fertilizers europe

GUIDANCE FOR FIGHTING FIRES AND/OR DECOMPOSITION INVOLVING SOLID MINERAL NITROGEN-BASED FERTILIZERS

product stewardship fertilizers

Issue 2015

GUIDANCE FOR FIGHTING FIRES AND/OR DECOMPOSITION INVOLVING SOLID MINERAL NITROGEN-BASED FERTILIZERS

Contents

Issue 2015

1. INTRODUCTION AND SCOPE

Fertilizers Europe, representing the mineral fertilizer manufacturers, has produced this document to give guidance on actions to be taken in the event of a fire or decomposition involving various nitrogen-based fertilizers in the distribution chain. These fertilizers include, for example, ammonium nitrate (AN), calcium ammonium nitrate (CAN), NPK's, ammonium sulphate nitrate (ASN), potassium nitrate, urea, ammonium sulphate, ammonium phosphates (MAP, DAP). This guidance deals only with solid mineral fertilizers (including blends) and focuses on fire and decomposition as starting events.

The purpose of this document is to provide guidance on fighting fires involving nitrogenous fertilizers with focus on nitrates. This guidance has been prepared for those who are familiar with safe fighting procedures and, therefore, assumes that they will take all necessary precautions for their own and others' safety. It does not deal with requirements for safe storage, for which a separate detailed guidance has been published *(see Fertilizers Europe's Guidance for the Storage, Handling and Transportation of Solid Mineral Fertilizers)*.

2. PRODUCT DESCRIPTIONS

- **Nitrate-based fertilizers**

Fertilizers containing both ammonium (NH_4^+) and nitrate (NO_3^-) forms of nitrogen, irrespective of their source are considered as ammonium nitrate-based (AN) fertilizers. For example: potassium nitrate combined with ammonium phosphate is also regarded in this category. Typical commercial products contain 33.5 – 34.5 % N in ammonium nitrate (AN), 26 – 27 % N in CAN and 10 – 26 % N in various other AN-based fertilizers such as NP and NPK. Potassium nitrate typically contains 13.7 % N.
The following table gives the total nitrogen content in fertilizers derived from AN:

AN %	100	90	80	70	60	50	45	30
N %	35	31.5	28	24.5	21	17.5	15.75	10.5

- **Classified fertilizers**

The term classified is used in this guidance to describe fertilizer products and related substances, which are classified as dangerous under the UN scheme for transport regulations *(Recommendations on the Transport of Dangerous Goods Model Regulations popularly known as The Orange Book)*. Individual substances or group of substances are assigned a specific number, called UN number, to facilitate their identification.

Classified AN-based fertilizers can fall into one of two classes:

- oxidizer, class 5.1, UN 2067
- capable of self-sustaining decomposition, class 9, UN 2071

Fertilizers which are not classified as above are regarded and described as **non-hazardous** or **non-classified** as regards to the transport regulations. However, it does not mean that they are totally free from the relevant potential hazard.

3. HAZARDS AND ASSOCIATE RISKS

1. Hazards

- **Fire**

Ammonium nitrate or potassium nitrate itself does not burn, but it is an oxidizing substance and as such can support combustion even in the absence of air. Therefore smothering with steam, powder, foam or sand is not effective and may aggravate the situation. The presence of combustible material is necessary to have a fire. The oxidizing nature of nitrates will enhance the fire hazard. The fire (or decomposition) hazard can increase if the product, particularly if spilled, is contaminated with combustible materials such as coal, grain, sawdust, oil, grease or elemental sulphur.

If a nitrate-based fertilizer is involved in a fire or is heated strongly, toxic gases e.g. nitrogen oxides, ammonia (depending on composition) or hydrogen chloride in case of chloride-based NPK may be released. Take precautions to avoid inhalation.

- **Decomposition**

Under the influence of heat, nitrate-based fertilizers, particularly those containing AN, can chemically break down. This is known as decomposition. The presence of a combustible substance is not necessary for the decomposition to take place. The risk of decomposition is dependent on a number of factors such as the type of product, the temperature of the heat source, the duration of exposure to the heat source, and the containment of the fertilizer. Contamination with sensitizing materials such as acids, chromates, chlorinated chemicals and various metals such as zinc and copper and their salts can also increase the risk of decomposition.

The thermal decomposition for most fertilizers requires a continuing heat source. The decomposition can be stopped by removing the heat source. However, certain compositions of NPK fertilizers are capable of undergoing self-sustaining decomposition. This means that the reaction will continue on its own even when the heat input (e.g. a

hot electric light bulb or hot welding material) is removed. Such decomposition needs to be tackled with water in a special way *[as described in Section 6]*. The potential for self-sustaining decomposition may be indicated on the product Safety Data Sheet or transport document as UN 2071 Classification applies.

