B172 Assessing the Forensic Utility of a Silicone Rubber Passive Sampler for the Detection of Pollutants in Aqueous Environments

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The goals of this presentation are to introduce the field of environmental forensics to attendees, provide historical context of passive samplers, illustrate the advantages and disadvantages of silicone rubber as a sampling medium, and discuss these attributes as they relate to a forensic investigation. The findings of the silicone rubber assessment will be presented, and future characteristics that require additional experimentation will be discussed.

This presentation will impact the forensic science community by illustrating how improving the methodology used to detect organic pollutants in aqueous systems will directly benefit the National Enforcement Investigations Center, the forensic laboratory of the Environmental Protection Agency (EPA). By implementing a passive sampler system, the EPA can more efficiently investigate suspected criminal activity, monitor high-risk areas, and increase sample throughput while decreasing costs. These benefits can be extended to environmental regulatory laboratories as well. Most importantly, effectively prosecuting environmental crimes will prevent the continued circumvention of the law, protecting our aquatic ecosystems and primary sources of drinking water. This study seeks to equip investigators with a powerful tool to prosecute environmental crimes by conclusively determining the effectiveness of a silicone rubber sampler for detecting organic pollutants in fresh water systems.

Environmental forensic investigations often center around the illicit release of toxic chemicals into rivers, lakes, and streams. The nature of illegal dumping into these aqueous environments leads to the evidence quickly dissipating and vanishing beyond detection. Organic pollutants are easily transported over large distances through waterways, and due to their highly lipophilic nature, are readily absorbed by the ecosystem.[1] Currently, to determine the presence of a suspected pollutant, analysis begins with "grab" or "active" sampling. This method is performed by repeatedly collecting large amounts of water in glass jars over the course of a predesigned sampling period.[2] The disadvantages of this traditional method are numerous, presenting the forensic chemist with unique sampling challenges. A novel approach to environmental forensic sampling is required to adjust to the concealed nature of the crime. Passive samplers have the potential to fill this role. This study determined if silicone rubber is a sampling medium adequately suited to be utilized by environmental forensics as an investigative tool to uncover clandestine dumping of chemical pollutants into aqueous systems.

To assess the performance of the silicone rubber sheets, the sheets first needed to be prepared for deployment. This procedure was optimized in the initial phase of experimentation and was set at five 2½-hour wash steps. The first three washing steps were in a 1:1 mixture of ethyl acetate and hexane, and the final two were in 1:1 mixture of ethyl acetate and methanol. This washing method was developed by O'Connell et al.[3] Once the commercial-grade silicone rubber was cleaned, it was ready for deployment. Initially, the sheets were tested in a controlled laboratory setting. A known amount of 83 target compounds was added to three liters of deionized water. After a predetermined amount of time, either one day, three days, five days, or seven days, the sheets were removed. Following deployment, the sheets were extracted by Soxhlet for eight hours in a 1:2 mixture of acetonitrile and methanol. This extraction was then solvent-exchanged to methylene chloride and blown down to one milliliter with a nitrogen stream. This condensed extract was analyzed by Gas Chromatography/Mass Spectrometry (GC/MS). Following successful laboratory testing, the silicone rubber sheets were field tested in nearby mountain streams and in the Denver, CO, Metro Wastewater's effluent system to determine resistance to environmental factors. The sheets withstood this harsher testing scenario.

The silicone rubber sampler absorbed a wide array of semi-volatile analytes commonly targeted in environmental analysis during laboratory testing. In field testing, the silicone rubber sampler was also capable of absorbing a range of compounds, including pesticides, polycyclic aromatic hydrocarbons, and various other compound classes at estimated concentration levels below the levels typically observed in environmental investigations. This preliminary testing is encouraging and suggests the silicone rubber sample is well suited for forensic use in investigating environmental crimes.

Reference(s):

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2. Namiesnik J., Zabigala B., Kot-Wasik A., Partyka M., Wasik A. Passive Sampling and/or Extraction Techniques in Environmental Analysis: A Review. *Anal Bioanal Chem.* 2005; 381: 279–301.
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Environmental Forensics, Semi-Volatile Organic Compound, Passive Sampler

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