

Marine Newslink

AUGUST 2022



WITH YOU ALWAYS



Every chemical reaction
has a transition state,
it brings a change.

FEATURE ARTICLE
Ammonium Nitrate

PHOTO(S)
OF THE MONTH

BACK-TO-BASICS
Question & Answer

Ammonium Nitrate and its fertilizer grade

Ammonium nitrate is a white crystalline salt that can be fairly cheaply produced from ammonia and nitric acid. It is soluble and often used as fertilizer, as nitrogen is needed for healthy plant development.

Ammonium nitrate in its pure form is not dangerous. It is, however, heat sensitive. At 32.2 degrees Celsius (89.96 degrees Fahrenheit), ammonium nitrate changes its atomic structure, which in turn changes its chemical properties.

When large quantities of ammonium nitrate are stored in one place, heat is generated. If the amount is sufficiently vast, it can cause the chemical to ignite. Once a temperature of 170 C is reached, ammonium nitrate starts breaking down, emitting nitrous oxide, better known as laughing gas. Any sudden ignition causes ammonium nitrate to decompose directly into water, nitrogen and oxygen, which explains the enormous explosive power of the salt.

hygroscopic as a solid, although it does not form hydrates. It is predominantly used in agriculture as a high-nitrogen fertilizer. Ammonium nitrate fertilizer grade (non hazardous) is an important fertilizer with NPK rating **34-0-0** (34% nitrogen). It is less concentrated than urea (46-0-0), giving ammonium nitrate a slight transportation disadvantage.



Ammonium nitrate has three entries in the DGL: UN1942 AMMONIUM NITRATE with not more than 0.2% total combustible material, including any organic substance, calculated as carbon to the exclusion of any other added substance,

Class 5.1, PG III UN2067 AMMONIUM NITRATE BASED FERTILIZER,

Class 5.1, PG III UN2071 AMMONIUM NITRATE BASED FERTILIZER,

Class 9, PG III UN1942 and UN2067 are Class 5.1 and have almost identical stowage, handling and segregation requirements.

UN2017 is Class 9 and has slightly modified requirements that recognise the different risks of this material.

The global market for ammonium nitrate is expected to be driven by the fertilizer industry. With growing world population, the demand for food has been rising, which in turn raises

WHAT IS AMMONIUM NITRATE?

WHAT IS AMMONIUM NITRATE?

Ammonium nitrate is a crystalline white solid. It's made in large quantities industrially by the reaction of ammonia with concentrated nitric acid.

$$\text{NH}_3 + \text{HNO}_3 \rightarrow \text{NH}_4\text{NO}_3$$

Ammonium nitrate's major use is in fertilizers as a source of nitrogen. It's also used in some explosive mixtures for mining and quarrying as an oxidizing agent.

APPROXIMATE PERCENTAGE USAGE OF AMMONIUM NITRATE

	APPROX. 78%		APPROX. 22%
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AMMONIUM NITRATE EXPLOSIONS

Pure ammonium nitrate does not explode easily and can be handled safely. The risk of explosion increases if it is contaminated with impurities. It decomposes at high temperatures and if confined can explode.

230 °C → DECOMPOSES
260-300 °C → EXPLODES*

*if confined

When ammonium nitrate decomposes, it primarily breaks down into a number of gases: nitrogen, water vapour and oxygen. This rapid release of gas causes an explosion.

$$2 \text{NH}_4\text{NO}_3(s) \rightarrow 2 \text{N}_2(g) + 4 \text{H}_2\text{O}(g) + \text{O}_2(g)$$

Various other reactions occur during decomposition. These make other gases, such as nitrogen dioxide and ammonia. Nitrogen dioxide causes the orange-red colour sometimes seen in smoke from these explosions.