Decomposition is generally accompanied by the evolution of toxic gases such as NO_x, N_2O, ammonia, hydrogen chloride or nitric acid vapors (depending on the product composition) *[More details in Section below]*.

- **Toxic fumes**

Most fertilizer materials break down when heated, releasing gases, some of which may be toxic or harmful. Fertilizers based on ammonia tend to be more prone than others in this regard and they include, for example, urea, MAP, DAP, as well as ammonium nitrate and AN-based fertilizers.

Those containing AN release water vapour, ammonia gas and oxides of nitrogen. Straight AN fertilizer containing mainly AN and inert substances gives off gases which contain predominantly nitrous oxide (N_2O) and water vapour. Nitrous oxide, also known as laughing gas, is not particularly toxic. NO_x gases are also given off in small concentrations, which depend on various factors.

NPK fertilizers can give off a number of gases e.g. ammonia, oxides of nitrogen and hydrogen chloride, depending on the source materials used and composition.

Nitrates of potassium, sodium and calcium are relatively more stable, but when strongly heated can give off oxides of nitrogen.

Certain oxides of nitrogen and ammonia are particularly toxic and the effects of their inhalation may be delayed and may lead to pulmonary oedema (fluid in the lung).

- **Explosion and detonation**

In simple terms, an explosion is defined as an event involving a sudden release of pressure energy. Fertilizers can give rise to an explosion when strongly heated in confinement. This phenomenon involves generation of gases due to heat, resulting in pressure built up and eventual rupture of the containing vessel or equipment. Detonation is another form of explosion – more severe and destructive, where a substance reacts generating a shock wave at supersonic speed which sustains the detonation reaction.

Standard quality fertilizer products have a high resistance to detonation and they are difficult to detonate. However, certain compositions of AN-based fertilizers can be made to detonate or explode under extreme conditions such as impact of a strong shock or heating under strong confinement.

The two main mechanisms which could cause a detonation in an ammonium nitrate fertilizer stack or bulk heap are:

1. *Thermal decomposition*: the development of rapid decomposition (deflagration) in a fire and its transition to detonation. Such a transition (commonly known as DDT) is not easy to achieve in AN-based fertilizers, as detrimental factors such as high % AN, high temperature, contamination with reactive/combustible substances or severe confinement are required.
2. *Shock initiation*: a shock produced by an adjacent explosion or impact of a high velocity projectile can initiate a detonation in the solid or molten fertilizer. Impact from high velocity projectiles can happen in a fire when AN-based fertilizer is confined in hollow sections of equipment such as conveyor rollers and components of vehicles and a rupture of the equipment happens. The rupture of welding equipment such as gas cylinders can have a similar effect. These projectiles are unlikely to have sufficient energy to initiate a detonation in normal solid products but molten and/or contaminated fertilizers can be more susceptible, in particular under conditions of high temperature and impact pressure. Roof beams or building structures which may collapse in a severe fire also are unlikely to have sufficient impact energy to initiate a detonation even in molten decomposing fertilizer.

2. Risk factors associated with the hazards

- **Fire**

Nitrates have oxidizing properties and will support fires in combustible materials even in the absence of air. AN-based fertilizers are themselves not combustible and are thermally stable at the normal storage conditions. Therefore the risk of fire depends on other general combustible materials, which may be present, such as parts of handling equipment, the fuels, lubricants and hydraulic fluids used therein and materials stored (e.g. seeds, hay and straw) or materials used in the construction of the store or bays (e.g. wood).

The risk of a fire can significantly increase when safety requirements are ignored, e.g. presence of combustible materials and sources of ignition. If a fire is not controlled and extinguished in the early stages it can intensify if nitrates and combustible materials are present.

- **Decomposition**

AN-based fertilizers do not spontaneously decompose. Heating or contamination with incompatible materials is necessary to increase the decomposition and toxic fume release risk. Hence, the risk of decomposition is dependent on a number of factors:

- type of product;
- temperature of the heat source;

- duration of exposure to the heat source;
- contamination with sensitizing materials such as acids, chromates, chloride and chlorinated compounds and various metals such as zinc and copper and their salts.

- **Toxic fumes**

See fire and decomposition.

- **Explosion and detonation**

AN-based fertilizers do not spontaneously explode. Factors increasing the potential for an explosion are:

- composition;
- intensity and duration of heating;
- contamination;
- confinement;
- shock or projectile impact.

When fires are tackled at an early stage, the risk of explosion is negligible. A default firefighting response of not tackling fires where fertilizer is present may allow small fires to develop and increase the number of incidents which could potentially escalate to explosion, putting more lives at risk. However, it is important to recognize the risk factors which could lead to explosion as there may be a set of circumstances which may make such a development more likely.

