

## **Study of pyrotechnic delay composition using reinforced composite material with carbon nanotubes**

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At present, the efforts of scientists are mainly aimed at the development of reinforced composite materials with carbon nanotubes. The unique properties of carbon nanotubes make it possible to use them in various branches of science and technology. With the introduction of the carbon nanotubes, the properties of materials and products from them change substantially.

Also in recent years there has been growing interest in the use of reinforced composite materials with carbon nanotubes as a fuel agent in pyrotechnic delay compositions

Pyrotechnic delay compositions are widely used in civil industrial systems and delay devices for various purposes, which serve to create time delays that provide the necessary duration.

In this work, to improve the macrokinetic characteristics, the reliability and the stability of delay composition, the reinforced composite material with carbon nanotubes were added. Ti and 4% CNT were mixed by the planetary ball mill AGO-2 with water cooling, which is the most energy-intensive of all devices of this type. Milling time was varied from 1 to 11 min. Particle size analysis showed that particle size exponential declined with increase in milling time. SEM results showed that after 2 min of milling on the surface of titanium particles there are no carbon nanotubes, which indicates their dispersion into titanium powder, then with an increase milling time mechanocomposites of various sizes of irregular shape are formed. Then Ti/CNTs were applied to fuel agent of delay composition. We studied the burning rate, burning time and physical and chemical characteristics of BaCrO<sub>4</sub>/CNTs/Ti delay composition.

Thus, the addition of certain amount of CNTs to the delay composition allows improve the physicochemical characteristics and increase the ignition reliability of delay compositions.