NH_3	NO_2	N_2O
AMMONIA	NITROGEN DIOXIDE	NITROUS OXIDE

Its chemical formula NH_4NO_3 . It is a white crystalline salt consisting of ions of ammonium and nitrate. It is highly soluble in water and

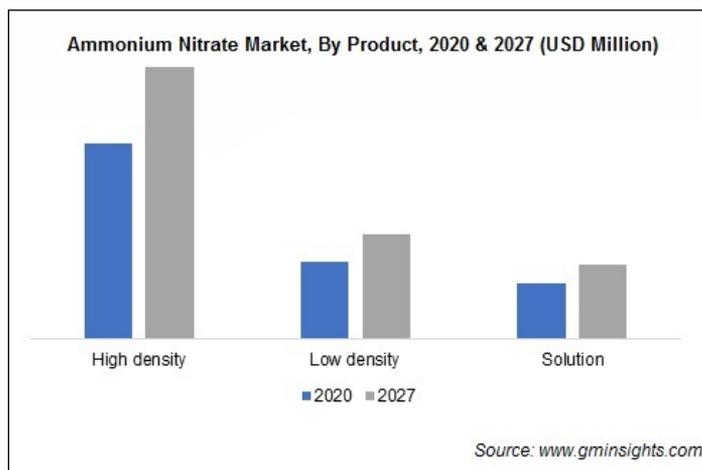
the demand for fertilizers. Ammonium nitrate is a key fertilizer ingredient, and hence, likely to witness increased demand from the fertilizer industry. However, rising prices may hinder market growth in the fertilizer sector. Ammonium nitrate is also used in the manufacture of explosives, making it a useful ingredient in defence, mining, quarrying and construction sectors.

The global ammonium nitrate market is being driven by the growing demand for the product in various industries. Aided by the growing investments to develop improved fertilizers, the market is expected to witness a further growth in the forecast period of 2022-2027, growing at a CAGR of 3.8%.

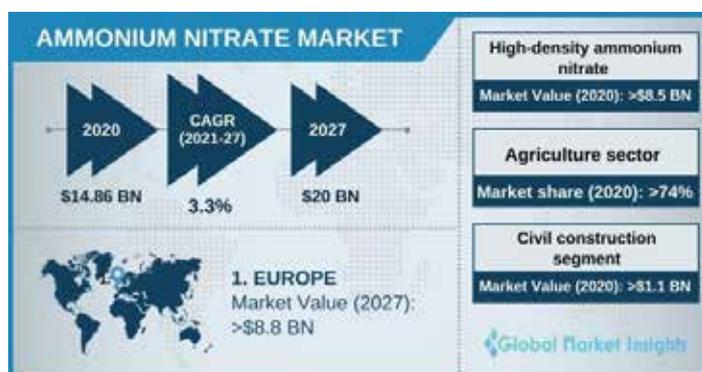
By application, the market is segmented into:

- Fertilisers
- Explosives
- Others

Ammonium nitrate (NH₄NO₃) is manufactured by neutralizing nitric acid (HNO₃) with ammonia (NH₃). Depending on intended use, ammonium nitrate is sold in several forms. Liquid ammonium nitrate may be marketed as fertilizer, while liquid ammonium nitrate may be concentrated to produce an ammonium nitrate "melt" to be used in solids formation processes. Solid ammonium nitrate may be produced as prills, grains, granules, or crystals. According to melt concentration, produced prills could be high or low density. High density crystals, prills, and granules granules are used as fertilizer while grains are employed for the manufacture of explosives. Low density prills can be used in fertilizer as well as explosives. Ammonium nitrate is a fast release fertilizer and enables the plants to quickly absorb nitrate and ammonium ions for immediate metabolism.

