December 19, 2016

Clemson University
310 Klugh Avenue
Clemson, South Carolina 29634

Attn: Mr. W. Robert Newberry, IV
E-mail: wnewber@clemson.edu

Re: Limited VOC Investigation Report
Harris A. Smith / Packaging Science Building
Room 115 – Digital Imaging
Clemson, South Carolina
Terracon Project No. 86127158 – Task 73

Dear Mr. Newberry:

Terracon Consultants, Inc. (Terracon) conducted a limited volatile organic compound (VOC) investigation in Room 115, located in the basement of the Harris A. Smith Building located on the main campus of Clemson University, in Clemson, South Carolina after employees working in the space expressed concerns related to indoor air quality. This service was conducted in general accordance with our Master Service Agreement with Clemson University.

PROJECT DESCRIPTION

Scope of Services

At the request of Clemson University, Terracon representative Mr. Benjamin Hestir conducted a limited VOC investigation in Room 115 in the basement of the Harris A. Smith Building on December 12-13, 2016. The manager of the space is Shane Hutchings. Reportedly, Mr. Hutchings and other employees there have been experiencing health related issues which they feel may be related to a solvent used for cleaning plates in a digital imaging device located in Room 115.

Terracon measured and data logged Total VOCs in the room using a MiniRae 3000 VOC monitor for approximately 24 hours.

Standard of Care

This limited VOC investigation was conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions in the same locale. Terracon did not attempt to identify every potential exposure or hazard present in the subject building. The results, findings, conclusions and recommendations expressed in this report are based on conditions observed during our sampling. Many factors, such as weather conditions, building occupancy, ventilation patterns and seasonal variations in fungal concentrations, can affect the conditions observed. The information contained in this report should not be relied upon to represent conditions that existed prior to or after this sampling. Terracon does not warrant the services of regulatory agencies, laboratories or other third parties supplying information that may have been used in the preparation of this report.

SAMPLING CRITERIA AND METHODS

VOC Monitoring

VOCs were data logged in the space by placement of a MiniRAE 3000 photoionization detector (PID). After the sampling event, the results were downloaded from the PID using the manufacturer's proprietary database software and then exported to Microsoft Excel for analysis.

Employee Interview

Mr. Hutchings provided information regarding the suspected source of the VOCs and the current building exhaust configuration and settings. Room 115 in the Harris Smith Building is the digital imaging lab, located on the lowest floor of the building. This room houses a digital printing plate maker, a Macdermid Evo Model 3A (Evo). The Evo has two separate local exhaust systems, both of which have been connected to larger building exhaust/HVAC system. According to Mr. Hutchings, the building exhaust system shuts down at night and on weekends, with the current weekday settings having the system shut down at 10 pm and start back up at 5:30 am. Periodically (reportedly 4-5 times per year, sometimes more), Packaging Science staff have to work either nights or weekends and have found that working in the vicinity of Room 115 when the building exhaust is not functioning produces respiratory irritation at a level that prevents them from working in the space. Mr. Hutchings provided the Safety Data Sheet (SDS) for the suspect solvent (DuPont™ Cyrel® Cylosol) and it is attached to this report along with photos from the work area.

Research on the principal component of the solvent (2-Ethylhexyl acetate, 40-60% of compound) listed on the SDS shows that the 2014 version of the American Congress of Government Industrial Hygienists (ACGIH) Book of Threshold Limit Values (TLVs) listed an exposure limit for this

compound of 10 parts per million (ppm) equivalent to 10,000 parts per billion (ppb) from a German agency.

The second major component of the solvent (benzyl alcohol, 15-30% of compound) listed on the SDS shows that the 2014 version of the ACGIH Book of Threshold Limit Values (TLVs) listed an exposure limit for this compound of 10 parts per million (ppm) from AIHA.

The third major component of the solvent (naphtha, 20-30% of compound) listed on the SDS shows that the 2014 version of the ACGIH Book of Threshold Limit Values (TLVs) listed an exposure limit for this compound of 50 parts per million (ppm) from a German agency.

FINDINGS

General Observations

- Room 115 and the surrounding portions of the Packaging Science Building were well organized and clean in appearance.
- Connections from the Evo to the principal solvent containers (55 gallon barrels) are not air tight and could be contributing to the VOC levels measured.
- The Evo device is exhausted directly into the building exhaust/HVAC system.

VOC Monitoring

On December 12 through 13 VOCs were measured in Room 115 of the Harris Smith/Packaging Science Building. Measurements of the VOC levels by the MiniRAE 3000 PID ranged from 528 ppb to 22,679 ppb over the approximate 24-hour period.

