B81 Characterization of Pre- and Post-Burn Smokeless Powders by Direct Analysis in Real-Time Time-of-Flight/Mass Spectrometry (DART®-TOF/MS) vs. Gas Chromatography/Mass Spectrometry (GC/MS)

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After attending this presentation, attendees will understand how smokeless powders may be analyzed and classified pre- and post-burning using DART®-TOF/MS and how these results compare to the more traditional GC/MS results.

This presentation will impact the forensic science community by providing a rapid means of smokeless powder identification and differentiation by DART®-TOF/MS, which may be applied to Gunshot Residue (GSR) and explosive analysis, such as debris analysis following a bombing event.

Smokeless powders were analyzed by DART®-TOF/MS for the presence of several organic compounds of interest, including diphenylamine, nitroglycerin, ethyl centralite, dinitrotoluene, phthalates, and others. Positive and negative mode analysis was performed for each sample, with helium carrier gas at 200˚C and grid voltages set at 150 V. Unburned samples were analyzed as neat samples, as the smokeless kernel itself, and as extracts. Extracts were prepared by following a simple GC/MS extraction, the National Center for Forensic Science's procedures using dichloromethane. Extraction is not necessary for DART®-TOF/MS analysis of solid smokeless powder kernels; however, extractions were performed to determine if extraction increased the number of organic compounds observed and to allow for GC/MS testing. Each smokeless powder was subsequently burned and analyzed. Unburned or partially burned smokeless powder particles and burned smokeless powder residues may be recovered following an explosive event, such as discharge of a firearm or an Improvised Explosive Device (IED). Therefore, unburned and burned samples were analyzed to simulate possible real-world evidence. Burned and unburned samples were then compared and differences in the identifiable organic compounds were recorded to determine the effect of burning on the smokeless powder and residue composition. Sample extracts were later analyzed by GC/MS to confirm composition and compare results obtained by DART®-TOF/MS and GC/MS.

Compounds of interest were easily identified in smokeless powders analyzed via DART®-TOF/MS, and within seconds. Following characterization of the organic components of each smokeless powder, a classification scheme may be developed to further characterize smokeless powders. Classification of smokeless powders based on the organic components may aid investigators in determining the brand or origin of a suspect smokeless powder, burned or partially burned, recovered at a crime scene.

Sample preparation for DART®-TOF/MS is simple and requires minimal effort, because smokeless powder kernels can be analyzed directly by DART®-TOF/MS. Additionally, DART®-TOF/MS is a more rapid technique than GC-MS. DART®-TOF/MS samples may be analyzed in seconds, and mass spectra may be observed and evaluated almost instantly; GC-MS may take more than ten minutes to run one sample after sample analysis, and mass spectra may not be observed or evaluated until the sample run has been completed. DART®-TOF/MS is a viable method for rapid analysis of smokeless powders, which may be applied to explosive and GSR analysis.

Smokeless Powders, Explosives, Gunshot Residue