermal sensitization studies of DBE in guinea pigs indicated that DBE is not a skin sensitizer. DBE demonstrated no mutagenic activity when tested in bacterial cell cultures, but it was positive in one study with cultured mammalian cells. DBE demonstrated no reproductive toxicity and was not uniquely toxic to the fetus in a developmental study. DBE produced

(HEALTH HAZARD INFORMATION - CONTINUED)

mild nasal lesions in rats.

HUMAN HEALTH EFFECTS:

Anticipated human health effects of overexposure include eye and skin irritation. Inhalation may cause irritation **of** the upper respiratory passages.

Overexposure may cause blurring of vision.

Carcinogenicity

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

Applicable Exposure Limits:

Exposure Limits for Dibasic Esters

AEL * (Du Pont): 10 mg/m³ - 8 Hr. TWA
TLV (ACGIH) : None Established
PEL (OSHA) : None Established

Exposure Limits for Methanol

AEL * (Du Pont): 200 ppm - 8 & 12 Hr. TWA - Skin
TLV (ACGIH) : 200 ppm, 262 mg/m³
STEL 250 ppm, 328 mg/m³ - Skin
PEL (OSHA) : 200 ppm, 260 mg/m³
STEL 250 ppm, 325 mg/m³ - Skin

Exposure Limits for Hydrogen Cyanide

AEL * (Du Pont): 10 ppm - 8 Hr. TWA
5 ppm - 12 Hr. TWA - Skin
TLV (ACGIH) : 10 ppm, 11 mg/m³ (Ceiling) - Skin
PEL (OSHA) : STEL 4.7 ppm, 5 mg/m³ - Skin

* AEL is Du Pont's Acceptable Exposure Limit.

Safety Precautions

Avoid breathing vapors or mist. Avoid contact with eyes, skin, or clothing. Wash thoroughly after handling.

*****~**

FIRST AID

INHALATION:

If inhaled, remove to fresh air immediately. If not breathing, give artificial respiration. If breathing is

(FIRST AID - CONTINUED)

difficult, give oxygen. Call a physician.

SKIN CONTACT:

Flush skin with water after excessive contact. Wash contaminated clothing before reuse.

EYE CONTACT:

In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

INGESTION:

If swallowed, do not induce vomiting. Immediately give two glasses of water, or activated charcoal slurry. Never give anything by mouth to an unconscious person. Call a physician.

NOTES TO PHYSICIAN

To prepare activated charcoal slurry suspend 50 g activated charcoal in 400 mL water in plastic bottle and shake well. Administer 5 mL/kg, or 350 mL for an average adult.

PROTECTION INFORMATION

Generally Applicable Control Measures and Procedures

Keep container tightly closed. Do not mix with strong oxidants, acids, alkalis.
Use ventilation that is adequate to keep airborne concentrations below exposure limits.

Personal Protective Equipment

EYE/FACE PROTECTION

Wear safety glasses. Wear coverall chemical splash goggles when the possibility exists for eye contact due to splashing or spraying of material.

RESPIRATORS

NIOSH/MSHA approved air purifying respirator with a organic vapor cartridge or canister may be permissible under certain circumstances where airborne concentrations are expected to exceed exposure limits. Protection provided by air purifying respirators is limited. Use a positive pressure air supplied respirator if there is any potential for an uncontrolled release, exposure levels are not known, or any other circumstances where air purifying respirators

(PROTECTION INFORMATION - CONTINUED)

may not provide adequate protection.

PROTECTIVE CLOTHING

Wear impervious clothing, such as gloves, apron, boots or whole bodysuit made from Butyl rubber, as appropriate.

*****~*****

DISPOSAL INFORMATION

Aquatic Toxicity :
DIBASIC ESTERS:

96 hour LC50, fathead minnows: 18-24 mg/L.

Spill, Leak, or Release

NOTE : Review FIRE AND EXPLOSION HAZARDS and SAFETY PRECAUTIONS before proceeding with clean up. Use appropriate PERSONAL PROTECTIVE EQUIPMENT during clean up. Remove source of heat, sparks, flame, impact, friction or electricity. Dike spill. Prevent liquid from entering sewers, waterways or low areas. Recover free liquid for reuse or reclamation. Recover undamaged and minimally contaminated material for reuse or reclamation. Soak up with sawdust, sand, oil dry or other absorbent material.

Waste Disposal

Treatment, storage, transportation and disposal must be in accordance with applicable Federal, State/Provincial, and Local regulations. Recover nonusable free liquid and dispose of in an approved and permitted incinerator. Recover nonusable free liquid and dispose of in an approved and permitted biological treatment system. Recover contaminated water and dispose of in an approved and permitted biological treatment system. Recover contaminated water and dispose of in an approved and permitted deepwell. Remove nonusable solid material and/or contaminated soil, for disposal in an approved and permitted landfill. Do not flush to surface water or sanitary sewer system.

SHIPPING INFORMATION

DOT

Proper Shipping Name

DIBASIC ESTER MIXTURE

Hazard Class : Not Regulated

Freight Class : Plasticizers + Solvents

DOT/IMO

Proper Shipping Name

DIBASIC ESTER MIXTURE

Hazard Class : Not Regulated

(SHIPPING INFORMATION - CONTINUED)

Shipping Containers

Tank Car : 170,000 lbs
Tank Truck : 42,000 lbs
Steel Drums : 485 lbs

*****~*****

STORAGE CONDITIONS

Store in well ventilated area. Keep container tightly closed.

TITLE III HAZARD CLASSIFICATIONS

Acute: Yes
Chronic: Yes
Fire: No
Reactivity: No
Pressure: No

*****t*****

ADDITIONAL INFORMATION AND REFERENCES

The hydrogen cyanide concentration in DBE is so low as to be toxicologically insignificant when DBE is used as a solvent. However, when reacting DBE with an alcohol and subsequent recovery of methanol, concentration of highly volatile impurities to toxicologically significant levels can occur in the light ends when methanol is topped in order to purify the methanol for reuse. Processors should be aware of this potential hazard.

*t*****

The data in this Material Safety Data Sheet relates only to the specific material designated herein and does not relate to use in combination with any other material or in any process.

Date of latest Revision : 90/04/17
Responsibility for MSDS : Petrochemicals - Env. Affairs
E.I. du Pont de Nemours & Co.
Wilmington, DE 19898
302/999-4792

PRODUCT SAFETY ALERT BULLETIN

DU PONT DBE SOLVENT AND BLURRED VISION

Recently a limited number of incidents of temporary blurred vision have been reported by users of DBE Dibasic Esters in some solvent cleaning applications. Symptoms have lasted from one hour to several hours after termination of direct exposure. No permanent vision impairments have been reported. **Our Investigations indicate that, In each of these Incidents, the DBE concentration In air was above the recommended limits, and/or there was extensive and prolonged skin contact with DBE.** No adverse health effects have been reported when DBE was used in enclosed processes or when proper ventilation was used to limit airborne concentrations. Additional tests are being conducted to supplement data from these investigations. There have been no incidents involving use of the DBE fractions (DBE-2, DBE-3, DBE-4, DBE-5, DBE-6 and DBE-9).

We recommend that you immediately ensure that the following safe handling procedures are being practiced:

- 1. Provide adequate air flow In areas where DBE Is used In open containers so that the 8-hour time-weighted average concentration of DBE In air Is no more than 10 milligrams per cubic meter (1.5 ppm), OR use a respirator to give equivalent protection.**
- 2. Wear safety glasses at all times. Use coverall goggles to prevent eye contact, If the possibility of splashing or spraying of the material exists.**
- 3. Use protective clothing as appropriate, such as gloves, aprons, boots, or whole body suits made of an Impervious material such as butyl rubber to prevent skin exposure.**

Additional details are included in the attached Material Safety Data Sheet (MSDS). Du Pont or your local supplier can provide additional assistance if needed. Please call (800) 231-0998 to contact a Du Pont DBE representative.

Du Pont believes that DBE is safe and effective when handled as directed and reserves the right to supply DBE only to those users who use DBE as recommended.



E. I. DU PONT DE NEMOURS & CO.
Petrochemicals Department
Wilmington, Delaware

SAFETY & QUALITY are our way of life

MATERIAL SAFETY DATA SHEET

ARCONATE™ 1000 PROPYLENE CARBONATE

MSDS No.
HCR003253

Rev. Date
11/02/90



ARCO CHEMICAL COMPANY
3801 WEST CHESTER PIKE
NEWTOWN SQUARE, PA. 19073
DISTRIBUTED BY
PRILLAMAN CHEMICAL CORP.
FAYETTEVILLE, N. C. 28301

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

This product is covered by the OSHA Hazard Communication Rule and this document has been prepared in accordance with the MSDS requirements of the rule.

