Resources You Should Consult to Help Make Your Decisions:

[***Note***: these are only a few sources; many other good references exist]

- The Integrated Solvent Substitution Data System (ISSDS), part of Enviroene, a multi-part World-Wide Web resource site [**http://es.inel.gov/ssds/ssds.html**], which provides solvents and alternatives information, links to health and toxicity information, material safety data sheets (MSDSs), and more.

- The Solvents Alternative GuidE (SAGE) [on the Control Technology Center bulletin board, at (919) 541-5742 (via modem); also part of ISSDS], a system that evaluates your current cleaning operation and needs, and identifies possible surface cleaning alternative solvents and processes that best suit operating and material requirements.

EPA TSCA Hotline ((202) 554-1404) for:

- Background documents explaining the ecological toxicity and persistence ratings of this guide.

- Answers to questions about how to use this guide.

- Details about the human health effects of listed chemicals and for chemicals that are **not** on this list.

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Environmental Protection
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EPA

AQUEOUS AND SEMI-AQUEOUS SOLVENT CHEMICALS: ENVIRONMENTALLY PREFERABLE CHOICES

GUIDE and WALL CHART

Purpose of this Guide:

The U.S. Environmental Protection Agency (EPA) developed this guide to provide companies with information to help them make responsible environmental choices for chemicals used in metal cleaning.

EPA is aware of a general trend in industry to reduce or eliminate use of halogenated solvent cleaning systems. In addition, EPA knows that many firms now use or may soon begin using aqueous (water-based) and semi-aqueous (partially water-based) cleaning processes.

While use of these chemicals generally will be better for the environment, the chemicals can still be of concern when released to water. EPA hopes this guide will help minimize such adverse effects, and also focus solvent selection on a thorough consideration of costs, health effects, and effectiveness, as well as the persistence and ecotoxicity factors which are the focus of this guide.

Although metal-cleaning businesses often have access to information on human health effects, product effectiveness, and cost, more limited information is readily available on the environmental effects of alternative chemicals used in aqueous and semi-aqueous cleaning chemicals.

This guide and wall chart should help companies make environmentally responsible choices when choosing substitute cleaning systems by providing environmental effect and persistence information on some of the most commonly used alternative chemicals. It also refers the user to resources for health effects, toxicity, and process change information.

What This Guide Does:

This guide rates a number of aqueous and semi-aqueous solvent chemicals, by toxicity and persistence in the environment. The toxicity rating indicates a level of potential harm to aquatic organisms, such as fish and algae, upon release of the chemical to surface water. The persistence rating indicates how long the chemical will remain in the water before it degrades into stable components. In general, chemicals which degrade into stable components are less likely to pose environmental problems.

How To Interpret The Ratings:

[Ratings are based on standard EPA hazard and persistence criteria]

Ecological Toxicity is based upon the effects of the chemical on aquatic organisms, such as fish and algae. The organisms are exposed to varied concentrations of the chemical in water over a 2-to 4- day period. The ratings are determined by the chemical concentration at which 50% of the aquatic organisms die. The ratings are:

High - 50% of organisms die at 1 part per million or less of the chemical.
Moderate - 50% of organisms die at > 1 part per million, but ≤ 100 parts per million.
Low - 50% of organisms die at > 100 parts per million.

Persistence ratings are based upon how long it takes the original chemical to completely break up into stable components when it is released to the environment. The ratings are:

High - longer than 6 months to completely break up.
Moderate - breaks up in less than 6 months, but longer than 1 month.
Low - breaks up in 1 month or less.

Some Things To Consider When Using This Guide:

- Determining which solvent chemicals to use requires a careful balancing of the environmental, health, cost, and other factors with your needs for an effective cleaning product. This guide focuses on environmental factors only; check other resources (see Resources section) to ensure that you make a well-informed decision and consider all factors.
- Toxicity is generally more important than persistence.
- The percentage of each chemical in a formulation also must be considered when making substitution choices. For example, a cleaner containing a small percentage of a chemical with a high ecological toxicity rating may be less harmful to the environment than a cleaner with a large percentage of a moderate ranked chemical.
- The toxicity ratings in this guide are based on the specific chemical and do not consider the potential effects of combining more than one chemical in a formulation.
- The criteria for determining the ratings were based on either measured and/or predicted values for both ecological toxicity and persistence.

If you are unsure about which chemicals you are using, call your supplier for more information. To be sure the information you receive is correct, refer to the chemicals by their Chemical Abstracts Service (CAS) number, rather than chemical name, since chemicals often have more than one name.

