Gas Generators are Based on Carbonaceous Materials

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Abstract

In this paper the results concerning development of energy-intensive materials on the base of KNO_3 and carbonaceous materials in gas-generating chemical cartridges were applied. Shows the results of investigation non-explosive destroying mixture based on local materials promoting expansion force in the closed volume 30 MPa was developed. Described carbonaceous materials which are used in gas-generating chemical cartridges, proposed the investigations about sensitivity to mechanical influences and degree of emission of gaseous and condensed products.

Keywords: gas generator chemical cartridge (GCC), gas generator composition, non-explosive destroying mixture.

Introduction

Gas generating compositions are the compositions which during burning produces a relatively minimal amount of solid particles and relatively liberal amount of gas. For investigation of gas generator systems the law of "gasification" is applied. This characteristic relation, making relation between pressure, temperature and specific volume of gas, allows in future to apply the obtained dependences for definition of necessary parameters under working conditions of gas generator [1]. The aim of investigators in this field is the reduction of solid particle amount and expansion in the number of gaseous products per gram or per unit of the gas and generating composition.
Recently, gas generating compositions have been widely applied both in military and in civilian sphere. For example, in production of airbags the gas generating compositions on the basis of azides are used. Also, when laying different communications, during destruction of concrete brick-built structures in circumstances where compact planning, the efficiency and security considerations are very relevant, is necessary to use the substances which creating the pressure in the hole due to reaction of deflagration combustion instead explosion. The great majority of currently used materials for extraction of block stone of non-mechanical type are explosives and in a varying degree, have a

blasting effect. Generally, their use is always accompanied by great risks. [2] Largely, the gas generating mixture consists of: a) the fuel is easily generating in gas; b) an oxidizer; c) binders [3].

Researchers pay great attention for the development of energy fuel, it is one of the main objects for research of gas generating compositions [4]. Useful combustibles must have a maximum degree of transition to the gaseous phase at thermal decomposition. We should not forget about the environmental side and the impact of gas generators combustion products to the human body.

The authors of this research were worked out with carbonaceous materials on the basis of mineral and vegetable raw materials [5]. Carbonaceous materials have been developed for the use in gas-generating chemical cartridges (GCC). As the result of undertaken studies, it has been found that the range of fragments distribution of concrete is depending on quantity of gas-generating composition as well as chemical composition. If the breakable block is covered with armor the fragment distribution is absent. The use of this type of device for installation of various communications, the destruction of concrete bricks which are densely built-up to each other in residential areas that provides the security guarantees. This article presents the introduction to the study of gas generating compositions of carbon-based materials carbonized apricot kernels.

The apricot kernels are easily combustible carbonaceous material with a porous structure, wherein the content of carbon reaches 85-90%. Many important fact is that the chemical activation of this material can change its structure. For example, to obtain a pore size of meso to micron size and orientation desired.

The main function of nitrocellulose solid fuels (NSF) - to adjust more or less constant pressure and bring the pressure in the destructive device to 900-1000 kg / cm^2. Cement stone at water/concrete precursor solution is equal to 0,4 and modifying chemical additive component (HC - $CaCl_2$) in first 15 minutes has hardening rate 8 MPa/hour. The maximum level of concrete stone strength during 30 minutes reaches 23 MPa/hour.

Experimental part

Developed quick-mix to create a closed volume.

Table 1: Conducted field tests of compositions and structure of GCC-1 and GCC-2.

Weight,%	The composition of the GCC -1	Composition GCC - 2
Carbon black	10	10
Sulfur	10	10
Oxidizer(KNO_3)	80	70
Nitrocellulose solid fuels	-	10

RESULTS AND DISCUSSIONS

The development of gas generator products in deflagration combustion mode.

The maximum range of concrete fragment distribution at the initiation of gas generating compositions №1 ranged from 60 cm to 2 m. The maximum range of concrete piece at the initiation of gas-generating compositions of gas generator products -2 ranged from 1 to 3 meters. The data of field tests are summarized in diagram. The researches on concrete fragment distribution by closed armored shell were carried out (Figure 1a). The concrete fragment distribution doesn't observe (Fig. 1b).

a) b)

a) Monolithic concrete block, b) Monolithic concrete block is crushed by gas generator.

Figure 1. Destruction of concrete blocks by closed armored cover.

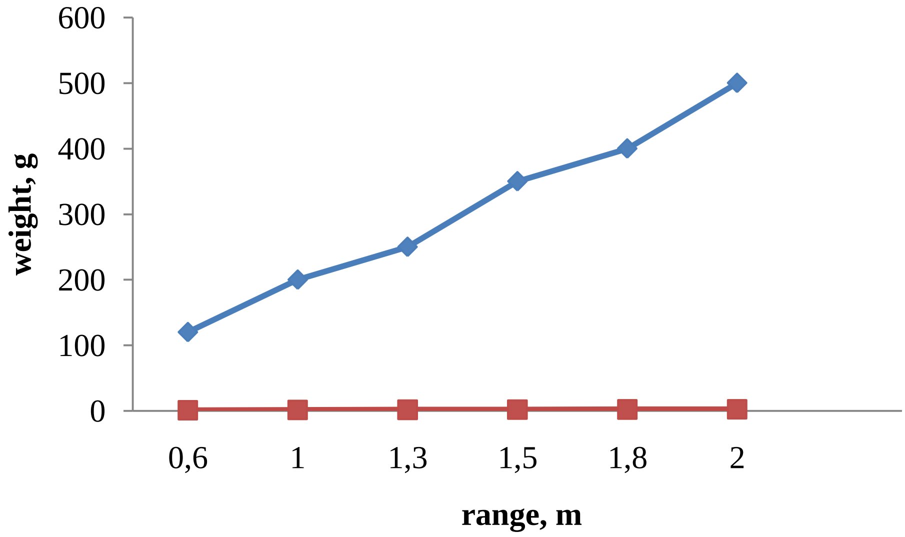

Figure 2. Defining of propellant properties of gas-generator compositions № 1 depending on mass of pyrotechnic compounds

