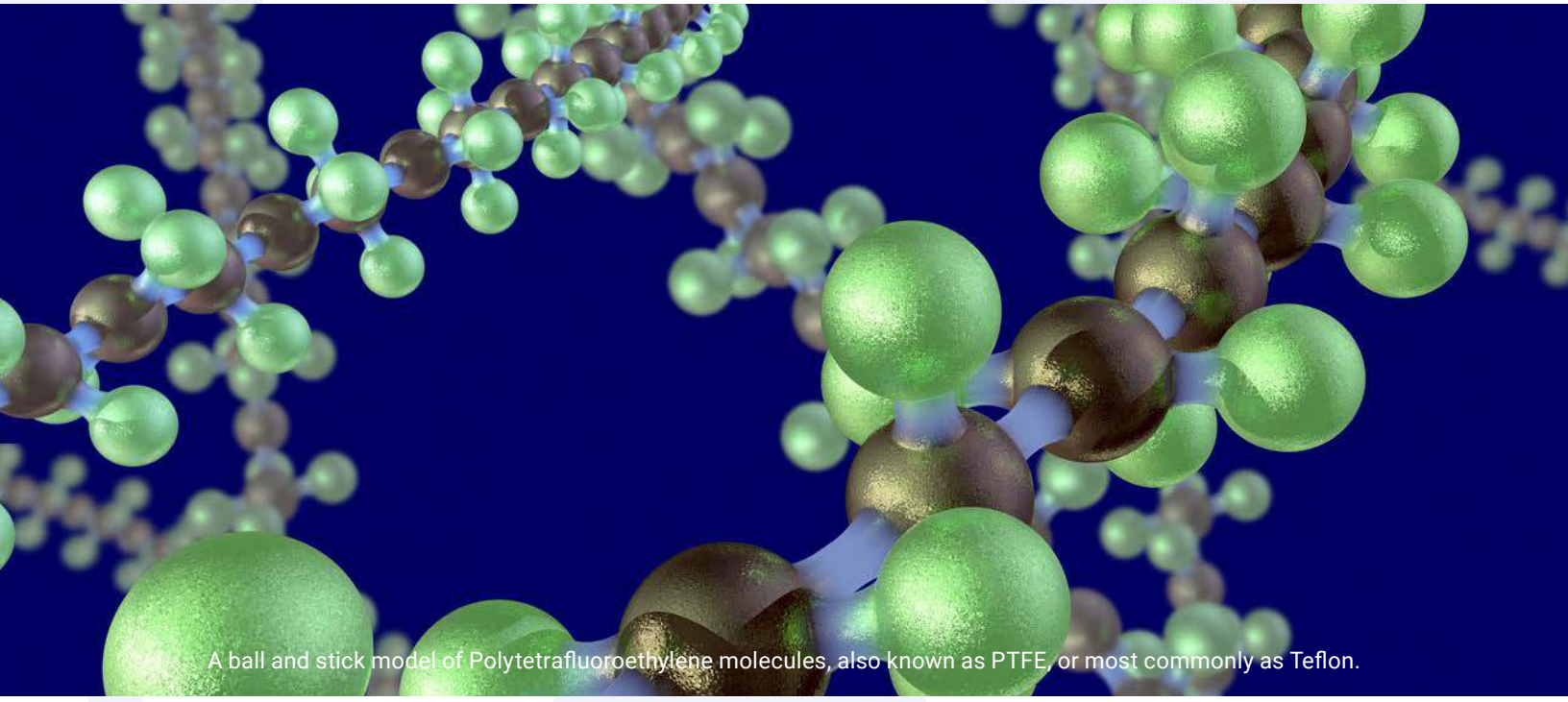
SWANA
APPLIED RESEARCH FOUNDATION

Executive Summary
Prepared for:
SWANA Applied Research Foundation
Waste Conversion and Energy Recovery Group Subscribers

PFAS FATE AND TRANSPORT IN WASTE-TO-ENERGY FACILITIES



A ball and stick model of Polytetrafluoroethylene molecules, also known as PTFE, or most commonly as Teflon.

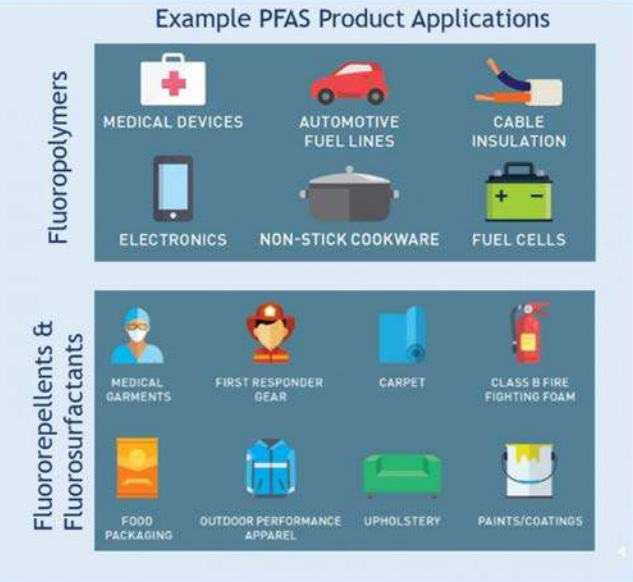
Perfluoroalkyl and polyfluoroalkyl substances (PFAS) are a group of man-made chemicals that have been used in industrial processes and consumer products throughout the world since the 1950s. As a result of their widespread use, PFAS can be found in drinking water, food and food wraps, indoor dust, some consumer products, and workplaces. Within the PFAS group, perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) have become chemicals of emerging concern to the public's health.