| | | | |
|---|--|---|--|
| I. General | | | |
| Trade Name ARCONATE 1000 PROPYLENE CARBONATE | | Telephone Numbers EMERGENCY 800/424-9300 CHEMTREC 215/353-8300 ARCO CHEM CUSTOMER SERVICE 800/321-7000 INFO ONLY | |
| Other Names N/P | | | |
| Chemical Family N/P | | DOT Hazardous Materials Proper Shipping Name NOT REGULATED | |
| Generic Name DIOXOLANONE | | DOT Hazard Class NOT REGULATED | |
| CAS No. 108-32-7 | Company ID No. E000325300 | UN/NA ID No. N/AP | |
| II. CAUTION Summary of Hazards | | | |
| PHYSICAL HAZARDS: | | SLIGHTLY COMBUSTIBLE LIQUID | |
| ACUTE HEALTH EFFECTS: (SHORT-TERM) | | MODERATE EYE IRRITANT SLIGHT SKIN IRRITANT NO SKIN ABSORP. HAZARD IDENTIFIED FROM DATA FOUND NO INGESTION HAZARD IDENTIFIED FROM DATA FOUND NO DATA ON INHALATION FOUND | |
| CHRONIC HEALTH EFFECTS: (LONG-TERM) | | PROLONGED, EXCESSIVE EXPOSURE TO AEROSOL MAY CAUSE RESPIRATORY IRRITATION. | |
| III. Fire and Explosion | | | |
| Flash Point (Method) GT 226° F (SETA) | | Autoignition Temperature (Method) N/DA | Flammable Limits (% Vol. in Air) At Normal Atmospheric Temperature and Pressure Lower 1.7 Upper 32.5 |
| Fire and Explosion Hazards | WHEN HEATED ABOVE FLASH POINT, RELEASES VAPORS. WHEN MIXED WITH AIR AND EXPOSED TO IGNITION SOURCE, VAPORS CAN BURN IN OPEN OR EXPLODE IF CONFINED. VAPORS MAY BE HEAVIER THAN AIR. MAY TRAVEL LONG DISTANCES ALONG GROUND BEFORE IGNITING/FLASHING BACK TO VAPOR SOURCE. FINE SPRAYS/MIST MAY BE COMBUSTIBLE AT TEMPERATURES BELOW NORMAL FLASH POINT. | | |
| Extinguishing Media | DRY CHEMICAL CO2 WATERSPRAY | | |
| Special Firefighting Procedures | DO NOT ENTER FIRE AREA WITHOUT PROPER PROTECTION. SEE "DECOMPOSITION PRODUCTS POSSIBLE. FIGHT FIRE FROM SAFE DISTANCE/PROTECTED LOCATION. HEAT MAY BUILD PRESSURE/RUPTURE CLOSED CONTAINERS, SPREADING FIRE, INCREASING RISK OF BURNS/INJURIES. DO NOT USE SOLID WATER STREAM/MAY SPREAD FIRE. USE WATER SPRAY/FOG FOR COOLING. AVOID FROTHING/STEAM EXPLOSION. BURNING LIQUID WILL FLOAT ON WATER. NOTIFY AUTHORITIES IF LIQUID ENTERS SEWER/PUBLIC WATERS. | | |

IV. Health Hazards

Summary of Acute Hazards MODERATE HEALTH HAZARD - SEE BELOW FOR ROUTE-SPECIFIC DETAILS.

| ROUTE OF EXPOSURE | SIGNS AND SYMPTOMS | Primary Routes |
|-------------------|---|-------------------------------------|
| Inhalation | NO APPROPRIATE HUMAN OR ANIMAL HEALTH EFFECTS DATA ARE KNOWN TO EXIST. | <input type="checkbox"/> |
| Eye Contact | MAY CAUSE MODERATE IRRITATION, INCLUDING BURNING SENSATION, TEARING, REDNESS OR SWELLING. | <input checked="" type="checkbox"/> |
| Skin Absorption | NO SIGNIFICANT SIGNS OR SYMPTOMS INDICATIVE OF ANY HEALTH HAZARD ARE EXPECTED TO OCCUR AS A RESULT OF SKIN ABSORPTION EXPOSURE. | <input type="checkbox"/> |
| Skin Irritation | MAY PRODUCE SKIN IRRITATION. | <input type="checkbox"/> |
| Ingestion | NO SIGNIFICANT SIGNS OR SYMPTOMS INDICATIVE OF ANY ADVERSE HEALTH HAZARD ARE EXPECTED TO OCCUR AS A RESULT OF INGESTION. | <input type="checkbox"/> |

Summary of Chronic Hazards and Special Health Effects PROLONGED, EXCESSIVE EXPOSURE TO AEROSOL MAY CAUSE RESPIRATORY IRRITATION.
THIS MATERIAL OR ITS EMISSIONS MAY AGGRAVATE PULMONARY/BRONCHIAL DISEASE AND/OR CAUSE BREATHING DIFFICULTY.

V. Protective Equipment and Other Control Measures

| | |
|-----------------------------------|---|
| Respiratory | NO SPECIAL RESPIRATORY PROTECTION EQUIPMENT IS RECOMMENDED UNDER ANTICIPATED CONDITIONS OF NORMAL USE WITH ADEQUATE VENTILATION. |
| Eyes | EYE PROTECTION SUCH AS CHEMICAL SPLASH GOGGLES AND/OR FACE SHIELD MUST BE WORN WHEN POSSIBILITY EXISTS FOR EYE CONTACT DUE TO SPLASHING OR SPRAYING LIQUID, AIRBORNE PARTICLES, OR VAPOR. CONTACT LENSES SHOULD NOT BE WORN. |
| Skin | WHEN SKIN CONTACT IS POSSIBLE, PROTECTIVE CLOTHING INCLUDING GLOVES, APRON, SLEEVES, BOOTS, HEAD AND FACE PROTECTION SHOULD BE WORN. THIS EQUIPMENT MUST BE CLEANED THOROUGHLY AFTER EACH USE. |
| Engineering Controls | BOTH LOCAL EXHAUST AND GENERAL ROOM VENTILATION ARE USUALLY REQUIRED. |
| Other Hygienic and Work Practices | USE GOOD PERSONAL HYGIENE PRACTICES. WASH HANDS BEFORE EATING, DRINKING, SMOKING, OR USING TOILET FACILITIES. PROMPTLY REMOVE SOILED CLOTHING/WASH THOROUGHLY BEFORE REUSE. SHOWER AFTER WORK USING PLENTY OF SOAP AND WATER. |

VI. Occupational Exposure Limits

| Substance | Source | Date | Type | Value/Units | Time |
|--------------------------|--------|------|------|-------------|------|
| NO ESTABLISHED STANDARDS | | | | | |



ARCONATE™ 1000 PROPYLENE CARBONATE

MSDS No.
HCRO03253
Rev. Date
11/02/90

VII. Emergency and First Aid

| | |
|--|---|
| Inhalation | IF OVERCOME BY EXPOSURE, REMOVE VICTIM TO FRESH AIR IMMEDIATELY. GIVE OXYGEN OR ARTIFICIAL RESPIRATION AS NEEDED. OBTAIN EMERGENCY MEDICAL ATTENTION. PROMPT ACTION IS ESSENTIAL. |
| Eye Contact | IN CASE OF EYE CONTACT, IMMEDIATELY RINSE WITH CLEAN WATER FOR 20-30 MINUTES. RETRACT EYELIDS OFTEN. OBTAIN EMERGENCY MEDICAL ATTENTION. |
| Skin Contact | IMMEDIATELY REMOVE CONTAMINATED CLOTHING. WASH SKIN THOROUGHLY WITH MILD SOAP/WATER. FLUSH W/ LUKEWARM WATER FOR 15 MINUTES. IF STICKY, USE WATERLESS CLEANER FIRST. SEEK MEDICAL ATTENTION IF ILL EFFECT OR IRRITATION DEVELOPS. |
| Ingestion | IF LARGE QUANTITY SWALLOWED, GIVE LUKEWARM WATER (PINT) IF VICTIM COMPLETELY CONSCIOUS/ALERT. DO NOT INDUCE VOMITING/RISK OF DAMAGE TO LUNGS EXCEEDS POISONING RISK. OBTAIN EMERGENCY MEDICAL ATTENTION. |
| Emergency Medical Treatment Procedures | MAINTAIN AIRWAY. PROVIDE OXYGEN AND/OR VENTILATION ASSISTANCE, IF NEEDED. IF EXPOSED, TREAT SKIN AND EYE BURNS OR IRRITATION CONVENTIONALLY AFTER DECONTAMINATION. |

VIII. Spill and Disposal

Precautions if Material is Spilled or Released

EVACUATE/LIMIT ACCESS. EQUIP RESPONDERS WITH PROPER PROTECTION. STOP RELEASE. PREVENT FLOW TO SEWERS/PUBLIC WATERS. NOTIFY FIRE/ ENVIRONMENTAL AUTHORITIES. RESTRICT WATER USE FOR CLEANUP. IMPOUND/RECOVER LARGE LAND SPILL. SOAK UP SMALL SPILL WITH INERT SOLIDS. USE SUITABLE DISPOSAL CONTAINERS. ON WATER, MATERIAL PARTIALLY SOLUBLE/MAY FLOAT OR SINK. CONTAIN/MINIMIZE DISPERSION/COLLECT. DISPERSE RESIDUE TO REDUCE AQUATIC HARM. REPORT PER REGULATORY REQUIREMENTS.

Waste Disposal Methods

CONTAMINATED PRODUCT/SOIL/WATER, SPENT SOLVENT AND SPILL CLEANUP MATERIALS MAY BE RCRA/OSHA HAZARDOUS WASTE (SEE 40 CFR 261 AND 29 CFR 1910). WASTE MAY BE DESIGNATED F003, F004, F005 UNDER RCRA LISTINGS DEPENDING ON SPECIFIC SOLVENTS INVOLVED. LANDFILL SOLIDS AT PERMITTED SITES. USE REGISTERED TRANSPORTERS. BURN CONCENTRATED LIQUIDS. AVOID FLAMEOUTS. ASSURE EMISSIONS COMPLY WITH APPLICABLE REGULATIONS.

IX. Components (This may not be a complete list of components)

| Component Name | CAS No. | Carcinogen## | Composition amount (Wt.) (See Qualification on Page |
|---------------------|----------|--------------|--|
| PROPYLENE CARBONATE | 108-32-7 | N/AP | GT 99.3 PERCENT |

| | | | |
|--|---|---------------------------------|------------------------------------|
| Boiling Point 468° F | Viscosity Units, Temp. (Method) AP 2 CST AT 100° F (BROOK) | | Dry Point N/AP |
| Freezing Point N/DA | Vapor Pressure N/DA | | Volatile Characteristics SLIGHT |
| Specific Gravity (H ₂ O = 1 at 39.2° F) AP 1.2 70° F / 70° F | Vapor Sp. Gr. (Air = 1.0 at 60° - 90° F) N/DA | Solubility in Water MODERATE | pH AP 5.5 TC 7.5 |
| Hazardous Polymerization NOT EXPECTED TO OCCUR | Other Chemical Reactivity N/P | | Stability STABLE |

Other Physical and Chemical Properties N/P

Appearance and Odor LIGHT YELLOW LIQUID - SLIGHT ODOR

Conditions to Avoid HEAT, SPARKS, OPEN FLAME, OXIDIZING CONDITIONS

Materials to Avoid STRONG ACIDS, BASES, AND PEROXIDES

Hazardous Decomposition Products INCOMPLETE COMBUSTION CAN RESULT IN CARBON MONOXIDE, CARBON DIOXIDE AND OTHER TOXIC GASES.