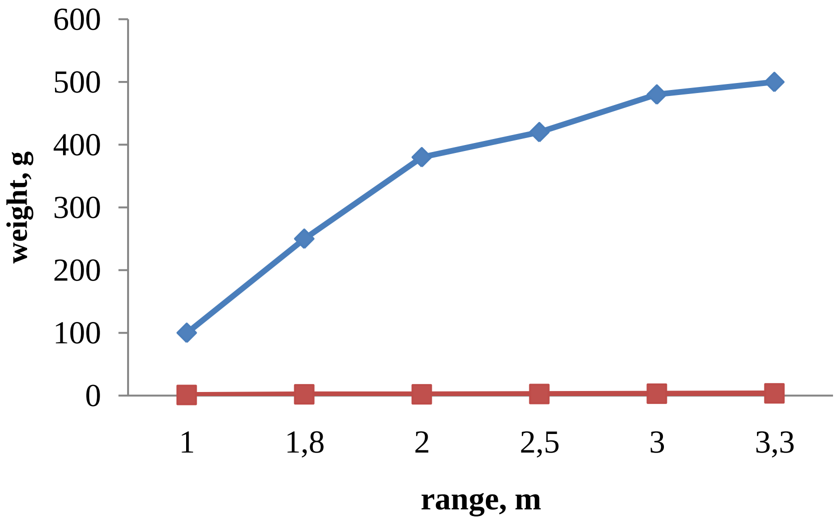

Figure 3. Defining of propellant properties of gas-generator compositions № 2 depending on mass of pyrotechnic compounds

From specified relations (Figures 2 and 3) it can be seen that when there is an increase of pyrotechnic composition mass from 100 to 500 g the linear dependence of extending range of concrete fragment distribution is observed. However, the composition with gas-generator products-2 has greater range of concrete fragment distribution by 1.65 times. This feature of GGP -2 is explained by the presence in composition of nitrocellulose solid fuel, which is initially regulates more or less constant pressure, but along with this it can bring the pressure in the destructive device to 900-1000 kg/cm^2, and as a consequence, the concrete fragment distribution is increased. The represented data in Figures 2 and 3 show that the optimal composition for maximum concrete fragment distribution make compositions with weight 300-350 g. of initial pyrotechnic composition. Therefore an influence of primary components of sulfur, technical carbon, oxidant and nitrocellulose solid fuel was investigated.

Table 2: Distance of concrete fragment distribution from composition of components

Primary components GCC -1, %			Distance ,m	Primary components GCC-2, %				Distance, m
Carbon black	S	KNO_3		Carbon black	S	NSF	KNO_3	
№1 sample				№1 sample				
10	10	80	1	10	10	10	70	2,5
8	12	80	1,3	8	8	14	70	2,6
6	14	80	1,4	6	6	18	70	2,8
4	16	80	1,5	4	4	22	70	2,3
№2 sample				№2 sample				
10	8	82	1,4	10	8	12	70	2,6
10	6	84	1,5	10	6	10	74	2,3
10	4	86	1,5	10	4	8	78	2,6
10	2	88	1,4	10	2	6	82	1,6

In table 2 the effect of varying of primary components for distance of concrete fragment distribution was investigated. The table shows that in composition of GCC-1 (№1 sample) at constant content of NH_4NO_3 (80 %), with reducing of sulfur content and with increase of carbon black content the distance of concrete fragment is reduced. This is explained by the fact that the sulfur is well interact with ammonium nitrate, and increases the rate of thermal decomposition of ammonium nitrate, whereupon the reaction is occurred more completely, so the distance of concrete fragment distribution with increasing of sulfur ratio is increased. An intensive decomposition of ammonium nitrate is occurred in the temperature range of 483-613 K.

Gas generating chemical cartridges of different composition and various weigh ratios were introduced to the bore holes. With a view to creating of enclosed volume the bore hole is hermetically filled with fast-acting mixtures. Curing time is 15-20 min. Crushing strength of fast-acting mixtures was from 15 – till 20 MPa.

For development of production technology of fast-acting mixture the character of strength were investigated in depending on feed point of it to the process for concrete preparation. From experiments it was found that most effective properties of solidifying are occurred when the chemical solution is introduced into prepared concrete mixture. The obtained results are shown in diagram in figure 1 and figure 2.

Conclusion

- Thus, as the result of investigation, the chemical compositions containing carbon nanomaterials were obtained. Quick-hardening mixtures, the curing time was 15 - 20 minutes, a crushing strength of which was exactly 15 - 20 MPa. The developed technologies allowing to make the respect explosion during failure of concrete brick-built structures in circumstances where compact planning.
- As the result of conducted studies it was revealed that the distance of concrete fragment distribution depends on the amount of gas-generator structure and chemical composition
- On the basis of experimental data the composition of non-explosive breaking mixture based on local materials is developed, generated force of expansion in close volume was 30 MPa. The composition of quick-hardening mixture having a hardening rate of 8 MPa/h is developed. The maximum level of set strength for 30 minutes at the age of hardening reaches 23 MPa.

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