4. PREVENTION AND PREPAREDNESS

It is important that in order to minimize the above risks, relevant safety and security precautions are taken and emergency plans are put in place to control the hazards should they arise. These should include, for example:

- Storage buildings (on production sites and in the distribution chain) should be designed with minimum use of combustible materials;
- Sources of heat e.g. heaters, steam pipes and light bulbs, should be kept away from the stored fertilizer;
- Maintenance activities, particularly those involving hot work, must be controlled to prevent heating of the fertilizer;
- Cross-contamination of the fertilizer with other materials must be avoided;
- Confinement of fertilizer in drains and hollow sections must be avoided;
- Movement and maintenance of vehicles must be controlled to ensure the fertilizer is not contaminated with oil spills and is not affected by hot exhaust gases;
- Storage buildings should be secured from thefts and unauthorized access;

- All stores, outdoors or indoors, should have a reliable means of alerting the emergency services;
- Stores should be adequately equipped with fire-fighting equipment:
  - A fire water supply via a typical water hydrant(s) from a piped supply or a reservoir;
  - A standard water supply capable of reaching all parts of the storage area, or an adequate supply of water extinguishers for fighting initial outbreaks of fire;
  - Chemical extinguishers for fires on equipment where fertilizers are not directly involved;
  - Where applicable, detection systems may be appropriate.
- Specialised personal protective equipment such as self-contained breathing apparatus should be provided in accordance with local/national requirements;
- Emergency plans should be drawn in consultation with the local fire brigade and practiced.

5. INITIAL RESPONSE AND ASSESSMENT

If despite of the preventive measures described in Chapter 3 an incident still happens, the following steps are recommended:

1. Raise alarm and evacuate the incident location (e.g. storage area);
2. Call the fire services and advise them that fertilizers are involved;
3. Check for flames: If smoke or fumes are observed in a fertilizer store and if it is safe to do so (i.e. not being affected by the flames, fumes or smoke), check to see if flames can be detected. If flames are seen, then a fire involving combustible material or the building itself is likely. If no flame can be seen, then fertilizer decomposition is probably taking place;
4. Do an initial risk assessment taking into account all relevant factors. Firefighting personnel need to be involved in this assessment. The following approach is suggested to carry out such a risk assessment:
   → Collect the relevant information:
     » Check if nitrate-based fertilizer is involved;
     » Plan of storage area and materials present, if available;
     » Fertilizers: storage location, quantity, type, bulk or bagged, Safety Data Sheets, transport documents, etc. ;
     » Assess relevant factors: consider the percentage of AN in the products, the nature of other ingredients, data on explosion hazard from SDS, etc. ;
     » Where fertilizers contain <50% ammonium nitrate or potassium nitrate, the risk of explosion is judged to be negligible;
     » Experience also shows that adding materials such as calcium carbonate,

dolomite and those which improve product quality also have explosion mitigating effects;
  - » Check for combustible materials: locations, quantity, type e.g. oils, packaging, pallets.

→ Assess if fertilizer itself is affected. Signs or indicators include:
  - » Fire in direct contact with fertilizer materials;
  - » Fertilizer affected by significant thermal radiation or hot gases (i.e. significant heating);
  - » Fertilizer is contaminated with combustible or organic materials e.g. oils.

→ Determine if the fire is intense and established on the basis of
  - » The amount of combustible material involved;
  - » The duration of the fire. Prolonged fire can give rise to substantial melting or generation of toxic gases.

6. INCIDENT RESPONSE

- **Decomposition only**

  - If a minor decomposition is taking place, direct substantial quantities of water on the seat of the decomposition. If safe to do so, try to remove the decomposing material from the main heap.
  - Tackle a major decomposition of fertilizer with the effective application of water, preferably with high pressure water jets directed at the seat of the decomposition. This can be effectively achieved with the use of special lances such as Victor lances *(see Appendix 1 for details)*. This is particularly important in the case of fertilizers that are capable of self-sustaining decomposition.

- **Fire incidents**

→ Fertilizer not involved in the fire

Fires where the fertilizer itself is not directly involved may be extinguished by means of normal firefighting practices, e.g. water, chemical extinguishers, foam or sand. This could include fires on equipment or ancillary materials e.g. rags, pallets, rubbish and oil/lubrication in a mechanical shovel.

For an incident with a truck, where the tractor unit is not involved in the fire, recommend decoupling the trailer and removing the tractor unit (with fuel, tyres etc.) from the location if safe to do so.

