Lessons learned from accidents involving ammonium nitrate

Maureen Wood
Major Accident Hazards Bureau

Speaker Maureen Heraty Wood

Outline of the presentation

- Accidents involving ammonium nitrate
- Lessons learned from selected accidents involving ammonium nitrate
- Seveso sites with ammonium nitrate in the EU

Dangerous phenomena associated with ammonium nitrate

Fire: Ammonium nitrate itself does not burn. As an oxidiser, however, it can support combustion and intensify a fire

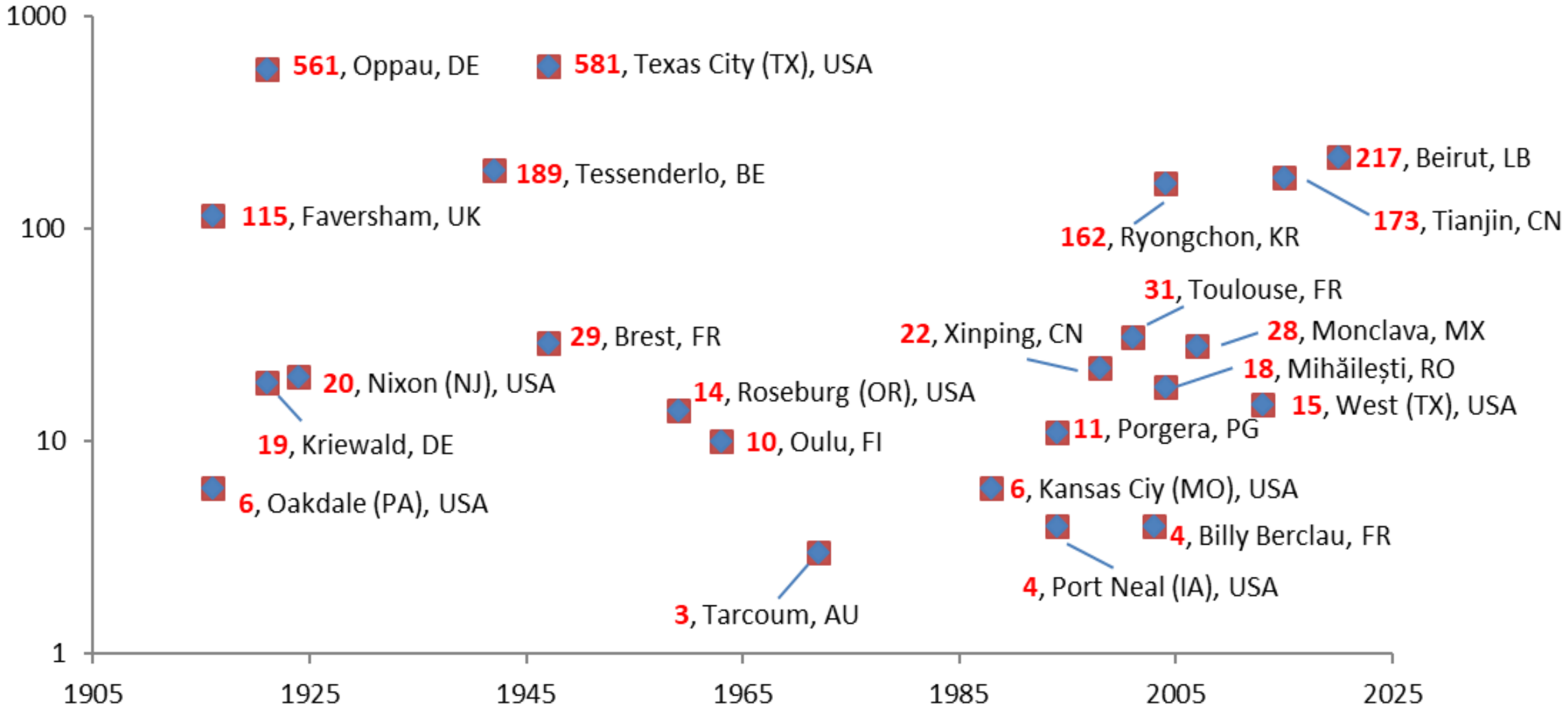
Decomposition: Contamination by combustible materials or incompatible inorganic substances can make it sensitive to explosion if it comes into contact with a heat source.

Differences in composition of ammonium nitrate will affect explosive potential. The higher the percentage of ammonium nitrate, the higher the explosive potential.

Industrial grade, used for blasting in mining and quarries, has the highest content among commercially sold ammonium nitrate products.

There have been numerous accidents involving ammonium nitrate since it first was produced in mass quantities at the beginning of the 20th century.

