

A NEW TERPENE SOLVENT TECHNOLOGY for REPLACING CONTROLLED and RESTRICTED SOLVENTS

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ABSTRACT

Tarksol® based Terpene solvents are excellent alternatives to ozone depleting halogens and other regulated solvents for metal cleaning and degreasing applications. The Tarksol® patented technology offers the first terpene solvents and microemulsions with little or no terpene odor and a flash point of over 212°F.

It has been reported and documented that terpene solvents have been demonstrated to be safe for people and the environment. Terpenes have shown excellent solvent properties as replacements for CFC and chlorinated solvents.

To date, all available terpene solvents have flash points (Tag Closed Cup), under 200°F and very strong odor. The low flash points contribute to hazardous storage, transportation, work areas, and waste concerns. The high degree of odor contributes to objectionable work stations.

The new Tarksol® Terpene Technology allows terpene solvents with flash points over 200°F and a very low degree of odor. The patented technology now offers aqueous, semi-aqueous and environmentally safe solvent blends for all types of applications and replacements for CFC's and chlorinated solvents.

This paper describes the fundamentals of this new patented technology and outlines its advantages relating to existing terpenes, CFC solvents, chlorinated solvents and aliphatic/paraffinic hydrocarbons.

INTRODUCTION

A. Terpene Hydrocarbons

Terpenes are naturally occurring, 10 carbon organic molecules manufactured in nature by green plants. They are the raw materials for many of the flavors and fragrances enjoyed by man. It has been well documented that terpene hydrocarbons and alcohols are excellent solvents with the following advantages to humans and the environment:

TERPENE HYDROCARBONS AND ALCOHOLS

1. Many terpenes are designated GRAS (Generally Regarded as Safe) by the FDA and FEMA (Flavor Extracts Manufacturing Association) and are approved for human consumption in foods.
2. National Toxicology Program (NTP) conducted a two year toxicology and carcinogenicity study on a terpene and found it to be non-toxic and non-carcinogenic to humans.

3. Naturally occurring chemicals, of which, 480×10^6 metric tons released into the atmosphere annually from green plants and trees.
4. Biodegradable.
5. Non-Ozone Depleting.
6. Non-Global Warming Potential.
7. Low V.O.C.'s and Emulsions are not a V.O.C. per EPA Test Method # 8240.
8. Not regulated under the U.S. Federal Legislations and Regulations.
9. Low Toxicity and Low Skin Irritation.
 - a. Terpene Hydrocarbons
Acute Oral (RAT) - LD50 3540 mg/kg
Skin Irritation (Rabbit) - Not a primary irritant
 - b. Terpene Alcohols
Acute Oral (RAT) - LD50 4300 mg/kg
Skin Irritation (Rabbit) - 3000 mg/kg
10. Low Inhalation Hazard.

In the past, all Terpene Hydrocarbons have low flash points and can be highly flammable. The only major drawback to terpene solvents, is that their flash point and the objectionable odor.

B. Aliphatic and Paraffinic Hydrocarbons

The Aliphatic and Paraffinic Hydrocarbons are broken into two groups:

1. Inexpensive, well-known aliphatic hydrocarbons, such as Mineral Spirits, Kerosene and Stoddard Solvent.

2. New Paraffinic Hydrocarbons which are relatively expensive and will most likely find a niche in specialized cleaning applications.

These products are generally flammable or combustible and they are V.O.C.'s and hence, photochemical smog producers. On a broad basis, these products will not be serious contenders for the chlorinated solvent market.

C. Aqueous and Semi-Aqueous Products

There is no question that the popular broad based replacements for chlorinated, CFC, aliphatic and paraffinic solvents in the future will be Aqueous or Semi-Aqueous products; from an environmental, worker safety, and cost basis.

1. Aqueous alkaline cleaners have been well known for many years. They have extremely high ph and consist of alkaline salts or builders, organic or inorganic additives and surfactants.

