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[54] **SOLID GAS GENERATING AND GUN PROPELLANT COMPOSITIONS CONTAINING A NITROAMINOTETRAZOLE SALT**

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[51] **Int. Cl.²** **C06D 5/06**

[58] **Field of Search** 149/18, 19, 20, 92, 109, 149/19.4, 19.5, 19.6, 19.9, 19.91, 36

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[57] **ABSTRACT**

Solid gas generating and gun propellant compositions which employ certain nitroaminotetrazole salts such as guanidinium 5-nitroaminotetrazole, ammonium 5-nitroaminotetrazole and hydrazinium 5-nitroaminotetrazole as modifying ingredients in admixture with an oxidant and a suitable compatible binder material.

6 Claims, No Drawings

SOLID GAS GENERATING AND GUN PROPELLANT COMPOSITIONS CONTAINING A NITROAMINOTETRAZOLE SALT

BACKGROUND OF THE INVENTION

This invention relates generally to solid composite propellant compositions and more particularly to solid composite propellant compositions especially useful as gas generating and gun propellants.

Recently, there has been a great demand for gas generating propellants and gun propellants which are cool burning, non-corrosive and produce a high percentage of gas.

In the past, attemps to improve gas generating compositions and gun propellants have been unsuccessful for various reasons. For example, while the addition of certain modifiers have lowered the flame temperature and increased gas production, these modifiers have contributed to the production of undesirable corrosive products. Other modifiers which have been utilized, while not producing corrosive materials, have not succeeded to significantly lower the flame temperature or increase gas evolution.

SUMMARY OF THE INVENTION

Accordingly, it is one object of this invention to provide a solid composite gas generating and gun propellant.

Another object of the present invention is to provide a solid composite gas generating and gun propellant which is cool burning and produces a high percentage of gas.

Still another object of the instant invention is to provide a solid composite gas generating and gun propellant which only yields non-corrosive materials upon combustion.

These and other objects are achieved by providing a composite propellant composition comprising an oxidant, such as 1,3,5,7-tetranitro-1,3,5,7-tetraazacyclooctane (HMX), a nitroaminotetrazole salt selected from the group consisting of guanidinium 5-nitroaminotetrazole (GNAT), ammonium 5-nitroaminotetrazole (ANAT), and hydrazinium 5-nitroaminotetrazole (HNAT), and a suitable compatible binder material.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Pursuant to the present invention, an improved gas generating and gun propellant is provided by an admixture of an oxidant, preferably 1,3,5,7-tetranitro-1,3,5,7-tetraazacyclooctane (HMX), in an amount of from about 5 to about 90 percent by weight, a nitroaminotetrazole salt in an amount of from about 5 to about 70 percent by weight and a suitable compatible polymeric binder in an amount of from about 5 to about 28 percent by weight of the total composition.

Although HMX is the preferred oxidant of the instant invention, other oxidants, which are traditionally employed for this purpose and are compatible with the nitroaminotetrazole salt modifiers of this invention, may also be employed. Some of these are, for example, ammonium nitrate,5-aminotetrazole nitrate, ammonium perchlorate (AP), and mixtures thereof. It should be noted, however, that where the absence of non-corrosive gases upon combustion is desired ammonium perchlorate is not particularly well suited.

The nitroaminotetrazole salts of the present invention which impart the low flame temperature and high percentage of gas upon combustion to the propellant compositions of this invention are selected from the group consisting of guanidinium 5-nitroaminotetrazole, ammonium 5-nitroaminotetrazole and hydrazinium 5-nitroaminotetrazole. These nitrogen rich salts also provide good burning rate characteristics to the compositions.

The optimum amount of the nitroaminotetrazole salt utilized in the propellant compositions of this invention is generally dependent upon the application of the composition. For gas generator purposes the nitroaminotetrazole salt content should not exceed about 50 percent by weight of the total composition while for gun propellant use higher quantities are applicable.

The oxidant and nitroaminotetrazole salts of the present invention may be incorporated into any compatible conventional binder matrix material. Generally, these are for example, polyesters, polybutadienes, polyurethanes, polyglycols, polybutadienes with hydroxy or carboxy functionality, polyesters with hydroxy functionality, polyethers, vinyltetrazoles, glycidyl ether epoxy resins, and copolymers, etc. More specifically, binder materials such as polyglycol adipate, Butarez CTL I (a mixture of carboxyl-terminated polybutadiene and non-functional polybutadiene), Butarez CTL II (carboxyl-terminated polybutadiene), the terpolymer of 2-methyl-5-vinyltetrazole: butyl acrylate: acrylic acid, and R-45 (a hydroxyl-terminated polybutadiene) are within the scope of this invention.