→ Fertilizer involved in the fire

» Avoid breathing the fumes; they can be toxic;

» Keep spectators away from the scene;

» Keep all personnel not involved in fire-fighting away from the scene of the fire and in particular, keep people away from the fumes;

» Provided it can be done safely and it does not accelerate the burning of combustible materials, ensure maximum ventilation as quickly as practicable by opening all doors, windows and roof vents ; as far as possible, this should be done from outside the building;

» If not already done in the initial assessment, inform the fire responders on their arrival of the types of fertilizers that are involved particularly if AN-based fertilizers are present and that self-contained breathing apparatus may be required. Provide Safety Data Sheets of the products involved;

» If nitrate-based fertilizers are involved, use plenty of water to intervene. Do not use chemical extinguishers, foam or sand; attempts to smother a fire by these means are useless and potentially hazardous. In particular, never try to smother the fire with steam;

» Fight the fire from upwind and from outside the buildings, if possible. Use self-contained breathing apparatus when entering fumes;

» Protect drains by suitable materials, e.g. sand, to prevent molten ammonium nitrate entering the drains and reduce the risk of any decomposition of AN taking place in confinement;

» Where combustible material is the source of the fire, extinguish this source as a matter of priority;

» If necessary, keep adjacent fertilizer cool by spraying with water;

» Under severe fire conditions (intense and prolonged):

- The application of water to hot ammonium nitrate may cause eruptions of steam and splashing of the melt;

- Depending on the risk assessment there are two main options:

1) evacuation of the area, or

2) continue normal firefighting.

The following factors contribute to a 'high risk scenario': high concentration of AN in the fertilizers, a classification for transport or storage of the concerned fertilizers, a high level of contamination with incompatible and/or combustible materials. A possible confinement of the fertilizer, e.g. in a solid bulk tanker, could be a contributory factor for a high risk scenario. Factors pointing to a 'low risk scenario' are low concentration of AN in the fertilizers, no classified fertilizers, presence of NPK fertilizers only, a low level of contamination with incompatible and or combustible materials. In the case of a high risk

scenario, evacuation should be considered. In case of a low risk scenario firefighting is the first priority;

- If the initial assessment indicates the possible risk of an explosion, consider evacuation of all personnel. Set up a remote unmanned water deluge, where possible and if safe to do so;

- If a high risk scenario is recognized, consider evacuation of all personnel to a proper distance. Based on experience and depending on various factors, a distance in the order of 300 – 500 meters may be appropriate.

» In a serious emergency situation if supply of fresh water is not available, other readily available water such as sea water or brackish water can be used to extinguish a fire;

» Truck-related incidents are a particular case where additional caution is required – fuel is present which can lead to an intense but localized fire. If considered safe to do so, set up water deluge and move personnel away from the scene;

» In a remote or isolated location, it may be appropriate to avoid any risk to fire-fighters by remaining at a safe distance and allowing the fire to burn out;

» Victor lances were developed to stop decompositions in bulk or bagged fertilizers. The lance usually consists of a nozzle fitted to a tube. A description and drawing of the victor lance are attached;

» During the fire, consider retaining and/or disposing of contaminated water in a proper manner.

7. POST INCIDENT ACTIONS

- Continue supervision until there is no further risk of decomposition or recurrence of the fire.
- Affected bagged stacks should be dismantled to ensure hot spots are identified and dealt with.
- Where necessary, advise the relevant local and/or water authority if water contaminated with fertilizer has entered watercourses etc.
- After the fire, clean up the area efficiently under the supervision of a competent person. Dispose of damaged or contaminated fertilizer in a safe manner.

8. FIRST AID PROCEDURES

Any person who has possibly inhaled oxides of nitrogen or ammonia gas must be removed from the fumes, made to lie down in shade, kept warm and made to rest even though no symptoms may be evident. Seek immediate medical help and keep the affected person under medical supervision for at least 48 hours. Consult the Safety Data Sheet.

9. PAST INCIDENTS

A number of incidents have occurred with these fertilizers over the years; selected examples are described in Appendix 2 to bring out learning points by illustrating various factors which can play a part in the development and control of the incident.

ANNEXES

1. Victor Lances
2. Incident examples for fire fighting guidance

ANNEX 1

VICTOR LANCES

The Victor lance was developed by Gewerkschaft Victor and is especially useful to extinguish decompositions in small quantities of a few hundred tonnes or in piles of bagged fertilizers. The lance consists of a nozzle (see diagram) fitted to a tube of 3m length and a diameter of 25mm. If necessary this lance can be lengthened by connecting other 3m pieces with the aid of screw couplings. At a water pressure of 8 bars this nozzle has a water capacity of about 280 l/min. The lance is easy to handle and pierces through the fertilizer very quickly to reach the heart of the decomposition, even if the product is caked. Furthermore, extinguishing can be achieved with less water compared to a normal nozzle or spray.

