Safety Aspects

Your guide to safe storage, handling and use of technical grade ammonium nitrate
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Ammonium nitrate is primarily used as a fertilizer, but also used as a blasting agent when mixed with fuel oil (ANFO). Generally, the risk associated with the production, distribution and use of pure ammonium nitrate (AN) is low. However the hazardous properties of AN can give rise to a decomposition with release of toxic fumes or detonation as the worst case under very specific conditions.

AN is classified as an oxidising agent Class 5.1 (UN No. 1942 for technical grade and UN No. 2067 for fertilizer grade). Being an oxidiser, AN will support the burning of organic matter. Technical grade AN is used extensively to support the “fast” burning required in explosives.

Pure AN is a colourless, water soluble, crystalline substance. Decomposition starts at 210 degrees C. Technical grade AN is supplied as a porous material in prilled form, with a density in range 700–800 g/litre. It may start to decompose at lower temperatures than for pure AN due to chemical additives. Decomposition of AN takes place through several reactions:

• in early stage sublimation to ammonia and nitric acid dominates.
• at slightly higher temperature, nitrous oxide (N2O) is the main decomposition product.
• above 260 degrees C toxic nitrogen oxide gases (NOx) are formed in considerable amounts.

This brochure forms part of our contribution to reduce risks when handling ammonium nitrate. In it we have summarized our knowledge and the key factors for safe handling, storage and use of ammonium nitrate in the explosive industries. Local and national legal requirements should be checked and must always be complied with.

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Whatever the quantity you store, the principles of good and safe storage is important to ensure that the quality is maintained right up to the point of use. Ammonium nitrate (AN) is readily soluble in water and has a crystal transition point of 32 degrees C. Both of these properties have influence on suitable storage conditions. It is desirable that storage temperature should be kept below 32 degrees C. It should be noted that if the product is cycled through 32 degrees C several times the prill structure of the AN-material will break down.

- Store well away from other chemicals, fuel oil, metal powder and combustible materials – also separate the storage from off-spec product, explosives, explosive manufacturing or blasting operations.
- Wherever possible, store the bags covered on a smooth level surface in a suitable building made of non-flammable materials. Inside the building, stacks should be at least 1 m away from walls, eaves and beams. Avoid lamps hanging directly above the stacks or secure the lamps from falling down with an extra chain.
- Even if the risk associated with the storage and handling of AN is very low, the hazardous properties can in certain situations as a big fire give rise to a decomposition or detonation as worst case. To minimise the consequences in a worst case scenario, the amount of AN in each stack should be limited based on the storage location and the distance to “sensitive” locations such as residential areas, main roads etc in the vicinity. The amount can be calculated by using a model developed for Yara by the Dutch Research institute TNO (see figure next page).
- The separation distance between stacks for preventing sympathetic detonation is depending on the sensitivity of AN and the configuration of the stack of bags. As an example it should be at least 7-9 m for AN with density of 0.8 (kg/l) if you store the bags in “bulk-wise “ configuration like the picture on next page.
- If bags have to be stored outside, then the bags should be placed on a drained and clean area and covered to protect from sunshine or heavy rain. In countries with hot climate be aware of the risk for high temperatures underneath the covering. If possible choose a north-facing site to minimise direct sunlight.
- Make sure there is no source of ignition in the store. No vehicle parking inside the storage or close to an outside located stack.
- “No smoking” signs must be clearly and visible at all entrances. Make sure all electric equipments are in good and approved conditions.
- Avoid draining system in all areas, inside as well as outside, where product or molten concentrate can deposit, in an event of fire.
- Keep storage buildings well secured by locking and visible signs, to prevent unauthorised access.
- Follow a good house-keeping standard. Pick-up spills and keep storage areas and equipment clean in order to prevent contamination of product.
- Make sure there is a valid Safety Data Sheet available at store site.
- Keep records of the amount of product in store and follow a first-in, first-out principle. Report immediately any loss of product to relevant authority.
- Sufficient supply of fire fighting water and fire hydrants must be readily available in the vicinity of the storage. Inspect all equipment regularly. Ask the local fire-brigade for advice and keep them well informed regarding your facilities on site.
Safe stacking

- To minimise the consequences in a worst-case scenario, the amount in each stack should be limited.
- The amount can be calculated by using a model developed for Yara by the Dutch Research Institute TNO. In this calculation an overall TNT equivalence of 0.20 has been used for technical ammonium nitrate (TAN).
- In many risk evaluations, an overpressure of 14 kPa (140 mbars) is the maximum acceptable level at public roads, residential areas etc. Statistically this overpressure will result in a lethality of 1%. The curve below can be used to calculate the required distance between a stack of TAN and residential areas. The chart is only intended as guideline and local regulations/legislation might require different distances.
- Do not stack more than three bags in height.
- For good stability, one bag should form a “bridge” over the two bags below.
- The floor or ground must be dry and clean. A good advice is to use a fibre cloth between the bags and the ground in case of storing outside on gravel.
- To minimise the separation distance between the stacks to 7-9 m for TAN with a density of 0.8 kg/l bags should be stored in “bulk-wise” configuration, (see picture below).

![Amount of TAN vs distance for pressure of 14 kPa](image)

*“Bulk-wise” configuration of a stack with 3 layers. Notice that each layer starts at 1.5 bag for the layer underneath.*
Handling and moving product around the site

When handled correctly, ammonium nitrate (AN) is safe. It is non-toxic and can not burn or explode spontaneously. If exposed to heat or fire, AN will decompose and release toxic fumes. If heated up under confined conditions, AN may detonate.

