

1

3,409,484

THICKENED INORGANIC OXIDIZER SALT SLURRIED EXPLOSIVE CONTAINING AN ALKYLAMINE NITRATE AND AN AIR-EN- TRAPPING MATERIAL

Joseph J. Minnick, Marion, Ill., assignor to Commercial Solvents Corporation, New York, N.Y., a corporation of Maryland

No Drawing. Filed Sept. 15, 1967, Ser. No. 668,193
12 Claims. (Cl. 149—21)

ABSTRACT OF THE DISCLOSURE

Thickened slurry explosive compositions containing an inorganic nitrate oxidizing salt, a lower alkylamine nitrate, water, as sensitizer a non-explosive, finely-divided, air-entrapping material and a thickening agent. These explosive compositions are useful in small bore hole blasting operations.

BRIEF SUMMARY OF THE INVENTION

This invention relates to thickened slurry explosive compositions comprising an inorganic nitrate oxidizing salt, a lower alkylamine nitrate, water, as sensitizer a non-explosive, finely-divided, air-entrapping material, and thickening agent. In a particular aspect, this invention relates to thickened slurry explosive compositions having high rates of detonation, high brisance and suitable for use in small bore hole blasting operations, said composition containing an inorganic nitrate oxidizing salt, a lower alkylamine nitrate, water, thickening agent, and as sensitizer a non-explosive, finely-divided, air-entrapping material.

The use in explosive compositions of inorganic nitrate salts, such as the alkali metal nitrates, the alkaline earth metal nitrates, and in particular ammonium nitrate, has become widespread in the mining and quarrying arts. For example, thickened aqueous slurries containing ammonium nitrate have found extensive use in many blasting operations.

Even though explosive compositions such as those described above have proven effective for numerous uses, such compositions are generally not suitable as explosives for use in small bore hole applications unless sensitized by a sensitizer which is itself a high explosive, such as for example trinitrotoluene (TNT). The principal reason for this is that without the employment of a high explosive sensitizer the detonation velocities of such compositions are not sufficiently high to give the desired results. For reasons of economy and, more importantly, for reasons of safety, it is desirable to avoid the use of high explosive sensitizers in ammonium nitrate containing explosive compositions.

It is an object of the present invention to provide thickened explosive compositions containing an inorganic nitrate oxidizing salt, a lower alkylamine nitrate, water, thickening agent, and a non-explosive sensitizer.

It is a further object of the present invention to provide thickened slurry explosive compositions containing an inorganic nitrate oxidizing salt, a lower alkylamine nitrate, water, a thickening agent, and a non-explosive sensitizer which have high rates of detonation, high brisance and are suitable for use in small bore hole blasting operations.

Other objects and advantages of the present invention will be apparent from the specification and appended claims.

The present invention resides in the discovery that explosive compositions having high rates of detonation, high brisance and suitable for use in small bore hole blasting operations are prepared by forming an admixture

2

of from about 10 to about 90% by weight of an inorganic nitrate oxidizing salt, from about 5 to about 50% by weight of a lower alkylamine nitrate or mixtures of lower alkylamine nitrates, a thickening agent, and a sensitizing amount of a non-explosive, finely-divided, air-entrapping material, the said weights being based on the total weight of the nitrate salt, the water and the lower alkylamine nitrate. Such compositions are of low volatility and may be safely stored under standard storage conditions over long periods of time.

The "detonation rate" of an explosive composition is the rate at which the detonation front passes through the explosive material. Detonation rate is typically expressed in feet per second. For the purpose of the present invention, high detonation rates are generally considered to be in excess of 14,000 feet per second. The compositions of the present invention have detonation rates in excess of 16,000 feet per second, with detonation rates in excess of 20,000 feet per second being reasonably common.

Detailed description

Any suitable lower alkylamine nitrate, for instance lower alkylamine nitrates having from 1 up to about 8 carbon atoms, may be used in the present invention. Included among such lower alkylamine nitrates are methylamine nitrate, ethylamine nitrate, propylamine nitrate, butylamine nitrate, octylamine nitrate, and the like. Because of its ready availability and the excellent results obtained therewith, methylamine nitrate is preferred in the present invention.

