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PFOA Defluorination Using DMSO/NaOH Mixture

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Persistent per- and polyfluoroalkyl substances (PFAS) result in diffuse pollution.
To address this issue, Trang et al. investigated a low-temperature degradation (80-120℃) of perfluorooctanoic acid (PFOA) (at 36 g/L) using a mixture of dimethyl sulfoxide (DMSO), NaOH (30/1 NaOH/PFOA molar ratio) and milli-Q water (8/1 DMSO/water volume ratio). We explored a more practical degradation process.
PFOA doping concentration (893 mg/L) was selected to decrease the dilution factor and quantify PFOA and by-products at µg/L level, while enabling F- measurements. The degradation process was examined over six days at 120℃.
Ultra-high-pressure liquid chromatograph coupled with a mass spectrometer (UPLC-MS) was performed for quantitation of PFOA, perfluoroheptanoic acid (PFHPa), perfluorohexanoic acid (PFHxA), perfluoropentanoic acid (PFPeA), and perfluorobutanoic acid (PFBA). For fluoride F- analyses, a selective F- electrode was used. SEM-EDS were coupled for NaF characterization of dried surface of 20 µL of the mixture after reaction.
Experiments highlighted the necessity of maintaining at least twice larger the DMSO/H2O volume and twenty to one higher the NaOH/PFOA mole ratio to ensure effective PFOA defluorination while minimizing by-products. PFHpA, PFHxA, PFPeA fell below the limit of quantification after 30 min; PFBA after 12 hours, while surfaces of peaks at 325 m/z, 275 m/z, 229 m/z, 225 m/z and 114 m/z (TFA) by-products were declining versus time without reaching zero after six days. Simultaneously, F- content reached its maximum (⊠ 80% vs total F provided by PFOA) after 18 hours. This maximum is identical to that at 140℃. Experiments are in progress to identify and quantify unusual by-products and carry out mass balance.

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