B188 Fabric Phase Sorptive Extraction Media: A Highly Effective Forensic Sample Collection and Storage Device

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After attending this presentation, attendees will understand the working principle, advantages, and potential applications of the recently developed sample preparation technique known as Fabric Phase Sorptive Extraction (FPSE) in preparing forensic samples for instrumental analysis. The preparation capabilities of FPSE include extraction as well as storage.

This presentation will impact the forensic science community by proving that FPSE media can be used for the extraction of samples of forensic interest. Use of FPSE also reduces the collection steps involved in performing an extraction, therefore reducing the expensive labor and supply costs associated with collecting the sample from the field/crime scene and transporting it to the analytical laboratory before instrumental analysis begins.

FPSE has been shown to be a simple and more effective alternative to traditional, commercially available extraction techniques for preparing forensic samples for instrumental analysis and highly effective in extracting illicit drugs, nitroaromatic explosives, and other trace organic compounds of forensic significance directly from biological/environmental samples. The current study illustrates the application of FPSE in extracting and retaining eight compounds of interest from water. These compounds are: 3,4- and 3,5-dimethylphenol (compound class: phenols); Diphenylamine (DPA) and 2-Nitrodiphenylamine (NDPA) (compound class: amines); benzophenone and t-chalcone (compound class: ketones); and, phenanthrene and anthracene (compound class: Polycyclic Aromatic Hydrocarbons (PAHs)).

The two selected PAHs were included by the United States Environmental Protection Agency (U.S. EPA) in their Priority Pollutants List because of their carcinogenic properties. 3,4-dimethylphenol, 3,5-dimethylphenol, NDPA, and DPA are toxic to humans and wildlife which makes them relevant in the fields of environmental and criminal forensics. Benzophenone derivatives, such as benzophenone-3 which is commonly used in sunscreen products, have been found to be toxic and present serious ecological risks. Benzophenone and t-chalcone were chosen to represent ketones, which is a prevalent functional group in chemistry. Various methodologies have been developed and published over the years for sample preparation for the chemical analysis of these compounds. These methodologies have been based on techniques including, but not limited to, Solid Phase Extraction (SPE), Liquid-Liquid Extraction (LLE), Solid-Phase Microextraction (SPME), and Stir Bar Sorptive Extraction (SBSE).

Methods involving sample preparation by FPSE were developed for these eight compounds with each class treated separately because of the wide range of chemical properties within this group. The effects of extraction and desorption parameters such as extraction volume, extraction time, ionic strength, stirring rate, desorption time, and desorption solvent system on the extraction/desorption efficiency were investigated and optimized. FPSE was coupled to high-performance liquid chromatography with ultraviolet detection. The developed method was used for the determination of analytical merits: intra-day and inter-day repeatability, linearity, limit of detection and limit of quantitation. This method was also applied to extracting these compounds from spiked samples of water from a local pond and from reclaimed water. The optimized and validated FPSE methods were combined for extractions of the aforementioned group of eight compounds. Once these were extracted, the FPSE media were stored under refrigeration and desorption was done more than a month later with no loss of analytes.

FPSE addresses some important shortcomings of conventional extraction and microextraction techniques. For instance, extractions from pond and reclaimed water were done without any sample pretreatment such as filtration or centrifugation of the sample prior to extraction. FPSE utilizes a small flexible media coated with sol-gel hybrid organic-inorganic polymeric material as the extraction sorbent. The sol-gel coating process results in a highly porous polymeric network chemically bonded to the substrate surface. The hybrid material inherently possesses high thermal, chemical, and mechanical resistance as well as high specific surface area. Comparing to the primary contact surface area of 1,000mm^2 for FPSE vs. 100mm^2 for SBSE vs. 20mm^2 for SPME, FPSE is superior which translates into greater extraction efficiency of either of these techniques. The high primary contact surface area of FPSE media increases the probability of the successful sorbent-analyte interaction for an effective analyte extraction, resulting in fast extraction equilibria along with high preconcentration factor.

Retentive Characteristics, FPSE, Forensic Evidence