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SENSITIZED NITROPARAFFIN

Robert L. Beegle, Jr., Pasadena, Robert C. Brown, West Covina, and Claiborne M. James, San Dimas, Calif., assignors to Aerojet-General Corporation, Azusa, Calif., a corporation of Ohio
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This invention relates to explosive compositions. In particular, this invention relates to explosive compositions containing nitroparaffins sensitized by organic amines.
The explosive compositions of this invention find particularly valuable application in quarrying where a powerful explosive having a high rate of detonation is required. The superior properties of our explosive compositions make them useful in mining, for military purposes, in oil well production and in other applications where the use of explosives is necessary.
Explosives which can be handled in liquid form are known, however, they are subject to serious disadvantages in that they are very sensitive to shock and are available only in this very sensitive state. Also, these known explosives are dangerous to manufacture. Transportation of these sensitized explosives is very difficult and requires extreme caution.
An object of this invention is to overcome the above mentioned disadvantages of the prior art. Further objects and advantages will become apparent hereinafter.
The explosive compositions of this invention can be prepared by mixing, at the site where the explosive is to be used, a sensitizer or mixture of sensitizers, such as lower alkylimine, arylalkyleneamine, monoethanolamine, alkylphosphorousamide, aryldiamine, aminopyridine, N, N'-diethyl-p-phenylenediamine, hydrazine, hydrazine compounds or alkylaryldiamine; and a nitroparaffin.
The following example is submitted to illustrate and not to limit the invention.

EXAMPLE

Qualitative Tests of Sensitized Nitroparaffins

The following tests were conducted using sensitized nitromethane. The leach tests were carried out by frequently shaking mixtures containing about equal volumes of solutions of sensitizer in nitromethane and water or aqueous sodium chloride solution, the aqueous sodium chloride solutions were prepared to simulate sea water.
After frequent shaking for the time noted in the table, the aqueous and nitromethane mixtures were allowed to stand and form into two layers. The nitromethane layers were tested for detonation properties.
In the detonation procedure No. 1, 15 cc. samples of sensitized nitromethane solution were placed in 20 x 150 mm. Pyrex glass test tubes. The test tubes were placed behind a safety shield and detonated with a No. 6 or 8 blasting cap or a Chestnut Booster (hereafter designated, C.B.). A Chestnut Booster is an electrical blasting cap which has two pieces of detonating fuse two or three inches long, such as Primacord, manufactured by Ensign-Brickford, taped to its sides. The ends of the detonating fuse which project over the end of the blasting cap are cut at about a 30° angle to the longitudinal axis of the fuse. The cut faces are then taped together. When detonated, the point of juncture between the two fuses produces a very sharp shock. The use of this type of booster is sometimes necessary where the charge of sensitized nitroparaffin is not tightly restricted.
In detonation procedure No. 2, 15 cc. samples of sensitized nitromethane solution were placed in 10 x 150 mm. Pyrex glass test tubes. The test tubes were placed in a piece of steel tubing having an inside diameter just large enough to receive the test tubes. The composite containers holding sensitized nitromethane were placed behind a safety shield and fired with blasting caps or a C.B. The results of the qualitative tests are set forth in the table below.

TABLE.—TEST RESULTS

Table with 7 columns: Sensitizer, Concentration, weight percent, Detonation procedure No., Detonator, Number of tests, Number of detonations, Leach solution, Leach time (hrs.). Rows include various sensitizers like Propylene diamine, Ethylene diamine, Hydrazine, N,N-dimethyl hydrazine, Ethylenimine, Hexamethyl phosphorous triamide, Monoethanol amine, Ethylene diamine, Propylene diamine, N,N'-diethyl-p-phenylene-diamine, Benzylamine, and Do.