The lower alkylamine nitrate is employed in the compositions of the present invention in an amount in the range of from about 5 to about 50%, with an amount in the range of from about 10 to about 35% being preferred.

Any suitable inorganic nitrate oxidizing salt or mixture of two or more such salts may be employed in the compositions of the present invention with ammonium nitrate being preferred when methylamine nitrate is the lower alkylamine nitrate. When sodium nitrate or mixtures of sodium nitrate and ammonium nitrate are employed, a lower alkylamine nitrate other than methylamine nitrate is preferred. The form and particle size of ammonium nitrate (or other salt) are not critical features of the present invention. For example, low density and high density ammonium nitrate prills as well as ground or granular ammonium nitrate may be employed. Preferably, the particle size of the nitrate salt is sufficiently small to pass a 20 mesh screen.

As previously indicated, the inorganic nitrate oxidizing salt is employed in an amount in the range of from about 10 to about 90%, with an amount in excess of 40% being preferred.

The water content of the compositions of the present invention is such as to dissolve all or a portion of the inorganic nitrate salt. Water is employed in the compositions in an amount in the range of from about 5 to about 50%, with an amount in the range of from about 5 to about 30% being preferred.

The sensitizers employed in the compositions of the present invention are non-explosive, finely-divided, air-entrapping materials. Examples of such sensitizers include resin balloons, bagasse, wood flour, cork, balsa, and the like. Resin balloons of use as sensitizers in the compositions of the present invention are water-insoluble, thin-walled, hollow, spherical balloons of a polymerized thermosetting resin selected from the group consisting of urea formaldehyde and phenol formaldehyde. Such resin balloons are commercially available and are more fully described in U.S. Patent 3,101,288 to Coursen et al., issued Aug. 20, 1963.

The amount of non-explosive sensitizer required to sensitize the compositions of the present invention will

vary and will depend, among other things, upon the particular sensitizer employed and the degree of sensitization desired. Generally, an amount in the range of from about 0.1 to about 6.0% by weight is suitably employed, with amounts in the range of from about 0.4 to about 3.0% being preferred, the weights based on the total weight of the composition.

The class of materials used as thickeners for aqueous inorganic nitrate oxidizing salt explosive compositions is known and is illustrated by such materials as guar gum, gum Arabic, pregellatinized starch and carboxymethyl cellulose, with guar gum being preferred. The amount of thickening agent employed in the composition of the present invention will, of course, depend upon the particular thickening agent and the viscosity desired for the particular composition. An amount of thickening agent in the range of from about 0.5 to about 5.0% by weight based on the weight of the total composition is typically employed.

The compositions of the present invention may optionally contain, for example, a metal powder, such as aluminum, to enhance their power, a carbonaceous material, such as fuel oil, to provide oxygen balance when required, and a nitroparaffin, such as nitromethane, to obtain higher brisance.

The compositions of the present invention are prepared by known mixing procedures. The lower alkylamine nitrates are soluble in water, and if desired, may first be dissolved in water before mixing with other ingredients. The compositions may be safely manufactured, stored and shipped and hence may be prepared in a processing plant and transported to the blasting site. If desired, the compositions may also be prepared at the site.

The compositions of the present invention are resistant to water, making them useful in wet as well as dry holes. The compositions require no container even in wet holes. They displace water and maintain their integrity without dilution for extended periods of time before detonation. The compositions have a density in excess of 1.0 and because of this high density possess high bulk strength.

The compositions of the present invention are detonated in the known manner by conventional booster systems, such as for example Pentolite, Composition B, RDX, and the like. The amount of booster is determined in accordance with known practice in the use of the particular booster chosen.

The invention will be understood more fully by reference to the following specific examples. It is understood that the examples are presented for the purpose of illustration only and are not intended as a limitation of the invention.

Example 1

A series of runs was conducted in which the detonation velocities of thickened slurry explosive compositions having ingredients in the parts by weight indicated in Table 1 were determined. In the runs ground ammonium nitrate of particle size sufficiently small to pass a 20 mesh screen was employed. Detonation was accomplished with one-half pound Composition B boosters. In the table all parts are by weight.

