

Refrigerant in cars: Refreshingly cool, potentially toxic

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The refrigerant R1234yf is being considered for use in air conditioning systems in cars. Chemists at Ludwig-Maximilians-Universitaet (LMU) in Munich now show that, in the event of a fire, it releases the highly poisonous carbonyl fluoride, and urge that its safety be reassessed.

According to EU guidelines, the new compound R1234yf should in future be used as the refrigerant in air-conditioning systems for automobiles. But the compound is inflammable, and LMU chemists have now shown that combustion of the cooling agent leads to the formation of the highly toxic carbonyl fluoride. "It has been known for some time now that combustion of R1234yf results in production of the toxic hydrogen fluoride. Our analysis has now shown that 20% of the gases produced by combustion of the compound consist of the even more poisonous chemical carbonyl fluoride," says Andreas Kornath, Professor of Inorganic Chemistry at LMU Munich. He and his co-workers have just published the results of their investigation in the journal *Zeitschrift für Naturforschung*.

Carbonyl fluoride is structurally related to phosgene (which contains chlorine in place of fluorine), which was used as a chemical weapon during the First World War. The simplest fluoride, hydrogen fluoride (or hydrofluoric acid, HF) is also highly corrosive and so toxic that burns about as big as the palm of one's hand can be lethal. The agent binds avidly to calcium in body fluids, and this can result in heart failure unless an antidote is rapidly administered. Carbonyl fluoride is even more dangerous, because it penetrates the skin more easily, and causes severe

irritation of the eyes, the skin and the airways. If inhaled, it can damage the alveoli in the lungs, allowing it to reach the circulation and shut down vital functions.

According to guidelines issued by the European Union, automobile manufacturers are legally obligated to use an environmentally friendly refrigerant in the [air-conditioning systems](#) installed in their cars. Use of the previously approved refrigerant R134a in new models has been forbidden in the EU since 2011, as the agent had been shown to contribute to the global warming in the atmosphere. However, its recommended replacement R1234yf has already been the subject of much heated debate in Germany. Studies carried out by various institutions and by German auto manufacturers had pointed to the compound's flammability, and shown that, in the event of accidents in which vehicles catch fire, [combustion](#) of R1234yf leads to the release of [hydrogen fluoride](#).

"The risk analyses carried out by the manufacturers of the refrigerant so far have not taken carbonyl fluoride into account. In light of our results, we advise that the risks associated with R1234yf should be urgently reassessed," Kornath adds.

Provided by Ludwig Maximilian University of Munich

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