Sicherheit in Technik und Chemie

BAM
Bundesanstalt für Materialforschung und -prüfung

CHARACTERISTICS OF AMMONIUM NITRATE (AN) AND AMMONIUM NITRATE BASED FERTILIZER

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Properties of ammonium nitrate

T > 170 °C:

$NH_4NO_3 \longrightarrow 2H_2O + N_2O$ (Decomposition)

Strong initiation:

$2\ NH_4NO_3 \longrightarrow 4\ H_2O + N_2 + O_2$

Sum:	**NH_4NO_3**
Melting point:	169 °C
Boiling point:	210 °C (atmospheric pressure)
Decomposition:	Up to 170 °C

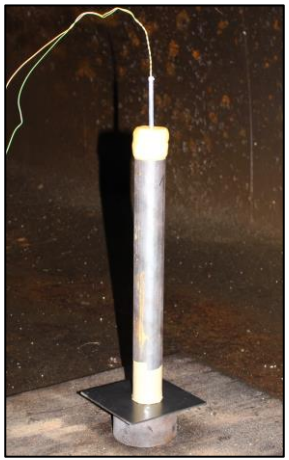
Use of ammonium nitrate

Explosive power of ammonium nitrate

Trauzl-Test Nitropenta-detonator (Cu) Nr.8

	Expansion (cm^3/ 10 g)
pure AN	178 ml/dag
AN + 5.5 % Oil, particle size 0.5 mm to 1.0 mm	286 ml/dag
AN + 5,5 % Öl, particle size less than 0.5 mm	353 ml/dag
TNT	300 ml/dag

Tests - Detonability



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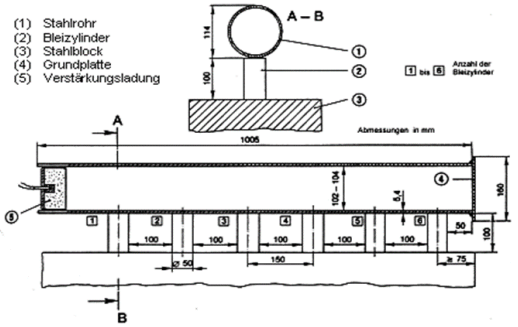
UN Test 1 (a)

UN Test 2 (a)



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Detonability of ammonium nitrate

	UN-GAP-Test 1 (a)	UN-GAP-Test 2 (a)	4-Inch-Steel tube
Technical AN (UN 1942)	Yes	No	Yes (Depends on bulk density)
AN as fertilizer (UN 2067)	No	No	No
AN + 5,5 % Öl (ANFO) as high explosive	Yes	Yes	Yes

AN of class 5.1
UN 1942 and UN 2067

UN 1942:

AMMONIUM NITRATE with not more than 0.2 % combustible substances, including any organic substance calculated as carbon, to the exclusion of any other added substance

UN 2067:

AMMONIUM NITRATE BASED FERTILIZER

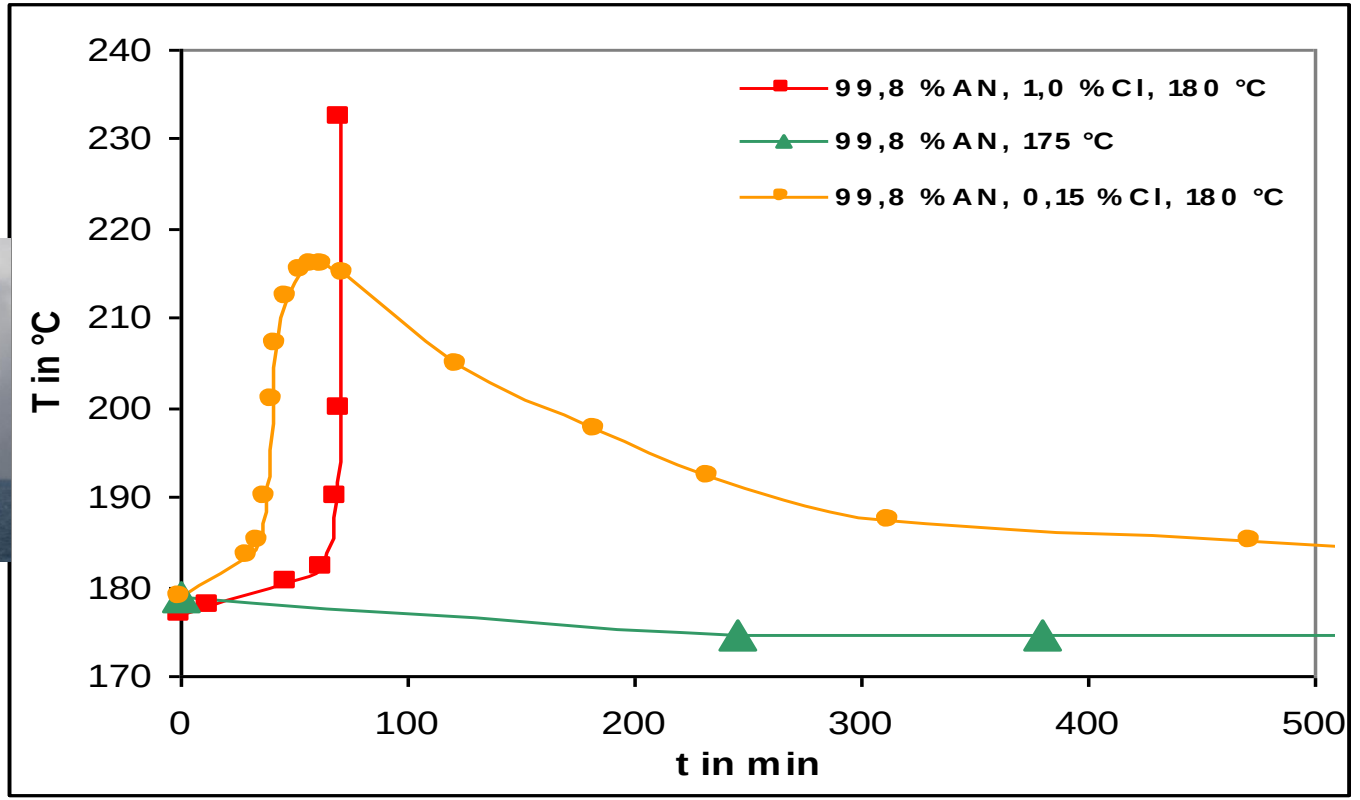
These entry may only be used for ammonium nitrate and ammonium nitrate based fertilizers that are too insensitive for acceptance into Class 1 when tested in accordance with Test Series 2 (see Manual of Tests and Criteria, Part I).