VOC levels began a steady climb after 10 pm when the building exhaust was turned off and reached a peak just before 5:30 am at which point they dropped back to approximately 1,500 – 2,000 ppb. A graph showing monitoring results are attached.

CONCLUSIONS

The following conclusions are provided based on our assessment:

- Additional control options or separation of the Evo local exhaust system from the main building exhaust/HVAC should be evaluated to allow staff to conduct after hour work as needed without having to rely on personal protective equipment. The shutdown of the building HVAC system in this area causes an increase in VOC levels at night.
- Increased VOC levels at night may exceed recommended occupational exposure values to personnel working in and around the area.

- If, in fact, the suspect plate cleaning solvent is the major contributor to the TVOC levels measured, the levels are in excess of a German indoor air standard for the principal ingredient (2-Ethylhexyl acetate – 10,000 ppb) and in excess of an AIHA standard for the secondary component (benzyl alcohol – 10,000 ppb).

Terracon appreciates the opportunity to provide this service to Clemson University. If you have any questions regarding this limited VOC investigation report, please contact the undersigned at 864-292-2901.

Sincerely,
Terracon Consultants, Inc.

Benjamin Hestir, P.E.
Project Industrial Hygienist

Jeffrey A. Gurrie
Senior Industrial Hygienist

Attachments: Photographs
Monitoring Results Graph
Safety Data Sheet (SDS) for 2-Ethylhexyl Acetate