XI. Additional Precautions

STORE IN TIGHTLY CLOSED, PROPERLY VENTED CONTAINERS AWAY FROM HEAT, SPARKS, OPEN FLAME, AND STRONG OXIDIZING AGENTS. STORE WITH BUNG IN UP POSITION. CAREFULLY VENT INTERNAL PRESSURE BEFORE REMOVING CLOSURE.

Handling, Storage and Decontamination Procedures FOLLOW STANDARD PLANT PROCEDURES OR SUPERVISOR'S INSTRUCTIONS FOR DECONTAMINATION OPERATIONS.

SOME OF THE INFORMATION PRESENTED AND CONCLUSIONS DRAWN HEREIN ARE FROM SOURCES OTHER THAN DIRECT TEST DATA ON THE MATERIAL ITSELF

General Comments

- - - Note - - - Qualifications: EQ = Equal AP = Approximately N/P = No Applicable Information Found
LT = Less Than UK = Unknown N/AP = Not Applicable
GT = Greater Than TR = Trace N/DA = No Data Available

Disclaimer of Liability

The information in this MSDS was obtained from sources which we believe are reliable. HOWEVER, THE INFORMATION IS PROVIDED WITHOUT ANY WARRANTY, EXPRESS OR IMPLIED, REGARDING ITS CORRECTNESS.

The conditions or methods of handling, storage, use and disposal of the product are beyond our control and may be beyond our knowledge. FOR THIS AND OTHER REASONS, WE DO NOT ASSUME RESPONSIBILITY AND EXPRESSLY DISCLAIM LIABILITY FOR LOSS, DAMAGE OR EXPENSE ARISING OUT OF OR IN ANY WAY CONNECTED WITH THE HANDLING, STORAGE, USE OR DISPOSAL OF THE PRODUCT.

This MSDS was prepared and is to be used only for this product. If the product is used as a component in another product, this MSDS information may not be applicable.



ARCONATE™ 1000 PROPYLENE CARBONATE

MSDS No
HCRO032E
Rev. Date
11/02/90

XII.

Regulatory Information

SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT OF 1986 (SARA), TITLE III

SECTION 311/312 HAZARD CATEGORIES
NONE KNOWN TO APPLY

SECTION 313

NO CHEMICALS IN THIS PRODUCT EXCEED THE DE MINIMUS REPORTING LEVEL ESTABLISHED BY SARA
TITLE III, SECTION 313 AND 40 CFR 372.

TOXIC SUBSTANCES CONTROL ACT (TSCA)

ALL COMPONENTS OF THIS PRODUCT ARE LISTED ON THE TSCA INVENTORY.

COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT (CERCLA)

NO CHEMICALS IN THIS PRODUCT ARE SUBJECT TO THE REPORTING REQUIREMENTS OF CERCLA.

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT OF 1988 - PROPOSITION 65

BASED ON INFORMATION CURRENTLY AVAILABLE, THIS PRODUCT IS NOT KNOWN TO CONTAIN ANY CHEMICALS
CURRENTLY LISTED AS CARCINOGENS OR REPRODUCTIVE TOXINS UNDER CALIFORNIA PROPOSITION 65 AT LEVELS
WHICH WOULD BE SUBJECT TO THE PROPOSITION. IF YOU REFORMULATE OR FURTHER PROCESS THIS PRODUCT,
YOU SHOULD FURTHER EVALUATE THIS PRODUCT BASED UPON SUCH REFORMULATION OR PROCESSING, AS WELL AS
UPON ITS FINAL COMPOSITION AND USE.

XIII.

Label Information

| | | |
|--------------------------------|---|--|
| Manufacturer: | ARCO CHEMICAL COMPANY 3801 WEST CHESTER PIKE NEWTOWN SQUARE, PA. 19073 | Telephone Numbers EMERGENCY 800/424-9300 CHEMTREC 215/353-8300 ARCO CHEM CUSTOMER SERVICE 800/321-7000 INFO ONLY |
| Use Statement: | FOR INDUSTRIAL USE ONLY | |
| Signal Word: | CAUTION | |
| Physical Hazards: | COMBUSTIBLE | |
| Health Hazards: | EYE IRRITANT SKIN IRRITANT | |
| Precautionary Measures: | DO NOT HANDLE NEAR HEAT, SPARKS, OR OPEN FLAME. AVOID CONTACT WITH EYES. AVOID PROLONGED OR REPEATED CONTACT WITH SKIN. WASH THOROUGHLY AFTER HANDLING. | |
| DOT Information: | UN/NA ID Number- N/AP Hazard Class- NOT REGULATED Proper Shipping- NOT REGULATED Component Name PROPYLENE CARBONATE | CAS Number 108-32-7 |
| Instructions: | DRY CHEMICAL CO2 WATERSPRAY | |
| In case of fire, use- | | |
| First Aid -Inhalation | IF OVERCOME BY EXPOSURE, REMOVE VICTIM TO FRESH AIR IMMEDIATELY. GIVE OXYGEN OR ARTIFICIAL RESPIRATION AS NEEDED. OBTAIN EMERGENCY MEDICAL ATTENTION. PROMPT ACTION IS ESSENTIAL. | |
| -Eye Contact | IN CASE OF EYE CONTACT, IMMEDIATELY RINSE WITH CLEAN WATER FOR 20-30 MINUTES. RETRACT EYELIDS OFTEN. OBTAIN EMERGENCY MEDICAL ATTENTION. | |
| -Skin Contact | IMMEDIATELY REMOVE CONTAMINATED CLOTHING. WASH SKIN THOROUGHLY WITH MILD SOAP/WATER. FLUSH W/LUKEWARM WATER FOR 15 MINUTES. IF STICKY, USE WATERLESS CLEANER FIRST. SEEK MEDICAL ATTENTION IF ILL EFFECT OR IRRITATION DEVELOPS. | |
| -Ingestion | IF LARGE QUANTITY SWALLOWED, GIVE LUKEWARM WATER (PINT) IF VICTIM COMPLETELY CONSCIOUS/ALERT. DO NOT INDUCE VOMITING/RISK OF DAMAGE TO LUNGS EXCEEDS POISONING RISK. OBTAIN EMERGENCY MEDICAL ATTENTION. | |
| In case of spill, | EVACUATE/LIMIT ACCESS. PREVENT FLOW TO SEWERS/PUBLIC WATERS. IMPOUND/RECOVER LARGE LAND SPILL; SOAK UP SMALL SPILL. ON WATER, MATERIAL IS PARTIALLY SOLUBLE. CONTAIN/MINIMIZE DISPERSION/COLLECT. REPORT PER REGULATORY REQUIREMENTS. | |
| Protective Equipment: | | |
| -Respiratory | NO SPECIAL RESPIRATORY PROTECTION NORMALLY REQUIRED WHEN USED WITH ADEQUATE VENTILATION. | |
| -Eye | CHEMICAL SPLASH GOGGLES AND/OR FACE SHIELD. | |
| -Skin | PROTECTIVE CLOTHING INCLUDING GLOVES, APRON, SLEEVES, BOOTS, AND FULL HEAD/FACE PROTECTION. | |

**GAF CHEMICALS CORPORATION**

A Subsidiary of GAF CORPORATION

Telephone
201 628 3000
1361 Alps Road
Wayne, NJ 07470

Emergency
Medical Information: 1 800 228 5635
Transportation
Emergency: CHEMTREC 1 800 424 9300

MATERIAL SAFETY DATA SHEET**SECTION 01 - IDENTIFICATION**

MSDS NO 0434 REV 1 DATE 06/89 SHIP SHAPE RESIN CLEANER

DOMESTIC TRADE NAME SHIP SHAPE RESIN CLEANER
EXPORT TRADE NAME:

CAS REGISTRY NO MIXTURE - -
CAS REGISTRY NAME ORGANIC BASED SOLVENT - ALL COMPONENTS ARE LISTED ON TSCA INVENTORY
SYNONYM MIXTURE - CLEANER

SECTION 02 - PHYSICAL & HEALTH HAZARD INGREDIENTS

CAS REGISTRY NO 00000872-50-4
CAS REGISTRY NAME 1-METHYL-2-PYRROLIDINONE
COMMON NAME N-METHYLPYRROLIDONE
HAZARD %
HAZARD REFERENCE TLV TWA 100 PPM (ESTIMATED)

SECTION 03 - PHYSICAL & CHEMICAL CHARACTERISTICS

BOILING POINT NO DATA FOUND
VAPOR PRESSURE NO DATA FOUND
VAPOR DENSITY (AIR=1) NO DATA FOUND
WATER SOLUBILITY NO DATA FOUND
MELTING/FREEZING POINT NO DATA FOUND
APPEARANCE WATER THIN LIQUID
SPECIFIC GRAV (WATER=1) 1.0820
PERCENTAGE VOLATILES NO DATA FOUND
EVAPORATION RATE NO DATA FOUND
PH OF SOLUTION 4.60 - APPROXIMATELY 10% SOLUTION
ODOR SWEET ESTER LIKE ODOR

SECTION 04 - PHYSICAL HAZARD DATA

FLASH POINT 198.00 DEG F (TCC)
AUTOIGNITION TEMP NO DATA FOUND
FLAMMABLE LIMITS NO DATA FOUND

FIRE FIGHTING MEDIA:
DO NOT USE WATER

SPECIAL FIRE FIGHTING PROCEDURES:
FIREFIGHTERS SHOULD WEAR POSITIVE PRESSURE SELF CONTAINED BREATHING APPARATUS WITH A FULL FACE
PIECE COOL FIRE EXPOSED CONTAINERS WITH WATER SPRAY DO NOT PUT FIRE OUT UNLESS FLOW FEEDING IT
CAN BE SAFELY STOPPED CAUTION AFTER FIRE IS EXTINGUISHED MATERIAL VAPORS COULD ACCUMULATE AND
TRAVEL TO A SOURCE OF IGNITION AND FLASH BACK DUE TO SOLVENT.