UN 1942 – problematic?

BAM tested 20 different products according to UN test series 2:

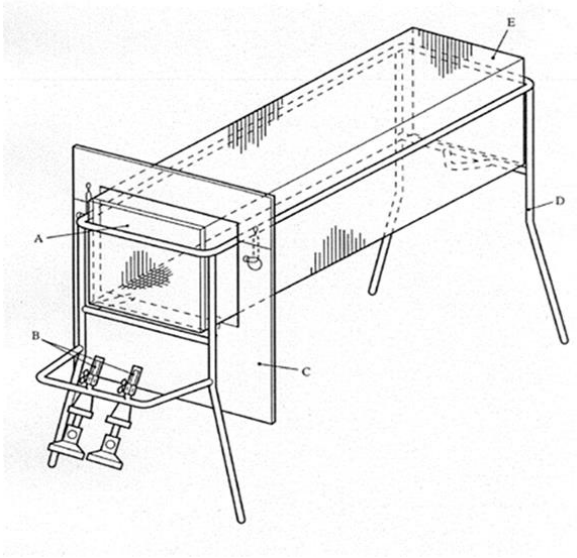
State	Number	Test series 2
Sweden	5	Okay
Germany	5	Okay
Netherlands	6	Okay
Brasil	2	Okay
Croatia	2	Okay

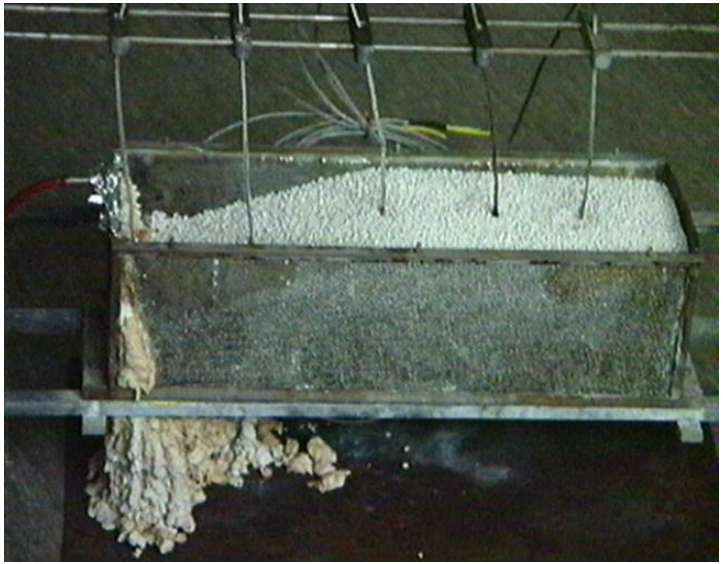
Influences on exothermic decomposition



Trough-Test (UN-Test S.1):

Self-sustaining exothermic decomposition





Storage regulation (Germany)

Classification of ammonium nitrate based products in groups

Group A
Detonable

Group B
Self-sustaining exothermic decomposition

Group C
Neither A nor B, develop nitrogen oxides by heating

Group D
not dangerous in aqueous solution or suspension but able to detonate in crystallized state

Group E
ammonium nitrate based mixtures, water-oil-emulsion, pre-products for production of high explosives

Group A
Technical AN/ fertilizer quality

Composition:

- Ammonium nitrate: more/ equal 90 %
- Chloride content: less/ equal 0,02 %
- Inerte substances: less/ equal 10 %
- Combustible substances: maximum 0,2 %

Group A
protection against contamination/ limitation of damage/ effect

- **Storage and transport (also in-house) only packed**
- **Division into subsets of maximum 25 tons**
- **Additional requirements**
  - **Construction of warehouses**
  - **Safety distances between the subsets (Prevention of detonation propagation)**
  - **Distances to buildings (e.g. residential buildings)**

    $E = 11\sqrt[3]{11}$ **(for 25 t, 320 m)**
  - **Distances to public transport routes**

    2/3 E (for 25 t, 213 m)

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THANK YOU

FOR YOUR ATTENTION

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