Photographs



Photo #1 The room investigated



Photo #2 The solvent used in the Evo digital plating equipment



Photo #3 Solvent label

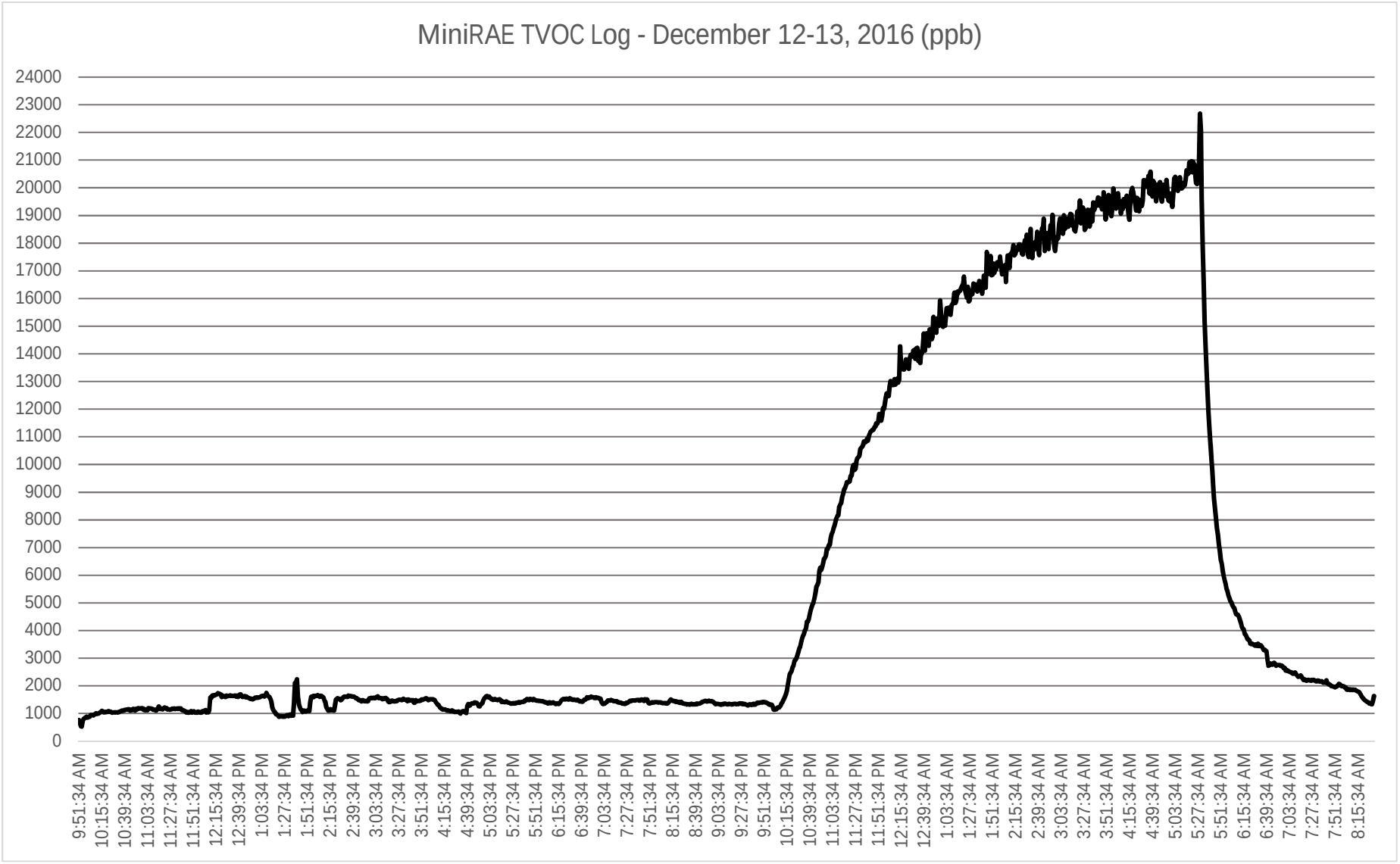


Photo #4 The Evo digital plating equipment



Photo #5 Evo local exhaust connections to main building exhaust system

Monitoring Results



MiniRAE 3000 Datalog from Harris Smith Bldg Dec 12-13, 2016.xlsx

Safety Data Sheet

DuPont™ Cyrel® Cylosol Plate Washout Solution

Version 2.0

Revision Date 06/08/2015 Ref. 130000030584

This SDS adheres to the standards and regulatory requirements of the United States and may not meet the regulatory requirements in other countries.

SECTION 1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	DuPont™ Cyrel® Cylosol Plate Washout Solution
Tradename/Synonym	:	Cylosol Washout Solution
Product Use	:	Manufacture of printing plates, Processing aid, not otherwise listed
Restrictions on use	:	Consumer use
Manufacturer/Supplier	:	DuPont 974 Centre Road Wilmington, DE 19805, USA
Product Information	:	1-302-774-1000
Medical Emergency	:	1-800-441-3637 (outside the U.S. 1-302-774-1139)
Transport Emergency	:	CHEMTREC: +1-800-424-9300 (outside the U.S. +1-703-527-3887)

SECTION 2. HAZARDS IDENTIFICATION

Product hazard category

Flammable liquids	Category 4
Acute toxicity (Inhalation)	Category 4
Skin irritation	Category 2
Serious eye damage/eye irritation	Category 2A
Skin sensitisation	Category 1
Aspiration hazard	Category 1

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Label content

Pictogram :



Signal word : Danger

Hazardous warnings : Combustible liquid.
May be fatal if swallowed and enters airways.
Causes skin irritation.
May cause an allergic skin reaction.
Causes serious eye irritation.
Harmful if inhaled.

Hazardous prevention measures : Keep away from heat/sparks/open flames/hot surfaces. No smoking.
Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
Wash skin thoroughly after handling.
Use only outdoors or in a well-ventilated area.
Contaminated work clothing should not be allowed out of the workplace.
Wear protective gloves/ eye protection/ face protection.
IF SWALLOWED: Immediately call a POISON CENTER or doctor/ physician.
IF ON SKIN: Wash with plenty of soap and water.
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
Call a POISON CENTER or doctor/ physician if you feel unwell.
Do NOT induce vomiting.
If skin irritation or rash occurs: Get medical advice/ attention.
If eye irritation persists: Get medical advice/ attention.
Take off contaminated clothing and wash before reuse.
In case of fire: Use dry sand, dry chemical or alcohol-resistant foam for extinction.
Store in a well-ventilated place. Keep cool.
Store locked up.
Dispose of contents/ container to an approved waste disposal plant.

Other hazards
The following percentage of the mixture consists of ingredient(s) with unknown acute toxicity: 50 %

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS-No.	Concentration
2-Ethylhexyl acetate	103-09-3	40 - 60 %
Benzyl alcohol	100-51-6	15 - 30 %

Naphtha (petroleum), hydrotreated heavy		20 - 30 %

The specific chemical identity and/or exact percentage (concentration) of composition has been withheld as a trade secret.