Fatal ammonium nitrate accidents in history



Characteristics of the fatal ammonium nitrate disasters

- Of the 23 disasters in the chart, around half took place in storage associated with production or in a cargo container in transport.
- It seems that at least 3 might have occurred during production
- Suspected causes included:
  - Accidental ignition source (e.g., fire, electrical fault)
  - Storage conditions (e.g., humidity, incompatible substances)
  - Attempt to blast caked AN with explosives (3 events)
  - Collision
  - Production processes
- The composition of the AN involved is often not specified (in open sources), described as “ammonium nitrate used for production of fertilizers and explosives”. More recent cases occurring in OECD countries are more specific.
- Amounts involved ranged from 1.4 to 3,900 tonnes

Some examples of lessons learned from the MAHB Lessons Learned Bulletin* on fertilizers - 1

Case 1: Fire in a warehouse storing numerous products, including sugar, molasses, fertilizers, and cereals – 31 killed, over 2,500 injured, severe property damage

Contributing factors to the event

- Contamination due to poor storage conditions
  -Due to the conditions of transport, fertilizer became mixed with organic material
  -Wooden pallets were in contact with the fertilizer compounds.
- Defective, poorly insulated power cables were nearby the fertilizer pile
- These compounds then caught fire during decomposition and released heat, accelerating the decomposition.
- No effective means of firefighting, in place, such as a water riser and a self-propelled fire hose.

Lessons learned

- Storage and handling practices to avoid potential for contamination during transport and storage
- Avoidance of ignition sources
- Appropriate preparedness measures including automated fire detection and mitigation as well as fire fighting equipment

* https://minerva.jrc.ec.europa.eu/en/shorturl/minerva/5_mahb_bulletin_no5_final_fortheweb

Some examples of lessons learned on fertilizers - 2

Case 2: Explosion of a temporary storage for downgraded ("off-spec") temporary material (Toulouse, France, 21/09/2001)

There are still uncertainties on the direct causes and the possible scenarios regarding the explosion. The findings presented here are considered the most probable.

Contributing factors to the event

- Three different subcontracting companies worked in the warehouse (the downgraded AN was picked up, unloaded and removed by them).
- The storage building involved in the accident did not have nitrogen oxide detectors
- The accident scenarios for the site did not include the downgraded ammonium nitrates store

Lessons learned

- Risk assessment and inspection practices should consider all AN products on the site, and not overlook hazards of "off-spec" products
- Awareness of risks and hazards associated with ammonium nitrate among operators may be far widespread than originally thought
- More knowledge is needed to identify sub-standard products and associated hazards.

Some examples of lessons learned from the MAHB Lessons Learned Bulletin on fertilizers - 3

Case 3: Fire in a storage and distribution company – 15 killed and over 200 injured (West, TX, USA, 2013)

Contributing factors

- The warehouse was separated into wooden bins and stored combustible seeds.
- There were no monitors, alarms or automated fire protection measures in place
- Responders were not aware that ammonium nitrate was present in the warehouse
- No standards were in place that restricted certain types of development around the facility

Lessons learned

- Ammonium nitrate should have been considered in the hazard assessment
- Separation of combustible materials from organic substances reduces potential conflagration & explosion
- Existing professional standards for preventing ammonium nitrate accidents were confusing, contradictory, and out-of-date
- Development should be restricted around sites that handle or store ammonium nitrate
- Local authorities and responders should also be aware of all ammonium nitrate storage & aware of the risks
- Storing ammonium nitrate in bulk should not be allowed without proper fire prevention, protection and mitigation measures.

Amendment to Seveso Directive to address ammonium nitrate risk (2003/105/EC)

- Range of Coverage. Seveso should expanded to cover all ammonium nitrate, ammonium nitrate compounds, simple ammonium nitrate-based fertilisers, and composite fertilisers (e.g., NPK),
  - To reduce potential of making ammonium nitrate sensitive to detonation
  - To promote best practices to reduce potential for contamination
  - To promote awareness and application of effective practices

- EU detonability test should become mandatory for all ammonium nitrate products intended for market in the European Union (necessitating a modification to EU Directive 80/876/EC now Regulation EC 2003/2003)

The EU 2002 workshop made additional recommendations for the substance criteria but eventually the above recommendations made it into the Directive. For more information, you can read the workshop summary here:

https://minerva.jrc.ec.europa.eu/EN/content/minerva/79837f29-3146-480c-be69-af86e1639a75/srtseviiammoniumnitratesafetypdf

Substance criteria in the Seveso Directive

Different types and physical status
Based on definitions in UN ADR (except for off-spec

