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IDA GLOBAL CONNECTIONS

The Elements Needed to Achieve Lower Desalination Tariffs

An exclusive interview with Mr. Mohammad Abunayyan

Chairman, ACWA Power International

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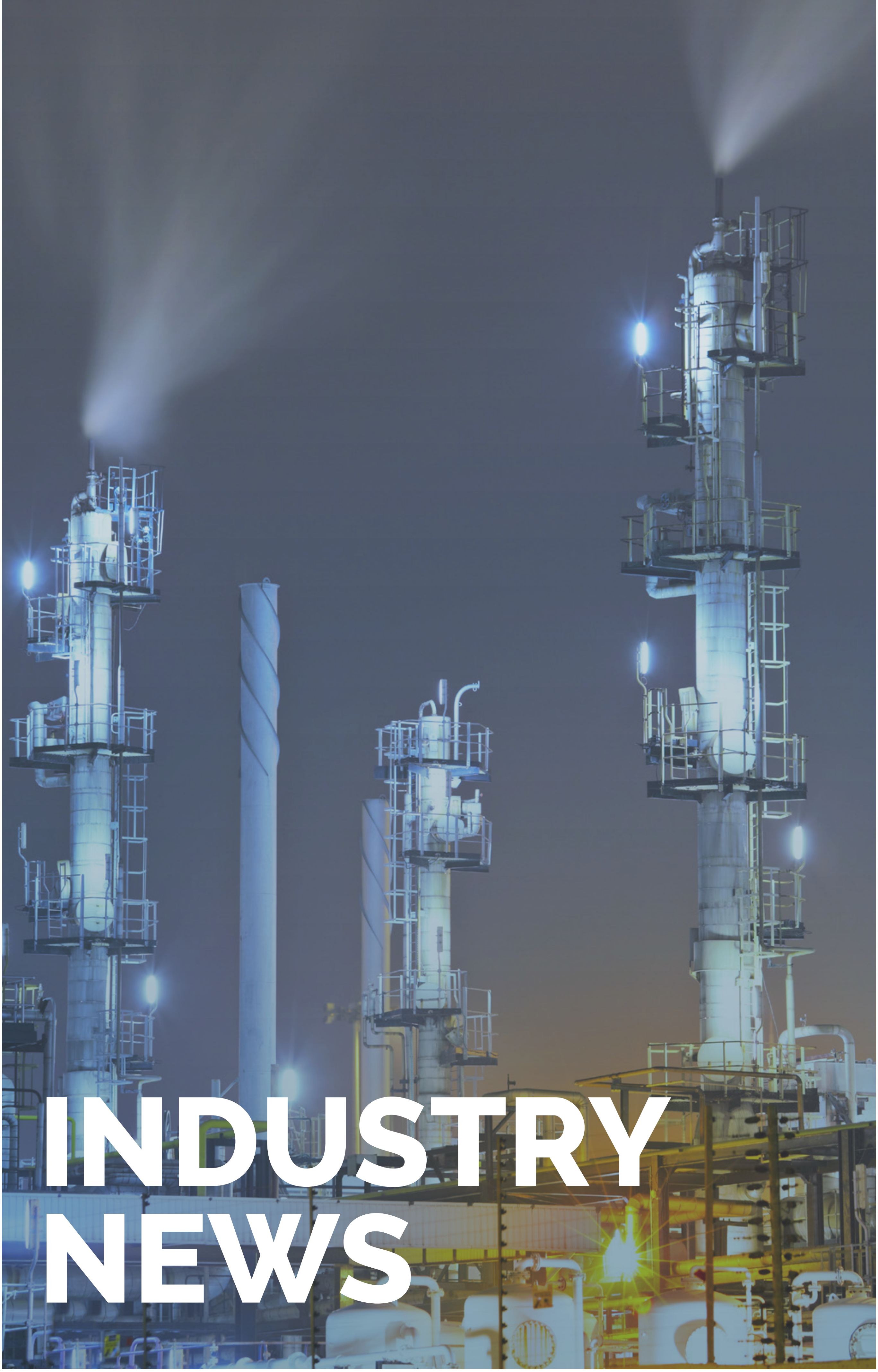
INDUSTRY
NEWS

LIVING WITH EIGHT DECADES OF PFAS CONTAMINATION - WHAT IS KNOWN AND WHAT IS UNKNOWN

By Dr. Mohamed Ateia, Department of Chemistry, Northwestern University

The recent estimates suggest that 5000–9000 per- and polyfluoroalkyl substances (PFAS) are already in the market taking many forms as varied as clothing, furniture, adhesives, food packaging, heat-resistant non-stick cooking surfaces, electronic devices, batteries and firefighting foam for combating high-hazard flammable liquid fires. PFAS – such as PFOA, PFOS, GenX – are practically unreactive, non-biodegradable, and incredibly resistant to extreme heat which put them among the most persistent toxic compounds in existence. Within just eight decades since their first production, PFAS have entered our food chain, water sources, and even our atmosphere – they are found in the blood of virtually everyone on Earth, including newborn babies. They will not change the color or odor of your drinking water, but many tap and bottled water sources are contaminated with varying concentrations of PFAS. In the US alone, more than 200 million Americans could have the toxic PFAS in their drinking water at a concentration of 1–10 part per trillion (ppt) or higher as studied by scientists at the Environmental Working Group. The past decade has witnessed an increased attention and research activities on PFAS regarding their monitoring, treatment, and regulation.

