

# **Scientific aspects of the development of water-gel explosives based on recyclable single-base propellants to ensure the required detonation parameters**

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## **Abstract**

Industrial utilization of various types of weapons is one of the most important problems of the modern world. The current Federal Target Program of Russian Federation (FTP) "Industrial utilization of weapons and military equipment for 2011-2015, and for the period up to 2020", an almost complete transition to industrial disposal of ammunition is planned, providing for the completion and subsequent refusal of destruction by detonation, which leads to the accumulation of ammunition demilitarization products.

During the years of the previous FTPs, many methods for the utilization of ammunition were developed, including the extraction of energy-intensive components with subsequent reuse in explosive compositions for industrial needs, dozens of formulations of such explosive compositions were developed and approved by the supervisory authorities for regular use. Most of the formulations were developed empirically, based on theoretical assumptions of the physics and chemistry of the detonation process, as well as expediently on the performance indicators of industrial explosives (IE). At the same time, the specificity of the detonation proceeding when using utilized energy-intensive materials as components was practically not taken into account, which is necessary to expand the field of application and increase the efficiency of realizing the potential of conversion products.

The group of the most difficult energy-saturated components from the point of view of involvement in the secondary circulation includes single base propellants (SBP), which increase the ability to explosive transformation under certain conditions, in particular, the use of high-density fillers of low compressibility. High energy water gels are one of the most promising fillers that allow not only to reduce the hazard in handling, but also to increase the effectiveness of the explosive effect.

Formation of the scientific aspects of the development of formulations of such SBP water-gel compositions (SBPWG), taking into account the existing technologies for the production of special products, requires the study of the influence of various factors on the detonation process of explosive compositions.

The goal of present research work was improvement of the technology for the development of SBPWG formulations with taking into account the features of the detonation process and the influence of the components of SBPWG for detonation parameters.

**Scientific novelty:**

Aspects of a scientifically based approach to development of formulations of SBPWG compositions based on recyclable SBP to provide the necessary detonation parameters were formulated.

Detonation velocities, mass velocities and pressures of detonation of SBPWG compositions based on recycled granulated SBP of various brands with the use of water gels with different energy characteristics were determined.

The profiles of the mass velocity of SBPWG compositions were obtained by electromagnetic method for determining the parameters of detonation and shock waves. A number of features, that able to significantly influence the application practice similar compositions were noted.

The effect of the composition of water gels on the boundary detonation conditions of SBPWG compositions were studied. Critical detonation diameters and minimum content of SBP that providing stable detonation for studied composition of water gels were obtained.

An experimentally substantiated mechanism of detonation process in SBPWG compositions were described.

**Practical importance:**

Recommendations for the development and modification of formulations, in order to take into account the features of the state of the used SBP and the effect of the composition of the water gels and the realized mechanism of the explosion to control the parameters of detonation depending on the target application were given.

The parameters of detonation, features of the flow and propagation of the detonation process, characteristic of SBPWG compositions based on recyclable granulated SBP size, form and condition of the propellant elements for water gels based on nitrates were defined and described.

Practical recommendations for development of formulations of SBPWG compositions for industrial partners were given.

**Discussed provisions of defense:**

The results of an experimental study of the effect of chemical composition of water gel to the critical detonation diameter of SBPGW compositions;

The results of an experimental study of the effect of the content of water gels in SBPWG compositions for their detonation ability;

The results of an experimental study of the effect of chemical composition of water gels on the detonation parameters of SBPWG compositions;

The results of an experimental study of the effect of the size of propellant elements on the parameters of detonation of SBPWG compositions;

The results of the analysis of the processes occurring in the detonation wave determining the flow of detonation in SBPWG compositions;

Recommendations for the development of formulations of SBPWG compositions based on recyclable SBP to ensure required parameters of detonation.