United States Patent Office

3,356,547

Patented Dec. 5, 1967

3,356,547

WATER-IN-OIL EXPLOSIVE EMULSION CONTAINING ORGANIC NITRO COMPOUND AND SOLID EXPLOSIVE ADJUVANT

Adolf Berthmann and Clemens Franze, Leverkusen, and Paul Lingens, Cologne-Marienburg, Germany, assignors to Dynamit Nobel A.G., Troisdorf, Bez. Cologne, Germany, a corporation of Germany

No Drawing. Continuation of application Ser. No. 301,178, Aug. 9, 1963. This application Apr. 4, 1966, Ser. No. 544,346

Claims priority, application Germany, Aug. 24, 1962, D 39,680

4 Claims. (Cl. 149—51)

This application is a continuation of application Ser. No. 301,178, filed Aug. 9, 1963, now abandoned.

The subject of copending application Ser. No. 179,491, filed Mar. 13, 1962, now Patent 3,231,437, is detonatable aqueous emulsions which are formed of water and liquid or fusible explosive and these compositions are water-in-oil emulsions. The emulsification is achieved by the use of appropriate stabilizers and emulsifiers which have a solution affinity both for the detonatable component and for the aqueous phase. In an addition to said copending application, a further copending application, Ser. No. 196,445, filed May 21, 1962, now Patent 3,212,945, discloses improvement in that carbon carriers and/or oxygen carriers and water-soluble organic explosives can be dissolved in the aqueous phase.

It has now been found that these emulsions can also be used together with solid substances to constitute new explosive mixtures. The solids to be added may consist of oxygen carriers, combustible substances, detonatable substances, inert substances or a combination of these substances, depending on the type of application.

The important advantages of the explosive mixtures of the invention can be summarized as follows:

By the combination of detonatable emulsions with solids, explosives can be produced in many different consistencies according to the ratio of solids to emulsion; for example, they may be powdered, gelatinous or even castable at ordinary temperatures.

The density of the customary powdered explosives can be advantageously controlled by the water content of the emulsion, without greatly affecting their other technical characteristics.

The effect described in the above-mentioned principal application of the reduction of the sensitivity to impact of the detonatable emulsions is also observed in the explosive mixtures of the present invention. For example, it is possible in the case of many commercial gelatinous explosives to considerably reduce their sensitivity to impact by emulsifying them with aqueous solutions, thus contributing considerably towards safety in handling them.

The brisance of explosive mixtures based on the present invention can be controlled within very wide limits and can be adapted to the desired application. It is also

possible in this manner to increase the heaving effect of the explosive at the expense of its brisance.

In the manufacture of explosive mixtures containing detonatable emulsions an important economic advantage lies in the fact that the percentage of nitroglycerin (nitro compounds) often can be reduced.

The manufacture of the explosive mixtures of the invention is generally performed in such a manner that the detonatable emulsion is worked together with the solid, which is ground to the fineness customary for explosives, in an appropriate mixing apparatus, until it is homogenized, i.e. thoroughly interspersed with respect to the emulsion. Another possibility is to mix the solid first with the aqueous phase and then to add the organic phase (nitroglycerin or nitro compounds) along with emulsifying aids. Also, the aqueous solution can be emulsified with a mixture of the solid and the organic phase. The proportion of emulsion can be about 10–75% of the composition depending on the properties desired.

The advantages of the explosives made according to the invention are now to be described in a number of examples:

EXAMPLE 1

(Powder explosive)

Composition.—13% emulsion consisting of:

9.8 parts nitroglycol
0.1 part collodion cotton
0.1 part of a sorbitol-base emulsifier known by the commercial name of "Span 65," which is partially esterified with fatty acid
3 parts of a saturated, aqueous solution of NH_4NO_3 and $Ca(NO_3)_2$
79% NH_4NO_3
4% wood flour
4% brown coal dust

Test data:

Density	g./cc.	1.06
Lead block test	cc.	360
Hess upset test	mm.	19.0
Propagation of detonation on sand	cm.	20
Energy level	m.-t./l[1]	100.3

[1] Meter-tons per liter.

A standard explosive which contains an additional 3% NH_4NO_3 has the following test data:

Density	g./cc.	0.93
Lead block test	cc.	350
Hess upset test	mm.	18.6
Propagation of detonation on sand	cm.	30
Energy level	m.-t./l.	90.4

As the data on the standard explosive show, it is possible by the use of an emulsion to increase the density and hence the energy level of a powder explosive.

EXAMPLE 2

(Gelatinous explosives with varying water content)

Percentage compositions and test data:

Emulsion			1:1 Molar Mixture, Percent of $NaNO_3$ Plus NH_4Cl	Wood Flour, Percent	Hess Upset Test, mm.	Energy Level, m.-t./l.
Percent Nitroglycerin 60/40 gelatinized	H_2O, Percent	Calcium Stearate, Percent				
30	-------	0.5	66.5	3	230	88.6
30	2	0.5	64.5	3	27	90.0
30	4	0.5	62.5	3	17.5	91.5
30	6	0.5	60.5	3	16.5	92.8
30	8	0.5	58.5	3	11.6	94.2

Despite the substitution of the energy-supplying salt pair ($NaNO_3+NH_4Cl$) by an inert substance (H_2O), a marked increase in the energy level is achieved. The brisance (taking the Hess test as the measure of this factor) can be adjusted within wide limits by varying the water content.

