



Replacing TCE: Alternatives for Surface Cleaning Operations

Introduction

Trichloroethylene is a man-made solvent. One of this solvents major uses is a cleaning agent. TCE has been listed by the EPA as a probable human carcinogen and a possible reproductive hazard (teratogen). Acute exposure to TCE affects the central nervous system, the kidneys and the liver. Because of its potential health effects, this chemical is regulated throughout its lifecycle. Many uses are heavily restricted due to its toxicity.

Hazard Summary

All contact with this chemical should be reduced to the lowest possible level. Many scientists believe there is no safe level of exposure to a carcinogen. Handle with extreme caution.

<i>ACUTE EFFECTS (SHORT TERM)</i>	<i>CHRONIC EFFECTS (LONG TERM)</i>	<i>CANCER HAZARDS</i>
Can affect you when breathed in.	May cause a skin allergy.	It may cause mutations (genetic changes).
Contact can irritate and burn the skin and eyes.	Repeated exposure can cause memory loss, headache, depression and weakness in the arms and legs.	There is evidence that TCE causes cancer in animals.
Exposure can cause lightheadedness, dizziness, unconsciousness, visual disturbances, nausea and vomiting.	May damage the liver and kidneys.	It may cause lung and liver cancer.
Very high levels can cause irregular heartbeat which can be fatal.	Repeated contact can cause irritation, blistering, roughening and cracking of exposed skin.	

Workplace Exposure Limits

- OSHA The legal airborne permissible exposure limit (PEL) is 100 ppm averaged over an 8-hour work shift, 200 ppm not to be exceeded during any 15 minute work period and 300 ppm for 5 minutes in any 2-hour work period.
- NIOSH Recommended airborne exposure limit is 25 ppm over a 10-hour work shift
- ACGIH Recommended airborne exposure limit is 50 ppm averaged over an 8-hour work shift and 100 ppm as STEL (Short Term Exposure Limit).

Environmental Fate

TCE evaporates to air during cleaning operations. Precipitation carries TCE to the ground and water bodies. Furthermore, TCE in soil and water can filter down through to ground water and drinking water supplies. TCE breaks down in air within a few weeks but requires longer time in underground water supplies.

Alternatives

There are many alternatives for TCE in cleaning operations. The Toxics Use Reduction Institute maintains a research laboratory to assist companies to find safer cleaning chemicals and methods. This lab, the Surface Solutions Laboratory, has worked closely with over 20 companies in Massachusetts that were/are trying to replace TCE in cleaning applications. A wide range of industries are represented by these companies: Aircraft, Electronics, General Mfr, Metal working, Metal-Electronics, Optical and Plating.

Process Specific

The products tested for TCE replacement have been evaluated for various companies on specific contaminants under conditions that closely match each company's process specific operating conditions. This approach has allowed for more meaningful and useful results.

Contaminants Removed

The lab has conducted over 100 experiments on 11 different contaminant types. The following tables list the types of contaminants and the products that were successful in replacing TCE for cleaning operations.

Abrasives

Abrasive cleaning has been performed for ceramics parts for a company that manufactures parts for the semiconductor industry.

Company Name	Product Name	Classification	Contaminant Specifics Info
Amax Corporation	Safety First	Semi-Aqueous	Abrasive - Aluminum Oxide
Brulin Corporation	Formula 815 GD	Alkaline Aqueous	Abrasive - Boron Carbide
Innovative Organics Inc	Amberclean L 12	Alkaline Aqueous	
LPS Laboratories	LPS Precision Clean	Alkaline Aqueous	
National Diagnostic	Opti Clear	Terpene	
US Polychem Corporation	Polyspray Jet 790 XS	Alkaline Aqueous	

Buffing Compounds

Buffing compound removal has been conducted for brass and some silver parts for a metal working shop and a light manufacturer.

Company Name	Product Name	Classification	Contaminant Specifics Info
Calgon Corporation	Geo Guard 2215	Alkaline Aqueous	Buffing compound
Chrisal USA Inc	Super CMF 240	Alkaline Aqueous	Buffing compound - Anchor Chemical Co, Anchor Spin G-10
International Products Corp	Micro 90	Alkaline Aqueous	Buffing compound - Jackson Lea Antique Buffing compound LM-12 (9000-70-8,1344-28-1,409-21-2,1309-37-1)
Magnaflux	Daraclean 282 GF	Alkaline Aqueous	Buffing compound - Matchless Metal Polishing Co, 516 Tripoli Compound
Oakite Products	Inproclean 3800	Alkaline Aqueous	Buffing compound - Matchless Metal Polishing Co, Z-230 Buffing Compound (7429-90-5)
US Polychem Corporation	Polyspray Jet 790 P	Alkaline Aqueous	Buffing compound - The Lea Manufacturing Company Learok 2-B-111 - Abrasive, Fatty acids, Glycerides and petroleum wax/oil mix-silica dust (14808-60-7)

Coatings

Coatings cleaning for a tool manufacturing company have been conducted on steel surfaces using immersion.

