Lessons Learned Bulletin No. 5

Chemical Accident Prevention & Preparedness

Major accidents involving fertilizers

The aim of the bulletin is to provide insights on lessons learned from accident reported in the European Major Accident Reporting System (eMARS) and other accident sources for both industry operators and government regulators. In future the CAPP Lessons Learned Bulletin will be produced on a semi-annual basis. Each issue of the Bulletin focuses on a particular theme.

Summary

In preparing this bulletin, 25 major accidents in eMARS involving fertilizers were studied together with an additional 25 accidents from other free sources, including also accidents in transport. Events were chosen on the basis that ammonium nitrate or NPK fertilizer (nitrogen-phosphorus-potassium) was involved in the accident.

In general, with some exceptions, most accidents occurred in warehouses or general chemicals manufacturers, but transport accidents involving ammonium nitrate fertilizers have also caused serious accidents resulting in severe casualties and property damage.

Please note:

The accident descriptions and lessons learned are reconstructed from accident reports submitted to the EU's Major Accident Reporting System

https://emars.jrc.ec.europa.eu

as well as other open sources. EMARS consists of over 800 reports of chemical accidents contributed by EU Member States and OECD Countries.

Accident 1
Wholesale and retail storage and distribution

Sequence of events

A fire occurred in a warehouse storing fertilizers and chemical products belonging to a wholesale distributor of numerous products, including sugar, molasses, fertilizers, and cereals. The storage installation was subdivided into 8 compartments of which two contained NPK (15% N, 8% P, 22% K) fertilizers in quantities of 600 tonnes and 850 tonnes respectively. In addition, one compartment also contained 650 tonnes of ammonium nitrate fertilizer and the other was also storing 200 tonnes of 46% urea solution. On 29th October 1987 smoke was detected by an operator in Box No. 2 of the warehouse, that is, the compartment that contained 850 tonnes of NPK fertilizer. The first reaction of the personnel was to attack the source of the fire with portable fire extinguishers, in the absence of activated fire hose reels. Arriving on the site, firemen observed that very thick smoke was emitted from the storage compartment. It also appeared that a fire was burning beneath the mass. However, the intervention of the firefighters appeared to focus solely on the presence of ammonium nitrate fertilizer, ignoring, the nature of the other chemical products. Further, disagreements between experts occurred which delayed the application of effective response methods. The accident resulted in the slight injury of three employees and 38000 people were evacuated for 8 hours.

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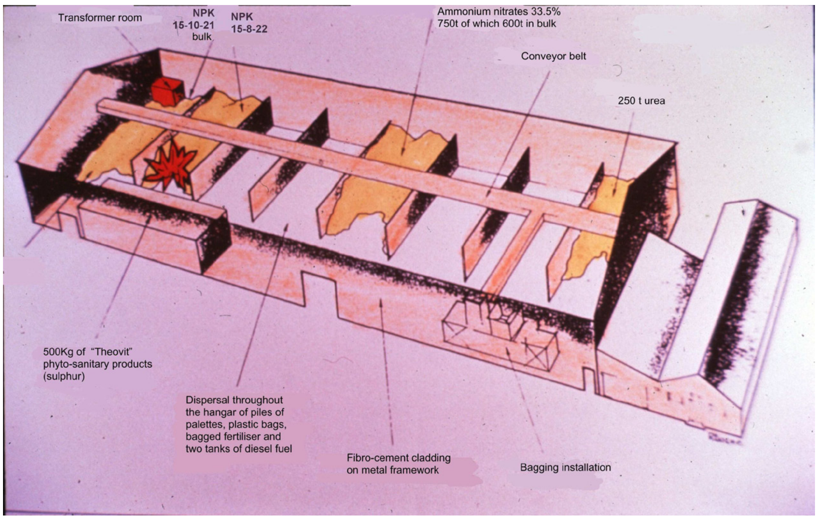

Figure 1: The installation concerned Source: ARIA N° 5009

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Major accidents involving fertilizers

