ADVANCING THE AQUEOUS FILM FORMING FOAM (AFFF) DEPLOYMENT PATHWAY: RECOMMENDATIONS FOR RESPONSIBLE USE & MANAGEMENT IN NORTH CAROLINA

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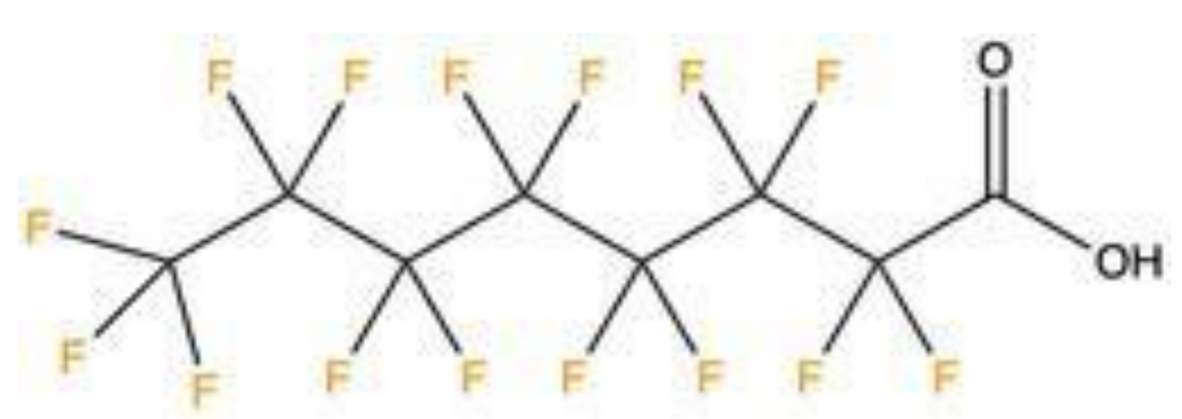
Background

Per- and polyfluoroalkyl substances (PFAS) are an expanding class of synthetic compounds that pose a major threat to environmental integrity and public welfare. Collectively known as "forever chemicals," PFAS characteristically bioaccumulate within living organisms and do not naturally degrade in the environment, thereby amplifying their potential for adverse ecological and health effects.

The chemical nature of PFAS make them desirable for common consumer and industrial applications, particularly as precursor agents for aqueous film-forming foams (AFFFs). AFFFs, commonly employed in firefighting to extinguish flammable liquid and gas fires (Class B), contain PFAS.[1] Research has shown that these chemicals have been connected to numerous downstream issues, including drinking water contamination near fire fighting facilities and airports, altered immune functions, developmental disorders and cancer.[2] These concerns underscore an urgency for practical and political intervention to address PFAS and AFFF contamination and exposure across the state of North Carolina.



Perfluorooctanoic acid (PFOA)

Motivations & Methods

Our motivation stems from recent federal and state regulatory agendas aimed at mitigating PFAS pollution from all environmental domains. It includes the U.S. Environmental Protection Agency's (EPA) creation of the PFAS Strategic Roadmap and, on the state level, the North Carolina Department of Environmental Quality's (NCDEQ) development of its own Action Strategy for PFAS.[3] We've also seen state officials such as Attorney General Josh Stein take legal action to hold manufacturers responsible. Since 2021, Stein has filed six lawsuits against 14 companies over the toxic firefighting foam contamination across the state, including at the Charlotte Douglas International Airport.[4] Wanting to gain insight on the fate and treatment of AFFF after manufacturing and use, we designed a research study to chart its lifecycle.

Our research team used a mixed-methods, qualitative research approach conducting literature and legislative reviews, in addition to interviewing the following North Carolina environmental public administrators and professionals:

- Adam Ulishney, Deputy Director, Division of Waste Management at NCDEQ
  - Relayed NCDEQ's current approach to PFAS waste, along with hazardous waste management.
- Dr. Arash Kasebi, Postdoctoral Research Fellow at NC State, Volunteer Firefighter
  - Provided insight on the nature of AFFF deployment and training for AFFF alternatives.

