

Lifetime prediction of ammunition



Swelling due to the formation of hydrogen gas.

Lifetime prediction of ammunition is of importance for all kind of energetic materials. Not only for safety and performance but also for economical reasons.

Why lifetime prediction of ammunition at TNO ?

The Dutch Ministry of Defence, the MoD, is responsible for purchase, maintenance and disposal of their ammunition. For ammunition purchase it is important to compare the expected lifetime of the ammunition of different suppliers. Once the guaranteed lifetime is expired it is of great significance to know whether the ammunition can still function well and safe for a few more years. During maintenance one needs to know how and when to perform periodic inspection. During and after 'out of area' operations one needs to know whether the ammunition will function properly.

The Dutch MoD realised that a large amount of money can be saved if there is a good knowledge of the expected lifetime of their ammunition and how the ammunition deteriorates. TNO has build up expertise since 1993 with respect to shelf life of ammunition because of its position as well known independent adviser for the Dutch MoD.



Still safe to use this gun propellant after 10 years?

Causes of deterioration of ammunition

During storage high temperatures will cause accelerated ageing of the energetic material. An increase of 10 °C will generally accelerate a chemical reaction 2 to 3 times. In case of a bad packaging, moisture can enter into the energetic material causing degradation reactions. During transport, vibration may cause cracks in the material leading to an increased burning rate. Temperature shocks during air plane take-off for example might also cause cracking or debonding of rocket propellants. This can result in an explosion during functioning. Also other causes are identified.

Expertise on life time prediction; examples of work

Within TNO four different research groups work together in order to build up expertise on ageing of pyrotechnics, gun propellants, and rocket propellants. The different research topics are listed below. Some examples of projects are given.

Pyrotechnics

- A general approach of life time prediction of ammunition
- Ageing of Magnesium / Teflon / Viton
- Lifetime extension of smoke grenades
- Lifetime prediction of coloured smoke hand grenade100
- Lifetime prediction of mortar (light and smoke) ammunition

Rocket Propellants

- Methodology to predict lifetime of rocket motors by using samples.
- LARM computer code: Lifetime assessment of rocket motors
- Influence of 1000 hours of flight on Sidewinder AIM-9L
- Life time extension study of standard missile
- Advise surveillance Stinger

Corrosion caused by moisture.



Gun Propellants

- Method to predict the safe storage life time of gun propellants
- Various techniques to determine performance of (aged) gun propellants
- Surveillance of gun propellants
- Life time extension of 155 mm gun propellants
- Determination of the 'real age' of gun propellant that has been stored in Cambodia

Chemical Analysis

to support research on aged energetic materials

- Method to determine the reaction rate of binder systems with oxygen
- Technique to determine the migration of plasticiser in propellants
- Method to determine stabiliser content in gun propellants
- Exudation of TNT in 120 mm mortar grenades

Safe to fire?



TNO Defence, Security and Safety

'TNO Defence, Security and Safety' is the title under which TNO operates as a strategic partner for the Dutch Ministry of Defence and makes innovative contributions to enhance the safety and security of the Netherlands both at home and abroad. We also use our accumulated knowledge for businesses, industries and foreign governments.

Located at Rijswijk
Lange Kleiweg 137
P.O. Box 45
2280 AA Rijswijk

T +31 15 284 2842
F +31 15 284 3991

www.tno.nl

ir. H.L.J. Keizers
T +31 15 284 3378
F +31 15 284 3958