A105 The Overlooked Potential of the Absorption of the Explosive Component 2,4-Dinitrotoluene by Disposable Gloves: Extraction and Detection

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After attending this presentation, attendees will understand how vapors from volatile compounds found in explosives can be absorbed by, and later extracted from, polymers and detected using chromatographic methods. The extraction of the explosives from two polymers will be described and detection of the explosive will be illustrated using High Performance Liquid Chromatography (HPLC). HPLC will also be used for the measurement of the kinetic parameters that determine how long an explosive component resides in the polymers.

This presentation will impact the forensic science community by showing how the results of the study indicate that both the nitrile rubber and latex rubber gloves absorb DNT at readily detectable levels. In the experiments reported here, the half-life of the DNT in nitrile rubber was measured to be 15.9 days. In the experiments, the DNT was detectable (HPLC with UV/VIS detection) in nitrile rubber samples 35 days after removing the rubber samples from a container that also held a small open vial containing solid DNT. The results indicate the potential use of the analysis of gloves to support their prior proximity and exposure to explosives. The period of time that the compound will remain detectable in the rubber will depend on the time it is exposed to the compound, the nature of the exposure (e.g., closed or open environment), the environmental conditions once the rubber is no longer exposed to a DNT source, and the detection method (the use of a gas chromatograph/mass spectrometer will extend the detection period).

The absorption of volatile compounds by specific materials is well documented, and is the basis of Solid Phase Micro Extraction (SPME). In SPME, a fiber coated with a specific absorbent is exposed in a container holding a sample, and the volatile compounds released by the sample are absorbed by the material on the fiber. In this approach, the absorbed compounds concentrated on the fiber are isolated from the bulk of the sample. The absorbed compounds are released from the fiber later for analysis by heating the fiber. Polymeric materials found at crime scenes that possess the innate ability to absorb a volatile compound have apparently not been studied with respect to their potential to absorb volatile evidence. The hypothesis of this study is that specific polymers, for example, those that are found in disposable gloves, have the ability to absorb and retain explosive components which can be extracted later and detected.

In this study, the ability of latex and nitrile rubber polymers to absorb the vapors of 2,4-dinitrotoluene (DNT; a component in several explosive formulations) was studied. The extraction conditions were developed, and the half-life of the DNT in glove samples was determined. The use of DNT is uncommon in consumer products; aside from explosives, its primary use is to synthesize the precursor to azo dyes and polyurethane, both of which are found in consumer and industrial products. The DNT is used to synthesis toluene diamine and two or more synthetic steps later (depending on the product), the toluene diamine is converted to an azo dye or polyurethane. DNT has been reported as an impurity in precursors to polyurethane, and it is present as an environmental contaminant in soil and water in locations where DNT has been produced for the uses stated above.

The results of the study indicate that both the nitrile rubber and latex rubber gloves absorb DNT at readily detectable levels. In the experiments reported here, the half-life of the DNT in nitrile rubber was measured to be 15.9 days. In the experiments, the DNT was detectable (HPLC with UV/VIS detection) in nitrile rubber samples 35 days after removing the rubber samples from a container that also held a small open vial containing solid DNT. The results indicate the potential use of the analysis of gloves to support their prior proximity and exposure to explosives. The period of time that the compound will remain detectable in the rubber will depend on the time it is exposed to the compound, the nature of the exposure (e.g., closed or open environment), the environmental conditions once the rubber is no longer exposed to a DNT source, and the detection method (the use of a gas chromatograph/mass spectrometer will extend the detection period).

The principle established by the presented results will impact the forensic community by alerting the community to the potential use of polymers as evidence when volatile compounds are relevant to the case.

Explosive Detection, Explosive Vaporization, Explosive Absorption

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