Production and storage of fertilizers

As a substance, ammonium nitrate has a long history. (It was first produced in 1659). It is a "dual-use" substance from which either fertilizers or explosives can be produced. It is produced at a large scale throughout the world (over 20 million tonnels in 1998) with over a third of this production based in Europe (over 7 million tonnes in 1998). It is without doubt important for western society. It is an easily absorbed and efficient source of nitrogen for plants and particularly suitable to growth conditions of the European climate. Its efficient absorption rate means that it is relatively friendly to the environment relative to other manufactured fertilizers; the amount of nitrogen lost to the atmosphere is normally low.

History of accidents involving ammonium nitrate fertilizers

Ammonium nitrate caused a few of the most catastrophic events of the 20th century in peaceful times. The two most notorious and disastrous accidents in the western world were the Oppau, Germany, accident from the detonation of 450 tonnes of sulfo-ammonium nitrate fertilizers in storage that killed 561 people. In 1947, in Texas City, Texas (USA) a ship carrying 2600 t of ammonium nitrate exploded and set fire to a nearby vessel hold 960 tonnes of ammonium nitrate. 581 people in total were killed. Detailed descriptions and lessons learned from these accidents can be found from many sources. Several books have been written that cover these disasters and there is also substantial information on these and other ammonium nitrate accidents available in open sources online.

Still since then, ammonium nitrate has been involved in numerous accidents causing explosions, fires, and releasing toxic fumes. It has been recognized in many countries that even small storages of ammonium nitrate fertilizers, defined as low as 10 tonnes in some legislation, may place the population at high risk if proper safety measures and procedures are not fully in place (http://ipsc.jrc.ec.europa.eu/fileadmin/repository/sta/mahb/docs/SpecialRegulatoryTopics/Ammonium_nitrate_safety.pdf). The chart below depicts the fatalities and tonnage associated with AN accidents identified by this study from 1916 until present.