When handling and transporting AN around the site notice the following:

• Avoid contamination by combustible materials such as diesel oil or grease, and by chemicals of any kind.
• Do not weld or apply heat to equipment which may have contained AN without first washing thoroughly.
• Ensure transport equipment is clean before loading and do not transport AN together with combustible material or explosives.
• All vehicles should be checked regularly for any fuel or oil leaks as this can be mixed with ammonium nitrate.
• Avoid unnecessary exposure to the air to prevent moisture pick up.
• When using fork lift for big bags:
  – avoid using the fork directly into the loop – the bags can slide on the fork generating friction heat which will damage the material in the loop.
  – use a hook mounted on the fork or tubes properly secured so they cannot slide off the forks.
  – drive slowly and smoothly especially when travelling over rough ground.
• For safety reasons, it is recommended to use big bags since they can be easily handled mechanically. Where palletised small bags are used, retain the pallets and use suitable lifting equipment.
• Accumulated deposits of contaminated dust, particularly with organic materials will increase the risk for decomposition and fire-hazard.
• Contaminated or deteriorated product shall be handle in appropriate way. Separate them from conforming product and keep records of it. Certain inert materials can be used to render safe potentially hazardous materials. Recommended inert materials for mixing include: limestone, dolomite, magnesite, clay, gypsum, phosphate-rock, sand or calcium-sulphate-anhydrite. Mix with inert material in ratio 1:1. Guidance for handling of non-conforming or off-spec materials are given in EFMA guidance document published by EFMA 2004.
Safe use

When handling ammonium nitrate (AN) in bags:

- Make sure the operators are well trained and competent in handling the product.
- Never position yourself directly underneath a lifted big bag or pallet.
- When emptying the bag, ensure the operator stand well back from the load and slash from the bottom using a knife with a long shaft. However, it is even more safe to install fixed knives on the top of the hopper.
- Ensure that the bags are properly emptied. Dispose of the empty bags according to local regulations. In some countries there is a system for recycling bags. Alternatively, the bags can be disposed of by high temperature incineration.

When using ammonium nitrate (AN) for production of explosives*:

- When producing ANFO, make sure to add sufficient amount of fuel to the prills in order to achieve a mixture which is close to oxygen balance. Deviations decreases the available energy output and increases the amount of toxic gases produced upon detonation.
- Mixers and hoses should be constructed to avoid the build up of static potential.
- It is of particular significance to clean all equipment used for handling AN before hot work (welding etc).
- No copper, copper alloys or zinc shall be used for any part with which the product may come into contact.
- Because of the corrosive nature of AN, care should be taken in the choice of materials (e.g stainless steel) of construction.
- The loading and mixing equipment should be thoroughly cleaned after use. Loose material should be collected in suitable receptacles for disposal. Cleaning before maintenance work should be rigorous.
- All spillage of AN, fuel oil or ANFO should be collected in a suitably labelled container and steps taken to avoid contamination of any water course.

* Reference is made to “Code of good practice for the transportation, storage, mixing and handling of ammoniumnitrate and ANFO”; Federation of European explosives manufacturers; Publication No. 27
Personal safety

When handling ammonium nitrate:

• Wear dust mask and safety goggles in case dust is generated when handling the product.
• Wear gloves when handling AN to prevent skin irritation. Always wear gloves and suitable protective clothing when handling ANFO.
• Eye wash solution and washing facilities should be available in working areas.

First aid after fire or decomposition of product:

• Remember that toxic fumes (NOx) can be released from AN in case of fire or contact with hot equipment.
• Gasmasks should be available at sites where the risk for decomposition is obvious.
• If someone inhales the fumes, move the person away to a safe place, let the person rest and keep him/her warm, and call for a doctor. Inform the doctor of the nature of the exposure and provide a copy of the Safety Data Sheet. Note that symptoms after inhalation may be delayed for up to 48 hours.
• Molten material in contact with skin will cause burns. Wash with large amounts of cold water and seek medical assistance.
What to do in an emergency

Be prepared:
- Have a documented emergency contingency plan.
- Make sure that people know what to do in case of an emergency.
- Train regularly on emergency situations, such as a fire, an injury, or dealing with spillages.
- Establish well known and displayed meeting places which can be used in case of evacuation. Should be located at safe distances and in different directions from the storage.

First Aid:
- If products come into contact with the skin, wash the affected area with soap and water.
- If ammonium nitrate gets into eyes, wash with large amounts of eye wash solution or water. If symptoms persist, obtain medical advice.
- If ammonium nitrate is ingested do not induce vomiting. Give the person milk or water to drink and obtain medical assistance.
- If fumes are inhaled, remove the person(s) from the exposed area, keep the person(s) warm and at rest, and seek medical advice.

Fire or Decomposition:
- Call the fire brigade and inform them immediately what materials are involved.
- Evacuate the area exposed to toxic fumes and all people not involved in emergency duties.
- Avoid breathing fumes. Wear an approved breathing mask.
- Open up doors and windows to provide maximum ventilation.
- If safe to do so, find the source of the fire and try to control it.
- For extinguishing a decomposition of AN, use plenty of water. DO NOT use chemicals, foam, steam or sand.
- Prevent molten product and polluted water from entering drains.
- Inform the appropriate environmental agency if there is a risk for water pollution.
- Always be aware of the risk of detonation. In case of a severe fire involving AN, and/or AN in confined space, evacuate the area until the fire stops by itself.
What is on the labels?

On the bags we have printed labels according to the regulations together with a range of other useful information.
Ammonium Nitrate
Porous Prills

Produced in Sweden

Risk phrases:
- Kan understödja brand (SE)
- Kan vaere brannforsterkende (NO)
- May intensify fire (GB)
- Saattaa kiihdyttää tulipaloa (FI)
- Peut aggraver in incendie (FR)
- Brandfördernd (DE)
- Puede agravar un incendio; comburente (ES)

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