SECTION 4. FIRST AID MEASURES

General advice	:	No applicable data available.
Inhalation	:	If inhaled, remove to fresh air. If breathing is difficult, give oxygen. If not breathing, give artificial respiration. Get medical attention.
Skin contact	:	Wash off with plenty of water. Wash contaminated clothing before re-use. Get medical attention if irritation develops and persists.
Eye contact	:	Immediately flush eyes for at least 15 minutes. Get medical attention.
Ingestion	:	Do NOT induce vomiting. Call a physician or poison control centre immediately.
Most important symptoms/effects, acute and delayed	:	Aspiration may cause pulmonary oedema and pneumonitis.
Protection of first-aiders	:	No applicable data available.
Notes to physician	:	No applicable data available.

SECTION 5. FIREFIGHTING MEASURES

Suitable extinguishing media	:	Water, Foam, Dry chemical, Carbon dioxide (CO2)
Unsuitable extinguishing media	:	No applicable data available.
Specific hazards	:	Static charges can accumulate and lead to a spark capable of starting a fire.
Special protective equipment for firefighters	:	Exposure to decomposition products may be a hazard to health. Wear self-contained breathing apparatus for firefighting if necessary.

Further information	:	Evacuate personnel to safe areas. Stop spill/release if it can be done with minimal risk. Do not allow run-off from fire fighting to enter drains or water courses.

SECTION 6. ACCIDENTAL RELEASE MEASURES

NOTE: Review FIRE FIGHTING MEASURES and HANDLING (PERSONNEL) sections before proceeding with clean-up. Use appropriate PERSONAL PROTECTIVE EQUIPMENT during clean-up.

Safeguards (Personnel)	:	Avoid contact with skin, eyes and clothing. Ensure adequate ventilation. Wear suitable protective equipment.
Environmental precautions	:	Prevent further leakage or spillage if safe to do so. Prevent product from entering drains. Clean contaminated floors and objects thoroughly while observing environmental regulations.
Spill Cleanup	:	Contain spill. Soak up with inert absorbent material. Collect and contain contaminated absorbent and dike material for disposal. Keep in suitable, closed containers for disposal. Ventilate the area. Clean contaminated surface thoroughly.
Accidental Release Measures	:	Dispose of in accordance with local regulations.

SECTION 7. HANDLING AND STORAGE

Handling (Personnel)	:	Avoid breathing vapours or mist. Keep away from heat and flame. Do not use in areas without adequate ventilation. Provide adequate ventilation. When using do not eat, drink or smoke. Do not breathe vapours or spray mist. Wash hands before breaks and at the end of workday. Avoid contact with the skin and the eyes. Keep away from food and drink.
Handling (Physical Aspects)	:	Keep away from heat and sources of ignition. Avoid formation of aerosol.
Dust explosion class	:	No applicable data available.
Storage	:	Store at room temperature in the original container. Keep away from sources of ignition - No smoking. Do not store or consume food, drink or tobacco in areas where they may become contaminated with this material. Keep container closed when not in use. Do not reuse empty container.

Stable under normal conditions.

Storage period : No applicable data available.

Storage temperature : No applicable data available.

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Personal protective equipment

Respiratory protection : Where there is potential for airborne exposures in excess of applicable limits, wear approved respiratory protection with dust/mist cartridge.

Hand protection : Material: Nitrile rubber
Break through time: 60 min
Permeation rate: 480 min
Glove thickness: 0.4 mm
Additional protection: Gloves must be inspected prior to use., Gloves should be discarded and replaced if there is any indication of degradation or chemical breakthrough., As the product is a mixture of several substances, the durability of the glove materials cannot be calculated in advance and has to be tested before use.

Eye protection : Face-shield Chemical resistant goggles must be worn.

Skin and body protection : Impervious clothing

Exposure Guidelines

Exposure Limit Values

2-Ethylhexyl acetate
No applicable data available.

Benzyl alcohol

AEL *	(DUPONT)	10 ppm	8 & 12 hr. TWA

Naphtha (petroleum), hydrotreated heavy
No applicable data available.

* AEL is DuPont's Acceptable Exposure Limit. Where governmentally imposed occupational exposure limits which are lower than the AEL are in effect, such limits shall take precedence.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance		
Physical state	:	liquid
Form	:	liquid
Color	:	colourless
Odor	:	sweet
Odor threshold	:	No applicable data available.
pH	:	Not applicable
Melting point/range	:	No applicable data available.
Boiling point/boiling range	:	Boiling point/boiling range 188 - 210 °C (370 - 410 °F) at 1,013 hPa
Flash point	:	>62 °C closed cup
Evaporation rate	:	No applicable data available.
Flammability (solid, gas)	:	No applicable data available.
Upper explosion limit	:	7.9 vol%
Lower explosion limit	:	2.3 vol%
Vapor pressure	:	< 1 hPa
Vapour density	:	No applicable data available.
Specific gravity (Relative density)	:	0.877
Water solubility	:	negligible
Solubility(ies)	:	No applicable data available.

