Incidents and Reports Related to Class II Oxidizer Fires

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Acknowledgements

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NFPA Resources

**NFPA Fire investigation reports**

*Sprinklered bulk retail store fire, Albany, GA, April 1996*
Pool chemicals were involved. Sprinkler system was inadequate for hazard. The property was destroyed.

*Sprinklered bulk retail store fire, Quincy, MA, May 1995*
Pool chemicals and motor oil were stored near each other. While the sprinkler system was inadequate for hazard, it did confine the fire to approximately 1,000 square feet. Property damage was estimated at $4 million.

Sprinklered *Storage Warehouse, Phoenix, AZ, August 2000*
The fire started in the bulk storage area of the home and garden supply warehouse. Cal-hypo and trichlor materials were stored there. Although the property was sprinklered, the building was destroyed.

*Four reports from the Fire Protection Research Foundation*

*Assessing the List of Typical Oxidizers* (2013)
*Development of an Enhanced Hazard Classification System for Oxidizers* (2006)

*From NFPA Journal*


*From “Firewatch” in NFPA Journal*

Leaking chemical ignites fire below clean room, Texas
A single sprinkler extinguished a small fire in the interstitial space of a raised floor system below a clean room at a three-story plant that manufactured silicon wafers.
The building had concrete floors and walls, and a concrete roof deck covered with a built-up surface that included gravel. The property was protected by fire detection and sprinkler systems monitored by an alarm company.

The fire department received the alarm at 5:42 p.m. and arrived eight minutes later to find cold smoke inside the building. Building representatives led them to a production area on the second floor, where they found a single sprinkler operating in the raised floor system of a Class 10,000 clean room, under which ran piping and electrical cables. They confirmed that the fire was out and shut off the sprinkler.

Investigators determined that 30 percent hydrogen peroxide slowly dripping from a reducing elbow in the piping under the raised floor reacted with an accumulation of an adhesive to produce enough heat to start a fire. During the initial size-up and control, three firefighters were exposed to chemicals and had to be decontaminated and taken to the hospital for follow-up.

The value of the building, its contents, and estimated losses were not reported.


Teacher injured in science lab explosion, Minnesota

A high school science teacher was burned when an experiment he was preparing exploded, forcing the evacuation of the school until hazardous materials teams determined it was safe to reenter.

The high school, which was of unprotected, noncombustible construction, had sprinklers installed throughout, although the explosion did not create enough heat to activate them. The fire alarm system, which included manual pull stations and notification devices, operated as designed.

When the explosion occurred, the teacher was mixing acetone and hydrogen peroxide on a table, which the force of the blast shoved down toward the floor, damaging a tray and a chair. The explosion's pressure wave displaced furniture, ceiling tiles, and glass on a chemical fume hood and forced open the 20-minute fire door, allowing debris to spread into a corridor. A staff member responding to the explosion found the disoriented teacher slumped over a sink, trying to wash his face and clean up. Staff called 911 to report the blast.

Firefighters transported the teacher to the hospital, where he was treated for burns and ruptured eardrums. The hazardous materials response crews ordered the building emptied, and the staff used the manual pull station and intercom to evacuate the school until they could determine what had happened. Once crews stabilized the scene, the school reopened.
The value of the school and its contents was not reported. Nor were damage estimates. However, the damage was isolated to the room of origin.


**Sprinklers slow warehouse fires involving hazardous materials**

UTAH—Sprinklers installed in a warehouse in which hazardous materials were stored activated when the materials ignited, sending a water flow alarm to the fire department at 9:37 a.m. and slowing the spread of fire until responding firefighters extinguished the blaze.

The hazardous materials response team identified the material as an organic peroxide liquid that was supposed to be stored at temperatures 50°F to -4°F (10°C to -20°C) below what is referred to as the “self-accelerating decomposition temperature.” Investigators determined that the temperature control for the material was inadequate.

When the product reached its self-accelerating decomposition temperature, the plastic storage containers ruptured, and the product came into contact with organic materials, which then ignited.

The fire department investigation report did not include an estimate of fire damage to the building or its contents. However, the report did note that the blaze compromised the structure’s cooling system and its fire protection system.


**Publications from other organizations**

*Chemical Safety Board*

*Fire and Community Evacuation in Apex, NC- October 2006*

Published 2008

The fire was in a hazardous waste facility. “The initial “sofa-size” fire observed by firefighters was in the oxidizer bay where a fiberboard container of unspent aircraft oxygen generators and containers of solid chlorine-based pool chemicals were awaiting final shipment.” (p. 6)

*West Fertilizer Explosion and Fire April 2013*

“A massive explosion at a fertilizer storage and distribution facility fatally injured twelve volunteer firefighters, two members of the public and caused hundreds of injuries.”

“Case study of the Domino effect in a catastrophic solid oxidizer fire“ by RA Ogle, JC Ramirez, TM Hetrick. This paper was originally presented at the 10th Global Congress on Process Safety, New Orleans, LA, March 31 to April 2, 2014.

**Abstract**

This case study examines a succession of three separate fires which occurred in a period of 4 days at an agricultural chemical manufacturing facility. The facility was located in a small chemical park. The succession of fires illustrates the concept of the domino effect: the first fire caused the second fire, and the second fire caused the third. The final fire was responsible for the total destruction of two businesses and the interruption of a third business. Each fire involved the solid oxidizer sodium chlorate.

