David Burns, J Environ Anal Chem 2018, Volume 5
DOI: 10.4172/2380-2391-C1-001

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Green chemistry used to remediate bulk PFAS in contaminated waters: Foam fractionation

Statement of the Problem: Fluoro-chemicals containing fully or partially fluorinated carbon chains, including a specific category known as PFAS, have emerged as potential contaminants of concern in ground, surface and landfill leachate waters. Separation/extraction of PFAS, including the PFOS, PFHxS, PFOA and FTS's have proven difficult. The purpose of this presentation is to provide an account of how green chemistry was used to develop a laboratory and field trial conceptual engineering design to gain commercial advantage.

Methodology & Theoretical Orientation: Application of Aqueous Film-Forming Foam (AFFF) is used to extinguish high temperature hydrocarbon fires and was hypothesized that removal from contaminated waters could also be accomplished by foaming. The principles of green chemistry were used to identify potential treatment candidates possessing a favorable position on a technology comparison cost curve and evaluation against traditional treatments. Rapid foam fractionation was developed including a hyper-concentration step. The methodology was confirmed by laboratory bench-scale testing, treatability trials and is pending a full-scale three year field trial in Australia.

Findings: Foam fractionation was found to remove 99% of priority PFAS compounds across concentrations ranges 0.5 ug/l-20 mg/l. Separation and removal time occurred within 5-45 minutes, dependent upon starting concentrations. Experiments found that longer chain (≥C6) PFAS were highly amenable to separation.

Conclusion & Significance: Foam fractionation represents a simple, efficient and elegant method to remove bulk PFAS from contaminated water, located forward of other specialized polishing techniques capable of obtaining a combined cleanup target PFOS+PFHxS in drinking water or 99% ecological trigger value of 0.07 ug/l and 0.00023 ug/l, respectively. Foam fractionation offers significant cost savings in a multi-stage water treatment plant.

Biography

David Burns is an Analytical Chemist with a BSc from Newcastle University and former Co-Founding Owner of LabMark Laboratories in 1997. He has a passion for applying the principles of green chemistry and industrial ecology to seek commercial advantages in collaborative projects.

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