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PROCESS OF PRODUCING CYCLONITE-CONTAINING EXPLOSIVE

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This invention relates to a method of producing high velocity gelatinous explosives of the non-nitroglycerin type by a procedure different from that ordinarily followed for such compositions and one giving particular consideration to safety requirements.

This application is a continuation-in-part of our copending applications, Serial No. 494,014, filed July 9, 1943, and Serial No. 490,878, filed June 15, 1943, now both abandoned.

The usual type of plastic high explosive for commercial use comprises the gelatin dynamites, which are based on gelatinized nitroglycerin as the principal explosive ingredient. Such explosives are excellently adapted for certain blasting applications in that they possess high densities and consequent high loading strength, fill the borehole compactly because of their plasticity, and have high water resistance. The gelatin dynamites are prepared by forming a gelatinous mass by incorporation of nitrocotton in nitroglycerin and mixing into said mass the solid non-explosive ingredients. Only limited dust hazards are present because of the fact that the explosive ingredient is a liquid. One drawback to such explosives comes in the fact that, while possessing initial high velocity of detonation, they do not always retain this velocity after storage for considerable periods of time.

Plastic explosives of the foregoing high density characteristics would be valuable for military uses also, but it is essential there that consistently high velocity be attained in a very short interval of time even with relatively small charges, and that such velocity be maintained even after long periods of storage. It would be desirable also that, in such uses, the explosive charge should be sufficiently insensitive to shock that it would be incapable of initiation by a rifle bullet, for example, or by other similar impact, a degree of insensitiveness that is not possessed by the known gelatin dynamites. An explosive composition that would have these desired properties and that at the same time could be manufactured with completeness of incorporation would represent a desirable advance.

An object of the present invention is a method of producing high velocity gelatinous explosives without the necessity of employing liquid high explosive ingredients. A further object is such a method in which the explosive sensitizing ingredient is a normally solid explosive compound, present in the finished product in substantially dry form. A still further object is a method wherein the hazards of dustiness in the handling

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of dry solid explosive compounds are avoided and which allows the preparation of a gelatinous high velocity explosive of a relatively low degree of sensitivity to impact but capable, on initiation, of attaining maximum velocity very rapidly. Other objects will be disclosed as the invention is described at greater length in the following.

We have found that the foregoing objects are accomplished and a gelatinous explosive of the desired characteristics obtained without hazard, when we mix a blend of aromatic nitrocompounds with a normally solid high velocity crystalline explosive compound in wet condition, heat this blend to an elevated temperature and maintain it at such temperature sufficiently to remove substantially all of the water, introduce nitrocellulose into the blend while it is still at an elevated temperature, whereby gelatinization is effected, and then cool the gelatinized mass. While various normally solid high velocity explosive compounds may be employed as sensitizing agent in the foregoing procedure, cyclotrimethylenetrinitramine, commonly designated as cyclonite, is our preferred material for use, because of its superior thermal stability. Desirably a blend of dinitro- and trinitrotoluene will be present in the initial blend of nitrocompounds with sensitizer, when a relatively high temperature is attained, and mononitrotoluene and nitrocellulose will be added when the temperature has been reduced, though still at an elevated level. The addition of mononitrotoluene at the lower temperature is advantageous due to the greater volatility of this nitrocompound and its presence in the final product is desirable, though not necessary, because of the greater resistance to freezing at low atmospheric temperatures when this ingredient is present.

The method of manufacture will be understood more clearly by reference to the specific embodiments described in the following examples, which are given by way of illustration only and are not to be taken as limiting in any way.

Example 1

Cyclonite in the amount of 482.4 pounds, wet with approximately an additional 10% of water, was introduced into a jacketed kettle, together with 78 pounds of dinitrotoluene and 30 pounds of trinitrotoluene. These materials were thoroughly mixed by mechanical agitation, and the mixture was then heated by passing steam into the jacket. The time required was approximately 20 minutes for the addition of the initial ingredients, and 120 minutes for heating the charge to about 93° C. At this point, the steam

was turned off and cold water was run into the jacket. When the mass had cooled to around 65° C., 6 pounds of dimethylformamide was added, which functions as a plasticizer and freezing point depressant. When the cooling had progressed to 60° C., 3.6 pounds of nitrocotton was introduced. The mixture was then allowed to cool to around 32° C., at which time the gelatinized mass was removed from the mixer, the entire cooling and gelatinization time comprising about 70 minutes. The percentage composition of the finished product was as follows:

	Per cent
Dinitrotoluene	13.0
Trinitrotoluene	5.0
Cyclonite	80.4
Dimethylformamide	1.0
Nitrocotton	0.6
	100.0

Example 2

A 600-pound mix of gelatinous explosive of the following composition was prepared:

	Per cent
Dinitrotoluene	12.0
Trinitrotoluene	5.0
Mononitrotoluene	2.0
Cyclonite	79.4
Dimethylformamide	1.0
Nitrocellulose	0.6
	100.0

The same general procedure was followed as in Example 1, the operating temperatures and the times being substantially the same. The cyclonite used had a water content of 9.5%. The mononitrotoluene was added at the same time as the dimethylformamide, and these two were both distributed evenly throughout the mass by the time the nitrocotton was added.

The gelatinous explosive, after rolling, had a density of 1.56 and in 2½ in. diameter cartridges, when suitably primed, showed a velocity of detonation of 7,000–8,000 meters per second. It was sufficiently sensitive to be detonated by a No. 6 tetryl blasting cap but sufficiently sensitive that it gave no detonations under the impact of a rifle bullet. The product was cohesive and sufficiently plastic to be readily moldable at temperatures between −26° and +49° C.