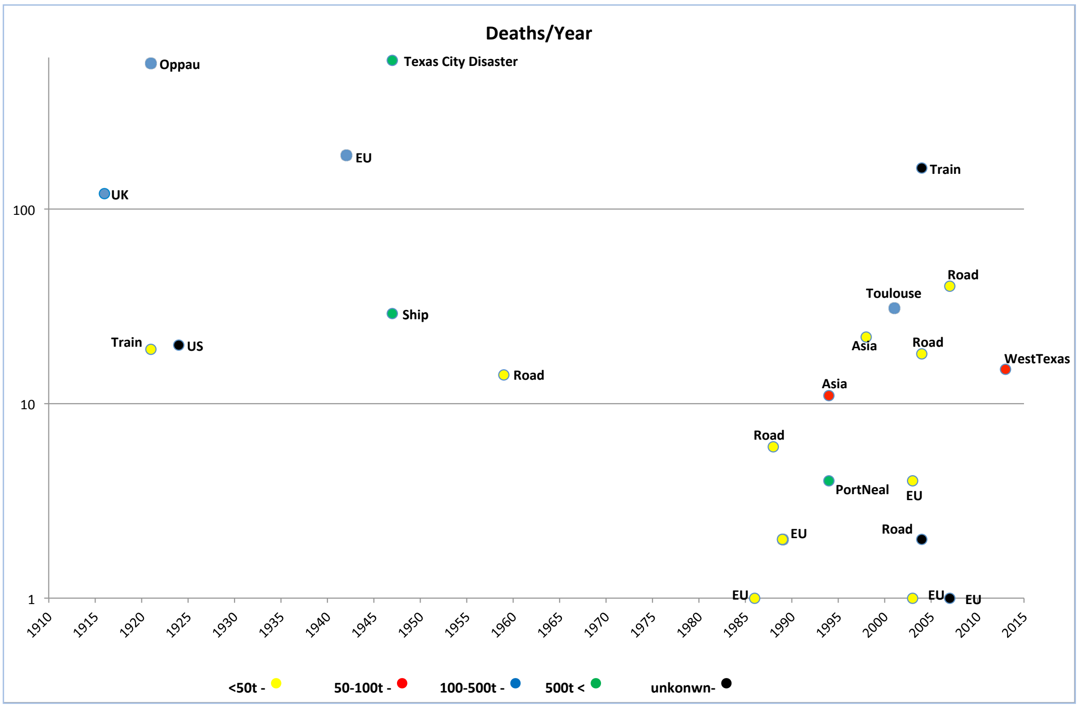

Figure 2 Fatalities and tonnage associated with AN accidents
(Source: eMARS and http://en.wikipedia.org/wiki/Ammonium_nitrate_disasters.)
If you would like a list of the accidents in this chart and references used, please send an email with your request to emars@jrc.ec.europa.eu.

Major accidents involving fertilizers

Accident 2
General chemicals manufacture

Sequence of events

Self-decomposition of NPK fertilizers led to a fire in a storage silo and release of toxic substances, mainly nitrogen oxides. The silo contained approximately 15,000 tonnes of the product, but the fire was detected early enough (probably from the fumes rather than automatic detection) to avoid serious consequences. Five firefighters were treated for minor injuries in hospital and some onsite personnel suffered from eye and throat irritation and burning. Some neighbouring establishments and houses were evacuated and other areas were told to shelter-in-place for some time (duration not specified), In the end, no offsite injuries were reported. The fire was controlled after most of the material was removed by mechanical means.

Causes

It was thought that exposure to moisture had caused caking in a portion of the product. In addition, the product may have been in contact with organic material, specifically, pigeon excrement, due to the considerable quantity of pigeons present in the silos. Over a two-month period, some of the product involved in the accident had been exposed to ambient conditions during a period in which the region experienced a lot of rain. Self-sustaining decomposition caused by the presence of a contaminant would have likely been accelerated by the presence of anomalous crystal structures (caking) in the product.

Important findings

- A portion of the product had been exposed to ambient temperatures in a period when the region was experiencing a lot of rain. Leaks in the silo roof caused water to fall on the exposed lot, generating a possible recrystallization or caking of the fertilizer.
- No documentation available at the installation reflected the possibility that such an accident could take place.
- A large amount of the NPK was stored in the same location without proper separation. This practice was actually counter to company practice regarding storage conditions.

Lessons Learned

- Storage facilities should strive to eliminate the possibility that impurities are introduced into the ammonium nitrate. Preventive measures should be in place to prohibit birds and animals from contact with the product or, if this is not possible, ammonium nitrate should not be stored in that facility
- In storage of ammonium nitrate compounds, exposure to water should be avoided in order to prevent caking. A nonconformity in the fertilizer structure, such as caking, can accelerate oxidisation Facilities should be appropriately constructed and maintained to avoid leaks, flooding, or formation of pockets of moisture in areas where the ammonium nitrate is located.
- Employees should be regularly trained and tested on critical safety procedures and periodic monitoring should take place to ensure that procedures have been followed.
- The follow-up investigation also recommended that temperature monitors should be installed in each storage silo.

[eMARS accident #263]

Accident 3
Production and storage of fertilizers

Sequence of events

An explosion occurred in an NP buffer in the neutralization process of the production activity. Production in the fertilizer plant had been stopped due to maintenance work in the ammonia storage area, and as a result, there could be no supply of ammonia to the plant. Just prior to the explosion, an automatic fire detector, directly connected to the control room of the local emergency preparedness unit and the plant, went off. In addition, gas was observed by the operators in the factory and the building was evacuated with staff directed to the designated meeting points. Shortly after the evacuation, the explosion took place. The pressure from the explosion caused window damage in the meeting place area and 5 operators were injured due to glass fragments. The explosion caused a fire in the third floor of the building. The fire was extinguished after a little over an hour.

