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STUDY RELATED TO IMPROVE PERFORMANCE OF A NEUTRALIZING GAS DYNAMICS SYSTEM

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ABSTRACT

Worldwide, the series of attacks "with bomb" are the most common, accounting for over 80% of terrorist attacks. The many constructive solutions of Improvised Explosive Devices (I.E.D), would require for defusing sequence at least as many variations of cancellation. To anticipate in a shorter time (intervention time) the manner in which an explosive device was made (possibly, up to several months) is another factor leading to the adoption of a uniform neutralization solution by mechanical disruption (mechanical separation of the constituent elements of a hand made explosive device, using different agents of disruption). In this paper, we analyzed the possibility to improve performance of a neutralizing gas dynamics system.

KEYWORDS: explosive device, disrupter, gas dynamics system

1. Introduction

Nowadays, it is unanimously accepted the fact that there are no precise methods and certain solutions, infallible, in the activity of neutralization the improvised explosive devices. It is worth mentioning the difference in content between the neutralization activity of improvised explosive devices and the neutralization activity of industrial ammunitions (projectiles, bombs, grenades, fuses etc).

While at the improvised explosive devices the dissimulation, structure, way of working, are elements difficult to intuit and determine, at the industrial ammunitions, the shapes, constructive scheme, way of working, and destination are in majority known or well known.

Also, classic ammunition, except certain categories of mines or aircraft bombs are not equipped with "traps".

The existing cases demonstrate that, because of these "traps" in the organization of improvised explosive devices there are few who survived an attempt to defuse them. Given the technical, financial possibilities, material and technical knowledge base and experience possessed by bombers, it is accepted that the devices may be designed and constructed and practically impossible to be neutralized by conventional methods and manual defusing. In these circumstances, the only realistic option in dealing pyrotechnist - improvised explosive devices is the safe neutralization performed from the distance, in secure conditions, always following the people protection, reducing property damage and removing the uncertainty created.

2. The gas-dynamics system (disrupter)

The most used method for neutralize an improvised explosive device is generation of shock waves by means of the impact method between a projectile or a jet formed from diverse disrupting backgrounds and the improvised explosive device.

The neutralization systems (gas-dynamics systems) that propels the kinetic projectiles using explosives, are used to transmit large shocks to various inert or reactive targets.

These shocks have a significant impact on the targets, transmit changes in state and kinematic parameters, leading to either dismantling targets or initiating explosive charges receivers.

The gas-dynamics system (disrupter) is intended to neutralize improvised explosive devices. The neutralization is performed by pulling with the disruptor using different media (water, antifreeze, sand, shot, bolt penetration etc...). The propulsion of disruption media above mentioned on the improvised explosive device is made with electric pyrotechnic cartouches CPE-127 000, cal. 12.7mm or specialized cartouches cal. 12 mm.

The system of improvised explosive neutralizing devices with DR-2 disrupters provides, during the specific interventions, the display in technical parameters for which it is intended, in the following environmental conditions:

- temperature: $30^{0}C \div 50^{0}C$
- atmospheric pressure: normal
- relative humidity: normal

The technical - tactical features of the disruptor are:

- calibre: 30 mm;
- length: approx. 487 mm;
- clamping area diameter of the disrupter on cap DR-2 ϕ 49 mm;
- mass: approx. 6.5 kg;
- capacity: approx.200 cm^3;
- load thrown type: water, antifreeze, sand, balls (shot) metal bolt;
- ammunition: - electric pyrotechnic cartouche CPE -127-000 cal. 12.7 mm; special cartouche calibre 12;

The ammunition used in shooting with the disruptor are: electric pyrotechnic cartouche CPE-127000, cal.12,7 mm; flinging load standard is ω = 9 g of powder VUFL; depending on the nature of the mission we can prepare cartouches with increased load (up to 18 g); specialized cartouche cal. 12.