FIRE/EXPLOSION HAZARDS
COMBUSTIBLE LIQUID DANGEROUS FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME VAPORS ARE HEAVIER THAN
AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK VAPOR AIR
MIXTURES ARE EXPLOSIVE DUE TO SOLVENT

NFPA HAZARD CODES HEALTH/FLAMMABILITY REACTIVITY
NO DATA FOUND
HMIS HAZARD CODES - HEALTH/FLAMMABILITY REACTIVITY
NO DATA FOUND

SECTION 05 - REACTIVITY DATA

STABILITY STABLE
HAZARDOUS POLYMERIZATION WILL NOT OCCUR

CONDITIONS TO AVOID
AVOID CONTACT WITH STRONG OXIDIZING AGENTS AVOID HEATING ABOVE FLASH POINT AVOID HEAT FIRE AND
IGNITION SOURCES

INCOMPATIBLE MATERIALS
STRONG OXIDIZING OR REDUCING AGENTS

HAZARDOUS DECOMPOSITION PRODUCTS
CARBON MONOXIDE CARBON DIOXIDE OXIDES OF NITROGEN SMOKE

SECTION 06 - HEALTH HAZARD DATA

- ACUTE TOXICITY

ORAL TOXICITY
HAZARD ASSESSMENT BASED ON COMPONENT TESTING



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Transportation
Emergency: CHEMTREC 1 800 424 9300

MSDS NO. 0434 REV. 1 DATE 08/89 SHIP SHAPE RESIN CLEANER

SECTION 08 - HEALTH HAZARD DATA (CONT.)

DERMAL TOXICITY
HAZARD ASSESSMENT BASED ON COMPONENT TESTING

INHALATION TOXICITY
HAZARD ASSESSMENT BASED ON COMPONENT TESTING

SKIN IRRITATION:
HAZARD ASSESSMENT BASED ON COMPONENT TESTING

EYE IRRITATION:
HAZARD ASSESSMENT BASED ON COMPONENT TESTING

SENSITIZER NO
NO DATA FOUND

DOT CORROSIVE NO
NO DATA FOUND

PRIMARY ROUTE(S) OF ENTRY: INHALATION / ABSORPTION / CONTACT

- SIGNS & SYMPTOMS OF EXPOSURE -

SYMPTOMS OF INGESTION
NO EFFECTS OF EXPOSURE EXPECTED

SYMPTOMS OF INHALATION:
WILL CAUSE PALLOR, NAUSEA, LACK OF COORDINATION, STUPOR

SYMPTOMS OF SKIN CONTACT:
CONTACT MAY CAUSE IRRITATION, REDNESS, SWELLING OR DERMATITIS

SYMPTOMS OF EYE CONTACT:
VAPORS SLIGHTLY UNCOMFORTABLE, SPLASHES IRRITATING, WILL CAUSE PAINFUL BURNING OR STINGING OF EYES AND LIDS, WATERING OF EYES AND INFLAMMATION OF CONJUNCTIVA

- EMERGENCY FIRST AID PROCEDURES

FIRST AID FOR INGESTION:
GENERAL PRECAUTIONARY MEASURES SUGGEST INDUCING VOMITING IMMEDIATELY BY GIVING TWO GLASSES OF WATER AND STICKING FINGER DOWN THROAT. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON. CALL A PHYSICIAN.

FIRST AID FOR INHALATION:
REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION, PREFERABLY MOUTH-TO-MOUTH. IF BREATHING IS DIFFICULT, GIVE OXYGEN. CALL A PHYSICIAN.

FIRST AID FOR SKIN CONTACT:
FLUSH SKIN WITH WATER

FIRST AID FOR EYE CONTACT:
IMMEDIATELY FLUSH EYES WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. CALL A PHYSICIAN.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE
NO DATA FOUND

EXPOSURE LIMITS:
SEE SECTION 02 FOR PHYSICAL & HEALTH HAZARD INGREDIENTS

- OTHER TOXICITY -

OTHER ACUTE TOXICITY NO DATA FOUND

SUB CHRONIC ORAL TOXICITY NO DATA FOUND

SUB CHRONIC INHALATION TOXICITY NO DATA FOUND

SUB CHRONIC MISCELLANEOUS TOXICITY NO DATA FOUND

AQUATIC TOXICITY NO DATA FOUND

TUMORIGENICITY NO DATA FOUND

MUTAGENICITY NO DATA FOUND

REPRODUCTIVE TOXICITY NO DATA FOUND



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Transportation
Emergency: CHEMTREC 1 800 424 9300

MSDS NO 0434 REV : DATE 08/89 SHIP SHAPE RESIN CLEANER

SECTION 06 - HEALTH HAZARD DATA (CONT.)

MISCELLANEOUS TOXICITY NO DATA FOUND

SECTION 07 - OCCUPATIONAL CONTROL PROCEDURES

VENTILATION:

USE WITH ADEQUATE VENTILATION

RESPIRATORY PROTECTION

NIOSH-APPROVED RESPIRATOR, WHERE TLV OR PEL MAY BE EXCEEDED

EYE PROTECTION

CHEMICAL GOGGLES.

SKIN PROTECTION

IMPERVIOUS GLOVES

PERSONAL HYGIENE

WASH THOROUGHLY AFTER HANDLING.

PROTECTIVE MEASURES DURING REPAIR/MAINTENANCE OF EQUIPMENT.

WASH EQUIPMENT THOROUGHLY WITH STEAM OR WARM WATER UNTIL CLEAN. CHECK FOR FLAMMABLES WITH AN EXPLOSION METER AND ALSO CHECK THE OXYGEN LEVEL WITH AN OXYGEN METER. IN ALL CASES FOLLOW GOOD INDUSTRIAL SAFETY PRACTICES BEFORE ENTERING EQUIPMENT.

SECTION 08 - PRECAUTIONS FOR SAFE HANDLING, STORAGE, AND USE

PRECAUTIONARY MEASURES

AVOID CONTACT WITH EYES AND SKIN. WASH THOROUGHLY AFTER HANDLING. AVOID BREATHING VAPORS OR MIST. USE WITH ADEQUATE VENTILATION. KEEP THIS CONTAINER AND VAPORS FROM THIS CONTAINER AWAY FROM HEAT AND FLAME. KEEP CONTAINER CLOSED.

SPILL/LEAK CLEAN-UP PROCEDURES

ELIMINATE SOURCES OF IGNITION. ABSORB WITH EARTH, SAND OR SIMILAR INERT MATERIAL AND DISPOSE OF WITH SOLID WASTE ACCORDING TO FEDERAL, STATE AND LOCAL REGULATIONS. FLUSH SPILL AREA WITH WATER.

DISPOSAL METHOD:

DISPOSE OF WITH LIQUID WASTE ACCORDING TO FEDERAL, STATE AND LOCAL REGULATIONS.

MATERIAL SAFETY DATA SHEET

PRODUCT NAME: TIPSOLVE II
PRODUCT CODE: M-2716

HMIS CODES: H F R P
2 1 0

===== SECTION I - MANUFACTURER IDENTIFICATION =====

MANUFACTURER'S NAME: PRILLAMAN CHEMICAL CORP.
ADDRESS: P.O. BOX 4024, 825 FISHER RD.
EMERGENCY PHONE: 800-424-9300 (24hrs) INFORMATION PHONE: 703-638-8829
DATE REVISED : 03-25-91 NAME OF PREPARER : PRILLAMAN CHEMICAL
REASON REVISED : NEW

===== SECTION II - HAZARDOUS INGREDIENTS/SARA III INFORMATION =====

| HAZARDOUS COMPONENTS | CAS NUMBER | OCCUPATIONAL EXPOSURE LIMITS | | | VAPOR PRESSURE mm Hg @ TEMP | WEIGHT PERCENT |
|------------------------------|------------|------------------------------|-----------|------------|--------------------------------|-------------------|
| | | OSHA PEL | ACGIH TLV | OTHER | | |
| DIOXOLANONE | 108-32-7 | N.EST. | N.EST. | N.EST. | 0.1 | 100F |
| n-METHYL-2-PYRROLIDONE (NMP) | 872-50-4 | N.EST. | N.EST. | 100ppm*MFG | 1.0 | 70F |
| PROPRIETARY SUEFACTANT | PROPRIETRY | N. EST. | N. EST. | LD50:<500 | 4.5 | 68F |

*** No toxic chemical(s) subject to the reporting requirements of section 313 of Title III and of 40 CFR 372 are present. ***
DOT INFORMATION: NOT REGULATED BY DOT.

===== SECTION III - PHYSICAL/CHEMICAL CHARACTERISTICS =====

BOILING RANGE: 320 to 468 Deg F SPECIFIC GRAVITY (H2O=1): 1.2
VAPOR DENSITY: HEAVIER THAN AIR EVAPORATION RATE: SLOWER THAN ETHER
COATING V.O.C.: 10.02 LB/GL (1201 G/L)
MATERIAL V.O.C.: 10.02 LB/GL (1201 G/L)
SOLUBILITY IN WATER: COMPLETE
APPEARANCE AND ODOR: COLORLESS LIQUID/ MILD, ESTER ODOR

===== SECTION IV - FIRE AND EXPLOSION HAZARD DATA =====

FLASH POINT: 270 DEG.F METHOD USED:
FLAMMABLE LIMITS IN AIR BY VOLUME- LOWER: 1.3% UPPER: 32.5%

EXTINGUISHING MEDIA: FOAM, CO2, DRY CHEMICAL

SPECIAL FIREFIGHTING PROCEDURES

WATER OR FOAM MAY CAUSE FROTHING. USE WATER TO COOL FIRE-EXPOSED CONTAINERS. IF A LEAK OR SPILL HAS NOT IGNITED, USE WATER SPRAY TO DISPERSE THE VAPORS FOR PROTECTION OF PERSONS ATTEMPTING TO STOP THE LEAK.

UNUSUAL FIRE AND EXPLOSION HAZARDS

NONE

===== SECTION VII - PRECAUTIONS FOR SAFE HANDLING AND USE =====

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

EVACUATE ACCESS. STOP RELEASE. PREVENT FLOW TO SEWERS. RESTRICT WATER USE FOR CLEANUP. WIPE UP OR ABSORB ON SUITABLE MATERIAL AND SHOVEL UP. DISPERSE RESIDUE TO REDUCE AQUATIC HARM. REPORT PER REGULATORY REQUIREMENTS.