Causes

The cause of the accident was identified as decomposition of ammonium nitrate in the NP buffer tank due to high temperature and low pH in the tank. These conditions resulted in the formation of a large amount of gas leading to rupture of the tank from overpressure. The overheating was the result of a leaking steam valve on the 20 bar steam supply to the tank. The NP buffer tank was the last unit before the liquor was pumped to the evaporation and prilling section for making the final product prills. The off gas from the tank is connected to the recovery system for ammonia. In this process, the addition of ammonia neutralizes the acidic liquor from the process immediately prior. The ammonia flow was controlled by an online automatic pH measurement, located at the 25% level of the tank. In addition, ammonium nitrate is added to obtain the correct ratio between N and P in the final product.

Important findings

- The NP buffer tank had no instrumented safety functions, but a high temperature alarm on 145 ° C was installed. Also, there was a high and low alarm on the automatic pH measurement and a high alarm on the online chlorine analyser.
- No hazards had been associated with the NP buffer tank in the Hazop study or the risk analysis.
- Two evenings before the accident a high alarm for temperature went off. It was acknowledged and dismissed without investigation.
- The evening of the day before the accident, the temperature continued to register on the high side, but since pH was high and the steam valves were shut, it was assumed that the temperature measurement was wrong,

Lessons Learned

- Hazard identification should have drawn attention to the elevated risk associated with the presence of ammonium nitrate in a process tank while the process was idle. Safety procedures and controls for process equipment are usually designed to manage risks when the process is running and cannot be automatically assumed to be capable of also controlling substances safely in abnormal situations.

(Continued on the back of the page...)

(Continued from accident 3) Production and storage of fertilizers

- Hazard identification should pay particular attention to the sensitivity of ammonium nitrate to changes in operating conditions. As such it should also take into account the plant life cycle and unintended events that could adversely affect these conditions in order to establish appropriate safety controls and procedure for these situations.
- The installation of appropriate instrumented safety functions are a typical control measure that could assist the operator in limiting consequences from unexpected ammonium nitrate reactions under a wide range of conditions.
- Alarm management is a common challenge at many processing plants where there are numerous processes with numerous alarm for each covering a wide range of functions. The failure to respond to the high temperature alarm suggests that the company did not have an adequate system for prioritising alarms to ensure an appropriate and timely response to emergencies. In addition, employee trainee should also instill a heightened awareness in operations staff to nonconformities, negative indicators, and pre-emergency alerts during shutdown periods.

[eMARS accident #694]

Accident 4 General chemicals manufacture

Sequence of events

At 10.17 a.m. on 21 September 2001 a severe explosion occurred in Shed 221, a temporary storage of downgraded ammonium nitrates at the AZF industrial site in Toulouse, France. The detonation, felt several kilometer away, corresponded to a magnitude of 3.4 on the Richter scale. Significant dust fallout from the installations and a 7 m deep crater (65x45m) were observed outside the plant. A large cloud of dust from the detonation and red smoke drifted to the north-west. The appearance of the smoke is linked to the emergency shutdown of the nitric acid manufacturing installation. Before rapidly dissipating, the cloud containing ammonia and nitrogen oxides sickened witnesses who complained of eye and throat irritations. The atmospheric pollutants released after the detonation lead to the formation of nitric acid (HNO3), ammonia (NH3), nitrogen dioxide (NO2) and nitrous oxide (N2O) from ammonium nitrate. As a precautionary measure, the local governmental authority ("Préfecture") requested that the population of Toulouse confine themselves to their homes, however, windows were broken. The accident resulted in 31 casualties (22 on site and 9 off site), 30 people were seriously injured and 300 people were hospitalized. In addition, 2500 people received hospital treatment.

Causes

There are still uncertainties on the direct causes and the possible scenarios regarding the explosion. The final legal expert report concluded that it was a chemical accident, due to an accidental combination of sodium dichloro-isocyanurate (SDIC a product used for water treatment) and downgraded ammonium nitrate, causing the explosion. The operator has always disavowed this theory. In the early phase of the investigation some theories were formulated concerning the causes, such as terrorist attack or unintentional external causes but in due time none of these were able to be proved.

