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WASTE INCINERATION OF POLYTETRAFLUOROETHYLENE (PTFE) TO EVALUATE POTENTIAL FORMATION OF PER- AND POLY-FLUORINATED ALKYL SUBSTANCES (PFAS) IN FLUE GAS

Background

The polymers we use in our everyday lives share many characteristics, but at a molecular level each one has a unique chemical structure. Those variations result in different reactions and results when the polymer is exposed to heat, cold, fire and other environmental factors.

The authors of [this study](#) sought to examine the distinct properties of polytetrafluoroethylene (PTFE) when it is exposed to incineration conditions of the type that occur at a typical municipal waste disposal facility in Europe and Asia.

The polymer PTFE is a distinct member of the fluoropolymer class of per-and poly-fluorinated alkyl substances (PFAS). The list of PFAS includes more than 4,000 substances, which have very different properties. Some chemicals in this broad group of PFAS are of environmental concern because they are small enough to cross a cell membrane, persist in the environment, and have the potential to contaminate water. A series of studies have found that fluoropolymers, such as PTFE, meet the scientific standards for polymers of low concern while in use, whether as a membrane in waterproof clothing or as a medical device implanted in a patient's heart. The studies demonstrated that high molecular weight fluoropolymers, such as PTFE, do not degrade into persistent fluorinated chemicals that can contaminate water or cross a cell membrane (PFAS of Environmental Concern).

The new, [peer-reviewed paper](#) published in international scientific journal *Chemosphere* sought to build on previous studies by examining what happens to a PTFE polymer at the end of its life — when it's thrown away and ends up in a municipal waste incinerator. The study subjected the polymer to the conditions of such an incinerator to determine whether PTFE would break down into PFAS of Environmental Concern.



Findings

A series of complex experiments found:

- PTFE burned at temperatures typical of a municipal waste incinerator does not degrade into the identified PFAS of Environmental Concern.
- PTFE, under standard municipal waste incineration, is essentially transformed to carbon dioxide and hydrogen fluoride.

CONCLUSION

Municipal incineration of PTFE is an acceptable way to dispose of the fluoropolymer and would not pose an environmental concern.

The Experiment

The authors of the study worked with scientists from the Karlsruhe Institute of Technology, a world-renowned, government funded research university in Germany, to conduct the experiment.

The scientists tested the PTFE by burning PTFE pellets supplied by W. L. Gore & Associates with natural gas, wood pellets and air in a pilot incinerator that recreates the conditions of a typical municipal incinerator at a city waste facility and at a scale exponentially larger than laboratory experiments.

The experiment, following a year of preparation and conducted over a month, added high amounts of PTFE to an incineration waste stream. The combustion gases were treated at two different temperatures, 870°C and 1020°C for 4 seconds and 2.7 seconds respectively, then cooled through the boiler to about 300°C for sampling. The treatment temperatures and times correspond to low to normal operating conditions used in waste incineration facilities. Cooling to 300°C allowed for any reactions from condensation.

The scientists also paired each PTFE incineration with a control burn, free of PTFE, to ensure that background contaminants in the wood, air or natural gas did not skew the results.

For each burn, scientists took samples of flue gases immediately after the boiler, but before the pollution control devices, to investigate for 31 different PFAS compounds using Liquid Chromatography-Mass Spectroscopy.

The labs detected 11 PFAS randomly in both neutral burns and PTFE burns, leading the scientists to conclude that the source of the PFAS are due to background contamination rather than the addition of PTFE.