- 1. Ammonium nitrate (fertiliser grade) 50005/10,000t thresholds
  Capable of self-sustaining decomposition) UN ADR 2067 Note 306
- 2. Ammonium nitrate (fertiliser grade) 1250g/5000t thresholds
  Corresponds to UN ADR 2067 Note 307
- 3. Ammonium nitrate (technical grade) 350t/2,500t thresholds
  Corresponds to UN ADR 1942
- 4. Ammonium nitrate (off-spec material) 10t/50t thresholds

Partial Numbers for Ammonium and Potassium Nitrates on Seveso sites in EU Ports (EU eSPIRS database, 12/2021)

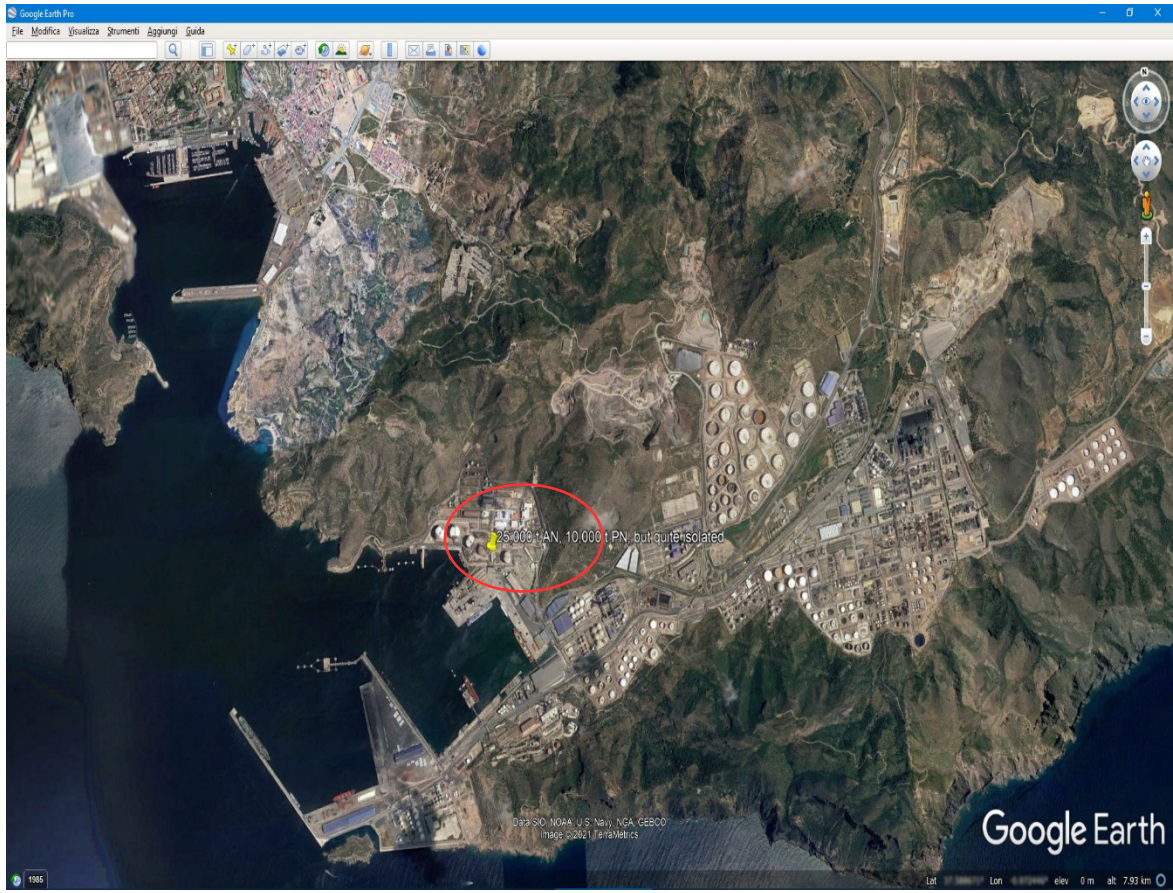
- Published data in eSPIRS (GBR and CHE included) count 12,233 establishments
- 2,534 establishments are reported with substances

- I.e. 2,534/12,233 --> **20.7%** establishment records in eSPIRS reported with substances
- No data from the "bigs" (DEU, FRA, GBR, ITA)

- **151** establishments report Ammonium Nitrates, Potassium Nitrates or both
- 151/2,534 --> **6%**

- Visual check in GoogleEarth based on the georeferences, the names and the addresses:

- 18 Channel Ports (docks in internal channels)
- 25 See or Lake Ports
- ----------
- **43 Total in ports**



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