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CAST EXPLOSIVE COMPOSITION

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6 Claims. (Cl. 52—7)

This invention relates to high density explosive charges, particularly of the cast type, having particular advantages in properties because of their novel compositions.

This application is a continuation of my copending application Serial No. 72,996 filed January 26, 1949, now abandoned.

Explosive compositions comprising essentially blends of a low melting explosive compound such as trinitrotoluene with one or more inorganic nitrates have found important applications, both civil and military. Because of the low fusion point of trinitrotoluene, this compound is well adapted for use in cast explosives, which, because of their high density, make possible the attainment of high bulk strength. Whereas trinitrotoluene by itself is highly deficient of oxygen, its blends with ammonium nitrate or other inorganic nitrate are more nearly balanced with respect to oxygen. Amatol-type compositions, for example, have found important uses, containing between 40 and 80 parts of ammonium nitrate and 60 to 20 parts trinitrotoluene by weight.

Thorough incorporation of the solid ammonium nitrate with the molten trinitrotoluene is necessary, prior to casting, if satisfactory results are to be obtained. Since the mutual solubility of the two materials is low, there is danger of segregation of the components, which would result in a lack of uniformity in composition and propagating power. With mixtures relatively low in the fusible component, a disadvantage is encountered from poor flowing properties of the dispersions.

An object of the present invention is a high explosive composition comprising an inorganic nitrate and an organic explosive compound of a fusion point below 100° C., said composition being characterized by markedly improved flowing properties at temperatures at which the low melting compound is in molten condition. A further object is such a composition comprising ammonium nitrate and trinitrotoluene. A still further object is a composition of the nature described, in which the improved flowing properties have resulted from the inclusion of a novel ingredient in small proportions. A further object is a blend of the aforementioned ingredients, in which the tendency to segregation has been reduced prior to solidification. Additional objects will be disclosed as the invention is described in more detail in the following.

I have found that the foregoing advantages are accomplished when I formulate an explosive composition comprising an inorganic nitrate, trinitrotoluene, and a small percentage of a monobasic fatty acid having a melting point below 100° C. and containing at least eight carbon atoms. While I do not wish to be limited as to the method of preparation, desirably the major ingredients will be preheated separately and blended at a temperature at which the TNT is in molten condition. Ammonium nitrate is the preferred inorganic nitrate, or mixtures of this with sodium nitrate, and stearic or palmitic acid the fatty acid.

While different procedures may be followed in the preparation of explosive charges according to the invention, the following was found satisfactory and will be understood to be illustrative only and not limiting in any way.

Example 1

Ammonium nitrate in the amount of 71.8 parts by weight was introduced into a mixing apparatus in which agitation was provided by revolving blades, and 0.2 part of stearic acid was added. The mixture was heated for a short time at a temperature between 70° and 75° C. Subsequently, the ammonium nitrate was introduced into a graining kettle, and 35.0 parts of molten trinitrotoluene was then added gradually, the latter being at a temperature above 90° C. Thorough incorporation of the ingredients was effected, the temperature of the mixture being maintained around 85° C. The composition was then poured into large-diameter paper tubes of sturdy structure, for example 5 in. in diameter by 16 in. length, and the cartridges were closed by suitably crimping the open ends. The cast explosive had a density of around 1.60 g./cc. Whereas the explosive mixture described was very fluid and pourable, a blend of the same proportions of ammonium nitrate and trinitrotoluene by themselves, with no fatty acid additive, was not truly pourable, though wet in appearance.

Example 2

Following the procedure described in Example 1, the following compositions were prepared:

Composition	A	B	C	D	E	F
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
TNT	34.0	34.0	34	34.0	34.0	34.0
#3 NH_4NO_3*	15.0	15.0	15.0	15.0	36.8	36.8
#2 NH_4NO_3**	20.0	20.0	20.0	20.0		
$NaNO_3$	30.0	30.0	30.0	30.0	26.7	26.7
Chalk	1.0	0.98	0.95	0.9	1.0	1.0
Stearic Acid		0.02	0.05	0.1	1.5	2.5

*Not more than 20% held on 35 mesh screen and from 15–35% passing 100 mesh screen.

**Not more than 15% held on 14 mesh screen, 30–55% held on 20 mesh screen, and not more than 5% passing a 35 mesh screen.

The results were as follows:

Composition A. Soft, slushy (like dry appearing apple sauce), grainy not smooth. Formed mounds 1–2 in. in height while being loaded into shell. Shells were bounced to give a full shell, the average weight of a 4 x 12 inch shell was 8 lb. 12½ oz.

