



Engineering Sciences Section – 2008

C16 Explosion Investigation and Reconstruction Using Multidisciplinary Methods

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The goal of this presentation is to familiarize investigators with multi-disciplinary methods including witness interviews, as found conditions, debris analyses, blast marker identification, engineering analyses of the response of structures to explosions, combustion energy, pressure and impulse calculations, engineered system fault analyses, and medical evaluation of injuries.

This presentation will impact the forensic science community by increasing appreciation of the value of gestalt. Reconstruction is developed using a multidisciplinary team approach. The totality of the evidence from different methods yields a robust reconstruction on which public policy recommendations can be based.

On January 25th 2005, an explosion at an acetylene production and bottling facility killed three people and gravely injured a fourth. A primary issue was whether the fuel for the explosion was leaked acetylene or propane gas from a heating appliance. Using the actual incident as a case study, attendees will learn how multidisciplinary techniques were applied to reconstruct the explosion identifying acetylene as the fuel.

Acetylene and a handful of other gases burn very rapidly compared to hydrocarbons like propane. One consequence of rapid combustion is the creation of shock-like impulsive forces. Such forces can shatter certain construction materials while leaving other structural materials unaffected. In the instance at hand this manifested itself in a particular debris pattern. Similarly, damage to structural components may serve as blast markers allowing conclusions to be reached about overpressure and impulse. These techniques suggested acetylene was the fuel rather than propane.

Yet, the methods above were insufficient to build a conclusive case. Consequently, investigators obtained an exemplar propane appliance and conducted a failure modes analyses to demonstrate the improbability of failure of the appliance as a source of the leaked propane. They also considered the nature of injuries that resulted from the explosion. Medical opinion supported the theory that the injuries were consistent with what would be expected from a rapidly burning fuel. These additional considerations and others were sufficient to conclude acetylene was the fuel for the explosion.

Investigators then completed an engineering analysis of the acetylene production process to develop a plausible theory for how acetylene leaked to form an explosive vapor cloud. The Safety Board consequently published a safety bulletin directed at the acetylene industry and made safety recommendations including one for regulatory change.

Accident, Reconstruction, Explosion