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EXPLOSIVE COMPOSITION

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This invention relates to a high explosive composition, and more particularly to a modified blasting gelatin.

Blasting gelatin is one of the strongest commercial explosives, being considered to have essentially 100% of the strength of nitroglycerin. It comprises over 90% of nitroglycerin ordinarily, and between 4 and 8% of dissolved nitrocotton, whereby it takes on a tough, rubbery consistency. It is customary to include in the composition, also, around 1.0% of an acid accepting material such as calcium carbonate. A portion of the nitrocotton may likewise be replaced by other ingredients.

One of the principal uses of blasting gelatin is in the shooting of oil wells, where it is lowered to great depths in the well, for example, to 5,000 or 10,000 ft. or more. Under the high pressures encountered at such depths, it is essential that the blasting gelatin remain sufficiently sensitive to propagate the explosion throughout the entire mass. It is important, also, that the velocity of detonation be at the maximum, and not of a low order, if satisfactory execution is to be obtained. Some difficulties with respect to sensitiveness and velocity have been encountered in the case of explosives of this type as made heretofore.

An object of the present invention is a gelatinized explosive high in nitroglycerin and possessing very favorable properties under conditions of confinement by high pressures. A further object is a modified blasting gelatin characterized by an improved degree of sensitiveness to propagation. A further object is such an explosive capable of detonation at its maximum velocity under unfavorable conditions. A still further object is a modified blasting gelatin containing an added ingredient which imparts superior properties thereto. Additional objects will be disclosed as the invention is described more at length hereinafter.

We have found that the foregoing advantages are attained when we introduce into a blasting gelatin composition a relatively small amount of an oxide of a metal of a certain group. We find that the oxides which bring about this favorable effect are those taken from the class of metals consisting of manganese, copper, titanium, lead, tin, and iron, particularly ferric iron. In the manufacture of blasting gelatin, the customary procedure is to introduce the requisite amount of liquid nitroglycerin into the mixing bowl at the proper temperature. The weighed amounts of nitrocotton and other ingredients are then added, together with the inorganic oxide. Agitation is then started and mixing continued until thorough incorporation and gelatinization have resulted.

The following examples will serve to illustrate more clearly the method of carrying out our invention and the advantages resulting therefrom.

Example 1

Blasting gelatins in 1¼" diameter cartridges were prepared having nitroglycerin contents of 91% and suitable proportions of nitrocotton, together with small quantities of an inorganic oxide. Tests were carried out on standard blasting gelatin and on similar explosives containing oxides of tin, manganese, and lead, respectively. The following results were obtained:

Oxide	Amount	Sensitiveness of blasting gelatin after 2 months' storage at 120° F.	Velocity after 2 months' storage
	Per cent	*Inches*	
None		0	Failed to shoot.
SnO_2	1	1	6,560 m./sec.
MnO_2	1	12	7,140 m./sec.
PbO	1	2	6,670 m./sec.

In the foregoing tabulation, the sensitiveness results were obtained by separating two sticks of the blasting gelatin by definitely spaced intervals and determining the greatest distance at which consistent detonations of the second cartridge were obtained as the result of the detonation of the first cartridge and propagation of the resulting explosive wave across the air gap. From the above tabulation it is seen that, in the case of the standard blasting gelatin, the explosive did not propagate even when there was no air gap, while in the presence of 1% MnO_2 propagation took place across a gap of 12". With the blasting gelatins containing tin and lead oxides, intermediate increases in sensitiveness were obtained as well as an improvement in velocity. While the standard failed to shoot in the velocity test, the samples containing the various oxides detonated at high velocity, the blasting gelatin containing manganese dioxide showing the high velocity of 7140 meters per second.

Example 2

Similar mixings of blasting gelatins were tested in the same manner, with the following results:

Oxide	Amount	Sensitiveness
	Percent	*Inches*
None		2
CuO	1	10
Fe_2O_3	1	10
TiO_2	1	10

The advantages of the presence of copper oxide, ferric oxide, and titanium dioxide are shown by the increased sensitiveness obtained.

