HFOs and TFA

KNOW THE FACTS

Trifluoroacetic acid, or TFA, is a naturally occurring organic acid with a similar structure to acetic acid (e.g., vinegar).

95% NATURALLY OCCURRING[1]

From volcanic activity, emitted by deep-sea vents

>200 million tons found in the world's oceans[2, 3, 4]

5% MANMADE

Manufacturing: Used as an intermediate in many chemical processes, including pharmaceutical production[5]

Agriculture: From breakdown of specific fertilizers and herbicides[6]

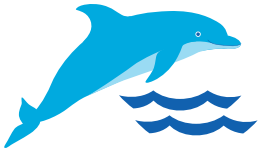
Sewage treatment: Formed during the breakdown and ozonation of some effluents[7]

Refrigerants: From atmospheric decomposition of certain refrigerants, including HFC-134a and HFO-1234yf[8]

Proper handling of refrigerants, e.g., responsible recovery, recycling, and reclamation, as well as routine system inspection, reduces the likelihood and potential magnitude of leakage and emissions.

Does manmade TFA harm the environment or human health?

Numerous independent studies conducted over the past two decades have concluded that TFA from manmade sources **DOES NOT** pose a risk to the environment or human health.[9, 10, 11, 12]



In fact, research has demonstrated that, even if you multiplied today's environmental TFA levels by 1,000x, they would **STILL NOT** adversely affect humans, other mammals, or the environment.[13]

Will future HFO refrigerant use significantly increase the amount of TFA in the environment?

If all the AC units in all the world's cars were equipped with **HFO-1234YF**, it would only increase the amount of TFA in the world's oceans by **0.04%**[14]

"TFA **DOES NOT** bioaccumulate nor is it toxic at the low to moderate exposures currently measured in the environment or those predicted in the distant future."

– UNEP 2022 Assessment Report of the Environmental Effects Assessment Panel

The Environmental Benefits of HFO-1234yf

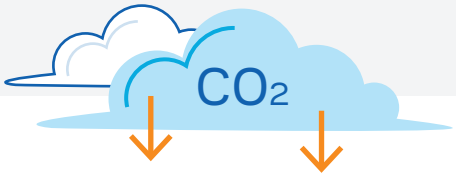
HFO-1234YF REFRIGERANT is a high-performing, non-ozone depleting alternative to legacy refrigerants, with a

99% REDUCTION

in global warming potential (GWP).

When HFO-1234yf is combined with other components, the resulting lower-GWP blends are suitable for a range of cooling and refrigeration applications, and enable excellent system energy performance—**maximizing the benefit to the environment while minimizing life cycle cost**.

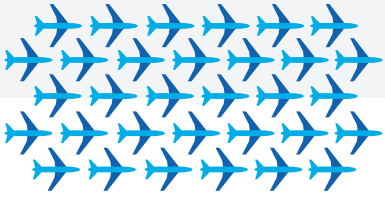
Opteon™ XL refrigerants for commercial applications, which include HFO-1234yf, deliver a **significantly lower climate-change impact** than other alternative technologies, including CO2 and hydrocarbons.[15]



By 2025, the global use of Opteon™ refrigerants is expected to have **eliminated an estimated**

325 MILLION TONS OF CO_2 EQUIVALENT

=



That's equal to the greenhouse gas emissions produced by

193 MILLION transatlantic flights [16]

Our Commitment

Chemours stands behind the safety and sustainability of our products, and we have confidence in the long-term viability of our Opteon™ HFO refrigerants product portfolio. Reducing greenhouse gas (GHG) emissions is a key component of our Corporate Responsibility Commitment. We've set a goal of achieving net-zero operations by 2050, in part by offsetting our direct and indirect GHG emissions with the emissions avoided by using our products, including Opteon™ refrigerants.

For more information, visit opteon.com.

Opteon™

[1] "Environmental Effects of Ozone Depletion and Its Interactions with Climate Change: 2014 Assessment," co-chairs Bornman, J.F, Paul, N., and Shao, M., UNEP, January 2015.

[2] Scott B.F., et al., "Haloacetic Acids in the Freshwater and Marine Environment," First International Symposium on Atmospheric Reactive Substances, 14-16 April 1999, Bayreuth, Germany.

[3] Von Sydow L., et al., "Natural background levels of trifluoroacetate in rain and snow," *Environmental Science & Technology*, 34, 3115-3118, 2000.

[4] Frank H., et al., "Trifluoroacetate in Ocean Waters," *Environmental Science & Technology*, 36, 12-15, 2002.

[5,6,7] Bavarian State Office for the Environment, "F-Gases and Water Protection: Trifluoroacetic Acid (TFA)," presentation from conference, "The Way to Natural Refrigerant Technologies," WWA Nuremberg, 2019.

[8] "EFCTC Special Review: Understanding TFA," European Fluorocarbons Technical Committee, 2016.

[9] Boutonnet J.C., et al., "Environmental Risk Assessment of Trifluoroacetic Acid," *Human and Ecological Risk Assessment*, 5(1), 59-124, 1999.

[10] Solomon K.R., et al., "Sources, fates, toxicity, and risks of trifluoroacetic acid and its salts: Relevance to substances regulated under the Montreal and Kyoto Protocols," *Journal of Toxicology and Environmental Health*, 19, 289-304, 2016.

[11] "Environmental Effects of Ozone Depletion and Its Interactions with Climate Change: 2022 Assessment Report," UNEP, March 2023.

[12] DeKant W. and DeKant R., "Mammalian toxicity of trifluoroacetate and assessment of human health risks due to environmental exposures," *Archives of Toxicology* (2023) 97:1069–1077.

[13] "EFCTC Special Review: Understanding TFA," European Fluorocarbons Technical Committee, 2016.

[14] Henne S., et al., "Future Emissions and Atmospheric Fate of HFC-1234yf from Mobile Air Conditioners in Europe," *Environmental Science & Technology* 46 (3):1650-8 (2012).

[15] "The Path to Reducing Climate Change Emissions from Commercial Refrigeration Application," Chemours white paper, featuring results of a third-party study conducted by WAVE Refrigeration.

[16] CO_2 Calculator, German Environment Agency (Umweltbundesamt), www.umweltbundesamt.de (Figure based on one-way flight between London Heathrow and New York JFK.)

C-11904 (1/20)