Enhanced Reductive Defluorination of 6:2 Fluorotelomer Alcohol Using Bio-Electrochemical Systems

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Current research on the biological degradation of poly- and perfluorinated alkyl substances (PFASs) is still challenged by two limitations: 1) Poor feasibility: successful biodegradation is limited to a small number of perfluoroalkyl acid precursors such as fluorotelomer alcohols (FTOHs); 2) Lack of means to precisely study the mechanism: conventional biological methods can only create an anaerobic (vs. aerobic) environment, which cannot pinpoint whether the mechanism is oxidative or reductive.This study uses Bio-Electrochemical Systems (BES) to precisely accomplish and enhance reductive PFAS degradation. BES is a platform technology where bacteria directly exchange electrons with solid electrodes to catalyze biochemical reactions. It has great potential for studying and enhancing PFAS degradation because it can: 1) Enhance bio-reactions by utilizing electric power; 2) Precisely separate oxidation and reduction reactions given the fuel-cell-like setup. This study monitored the reductive defluorination of 6:2 fluorotelomer alcohol (6:2 FTOH) for over two months in BES. The results indicated that BES significantly increased (p-value<0.05) the rate of F- release under -0.55V poised potentials (vs. AgCl), and decreased the accumulation of 6:2 fluorotelomer carboxylic acid (6:2 FTCA), an intermediate degradation product (Fig 1). This study was the first time that reductive PFAS bio-degradation was precisely achieved, and the first report of successful BES-driven PFAS degradation. The findings provided the proof of concept needed to further explore whether enhanced defluorination can be accomplished with BES on more recalcitrant PFAS classes (e.g., perfluoroalkyl acids), and develop a new remediation technology.