Example 3

Blasting gelatins were prepared containing (1) no added oxide, and (2) manganese dioxide. These were packed in 1¼" diameter cartridges and tested for sensitiveness and velocity, both when fresh and after 1 month's storage at 120° F. It will be seen from the results below that the sample containing no oxide was at least equal to the one containing manganese dioxide when freshly made, but that the standard sample became quite insensitive on storage, while the one containing manganese dioxide showed little deterioration.

Oxide	Amount	Sensitiveness		Velocity	
		1 day	1 month at 120° F.	1 day	1 month at 120° F.
	Percent	*Inches*	*Inches*		
None		22	0 (Failed)	7,290	Failed.
MnO_2	1	15	10	6,860	7,650.

The foregoing examples show strikingly the improvement in blasting gelatins by the inclusion of small amounts of certain finely divided metal oxides, especially with regard to the retention of their initial properties after storage under severe conditions. We find an amount between 0.1 and 5.0% of the oxide to be desirable, and our preferred range is between 0.4 and 2%. While various inorganic oxides have improved the properties of the blasting gelatins, we find manganese dioxide to be particularly effective in this respect.

It is essential for the attainment of the several advantages of the invention that the inorganic oxide be in finely divided form. Preferably, such oxide will be sufficiently fine that substantially all will pass a 100-mesh screen. In the case of manganese dioxide, our preferred material, advantageous results have been obtained when using material such that the greater part passed a 30-mesh screen but was held on a 65-mesh screen. The use of 100+ material, however, gives more certain results.

Our invention has been described as particularly applicable to blasting gelatins. While this is the place of maximum advantage, we find the oxides mentioned to give improvement in the case of all gelatinized explosives containing more than 80% nitroglycerin or other liquid explosive nitric ester. Desirably such explosives will have a nitroglycerin content of over 88%, and, in the case of blasting gelatins, the nitroglycerin content will ordinarily be above 90%. When the term "nitroglycerin" is used, we intend this to include not only the chemical compound itself but also nitroglycerin containing other dissolved nitrated materials, such as ethylene glycol dinitrate, nitrated sugars, nitrated polymerized glycerin, dinitrochlorhydrin, and the like, which have been added for the purpose of depressing the freezing point, or for other reasons. While the examples and description have disclosed nitrocotton as the gelatinizing agent for the nitroglycerin, it will be understood that other appropriate forms of nitrocellulose may be used. We likewise find the invention best adapted to gelatinized compositions containing a relatively high ratio of nitrocellulose to liquid explosive nitric ester, for example not less than 1 part of the former to 25 parts of the latter. In other words, the invention is especially adapted to tough, rubbery compositions such as blasting gelatins and to gelignite types, but not limited thereto.

We have described our invention at length in the foregoing. It will be understood, however, that many variations may be introduced without departure from the scope of the invention. We intend to be limited therefore only by the following patent claims:

1. A high explosive composition comprising more than 80% of a liquid explosive nitric ester, nitrocellulose, and between 0.1% and 5.0% of an inorganic oxide in finely divided form taken from the group consisting of the oxides of manganese, copper, titanium, lead, tin, and ferric iron.

2. A modified blasting gelatin containing more than 88% of a liquid explosive nitric ester, nitrocellulose, and between 0.1 and 5.0% of a finely divided inorganic oxide taken from the group consisting of the oxides of manganese, copper, titanium, lead, tin, and ferric iron.

3. A modified blasting gelatin comprising at least 90% of nitroglycerin, nitrocellulose as gelatinizing agent, and between 0.1 and 5.0% of manganese dioxide.

4. A modified blasting gelatin containing more than 88% of a liquid explosive nitric ester, nitrocellulose, and between 0.1 and 5.0% of an inorganic oxide of such degree of fineness that substantially the greater part will pass a 100-mesh screen, said oxide being taken from the group consisting of the oxides of manganese, copper, titanium, lead, tin, and ferric iron.

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