WASTE DISPOSAL METHOD

CONTAMINATED PRODUCT/SOIL/WATER, SPENT SOLVENT AND SPILL CLEANUP MATERIALS MAY BE RCRA/OSHA HAZARDOUS WASTE. WASTE MAY BE DESIGNATED P003, P004, P005 UNDER RCRA LISTINGS DEPENDING ON SPECIFIC SOLVENTS INVOLVED. LANDFILL SOLIDS AT PERMITTED SITES. USE REGISTERED TRANSPORTERS. BURN CONCENTRATED LIQUIDS. AVOID FLAMEOUTS. ASSURE EMISSIONS COMPLY WITH REGULATIONS.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

STORE IN TIGHTLY CLOSED, PROPERLY VENTED CONTAINERS AWAY FROM HEAT, SPARKS, OPEN FLAME, AND STRONG OXIDIZING AGENTS. STORE WITH BUNG IN UP POSITION. CAREFULLY VENT INTERNAL PRESSURE BEFORE REMOVING CLOSURE.

OTHER PRECAUTIONS

MATERIALS TO AVOID - STRONG ACIDS, BASES, AND PEROXIDES. MINIMUM FEASIBLE HANDLING TEMPERATURES SHOULD BE MINIMIZED. WATER CONTAMINATION SHOULD BE MINIMIZED. WATER CONTAMINATION SHOULD BE AVOIDED. INCOMPLETE COMBUSTION CAN RESULT IN CARBON DIOXIDE AND OTHER TOXIC GASES.

===== SECTION VIII - CONTROL MEASURES =====

RESPIRATORY PROTECTION

NO SPECIAL RESPIRATORY PROTECTION EQUIPMENT IS RECOMMENDED UNDER ANTICIPATED CONDITIONS OF NORMAL USE WITH ADEQUATE VENTILATION. BELIEVED TO BE MINIMALLY IRRITATING.

VENTILATION

NO SPECIAL RESPIRATORY PROTECTION NORMALLY REQUIRED WHEN USED WITH ADEQUATE VENTILATION.

PROTECTIVE GLOVES

PROTECTIVE CLOTHING INCLUDING GLOVES, APRON, SLEEVES, BOOTS, AND FULL HEAD/FACE PROTECTION.

EYE PROTECTION

CHEMICAL SPLASH GOGGLES AND/OR FACE SHIELD.

OTHER PROTECTIVE CLOTHING OR EQUIPMENT

PROTECTIVE CLOTHING INCLUDING GLOVES, APRON, SLEEVES, BOOTS, AND FULL HEAD/FACE PROTECTION.

WORK/HYGIENIC PRACTICES

CLEANSING EXPOSED SKIN AREAS SEVERAL TIMES DAILY WITH SOAP AND WATER, AND LAUNDERING SOILED WORK CLOTHING WEEKLY.

===== SECTION IX - DISCLAIMER =====

DISCLAIMER

PRILLAMAN BELIEVES THE INFORMATION ON THIS MATERIAL SAFETY DATA SHEET IS ACCURATE. THE SUGGESTED PROCEDURES ARE BASED ON EXPERIENCE AS OF THE DATE OF PUBLICATION. THEY ARE NOT NECESSARILY ALL-INCLUSIVE NOR FULLY ADEQUATE IN EVERY CIRCUMSTANCE. ALSO, THE SUGGESTIONS SHOULD NOT BE CONFUSED WITH NOR FOLLOWED IN VIOLATION OF APPLICABLE LAWS.



A C C E P T

FLUID RECOVERY

MSDS ATTACHED

* * F L U I D R E C O V E R Y * *

CUSTOMER INFORMATION:

BILLING ADDRESS:

GRADY WHITE BOATS
GREENVILLE BLVD, N.E.
GREENVILLE

NC 27834

PO BOX 1527
GREENVILLE

NC 27834

ATTN: DOUG HOFFMAN

BRANCH: 317101 TONY CROTTS COUNTY: PITT

NATURE OF BUSINESS: BOAT MFG

FEDERAL EPA ID: NCDO44387538 STATE EPA: ID:

MANIFEST ADDRESS IS FACILITY MANIFEST TO SAFETY-KLEEN SIC #: 3732

MATERIAL: DBE

PROCESS: CLEANING TOOLS

VOLUME: 150 GALS PER WEEK

VOLUME ON HAND: 55

STORAGE CAPACITY: 55 IN DRUMS

SHIPPING FREQUENCY: WKLY IN DRUMS

COLOR: GREEN

LAYERS: ONE

PHYSICAL STATE: LIQUID

VISCOSITY: LOW

MATERIAL COMPOSITION(VOL%):

DIBASIC ESTER (TM DUPONT)

CODE

MIN

MAX

TYPICAL

POLYESTER RESIN

DBE

0.0

75.0

STYRENE

0.0

15.0

MEK PEROXIDE

0.0

10.0

RESTRICTED SUBSTANCES: NONE

D.O.T. HAZARDOUS MATERIAL: CUSTOMER REQUEST ASSISTANCE

EPA HAZARDOUS WASTE: CUSTOMER REQUEST ASSISTANCE

P.O. NO: 54509

BRANCH: 317101

DATE: 01/24/90

TYPE OF SAMPLE: COMPOSITE

NUMBER OF DRUMS SAMPLED: 2

TAKEN BY: SALESREP

CONTACT: DOUG HOFFMAN

TITLE: PLANT ENGR

PHONE: 919-000-0000

SURVEY COMMENTS: PLEASE REVIEW FOR DBE RECOVERY IN SK-DUPONT AGREEMENT.

H & S OK, CAP & EJE 02/08/90

CORPORATE REVIEWS: DISPOSITION REVIEWER DATE

TECHNICAL: ACCEPT EJE 02/26/90

HANDLING CODES: 502/T63

PRICING CODE: F3

REGULATORY: ACCEPT TAL 02/26/90

OPERATING: ACCEPT JWH 02/27/90

APPROVED FACILITIES:

(658) SAFETY-KLEEN CORP (635) SAFETY-KLEEN CORP

STATE HWY 146 1200 SYLVAN ST

NEW CASTLE KY 40050 LINDEN NJ 07036

FED EPA#: KYD053348108

NJDO02182897

STATE EPA#:

TELEPHONE: 502/845-2453

201/862-2000

IL. AUTH#:

EPA WASTE CODES
D001

APPROVD 0002026 DRUM OR BULK

0000999 SPECIAL NOTICE

DOT-EPA RQ WASTE FLAMMABLE LIQUID, N.O.S.

PROPER SHIPPING DESCRIPTION WAS BASED

DESC. (STYRENE) UN1993

ON KNOWLEDGE OF SIMILIAR WASTES, AND

(D001)(ERG#27)

WAS NOT BASED ON THIS SINGLE ANALYSIS.

COMMENTS: OK FOR RECOVERY. FRS CAT III. OK FOR DBE RECOVERY
PROGRAM. SEE JIM OSTROWSKI FOR DETAILS.THIS SERVES AS NOTICE PER, 40CFR264.12(B), THAT THE FACILITY(IES) NOTED ABOVE
HAS THE APPROPRIATE PERMITS AND IS WILLING TO RECEIVE THE MATERIAL DESCRIBED.

ACCEPT
MSDS ATTACHED

FLUID RECOVERY
LADY WHITE BOATS

** FLUID RECOVERY **

GENERAL ANALYSIS OF TOTAL SAMPLE

COLOR : BROWN/GREEN
WATER CONTENT : 0.4 WT%
FLAMMABILITY :
FLAMMABILITY : NO FLASH AT 102 F BY SETAFLASH
PH : EXTRACT BY METER 6.4
RADIOACTIVITY : NONE DETECTED

HEAT EVALUATION OF TOTAL SAMPLE

HEAT CONTENT: 9900 BTU/LB
TOTAL FLUORINE F : < 0.1 WT%
TOTAL BROMINE BR: < 0.1 WT%
ASH UPON COMBUSTION: < 1.0 WT%
TOTAL CHLORINE CL: < 0.0 WT%
TOTAL SULFUR S : < 0.1 WT%

GENERAL COMPOSITION:

| | SPECIFIC GRAVITY | VISCOSITY (CENTIPOISE) | GENERAL COMPOSITION BY: | |
|-------------------------------|------------------|------------------------|-------------------------|--------------|
| | | | APPEARANCE (VOL%) | TOTAL (VOL%) |
| AQUEOUS PHASE (FREE WATER) | | | 0.0 | 0.0 |
| ORGANIC PHASE (FEEDSTOCK) | | | 99.0 | 99.0 |
| BOTTOM SLUDGE (SEMISOLIDS) | | | 0.0 | 0.0 |
| BOTTOM SOLID (SETTLED SOLIDS) | | | 1.0 | 1.0 |
| TOTAL | 1.080 | < 50 CPS | 100.0 | 100.0 |

RECOVERY EVALUATION OF TOTAL SAMPLE

| COMPOSITION OF: | | TOTAL SAMPLE (VOL%) | TOTAL SAMPLE (VOL%) |
|--|--|---------------------|---------------------|
| BOTTOMS OIL | | 28.0 | 28.0 |
| BOTTOMS NON-OIL | | 0.0 | 0.0 |
| PHASED DISTILLATE WATER | | 0.0 | 0.0 |
| DISTILLATE SOLVENT | | 72.0 | 72.0 |
| TOTAL | | 100.0 | 100.0 |
| BOTTOMS DESCRIPTION : OIL | | | |
| OVERHEAD ENDPOINT TEMP: 415 | | | |
| COMMENTS: DIST RANGE 158F TO 415F/THERMALLY STABLE | | | |

VOLATILE ORGANIC COMPOSITION OF TOTAL SAMPLE BY GAS CHROMATOGRAPHY

SAMPLE PREPARATION METHODS: CS2-EXTRACT
DETECTION METHODS : FID, FID

| COMPOUND NAME | CODE | CAS NUMBER | COMPOSITION OF: | | TOTAL SAMPLE (VOL%) |
|---------------------------|------|------------|-------------------------|--------------------------|---------------------|
| | | | VOLATILE ORGANICS (WT%) | VOLATILE ORGANICS (VOL%) | |
| IBASIC ESTER (TM DUPONT) | DBE | 1-31-0 | 95.3 | 94.5 | 68.0 |
| TYRENE | STY | 100-42-5 | 3.9 | 4.7 | 3.4 |
| TOTAL OTHERS (<1.0% EACH) | TO | 0-05-5 | 0.8 | 0.9 | 0.6 |
| TOTAL | | | 100.0 | 100.0 | 72.0 |

SUMMARY OF VOLATILE ORGANIC COMPOSITION BY COMPOUND CHEMICAL CLASS WT%:

| | | |
|-----------------------|------|------------------------|
| ALCOHOLS | | ALIPHATIC HYDROCARBONS |
| AROMATIC HYDROCARBONS | 3.9 | CHLORINATED SOLVENTS |
| ESTERS | 95.3 | ETHERS |
| GLYCOL ETHERS | | INHIBITORS |
| KETONES | | NITROGEN COMPOUNDS |

SPECIFIC ORGANIC COMPOSITION

POLYCHLORINATED BIPHENYLS (PCBS): NONE DETECTED <

| | | | | | | |
|----------------------|-----------|--------------------|-----------------------|--|----------|------------------|
| LABORATORY REVIEW: A | | | TRACKING INFORMATION: | | DATE | FACILITY |
| LEVEL: | SEG CODE: | RELEASED: 03/02/90 | SURVEY RECEIVED : | | 02/09/90 | SK TECHNICAL CEN |
| AB REVIEWERS: | CR CR | ANALYZED: 02/21/90 | SAMPLE RECEIVED : | | 02/09/90 | |
| | | | RESAMPLE SHIPPED : | | | |
| | | | RESAMPLE RECEIVED: | | | |

THE ANALYSES CONTAINED HEREIN ARE PERFORMED SOLELY FOR THE PURPOSE OF QUALIFYING THE ANALYZED MATERIALS FOR ACCEPTANCE BY SAFETY-KLEEN IN ACCORDANCE WITH ITS PERMITS AND PROCESSING CAPABILITY.