TABLE.—TEST RESULTS—Continued

Sensitizer	Concentration, weight percent	Detonation procedure No.	Detonator	Number of tests	Number of detonations	Leach solution	Leach time (hrs.)
Benzylamine	6	1	No. 8	8	7	Aqueous sodium chloride	24
Do.	8	1	No. 8	8	7	do.	24
Do.	6	1	No. 8	8	6	Dist. water	72
Do.	8	1	No. 8	8	6	Aqueous sodium chloride	72
Do.	6	2	No. 8	8	8	None	—
Do.	6	2	No. 8	5	5	Dist. water	4
Do.	6	2	No. 8	5	5	Aqueous sodium chloride	24
Do.	6	2	No. 8	5	5	do.	72
Do.	8	2	No. 8	5	5	Dist. water	72
2,4-diaminotoluene	4	1	No. 8	12	8	None	—
Do.	6	1	No. 8	12	10	do.	—
Do.	6	1	No. 8	6	3	Dist. water	4
Do.	6	1	No. 8	8	5	Aqueous sodium chloride	24
Do.	6	1	No. 8	7	5	Dist. water	24
Do.	6	1	No. 8	10	9	do.	72
Do.	6	1	No. 8	10	8	Aqueous sodium chloride	72
Do.	6	1	No. 8	9	5	Dist. water	4
Do.	6	1	No. 8	6	1	Aqueous sodium chloride	4
Do.	6	2	No. 8	8	8	None	—
Do.	6	2	No. 8	5	5	Aqueous sodium chloride	24
Do.	6	2	No. 8	5	5	Dist. water	24
Do.	6	2	No. 8	5	4	Aqueous sodium chloride	72
Do.	6	2	No. 8	5	5	Dist. water	72
Do.	6	1	No. 8	18	12	None	—
2,6-diaminopyridine	4	1	No. 8	8	7	do.	—
Do.	6	1	No. 8	8	4	Dist. water	4
Do.	6	1	No. 8	9	9	Aqueous sodium chloride	4
Do.	6	2	No. 8	8	8	None	—
Do.	6	2	No. 8	5	5	Dist. water	4
Do.	6	2	No. 8	5	5	Aqueous sodium chloride	4
Do.	6	2	No. 8	5	5	Dist. water	24
Do.	6	2	No. 8	5	4	Aqueous sodium chloride	24
Do.	6	2	No. 8	3	3	Dist. water	72
Do.	6	2	No. 8	3	3	Aqueous sodium chloride	72
None	—	1	No. 8	5	0	None	—
Do.	—	2	No. 8	5	0	do.	—
Do.	—	2	C.B.	5	0	do.	—
Pyrrole	2	1	No. 8	3	0	do.	—
2,3-dimethyl aniline	2	1	No. 8	3	0	do.	—
Do.	4	1	No. 8	3	0	do.	—
Dibenzylamine	2	1	No. 8	3	0	do.	—
Do.	4	1	No. 8	3	0	do.	—
p-Toluidine	4	1	No. 8	3	0	do.	—
1-naphthylamine	4	1	No. 8	3	0	do.	—
Benzidine	4	1	No. 8	3	0	do.	—

In addition to those compounds set forth in the specific examples, the following compounds are sensitizers, when used alone or in a mixture with one another, within the scope of our invention:

Alkyleneimines such as—

Propyleneimine

Monoaryalkyleneamines such as—

1-amino-2-phenol ethane

p-Tolylenediamine

p-Methylenediamino benzene

Alkylphosphorous amides such as—

Triethylene phosphorous triamide

N,N-dimethylphosphorous triamide

Aryldiamines such as—

o-Diamino benzene

1,2-diaminonaphthalene

p-Diamino benzene

9,10-diaminoanthracene

Aminopyridines such as—

2-amino pyridine

2,4,6-triamino pyridine

Alkyldiamino benzenes such as—

1-ethyl-2,4-diamino benzene

N,N-dimethyl-1,3-diamino benzene

N-propyl-o-phenylene diamine

Hydrazine compounds such as—

N,N'-dimethyl hydrazine

Propyl hydrazine

N,N,N'-triethyl hydrazine

N,N'-diphenyl hydrazine

N-phenyl-N-methyl hydrazine

Benzyl hydrazine

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Nitroparaffins which find valuable application, when used alone or in mixtures with one another, within the scope of this invention, include the following:

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Mononitromethane

1- or 2-nitropropane

Symmetrical dinitroethane

1,3-dinitropropane

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1,1,3-trinitrobutane

Nitroethane

1,1,2-trinitroethane

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The nitroparaffins used in this invention will preferably have a slight negative oxygen balance. For this reason when mixtures of nitroparaffins are used it is necessary to select and proportion the nitroparaffins which make up the mixture so that the mixture will have a slightly negative oxygen balance.

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Our preferred nitroparaffin is mononitromethane because it has an oxygen balance which renders it relatively safe to handle when unsensitized, it has a low freezing point, it can be stored safely and when sensitized can be detonated with a standard blasting cap.

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The sensitizers of this invention can be employed in concentrations from about 0.5% to about 20% by weight

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of the solution of sensitizer and nitroparaffin. Preferably, the sensitizer is present in the amount of about 2% to about 10% by weight of the solution of sensitizer and nitroparaffin, since large amounts tend to dilute and reduce the explosive power of the nitroparaffin.

Preferably the sensitizer and nitroparaffin are stored, handled and transported in separate containers, being mixed together only at the time and place where they are to be used. This procedure provides a very safe method for working with a very powerful explosive, since unsensitized nitroparaffins can be handled safely with only the precautions normally used in handling inflammable liquids. The sensitizers by themselves require no higher degree of care than the nitroparaffins. The nitroparaffin can, however, be sensitized, if desired, before storage or shipping. Since the sensitized nitroparaffins are very stable to shock, being almost impossible to detonate without the use of a booster, such as an electric blasting cap, they can be handled and stored with safety if the standards of safety normally employed with explosives are observed.

The sensitizer and nitroparaffin can be mixed in any manner and vessel desired. As will be understood in the art, the use of equipment which is likely to give off sparks must be avoided and the materials should be kept cool before, during and after mixing.

