OPTIMIZATION OF PERFLUOROOCTANOIC ACID (PFOA) DEGRADATION IN WATER BY COLD ATMOSPHERIC PLASMA (CAP)

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Known as “forever chemicals” per- and polyfluoroalkyl substances (PFAS) are main constituent of the persistent organic pollutants (POPs) because of their remarkable persistency and ability to undergo long-range transport through soil and water and extended bioaccumulation. The removal of PFAS has been pursued by different methods mainly physical, chemical, and biological treatment, exhibiting though several limitations including non-effective destruction, use of chemicals, secondary pollution and high energy requirements. Among the various water remediation methods cold atmospheric plasma (CAP) is regarded as rapid, environmentally friendly and cost-effective being established as an advantageous method for the destruction of organic pollutants in water. Recently, more and more efforts explore the potential of the CAP method for the destruction of PFAS. The effectiveness of CAP is based on the generation of highly oxidative and reductive reactive oxygen and nitrogen species (RONS), UV radiation and high energy electrons, which can successfully destruct organic pollutants. However, the destruction of PFAS from water is a challenging task. PFAS consist of a fluorinated alkyl chain and a polar head group that give them surfactant-like properties and makes them resilient and difficult to degrade.

In this study, for the first time, a direct comparison of two different CAP remediation approaches (gas-liquid dielectric barrier discharge plasma vs underwater plasma bubbles) towards the degradation of perfluorooctanoic acid (PFOA) in water was performed. Besides reactor configuration, many other critical parameters were investigated such as plasma gas, initial PFOA concentration, water matrix and pulsed-plasma waveform. The physicochemical properties of plasma treated water were determined and correlated with the PFOA degradation efficiency. The results of the present work provide insightful knowledge for the effective and energy efficient plasma-based treatment of PFOA-contaminated water.

KEYWORDS: Water treatment, Perfluorooctanoic acid (PFOA), Cold atmospheric plasma (CAP), Dielectric Barrier Discharge (DBD), Plasma Bubbles

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