NOTICE OF LAND DISPOSAL RESTRICTION OF WASTE IS REQUIRED UNDER 40 CFR PART 268.

NOTICE OF LAND DISPOSAL RESTRICTION OF WASTE

TO: SAFETY-KLEEN CORP EPA ID NO: NJD002182897

1200 SYLVAN ST

LINDEN NJ 07036

Under manifest number _____ line number _____ (enter 11a, 11b, 11c, OR 11d) the Generator noted below is shipping to you a waste determined to be restricted under 40 CRF Part 268. In accordance with 40 CFR 268.7, the generator hereby provides notice that the waste is restricted and the EPA waste code and the appropriate treatment standards are as follows:

EPA Waste Codes: **D001**

| <u>F001-F005 Spent Solvents</u> | <u>TREATMENT STANDARDS (mg/l)</u> | | <u>Check All That Apply</u> |
|--|-----------------------------------|---------------------------------|-----------------------------|
| | <u>Wastewater w/Solvents</u> | <u>All Other Solvent Wastes</u> | |
| Regulated Hazardous Constituent | | | |
| Acetone | 0.05 | 0.59 | _____ |
| Benzene | 0.07 | 3.7 | _____ |
| n-Butyl alcohol | 5.0 | 5.0 | _____ |
| Carbon disulfide | 1.05 | 4.81 | _____ |
| Carbon tetrachloride | 0.05 | 0.96 | _____ |
| Chlorobenzene | 0.15 | 0.05 | _____ |
| Cresols (and cresylic acid) | 2.82 | 0.75 | _____ |
| Cyclohexanone | 0.125 | 0.75 | _____ |
| 1,2-Dichlorobenzene | 0.68 | 0.125 | _____ |
| Ethyl acetate | 0.05 | 0.75 | _____ |
| Ethyl benzene | 0.05 | 0.053 | _____ |
| Ethyl ether | 0.05 | 0.75 | _____ |
| Isobutanol | 5.0 | 5.0 | _____ |
| Methanol | 0.25 | 0.75 | _____ |
| Methylene chloride | 0.2 | 0.96 | _____ |
| Methylene chloride(from Pharm. Industry) | 0.44 | 0.96 | _____ |
| Methyl ethyl ketone | 0.05 | 0.75 | _____ |
| Methyl isobutyl ketone | 0.05 | 0.33 | _____ |
| Nitrobenzene | 0.65 | 0.125 | _____ |
| Pyridine | 1.12 | 0.33 | _____ |
| Tetrachloroethylene | 0.079 | 0.05 | _____ |
| Toluene | 1.12 | 0.33 | _____ |
| 1,1,1-Trichloroethane | 1.05 | 0.41 | _____ |
| 1,1,2-Trichloroethane | 0.03 | 7.6 | _____ |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 1.05 | 0.96 | _____ |
| Trichlorethylene | 0.062 | 0.091 | _____ |
| Trichlorofluoromethane | 0.05 | 0.96 | _____ |
| Xylene | 0.05 | 0.15 | _____ |

| <u>California List Prohibited Wastes</u> | <u>Level (mg/l)</u> | <u>Treatment Standard</u> |
|--|---------------------|---------------------------|
| Halogenated Organic Compounds | 1000.0 | Incineration |
| Arsenic (As) Nonwastewaters | 500.0 | None |
| Mercury (Hg) Nonwastewaters | 20.0 | None |
| Nickel (Ni) | 134.0 | None |
| Thallium (Tl) | 130.0 | None |
| Chlorinated Biphenyls (PCB's) | 50.0 | Incineration |

| <u>Waste Descriptions and/or Treatment Subcategory</u> | | <u>Treatment Standards Reference in 40 CFR and Technology Codes for 40 CFR 268.42(a)</u> | | <u>Check All That Apply</u> |
|--|--|--|----------------------------------|-----------------------------|
| <u>Waste Code</u> | <u>Description</u> | <u>Wastewaters</u> | <u>Nonwastewaters</u> | |
| D001: | Wastewaters (<1.0 wt% TOC and TSS) | 268.42(a) DEACT | NA | |
| | Low TOC Ignitable Liquids (<10 wt% TOC) | NA | 268.42(a) DEACT | |
| | High TOC Ignitable Liquids (>10 wt% TOC) | NA | 268.42(a) RORGS, FSUBS, or INCIN | <u>X</u> |
| D002 | Corrosives, all subcategories & CA list | 268.42(a) DEACT | 268.42(a) DEACT | |
| D004 | Arsenic (As) | 268.43(a) | 268.41(a) | |
| D005 | Barium (Ba) | 268.43(a) | 268.41(a) | |
| D006 | Cadmium (Cd) | 268.43(a) | 268.41(a) | |
| D007 | Chromium (Cr) | 268.43(a) | 268.41(a) | |
| D008 | Lead (Pb) | 268.43(a) | 268.41(a) | |
| D009: | Low Mercury Subcategory (<260 ppm Hg) | 268.43(a) | 268.41(a) | |
| | High Mercury Subcategory (>=260 ppm Hg) | 268.43(a) | 268.42(a) RMERC | |
| D010 | Selenium (Se) | 268.43(a) | 268.41(a) | |
| D011 | Silver (Ag) | 268.43(a) | 268.41(a) | |
| Other Codes | See attachment for supplemental list | | | |

Generator Name: GRADY WHITE BOATS EPA ID: NCD044387538

Generator Representative Signature: _____

Name & Title of Representative: _____

Safety-Kleen Sample Number: 083120 Control Number: 0055186

NOTICE OF LAND DISPOSAL RESTRICTION OF WASTE

TO: SAFETY-KLEEN CORP EPA ID NO: KYD053348108

STATE HWY 148

NEW CASTLE KY 40050

Under manifest number _____ line number _____ (enter 11a, 11b, 11c, OR 11d) the Generator noted below is shipping to you a waste determined to be restricted under 40 CFR Part 268. In accordance with 40 CFR 268.7, the generator hereby provides notice that the waste is restricted and the EPA waste code and the appropriate treatment standards are as follows:

EPA Waste Codes: **D001**

| <u>F001-F005 Spent Solvents</u> <u>Regulated Hazardous Constituent</u> | <u>TREATMENT STANDARDS (mg/l)</u> | | <u>Check All That Apply</u> |
|---|-----------------------------------|---------------------------------|-----------------------------|
| | <u>Wastewater w/Solvents</u> | <u>All Other Solvent Wastes</u> | |
| Acetone | 0.05 | 0.59 | _____ |
| Benzene | 0.07 | 3.7 | _____ |
| n-Butyl alcohol | 5.0 | 5.0 | _____ |
| Carbon disulfide | 1.05 | 4.81 | _____ |
| Carbon tetrachloride | 0.05 | 0.96 | _____ |
| Chlorobenzene | 0.15 | 0.05 | _____ |
| Cresols (and cresylic acid) | 2.82 | 0.75 | _____ |
| Cyclohexanone | 0.125 | 0.75 | _____ |
| 1,2-Dichlorobenzene | 0.68 | 0.125 | _____ |
| Ethyl acetate | 0.05 | 0.75 | _____ |
| Ethyl benzene | 0.05 | 0.053 | _____ |
| Ethyl ether | 0.05 | 0.75 | _____ |
| Isobutanol | 5.0 | 5.0 | _____ |
| Methanol | 0.25 | 0.75 | _____ |
| Methylene chloride | 0.2 | 0.96 | _____ |
| Methylene chloride(from Pharm. Industry) | 0.44 | 0.96 | _____ |
| Methyl ethyl ketone | 0.05 | 0.75 | _____ |
| Methyl isobutyl ketone | 0.05 | 0.33 | _____ |
| Nitrobenzene | 0.65 | 0.125 | _____ |
| Pyridine | 1.12 | 0.33 | _____ |
| Tetrachloroethylene | 0.079 | 0.05 | _____ |
| Toluene | 1.12 | 0.33 | _____ |
| 1,1,1-Trichloroethane | 1.05 | 0.41 | _____ |
| 1,1,2-Trichloroethane | 0.03 | 7.6 | _____ |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 1.05 | 0.96 | _____ |
| Trichloroethylene | 0.062 | 0.091 | _____ |
| Trichlorofluoromethane | 0.05 | 0.96 | _____ |
| Xylene | 0.05 | 0.15 | _____ |

| <u>California List Prohibited Wastes</u> | <u>Level (mg/l)</u> | <u>Treatment Standard</u> |
|--|---------------------|---------------------------|
| Halogenated Organic Compounds | 1000.0 | Incineration |
| Arsenic (As) Nonwastewaters | 500.0 | None |
| Mercury (Hg) Nonwastewaters | 20.0 | None |
| Nickel (Ni) | 134.0 | None |
| Thallium (Tl) | 130.0 | None |
| Chlorinated Biphenyls (PCB's) | 50.0 | Incineration |