Company Name	Product Name	Classification	Contaminant Specifics Info
AGA Chemical	AK 225	HCFC	Coating - Rochester Midland Corp RI 780 Rust Preventive coating (8052-41-3, 95-63-6)
AW Chesterton	278 Super Solv	Petroleum Distillate	
Dynamold Solvents Inc	DS 108	Petroleum Distillate	
Gemtek Products	SC Aircraft & Metal Cleaner	Alkaline Aqueous	
Metabolix Inc	Metabolix E3HB	Ester	
Oakite Products	Inproclean 3800	Alkaline Aqueous	
Solvent Kleene Inc	D Greeze 1000	Petroleum Distillate	

Fluxes

One request has come to SSL for replacing TCE for flux removal. The company manufactured brass bellows.

Company Name	Product Name	Classification	Contaminant Specifics Info
Church & Dwight	Armaklean E 2002	Alkaline Aqueous	Flux - Kester Solder 1544 Rosin Solder flux (64-17-5, 78-92-2, 8050-09-7)
Oakite Products	Inproclean 4000 T	Terpene-Organic	

Greases

Grease removal has been investigated for two industry types, a musical instrument manufacturer and a tool maker. Brass, ceramics and steel parts were cleaned using immersion and/or ultrasonic energy.

Company Name	Product Name	Classification	Contaminant Specifics Info
Alconox Inc	Liquinox	Alkaline Aqueous	Grease - Hibrenia Way Apiezon M1
Calgon Corporation	Geo Guard 2215	Alkaline Aqueous	Grease - Selmar Tuning Slide and Cork Grease No 2942 petroleum distillates
Gemtek Products	SC Aircraft & Metal Cleaner	Alkaline Aqueous	Grease - Valvoline wheel bearing grease
International Products Corporation	Micro 90	Alkaline Aqueous	
Metabolix Inc	Metabolix E3HB	Ester	
Oakite Products	Inproclean 3800	Alkaline Aqueous	
Sky Products Company Inc.	Cleaner #10	Alkaline Aqueous	

Inks/Paints

Two companies were serviced successfully for paint/ink cleaning. A ceramic capacitor/electronics manufacturer and a tool making company requested help cleaning plastic and steel pieces. Cleaning was performed using an immersion process.

Company Name	Product Name	Classification	Contaminant Specifics Info
AW Chesterton	278 Super Solv	Petroleum Distillate	Ink
Brulin Corporation	Compliance	Caustic	Paint
Chrisal USA Inc	Super CMF 240	Alkaline Aqueous	Paint - Varnish Mix Cooper Creek Chemicals Cooper Black Tank Paint (64742-89-8, 8052-42-4, 108-88-3); Sherwin Williams Co V74B2 Black Asphaltum (64742-89-8, 64742-88-7, 8052-42-4)
Dynamold Solvents Inc	DS 108	Petroleum Distillate	
Gemtek Products	SC Aircraft & Metal Cleaner	Alkaline Aqueous	
Metabolix Inc	Metabolix E3HB	Ester	
Solvent Kleene Inc	D Greeze 1000	Petroleum Distillate	

Cutting Fluids/Lubricants/Oils

Oil removal was the largest contaminant field being cleaned with TCE. Eight companies utilized the lab's services for parts made from steel, carbon steel, stainless steel, aluminum, brass and ceramics. Immersion, ultrasonic and other mechanical agitation systems were used to aid the alternative chemistries.

Company Name	Product Name	Classification	Contaminant Specifics Info
AGA Chemical	AK 225	HCFC	Cutting Fluid
Amax Corporation	Safety First	Semi-Aqueous	Cutting Fluid - Steco Corp, Tap Magic Protap (112-80-1, 112-62-9)
AW Chesterton	278 Super Solv	Petroleum Distillate	Lubricant
AW Chesterton	KPC 820 N	Alkaline Aqueous	Lubricant - ITW Fluid Products Power Stamp II diluted 5:1 with water
Bio Chem Systems	Bio T 300 B	Terpene-Semi-Aqueous	Lubricant - New England Industrial Lubricants Neilcut 333
Bio Chem Systems	Green Stuff (6325)	Alkaline Aqueous	Lubricant - W.A. Wood #30 Lube Oil
Brulin Corporation	Formula 815 GD	Alkaline Aqueous	Oil
Calgon Corporation	Geo Guard 2215	Alkaline Aqueous	Oil - 90 Wt Geat Oil
Dynamold Solvents Inc	DS 108	Petroleum Distillate	Oil - Castrol Industrial North America Castrol Quench G quench oil (64742-55-8, 64742-65-0, 8052-42-4)
Ecolink	Vortex	Semi-Aqueous	Oil - Clover Grease Lapping Oil
Fine Organic Corporation	FO 2085 M	Alkaline Aqueous	Oil - Exxon Kutwell 40 (64742-52-5, 64742-53-6)
Gemtek Products	SC Aircraft & Metal Cleaner	Alkaline Aqueous	Oil - Hubbard Hall Inc, Metal Guard 270
Innovative Organics Inc	Amberclean L 12	Alkaline Aqueous	Oil - Hydraking 32AW