EXAMPLE 3

(*Gelatinous mining explosive*)

Composition.—35% emulsion consisting of:

20 parts 60/40 nitroglycerin
0.8 part collodion cotton
0.2 part zinc oxystearate
14 parts of an aqueous solution of 34.7% cane sugar, 27.8% $Ca(NO_3)_2$, 23.6% NH_4NO_3 and 13.9% H_2O
40% $NaNO_3$
25% NH_4Cl

Test data:

Density	g./cc.	1.65
Lead block expansion	cc.	212
Hess upset test	mm.	12.7
Propagation of detonation on sand	cm.	3
Propagation of detonation (cardboard tube)	cm.	5

This explosive complies with the Class 1 specifications as gas proof, and yet, at 212 cc., its lead block expansion or power is 15% greater than that of the ordinary Class 1 mining explosive of the following composition:

Nitroglycerin	Percent	30
Ammonium nitrate	do	26.5
50% calcium nitrate solution	do	3
Wood flour	do	0.5
NaCl	do	40.0
Lead block expansion	cc.	185

in spite of the fact that the latter has a substantially higher content of a brisant explosive.

EXAMPLE 4

(*Gelatinous rock blasting explosive*)

Composition.—34 parts emulsion consisting of:

20 parts 60/40 nitroglycerin
0.6 part collodion cotton
0.1 part of a sorbitol-base emulsifier sold under the commercial name "Tween 80," which is partially esterified with fatty acid and is partially ethoxylated.
13.3 parts of an aqueous solution of 34.7% cane sugar, 27.8% $Ca(NO_3)_2$, 23.6% NH_4NO_3, 13.9% H_2O
64 parts NH_4NO_3
2 parts wood flour
3 parts powered brown coal

Test data:

Density	1.55 g./cc.
Lead block expansion	370 cc.
Hess upset test	14 mm.
Propagation of detonation	4 cm.
Koenen-Ide impact test	1 kg., 50 cm.

This explosive is of about the same power as the one known by the commercial name of Ammon-Gelit 3 (lead block expansion 375 cc.), but it is substantially safer to handle (Ammon-Gelit 3 impact test: 1 kg., 20 cm.), and more economical, since it uses 2% less nitroglycerin than Ammon-Gelit 3 and contains no aromatic nitrocompounds (Ammon-Gelit 3: 11% aromatic nitrocompounds).

EXAMPLE 5

(*High-brisance gelatinous explosive*)

Composition.—35% emulsion consisting of:

19 parts 60/40 nitroglycerin
0.8 part collodion cotton
0.2 part calcium oxystearate

14.7 parts saturated aqueous solution of NH_4NO_3, $Ca(NO_3)_2$ and NH_4ClO_4
0.3 part guar flour
25% NH_4ClO_4
40% Hexogen [RDX, trimethylenetrinitroamine]

Test data:

Density	1.58 g./cc.
Lead block expansion	450 cc.
Hess upset test	Greater than 30 mm.
Detonation rate	7200 m./sec.
Kast impact test	1 kg., 20 cm.

Composition of a comparable explosive without emulsion:

60/40 nitroglycerin	Percent	33.5
Collodion cotton	do	1.5
HN_4ClO_4	do	25
Hexogen [RDX, trimethylenetrinitroamine]	do	40

Test data:

Density	1.58 g./cc.
Lead block expansion	500 cc.
Hess upset test	Greater than 30 mm.
Detonation rate	7700 m./sec.
Kast impact test	1 kg., 8 cm.

The emulsion explosive of this example still has a high brisance, as shown by the Hess upset test and the detonation rate, although it contains only 20% nitroglycerin as compared with 35% for the comparable explosive. As the two impact tests show, the handling safety has been appreciably increased.

EXAMPLE 6

(*Castable explosive*)

Composition.—60% emulsion consisting of:

35.4 parts 60/40 nitroglycerin
0.3 part collodion cotton
23.8 parts saturated ammonium nitrate solution
0.3 part of an emulsifier which is obtainable on the market under the name "Cremophor FM," and is a fatty acid condensation product
35.6% NH_4NO_3
4.4% brown coal dust

Test data:

Density	g./cc.	1.20
Lead block expansion	cc.	350

Due to the castability of this explosive, high charge densities can be achieved by direct pouring even into irregularly shaped cavities.

60/40 nitroglycerin used in the examples is 60 parts nitroglycerin and 40 parts nitroglycol.

While the invention has been described with respect to particular embodiments thereof, these embodiments are merely representative of the invention and do not serve to define the limits thereof.

What is claimed is:

1. An explosive composition comprising a detonatable water-in-oil explosive emulsion containing an emulsifying agent and wherein the oil is nitroglycerine or nitroglycol, and solid exposive adjuvant of the group ammonium nitrate, the salt pair sodium nitrate and ammonium chloride, RDX, the proportion of emulsion being about 10–75% by weight of the composition.

2. An explosive composition according to claim **1**, wherein said solid explosive adjuvant is solid ammonium nitrate, and imparts an increased energy level to the explosive.

3. An explosive composition according to claim **1**, wherein said solid explosive adjuvant is solid ammonium nitrate and solid sodium nitrate, and imparts an increased energy level to the explosive.

4. An explosive composition according to claim 1, wherein said solid explosive adjuvant is solid RDX, and imparts high brisance to the the explosive.

References Cited

UNITED STATES PATENTS

3,161,551 12/1964 Egly et al. ---------- 149—46

3,212,945 10/1965 Berthmann et al. ------ 149—47
3,231,437 1/1966 Berthmann et al. ----- 149—101

CARL D. QUARFORTH, *Primary Examiner.*

BENJAMIN R. PADGETT, *Examiner.*

S. J. LECHERT, JR., *Assistant Examiner.*