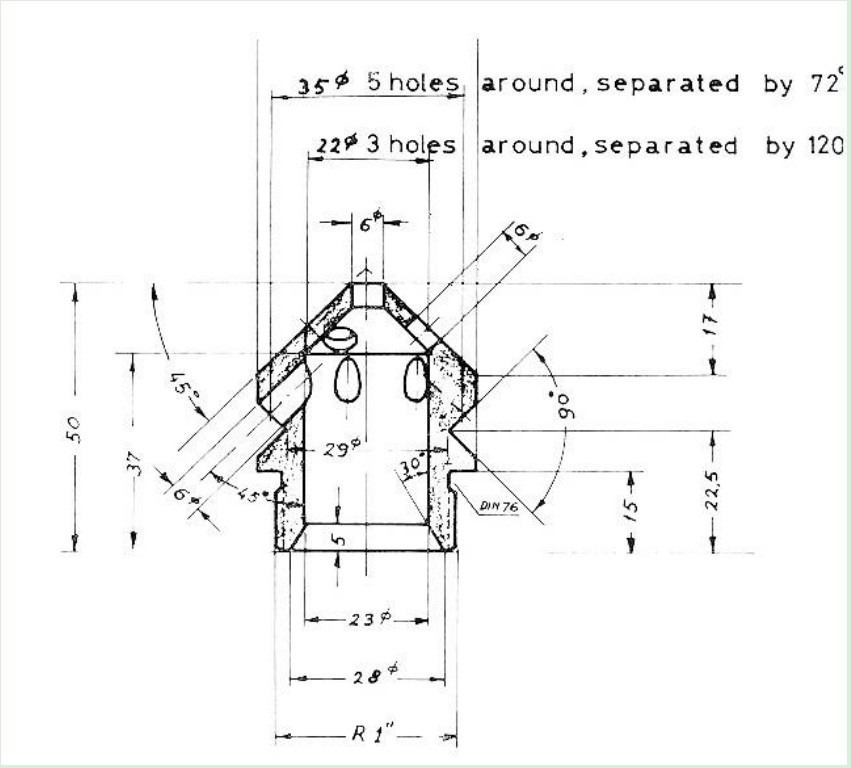

Diagram of Nozzle of Victor lance with dimensions in mm

product stewardship fertilizers

INCIDENTS EXAMPLES FOR FIRE FIGHTING GUIDANCE

Date and Place/Town/ Country where it happened
1.12.1978, a fertilizer warehouse, Londonderry, Northern Ireland, UK
Products involved
CAN and various compound fertilizers (NPK's, none capable of self-sustaining decomposition).
Activity: Storage or Transport-road / rail / sea
Storage
Incident type: Fire, explosion or decomposition
Fire and decomposition, caused by incendiary devices which were planted by terrorists.
Description of incident: events
A total of 4800 tonnes of various fertilizers on shrink-wrapped pallets. In addition, the store contained a wide range of agricultural chemicals, animal feeds, seeds, peat, paints and food items including sugar. These were not adequately separated from fertilizers. The incident started around mid-day on 1 December and lasted four days. Fumes were released over this period.
Consequences: fatalities, injuries, evacuation etc.
No personal injury or fatality. Main local roads remained closed for 4 days.
Actions by Fire fighters and emergency services
Some delay initially due to the risk from planted devices. Subsequently most efforts focused on hosing the fertilizer stock. The combustible materials kept the fire going. A change in the tactic on the fourth day: water application on the combustible materials started to bring the fire under control.
Cause(s) of the incident (if known)
Devices planted by terrorists.
Comments, direct learning points and wider industry recommendations
Do not store combustible materials in the same building or where they can contaminate or affect the fertilizer in the event of a fire. Always keep explosives and sources of ignition well away from fertilizers. Bearing in mind fertilizers are not combustible, focus firefighting efforts on the sources of fire (e.g. combustible materials, pallets and farm produce) or decomposition. If combustible materials are present and are on fire; they need to be attacked as a priority to stop them from affecting fertilizers.