International Products Corporation	Surface Cleanse 930	Neutral Aqueous	Oil - ITW Safetap
Kyzen Corporation	Metalnox M6314	Alkaline Aqueous	Oil - Metal Perserving Oil
LPS Laboratories	LPS Precision Clean	Alkaline Aqueous	Oil - Metal working fluids
MacDermid	ND 17	Alkaline Aqueous	Oil - Milacron Cimperial 1070
Magnaflux	Daraclean 232	Alkaline Aqueous	Oil - Park Chemical Corporation Haze Quench Oil
Magnaflux	Daraclean 282 GF	Alkaline Aqueous	Oil - Precision Finishing Inc, Chemtrol 229
Magnaflux	Daraclean 283	Alkaline Aqueous	Oil - Quenching oil (64742-54-7, 64742-56-9, 8052-42-4)
Metabolix Inc	Metabolix E3HB	Ester	Oil - Spartan Chemical MOAC 2945 Coolant (64742-52-5, 64742-53-5, 63449-39-8, 68608-26-4, 68918-91-2, 8002-26-4, 111-46-6, 107-41-5, 4719-04-4)
National Diagnostic	Opti Clear	Terpene	Oil - Speed Fam Industrial Applications Vehicle 210
Oakite Products	Inproclean 2000	Alkaline Aqueous	Oil - Speedfam #210 Oil-Based Vehicle
Oakite Products	Inproclean 3800	Alkaline Aqueous	Oil - Water Soluble Oil
Oakite Products	Inproclean 4000 T	Terpene-Organic	
Sky Products Company Inc.	Cleaner #10	Alkaline Aqueous	
Solvent Kleene Inc	D Greeze 1000	Petroleum Distillate	
Solvent Kleene Inc	D Greeze 500 LO	Organic	
Today & Beyond	Beyond 2001	Alkaline Aqueous	
Twin Rivers Corp	Methyl Ester 1618	Ester	
US Polychem Corporation	Polyspray Jet 790 P	Alkaline Aqueous	
US Polychem Corporation	Polyspray Jet 790 XS	Alkaline Aqueous	
Warren Chemical Company	Sea Wash 8 New	Neutral Aqueous	

Waxes

Four companies from the electronics and metal working sectors were using TCE on aluminum, brass, ceramics, copper, glass and steel surfaces. Cleaning was performed with either manual wiping, immersion and /or ultrasonic energy.

Company Name	Product Name	Classification	Contaminant Specifics Info
AG Environmental Products	Canola Gold CE110	Ester	Wax
Bio Chem Systems	Bio T 200 A	Terpene	Wax - Aremco Crystalbond 509 (25610-19-9, 107-21-1)
Bio Chem Systems	Bio T 300 B	Terpene-Semi-Aqueous	Wax - Beeswax
Calgon Corporation	Geo Guard 2215	Alkaline Aqueous	Wax - Roger Reed 6816 Wax, Naturally occurring organic and neutral materials
Dynamold Solvents Inc	DS 108	Petroleum Distillate	Wax - Roger Reed 93114 Wax, Hyrdocarbon waxes
Florida Chemical Company	Citrus Burst 7	Terpene	Wax - Roger Reed 98033 Wax, Hyrdocarbon waxes
Florida Chemical Company	D-Limonene	Terpene	Wax - Roger Reed 98045 Wax, Hyrdocarbon waxes
National Diagnostic	Opti Clear	Terpene	Wax- Zopher Mills Inc No 1563 Wax (mixture of waxes and resins)
Oakite Products	Inproclean 2000	Alkaline Aqueous	
Oakite Products	Inproclean 3800	Alkaline Aqueous	
Pentone Corporation	Citrikleen XPC	Terpene-Semi-Aqueous	
Solvent Kleene Inc	D Greeze 500 LO	Organic	
Universal Photonics	Uni Clear	Terpene	