

Request for exemption for refrigerant HCFO-1233zd

We would like to explain the hazard information regarding HCFO-1233zd(E) (hereafter referred to as 1233E). Note that 1233E is the fluorinated gas (CAS RN: 102687-65-0, Chemical Name: trans-1-chloro-3,3,3-trifluoropropene) with a boiling point of 18.3°C.

1233E is not readily biodegradable according to an OECD TG301D study. It is likely to partition to the water rather than to the sediment and soil compartments as it has a relatively low partition coefficient ($\log Pow = 2.2$). Furthermore, the high vapor pressure (1,516kPa at 30°C) suggests that the substance will volatilize rapidly from water and partition to the air. The rapid degradation of the substance in the air is supported by a publication from Sulbaek Andersen et al. (2018)¹, which shows a lifetime of 36 days by its reaction with OH in the air. Based on all the evidence, it is concluded that the substance is not persistent and bioaccumulative.

Ref. 1 shows that approximately 2% of TFA is produced by the atmospheric decomposition of 1233E. In addition, trifluoroacetic acid, which is a concern in the proposed restriction, has also been shown to pose a low risk of toxicity to living organisms and human bodies in the reports of the Environment Agency of Germany and Norway, who actually submitted this restriction proposal^{2,3}.

1233E is expected not to be mutagenic since it is negative in the Ames test of OECD TG471 and also negative in the chromosome aberration test of OECD TG473. The substance is also expected to have low toxicity to humans since the LC50 (rat) is 120,000ppm in the acute inhalation test of OECD TG403 and the NOAEC = 4,000ppm in the 90-day repeated inhalation test of OECD TG413. Based on these test results, the WEEL for 1233E is determined to be 800 ppm (8-hours, TWA)⁴.

Reference 1 indicates that 1233E has an ODP of less than 0.00030, a GWP of less than 5, and a POCP of 3.6. Therefore, in the concentrations expected in the environment its atmospheric degradation products will have a negligible impact on ecosystems. The substance does not adversely affect environmental problems such as ozone depletion and global warming, so it is environmentally acceptable.

Based on all hazard information, we would like to propose that 1233E should not be regulated as a PFAS.

[Request for exemption]

1233E for blowing agent use is mainly used as a raw material for rigid polyurethane foam. Rigid polyurethane foam is widely used as a heat insulator for consumer and industrial applications. Rigid polyurethane foam consists of minute independent bubbles formed by urethane resin, and gas derived from a blowing agent is sealed inside the bubbles. By using PFAS with low thermal conductivity such as 1233E for that gas, rigid polyurethane foam can achieve higher thermal insulation performance than other insulation materials. In addition, urethane resin has high specific strength and good resistance to low temperatures and dimensional stability. Taking advantage of these features, rigid polyurethane foam is mainly used as heat insulating material in the normal to low temperature range. Major thermal insulation applications are in houses, frozen and refrigerated warehouses, refrigerators, vending machines, plants handling low-temperature fluids such as LNG, LNG carriers, and liquid oxygen and liquid hydrogen tanks of large rockets.

Rigid polyurethane foam is produced by foaming the raw material with gas derived from a blowing agent in the process of solidifying the liquid material into a resinous state through a chemical reaction. The raw materials other than the blowing agent are polyol, catalyst, foaming agents, flame retardants, and isocyanate. The most common foaming method for rigid polyurethane foam is to vaporize the

blowing agent by reaction heat, but the blowing agent used for this method must have a low thermal conductivity of its gas and a boiling point near room temperature. In addition, many other characteristics are required, such as adequate solubility in the urethane raw material, chemical stability and non-toxicity, and non-flammability. There are very few options for blowing agents that satisfy these requirements, and fluorocarbons have been used in the past.

1233E has low gas thermal conductivity (0.0102 W/m·K, at 20°C) 5, a boiling point near room temperature (18.3°C) 5, chemical stability, low toxicity (WEEL=800ppm) 4, and nonflammability 4. Based on the above, we propose that the use of 1233E in blowing agent applications should be completely exempted from PFAS regulations.

1233E is also used as a refrigerant in centrifugal chiller. Since centrifugal chillers are used in air conditioners of large buildings and are filled with a large amount of refrigerant, nonflammable, low toxicity and low GWP properties are required to avoid risk in case of leakage. Although 1233E is a nonflammable, low toxicity and low GWP refrigerant, it is impossible to replace it with alternative refrigerants such as hydrocarbons while maintaining all its properties. Therefore, we request that 1233E in refrigerant applications should be exempted from PFAS regulations.

1. Atmospheric Environment vol179, 2018, P250-259 (<https://doi.org/10.1016/j.atmosenv.2018.02.018>)
2. German Environment Agency, Reducing chemical input into water bodies trifluoroacetate (TFA) as a persistent and mobile substance from many sources, 2021
3. Norwegian Environment Agency, Study on environmental and health effects of HFO refrigerants, 2017
4. Workspace Environmental Exposure Level (HCFO-1233zd(E)) (<https://tera.org/OARS/1233zdE%20HCFO%20OARS%20WEEL%20Public%20Comment.pdf>)
5. Materials Science & Engineering R vol.145, 2021, P100608 (<https://doi.org/10.1016/j.mser.2021.100608>)

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