| <u>Waste Descriptions and/or Treatment Subcategory</u> | | <u>Treatment Standards Reference in 40 CFR and Technology Codes for 40 CFR 268.42(a)</u> | | <u>Check All That Apply</u> |
|--|--|--|----------------------------------|-----------------------------|
| <u>Waste Code</u> | <u>Description</u> | <u>Wastewaters</u> | <u>Nonwastewaters</u> | |
| D001: | Wastewaters (<1.0 wt% TOC and TSS) | 268.42(a) DEACT | NA | |
| | Low TOC Ignitable Liquids (<10 wt% TOC) | NA | 268.42(a) DEACT | |
| | High TOC Ignitable Liquids (>10 wt% TOC) | NA | 268.42(a) RORGS, FSUBS, or INCIN | <u>X</u> |
| D002 | Corrosives, all subcategories & CA list | 268.42(a) DEACT | 268.42(a) DEACT | |
| D004 | Arsenic (As) | 268.43(a) | 268.41(a) | |
| D005 | Barium (Ba) | 268.43(a) | 268.41(a) | |
| D006 | Cadmium (Cd) | 268.43(a) | 268.41(a) | |
| D007 | Chromium (Cr) | 268.43(a) | 268.41(a) | |
| D008 | Lead (Pb) | 268.43(a) | 268.41(a) | |
| D009: | Low Mercury Subcategory (<260 ppm Hg) | 268.43(a) | 268.41(a) | |
| | High Mercury Subcategory (>=260 ppm Hg) | 268.43(a) | 268.42(a) RMERC | |
| D010 | Selenium (Se) | 268.43(a) | 268.41(a) | |
| D011 | Silver (Ag) | 268.43(a) | 268.41(a) | |
| Other Codes See attachment for supplemental list | | | | |

Generator Name: GRADY WHITE BOATS EPA ID: NCD044387538

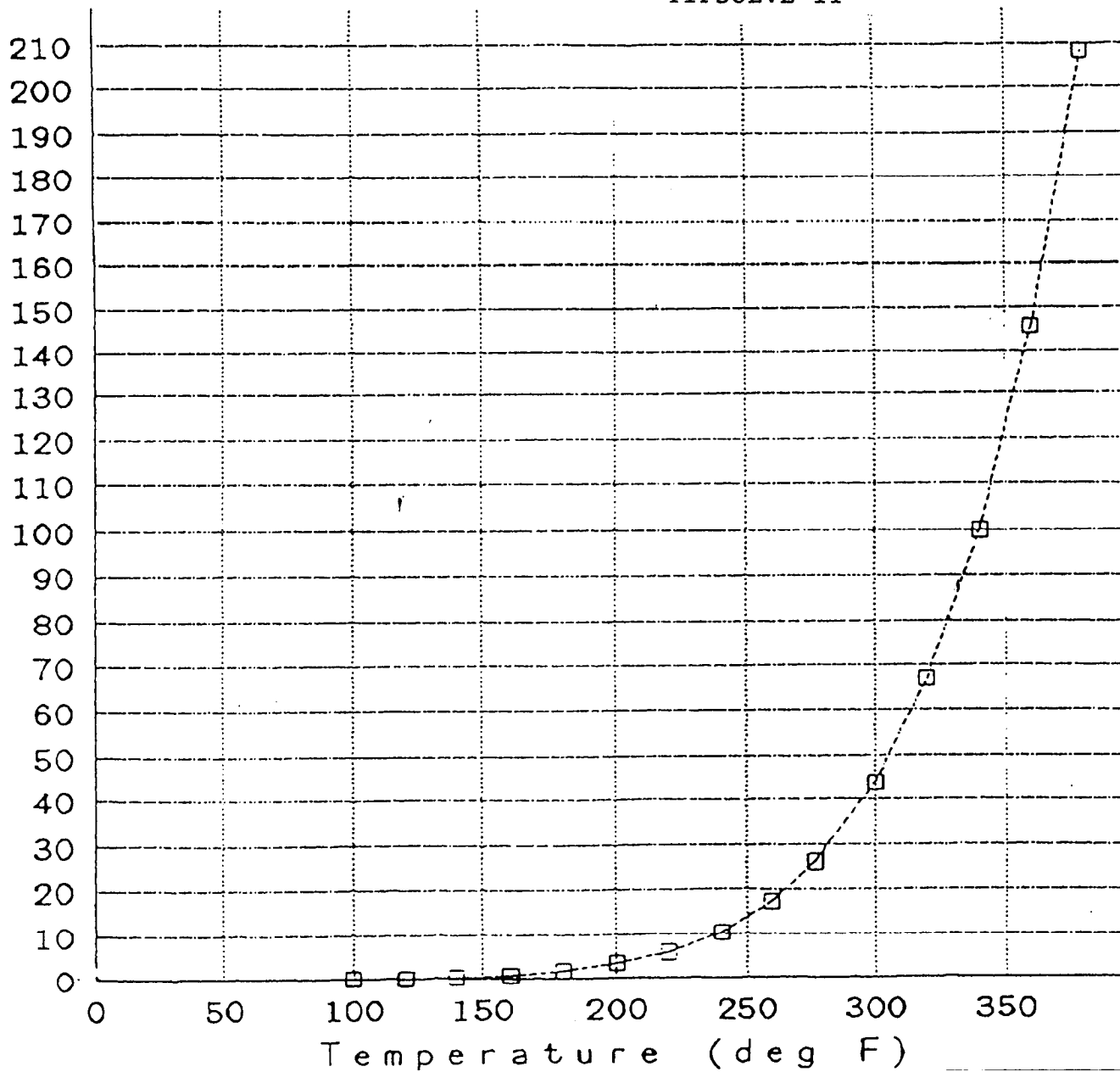
Generator Representative Signature: _____

Name & Title of Representative: _____

Safety-Kleen Sample Number: 083120 Control Number: 0055186

VAPOR PRESSURE

TIPSOLVE II



mm Hg

□--- Tipsolve II

EXECUTIVE SUMMARY

GAF SHIPSHAPE SOLVENT RESIN MATRIX EXPOSURE SERIES

COMBINED PROPERTY INDEX - AVERAGE INDEX VALUE

NOMENCLATURE: (RESIN TYPE)-(SOLVENT LEVEL)-(CATALYST LEVEL)

EXAMPLE: DCPD-0-1.5

| PANEL NO. | MATERIAL ID. | INDEX VALUE % | | | | | | AVG. INDEX% |
|--------------|-----------------|---------------|-------|----------|-----------|---------|-----------|----------------|
| | | SHEAR | COMP. | FLEX.ST. | FLEX.MOD. | TEN.ST. | TEN. MOD. | |
| 1 | DCPD-0-1.5 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| 2 | DCPD-1-1.5 | 91.5 | 103.0 | 105.5 | 106.9 | 100.1 | 106.9 | 102.3 |
| 3 | DCPD-5-1.5 | 106.9 | 97.0 | 92.3 | 91.2 | 96.0 | 91.2 | 95.8 |
| 4 | DCPD-10-1.5 | 88.0 | 96.2 | 89.7 | 95.7 | 107.1 | 95.7 | 95.4 |
| 5 | DCPD-5-H2O-1.5 | 86.1 | 93.4 | 80.6 | 86.8 | 81.3 | 86.8 | 85.8 |
| 6 | ISO-0-1.5 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| 7 | ISO-1-1.5 | 98.6 | 95.0 | 94.6 | 94.0 | 88.4 | 94.0 | 94.1 |
| 8 | ISO-5-1.5 | 114.4 | 92.7 | 111.2 | 108.0 | 113.3 | 108.0 | 107.9 |
| 9 | ISO-10-1.5 | 89.3 | 99.8 | 91.7 | 96.1 | 102.3 | 96.1 | 95.9 |
| 10 | ISO-5-H2O-1.5 | 102.9 | 91.5 | 94.2 | 91.6 | 81.9 | 91.6 | 92.3 |
| 11 | GP-0-1.5 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| 12 | GP-1-1.5 | 103.8 | 100.5 | 98.8 | 96.9 | 86.3 | 86.5 | 95.5 |
| 13 | GP-5-1.5 | 102.4 | 82.9 | 100.0 | 103.1 | 82.3 | 83.8 | 92.4 |
| 14 | GP-10-1.5 | 76.1 | 66.0 | 79.0 | 83.0 | 77.4 | 61.9 | 73.9 |
| 15 | GP-5-H2O-1.5 | 74.1 | 55.0 | 62.2 | 62.4 | 73.3 | 78.7 | 67.6 |
| 16 | VE-0-1.5 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| 17 | VE-1-1.5 | 95.7 | 106.3 | 102.2 | 106.3 | 90.6 | 94.9 | 99.3 |
| 18 | VE-5-1.5 | 91.3 | 108.3 | 97.4 | 99.9 | 94.3 | 91.7 | 97.2 |
| 19 | VE-10-1.5 | 84.6 | 97.9 | 83.2 | 81.0 | 106.9 | 97.2 | 91.8 |
| 20 | VE-5-H2O-1.5 | 77.7 | 90.5 | 78.6 | 78.4 | 93.4 | 99.3 | 86.3 |

