Quantification of Perfluorinated Compounds in Environmental Water Samples by Matrix-Assisted Laser Desorption Time-of-Flight Mass Spectrometry

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Background/Objectives. Perfluorinated compounds (PFCs), including perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), are an emerging class of environmental pollutants. These compounds are of particular interest due to their toxicity, bioaccumulative and non-degradative properties. These compounds are used in a wide range of industrial applications, including but not limited to, firefighting foams, textiles, carpets and food packaging materials. Due to their wide spread use, these compounds are now largely found in the environment and more recently, found to be present in human serum. The accumulation and persistence of these compounds in the environment and organisms has resulted in the unmet need for the development of fast, sensitive and cheap analytical techniques for their detection. Current methods for the detection of PFCs from groundwater involve a pre-enrichment step followed by the use high-performance liquid chromatography/ tandem mass spectrometry (LC-MS/MS). Although the approach is highly sensitive and reproducible, sample preparation, cost and through-put limitations hinders comprehensive screening of PFCs across various matrices. All routine PFC analyses require pre-enrichment, with solid-phase extraction (SPE) being the most commonly utilised approach. Here we employed an optimised SPE coupled with matrix-assisted laser desorption/ionisation time-of-flight mass spectrometry (MALDI-TOF MS) to detect and quantify PFCs.

Approach/Activities. We will establish a high-throughput and cost-effective method by using a MALDI-TOF MS platform. In recent times, the use of MALDI-TOF MS platforms to quantify enriched PFCs has been described (Cao et al., 2011; Cao et al., 2012). In this work we employed equivalent protocols in the extraction and quantification of PFCs from water samples supplied by Ziltek to establish a high-throughput and cost-effective platform in South Australia. Briefly, water samples were spiked with a labelled standard prior to various SPE enrichment strategies. Enriched PFCs samples were subsequently analysed using MALDI-TOF MS to deduce both limits of detection and quantitation as well as assess throughput and cost limitations.

Results/Lessons Learned. Preliminary results sought to confirm the ability of the MALDI-based approach to detect and quantify within acceptable limits in our hands. PFOS and PFOA was detected using MALDI-TOF MS at 5.38 and 41.4ng/L without concentration. Subsequent analyses of wash down water from fire training grounds of a commercial airport in Australia (provided by Ziltek Ltd.) showed the effectiveness of the applied SPE enrichment and measurement approach to detect PFCs at equivalent limits to LC-MS/MS and MALDI-TOF MS as previously described (Cao et al., 2011; Cao et al., 2012; Zhao et al., 2011). In contrast to LC-MSMS approaches, the MALDI-TOF MS platform allows analysis of ~1300 samples in 1 day after SPE enrichment, permitting more comprehensive screening of potentially contaminated sites.