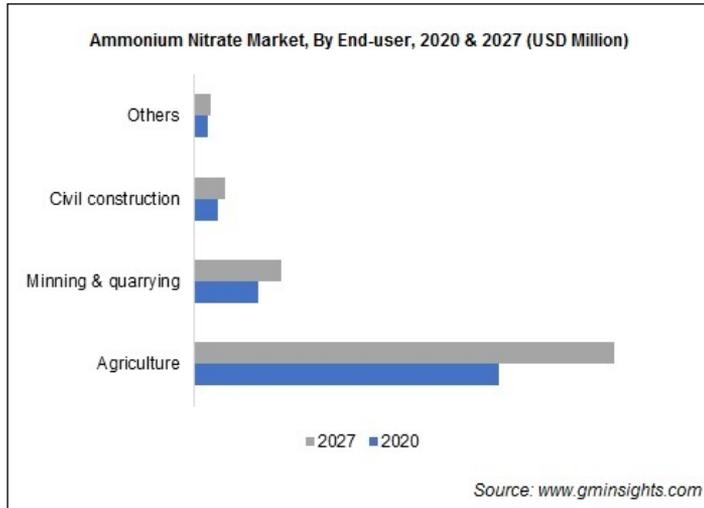


Several mining, quarrying, and construction industries use ammonium nitrate as a vital component of their blasting activities.

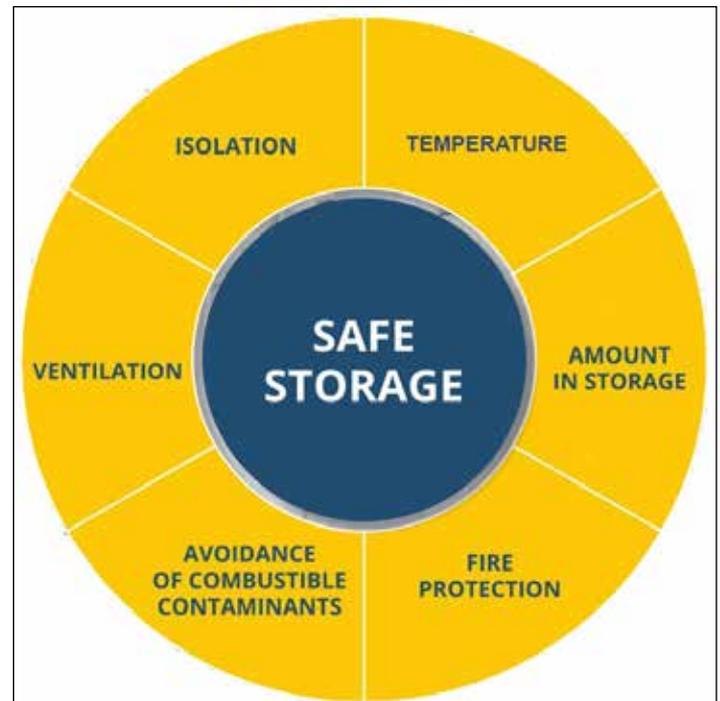


Ammonium nitrate (electronics grade) is used in the electronics industry. Pure forms of ammonium nitrate are used to produce high-quality nitrous oxide (N₂O) to be used in the electronics industry. This, in turn, increases the need for ammonium nitrate. Nitrous oxide is required for VLSI (very large-scale integration) or ULSI (ultra-large-scale integration). It is used in the gas-phase chemical deposition stage in the manufacture of semiconductors, LCD displays and thin-film

oxides for products such as computers, smart phones, robots, cars, health devices, and space rockets.

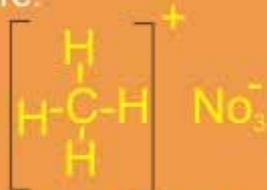


Ammonium nitrate (medical grade) is also a vital component in the healthcare industry. It is a key element in the nitrous oxide gas used in the manufacture of anaesthetics employed in dentistry and surgery, and as a propellant for drugs packaged in aerosols. Other applications of ammonium nitrate include cold packs and food additives.