Date and Place/Town/ Country where it happened
17.01.1973, Cherokee Nitrogen Company's bulk storage, Pryor, Oklahoma, USA.
Products involved
Ammonium Nitrate-fertilizer grade, containing an internal additive and an external coating.
Activity: Storage or Transport-road / rail / sea
Storage and dispatch.
Incident type: Fire, explosion or decomposition
Fire followed by an explosion.
Description of incident: events
A fire was observed in a conveyor belt area a short time after 7.20pm. It spread quickly to product conveyor housing and then through the upper part of the west end of the warehouse. Wood was widely used in its construction. Fire-fighting efforts by plant personnel were adversely affected by smoke and inadequate water supply pressure. The fire could not be controlled. The local fire brigade came, but before they could set up an effective system, an explosion took place; it was reported that a small explosion occurred which was soon followed by a major explosion. This was about half an hour after the fire was reported. The explosion was apparently centered near the forward portion of the motor of the front-end loader. A shallow long crater was formed, confined entirely to the work aisle. This appears to have been the result of packed AN in this area, which may have been contaminated by hydraulic oil. It is estimated that a few tonnes of the AN detonated. It is significant to note that the main pile of 14,000 tonnes was not affected.
Consequences: fatalities, injuries, evacuation etc.
No major injuries or fatalities.
Actions by Fire fighters and emergency services
Plant personnel tried to control the spread of fire using hoses but were not effective due to the severity of the fire and inadequate water supply pressure. Local fire brigade was unable to act due to the intervention by the explosion.

Cause(s) of the incident (if known)
The source of ignition of the fire is not known. It is speculated that a seized roller was heated sufficiently by friction of the moving belt to cause ignition when the belt was stopped. Another likely cause may have been the leakage of fuel from the front loader and its ignition by exhaust fumes. The fire engulfed the pay-loader which may have then become the centre of the explosion, involving the transmission or a propane aluminium fuel cylinder. This could have triggered a detonation in the molten AN formed around and possibly contaminated.
Comments, direct learning points and wider industry recommendations
Maintain adequate fire-fighting equipment, it should be easily accessible and ready for use. Water supply should be adequate. Good housekeeping to avoid leakage of oils and sources of ignition. Do not leave unattended vehicles in close proximity to stored AN. A few tones of AN which got contaminated and detonated did not cause detonation of the nearby main bulk uncontaminated AN.

Date and Place/Town/ Country where it happened
14.10.1982, Cory's warehouse, Ipswich, United Kingdom.
Products involved
Ammonium nitrate-fertilize grade, compound fertilizers, including some self-sustaining decomposition (SSD) type and potassium nitrate, all bagged.
Activity: Storage or Transport-road / rail / sea
Storage
Incident type: Fire, explosion or decomposition
Fire.
Description of incident: events
The warehouse building was a single story structure of steel, sheeted with corrugated iron. The roof was of corrugated iron sheet, asbestos cement and wired glass. It contained a total of 10700 tonnes of fertilizer products: approx. 3600 tonnes of ammonium nitrate-fertilizer grade and compound fertilizers which included 165 tonnes SSD type NPK. Various other items were also stored: 187 tonnes of charcoal in hessian bags, large quantities of wooden clothes pegs and garden furniture. These were distributed about the warehouse between stacks of fertilizers. Maintenance work involving welding was being carried out, when the fire started. The fire was brought under control after about six hours. Dense clouds of smoke evolved and were blown over the housing estate. A series of deflagrations (rapid combustion, low order explosions) were heard, considered to have resulted from mixtures of potassium nitrate and charcoal. There were no blast effects or crater formation. No explosion involving AN.
Consequences: fatalities, injuries, evacuation etc.
No fatalities or serious injuries. Several hundred residents were evacuated. Considerable fire damage to the warehouse.
Actions by Fire fighters and emergency services
The fire brigade arrived within 10 minutes of the first signs of fire. With 20 appliances they fought the fire and brought it under control.
Cause(s) of the incident (if known)
The cause of the fire was not definitely established. However it was concluded that the probable cause was a spark or conducted heat from welding work that was being carried out.

Comments, direct learning points and wider industry recommendations
Do not store combustible materials in the same building or where they can contaminate or affect the fertilizer in the event of a fire. Control source of ignition or initiation of fire. Take particular care and precautions when doing hot work e.g. welding near stored fertilizer.

Date and Place/Town/ Country where it happened
29.10.1987, a warehouse in the port area, Nantes, France
Products involved
Ammonium nitrate-fertilizer grade 750 tonnes, NPK fertilizers capable of self-sustaining decomposition (SSD) 1450 tonnes and urea 200 tonnes
Activity: Storage or Transport-road / rail / sea
Import and Storage.
Incident type: Fire, explosion or decomposition
Decomposition and subsequent fire.
Description of incident: events
The storage building was constructed from non-combustible materials: bricks, steel frame and asbestos sheeting roof. Fertilizers were stored in bulk in a number of bays. The shipment came from abroad; the main fertilizer 15:8:22 remained on the ship for a while before off-loading due to a strike. It is suspected that the fertilizers were contaminated by the ship's previous cargo, grain. Also, the fertilizer was discharged on a bed of sawdust to dry up the ground of the cell/bay that may have contaminated the fertilizer. Some hours after the discharge, fumes were seen coming from the bay holding 15:8:22. Attempts by workers to attack the beginning of fire by means of fire extinguishers with powder did not succeed. The fire brigade were called in, who on checking the store inventory were more concerned about AN and focused on hosing the AN bay, which was separated from the decomposing NPK by two empty bays. The hot gases ignited wooden pallets which were kept in front of the 15:8:22 bay. As the fume release escalated it became necessary to break the roof sheeting and sections of the wall to allow water hosing. The fumes stopped around 10 hours later. Hardly any NPK fertilizer was found left in bays after the incident, lost due to decomposition and washed away by fire water.
Consequences: fatalities, injuries, evacuation etc.
More than 38,000 local residents were evacuated. No fatalities or injuries.
Actions by Fire fighters and emergency services
Application of water by hoses mainly to AN. Concerns about contamination of river Loire. Roof sheeting broken to get access for hosing.

