EFCTC
EUROPEAN FLUOROCARBONS TECHNICAL COMMITTEE

cefic
sector group

LEARN ABOUT…
Safety, properties & use of fluorocarbons

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Maximum Recommended Guidance Levels (MRGLs) for impurities in fluorocarbons

Occupational Exposure Levels (OELs) exist for many fluorocarbons, but they only relate to individual substances. An OEL for a blend of fluorocarbons can be estimated using a method published by the American Conference of Industrial Hygienists (ACGIH) for estimating OELs for mixtures of substances which assumes that additive toxicity occurs. .

The estimate is based on the following relationship:

$X_a/OEL_a + X_b/OEL_b \ldots = 1/OEL_{blend}$, where

X_a is the mole fraction of "a",

OEL_a is the OEL for "a", etc.

A methodology has been derived by EFCTC for the estimation of acceptable levels of impurities or contaminants in fluorocarbon products, in which the "acceptable level" is the level of the impurity which would not significantly impact on the OEL for the product.

It is most applicable for cases where the product has a low level of toxicity and correspondingly high OEL, while the impurity has a high level of toxicity and correspondingly low OEL. In this case, the presence of a significant amount of the impurity would make the OEL for the product invalid such that a lower OEL would be required to afford the same level of protection to those using the product.

The procedure involves first determining the OELs for the product and the identified impurities either by using established OELs for the substances or, when not available, estimating them from OELs for fluorocarbons showing similar structural and toxicological characteristics. OELs can be found in published official lists (e.g. ACGIH TLVs) or from in-house values derived from the available experimental data. Where insufficient data is available on a specific impurity, a Temporary OEL (TeOEL) can be derived.

Safety factors are utilised to account for additive toxicity between the various constituents of the mixture and the potential for the impurity to fractionate in the vapour phase. The presence of multiple impurities, again assuming additive toxicity, can also be considered.

For a fluorocarbon product with a single impurity:
The MRGL = [(Impurity TeOEL/safety factor x Impurity Mol. Wt)/ (product OEL x product mol. Wt.)] x 100.

Example

HFC-134a contains F-133a as an impurity.
What is the MRGL of F-133a in liquefied commercial HFC-134a?

HFC-134a: Mol Wt = 102 ; OEL = 1000 ppmV
F-133a: Mol Wt = 118.5; OEL = 1 ppmV

Step 1.
Apply the default uncertainty factor of 30 to the impurity OEL to account for fractionation and interactive effects: 1 ppmV F-133a / 30 = 0.03 ppm V of F-133a.

Step 2.
Convert proportion to weight % basis. The following general equation can be used to calculate the weight % proportion.

MRGL = ((Impurity OEL/UF x Impurity MW) / (product OEL x product MW)) x 100

Therefore:

MRGL for F-133a as in impurity in HFC-134a = ((1/30 x 118.5) / (1000 x 102)) x 100
MRGL = (3.95 / 102000) x 100 = 0.0039 wt.% (39 ppm W/W, 39 mg/kg)