Important findings

- The safety report of the AZF factory did not take into account the downgraded ammonium nitrates store since it was considered as less dangerous (because of the smaller quantity stored). The safety report did not describe each possible accident scenario.
- Urbanization had considerably spread out in the vicinity of the site since the launching of the chemical activities. At the time of the accident, the chemical site was surrounded by business parks, hospitals, dwellings (C. Lenoble, C. Durand et al. / Journal of Loss Prevention in the Process Industries 24, 3 (2011) 227-236).
- On the site, 25 subcontracting companies worked continuously (100 subcontractors every day versus 250 employees for a total of 469 employees). Three different subcontracting companies worked in the warehouse (the downgraded AN was picked up, unloaded and removed by them) and the maintenance of this warehouse was carried out by another subcontractor (N. Dechy et al. / Journal of Hazardous Materials 111 (2004) 131–138).

(Continued from accident 4) General chemicals manufacture

- The storage building involved in the accident did not have nitrogen oxide detectors although other facilities were equipped with such sensors around the facility.

Lessons Learned

- Given the variety of ways in which ammonium nitrate can cause an accident and the many ways that such accidents can be made worse by circumstances, there are many accident scenarios that operators must consider. The site risk assessment should include all possible major accident scenarios, domino effects relating to the dangerous substances stored or produced on site should be carried out
- Operators should have full knowledge of the inherent hazards associated with the handling and storage of ammonium nitrate fertilizer and regularly review operating procedures to ensure they are being followed.
- The ammonium nitrate storage facilities were not directly managed by the AZF company but by subcontractors, whose knowledge of the products and the site could sometimes be incomplete. When contracting out of a technical process to a third-party the operator should ensure that all risks in the area and associated with the contractor's work have been identified and controlled If the area of work involves the presence of ammonium nitrate, then the contractor employees must all have sufficient training and awareness for working in the vicinity of this substance and particularly the danger of ignition. (MAHB Lessons Learned Bulletin No. 2 on major accidents involving contractors – JRC77996) .
- In order to cause as low impact as possible on the population, land-use planning or urban development control zone limits should be applied, even retroactively.

More information:

http://en.azf.fr/the-disaster/september-21-2001-800283.html

[EMARS Accident # 403.]

Figure 3: The area affected by the explosion (Source:©Archives Grande Paroisse)

Accident 5 Storage and distribution facility

Sequence of events

On the evening of April 17, a fire of undetermined origin broke out at the West Fertilizer Company Storage and distribution facility in West, Texas (USA). The facility had already closed for the day and was unattended. Firefighters found the warehouse building in flames and were in the process of extending hoses to fight the fire, and were applying some water to the blaze. Although the firefighters were aware of the hazard from the tanks of anhydrous ammonia as a result of previous releases, they were not informed of the explosion hazard from the approximately 60 tonnes of fertilizer grade ammonium nitrate inside the warehouse. While firefighters were positioned nearby, the ammonium nitrate suddenly detonated. A shock wave, traveling faster than the speed of sound, crushed buildings, flattened walls, and shattered windows. Innumerable projectiles of steel, wood, and concrete – some weighing hundreds of pounds – were hurled into neighborhoods. Twelve firefighters and emergency responders were killed along with at least two members of the public. More than 200 were injured and more than 150 buildings were damaged or destroyed. If this incident had occurred earlier in the day, many more people might have been killed or injured.

Causes

Investigators have confirmed that ammonium nitrate was the material that exploded, but the cause of the initial fire is as yet unknown. Nonetheless, preliminary findings suggest that lack of adequate prevention and mitigation measures in the storage facility may have substantially elevated the risk of a catastrophic event. In particular, the presence of combustible materials and the lack of fire protection system.