Partition coefficient: n-octanol/water	:	No applicable data available.
Auto-ignition temperature	:	No applicable data available.
Ignition temperature	:	no data available
Decomposition temperature	:	No applicable data available.
Viscosity, kinematic	:	No applicable data available.
Viscosity, dynamic	:	No applicable data available.
% Volatile	:	100 %

SECTION 10. STABILITY AND REACTIVITY

Reactivity	:	No dangerous reaction known under conditions of normal use.
Chemical stability	:	No decomposition if stored normally. Stable at normal temperatures and storage conditions.
Possibility of hazardous reactions	:	Polymerization will not occur.
Conditions to avoid	:	None reasonably foreseeable.
Incompatible materials	:	Strong oxidizing agents Strong acids and strong bases
Hazardous decomposition products	:	Benzyl alcohol is slowly oxidized to benzaldehyde in the presence of air.

SECTION 11. TOXICOLOGICAL INFORMATION

2-Ethylhexyl acetate

Dermal LD50	:	> 5,000 mg/kg , Rabbit
Oral LD50	:	5,140 mg/kg , Rat
Skin irritation	:	Severe skin irritation, Rabbit
Eye irritation	:	No eye irritation, Rabbit
Skin sensitization	:	Does not cause skin sensitisation., human

Repeated dose toxicity	:	Oral Rat - vapour NOAEL: 25 mg/kg LOAEL: 50 mg/kgMethod: No information available. Gastrointestinal effects, Liver effects, Information given is based on data obtained from similar substances.
Carcinogenicity	:	Not classifiable as a human carcinogen. Animal testing did not show any carcinogenic effects. Information given is based on data obtained from similar substances.
Mutagenicity	:	Tests on bacterial or mammalian cell cultures did not show mutagenic effects. Animal testing did not show any mutagenic effects. Information given is based on data obtained from similar substances.
Teratogenicity	:	Animal testing showed effects on embryo-fetal development at levels equal to or above those causing maternal toxicity.

Benzyl alcohol

Inhalation 4 h ALC - Approximate Lethal Concentration	:	> 1.105 mg/l , Rat Respiratory tract irritation
Dermal LD50	:	2,000 mg/kg , Rabbit
Oral LD50	:	1,230 mg/kg , Rat
Oral LD50	:	1,040 mg/kg , Rabbit Breathing difficulties
Skin irritation	:	Slight or no skin irritation, Rabbit
Eye irritation	:	Irritating to eyes., Rabbit Moderate eye irritation
Skin sensitization	:	Positive in human patch test., human
Repeated dose toxicity	:	Oral Rat - No toxicologically significant effects were found.

Carcinogenicity	:	Not classifiable as a human carcinogen. Animal testing did not show any carcinogenic effects.
Mutagenicity	:	Animal testing did not show any mutagenic effects. Evidence suggests this substance does not cause genetic damage in animals. Did not cause genetic damage in cultured bacterial cells. Genetic damage in cultured mammalian cells was observed in some laboratory tests but not in others.
Reproductive toxicity	:	No toxicity to reproduction Animal testing showed no reproductive toxicity.
Teratogenicity	:	Animal testing showed effects on embryo-fetal development at levels equal to or above those causing maternal toxicity.

Naphtha (petroleum), hydrotreated heavy

Inhalation 4 h LC50	:	> 5.61 mg/l , Rat
Dermal LD50	:	> 2,000 mg/kg , Rabbit
Oral LD50	:	> 5,000 mg/kg , Rat Central nervous system effects Gastrointestinal effects
Skin irritation	:	Severe skin irritation, Rabbit
Eye irritation	:	No eye irritation, Rabbit
Skin sensitization	:	Does not cause skin sensitisation., Guinea pig
Repeated dose toxicity	:	Inhalation Rat - vapour NOAEL: > 20 mg/lMethod: OECD Test Guideline 413 No toxicologically significant effects were found.
Carcinogenicity	:	Not classifiable as a human carcinogen. Overall weight of evidence indicates that the substance is not carcinogenic.
Mutagenicity	:	Animal testing did not show any mutagenic effects.

Did not cause genetic damage in cultured bacterial cells.
Did not cause genetic damage in cultured mammalian cells.

Reproductive toxicity : No toxicity to reproduction
Animal testing showed no reproductive toxicity.

