B51 Blast Suppression Foam Does Not Inhibit DNA Recovery and Analysis

Calvin R. Justus, PhD, Federal Bureau of Investigation/ORISE, 2501 Investigation Parkway, Quantico, VA 22135; Kelsey Kyllonen, MA, 1200 Green Tree Road, #202, Fredericksburg, VA 22406; Keith L. Monson, PhD, 2501 Investigation Parkway, Quantico, VA 22135; and Mark F. Kavlick, MPhil, 2501 Investigation Parkway, Quantico, VA 22135*

After attending this presentation, attendees will better understand the effects Aqueous Foam Concentrate-380 (AFC-380) blast suppression foam has on DNA recovery and analysis.

This presentation will impact the forensic science community by verifying that the use of AFC-380 does not obstruct DNA evidence collection or deter its subsequent analysis by Polymerase Chain Reaction (PCR).

To develop investigative leads in response to an Improvised Explosive Device (IED) explosion, biological evidence is collected from the exploding apparatus or surrounding material post-blast and analyzed. DNA collected from IED-blasted material can provide decisive evidence for ensuing criminal investigations or intelligence operations; however, recovery of high-quality DNA from exploded IEDs is infrequent and is met with considerable obstacles. The explosive force and heat produced by a blast can destroy or degrade DNA. PCR inhibitors may also be co-extracted, impeding amplification of target fragments and preventing identification of possible suspects. Aqueous blast suppression foam is commonly used in military and anti-terrorism applications to contain blasts associated with IEDs by suppressing the shock wave associated with detonation. The use of blast suppression foam in response to IED threats requires an understanding of any potential detrimental effect on DNA recovery, quality, and succeeding forensic analysis.

In this study, the effects of blast suppression foam on DNA recovery and analysis by two different quantitative Polymerase Chain Reaction (qPCR) methods were investigated. Human blood was spotted onto various sample materials, (e.g., PVC pipes, metal pipes, paper, and cloth). Samples were exposed to AFC-380, both with and without detonation, and compared to unexposed/undetonated controls. All samples were collected and swabbed, and DNA was extracted using the EZ1™ DNA Investigator Kit. DNA extracts were evaluated for nuclear DNA quantity and quality using the Quantifiler® Human Plus DNA Quantification Kit and for mitochondrial DNA quantity and quality using a custom qPCR method.

Overall, following analysis of nuclear and mitochondrial DNA by PCR, 86.2% of the samples were within the standards range of the assays (>0.005ng/µl nuclear DNA or >10 copies mitochondrial DNA). Out of the 13.8% that were not within standards range, 10.4% were blasted, indicating detonation-damaged biological evidence isolated from those particular samples. In addition, internal PCR controls of recovered samples that were treated with AFC-380 amplified similarly as untreated samples. Importantly, treatment with AFC-380 did not cause DNA degradation.

The results of this investigation provided no evidence that AFC-380 reduces DNA quantity (aside from potential DNA dilution effects), degrades DNA, or results in PCR inhibition. This study validates that use of AFC-380 should not obstruct the recovery and subsequent analysis of DNA collected from critical explosive device evidence.

DNA Analysis, Blast Suppression Foam, PCR

*Presenting Author