United States Patent Office 3,702,792 Patented Nov. 14, 1972

3,702,792

NOVEL POLYBASIC PROPELLANT

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No Drawing. Filed Sept. 15, 1971, Ser. No. 180,853
Int. Cl. C06b 19/02
U.S. Cl. 149—10 9 Claims

ABSTRACT OF THE DISCLOSURE

A novel process for the preparation of a polybasic propellant powder having a progressive rate of combustion by forming a polybasic propellant containing water-soluble, nitrogen-rich compounds, treating the said propellant with an aqueous media to dissolve the said water-soluble compound out of the surface layer and introducing into the resulting pores a desensitizer to control the rate of combustion and the propellant produced by the process.

STATE OF THE ART

Heretofore, only nitrocellulose powders (so-called monobasic powders) have been used for weapons of high ballistic power. In order to coordinate the rate of combustion of these propellant powders to the processes in the combustion area of the weapons optimally, the said powders were subjected to a surface treatment. Thereby, it was possible to delay the evolution of gas in the initial phase of the combustion which determines the maximum gas pressure. After combustion of the desensitized zones, an intensified evolution of gas occurs, leading to a progressive combustion which insures a favorable utilization of the propellant powder in the weapon.

The performance data for weapons of high ballistic power have been increasing continually, but nitrocellulose powders do not have the chemical and thermodynamic perequisites for a major increase in efficiency. Therefore, attempts have been made to use polybasic propellant powders for these weapons. The desired high muzzle energy and the usually extremely restricted combustion areas require a considerable increase of the energy potential. In order to maintain the gas pressures within acceptable limits, therefore, a greatly progressive combustion of the powder grain is required. A polybasic powder of nitroglycerine, nitrocellulose and nitroguanidine, for example, can be produced by known procedures also for weapons of high ballistic power, but the combustion curve of this powder, determined in the 300 cc.-manometric bomb, is highly degressive.

It is known from the literature that dibasic and polybasic powders cannot be surface-treated (Brunswig, Das rauchlose Pulver (Smokeless powder), Berlin and Leipzig 1926, p. 274; Stettbacher, Die Schiess-und Sprengstoffe (Firing and blasting materials), Liepzig 1933, p. 193). Although tribasic powders are made with the aid of small quantities of volatile solvents, they show under the microscope, similar to pure blasting oil powders, a sealed, homogeneous surface.

OBJECTS OF THE INVENTION

It is an object of the invention to provide a novel polybasic propellant suitable for use in weapons of high ballistic power.

It is another object of the invention to provide a novel process for the preparation of polybasic propellant powders.

These and other objects and advantages of the invention will become obvious from the following detailed description.

The novel process of the invention for the preparation of a polybasic propellant powder having a progressive rate of combustion, particularly in the initial stages, suitable for high combustion power weapons comprises forming a polybasic powder propellant containing a water-soluble, nitrogen-rich compound, surface treating the resulting propellant with an aqueous media to dissolve the said water-soluble compound from the outer layers of the propellant and introducing into the resulting pores in the propellant and on the surface of the charge a desensitizer to obtain a polybasic propellant with a progressive combustion rate. The aqueous treatment may be effected at temperatures from 15 to 100° C., preferably 50 to 80° C.

The polybasic powder propellant may be made of nitrocellulose and nitric acid esters of multivalent alcohols and will contain 20 to 60% by weight of a water-soluble, nitrogen-rich compound such as nitroguanidine, guanidine nitrate, ammonium nitrate, or dicyanodiamide.

This surface treatment of polybasic propellant permits the introduction of desensitizers, either in a single step or multistep treatment, to be added into the cavities to a predetermined depth so that the after combustion of the outer layer and upon beginning of the projectile movement, progressive combustion results so that the propellant may be used in high ballistic power weapons.

In a modification of the process of the invention, after the first treatment and/or following treatment stages, an intermediate wet storage of the solvent-moist powder is interposed or between the individual treatment stages, there may be an intermediate dry storage of the powder. In another modification, a water treatment may be interposed between the individual treatment stages and/or before the final drying of the powder.

The dissolving out of the water-soluble, nitrogen-rich compounds may be effected by a pretreatment of the powder propellant for half an hour with continuous agitation with water of a temperature of +50° C. in the ratio of 1 part powder per 3 parts water proves expedient. Addition of a dye allows the depth of penetration of the water into the powder grain to be observed by means of microtome section. The progress of the treatment is determined quantitatively.

Pretreatment with water of +50° C.

Dissolved quantity of nitroguanidine in percent of the treated propellant:

	Percent
½ hour	2.49
2 hours	3.01

This dissolving out brings about a lowering of the caloric content in the pretreated layer, so that the total heat of explosion of the powder drops after a half-hour extraction from 1130 cal/g. to 112 cal/g. and after a two-hour extraction to 1108 cal/g.