Despite having manufactured agricultural chemicals for over 25 years, the owner and management of the facility had lost their sense of vulnerability to the hazards of sodium chlorate. The fundamental root cause of these fires was the facility owner’s inadequate control of the hazards of sodium chlorate. Workers at the facility had little comprehension of the ability of sodium chlorate to cause organic materials to spontaneously ignite. Housekeeping at the facility was poor. And finally, too large of a quantity of sodium chlorate was stored inside the facility, and this large inventory of solid oxidizer was placed adjacent to combustible materials. Simple procedural safeguards would have been sufficient to prevent the ultimate property damage.”

“Abstract
More than three years after the Toulouse disaster, on 21st September 2001, the direct causes of the explosion of the storage of roughly 400 tons of off-specification ammonium nitrate (AN) in a fertilizer plant are not clearly established. It will probably be a major lesson to learn from this disaster. However the plant was located in the vicinity of Toulouse city and the explosion turned into a disaster with severe damages and effects: 30 people were killed, up to 10 000 people were injured, 14 000 people received therapy for acute post traumatic stress, and the cost was estimated by insurers of 1.5 billion Euro. Another major lesson is that, in the continuous debate on where to locate levers of actions for major accident prevention, the Land Use Planning (LUP) came back into the issue of regulators in France and the EU. Therefore, the aim of this paper is to provide information on the key points of the history of the LUP that was set between the plant and the neighbouring activities. Also, the damages of the disaster in this LUP context are discussed.”


“Abstract
Motivated by both the Toulouse explosion, and a series of recent unexpected handling and storage accidents in well-developed countries, the safety issues associated with the storage of fertilizer grades of ammonium nitrate (AN) are considered with a focus on low storage capacity premises. Such facilities are numerous and, in large agricultural countries, include thousands of end-users and hundreds of small distributors. The strong oxidative (sometimes explosive) properties of products containing significant amounts of AN have led to a long history of major accidents including mass explosions in large storage units and pre 1950s, to mass explosions in ships. A major breakthrough in safety was achieved in the 1950s, with the promotion – amongst other improvements – of better anti-caking agents. Although modern AN fertilizers complying with current standards are not considered as explosive material per se, the latent risk of accidental detonation under specific conditions remains a real issue, and from a scientific point of view, cannot be completely ruled out—as dramatically demonstrated by the Toulouse disaster in France. The new insight provided here is derived from: (1) a literature review on hazardous properties of AN and AN-based fertilizers; (2) a review of accidents focusing more particularly on the reporting of recent new cases involving relatively small quantities of previously ‘thought safe’ products; (3) an examination of both the relevant regulatory framework and the level of hazard control achieved; (4) appropriate discussions of the economical, technical and organizational factors that could lead to some underestimation of the risk compared to large scale storage facilities.
In terms of research requirements, the complex potential scenario ‘mass explosion following a fire’ requires further attention, as does the role and properties of molten ammonium nitrate, which could be the precursor for such an event to occur. Beyond research needs, reinforced legislative control by the authorities and further promotion of safe storage practices must be encouraged by the industry for end-users particularly. Such users have inherently the highest potential for undesirable situations, due both to the nature of their activities and also a possible lack of awareness of the real danger.

Ammonium nitrate: combustion mechanism and the role of additives by VP Sinditskii, VY Egorshev, A Levshenkov, and V. Serushhkin, Propellants, Explosives, Pyrotechnics 30 (2005), No. 4

Abstract
This paper presents an analysis of the observed combustion behavior of AN mixtures with different additives, fuels, and energetic materials. It has been determined on the basis of flame structure investigation by fine tungsten-rhenium thermocouples that the surface temperature of AN is controlled by the dissociation reaction of the salt occurring at the surface. Results obtained have indicated that the leading reaction of combustion of AN doped with additives proceeds in the condensed phase up to pressures of 20 – 30 MPa. A reason for the inability of pure AN to burn is suggested and the role of additives in the combustion mechanism is discussed.”

OSHA Accident Investigations

Event: 10/XX/2007, WV
Four Employees Are Injured In Chemical Explosion
On October XX, 2007, an employee was pumping hydrogen peroxide into a vat, and was unaware that the valve had been left open to another vat, containing silver oxide. The hydrogen peroxide and silver nitrate was mechanically mixed by the supervisor by turning the agitator on. This created a quick exothermic reaction, heating the silver nitrate and producing steam and hydrogen gas. The reacting silver nitrate and hydrogen peroxide shot out the top of the vat, and burned the supervisor who was standing in the area and the employee to a lesser degree. Two coworkers who came into the area to assist these employees suffered respiratory irritation. All four employees were hospitalized.

Event: 12/XX/2005, MD
Employees Injured In Chemical Explosion
On December XX, 2005, Employee #1, a truck driver, arrived at offloading point with a tanker truck loaded with Sodium Chlorite Solution. After making contact with security personnel, the employee made contact with wastewater operators at the site. One of
the wastewater operators reviewed the bill of laden and advised the employee that they were expecting the product and showed him where to connect his hoses to offload the product within a vessel in the wastewater building. The connection was made and after one of the wastewater operators reconfirmed and certified that the contents of the truck were suitably hooked to the appropriate vessel. Employee #1 began pumping the contents from his truck to the vessel. The vessel contained Ferric Chloride Solution and when the Sodium Chlorite Solution began mixing with the other chemical, a reaction occurred and generated an abundance of heat and pressure. This resulted in an explosion and chemicals rained on two of the wastewater operators, covering them with caustic liquids. They were immediately showered with emergency wash at the site, sent to the local hospital, and treated for minor respiratory irritation.

Event: 08/XX/2005, CA  Employee Suffers Second And Third Degree Burns

On August XX, 2005, Employee #1's clothing became wet with Sodium Chlorite. His clothing dried, but later caught fire, causing Employee #1 to suffer second and third degree burns to his legs. He was hospitalized for his injuries. No other details were given in the original narrative.