World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:19, No:05, 2025

Enhanced Poly Fluoroalkyl Substances Degradation in Complex Wastewater Using Modified Continuous Flow Nonthermal Plasma Reactor

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Abstract : Communities across the world are desperate to get their environment free of toxic per-poly fluoroalkyl substances (PFAS) especially when these chemicals are in aqueous media. In the present study, two different chain length PFAS (PFHxA (C6), PFDA (C10)) are selected for degradation using a modified continuous flow nonthermal plasma. The results showed 82.3% PFHxA and 94.1 PFDA degradation efficiencies, respectively. The defluorination efficiency is also evaluated which is 28% and 34% for PFHxA and PFDA, respectively. The results clearly indicates that the structure of PFAS has a great impact on degradation efficiency. The effect of flow rate is studied. increase in flow rate beyond 2 mL/min, decrease in degradation efficiency of the targeted PFAS was noticed. PFDA degradation was decreased from 85% to 42%, and PFHxA was decreased to 32% from 64% with increase in flow rate from 2 to 5 mL/min. Similarly, with increase in flow rate the percentage defluorination was decreased for both C10, and C6 compounds. This observation can be attributed to mainly because of change in residence time (contact time). Real water/wastewater is a composition of various organic, and inorganic ions that may affect the activity of oxidative species such as □□. radicals on the target pollutants. Therefore, it is important to consider radicals quenching chemicals to understand the efficiency of the reactor. In gas-liquid NTP discharge reactors □□. , □□□ − , □ . , □3, □2□2, □. are often considered as reactive species for oxidation and reduction of pollutants. In this work, the role played by two distinct □ .□ Scavengers, ethanol and glycerol, on PFAS percentage degradation, and defluorination efficiency (i,e., fluorine removal) are measured was studied. The addition of scavenging agents to the PFAS solution diminished the PFAS degradation to different extents depending on the target compound molecular structure. In comparison with the degradation of only PFAS solution, the addition of 1.25 M ethanol inhibited C10, and C6 degradation by 8%, and 12%, respectively. This research was supported with energy efficiency, production rate, and specific yield, fluoride, and PFAS concentration analysis with respect to optimum hydraulic retention time (HRT) of the continuous flow reactor.

Keywords : wastewater, PFAS, nonthermal plasma, mineralization, defluorination
Conference Title : ICW 2025 : International Conference on Wastewater
Conference Location : Tokyo, Japan
Conference Dates : May 27-28, 2025