Per- and Polyfluoroalkyl Substances (PFAS) in the Environment: An Overview of Three Case Studies

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Abstract

Per- and polyfluoroalkyl substances (PFAS), known as "forever chemicals," are used in a wide range of consumer and industrial products, including non-stick cookware, leather coatings, cleaners, shampoos, pesticides, firefighting foam, and many others [1]. Due to their persistence and bioaccumulation, PFAS are found in air, water, soil, and food. PFAS have been associated with kidney and testicular cancers, as well as several other adverse health effects in humans, including dyslipidemia, hormonal imbalance, immunotoxicity, and kidney injury [2]. Detecting and monitoring PFAS with environmental Nanosensors can facilitate rapid detection, reduce costs, and inform prevention strategies. This presentation will share three different case studies related to PFAS and environmental health concerns.

Case Study 1: PFAS are widely used in construction coatings and painting products. Occupational exposure as a painter has been classified by the International Agency for Research on Cancer (IARC) as a Group 1 carcinogen [3]. Exposure to PFAS has emerged as a significant concern and a possible contributing factor to the high risk of cancer among painters. We will present the results of a preliminary study on PFAS body burden among construction painters and product characterization. Independent chemical analyses are needed to determine specific PFAS compounds and their concentrations in products used by construction workers to guide targeted PFAS biomonitoring and prevention efforts.

Case Study 2: PFAS are the primary ingredient in Aqueous Film Forming Foams (AFFF) used to suppress Class B fires. The firefighting profession recently has been categorized as a Group 1 carcinogen. We will discuss the results of a national survey of fire training facilities (FTFs) aimed at collecting information on the current state of firefighter foam use, best practices, barriers, lessons learned from current efforts to transition to fluorine-free foams (FFFs), and field experiences using these alternatives [4]. Further testing is needed to evaluate these new alternatives as PFAS-free products.

Case Study 3: Funded by the Research Expertise from the Academic Diaspora Fellowship (READ) program in collaboration with our colleagues in Tirana, we measured PFAS concentrations in irrigation waters in Albania to determine contamination hotspots. Water samples from surface waters (e.g., rivers, streams, and reservoirs) and groundwater systems (e.g., wells) in Albania were analyzed for 50 PFAS at UMass Lowell. This presentation will cover our preliminary findings and suggestions for next steps.

Through this presentation, we aim to alert the NANOBalkan conference audience to the urgent need for developing environmental Nanosensors to detect PFAS sources, measure hotspot pollution, and identify communities at high risk.

1. Gaines, LGT [2023]. Historical and current usage of per- and polyfluoroalkyl substances (PFAS): A literature review. American Journal of Industrial Medicine.
2. Agency for Toxic Substances and Disease Registry (ATSDR) [2021]. Toxicological profile for Perfluoroalkyls. 2021, U.S. Department of Health and Human Services, Public Health Service, Atlanta, GA.
3. IARC [2010]. Painting, firefighting, and shiftwork. Working Group on the Evaluation of Carcinogenic Risks to Humans. IARC Monographs Evaluation of Carcinogenic Risks to Humans, 98: p. 9-764.
4. European Commission DG Environment [2019]. The use of PFAS and fluorine-free alternatives in fire-fighting foams. Stakeholder workshop background paper. Tuesday 24 September 2019 at the European Chemicals Agency (ECHA).