

TerranearPMC Safety Share

Week of August 24, 2015 – Hazardous Materials Disaster in China

Recently, the Chinese port city of Tianjin was rocked by a series of explosions. These explosions were so massive they could be seen from space. Tianjin has a population of 15 million and is a major base for China's petrochemical and shipping industries as well as a center for finance and high-tech industry. The Tianjin Economic Development Area has attracted foreign investors including Motorola, Toyota, Samsung and Novozymes.

The latest information regarding the explosions indicates that a shipment of "dangerous goods" was stored in a warehouse and caught fire which initiated these blasts. They were so strong that they shook homes on the other side of the city and sent flaming debris arching over nearby high-rise buildings. The blasts were so violent they sent vehicles and debris flying into the air and rattled homes for miles around. Questions are now being raised about whether the materials had been properly stored.

Hundreds of people were injured in the explosions while massive fireballs turned the night sky into day and shattered windows several miles away. The death toll keeps climbing daily as more and more victims are found. Twelve of the dead were from among the more than 1,000 firefighters sent to the mostly industrial zone to fight the ensuing blaze. Authorities have reported that the blasts started in the area where shipping containers in a warehouse, owned by Ruihai Logistics, were located. Current information indicates that various hazardous materials including flammable petrochemicals, sodium cyanide and toluene diisocyanate were stored.

After the initial blast, a second and even larger explosion occurred. Authorities believe that this blast was actually triggered by the first. The National Earthquake Bureau said the first blast was the equivalent of 3 tons of TNT, and the second 21 tons. The enormous fireballs from the blasts rolled through a nearby parking lot, turning a fleet of 1,000 new cars into scorched metal husks.

Other chemicals that have been confirmed to be stored in the Ruihai Logistics warehouse are calcium carbide, potassium nitrate and sodium nitrate. These chemicals are relatively stable; even when stored in close proximity to each other. However, in the presence of a fire, they can become quite dangerous. Such was the case in the Oklahoma City bombing in 1995 and the fertilizer plant disaster two years ago in Waco, Texas: both involved the combination of nitrates and organics. At the same time, calcium carbide, in the presence of water can also be very reactive.

Because the fire was so extensive, the warehouse's fire suppression system may have been overcome by the enormous demand and thus, was "defeated." When calcium carbide is heated and is mixed with water, acetylene can form. This is a very flammable material which is most notably used for welding processes (aka oxy-acetylene welding). It is a requirement in the U.S. that because acetylene is so flammable, there are specific storage requirements. These include keeping acetylene at least 20 feet away from oxidizers or separated by a minimum ½-hour fire rated shield.



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Based on Safety Data Sheets (SDSs) for calcium carbide (CaC_2 – CAS# 75-20-7), this substance readily absorbs water from air (hygroscopic), while contact with water liberates extremely flammable gases (such as acetylene). SDSs for CaC_2 specifically caution against storing near oxidizers, acids, alkalis and moisture.

One of the main contributing factors for this disaster is that the warehouse was a transit facility, meaning materials were stored temporarily and, many countries including the United States, a list of the various materials as well as SDSs for every chemical needs to be available: regardless of how long a chemical may be on-site. In this specific incident, information regarding the availability of such types of information and documentation has yet to be confirmed. Such documentation, even if it a material that was only stored in the warehouse for 12 hours, would have assisted firefighters when they arrived on the scene, as they would have had knowledge and an appropriate understanding for the best way to fight the fire. In this instance, quite possibly, authorities would have refrained from using water and instead, focused their efforts on community evacuation and shelter.

Whether this incident was the result of an incomplete hazard communications requirement (due to the short-term transit period) or an incomplete recordkeeping process, fire fighters were unaware of the hazards associated with deluging the warehouse with water. At this time the reasons for such actions and a lack of hazard documentation remains undetermined.

At this time, the specific event that initiated the first blast has not been made available (whether still unknown or officials wish to keep this information secured). However, evidence seems to indicate that the emergency responders were unaware of the importance to refrain from applying water and thus, creating the second (and more deadly) blast. Quite possibly, the warehouses' fire suppression system (i.e. automatic sprinkler system) may have been improperly designed for the actual occupancy (storage of hazardous materials as well as water-reactive materials) and therefore, the initial fire that activated the building's sprinkler system, caused a devastating effect due to the contact of incompatibles, rather than suppressing the fire. Quite possibly, water was used as it was easily available through the municipal supply; however, the appropriate fire suppressant should have been a dry chemical (ammonium phosphate – a typical material used in portable fire extinguishers) or carbon dioxide. Of course, these options would have cost more during the construction phase of the warehouse. Yet, as dictated through proper hazard identification, assessment and control, saving an initial cost can result in a steep payback in the future.

Many times we may feel that the posting of placards (such as the NFPA diamond hazard materials information system) outside a facility or the placards placed on trucks while transporting chemicals are merely exercises to ensure legal compliance. However, as the death-count continues to rise in Tianjin, China, we can see the importance of informing our community, workers and emergency responders with proper warning and information regarding chemical storage and use.



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