Important findings

- The warehouse where the ammonium nitrate was stored was made of wood and the ammonium nitrate itself was separated into wooden bins. The building also stored significant amounts of combustible seeds that likely contributed to the intensity of the fire.
- Existing professional standards for preventing ammonium nitrate accidents were confusing and contradictory and not up to date with current practice in other countries, For instance, they did not prohibit ammonium nitrate storage in wooden buildings or wooden bins,
- There were no monitors, alarms or automated fire protection measures in place to aid in obstructing the catastrophic chain of events following the ignition of the ammonium nitrate. According to professional standards, automatic sprinkler systems were not mandated unless more than 2500 tonnes of AN is being stored. It was estimated that only 30 tonnes that would have been necessary to devastate much of the town of West
- Firefighters were not made aware of the presence of an explosive hazard and as a result conducted their response effort at an unsafe distance from the source..

(Continued from accident 5) Storage and distribution facility

- The plant was last inspected by the safety authority in 1985. It was not a priority for inspections because it was not a manufacturer and had no prior record of a major accident. Ammonium nitrate was not in the scope of environmental regulations for preventing accidents with offsite consequences.
- No standards were in place that restricted certain types of development, such as schools, nursing homes, and hospitals, around ammonium nitrate storage facilities.

Figure 4: The scene following the accident (Source – U.S. Chemical Safety Board)

Lessons Learned

- The only scenario which was considered as dangerous in the storage facility was the accidental release of anhydrous ammonia. Conducting comprehensive hazard identification, analysis and risk assessment where hazardous substances are stored or handled is a basic requirement when operating dangerous establishments.
- Separation of combustible materials from organic substances is recommended to reduce potential conflagration and explosion once an ammonium nitrate fire has started.
- It should not be considered acceptable under any circumstance that a site storing ammonium nitrate in bulk quantities is allowed to operate without proper fire prevention, protection and mitigation measures.
- Development should be restricted around sites that handle or store ammonium nitrate or in the case of existing development in close proximity of the site, appropriate prevention and protection measures should be in place to reduce the risk as much as possible.
- Local authorities should be aware of the dangers associated with ammonium nitrate hazards and oversee the sites in their jurisdiction as appropriate to the level of risk. Even sites with relatively small quantities can be significant risks if they are in close proximity to human development (See Figure 1).
- Local responders should also be aware of all ammonium nitrate storage sites in the area and the maximum quantities that might be present, They should be trained on how to fight ammonium nitrate fires in accordance with the current best practice.
- The operator of the facility did not learn lessons from past accidents including the Texas City, Texas (USA) Disaster of 1947 or the more recent accident in Toulouse, France of 2001 and many others that have been published. (http://en.wikipedia.org/wiki/Ammonium_nitrate_disasters) Operators of ammonium nitrate sites should actively review lessons learned from past accidents and regularly update their knowledge on safety and risk management requirements.

More information: http://www.csb.gov

See also: EMARS Accident # 263 and El Dorado Chemical Co. Athens, Texas 29 May 2014 at

http://thescoopblog.dallasnews.com/2014/05/fire-reported-at-fertilizer-plant-in-athens.html/

Safety principles

- Elimination/minimisation of the presence of combustible materials and incompatible substances (such as explosives) in close proximity to the ammonium nitrate.
- Avoid co-storage of combustible materials in the same location as much as possible.
- Avoid strict confinement of the storage area; proper ventilation limits the progress of decomposition should it occur.
- Prevent moisture absorption to avoid caking.
- Be aware of and follow appropriate safety precautions associated with AN fertilizer storage, including packaging stacking, temperature and other elements.
- Ammonium nitrate may elevate combustion risks. Follow established norms for mitigating fires, such as having a sprinkler system in place to minimize the risk of spread of a fire.
- Control ignition sources (e.g. hot work, smoking, vehicles) with control of the electrical system in the storage.
- Contaminants, such as organic materials (oils or waxes) may increase the explosion hazard of ammonium nitrate. Handle off-specification,, downgraded or technical grade fertilizer contaminated with organic material safely and segregate them from other products.
- Even for short periods of storage of fertilizers a risk assessment is recommended.