A powder propellant thus prepared is subjected to a surface treatment with desensitizers such as camphor, centralite (diphenylurea derivatives), urethanes and phthalates in alcohol solution, and it is expedient to choose two- or multi-stage surface treatments with interposed intermediate wet storages or intermediate dry storages. The surface treatment is preferably carried out at about +40° C. with an intermediate drying at 50–55° C. In special cases, a water treatment may be provided after the last treatment stage and before drying, to remove solvents. The powder propellant thus treated is then finished in the usual manner.

In the following example there is described a preferred embodiment to illustrate the invention. However, it should be understood that the invention is not intended to be limited to the specific embodiment.

EXAMPLE

20 parts by weight of an alcohol-moist nitrocellulose (based on dry nitrogen content) having a nitrogen content of 13.15%, prepared from SW containing 13.35% nitrogen and CWS containing 12.6% nitrogen, and 100 parts by weight of nitroglycerin were mixed with agitation and allowed to stand for several hours to form a sectile gelatin. The gelatin mass is then powdered to obtain a preconcentrate. The powdered preconcentrate was processed with additional alcohol-moist nitrocellulose, nitroguanidine and Akardit II (methyl diphenylurea) in the amounts set forth in the following Table I to obtain a 15 kg. batch of material plus 1.7 kg. of acetone.

TABLE I

	Kneading batch dry weight, kg.	Nitrocellulose, kg.	Nitroglycerin, kg.	alcohol, kg.	Kneading batch (moist), kg.
Nitrocellulose (N=13.15%)	3.730	3.730	----------	0.708	4.440
Power preconcentrate	5.120	0.770	4.350	0.282	5.400
Nitroguanidine	6.000	----------	----------	----------	6.000
Akardit II	0.150	----------	----------	----------	0.150
Totals	15.000	4.500	4.350	0.990	15.990

The ingredients of Table I were thoroughly kneaded in a kneading machine for about 2½ hours and the mixture was then cured at room temperature for 8 to 14 days. The mass was then extruded with an extrusion press and cut into 2 mm. lengths' screened and dried under vacuum. The so-called "white grain" (because of white color due to nitroguanidine content) was subjected for half an hour to treatment with water at 50° C. with mechanical agitation and was dried. The resulting 15 kg. of white grain composition was then subjected to a four stage surface treatment in drums to apply the desensitizers.

In the first stage, the grains were sprayed with 4 equal portions of a 0.6% solution of 0.024 kg. of dibutyl phthalate in 0.292 kg. of 94% alcohol at 40 to 42° C. The second and third stages were the same using as the treatment solution, 0.8% solution of 0.0332 kg. of dibutyl phthalate in 0.227 kg. of 94% alcohol (2nd stage) and 1.0% solution of 0.040 kg. of dibutyl phthalate in 0.162 kg. of 94% alcohol (3rd stage). In the fourth stage, the solution used was 0.6% solution of 0.024 kg. of N,N'-diethyl-carbanilide in 0.162 kg. of 94% alcohol. After cooling, the resulting powder is removed from the treatment drums and dried in an oven at 50° C. for five hours to attain the desired moisture content. Depending upon the number of treatment stages, the total treatment time will be beween 4 and 32 hours. The resulting powder has a high caloric content but has a progressive combustion rate with a considerable increase of the resulting gas volume making it suitable for high ballistic weapons.

The energy content of the preconcentrate of the example could be increased by the addition of other explosives

such as trinitrotoluol and other water-soluble, nitrogen containing compounds such as ammonium perchlorate could be used.

Various modifications of the process and products of the application may be made without departing from the spirit or scope thereof and it is to be understood that the invention is to be limited only as defined in the appended claims.

We claim:

1. A process for the preparation of a double-base or triple-base nitrocellulose powder propellant having a progressive rate of combustion comprising forming a polybasic powder propellant containing a water-soluble, nitrogen-rich compound, surface treating the resulting propellant with an aqueous media to dissolve the said water-soluble compound from the outer layers of the propellant and introducing into the resulting pores in the propellant and on the surface of the propellant a desensitizer to obtain a polybasic propellant with a progressive combustion rate.

2. The process of claim 1 wherein the treatment with the aqueous media is effected at 50 to 80° C.

3. The process of claim 1 wherein the introduction of the desensitizer is a multistep treatment.

4. The process of claim 1 wherein the polybasic propellant is a mixture of nitrocellulose and nitric acid esters of polyvalent alcohols.

5. The process of claim 1 wherein the water-soluble, nitrogen-rich compound is selected from the group consisting of nitroguanidine, guanidine nitrate, ammonium nitrate and dicyanodiamide.

6. The process of claim 1 wherein after the first step, the solvent-moist powder is subjected to an intermediate wet storage.

7. The process of claim 1 wherein after the first and/or following step of introducing the desensitizer, the powder is subjected to dry storage.

8. The process of claim 1 wherein after introduction of the desensitizer, the solvent-moist powder is subjected to an intermittent wet storage.

9. The process of claim 1 wherein after introduction of the desensitizer, the powder is subjected to dry storage.

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U.S. Cl. X.R.

149—11, 98, 100