

Comparison of EkaSol 1™ to MEK and Acetone

Purpose This document summarizes the enhanced safety and quality attributes of TBF Environmental's EkaSol 1 product as compared to Methyl Ethyl Ketone (MEK) and Acetone.

Factors to consider When evaluating the safety and quality of the EkaSol 1 product, the following four factors must be considered:

- Safety of the solvent and risks of exposure to workers, such as:
 - flammability
 - toxicity
- Environmental considerations such as:
 - environmental toxicity
 - regulatory controls
- Ability to dissolve the desired substances when used in formulations or as a diluent.
- Chemical compatibility with substrate that is to be cleaned, when used as a cleaner/degreaser.

Safety factors The following table details the differences in the safety and quality factors for EkaSol 1, MEK and acetone.

	MEK	Acetone	EkaSol 1
Flashpoint (°C) (TCC)	-9 °C (16 °F)	-20 °C (-4 °F)	5 °C (41 °F)
Toxicity: Oral LD ₅₀ (rat) (mg/kg)	2737	5800	> 5000
Volatile Organic Compounds (VOC) (g/L)	800	exempt	2.66 [‡]
Maximum Incremental Reactivity (MIR)	1.48	0.43	0.47
Evaporation Rate (<i>n</i> -Butyl Acetate = 1)	3.86	6.4	3.62
Hansen Solubility Parameters (MPa) ^{1/2}	19.1	19.9	19.1
Dispersion (δ _D)	16.0	15.5	15.7
Polarity (δ _P)	9.0	10.4	6.4
Hydrogen Bonding (δ _H)	5.1	7.0	8.5
Hildebrand Solubility Parameter (MPa) ^{1/2}	19.3	19.7	19.9

[‡]ASTM Test Method 313-91. EkaSol is a blend of VOC-exempt solvents and is thus considered Zero VOC by the EPA.

Flammability Although EkaSol 1 has similar evaporation and solvency rates to MEK and Acetone, it has a much higher flashpoint. The flashpoint for MEK is -9 °C and for Acetone is -20 °C, compared to the flashpoint for EkaSol 1 which is 5.0 °C. EkaSol 1 is much less flammable and therefore safer than MEK and Acetone.

Toxicity LD₅₀ assesses toxicity derived from acute exposure. The acute oral toxicity of Methyl Acetate (MA) and EkaSol 1 are relatively high indicating they are both safe products. The acute oral toxicity of MEK is much lower than that of MA or EkaSol 1:

- MEK has an oral LD₅₀ of 2737 mg/kg body weight (rat)
- MA has an oral LD₅₀ of >5000 mg/kg body weight (rat)
- EkaSol 1 has an oral LD₅₀ of approximately 5000 mg/kg body weight (rat)

Although Acetone has a comparable LD₅₀ to MA and EkaSol 1, Acetone has been shown to enhance the toxicity of other chemicals through synergistic toxic effects (William 1983, Adams 1986, James 1985).

Toxicity - continued

Chronic studies assess toxic effects other than those derived from acute exposure.

Chronic studies:

- show no indication of MA causing toxic effects other than those derived from acute exposure.
- have found MEK to be carcinogenic (Toftgård, 1981; Burgaz, 2002) and cause serious developmental (Schwetz, 1991) and reproductive issues (Barlow, 1982), in addition to liver (Brautbar, 2002) and neural (Altenkirch, 1978) toxicity.

Methyl Acetate is used as a food additive and carries the favourable FEMA GRAS (Flavour and Extracts Manufacturers Association-Generally Regarded as Safe) designation by the Food and Drug Administration.

Overall, EkaSol 1 is a safer product compared to MEK and Acetone.

Definition: LD₅₀ is the amount of a material, given all at once, which causes the death of 50% (one half) of a group of test animals. The LD₅₀ is one way to measure the short-term poisoning potential (acute toxicity) of a material. The larger the LD₅₀ value, the safer a substance is.

Environmental considerations

Maximum Incremental Reactivity (MIR) is a measurement that quantifies relative ground-level ozone impacts of volatile organic compounds (VOCs) in units of gram ozone (O₃) per gram VOC.

EkaSol 1 has a lower MIR compared to MEK. The MIR values are:

- MEK = 1.48
- EkaSol 1 = 0.47

Ability to dissolve desired substances and chemical compatibility

Methyl Acetate may be a useful alternative to MEK for the purpose of surface cleaning, however, this represents only a small percentage of current MEK use. An effective MEK/Acetone replacement must be able to remove cured paints and resins as easily as MEK/Acetone, work as diluents, and as an effective substitute for MEK/Acetone in the production and formulation of resin type products.

EkaSol 1 is designed to closely mimic MEK and Acetone's properties such as evaporation rate and solubility. It is a patented blend of environmentally friendly and safe compounds. Our chemists developed and used mathematical models to calculate solubility parameters (Hansen, 2007) and flash points (Catoire, 2006) of the resulting mixtures.

While MA has limitations in the formulations of paints, coatings, adhesives and inks, EkaSol 1 has overcome these problems. The paint, coating, adhesive and ink industries are readily embracing EkaSol 1 for use in formulations as a replacement for MEK and Acetone.

References

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