Further information on safety procedures for handling ammonium nitrate can be found at the following links:

- http://www.hse.gov.uk/explosives/ammonium/
- http://www.ineris.fr/centredoc/synthese65281.pdf
- http://www.nfpa.org
- https://www.safework.sa.gov.au/uploaded_files/SSAN_Storage.T60.pdf

Major accidents involving fertilizers

Safety challenges most commonly associated with ammonium nitrate fertilizer hazards

The unique safety challenges associated with ammonium nitrate coupled with poor safety management culture could largely be considered the most important contributing factors across the accidents studied. Specifically, some of the most common factors associated with elevated risk to the population and first responders included:

- *Insufficient fire prevention, protection and control systems were in place.*
- *There was a lack of knowledge of the inherent hazards associated with the handling and storage of ammonium nitrate fertilizers, and in many cases, specifically the potential decomposition of such fertilizers was not considered.*
- *The operator did not adhere to basic safety requirements for handling ammonium nitrate and dangerous substances generally.*
- *Existing regulations did not adequately recognize the hazards of sites storing and handling bulk quantities of ammonium nitrate, As such, oversight was inadequate or entirely lacking.*
- *Likewise, the authorities often failed to recognise potentially vulnerable land-uses around ammonium nitrate installations, a risk that can be substantially elevated if adequate prevention and mitigation measures are not in place. Where such measures are not in place, even relatively low quantities of ammonium nitrate can cause accidents with serious off-site consequences.*
- *Operators seemed unaware of the many accidents involving ammonium nitrate that have occurred in their own countries as well as around the world, despite wide publication in open sources. Hence, they did not take advantage of the lessons learned.*
- *Establishing adequate safety procedures in particularly relating of training and awareness of hazards.*

The case studies provided in this bulletin are just a small sample of the reports available in the eMARS database involving fertilizers. Nonetheless, cases have been selected on the basis that they are somewhat typical of accidents involving fertilizers.

Please note: The selected cases also include a number of lessons learned, not all of which are described. The bulletin highlights those that it considers of most interest for this topic, with the limitation that full details of the accident are often not available and the lessons learned are based on what can be deduced from the description provided. The authors thank the country representatives who provided advice to improve the descriptions of the selected cases.

General characteristics of fertilizers

Commercial products made from ammonium nitrate, as a raw material, can be classified within two main categories, with very specific processes and uses, one being high-density prills or granules used as fertilizers and the other being low-density porous prills or granules (named "industrial or technical ammonium nitrate"), mainly used for the production of ANFO (Ammonium Nitrate+Fuel Oil) explosives. Chemically speaking, both products. fertilizers and explosives, essentially contain ammonium nitrate, but their physical forms are very different, producing different effects.

Ammonium nitrate has a complex behaviour and not surprisingly has undergone extensive research as a chemical substance. There are three main hazards associated with ammonium nitrate: fire due to its oxidizing nature, decomposition and explosion. The most important parameters that influence the presence of the hazard are particle (prill, granule) size, particle density/bulk density/porosity, purity, nitrogen content and confinement, as summarized briefly below.

