A70 Effects of Temperature, Exposure Time, and Sample Size on the Recovery of Smokeless Powder Constituents From Car Fires

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After attending this presentation, attendees will understand the concept of the recoverability of the components of smokeless powder from a car bomb fire.

This presentation will impact the forensic science community by allowing explosives analysts to realize trends between recovery of the components in smokeless powder and the temperature of the fire, the exposure time of the sample to the fire, and the sample size.

The analysis and identification of the explosives used in improvised explosive devices (IEDs), such as pipe bombs, are an important part of bombing investigations. Intact particles from low explosives such as smokeless powder can often be found in post-blast debris. However, if the pipe bomb is placed inside a car or other areas containing combustible material, the explosion could cause the combustible material to catch fire. This may completely burn smokeless powder residues.

This work seeks to determine the temperature at which the chemical components of various smokeless powders burn off and how great of an effect exposure time and sample size have on the recovery of the constituents in smokeless powder. This work also seeks to make correlations between laboratory samples and real samples from car fires, in terms of the temperature and time that the smokeless powder residue was exposed.

Samples of single base and double base smokeless powder were heated in covered crucibles at varying temperatures, with a constant exposure time. The exposure time was tested by keeping the sample size and temperature constant, while varying the heating time. The sample size was tested by holding the temperature and exposure time constant while varying the mass of the sample. All samples were extracted with dichloromethane (DCM), sonicated for 30 minutes, and then filtered through a 0.45 micron PTFE filter prior to the analysis by GC-MS. DCM extracts of IMR PB, a single base smokeless powder, contain diphenylamine (DPA) and dibutylphthalate (DBP). DCM extracts of IMR 700-X and 800-X, double base smokeless powders, contain nitroglycerin (NG) and ethyl centralite (EC).

At higher temperatures the more volatile components will disappear while less volatile components will remain. This is shown by keeping the sample size and exposure time constant, while varying the temperature. For example, DPA and DBP were completely consumed at 160°C and

190°C, respectively. Also, EC and NG were completely consumed at 150°C and 180°C, respectively.

The amount of time that the sample is exposed to heat can also affect the recovery of smokeless powder components. Even though the temperature inside a pipe bomb can be extremely hot, intact particles can be found among the debris. This is due to the fact that the amount of time that the sample is exposed to the heat is very short. However, in a fire, the sample is exposed to the elevated temperatures for an extended period of time. For example, DPA was still present after exposure to 140°C for one hour but was completely consumed after two hours. DBP, on the other hand, was still abundant even after an exposure time of two hours. In addition, even after a two hour exposure time at 140°C, neither NG nor EC in the double base powder were consumed.

Car fire samples were also analyzed for comparison to these results to determine the temperature at which the fire was burning when it was extinguished. These results can be used to explain why all or some of the components of smokeless powder are not present or are significantly reduced in abundance.

Smokeless Powder, Car Fire, Pipe Bomb

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