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Gossman Forensics - David Gossman, Louise Denlinger

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Fires and Explosions
Hidden Evidence

Hidden Evidence

Every fire and explosion scene has the potential to contain crucial evidence that is hidden or elusive. This evidence may be physically hidden under debris and ashes, or may be masked in the samples taken for laboratory analysis. The complex dynamics of a fire and/or explosion can affect chemical species in remarkable ways. Chemicals and their combustion or pyrolysis by-products may interact, vaporize, become coated by, or absorbed by other materials during an incident, making them easily overlooked by the inexperienced investigator. Knowledge of the physical and chemical characteristics and behaviors of the materials involved in an incident can lead to an awareness of the physical and chemical processes that occurred and played a causative role in the incident.

Case Example 1

A flash fire in a regulator of a medical oxygen cylinder, initially identified as a chemical contaminant in the oxygen rather than as a fire, left questions as to the cause. Laboratory analysis on several pieces of debris recovered from the incident revealed little information, although laboratory results from a fragment found inside the regulator prompted further questions and deeper investigation. Microscopic FTIR analysis of the fragment identified chemicals that appeared to be from a non-combustible gasket material commonly found inside the regulator. Upon further visual microscopic scrutiny of the morphology (shape) of the fragment, however, it was apparent further analysis was needed to uncover potentially hidden information.

This led to a laboratory controlled scraping of the outer surface of the fragment to analyze the underlying material. The interior of the fragment was a cellulosic material which was determined to be a contaminant within the oxygen regulator. This contaminant fragment, masked by vaporized and recondensed residue from the fire, provided the investigative link needed to understand the process involved in the causation of the fire that injured the plaintiff. The ability to recognize subtle abnormalities in analysis results can often reveal hidden evidence.

Case Example 2

A 55 gallon drum involved in a fire and explosion was sampled during the initial incident investigation. The sample was stored in a safe for a period of time awaiting laboratory analysis. Upon removal of the sample from the safe, visual observations indicated iron oxide (rust) had collected at the bottom of the sample jar. Research on the material shipped in the drum revealed the material would have an exothermic reaction in the presence of iron oxide acting as a catalyst.

The fire and explosion incident occurred while material was being pumped from the drum into an incinerator. The material was extracted from the drum by a pump fitted with a wand that was inserted into the drum. The wand was fitted with a screen as a safety control to prevent solids from entering the pumping system. Iron oxide solids would have collected against the protective screen of the wand, interacting with the waste material mixture as it was being sucked into the wand. The resulting rapid exothermic (heat producing) reaction was the source of the explosion.

It is helpful to more fully understand the chemical and heat reaction dynamics of this situation. While the rust was in contact with the contents of the drum all along, a number of factors helped prevent an explosion during transportation. During transit, the material was not being significantly mixed, so material near the rust would react, but "fresh" material was not being circulated near the rust very rapidly. The heat generated as the rust interacted with the nearby material was low enough that it could be carried away through the walls of the steel drum and dissipate. During pumping, however, the rust collecting on the inlet screen of the wand was rapidly exposed to all of the "fresh" material as it passed through the wand. There would have been insufficient time for the heat to dissipate.

Upon deeper investigation into the origin of the 55-gallon drum used to transport the waste material, documentation revealed important information. Apparently a recycled drum, instead of the specified new drum, had been used to store and transport the material. Hidden evidence led our team to the identification of an improper container utilized for storage and transport and its contribution to the incident. This also highlights the safety importance of shipping and handling regulations, and why it is important to adhere to what might appear to some to be a seemingly unnecessary requirement, such as only using new drums to transport waste material.

Case Example 3

A rail car that contained hazardous waste from the manufacture of toluene diisocyanate (TDI) exploded at a disposal facility. The National Traffic Safety Board (NTSB) formed the broad conclusion that a lack of procedures for safely off-loading TDI resulted in an over-pressurization of the container. Court cases, are easier to navigate, however, when more specific identification of the sequence of events leading up to the incident are identified.

Our team evaluated each identified chemical component in the rail car as well as the sequence of events that led to the explosion. There had been repeated attempts in the days leading up to the incident to unload the rail car, including heating it with steam. Earlier in the day of the incident, the pressure in the rail car had been manually released.

The required emergency pressure relief valve was removed from the rail car following the incident. Visual examination revealed that the valve was internally coated with a black residue, but testing of the valve showed that the valve was still functional. An understanding of the physics involved indicated that, just like opening a pressure cooker stopcock, rapidly releasing the atmospheric pressure in the rail car resulted in the material within the tank boiling violently. The black material identified on the pressure relief valve was splatter from the boiling material.

Unknown to the personnel at the time, heating of the TDI in the rail car had caused it to start to dimerize, where it reacted with itself in a chemical process that results in the release of carbon dioxide (CO_2) gas. The splattered material covered and blocked the pressure relief valve, preventing the release of the CO_2 gas from the rail car. This resulted in a violent explosion when the pressure from the confined CO_2 gas became sufficient to rupture the walls of the rail car about twelve hours later.

In this case, the hidden information was the awareness of the chemical processes, along with the physical characteristics of the components in the rail car combined with the sequence of events that occurred hours and days preceding the explosion.

Conclusion

These are just a few real world cases where the team at Gossman Forensics successfully uncovered hidden evidence that was paramount in determining the causation and resolving the resulting litigation. A multi-disciplined, experienced investigator with an in-depth understanding of chemistry and fire/explosion dynamics can uncover hidden and elusive evidence. It is critical that the fire and explosion investigator be deployed as soon after an incident as possible to ensure hidden evidence is not destroyed or removed inadvertently. Gossman Forensics understands the importance of vigilance, whether investigating the incident scene or interpreting laboratory analysis results to ensure potentially hidden evidence is uncovered.

Forensic Science Insights is a publication by Gossman Forensics, a division of ChemRight Laboratories, Inc. Please contact David Gossman, Chief Investigator, at 563-652-2822, by email at dgossman@gossmanforensics.com or visit us on the web at GossmanForensics.com.