- *Oxidizing nature Ammonium nitrate itself does not burn. As an oxidizer, however, it can support combustion and intensify a fire even in the absence of air, but only as long as fuel or combustible matter is also present.*
- *Thermal decomposition. Pure ammonium nitrate can undergo thermal decomposition if it receives enough energy. With proper ventilation, the decomposition stops as soon as the energy flow stops. In some cases the decomposition, initiated by an external heat source, will stop when the heat source is removed. With some AN fertilizer compounds, however, the decomposition will continue and will spread deep into the bulk of the material even when the heat source is removed. This process is referred to as self-sustaining decomposition and progresses relatively slowly.*
- *Decomposition is catalysed by a number of substances such as chlorides, which can accelerate the rate of decomposition. As an exception, ammonium nitrate-based NPK fertilizers are thermally stable and are not prone to self-heat dangerously under normal conditions of storage and transport.*
- *Explosive hazard. Ammonium nitrate can produce an explosion by one of three mechanisms: heating in confinement , run-away reaction, and detonation. Heating in confinement is a risk when ventilation is inadequate. The rapid decomposition of the ammonium nitrate leads to a considerable pressure build-up that can eventually cause an explosion. Note that, whilst uncontaminated solid AN requires a large amount of energy to initiate a detonation, molten AN (which would be produced in a fire) is much easier to initiate at high temperatures. A detonation in this case could also be initiated by projectiles (low amplitude shock).*
- *Uncontaminated ammonium nitrate is very difficult to detonate. Neither flame, nor spark nor friction can cause a detonation. Initiation by shock wave requires a large amount of energy. The degree of resistance is strongly dependent on the presence of voids or bubbles in the substance, hence the bulk density, and the degree of contamination by organic matter or fuel.*

The ammonium nitrate content affects the explosive potential. Research has shown that the explosion hazard is reduced if the ammonium nitrate content is limited to, for example, 90% (31.5%N), with a further reduction if this limit is lowered to 80% (28%N). It must be recognized however, that a potential explosion hazard (although somewhat reduced), still remains.

Motto
of the semester

Mao Tse Tung:
Complacency is the
enemy of study

MAHBulletin

Contact

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European Commission

Accident 1
Wholesale and retail storage and distribution

(Continued from cover page...)

Causes

Due to the conditions of transport (in the holds of a ship which had previously stored wheat) and the storage conditions (on a bed of sawdust to dry the floor of the box), the fertilizer became mixed with organic material. Also, it was found that defective, poorly insulated power cables were nearby the fertilizer pile. Furthermore, wooden pallets were in contact with the fertilizer compounds. These compounds then caught fire during decomposition and released heat, accelerating the decomposition.

Important findings

- The NPK fertilizer had been unloaded the day before the accident and completely filled the capacity of the storage compartment. At the time no abnormalities in the product (e.g., caking) were observed, although the temperature at the time (40o C) should have been identified as cause for concern...
- The electrical installation of the site was old and other potential unsafe conditions were present, such as lack of insulation, incomplete grounding, oversized circuit breakers as identified by a private verification in 1986 report. (No repairs were conducted as follow-up to the report.) The zone in which the fire started was located below the electrical cables that hung beneath the transport motor (http://www.aria.developpement-durable.gouv.fr/accident/5009_en/?lang=en).
- There was no effective means of firefighting, in place, such as a water riser and a self-propelled fire hose..

Lessons learned

An official summary of the incident provides a succinct summary of the lessons learned as follows:

- The incident would certainly not have reached such proportions if efficient means for response had been applied as soon as the heating had been detected, preventing the rapid development of the fire.
- Appropriate extinction equipment for the products stored must be at the disposal of personnel trained in emergency response, the prevention of risks, and the detection of abnormalities. In this case, the personnel of the establishment were not aware of the risk associated with fertilizers and only had powder extinguishers which are ill-adapted to this type of fire. No water extinguishing equipment, such as, fire hose reels, were available on the site.
- A sound characterisation of the risks involved, particularly an understanding the implications of storing of dangerous substances is indispensable to the implementation of efficient fire prevention and firefighting plans. Doubtless the loss of information concerning the nature of the products involved in the fire played a major role in the development of the incident. In the absence of characterisation of the products present and thus of the risks involved, disagreements between experts occurred which delayed the application of effective response methods. Furthermore, the establishment was not classified by the fire department and was subject to no emergency plan. It is essential that each emergency centre should hold an inventory of potential risks for its sector of intervention to enable efficient response from the moment that the alarm is given.
- Effective response requires also that there should be adequate and permanently available sources of water including, for example, when the tide is going out.

[EMARS Accident # 282 See also: EMARS Accident # 12 # 237 # 446 and # 710]

More information:
http://www.aria.developpement-durable.gouv.fr