Ammonium Nitrate

Chemical structure:



Chemical formula: NH_4NO_3 or $\text{N}_2\text{H}_4\text{O}_3$

Molar mass: 80.052 g/mol

Ammonium Nitrate Properties

Physical properties:

- Whitish crystalline solid
- Boiling point of 210°C
- Melting point of 169.6°C
- Density of 1.72 g/ml
- Highly mixable in water

Chemical properties:

- Weak acid, with pH of 5.4
- Attracts moisture from the atmosphere and therefore is hygroscopic
- Highly explosive when in contact with fire

- Ammonium Nitrate based fertilizer (non-hazardous) is described as a Group C cargo in the International Maritime Solid Bulk Cargoes (IMSBC) Code.
- Ammonium Nitrate based fertilizers (non-hazardous), under normal conditions, are stable materials. Under abnormal conditions, however, they can give rise to certain hazards; the main being the enhancement of fire, thermal decomposition with release of toxic fumes and under extreme conditions, explosion.
- The gas clouds produced during the above mentioned accidents were large enough to envelop the ship, and cover the sea area surrounding the ship. The vapour emitted

was highly toxic. Such condition could affect the safe abandonment of the ship and hinder rescue and firefighting efforts. In such events, cargo decomposition may last for multiple days and the temperatures in cargo holds may reach in excess of 500 deg cel.

- The best protection for seafarers is awareness of the decomposition process to allow it to be identified at an early stage. Regular monitoring of the cargo temperature throughout the voyage is crucial to detect beginning of decomposition.
- Any attempt to rescue the vessel / cargo is hampered by the fumes originating from the fire.
- Ammonium nitrate based fertilizer (UN 2071) must only be loaded in clean cargo space which can be opened up in an emergency. When bagged or containerised cargo is loaded the cargo shall be accessible through hatch entries and mechanical ventilation must enable the vessel to exhaust and gasses of fumes generated from decomposition before loading it should be considered that the cargo hatches would need to be opened if there is a fire to provide ventilation and to provide water for fire fighting. Also risk of stability due to flooding of the holds exist. It may be shipped in bags in break bulk and the temperature inside the cargo hold needs to be monitored closely / remotely.

According to the Guidance for sea transport of AMMONIUM NITRATE BASED FERTILIZERS (Ammonium Nitrate Non – Hazardous) by the Organization Fertilizers Europe* , the safety principles are

- avoidance of storage of combustible substances near fertilizers
- avoidance of storage of incompatible substances near fertilizers

- avoidance of cross contamination with remains of previous cargoes
- avoidance of cross contamination of next cargo with fertilizer
- avoidance of sources of heat likely to affect the fertilizer
- avoidance of application of heat (e.g. welding) to any section which may have trapped/confined fertilizer

Recommendations in case of decomposition or fire involving Ammonium Nitrate.

1. Provide maximum ventilation to remove the gases resulting from decomposition. Timely opening of cargo hatches can prevent the build-up of pressure and help cool the cargo, impeding the development of cargo decomposition
2. Wear, as necessary, protective clothing, and self-contained breathing apparatus
3. Application of water is most effective where injection pipes are used to deliver water to hot spots. Water spraying may not be sufficient to control the decomposition
4. Flooding of the cargo space may be considered, giving due consideration to the ship's stability and structural strength
5. The ship's gas firefighting installation should be effective

Risk Mitigation

- A. Insurers and insured need to check that the vessel is suitable in all respects , especially the fire fighting equipment's are in perfect order and structurally the ship is sound.
- B. Insurers / Insured might also call for a ship vetting inspection.
- C. Preferably not to load cargo in hold adjacent to engine room. For long voyages it is a mandatory requirement to stow ammonium nitrate fertilizer out of direct contact with the

metal engine room bulkhead which can be done using wooden board to provide air space between the cargo and bulkhead.

- D. Regular monitoring of cargo temperature is required and the vessel Master is to share regular reports with ship owner and management ashore.
- E. The cargo should be properly disclosed as IMDG and placarded accordingly.



The 192 mtr long Purple Beach was abandoned after the 33,720 DWT vessel caught fire whilst enroute from Immingham to Brake.