Teratogenicity : Animal testing showed no developmental toxicity.

Carcinogenicity

The carcinogenicity classifications for this product and/or its ingredients have been determined according to HazCom 2012, Appendix A.6. The classifications may differ from those listed in the National Toxicology Program (NTP) Report on Carcinogens (latest edition) or those found to be a potential carcinogen in the International Agency for Research on Cancer (IARC) Monographs (latest edition).

None of the components present in this material at concentrations equal to or greater than 0.1% are listed by IARC, NTP, or OSHA, as a carcinogen.

SECTION 12. ECOLOGICAL INFORMATION

Aquatic Toxicity

2-Ethylhexyl acetate

: Aquatic toxicity is unlikely due to low solubility.

: Aquatic toxicity is unlikely due to low solubility.

: Aquatic toxicity is unlikely due to low solubility.

Benzyl alcohol

96 h LC50	:	Oryzias latipes (Orange-red killifish) > 100 mg/l
96 h LC50	:	Pimephales promelas (fathead minnow) 460 mg/l
72 h EC50	:	Pseudokirchneriella subcapitata (green algae) 700 mg/l
96 h EC50	:	Scenedesmus quadricauda (Green algae) > 360 mg/l
48 h EC50	:	Daphnia (water flea) 230 mg/l
14 d	:	NOEC Oryzias latipes (Orange-red killifish) 5.1 mg/l
21 d	:	NOEC Daphnia magna (Water flea) 51 mg/l

Naphtha (petroleum), hydrotreated heavy

96 h LC50	:	Pimephales promelas (fathead minnow) 8.2 mg/l (calculated) Information given is based on data obtained from similar substances.
72 h ErC50	:	Selenastrum capricornutum (green algae) 3.1 mg/l OECD Test Guideline 201
72 h NOEC	:	Selenastrum capricornutum (green algae) 0.5 mg/l OECD Test Guideline 201
48 h EC50	:	Daphnia magna (Water flea) 4.5 mg/l OECD Test Guideline 202
21 d	:	NOEC Fish (unspecified species) 2.6 mg/l OECD Test Guideline 204
21 d	:	NOEC Daphnia magna (Water flea) 2.6 mg/l OECD Test Guideline 211

Environmental Fate

2-Ethylhexyl acetate

Biodegradability	:	rapidly biodegradable OECD Test Guideline 301 Readily biodegradable

Benzyl alcohol

Biodegradability	:	Readily biodegradable

SECTION 13. DISPOSAL CONSIDERATIONS

Waste disposal methods - Product	:	If recycling is not practicable, dispose of in compliance with local regulations. Never place unused product down any indoor or out door drain.
Waste disposal methods - Container	:	Do not reuse empty container. Contaminated/not cleaned containers should be treated/handled like product waste. Dispose of container properly. Refer to applicable Local, State/Provincial, and Federal Regulations, as well as industry Standards.
Contaminated packaging	:	No applicable data available.

SECTION 14. TRANSPORT INFORMATION

Not classified as dangerous in the meaning of transport regulations.

SECTION 15. REGULATORY INFORMATION

TSCA (US) Status	:	On the inventory, or in compliance with the inventory
SARA 313 Regulated Chemical(s)	:	This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.
PA Right to Know Regulated Chemical(s)	:	Substances on the Pennsylvania Hazardous Substances List present at a concentration of 1% or more (0.01% for Special Hazardous Substances): Aliphatic alcohol, Aliphatic Esters This product contains proprietary ingredient(s).
California Prop. 65	:	Chemicals known to the State of California to cause cancer, birth defects or any other harm: none known

SECTION 16. OTHER INFORMATION

Restrictions for use	:	Do not use DuPont materials in medical applications involving implantation in the human body or contact with internal body fluids or tissues unless the material has been provided from DuPont under a written contract that is consistent with DuPont policy regarding medical applications and expressly acknowledges the contemplated use. For further information, please contact your DuPont representative. You may also request a copy of the DuPont POLICY Regarding Medical Applications and DuPont CAUTION Regarding Medical Applications.

The DuPont Oval Logo is a registered trademark of E.I. du Pont de Nemours and Company.
Before use read DuPont's safety information. For further information contact the local DuPont office or DuPont's nominated distributors.

DuPont™ Cyrel® Cylosol Plate Washout Solution

Version 2.0

Revision Date 06/08/2015 Ref. 130000030584

Revision Date : 06/08/2015

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Significant change from previous version is denoted with a double bar.