Various fillers can be included in the sensitized nitroparaffin before or after it is sensitized. Such fillers include sawdust, powdered coal or carbon, starch, etc. Fillers are well-known in the art.

Since the nitroparaffins and sensitizers alone or in admixture with one another have very low freezing points the sensitized nitroparaffin explosives are particularly well suited for use in cold weather operations and where the materials must be stored in unheated areas. If accidentally frozen, the sensitized nitroparaffins can be thawed out with very little danger of an untimely explosion. While it is preferable not to overheat either the sensitized nitroparaffins or the separate sensitizer and nitroparaffins, it is possible to store either sensitized or unsensitized materials at temperatures up to about 120° F. for an indefinite period of time without detrimental effect.

Detonation of sensitized nitroparaffins can be accomplished by any booster means, such as electric blasting caps or a Chestnut Booster. Booster means are well known in the art. Multiple boosters can be used, if desired. For large charges a small charge of some other explosive, such as dynamite, can be used as a booster.

Sensitized nitroparaffins can be detonated at any temperature between the freezing point and the boiling point of the explosive. Detonation can be accomplished with the explosive held under any desired pressure.

Sensitized nitroparaffins can be contained in place at the site of use by conventional metal, plastic, wood, paper, etc., containers. If the charge is to be placed in a hole bored in a solid rock formation, such as granite, then the liquid sensitized nitroparaffin can be poured directly into the hole without the use of any other container. The sensitized nitroparaffins can be packaged in receptacles which serve as storage containers and also serve to contain the charge in place at the site of use.

When the sensitized nitroparaffins of this invention are used in oil wells to fracture oil bearing formations, it is necessary to use a sensitizer which will not be leached out or in some manner inactivated by the aqueous conditions sometimes present in oil wells.

Water or dampness often come in contact with explosives during storage or just prior to use in many applications, so it is desirable that sensitizers be available which are not inactivated by water. Even though they

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are to some extent water soluble, benzylamine, 2,4-toluenediamine and 2,6-diaminopyridine sensitizers are not leached out of sensitized nitroparaffins or inactivated by water. Nitroparaffins sensitized with these sensitizers can be poured through water and still be detonated. These sensitizers are preferred where the charge is to be exposed to water.

It will be understood that various modifications can be made in this invention without departing from the spirit thereof or the scope of the claims.

We claim:

1. An explosive composition comprising sensitizer in an amount from about 0.5% to about 20% by weight, said sensitizer being selected from the group consisting of lower alkyleneimine, arylalkyleneamine, monoethanolamine, alkylphosphorousamide, aryldiamine, aminopyridine, hydrazine, lower alkyl hydrazine and alkyldiamino benzene; and nitroparaffin.

2. The explosive composition of claim 1, wherein said sensitizer is a mixture of compounds selected from said group.

3. The explosive composition of claim 1, wherein said sensitizer is present in an amount from about 2% to about 10% by weight.

4. The explosive composition of claim 1, wherein said nitroparaffin is nitromethane.

5. An explosive composition comprising ethylene imine in an amount from about 0.5% to about 20% by weight and nitroparaffin.

6. An explosive composition comprising hydrazine in an amount from about 0.5% to about 20% by weight and nitroparaffin.

7. An explosive composition comprising monoethanolamine in an amount from about 0.5% to about 20% by weight and nitroparaffin.

8. An explosive composition comprising hexamethyl phosphorous triamine in an amount from about 0.5% to about 20% by weight and nitroparaffin.

9. An explosive composition comprising N,N-dimethyl hydrazine in an amount from about 0.5% to about 20% by weight and nitroparaffin.

10. An explosive composition comprising sensitizer in an amount from about 0.5% to about 20% by weight, said sensitizer being selected from the group consisting of lower alkyleneimine, arylalkyleneamine, monoethanolamine, alkylphosphorousamide, aryldiamine, aminopyridine, hydrazine, lower alkyl hydrazine and alkyldiamino benzene; nitroparaffin and inert filler.

11. An explosive composition comprising, by weight, 20% to 0.5% of benzylamine, and 80% to 99.5% nitromethane.

12. An explosive composition comprising, by weight, 20% to 0.5% 2,4-toluene diamine, and 80% to 99.5% nitromethane.

13. An explosive composition comprising, by weight, 20% to 0.5% 2,6-diamino pyridine, and 80% to 99.5% nitromethane.

14. An explosive composition comprising nitromethane and a monoarylalkyleneamine sensitizer in an amount from about 0.5% to about 20% by weight.

15. The explosive composition of claim 14 wherein said monoarylalkyleneamine is present in an amount from about 2% to about 10% by weight.

References Cited in the file of this patent

UNITED STATES PATENTS

1,485,003 Woodbury ----- Feb. 26, 1924

FOREIGN PATENTS

490,744 Canada ----- Feb. 24, 1953

558,435 Canada ----- June 3, 1958