Cause(s) of the incident (if known)
The cause of the fire was not definitely established. However it was concluded that the probable cause was a spark or conducted heat from welding work that was being carried out.
Comments, direct learning points and wider industry recommendations
Do not store combustible materials in the same building or where they can contaminate or affect the fertilizer in the event of a fire. Call fire brigade immediately. Focus firefighting efforts on the source of decomposition or fire (e.g. combustible materials, pallets and farm produce). NPK fertilizer, particularly the self-sustaining type, presents higher decomposition hazard than AN.

Date and Place/Town/ Country where it happened
26.01.2002, a fertilizer warehouse, Cartagena, Spain.
Products involved
Compound fertilizer, NPK 15-15-15.
Activity: Storage or Transport-road / rail / sea
Storage
Incident type: Fire, explosion or decomposition
Decomposition.
Description of incident: events
Decomposition occurred in a 15,000 tonnes heap of NPK 15-15-15 in a warehouse, which lasted 4 days. White smoke was seen coming from the chimney in the morning. Workers tried to find the decomposition focus and took out 250 tonnes of product. About 2 hours later, Cartagena fire brigade came and attempted to go inside to control but could not. In the afternoon a helicopter arrived fitted with a thermograph camera. Only in the North wall some slight hot points were found. The fire brigade destroyed part of the North wall to get better access to the decomposing fertilizer. The next day several holes were opened in the East wall to improve the water access to the pile. The road to the town was closed and companies in the area were evacuated. Hot molten product began to come out of the Western door. Workers began to build a sand reservoir to avoid discharge to the sea. Over the next three days more reservoirs were built, more windows were opened and a bulldozer provided with caterpillars was used to remove the product and to mix it with water in the warehouse. Finally the decomposition was stopped with more water application. During the incident white fumes were released consisting mainly of water vapour, N_2 and ppm levels of Cl_2, NH_3 and HCl. The fertilizer was classified as not capable of self-sustaining decomposition (SSD) i.e. type C according to the through test procedure. Contamination of the product in the warehouse was very unlikely. The source of initiation was possibly heat input due to an electric fault.

Consequences: fatalities, injuries, evacuation etc.
No fatalities or injuries. Evacuation of local company employees.
Actions by Fire fighters and emergency services
Used water to control decomposition.
Cause(s) of the incident (if known)
Suspect an electrical fault
Comments, direct learning points and wider industry recommendations
Control sources of ignition or heat by good maintenance and housekeeping to protect bulk heaps of fertilizer. Decomposition in large bulk heaps may not be self-extinguishing; application of large quantities of water with special (Victor) lances can be effective.

Date and Place/Town/ Country where it happened
26.09.2002, Montoir de Bretagne, France.
Products involved
Compound fertilizer 15-12-24, capable of self-sustaining decompoistion (Class 9, UN2071)
Activity: Storage or Transport-road /rail / sea
Sea transport, during loading of 3000 tonnes.
Incident type: Fire, explosion or decomposition
Decomposition
Description of incident: events
The loading started early morning when due to the darkness the lights in the hold number 1, where the cargo was being loaded, were switched on. After about seven and half hours when 2614 tonnes were loaded, smoke was seen coming from a manhole on tween decks in the stem part of the hold. Loading was stopped and the ship's electrician switched off the fuses. About 30 minutes later, the Master of the ship started the fire alarm and called the fire brigade and port authorities. The crew began to close the hatches, after releasing the very heavy smoke. After another 30 minutes the fire brigade went on board and started to spray water into the vessel from a jetty. Fire brigade proposed to fill ship's hold with water. Following discussion and consultation with the fertilizer producer, a first Victor lance was applied, injecting water directly inside the decomposing load. Later a second Victor lance was similarly applied. After another hour or so a fire tug was put in action followed by water injection onto the load. Successful application of the Victor lances into the seat of decomposition resulted in cessation of projections of particles on the surface and subsidence of the decomposition cloud. After an hour or so the fire tug stopped spraying water into the cargo and the fire brigade took over spraying from mast house. A few hours later the water spraying was stopped as the decomposition had stopped.
Consequences: fatalities, injuries, evacuation etc.
No injuries or fatalities, no evacuation. No water pollution. Approximately 80 to 100 tonnes of the fertilizer decomposed and the rest of the cargo was damaged by water.