ADVATAGES

- widely used for many years for a variety of soils
- economical, diluted to 5%
- compatible with various substances
- no VOC emmissions
- low toxicity
- non flammable

DISADVANTAGES

- low soil loading
- may be difficult to rinse
- formulas require optimization
- may not be compatible with some electronic components
- slow drying
- not efficient for heavy grease, tar and waxes

2. Semi - Aqueous (solvent & surfactant) and Aqueous microemulsion cleaners (solvents, surfactant and water) are the areas where most of the new technology lies. There are a wide variety of products offered by many large and small manufacturers. These are cleaning systems using a variety of Terpene, DiBasic Ester, Glycol Ethers, N-Methyl Pyrrolidone or other Hydrocarbons in combination with surfactants. They are applied in the following way:

a. Semi-Aqueous

Applied in concentrated form, followed by a water rinse.

b. Aqueous Microemulsion

Applied in diluted form, followed by a water rinse.

ADVATAGES

- low V.O.C.
- Terpenes work well at low temperatures.
- heavy soil loading, especially terpene based products
- excellent cleaning ability for heavy grease, tar, wax and hard to remove soils.
- good metal compatibility
- tremendous versatility in formulation; dust inhibitors can be added.
- low surace tension allows penetration of small spaces
- microemulsions are very cost effective

DISADVANTAGES

- in some formulations, mists of concentrated and diluted cleaner can be highly flammable (eg; d-limonene and other terpenes).
- d-limonene and terpene based products emit strong odors
- slow evaporation
- incomplete Federal controls for water discharges (ie; no efficient guidelines under Clean Water Act).
- Aquatic toxicity can be high. d-limonene concentration of concern is 7PPB, according to EPA

A NEW SOLVENT TECHNOLOGY for COMPLETE SAFETY and EXCELLENT PERFORMANCE

The EPA proposed ruling in the May 12, 1993, Vol. 58, No. 90 Federal Register describes Terpenes as approved alternatives for ozone depleting chemicals in three major cleaning applications. (1) Metal Cleaning; (2) Electronics cleaning and; (3) precision cleaning. The proposed ruling approves Terpenes in Aqueous cleaning and semi-aqueous cleaning in the above applications and as substitutes in aerosols, adhesives, coatings and inks. The major environmental concerns are *toxicity to aquatic life, flammability and unpleasant odor.*

A U.S. patent was issued on May 12, 1992, teaching a method to produce Terpenes with flash points over 200°F and microemulsions with flash points greater than 212°F with virtually no odor.

A total of 250 formulations were prepared as microemulsions and semi-aqueous terpene formulations and tested at three independent EPA and NYDEC certified laboratories. The formulations were prepared using commercial d-Limonene, Dipentene, Pine Oil, α-Terpinene, Terpinolene, α-Terpineol and Proprietary Terpene Hydrocarbons and alcohols. All formulations had flash points between 100°F and 140°F using DOT method ASTM D -56. The flash points varied depending upon the terpene base used and was independent of Terpene concentration. The terpene base used in the microemulsions ranged from 0.5% to 90%.

U.S. patent 5,112,5116 and other U.S. and Foreign patents pending, makes it possible to produce terpene alcohol and terpene hydrocarbon blends, terpene alcohol/solvent blends, terpene semi-aqueous solvents and terpene microemulsions with flash points greater than 200°F and with virtually no terpene odor.

The semi-aqueous and aqueous terpene microemulsions are now the favored choice to replace chlorinated, CFC, aliphatic and aromatic solvents in the future. They are now available in the marketplace and provide many of the following features:

1. Performance equal to or better than chlorinated solvents
2. Biodegradable.
3. Cost effective - products available that are effective at dilutions up to 1:20 with water.
4. Non-ozone depleting.
5. No global warming potential.
6. Non-Carcinogenic.
7. High flash point - over 100°F (TCC)
8. Low odor.
9. Non-toxic.
10. Low aquatic toxicity - LD50 - 41 mg/L
11. Not regulated under any of the five principle statutes pertinent to the use of solvents in the U.S. as administered by the EPA.
12. No or low V.O.C.'s per EPA Testing Method # 8240.
13. Low disposal costs.
14. Recyclable - ultrafiltration/membrane filtration.
15. Non-corrosive to metals.

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