The initiation of the cartridges is electrical and it can be done depending on the mission, from the exploser or car battery. From measurements made on a sample of 6 cartouches, calibre type 12.7 mm, the values of the masses of constituents resulted are presented in Table 1.

Table 1. *Mass characteristics of the existent cartouche calibre 12.7 mm*

Cartouche No.	**Total mass**	**Powder mass**	**Bure mass (sponge)**	**Stopper plug mass**
	[g]			
1	78.25	9.640	0.451	1.329
2	77.37	9.016	0.450	1.331
3	76.3	8.992	0.456	1.325
4	79.0	9.737	0.451	1.336
5	78.8	9.744	0.448	1.332
6	78.3	9.757	0.453	1.343

3. Experimental test results

To determine the performance characteristics of the disrupter there were made experimental studies and shootings, we determined:

- initial velocity of the projectile (agent of disruption being water);
- variation of the pressure in the pipe with respect to time;
- geometry of the water jet; the influence of various parameters on the operation of the disrupter (plugs, the amount of water etc.);
- the intensity of the sound wave emitted from the operation of the system.

Once all the experimental configuration elements are ready, after checking the triggering and signal acquisition (including continuity of speed circuit), it proceeds as follows:

- insert the agent of disruption, measuring its volume in advance; water is introduced the same time with retaining plugs mounting (if applicable);
- insert the cartouche into the chamber, taking care that the hole gas loan to be is in adequate position;
- electronic acquisition system of pressure and velocity restarts;
- electric supply of the cartouche is applied;
- acquiring results (the curve of pressure variation and time between speed frames);
- filming the geometric configuration of the water jet propelled by the disruptor;
- processing the results of pressure and speed acquisition;
- acquiring pictures with the geometric configuration of the water jet propelled by the disruptor.

In the case of the ballistic tests we followed: materials used, initial conditions, jet speed, pressure, noise level. Pictures of the geometrical configuration of the water jet propelled by the disruptor during shooting, for first shooting, are presented in Figure 1, a-d. The evolution of pressure depending on time, for first shooting, is shown in Figure 2.