Actions by Fire fighters and emergency services
Water was injected using victor lances and sprayed.
Cause(s) of the incident (if known)
The decomposition was initiated by a heat source, most probably an electrical light bulb. The shipmaster had received the information by safety data sheet that it was a classified fertilizer, UN 2071; he hadn't done preparations according to IMO-rules e.g. check heat sources and disconnect electrical fuses.
Comments, direct learning points and wider industry recommendations
Heat sources must be avoided under all circumstances Use of Victor lances is a very effective means of intervention in case of decomposition with NPK type fertilizers.

Date and Place/Town/ Country where it happened
2.10.2003, farm storage, Saint Romain en Jarez, Loire 42 in central France.
Products involved
Ammonium nitrate-fertilizer grade.
Activity: Storage or Transport-road /rail / sea
Storage
Incident type: Fire, explosion or decomposition
Fire followed by an explosion.
Description of incident: events
A fire occurred in a storage building on a farm. As the firemen were fighting the fire about 45 minutes to 1 hour later an explosion took place destroying the building and injuring several firemen. When the accident occurred, the barn's ground floor contained: between 3 and 5 tonnes of ammonium nitrate packaged in big-bags, 6,000 to 7,000 plastic crates, 500 kg of calcium oxide (quicklime), 500 wooden crates, a gasoline-powered forklift, a battery charger, two 13-kg gas bottles and miscellaneous farm machinery. Bales of hay and straw were stored on the intermediate floor, where the fire broke out. Alerted by the smell and emanating smoke, the farmer unsuccessfully tried to put out the fire using an extinguisher. Fire-fighters were notified and on arrival they had to battle an extremely violent barn blaze. The crew set out to extinguish the main source of combustion, with the aim of saving the adjoining house using 4 variable-rate nozzles, the team quickly faced water supply interruptions. The captain called for a "water supply backup". Once the house was out of danger, fire-fighters turned to two variable-rate nozzles in order to protect the flat that was still intact on the barn's first floor. After approximately 50 minutes, with a large portion of the barn roof already collapsed and the fire source having lost intensity, a hissing sound was heard followed by an explosion. As the fire-fighting equipment onsite was destroyed, the rescue team had to set up 5 new variable-rate nozzles and eventually had the fire contained. Since the hose streams were not able to reach the heart of the fire source, it took another several days before all of the residual fire outbreaks could be completely extinguished.

Consequences: fatalities, injuries, evacuation etc.
26 people injured, including 18 fire-fighters, 9 of whom seriously. The barn was totally destroyed; and many neighbouring village buildings, within a radius extending several hundreds of metres, sustained varying degrees of damage. Local residents evacuated.
Actions by Fire fighters and emergency services
Fought the fire using water nozzles. It seems that the fire-fighters had not been forewarned about the potential dangers of ammonium nitrate.
Cause(s) of the incident (if known)
The most plausible explanation is a burst light bulb that apparently had been left on.
Comments, direct learning points and wider industry recommendations
Do not store combustible and incompatible materials in the same building or where they can contaminate or affect the fertilizer in the event of a fire. Make firefighters aware of the presence of ammonium nitrate. Train firefighters in the hazards of ammonium nitrate fertilizers. Park vehicles at safe distances from fertilizers. A smoke detector coupled with an alarm can help reduce the detection period. The storage should be equipped regarding fire fighting.

product stewardship
fertilizers

Product Stewardship is defined as "the management of the safety, health and environmental aspects of a product throughout its lifecycle in an ethically responsible way". It is Responsible Care as applied to products. In our application of Product Stewardship we cover the total value chain, but also address additional issues such as Best Practices that are not necessarily just dealing with the product characteristics.

The Product Stewardship Program covers mineral fertilizers, their raw materials and intermediate products.

www.productstewardship.eu

fertilizers europe

Avenue E. van Nieuwenhuyse 4/6
B-1160, Brussels, Bélgica
Tel: +32 2 675 3550
Fax: +32 2 675 3961
main@fertilizerseurope.com

www.fertilizerseurope.com

twitter.com/FertilizersEuro
www.youtube.com/fertilizerseurope
www.facebook.com/fertilizerseuropepage
Group Fertilizers Europe