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Safety, properties & use of fluorocarbons

Created: June 2011

Updated: January 2016

Hydrofluoroolefins (HFOs)

HFOs contain hydrogen, fluorine and carbon like the HFCs, but they are distinctly different. They are olefins, which mean they have very short atmospheric lifetimes of a few days, leading to distinct environmental benefits.

HFOs are subject to all the legislation that applies to the supply and use of chemicals, including REACH in the EU.

HFOs are the fourth generation of refrigerants, with each generation being a step-change improvement on the previous generation. HFOs offer many of the key properties of existing HFCs, but with very low GWPs (Global Warming Potential).

The first significant application is MAC (mobile air-conditioning) but HFOs will also be used in other applications such as insulation foam, technical aerosols and solvents. HFOs may also be used in mixtures with HFCs where the properties of HFOs alone cannot achieve the required safety or performance standards. They can offer effective solutions where other fluids are not appropriate.

One of the main HFOs of commercial interest does break down to trifluoroacetic acid (TFA) in the atmosphere [1]. This is washed out of the atmosphere into the aqueous environmental compartment. However it has been concluded that TFA from HFOs would have negligible environmental impact [2, 3, 4]

TFA is a naturally occurring chemical present in seawater [5, 6] significant concentrations have been found in both coastal and deep-ocean seawater. TFA is also found in rain, river and lake water [7, 8] Those concentrations measured are far in excess of those that could occur as a result of atmospheric oxidation of man-made fluorocarbons.

HFOs with their marginal flammability characteristics or in mixtures with HFCs, are expected to be used in applications where the highly flammable hydrocarbons (HCs) are not appropriate.

HFOs are viable low GWP fluids for use in a range of applications. The safety and performance in use of these fluids and their attractive environmental properties hold considerable promise to improve the environmental performance of air-conditioning and refrigeration systems as well as in other applications.

See also: <http://www.fluorocarbons.org/chemical-families/hfos> and **Trifluoroacetic Acid (link!)**

Sources:

1. Hurley M.D., T.J. Wallington, M.S. Javadi, O.J. Nielsen, Atmospheric chemistry of $\text{CF}_3\text{CF}=\text{CH}_2$: Products and mechanisms of Cl atom and OH radical initiated oxidation, *Chem. Phys. Lett.*, 450, 263-267 (2008)
2. Luecken, D. J.; L.Waterland, R.; Papasavva, S.; Taddonio, K. N.; Hutzell, W. T.; Rugh, J. P.; Andersen, S. O., Ozone and TFA Impacts in North America from Degradation of 2,3,3,3-Tetrafluoropropene (HFO-1234yf), A Potential Greenhouse Gas Replacement. *Environmental Science & Technology* 2009, 44, (1), 343-348
3. Boutonnet J.-C., P. Bingham, D. Calamari, C. de Rooij, J. Franklin, T. Kawano, J.-M. Libre, A. McCulloch, G. Malinverno, J.M. Odom, G.M. Rusch, K. Smythe, I. Sobolev, R. Thompson and J. M. Tiedje, "Environmental Risk Assessment of Trifluoroacetic Acid", *Human and Ecological Risk Assessment*, 5,1, 59-124, 1999.
4. Madronich, S, M. Shao, S. R. Wilson, K. R. Solomon, J. D. Longstreth and X. Y. Tang, Changes in air quality and tropospheric composition due to depletion of stratospheric ozone and interactions with changing climate: implications for human and environmental health, *Photochem. Photobiol. Sci.*, 2015, 14, 149
5. Frank H., E.H. Christoph, O. Holm-Hansen and J.L. Bullister, Trifluoroacetate in Ocean Waters, *Environ. Sci. Technol.*, 36, 12-15, 2002
6. Scott B.F. R.W. MacDonald, K. Kannan, E. Fisk, A. Witter, N. Yamashita, L. Durham, C. Spencer and D.C.G. Muir, Trifluoroacetate (TFA) Profiles in the Arctic, Atlantic and Pacific Oceans, *Environ. Sci. Technol.*, 39, 6555-6560, 2005
7. Wujcik C.E., D. Zehavi and J.N. Seiber, Trifluoroacetic acid levels in 1994-1996 fog, rain, snow and surface waters from California and Nevada, *Chemosphere*, 36(6), 1233-1245, 1998.
8. Jordan A. and H. Frank, Trifluoroacetate in the Environment. Evidence for sources other than HFC/HCFCs *Sci. Technol.*, 33, 522-527, 1999