MONITORING: PFAS are everywhere around us. We almost always find them whenever we look for PFAS contamination. Studies have estimated that PFAS such as perfluoroalkanes have lifetimes in the thousands of years. Thus, PFAS will be present in the environment for centuries or longer, even if environmental releases cease today. Historically, the inability of achieving precise determination of PFAS from environmental samples have been due to the lack of isotopically labeled standards and the requirement of sensitive instruments to detect extremely low/trace concentrations (ppt levels). The exposure to PFAS occurs in complex mixtures of multiple PFAS, but fewer than 50 individual PFAS (often fewer than 10) are commonly measured in environmental media. Not long ago, new analytical methods show promise for more comprehensive screening of many known PFAS and measuring total fluorine or organofluorine. To cope with the dynamic industrial production of various PFAS, the researchers need quick adoption of monitoring programs and analytical techniques that should cover those emerging compounds.

Removing PFAS from water and ultimately degrading them into products that lack carbon-fluorine bonds will be important for decontaminating our water resources.

TREATMENT: PFAS have physicochemical attributes that challenge removing or degrading them in any aqueous environment. Their polar head groups make PFAS highly water soluble and nonvolatile, and their carbon–fluorine bonds confer environmental persistence. Currently, activated carbon and single-use ion exchange resins are the most used sorbents to remove PFAS from water. Yet these conventional sorbents have critical deficiencies, such as low affinity toward short-chain PFAS, and are impacted by background organic and inorganic constituents. The recent advancements in the development of PFAS-selective adsorbents now offer the possibility of short- and long-chain PFAS treatment using regenerable sorbents such as cyclodextrin polymers and amine-functionalized materials. However, current available data the treatment of PFAS-impacted waters will necessitate a treatment train approach. Such tandem-mode setups would consist of a separation step (e.g., adsorption or nanofiltration) followed by a destruction process applied to the adsorbents, retentate, and/or regeneration solutions. In addition, most public and regulatory attentions have so far focused on anionic PFAS with carboxylate or sulfonate polar groups, but zwitterionic and cationic polar groups are also found among PFAS. These emerging classes of PFAS requires more detailed studies to ensure the removal of the whole 'PFAS class' from our waters. Removing PFAS from water and ultimately degrading them into products that lack carbon-fluorine bonds will be important for decontaminating our water resources.

REGULATIONS: Due to their extremely recalcitrant nature and potential bioaccumulation and toxicity, exposure to PFAS may result in adverse health outcomes in humans and wildlife. A large number of studies have examined possible relationships between levels of PFAS in blood and harmful health effects in people. Very low doses of PFAS chemicals in drinking water have been linked to suppression of the immune system and are associated with an elevated risk of cancer and reproductive and developmental harms, among other serious health concern. However, not all of these studies involved the same groups of people, the same type of exposure, or the same PFAS. These different studies therefore reported a variety of health outcomes. Humans and animals react differently to PFAS, and not all effects observed in animals may occur in humans and vice versa. Additional research may change our understanding of the relationship between exposure to PFAS and human health effects. Yet, our current knowledge show the need to develop sufficiently protective regulations. The United Kingdom and the European Union have introduced drinking water guidelines at parts-per-billion levels for PFOS/PFOA and an annual average environmental quality standard for PFOS, respectively. In the US, the absence of an enforceable federal PFAS drinking water standard has embarked at least eight states to pursue more stringent standards than the combined 70 parts-per-trillion advisory level set by the United States Environmental Protection Agency (US EPA) for PFOS and PFOA. Recently, scientists are calling for regulating and managing PFAS as a 'single class' to replace the current chemical-by-chemical approach. The target is to minimize the exposure to PFAS by combining regulations with elimination of non-essential uses of PFAS and the development of safer alternatives.

About the Author

Mohamed Ateia will be Environmental Engineer and Group Leader with the United States Environmental Protection Agency (US EPA) as of August 2021. He is focusing on PFAS treatment at the Center for Environmental Solutions and Emergency Response (CESER), Cincinnati, OH. Dr. Ateia is currently a Research Associate at the Department of Chemistry at Northwestern University. Prior to joining Northwestern University, Dr. Ateia studied in Tokyo Institute of Technology, Japan and the University of Copenhagen, Denmark, then he completed a postdoctoral training at Clemson University. Dr. Ateia's research targets the development of new materials and techniques to adsorb and/or degrade emerging water pollutants (e.g. PFAS, DBPs, PPCPs, illicit drugs) as well as the mobility of new classes of contaminants in the environment (e.g. microplastics). His research at the EPA's Office of Research and Development will target the removal of micropollutants (mostly PFAS) and the assessment of various separation and destruction technologies from lab-scale to Superfund sites.