SAFE WELDING

What Can We Learn From the Beirut Explosion?

By Craig Ellis

Welding, cutting and brazing activities can be performed safely if the appropriate safety procedures and protocols are followed. Hazardous materials (e.g., flammable liquids and materials/chemicals) must be safely stored and kept away from potential ignition sources.

Several months ago in Beirut, Lebanon, a massive explosion occurred believed to be due to improper welding procedures and improper storage of hazardous materials.

What Happened?

On the afternoon of Aug. 4, 2020, two explosions occurred at the port of Beirut, the capital of Lebanon. The second explosion was extremely powerful, and caused at least 190 deaths, 6,500 injuries, U.S. $10 to $15 billion in property damage and left an estimated 300,000 people homeless. The event was linked to approximately 2,750 tons of ammonium nitrate, which had been confiscated by the Lebanese government from the abandoned ship MV *Rhosus*, then stored in a warehouse without proper safety measures for 6 years. The explosion was preceded by a fire in the same warehouse, but as of November 2020, the exact cause of the detonation is still under investigation (2020 Beirut Explosion, 2020).

Apart from the human and financial toll, the blast also destroyed the silo holding 85% of the nation's grain (Itani, 2020).

What Is Ammonium Nitrate?

Ammonium nitrate is a crystal-like white solid commonly used as a source of nitrogen for agricultural fertilizer. It can also be combined with fuel oils to create an explosive used in the mining and construction industries (BBC News, 2020).

Ammonium nitrate has the chemical formula NH_4NO_3 and is typically produced as small porous pellets. Ammonium nitrate does not burn on its own. Instead, it acts as a source of oxygen that can accelerate the combustion (burning) of other materials (da Silva, 2020).

Ammonium nitrate is relatively safe when stored properly. However, if there is a large amount of material stored for a long time, it begins to decay. Over time, ammonium nitrate will absorb little bits of moisture and eventually turn into a rock. This makes it more dangerous because if a fire reaches it, the chemical reaction will be much more intense.

At high enough temperatures, however, ammonium nitrate can also violently decompose on its own. This process creates gases including nitrogen oxides and water vapor. It is this rapid release of gases that causes an explosion (da Silva, 2020).

Cause of the Beirut Explosion

Although the investigation is ongoing, government officials initially believed that welding in the port district inadvertently sparked fireworks that were stored near the welding operation, which, in turn, set off a massive cache of ammonium nitrate that had been stored for years in warehouse 12.

Workers were welding a door at warehouse 12 as part of maintenance activities. A former port worker said, "There were 30 to 40 nylon bags of fireworks inside warehouse 12" (2020 Beirut Explosion, 2020).

Based on statements from government officials, it is believed that welding sparks ignited the nearby bags of fireworks (the first explosion), which subsequently caused the ammonium nitrate to explode (the second explosion).

Other Ammonium Nitrate Explosions

Ammonium nitrate decomposition can be set off if an explosion occurs where it is stored or if there is an intense fire nearby. The latter is what happened in the 2015 Tianjin explosion, which killed 173 people after flammable chemicals and ammonium nitrate were stored together at a chemical factory in eastern China (Itani, 2020).

In 1947, a ship carrying 2,000 tons of the chemical exploded in the port of Texas City, TX, killing 581 people. A mid-morning fire started on board the French-registered vessel SS *Grandcamp*, docked in the port, and detonated its cargo of about 2,300 tons (about 2,100 metric tons) of ammonium nitrate. This started a chain reaction of fires and explosions in other ships and nearby oil-storage facilities, ultimately killing at least 581 people. The cause of the initial fire on the SS *Grandcamp* was never determined (Texas City Disaster, 2020).

What Can Employers Do to Prevent a Similar Incident?

Your facility or operation may not have tons of hazardous materials in storage, but without the proper precautions, safeguards and procedures for welding operations and hazardous materials' storage, simple maintenance tasks could result in unwanted losses.

In response to this incident, consider the following about your facility or operation:

- Do you have designated welding areas where welding can be safely performed? Designated welding areas are typically permanent locations in your facility or operation designed for welding activities that produce open flame, sparks or heat.
- Do you have a hot-work permit program that allows welding to be safely performed at various locations at your facility or operation away from designated welding areas? Good hot-work permit programs establish written procedures to prevent fires resulting from temporary operations from welding activities that produce open flame, sparks or heat.
- As part of your hot-work program for welding activities, do you have trained fire watchers who are in place at least 30 minutes after the welding operations are complete? Trained fire watchers must be able to detect and extinguish possible smoldering fires.
- Have workers received the appropriate training on welding safety? Workers should understand the dangers associated with welding, cutting and brazing such as high temperatures, and fire and explosion potentials.
- Does your facility or operation have a strong hazardous materials program that ensures the safe and compatible storage of chemicals and other substances? Strong hazardous materials program management ensures that the physical and health hazards associated with these substances are effectively managed and mitigated.

Consistent implementation and practice of the preceding elements will also produce a safer work environment for your facility or operation.

OSHA & NFPA Standards

There are regulatory and consensus standards that address proper safety practices for welding, cutting and brazing and for proper hazardous materials

management. Following these regulatory and consensus standards can prevent similar incidents.

Welding, cutting and brazing are addressed in specific OSHA standards for general industry, shipyard employment, marine terminals and construction. These standards provide provisions and protocols for performing welding, cutting and brazing safely near combustible materials.

Flammable liquids and materials storage are addressed in OSHA standards for general industry in the hazardous materials subpart. Additionally, National Fire Protection Association (NFPA) 400 provides fundamental safeguards for the storage, use and handling of hazardous materials in all occupancies and facilities.

Conclusion

The devastation of the Beirut explosion caused an enormous human and financial toll on the city of Beirut and the nation of Lebanon. If those welding operations on Aug. 4, 2020, had been performed with the proper safety procedures and protocols along with appropriate storage of hazardous materials, that catastrophe may have been avoided. Remember, welding operations can be safely performed, and hazardous materials can be safely stored if the proper protocols and procedures are in place. **PSJ**

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The Beirut explosion caused at least 190 deaths, 6,500 injuries and left an estimated 300,000 people homeless.

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