Composition B. More creamy and smooth than A; more pourable and fluid. Flowed, and severe bouncing was not required to fill shell 4 x 12 in. shell average weight—8 lb. 15 oz.

Composition C. More creamy and smooth than B. Gave smooth surface on pouring into shell without any bouncing. 4 x 12 in. shell average weight—8 lb. 14 oz.

Composition D. Very creamy and fluid. Excellent pouring properties. 4 x 12 in. shell average weight, 8 lb. 13 oz.

Composition E. Readily pourable. 4 x 12 in. shell average weight, 8 lb. 13.2 oz.

Composition F. Not pourable—very slushy. 4 x 12 in. shells loaded by bouncing had an average weight of 8 lb. 9.7 oz.

The foregoing example illustrates the criticality of maintaining the fatty acid added within specific limits, i. e., between 0.01 and 2.0% by weight of the final composition, since excess fatty acid, as exemplified in composition F, reduces pourability. The optimum amount of fatty acid required for any composition will vary according to the amount of TNT present, the fineness of the ingredient, the moisture content of the ingredients, etc.

The explosives of the present invention consist mainly

of a blend of trinitrotoluene with an inorganic nitrate. Ammonium nitrate is the preferred inorganic nitrate because of its inherent properties as an explosive compound when properly primed and especially when blended with a sensitizing ingredient, whereby substantial oxygen balance is attained or approached. Other inorganic nitrates may be present, for example sodium nitrate, which may be present as the only nitrate or together with ammonium nitrate. Many other inorganic nitrates may also be used, such as calcium nitrate, lead nitrate, etc. Additional oxidizable ingredients may be present also, if desired, such as ferrosilicon, aluminum, dinitrotoluene, paraffin, starch, and the like.

Various fatty acids, singly or in mixtures, are available and suitable for use in the compositions, one requirement being that the fatty acids have a melting point below 100° C. so that they will be in liquid form at the temperature of incorporation and pouring. I find it desirable that the acid employed be one containing at least eight carbon atoms. Examples of fatty acids satisfactory for use are stearic acid, palmitic acid, oleic acid, lauric acid, and the like. Stearic acid is our preferred additive.

While a relatively wide range of compositions is possible, it will be understood that a particularly important field will be in ranges where the trinitrotoluene is present in relatively low percentages, such that flow properties of the molten mixtures require consideration. The fatty acid will be present in amounts between 0.01% and 2% by weight of the composition. The explosive charges according to the invention will preferably be within the composition limits by weight of 50–80% ammonium nitrate, 50–20% trinitrotoluene, and 0.01–2.0% fatty acid.

The explosives of the present invention have definite advantages over prior art compositions, particularly with respect to flowing properties. It is realized that, in shell filling operations, mixtures containing as low as 20% trinitrotoluene have been used, but such compositions had to be forced into the shell by the use of pressure, the molten portion serving substantially as lubricant. The compositions described herein, however, allow mixtures to be poured that otherwise would not flow or cause difficulty pourable mixtures to flow freely.

It will be understood that the invention is not limited to size of cartridges, and the dimensions of these may vary from those of the smaller dynamite cartridges to the larger quarry sizes, for example 5 in. by 24 in. in dimensions. If desired, a plurality of cartridges may be used, and the nature of the present compositions would allow novel methods of forming the explosive column. Prior to solidification, for example, projections in the form of hooks, bars, or various shaped objects may be inserted into the molten mixture, which become firmly secured on solidification. At the other end of the same cartridge, a preformed cavity or other device secured in place during solidification could be provided, whereby the assembly of various cartridge units would be facilitated. In a similar manner, lowering arrangements could be provided, comprising embedded arms of twisted metal or other material.

The invention has been described at length in the foregoing. It will be understood, however, that various modifications in the details of compositions, procedures, and attachments may be introduced without departure from the spirit of the invention. I intend to be limited only by the following claims.

I claim:

1. An explosive charge comprising a cast blend of between 50% and 20% of solid trinitrotoluene, between 50% and 80% of at least one solid granular inorganic nitrate distributed throughout the trinitrotoluene, and a monobasic fatty acid containing at least eight carbon atoms and having a melting point below 100° C., said fatty acid being present in an amount between 0.01% and 2%.

2. The explosive charge of claim 1, in which the inorganic nitrate is ammonium nitrate.

3. The explosive charge of claim 1, in which the fatty acid is stearic acid.

4. The explosive charge of claim 1, in which the inorganic nitrate is sodium nitrate.

5. The explosive charge of claim 1, in which the fatty acid is palmitic acid.

6. The explosive charge of claim 1, in which the fatty acid is oleic acid.

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