AQUEOUS AND SEMI-AQUEOUS SOLVENT CHEMICALS: ENVIRONMENTALLY PREFERABLE CHOICES WALL CHART

Chemicals Used in Cleaners, Grouped by Functional Type	Other/Common Names	CAS Numbers	Ecological Toxicity	Environmental Persistence
Acid Agents and Acids				
Citric acid	2-Hydroxy-1,2,3-propane carboxylic acid	77-92-9	Moderate	Low
Ethylenetetraacetic acid, sodium salt[1]	Sodium EDTA	7379-28-4	Moderate	Moderate
Ethylenediaminetetraacetic acid[1]	EDTA	60-00-4	Moderate	Moderate
Formic acid	Methanoic acid	64-18-6	Low	Low
Glucoheptonic acid	Glucosemonocarboxylic acid	23351-51-	Low	Low
Gluconic acid, sodium salt	Sodium gluconate	527-07-1	Low	Low
Gluconic acid	D-Gluconic acid	526-95-4	Low	Low
Hydrochloric acid	Muriatic acid	7647-01-0	Low	[2]
Phosphoric acid[3]	Orthophosphoric acid	7664-38-2	High	[2]
Sulfuric acid	Hydrogen sulfate	7664-93-9	Low	[2]
Alkalies				
Monoethanolamine	2-Aminoethanol	141-43-5	Moderate	Low
Potassium hydroxide	Caustic potash	1310-58-3	Low	[2]
Sodium tripolyphosphate[3]	STPP	7758-29-4	High	[2]
Sodium hydroxide	Caustic soda	1310-73-2	Low	[2]
Sodium carbonate	Soda ash	497-19-8	Low	[2]
Sodium sulfate	Sulfuric acid disodium salt	7757-82-6	Low	[2]
Sodium metasilicate	Sodium silicate	6834-92-0	Moderate	[2]
Tetrapotassium pyrophosphate[3]	Potassium pyrophosphate	7320-34-5	High	[2]
Tetrasodium pyrophosphate[3]	Sodium pyrophosphate	7722-88-5	High	[2]
Triethanolamine	TEA	102-71-6	Low	Low
Trisodium phosphate[3]	Sodium phosphate	7601-54-9	High	[2]
Surfactants				
Polyethoxylated nonylphenol[4]	Nonyl phenol ethoxylate	9016-45-9	Moderate	Low-Moderate
Sodium xylene sulfonate	Dimethylbenzenesulfonic acid, sodium salt	1300-72-7	Low	Low-Moderate
Hydrocarbon Solvents				
Dipentene	Terpene processing byproducts	68956-56-	High	Low
n-Hexane	Hexane	110-54-3	High	Low
d-Limonene	p-metha-1,8-diene	5989-27-5	High	Low
l-α-Pinene, d-α-pinene, β-pinene[5]	Pinenes	See Notes	High	Low
Non-Hydrocarbon Solvents				
Ethanol, 2-butoxy	EGBE	111-76-2	Low	Low
Ethanol 2- (2- butoxyethoxy)	DGBE	112-34-5	Low	Low
Ethanol	Ethyl alcohol	64-17-5	Low	Low
Methanol	Methyl alcohol	67-56-1	Low	Low
N-methyl-2-pyrrolidone	NMP	872-50-4	Moderate	Low
1-Nonanol	Nonyl alcohol	143-08-8	Moderate	Low
Other Chemical Classes Used [6]				
Fatty acids[7]	Various	Various	Low to High	Low-Moderate
Alkyl aryl sulfonates[7]	Various	Various	Low to High	Low-Moderate
Sulfated ethoxy phenols	Various	Various	Low	Low
Ethoxylated alkyl phenols[7]	Various	Various	Low to High	Varies
Naphthalene sulfonates	Various	Various	Low	Low

How To Interpret the Ratings

Ecological Toxicity is based upon the effects of the chemical on aquatic organisms, such as fish and algae. The organisms are exposed to varied concentrations of the chemical in water over a 2- to 4- day period. The ratings are determined by the chemical concentration at which 50% of the aquatic organisms die. The standard EPA hazard and persistence criteria are:

High - 50% of organisms die at 1 part per million or less of the chemical.

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Notes

1. In moderately hard water (120.0 - 150.0 mg/L as $CaCO_3$), the toxicity of EDTA is mitigated about 30 times by Calcium (Ca) and Magnesium (Mg) ions.
2. In this chart, environmental persistence ratings are only applied to organic compounds.
3. The concern for inorganic phosphates is their high potential to increase the growth of freshwater green algae, whose eventual death will reduce the available oxygen for aquatic life.
4. The ecological toxicity and persistence for this chemical are moderate and low-moderate; however, there is a high toxicity concern, and a moderate-high persistence concern for the chemicals that the product eventually breaks down to in the environment.
5. The CAS numbers for the pinenes are:

   7785-26-4,
   7785-70-8, and
   127-91-3

6. Due to the large number of chemicals used to make aqueous and semi-aqueous cleaners in each of these five categories, the individual chemicals could not be listed.
7. The toxicity for the chemicals in these three categories ranges from low to high toxicity. For additional information on the toxicity rating for chemicals in these categories, please call the number for the TSCA Hotline at (202) 554-1404.