M.V. Chesire with cargo of Ammonium Nitrate on fire enroute Norway to Thailand.



Bierut port was completely destroyed.

Disasters due to Ammonium Nitrate explosions.



The powerful blast – in which a stockpile of ammonium nitrate stored in a port warehouse exploded on 4 August 2020 – destroyed 77,000 apartments, wounded 7,000 people, displaced over 300,000 more and least at least 80,000 children homeless.

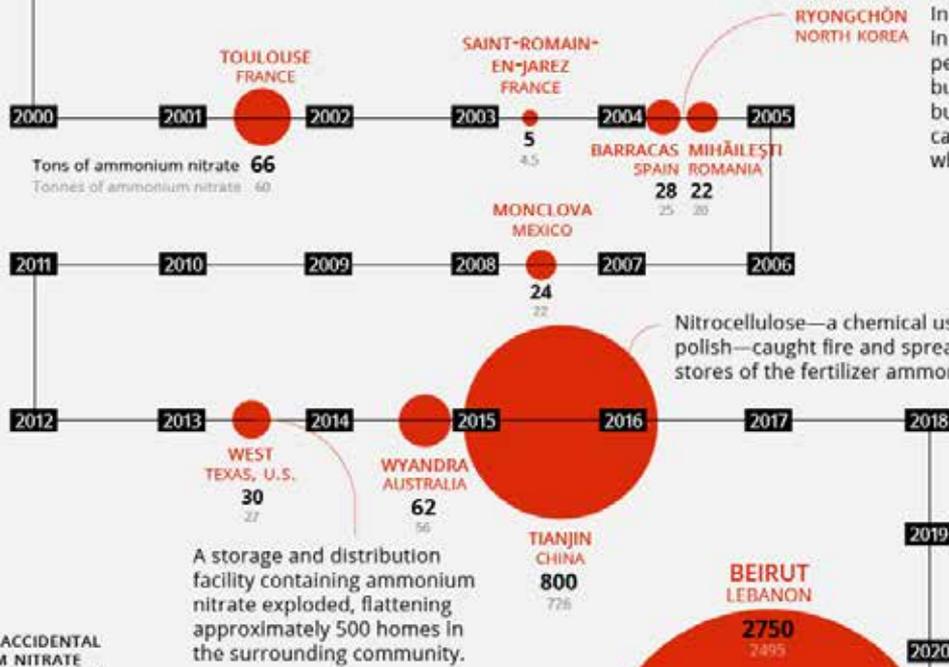
The ammonium nitrate in question was said to have been brought to the Lebanese capital on a freight ship that was impounded for safety reasons in 2013. It had been en route from Georgia to Mozambique. About 2,750 metric tons (3,025 short tons) of the highly explosive chemical was stored at the port since then without the necessary safety precautions in place.

The blast was so powerful that it could be heard in Cyprus, about 200 kilometers (120 miles) to the west, media reported.

20 Years of Ammonium Nitrate Explosions*



Ammonium nitrate is a key ingredient in fertilizer, so it is present in ports around the world. Unfortunately, the oxygen-rich material is a factor in explosions on a regular basis.



In 2004, a massive explosion occurred in the town of Ryongchŏn, killing 160 people and destroying nearly 2000 buildings. Officials released few details, but the explosion was believed to be caused in part by ammonium nitrate which ignited during a train collision.

Nitrocellulose—a chemical used in nail polish—caught fire and spread to illegal stores of the fertilizer ammonium nitrate.

A storage and distribution facility containing ammonium nitrate exploded, flattening approximately 500 homes in the surrounding community.

Damage and debris was reported as far as 2 miles from the blast site.

