SPECIAL ASPECTS OF ONSET AND DEVELOPMENT OF EXPLOSIVE TRANSFORMATION AND DETONATION IN DEFLAGRATING HES UNDER DIFFERENT INITIATING PULSES

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One of major concerns in development of initiating elements of various purposes is studying the onset and development of explosive transformation in explosives and pyrotechnic compositions (hereafter – HEs).

The presentation describes the experimental research results of explosive transformation onset and development in pressed samples of secondary deflagrating HE, namely perchlorate (5-nitrotetrazolato-N^2) pentaammine-cobalt(III) (NCP) under shock-wave (see Table 1), exploding wire (see Table 2) and optical (laser) initiation (see Table 3).

Radio interferometric technique with radiation of 3-mm wavelength was used.

The samples included pressed NCP samples: each sample was 4–12 mm high and ∅3.6 mm in diameter for shock-wave and optical (laser) initiation and ∅4.25 mm in diameter for exploding wire initiation.

In the experiments, we measured the induction time, t_{ind}, average explosive transformation velocity, D^*, detonation velocity, D (response time t_{resp}), and laser radiation power (energy). To record t_{resp} we used electrical contact sensors (hereafter – ECSs) of the twisted-pair type.

Table 1

The results of the investigation into explosive transformation onset and development in NCP HE under shock-wave initiation

No.	Average sample density, ρ, g/cm^3	Detonation velocity, D, km/s	Explosive transformation onset depth, H_{deapth}, mm	Induction time, t_{ind}, μs
1	1.6	6.0 ± 0.5	<1 mm*	3.1 ± 0.4**

* Explosive transformation onset depth is lower than the resolution of the radio interferometric technique.
**The operation time of the primer was not considered.

Table 2

The results of the investigation into explosive transformation onset and development in NCP HE under exploding wire initiation

No.	Average sample density, ρ, g/cm^3	Explosive transformation (detonation) velocity, km/s		Explosive transformation onset depth, H_{deapth}, mm	Induction time t_{ind}, μs
		D^*	D		
1	1.6	1.20 ± 0.5	5.71 ± 0.5	6.3±0.3	8.6 ± 0.4

Table 3

The results of the investigation into explosive transformation onset and development in NCP HE under laser initiation

No.	Average sample density, ρ, g/cm^3	Explosive transformation (detonation) velocity, km/s		Explosive transformation onset depth, H_{deapth}, mm	Induction time, t_{ind}, μs
		D^*	D		
1	1.7	3.75 ± 0.5	6.24 ± 0.5	1.1 ± 0.3	3.7 ± 0.4

According to the results obtained for the pressed NPC samples under shock-wave initiation, the induction time was t_{ind} = 3.1 ± 0.4 μs and the detonation velocity was D = 6.0 ± 0.5 km/s (see Table 1).

The results obtained under exploding wire and optical (laser) initiation show that the development of the explosive transformation occurs in two stages: low-rate stage. i. e. explosive transformation, and high-rate stage, i. e. detonation. For the studied samples under exploding wire initiation and optical (laser) initiation, the combustion velocity was D^* = 1.20 ± 0.07 km/s and 3.75 ± 0.07 km/s, respectively, and the detonation velocity was $D = 5.71 \pm 0.08$ km/s and 6.24 ± 0.08 km/s, respectively. We also defined the induction time values $t_{ind} = 8.6 \pm 0.4$ μs (exploding wire initiation) and 3.7 ± 0.4 μs (laser initiation) (see Tables 2, 3).

Thus, the results obtained from the investigation into special aspects of the onset and development of explosive transformation and detonation in the pressed samples of secondary deflagrating NCP HE under different types of initiating pulses showed that:

- the parameters of initiation under optical (laser) initiation and explosive transformation (detonation) behavior are close to shock-wave initiation mode;
- the induction time, t_{ind}, under exploding wire initiation generally exceeds the induction time, t_{ind}, under shock-wave and optical (laser) initiation approximately by the factor of 2.5.