



Trifluoroacetic acid

HCFCs and HFCs break down readily in the lower atmosphere¹ to form simple inorganic species already naturally present in the environment. However, in a few cases the break down is expected to stop at trifluoroacetic acid, a naturally occurring substance which is apparently resistant to further degradation^{2,3}.

In 1991, the fluorocarbon industry instigated a research programme to ascertain basic environmental and toxicological data. The risk from the future environmental levels of trifluoroacetic acid from future emissions of HCFCs and HFCs was assessed, with the conclusion that "they do not pose a threat to the environment"⁴. In the same assessment, the toxicity of trifluoroacetic acid to algae, higher plants, fish, animals and humans was evaluated. It was found to be of very low toxicity to all of these organisms.

Several recent assessments of the potential risk from using very short lived HFCs (such as HFC-1234yf in mobile air conditioning) reached the same conclusion; that no threat was posed to the environment^{5,6,7}. In each case, the anticipated TFA concentration in rainwater is expected to be much lower (generally by a factor of 1000) than the minimum concentration that has been shown to cause a biological effect.

There is a very large quantity of trifluoroacetic acid in the sea^{8,9,10,11}; significant concentrations have been found in both coastal and deep-ocean seawater. The amount implied from these measurements (approximately 100 to 200 million tonnes) suggests a long term source that has continued for at least 100 years (probably several thousand). Thus, trifluoroacetate is a natural component of seawater^{10,11}. This conclusion and the view that TFA would not pose a threat to the environment was endorsed by UNEP's Environmental Effects Panel in 2006¹². Speculatively, TFA is formed in and around hydrothermal vents in the oceans¹¹.

Trifluoroacetic acid is also found in rain, river and lake water. The rainwater concentration was sampled extensively in Germany and western USA in the late 1990s^{13,14} and the concentrations measured were far in excess of those that could occur as a result of atmospheric oxidation of man-made fluorocarbons. More recent measurements in China show similar concentrations of TFA in rainwater there¹⁵; despite the increase in atmospheric HFCs the incidence of TFA has not changed. The unavoidable conclusion is that environmental TFA does not depend on environmental HFCs.

Although the source of trifluoroacetate deposited over land has not been confirmed, the concentrations and locations are consistent with transport of oceanic material in much the same way as sea salt aerosol. This is released from the sea surface and transported in the atmosphere to be deposited several hundred kilometres inland^{16,17}.

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