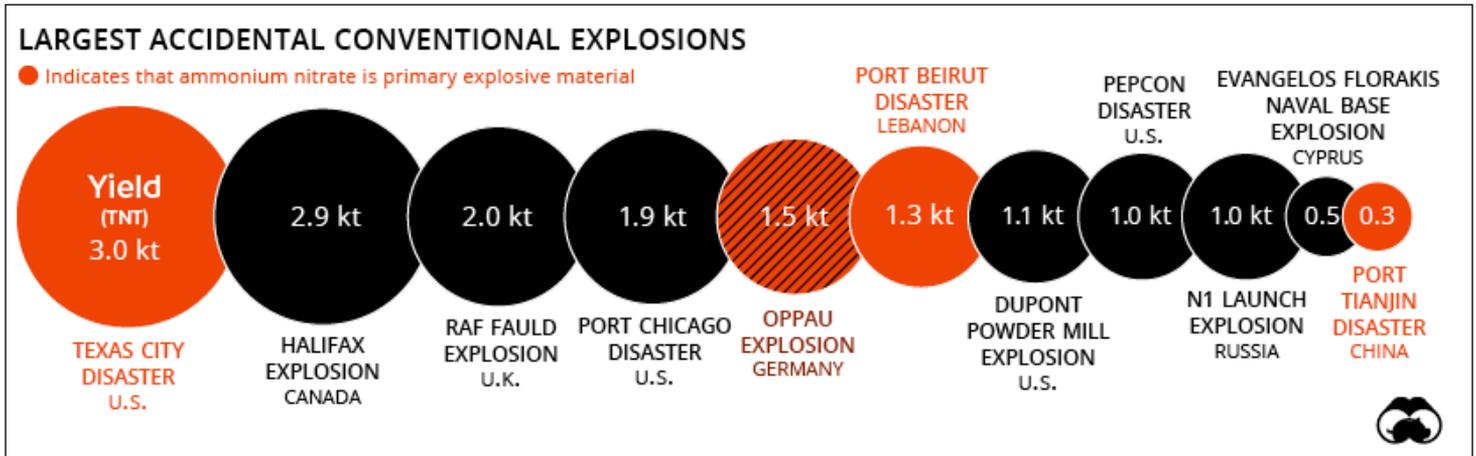
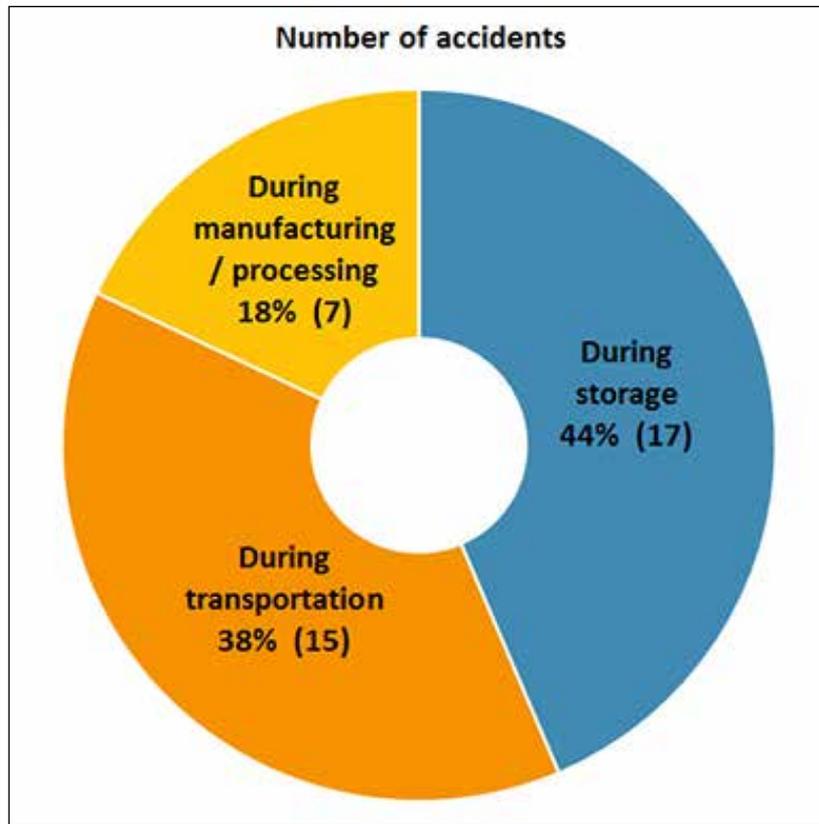
The recent ammonium nitrate-fueled explosion in Lebanon's capital was one of the largest accidental explosions ever recorded. The resulting shock wave ripped through the city's densely populated downtown districts, destroying nearby buildings—including grain silos storing ~85% of the country's grain supply. Over 300,000 people lost their homes.