GAF SHIPSHAPE SOLVENT
RESIN MATRIX EXPOSURE SERIES

BARCOL HARDNESS DEVELOPMENT

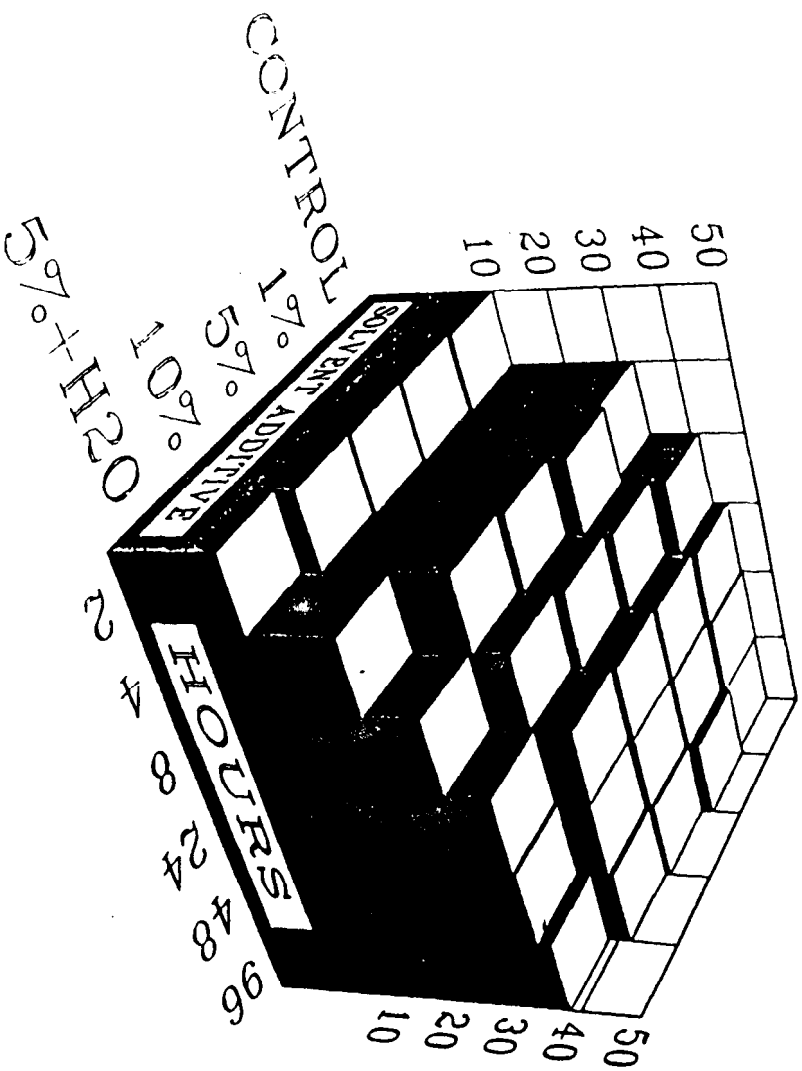
BARCOL IMPRESSOR GYZJ 934-1
AVERAGE - 10 READINGS

| RESIN TYPE | INTERVAL (HOURS) | SOLVENT | | | LEVEL | |
|---------------|---------------------|---------|------|------|-------|--------|
| | | 0% | 1% | 5% | 10% | 5%+H2O |
| DCPD | 2 | 10.2 | 9.5 | 9.1 | 8.5 | <5.0 |
| | 4 | 32.7 | 33.7 | 30.4 | 29.1 | 19.4 |
| | 8 | 41.4 | 38.5 | 36.9 | 35.0 | 28.4 |
| | 24 | 44.1 | 43.1 | 42.6 | 41.7 | 35.6 |
| | 48 | 44.4 | 43.3 | 42.6 | 41.5 | 36.0 |
| | 96 | 44.2 | 45.0 | 43.0 | 42.1 | 38.2 |
| ISO | 2 | 5.2 | 5.3 | 5.1 | <5.0 | <5.0 |
| | 4 | 30.6 | 31.5 | 32.4 | 31.1 | 28.6 |
| | 8 | 34.1 | 35.8 | 36.8 | 34.9 | 35.3 |
| | 24 | 37.5 | 38.2 | 38.7 | 37.9 | 35.8 |
| | 48 | 40.0 | 40.6 | 41.0 | 39.7 | 34.7 |
| | 96 | 40.0 | 40.7 | 41.1 | 39.9 | 35.1 |
| GP | 2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 4 | 26.1 | 24.4 | 21.1 | 19.4 | 11.2 |
| | 8 | 31.4 | 32.8 | 30.6 | 27.5 | 20.0 |
| | 24 | 34.2 | 34.1 | 33.4 | 29.5 | 21.8 |
| | 48 | 35.2 | 35.6 | 35.3 | 31.6 | 22.8 |
| | 96 | 37.6 | 37.7 | 35.1 | 30.1 | 22.7 |
| VE | 2 | <5.0 | <5.0 | 0.0 | 0.0 | 0.0 |
| | 4 | 22.8 | 21.6 | 20.7 | 19.4 | 21.5 |
| | 8 | 27.0 | 26.1 | 25.5 | 24.4 | 23.5 |
| | 24 | 30.2 | 28.3 | 27.7 | 26.3 | 30.2 |
| | 48 | 35.7 | 32.9 | 31.5 | 29.8 | 30.4 |
| | 96 | 36.4 | 35.8 | 35.2 | 33.4 | 30.0 |

* 1.5% MEKP CATALYST

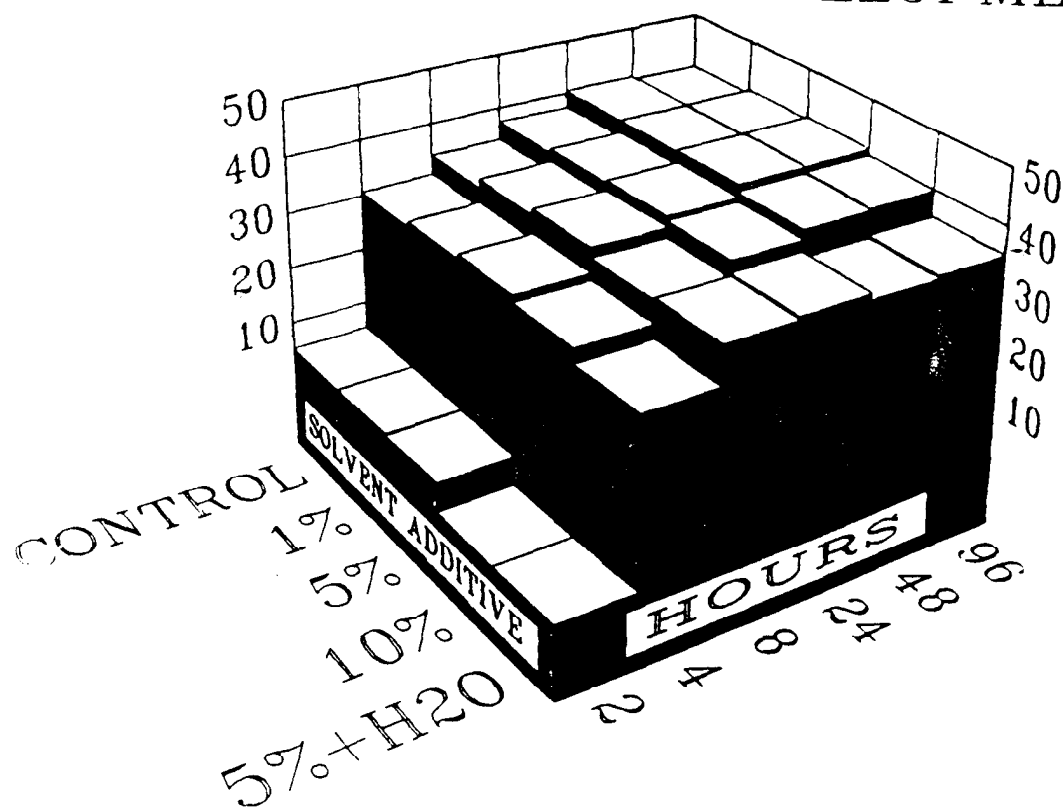
** TEMP. 77°F

BARCOL HARDNESS DEVELOPMENT



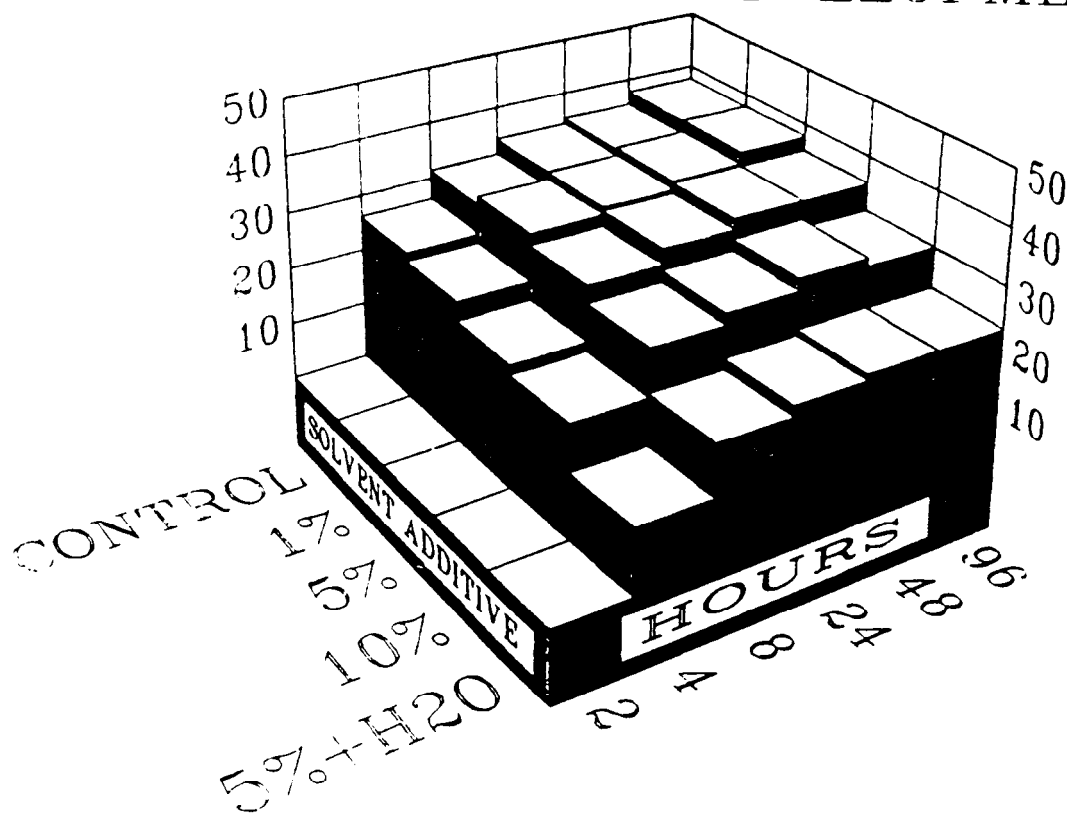
DCPD RESIN - 1.5% CATALYST @ 25~C

BARCOL HARDNESS DEVELOPMENT



ISO RESIN - 1.5% CATALYST @ 25°C

BARCOL HARDNESS DEVELOPMENT



GP RESIN - 1.5% CATALYST @ 25~C