ENERGETIC MATERIALS; SYNTHESIS - CHARACTERIZATION - LIFETIME AND OPERATIONAL USE

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Abstract

Gunpowder, also known as Black Powder, is the earliest known chemical energetic materials (since 11th century). It is a mixture of sulfur, charcoal, and potassium nitrate (saltpeter). The sulfur and charcoal act as fuels, and the saltpeter is an oxidizer. The discovery was done in China, and since than many compositions were made, also well-known as fireworks.

In that time stability and lifetime was not direct an issue. This became more important in the last century with the development of Nitrocellulose as a main component for gun propellant composition. Due to the way of processing cotton to nitrocellulose an instability issue is incorporated. During that time the first quality measurement techniques were developed. In the beginning based on chemical reactions, and nowadays more focussing on thermal parameters, including activation energy. In the meantime more new energetic materials are developed, with their specific way of measuring.

The lifetime of an ammunition article is ended when the article no longer functions properly. In order to function properly, the ammunition have to meet their requirements with respect to performance and safety. The performance can degrade due to high temperature, low temperature, temperature shock, sunshine, high relative humidity, vibrations, low-pressure etc. In order to predict the expected lifetime, the expected conditions during the article's lifetime need to be identified. All these parameters has to be taken into account during the surveillance programs.

These way of measuring results also in more realistic predictions of the lifetime of the energetic materials under different storage and operational conditions. The lifetime is strongly related to the storage / operational temperature. Since a few years new ways of measuring the real temperature are going on, and in the future this will be a crucial parameter in lifetime prediction studies.

Storage in large quantities of substances that are susceptible to self-heating is an everlasting concern, at least since major gunpowder explosions in The Netherlands a couple of centuries ago. The government tried to guarantee the public safety by moving these storages out of town, as was done in Delft after a terrible disaster in 1654, or by issuing guidelines on the transport of dangerous goods, as was done after the explosion of a powder transport ship in Leiden about 2 centuries later. Only since the beginning of the last century, substantial knowledge was derived about the background of self-heating.

Acknowledgments

Author thanks TNO and Dutch Ministry of Defence for financial support all over the years.

Topics : stability, energetic materials, lifetime