DEADLIEST ACCIDENTAL AMMONIUM NITRATE EXPLOSIONS IN HISTORY

LOCATION	YEAR	DEATHS
TEXAS CITY U.S.	1947	581
OPPAU GERMANY	1921	561
TESSENDERLO BELGIUM	1942	169
TIANJIN CHINA	2015	165
RYONGCHŎN NORTH KOREA	2004	160*
BEIRUT LEBANON	2020	157**
MONCLOVA MEXICO	2007	57
TOULOUSE FRANCE	2001	30
BREST FRANCE	1947	29
KANSAS CITY U.S.	1988	23

*Best estimate **As of Aug 6, 2020 †Excluding intentional attacks

Sources: Han, Zhe (2016). Thermal Stability Studies of Ammonium Nitrate. Doctoral dissertation, Texas A & M University; Braithwaite, Martin (2008), Ammonium Nitrate – Fertiliser, Oxidiser and Tertiary Explosive. A Review of Ammonium Nitrate Safety Issues based on Incidents, Research and Experience in the Safety Field; The Guardian, government reports.



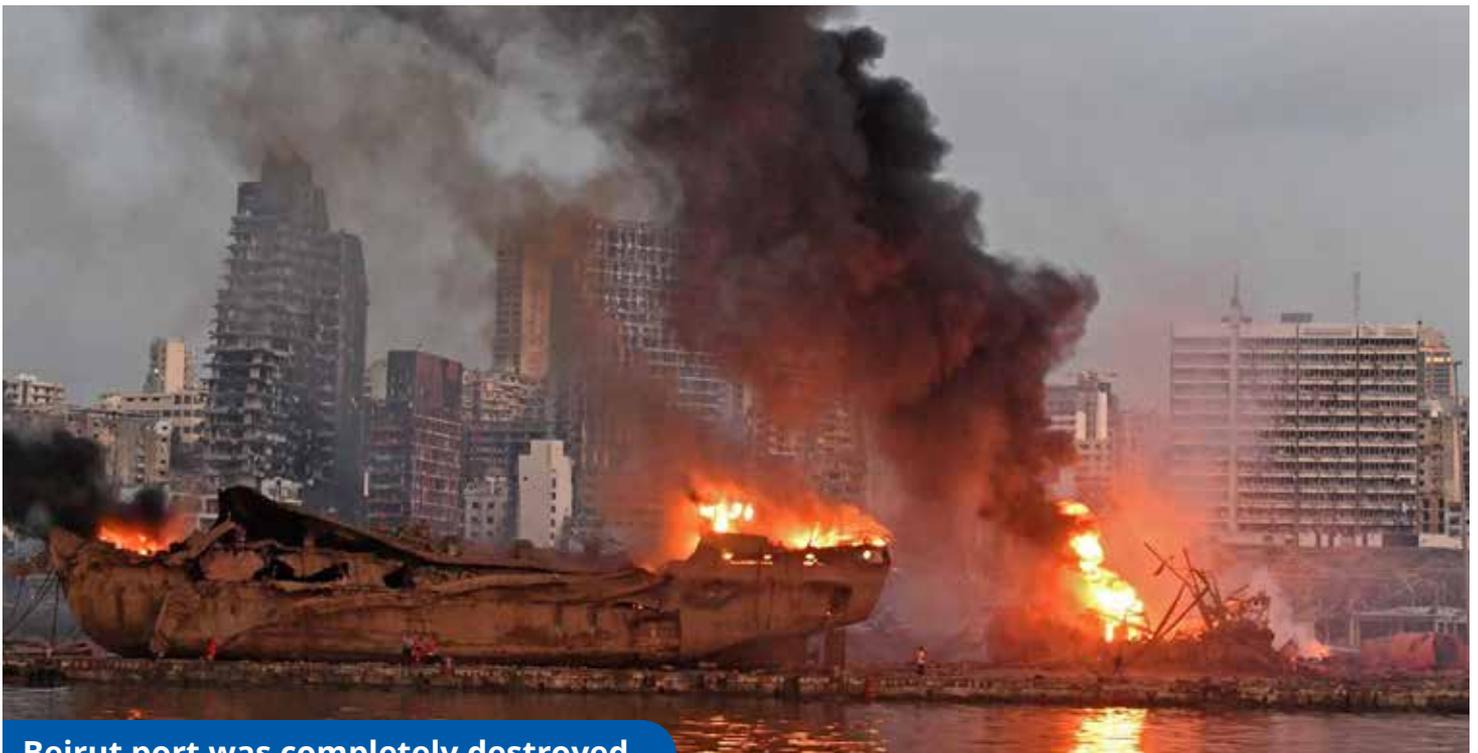
Topping the list is yet another ammonium nitrate explosion in 1947.