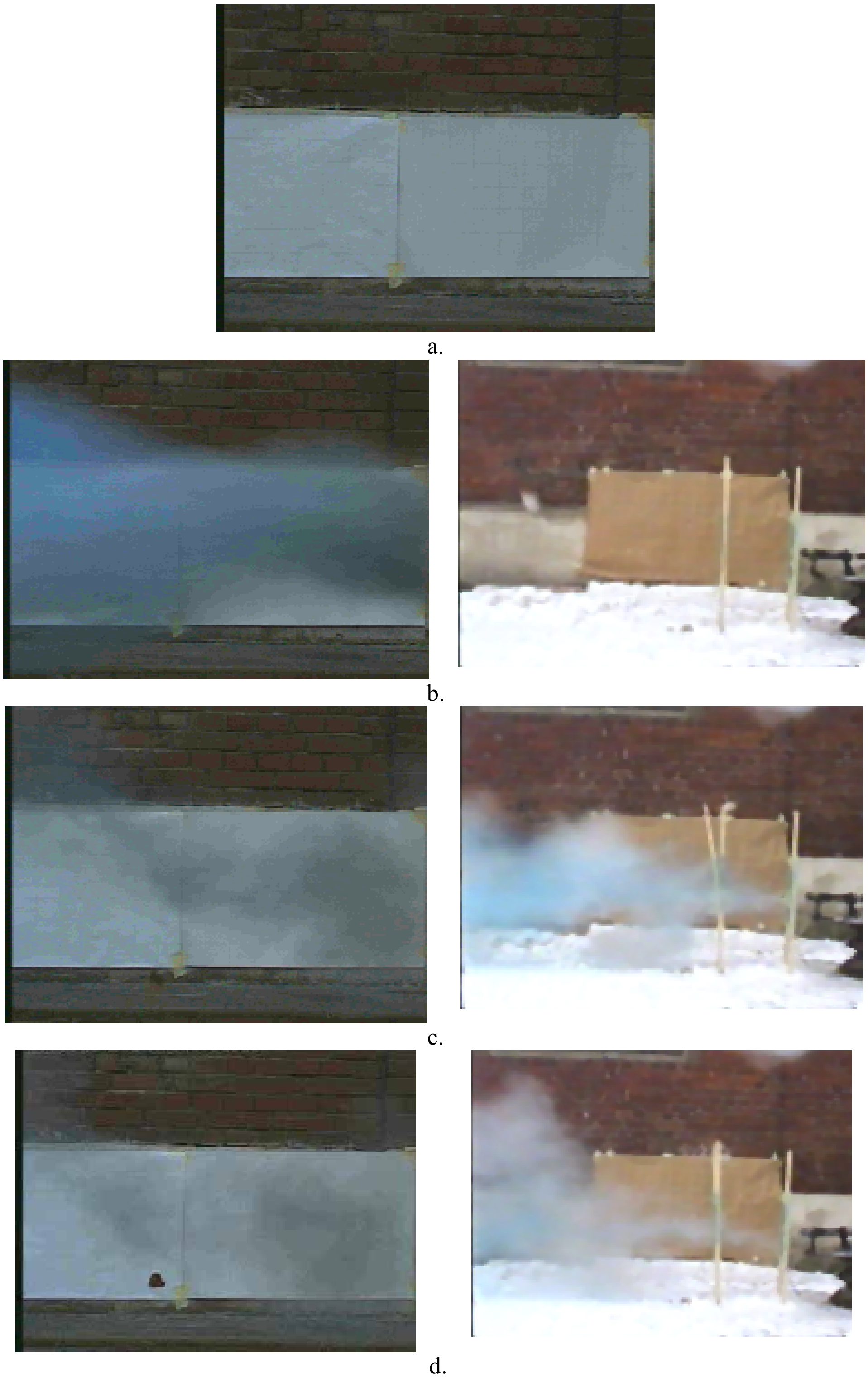

Fig. 1. *Analysis of the geometrical configuration of jets: images of the water jet, for first shooting: a. before shooting; b. after 40 ms; c. after 80 ms; d. after 120 ms*

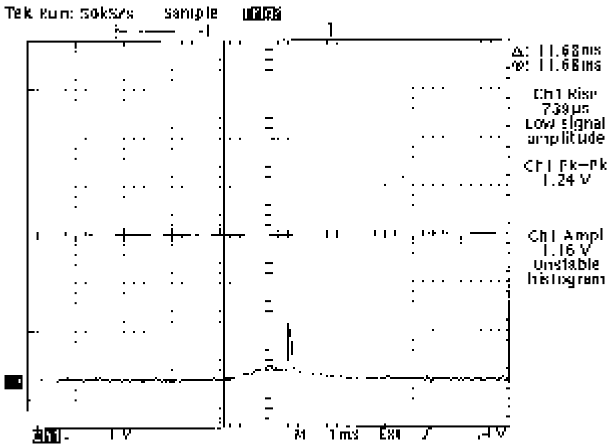	First shooting: p_{max1}=1160 bar t_{f1}=1.3 ms

Fig. 2. *Pressure versus time variation*

4. Conclusions

In the current use of the disrupter at the neutralization operations of some improvised explosive devices there have been found several shortcomings, such as:

- relatively heavy handling because of the entire mass system (hard-disruptor);

- initiating components pyrotechnic elements of some improvised explosive

- devices by the disrupting agent (electric detonating caps etc ...);

- the need for proximity to suspect parcel to obtain a good efficiency.

Given the assumptions presented, the results such as:

- explore the possibility of replacing the cartouche cal. 12.7 mm commonly used;

- study the ballistic characteristics of the existing cartouche:

- the initial speed of the jet and its geometric configuration;

- pressure value in loading chamber versus time;

- noise level produced at the load flinging initiation.

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