Forever No More: Proposed Designation of PFAS as Hazardous Substances & Emerging Destruction Methods

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Background

Per- and polyfluoroalkyl substances (PFAS) are a large group of synthetic compounds that pose a major threat to public and environmental health. The compounds are collectively known as "forever chemicals" because they do not naturally degrade in the environment and accumulate in living organisms.

Perfluorooctanoic Acid (PFOA)

The chemical structures of PFAS make them highly resistant to destruction, and exposure can lead to adverse health effects such as altered liver function, elevated cholesterol, and some cancers.

There is an urgent need to remove and destroy these chemicals, but efforts to achieve this are hampered by limited options for effective removal and destruction technologies, as well as insufficient incentives for public and private entities to remove them.

Objectives & Methods

The overall goal of this work was to identify policy and research opportunities that could help address the unmet need to remove and destroy forever chemicals.

Our objectives included:

- Examining the potential implications of a "hazardous substance" designation on PFAS removal and destruction efforts.
- Exploring progress towards and barriers to implementing a "hazardous substance" designation.
- Identifying the most promising existing destruction methodologies and technologies based on a cost-benefit analysis.

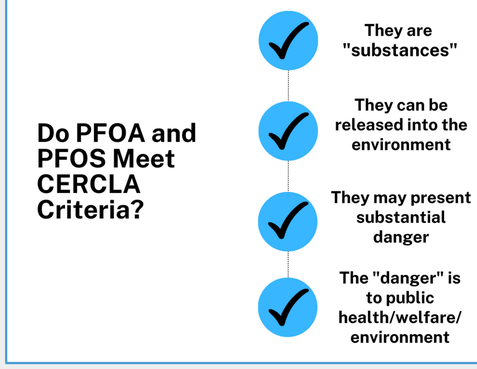
To achieve this, we performed the following activities:

- Reviewed literature, including academic peer-reviewed publications, white papers, government documents and websites.
- Conducted interviews with regulatory experts at the NC Department of Environmental Quality.
- Performed a cost-benefit analysis of existing destruction methodologies and technologies.

Key Findings: CERCLA Criteria

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), governed by the Environmental Protection Agency (EPA) and Department of Defense (DOD), is a framework for the cleanup and liability of designated "hazardous substances" released into the environment.[1] Since PFOA and PFOS meet CERCLA Criteria for "hazardous substances", this could be a feasible policy approach for PFAS:[3]

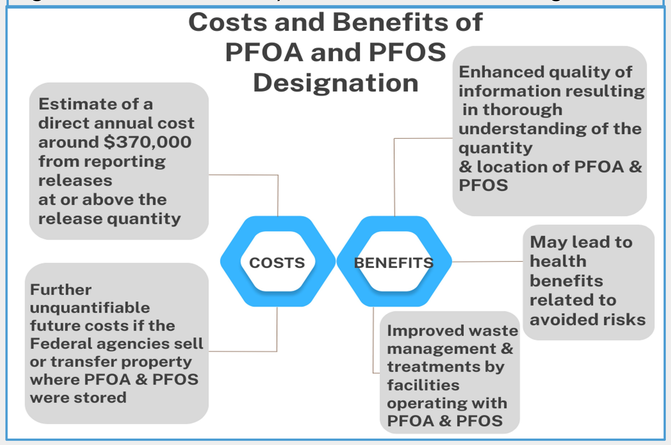
Figure 1. CERCLA "hazardous substance" criteria,



Effects of designating PFAS compounds such as PFOA and PFOS outlined by the EPA.[3]

1. Any person directing a vessel or facility must report releases of PFOA and PFOS of a pound or more.
2. Federal agencies must report PFOA and PFOS storage/disposal/release when selling property.
3. Dept. of Transportation must list and regulate CERCLA designated "hazardous substances" as "hazardous materials."

Figure. 2 Cost-benefit analysis of PFOA and PFOS designation.

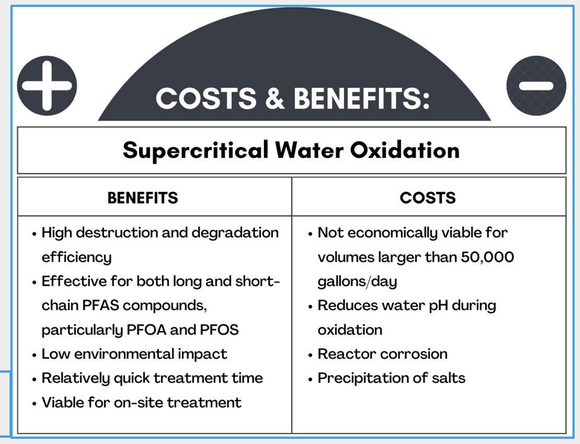


Key Findings: Destruction Technologies

Supercritical water oxidation (SCWO) is a novel and potentially optimizable approach to PFAS destruction and waste disposal. Adhering to oxidation mechanisms, solutions manipulated for SCWO maintain a specific temperature and pressure above the supercritical state of water (374℃ and 218 atm).[4]

At the supercritical state, the carbon-fluorine bonds that stabilize PFAS breakdown. Resulting products include carbon dioxide, water, and other harmless.[4]

Figure 3. Cost-benefit analysis of Supercritical water oxidation.



Key Findings: Public Health

Despite being phased out of production in 2002 and 2015, PFAS "legacy compounds" such as PFOS and PFOA continue to persist in water as well as the air[5]. This indicates prolonged PFAS contamination within the environment, which can lead to widespread PFAS exposure.

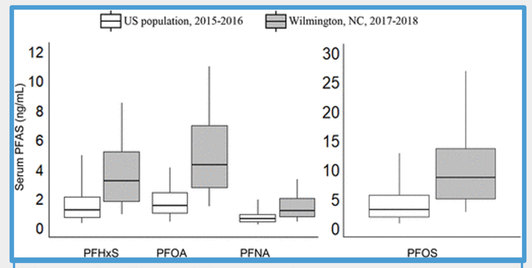


Figure 4. Adopted from Kotlarz, N. et. al., Legacy PFAS concentrations in blood samples from Wilmington compared to U.S. population.

PFAS have the ability to bioaccumulate in the human bloodstream over time.[6] More longitudinal public health studies are needed to evaluate this exposure, affecting the implementation of CERCLA Criteria for PFAS compounds in water and air.

Policy Recommendations

1. **Designating PFOA and PFOS as a CERCLA "hazardous substance" could provide a formal framework for cleanup and liability and help incentivize public and private entities to mitigate the release of PFAS chemicals into the environment.**

1. **Supporting public-private partnerships could help optimize and scale-up supercritical water oxidation methods of PFAS destruction.**

1. **Supporting longitudinal public health studies for PFAS-connected illnesses could inform water and air quality-based policies and potential implementation of CERCLA criteria.**

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