Known to history as the Texas City Disaster, the port accident was one of the biggest non-nuclear explosions to occur in history. The explosion killed over 500 people and injured thousands. The impact from the blast was so intense, it created a 15-foot wave that crashed along the docks and caused flooding in the area.

PHOTOS OF THE MONTH



2015 explosion in Tianjin



Beirut port was completely destroyed

BACK-TO-BASICS

QUESTION OF THE MONTH

- a. What is the molar mass of Ammonium Nitrate?
- b. When ammonium nitrate decomposes it primarily breaks down into a number of gasses, state these gasses?

Please send your replies/ answers ONLY to: marine.newslink@tataaig.com

LAST MONTH'S QUESTION

Manufacturer M/s. ABC Ltd from Chennai has sent a consignment of battery operated two wheelers to its dealer M/s XYZ Ltd in Delhi. The consignment is packed and loaded at the Assured's factory in dry containers for commencement of transit on 25-Apr-22. These vehicles were installed with fully charged batteries so that they could be self-driven for the purpose of loading & unloading. Total Value of the consignment was INR 70 Lacs. Policy coverage is as per Inland Transit (Rail/Road/Air) Clause A (All Risks) 2010 and Strikes Riot Civil Commotions. On 27-Apr-22, one of the vehicles in the container caught fire due to excessive heat and lack of ventilation and also damaged few others in the same container. The loss estimated by the surveyor due to this fire was INR 23.5 lakhs.

Please review the incidence as to admissibility of the claim under the scope of policy.

ANSWER

Claim is not tenable under General Exclusion no 2.3 of Inland Transit Clauses 2010.

2.3 loss damage or expense caused by insufficiency or unsuitability of packing or preparation of the subject-matter insured to withstand the ordinary incidents of the insured transit where such packing or preparation is carried out by the Assured or their employees or prior to the attachment of this insurance (for the purpose of these clauses "packing" shall be deemed to include stowage in container, land conveyance or railway wagon and 'employees' shall not include independent contractors)

As specified in the question, the consignment was packed and loaded at the Assured's factory. It means insured was privy to packing / stowage in container / loading etc. Since the consignment is of two wheelers, there is no other packing required to be done and there is no mention of independent contractors in question hence this is clear case of an unsuitability of packing.

IF YOU HAVE ANY COMMENTS/ FEEDBACK PLEASE SEND IT TO

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