One of the potential sources of environmental PFAS is emissions from waste-to-energy (WTE) facilities. For this reason, the SWANA Applied Research Foundation's (ARF) Waste Conversion and Energy Recovery (WCER) Group selected the topic of "PFAS Fate and Transport in WTE Facilities" for investigation. 12 organizations subscribed to the SWANA ARF's WCER Group in FY2021, each of which made a funding commitment to support the conduct of collective applied research in the WTE area.[1]

[1] *The subscribing members of the ARF's WCER Group include: CDM Smith; City and County of Honolulu, HI; Ecomaine, MA; City of Edmonton, Alberta, CN; Hennepin County, MN; I-95 Landfill Owners Group, VA; Montgomery County, MD; New River Resource Authority, VA; Olmsted County, MN; Solid Waste Authority of Palm Beach County, FL; Solid Waste Disposal Authority of Huntsville, AL; and York County Solid Waste Authority, PA.*

The research findings presented in the resulting report, *PFAS Fate and Transport in Waste-to-Energy Facilities*, are based on a comprehensive review of the literature and an analysis of the findings of laboratory, pilot-scale, and full-scale investigations of the PFAS emissions from WTE facilities and similar thermal combustion plants and processes.

Based on a limited number of sources, it appears that a value of 10 ng/g (0.01 parts per million or ppm) can be considered a representative figure characterizing the overall MSW PFAS content. More testing of individual MSW waste streams will be required to determine if the 10 ng/g figure is a true average representation of these substances across the board. It is not known, for example, if there are regional differences in the US based on either a concentration of historical production facilities or even cultural practices that would favor the use of PFAS compounds in one region compared to another.



SOURCE: https://www.oaklodgewaterservices.org/surface-water/page/public-information-brief-pfas.

The EPA has identified WTE combustion as a technology that can achieve up to 99 percent destruction of PFAS and has reported that fluorinated organic compounds such as PFAS require temperatures above 1,000˚C to achieve 99.99 percent destruction with one second residence time for unimolecular decomposition of PFAS. It is worthwhile to compare these requirements to the actual operating temperatures (800°C–1,100°C) and residence times (2s) indicative of US WTE facilities. Nevertheless, since the moisture content of incoming MSW loads can vary dramatically over time with rain and snow events resulting in lower boiler operating temperatures; more facility-specific evaluation and documentation of average plant boiler operating temperatures will be needed to lower possible regulatory concerns that plants might not routinely achieve the 1,000˚C target for optimal PFAS destruction.

The studies reviewed in this report indicate that PFOA is not emitted during the combustion of "Fluorotelomer-based Acrylic Polymers" (FTBPs) or polytetrafluoroethylene (PTFE) at temperatures (1000 °C) typical of the high end of US WTE facility operations and residence times (2s) representative of US WTE facilities. This is encouraging as PFOA is one of the two primary PFAS chemicals (the other being PFOS) that are of most concern from a health standpoint. A literature review conducted by the Department of Chemistry at Umeå University in Sweden concluded that the statement that PFOS is destroyed in the combustion zone of WTE facilities and is not reformed in the post-combustion zone can be made, albeit with a low level of confidence.

The EPA is concerned about the potential for products of incomplete combustion (PICs) to form during the combustion of PFAS-containing wastes in WTE facilities. However, in a study conducted at a pilot plant in Germany, none of the 31 types of PFAS that were identified as possible PICs from the incineration of PTFE were found in the flue gas.

Conclusions regarding the environmental impact of combusting PFAS-containing waste in WTE facilities include the following:

- Waste incineration of fluorotelomer based polymers (FTBPs) should not be expected to be a source of PFOA in the environment.
- Municipal incineration of PTFE using best available technology (BAT) is not a significant source of studied PFAS and should be considered an acceptable form of waste treatment.
- Waste incineration in Sweden is not a significant source of perfluoroalkyl acids (PFAAs) to the atmosphere or to the environment in general.

Based on the research conducted in this report, SWANA agrees that additional field tests need to be conducted to confirm the capability of US WTE facilities to destroy PFAS chemicals contained in MSW through high-temperature combustion while not generating harmful PICs in the process. This could be accomplished by stack testing air sampling data from a variety of US-based WTE plants once approved test methods have been established by EPA and other regulatory bodies.

The findings of the studies reviewed in this report are encouraging with respect to the ability of today's US WTE facilities to effectively treat solid waste that contains PFAS and not emit detectable levels of PFOA in the process. With respect to the formation of PICs, the pilot-scale investigation conducted at the Karlsruhe Institute of Technology is encouraging in its findings that the combustion of PTFE did not create any of the 31 types of PFAS suspected of being potential PICs produced during the combustion process.

In conclusion, based on this research, SWANA is cautiously optimistic regarding the role that WTE facilities can play in the destruction of PFAS in MSW. The thermal destruction of PFAS in high-temperature combustion systems such as WTE facilities may represent one of the few commercially proven options available to society for the destruction of these problematic, forever chemicals.

The full report, *PFAS Fate and Transport in Waste-to-Energy Facilities* is currently only available to SWANA ARF subscribers. SWANA members receive free access to ARF industry reports one year after publication.[2]

[2] *For more information on the SWANA Applied Research Foundation, contact Jeremy K. O'Brien, P.E., Director of Applied Research at SWANA at jobrien@swana.org, or 704-906-7269.*

SWANA APPLIED RESEARCH FOUNDATION

For more information visit SWANA.org