TABLE 1

Composition.....	A	B	C	D	E	F
Ammonium nitrate.....	46.8	47.8	48.3	57.9	59.4	67.1
Water.....	16.7	16.7	16.7	16.7	16.7	16.7
Resin balloons (phenol formaldehyde).....	2.0	1.0	0.5	2.0	0.5	2.0
Guar gum.....	1.2	1.2	1.2	1.2	1.2	1.2
Methylamine nitrate.....	33.3	33.3	33.3	22.2	22.2	10.0
Fuel oil.....						3.0
Detonation velocity, feet/second.....	21,000	>16,000	21,050	>16,000	>16,000	>16,000

The above formulations were prepared as follows: The methylamine nitrate and water were placed in a mixing machine and the mixer was operated until a solution was formed. The ammonium nitrate, resin balloons and guar

gum were then individually added to the solution under mixing. Mixing was then continued until a composition of substantially uniform viscosity was obtained. The mixing procedure was carried out at room temperature.

Example 2

Explosive compositions similar to those of Example 1 are shown in Table 2.

TABLE 2

Composition.....	G	H	I
Sodium nitrate.....	50.0	55.0	60.0
Water.....	15.0	15.0	15.0
Bagasse.....	2.0	2.0	2.0
Guar gum.....	1.2	1.2	1.2
Ethylamine nitrate.....	31.8		
Propylamine nitrate.....		26.8	
Octylamine nitrate.....			21.8

Since many embodiments of this invention may be made and since many changes may be made in the embodiments described, the foregoing is to be interpreted as illustrative only and the invention is defined by the claims appended hereto.

I claim:

1. A thickened slurry explosive composition comprising:

- from about 10 to about 90% by weight of an inorganic nitrate oxidizing salt,
- from about 5 to about 50% by weight of a lower alkylamine nitrate,
- from about 5 to about 50% by weight of water,
- a non-explosive, finely divided, air-entrapping sensitizing material selected from the group consisting of thin-walled, hollow, spherical balloons, bagasse, wood flour, cork, and balsa in amounts sufficient to sensitize the composition,
- a thickening agent in amounts sufficient to thicken the composition,

said weights being based on the total of the weights of the nitrate salt, the lower alkylamine nitrate and the water.

2. The composition of claim 1 wherein the lower alkylamine nitrate is methylamine nitrate.

3. The composition of claim 2 wherein the inorganic salt is ammonium nitrate.

4. The composition of claim 3 wherein the ammonium nitrate is of particle size sufficiently small to substantially completely pass a 20 mesh screen.

5. The composition of claim 1 wherein the amount of water is in the range of from about 5 to about 30%.

6. The composition of claim 1 wherein the amount of lower alkylamine nitrate is in the range of from about 10 to about 35%.

7. The composition of claim 3 wherein the amount of ammonium nitrate is in the range of from about 40 to about 90%.

8. The composition of claim 1 wherein the amount of sensitizing material is in the range of from about 0.1 to about 6.0% by weight based on the weight of the composition.

9. The composition of claim 8 wherein the sensitizing material is a polymerized thermosetting resin selected from the group consisting of phenol formaldehyde and urea formaldehyde in the form of thin-walled, hollow, spherical balloons.

10. The composition of claim 8 wherein the sensitizing material is bagasse.

11. The composition of claim 1 wherein the thickening agent is guar gum.

5

12. The composition of claim 1 wherein the inorganic salt is sodium nitrate.

References Cited

UNITED STATES PATENTS

2,947,618	8/1960	Stengel et al.	149—92	
3,013,382	12/1961	Doss	149—92 X	
3,031,839	5/1962	Larson	149—88 X	
3,058,301	10/1962	Larsen et al.	149—92	
3,088,272	5/1963	Stengel et al.	149—92 X	10

6

3,115,005	12/1963	Clark	149—92 X
3,161,551	12/1964	Egly et al.	149—47 X
3,212,254	10/1965	Fox	149—92 X
3,275,485	9/1966	Egly	149—89 X
3,301,724	1/1967	Scott	149—89 X
3,338,165	8/1967	Minnick	149—89 X

CARL D. QUARFORTH, *Primary Examiner.*
S. J. LECHERT, JR., *Assistant Examiner.*