AFFF PATHWAY

Manufacturing

AFFFs v. SFFFs

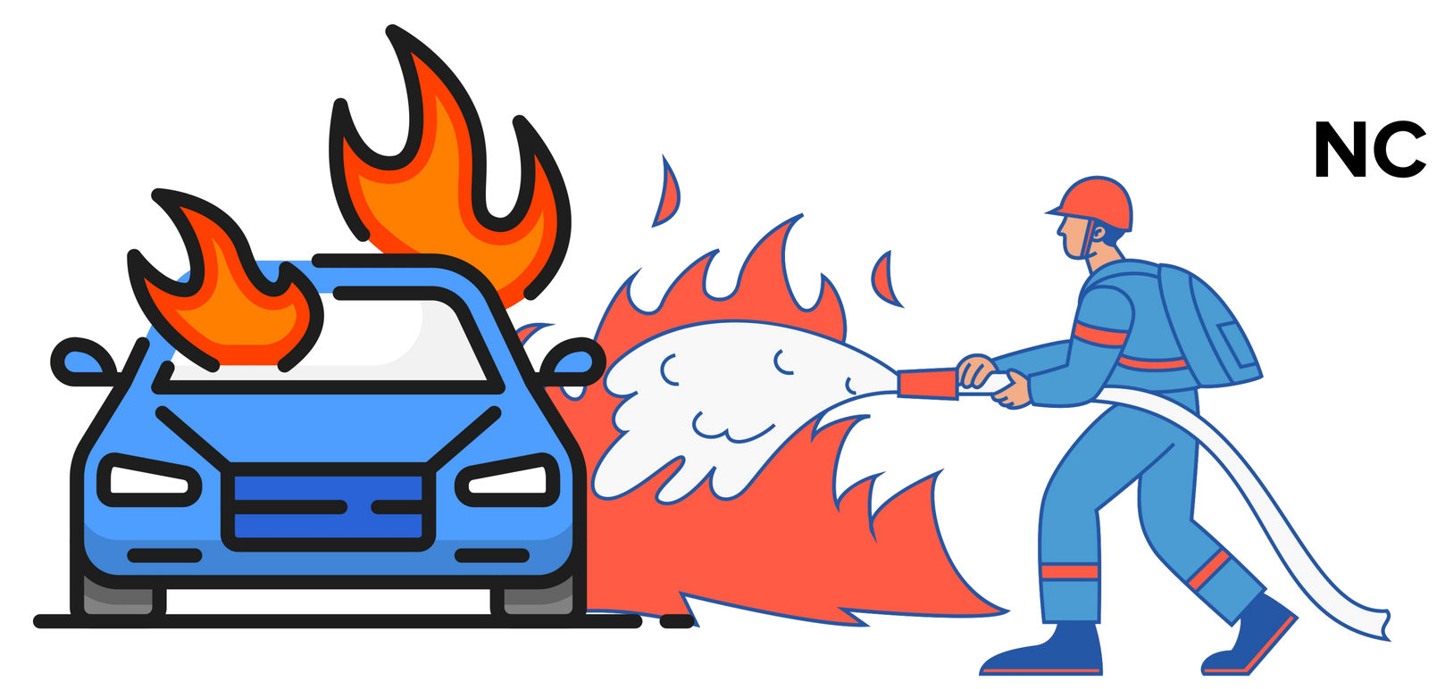
3% vs 6% formulations

Health risks

Environmental risks

→

Deployment



NC OSFM ImageTrend Elite

Use monitoring

Incident reporting

Storage inventories

→

Disposal

Third-party companies contracted for cleanup

Concerns:

Disclosure + Tracking

Terminal PFAS[5]

EJ impact[6]

KEY FINDINGS & RECOMMENDATIONS

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) & Resource Conservation and Recovery Act (RCRA): Statutory Signaling for Pollution Mitigation

Recent EPA actions involve CERCLA (Superfund) ***"hazardous substance"*** designations for PFOA and PFOS. While this first step is crucial for catalyzing pollution mitigation of legacy compounds, there is still major concern for the growing class of short-chain PFAS precursors and by-products in AFFF synthesis and deployment. In August 2023, the U.S. Department of Defense (DoD) Defense Environmental Restoration Program (DERP), in partnership with the EPA, designated not only **PFOA and PFOS**, but eight additional compounds - **PFBA, PFBS, PFNA, PFHxA, PFHxS, PFPrA, TFSI, and HFPO-DA** - under the CERCLA ***"imminently hazardous chemical substances"*** definition (Toxic Substance Control Act criteria).[7] The EPA also recently proposed designations for nine PFAS (eight found in AFFFs) as ***"hazardous constituents"*** under RCRA, with an additional rule clarifying the authority of the EPA to implement corrective action at RCRA sites for compounds meeting the statutory definition for a ***"hazardous waste"*** *(at least one: ignitability, corrosivity, reactivity or toxicity).*[8]

The next step in the CERCLA and RCRA process would be to further classify long-and-short chain compounds to holistically consider environmental contamination and exposure risks along the AFFF pathway and enhance enforceable legislation.

Enhancing Sustainable Synthetic Fluorine-Free Foam (SFFF) and Fire-Fighting Efficiency: Case-Specific Training and Formulation Optimization

Numerous stakeholders are involved in policy discussions to examine the implications of transitioning to synthetic fluorine-free foam, which includes both potential reduction of health risks among firefighters and ensuring the effectiveness of SFFF.[9] Fluorine-free foam is needed in order to achieve sustainable firefighting practices. PFAS substances found in AFFF accumulate in the environment due to their chemical durability, and eliminating them from firefighting foam usage would ensure bioaccumulation does not occur.[10] SFFF companies, such as National Foam, have developed an SFFF product with high biodegradability efficacy, dependent upon concentrations used.[11]

FUTURE CONSIDERATIONS

- Assessing political and practical feasibility for expanding CERCLA and RCRA designations for public-private AFFF waste management, similar to the DoD DERP CERCLA model.
- SFFF-specific training programs for firefighters in North Carolina, modeled after TEEX Fire Training Academy.[12]

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