A number of other materials may also be added in minor amounts to the propellant compositions of this invention, such as other coolants like oxamide, ammonium oxalate, axalic acid and guanidine nitrate, plasticizers such as dioctyladipate, wetting agents such as lecithin, crosslinking and curing agents like di and tri functional epoxides and ferric acetylacetonate (FeAA) and other burning rate and ballistic modifiers such as lead chromate ($PbCrO_4$).

Having generally described the invention the following Tables are set forth for purposes of illustration. It will be understood that the invention is not limited to these examples, but is susceptible to different modifications that will be recognized by one of ordinary skill in the art. It should be understood that all percentages are by weight.

Table I

Example	% binder[a)]	% 5-ATN	% GNAT	% ANAT	% HNAT	Burning rate in/sec at 1000 psi; 77°F
I	20	68	12	—	—	0.578
II	20	71.5	—	8.5	—	0.736
III	20	71.5	—	—	8.5	0.753

[a)]45% 1-methyl-5-vinyltetrazole, 45% methoxy ethyl-methyl tetrazole, 6% dimethyl acrylate, 4% cumene hydroperoxide

Table II

Example	% binder[b]	% HMX	% ANAT	% HNAT	% GNAT	burning rate in/sec at 1000 psi; 77°F
V	15	70	15	—	—	0.243
VI	15	70	—	15	—	0.250
VII	12	75	—	—	13	0.360
VIII	12	75	13	—	—	0.319

[b]11.2 parts R45M (a hydroxyl-terminated polybutadiene, molecular weight 2600, OH functionality 2.4, a product of Sinclair Petrochemicals, N.Y., N.Y.) to 0.8 parts toluene diisocyanate

Table III

Example	% binder[c]	% HMX	% GNAT	% oxamide	% AP	% $PbCrO_4$
IX	26	—	60	7.0	5.0	2.0
X	28.6	40	26.4	5.0	—	—

[c]2-methyl-5-vinyltetrazole: butyl acrylate: acrylic acid terpolymer

Table IV

Example	% binder[d]	% HMX	% GNAT	% oxamide	% $PbCrO_4$	% AP
XI	28.0	58	10	4.0	—	—
XII	27.0	64	5.0	4.0	—	—
XIII	27.0	57	5.0	4.0	2.0	5.0

[d]polyglycol adipate, KOPOX 170 (trifunctional epoxide crosslinking agent) Koppers, Pittsburgh, Pa., FeAA.

Most of the compositions of the hereinabove examples exhibit a flame temperature of about 2500°K, or less, which is desirable for gun wear reduction as well as other hardware wear reduction.

The propellant compositions made in accordance with this invention are useful in gun propellant applications and as gas generators. As gas generators, they may be employed, for example, for actuating gas pressure operated mechanical devices for driving engines, electric generator or motors and turbines; for operating pneumatic tools; and for the propulsion and guidance of rockets or other gas escape reaction propelled devices.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A solid propellant composition comprising an oxidant, a nitroaminotetrazole salt selected from the group consisting of guanidinium 5-nitroaminotetrazole, ammonium 5-nitroaminotetrazole and hydrazinium 5-nitroaminotetrazole and a compatible binder.

2. The solid propellant composition of claim **1** wherein said oxidant is present in amount within the range of from about 5 to about 90 percent by weight, said nitroaminotetrazole salt is present in an amount within the range of from about 5 to about 70 percent by weight and said binder is present in the amount within the range of from about 5 to about 28 percent by weight of the total composition.

3. The solid propellant composition of claim **2** wherein said oxidant is selected from the group consisting of 1,3,5,7-tetranitro-1,3,5,7-tetraazacylcooctane, ammonium nitrate, 5-aminotetrazole nitrate, ammonium perchlorate and mixtures thereof.

4. The solid propellant composition of claim **3** wherein said compatible binder is a polymer selected from the group consisting of a polyester, a polyurethane, a polyglycol, a polybutadiene, a polybutadiene having carboxy functionality, a polybutadiene having hydroxy functionality, a polyester having hydroxy functionality, a polyether, a vinyltetrazole, a glycidyl ether epoxy resin and copolymers thereof.

5. The solid propellant composition of claim **4** wherein said oxidant is 1,3,5,7-tetranitro-1,3,5,7-tetraazacyclooctane and said compatible binder is selected from the group consisting of the terpolymer of 2-methyl-5-vinyltetrazole: butyl acrylate: acrylic acid, hydroxyl-terminated polybutadiene cured with an isocyanate and polyglycol adipate.

6. The solid propellant composition of claim **2** wherein said compatible binder is a polymer selected from the group consisting of a polyester, a polyurethane, a polyglycol, a polybutadiene having carboxy functionality, a polybutadiene having hydroxy functionality, a polyester having hydroxy functionality, a polyether, a vinlytetrazole, a glycidyl ether epoxy resin and copolymers thereof.

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