Example 3

Another 600-pound mixing was prepared of the following composition:

	Per cent
Dinitrotoluene	10.0
Trinitrotoluene	4.0
Mononitrotoluene	5.0
Cyclonite	77.0
Nitrocotton	1.0
Tetryl	3.0
	100.0

The procedure followed was generally similar to that of Example 1. Cyclonite, wet with 11.0% water, was mixed with the dinitrotoluene and trinitrotoluene and the mixture was heated to about 86° C., this step requiring about 120 minutes, at which time the water had been substantially removed. The steam was turned off then and cold water run into the jacket. When the mass had cooled to around 77° C. (12 minutes), the tetryl was added and mixed in. After another 12 minutes of cooling, at 63° C., the nitrocotton was introduced, and in another 20 minutes, at 56° C., the mononitrotoluene. Agitation was continued throughout the process so that thorough blending had been effected each time before addition of a new ingredient.

The final gelatinous product had a density of 1.58 and a velocity of detonation of between 7,000 and 8,000 meters per second. The addition of the tetryl brings about an advantageous lowering of the freezing point without sacrifice of explosive strength or other properties.

In carrying out the method of the invention, the object is to prepare an explosive composition that will detonate at very high velocity and will attain such velocity in a very brief time interval, even when relatively small charges are used. At the same time, the composition should be of a lower order of sensitiveness to shock or impact than the standard gelatin dynamites, desirably not sensitive to the shock of a rifle bullet, particularly if intended for military use. Furthermore, the explosive should be highly water resistant and of high strength.

A normally solid granular high explosive compound is employed as explosive sensitizer in the compositions, and we find cyclonite especially suitable for such use because of its exceptional thermal stability, inasmuch as the initial mixture is to be heated to an elevated temperature to expel the water present in the wet explosive compound. Cyclonite can be heated for several hours without fear of decomposition to temperatures up to 100° C., and the higher the temperature used the more rapid the drying process. Other organic explosive compounds may be used, however, such as tetryl, ethylenedinitramine and the like, though the maximum drying temperature with these compounds will desirably be lower than with cyclonite.

A plastic composition is obtained by the gelatinizing of nitrocotton or other form of nitrocellulose with a blend of aromatic nitrocompounds. Various of these materials may be used for example, nitrobenzene, mono-, di- and trinitrotoluenes, nitroxylenes and nitronaphthalenes. Desirably a blend will be chosen that is in liquid condition at normal temperatures, since a more plastic explosive results thereby. Preferably a blend of nitrotoluenes will be used, either dinitro- and trinitrotoluene together, or these with added mononitrotoluene. The presence of the latter ingredient assures non-solidity of the nitrotoluene blend at relatively low temperatures. Whereas a 12–5–2 blend of DNT-TNT-MNT has a thaw point of −5° C., an 8–4–7 blend of the same nitrotoluenes has a similar value of −40° C. Nitrocotton will be present in sufficient amount to give the proper gelatinous consistency to the nitrotoluene blend.

The gelatinous explosive of the present invention will preferably have a final composition within the range of 60–85% cyclonite, 0.5–8.0% mononitrotoluene, 6–14% dinitrotoluene, 1–7% trinitrotoluene, and 0.4–1.5% nitrocellulose. Tetryl will be a desirable addition in some cases, in an amount between 1 and 10%, and other materials may be added as plasticizers, freezing point depressants, etc.

It will be apparent from a consideration of advantages of the invention that a considerable advance has been made. By the use of a solid explosive sensitizer in place of nitroglycerin and with a waterproofing gelatinous medium comprising a blend of nitrotoluenes, the desired low degree of sensitiveness to impact is obtained.

The hazards inherent in the handling of finely divided, dusty high explosive compounds, however, are avoided by maintaining said explosive compounds in completely wet condition until well beyond the initial stages of the manufacturing process, at which time the explosive is enclosed within a gelatinous matrix. We find it desirable to have the initial water content of the solid explosive compound between 7 and 20%.

The invention has been described adequately in the foregoing but it will be understood that many variations in details of compositions and operating conditions and procedures may be introduced. We intend to be limited only by the following claims.

We claim:

1. A method of preparing high velocity gelatinous explosives, which comprises mixing cyclotrimethylenetrinitramine having a water content between 7 and 20%, with a blend of nitrotoluenes in liquid form during at least a portion of the process, heating the mixture to a temperature between 65° C. and 100° C., and thereby substantially removing the water, cooling the mass, and introducing nitrocellulose into the mixture during the process of cooling.

2. The method of claim 1, in which the mixture of nitrotoluenes and cyclotrimethylenetrinitramine is heated to a temperature between 75° and 100° C.

3. A method of preparing high velocity gelatinous explosives, which comprises mixing a blend of dinitro- and trinitrotoluene in liquid form during at least a portion of the process with wet cyclotrimethylenetrinitramine having a water content of between 7 and 20%, heating the mixture to a temperature of between 75° and 100° C. and thereby removing the water, cooling the mixture and adding mononitrotoluene and nitrocellulose while the temperature is still elevated, and cooling the gelatinized mass.

4. The method of claim 3, in which tetryl in an amount of 1 to 10% is added to the mixture while it is at an elevated temperature.

5. The method of claim 3, in which the various ingredients are added in such amounts that the final composition comprises 60–85% cyclotrimethylenetrinitramine, 0.5–8% mononitrotoluene, 6–14% dinitrotoluene, 1–7% trinitrotoluene, and 0.4–1.5% nitrocellulose.

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