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PARTICULATE EXPLOSIVE COATED WITH DISCRETE PARTICLES OF POLYTETRAFLUOROETHYLENE

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No Drawing. Continuation of application Ser. No. 565,075, July 14, 1966. This application June 19, 1968, Ser. No. 742,954

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U.S. Cl. 149—4 6 Claims

ABSTRACT OF THE DISCLOSURE

An explosive composition which comprises particulate explosive material coated with solid polytetrafluoroethylene. This plastic composition may be prepared by mixing particulate explosive material with finely divided PTFE to distribute the PTFE over the surface of the particles and compressing the mixture in the absence of liquid to convert it to a coherent plastic mass.

This application is a continuation of application Ser. No. 565,075, filed July 14, 1966, now abandoned.

This invention relates to explosive compositions of the kind comprising particulate explosive and binding material therefor and to a process for preparing such compositions.

The explosive compositions of the invention comprise explosive particles coated and bound together by a binding agent which, initially at least, confers plastic properties on the composition. Explosive compositions of a plastic consistency are advantageous for many uses because they can be readily shaped by pressure deforming operations such as extrusion or moulding.

In general, the binding agents used to plasticise explosives have been viscous (usually oleaginous) liquids which tend to give a sticky product and to exude under pressure or to migrate from the composition when in contact with absorbent material. Usually the liquid binding agent comprises a sensitive explosive liquid such as, for example, nitroglycerine.

It is an object of the present invention to provide a non-sticky plasticised explosive composition which does not include a liquid binding agent.

We have discovered that particulate explosive solids can be plasticised by coating the particles with solid polytetrafluoroethylene (PTFE) without markedly impairing the explosive properties.

Thus an explosive composition of this invention comprises particulate explosive material coated with solid polytetrafluoroethylene. This plastic composition may be prepared by the process of the invention which comprises mixing particulate explosive material with finely divided PTFE to distribute the PTFE over the surface of the particles and compressing the mixture to convert it to a coherent plastic mass.

Although it is possible to obtain plastic explosive compositions wherein the particles are incompletely covered with PTFE, it will be obvious that it is preferable that the quantity of PTFE used and the degree of mixing should be sufficient to effect complete coverage of the surface of the particles. In general, the degree of binding of the plastic composition increases with increasing PTFE content up to PTFE contents of about 30% by weight. PTFE contents in the range 1–5% by weight are usually sufficient to give compositions which can be formed in

coherent plastic state under very light compression and which have a consistency somewhat resembling the confection known as marshmallow.

In this form they may be extruded through a nozzle into the form of a cord or column or may be rolled or moulded into the form of a pliable sheet. When highly compressed the compositions substantially lose their plasticity and become hard, rigid solids.

The plasticising and binding effect of PTFE is believed to result from the cohesion of the PTFE coating layers which, because of the low coefficient of friction between them, can slip over each other when the mass is subjected to pressure. The use of PTFE as binding material in these explosives permits the preparation of plastic explosives of higher strength than those hitherto available because of the relatively low proportions required. PTFE, being chemically and thermally stable, does not affect the stability of the explosive composition.

An especially useful plastic composition of this invention is one in which the particulate solid is pentaerythritol tetranitrate (PETN) since it may be moulded as the core of detonating fuse-cord to give a fuse-cord which is easier to manufacture than the commonly used fuse-cord containing a core of dry particulate PETN encased in a thermoplastic sheet.

Compositions of the invention may be advantageously formed into shaped charges or into plastic sheet explosive, specially suited to the requirements of metal forming operations. They may also be used as detonator, booster and propellent charges.

Other common particulate explosives which may be comprised in plastic compositions of the present invention include cyclotrimethylene trinitramine, blackpowder, TNT, pentolite, tetryl, styphnic acid, and explosive mixtures comprising chlorates, perchlorates, and nitrates of sodium, potassium, calcium or ammonia. A powdered TNT/ammonium nitrate explosive may, for example, be admixed with PTFE to form a plastic explosive which may be sheeted and used for metal forming, or cyclotrimethylene trinitramine may be plasticised with PTFE to form a plastic composition which is superior for shaped charges to the wax-plasticised compositions usually employed. The velocity of detonation of such plastic explosive compositions may be varied by varying the density or by the inclusion therein of non-explosive particulate solids such as, for example, sodium chloride, or in the case of sheet explosive by varying the sheet thickness. The strength of sheet explosives may be improved by incorporating fibrous material such as cellulose.

The average particle size of the particulate explosive constituent of the composition is not critical; good compositions may be obtained with particles as small as 1 micron or as large as 1000 microns.

Plastic explosive compositions of the invention may be prepared by admixture of the particulate explosive with finely divided dry PTFE, an especially convenient material being in the form of a "coagulated dispersion" obtained by coagulating and drying a liquid dispersion of PTFE. However, superior compositions are obtained if the PTFE is used in the form of a fine dispersion in a liquid medium and the liquid is removed after mixing. The particle size of the PTFE in the dispersion may conveniently be 0.1–5μ. As the liquid medium, water is generally satisfactory, although with certain very water-soluble explosive materials it may be found more convenient to use an organic liquid. Aqueous dispersions may advantageously contain a wetting agent such as, for example, sodium lauryl sulphate or Triton X (registered trademark). Using aqueous dispersions of PTFE, the PTFE may be coagulated on the water-wet particulate explosive by adding acetone to the mixture, and the com-

position may be freed from acetone and wetting agent by filtering and washing with water.

In an alternative method of preparation applicable to easily melted explosive materials such as TNT, the PTFE, in the form of a dispersion in a liquid medium, may be mixed with vigorous stirring with the molten material and the mixture cooled to solidify to a plastic mass.

The invention is further illustrated by the following examples in which all parts and percentages are by weight.

Example 1

95 parts of PETN were mixed with 20 parts of water and 8.3 parts of a 60% aqueous dispersion of PTFE, commercially available as Fluon (registered trademark) grade GPI, were added and the mixture stirred for a few minutes. The mixture was then dried at 70° C. for 2 hours. The powder obtained (containing 5% by weight of PTFE) was, under light compression or rolling on a board with a rolling pin, converted into a plastic mass. The Abel heat test (170° F.) of the PETN/PTFE plastic explosive product was 40+ minutes.

A 10 g. sample of this plastic explosive was converted to a pellet of density 1.7 g./cc. at a pressure of 12 tons per sq. in. in a ¾" diameter mould.

A ⅛" cord, initiated unconfined with a No. 6 ASA detonator, propagated at a velocity of detonation of 3.7 km./sec.

A sheet of the plastic explosive product approximately ⅛" thick by ¾" wide and 10" long, when initiated unconfined with a No. 6 ASA detonator, propagated at a velocity of detonation of 4.8 km./sec.

Example 2

99 parts of PETN, wetted with 20 parts of water, were mixed with 1.7 parts of a 60% aqueous dispersion of PTFE as used in Example 1 and the mixture stirred for a few minutes. 20 parts of acetone were added and the mixture stirred for 5 minutes and then transferred to a filter and washed with warm water at 70° C. The resulting dough-like mixture was dried at 70° C. for two hours after which it was rolled into the form of a sheet ⅛" thick. A ⅛" wide x 10" long strip of this sheet propagated detonation at 3.7 km./sec. when initiated unconfined with a No. 6 ASA detonator.

Examples 3–7

In these examples, 100 parts of a mixture of PETN and sodium chloride, wetted with 10 parts of water, were mixed with 8.3 parts of a 60% aqueous dispersion of PTFE as used in Example 1 and the mixture was stirred for 5 minutes and then dried at 70° C. for 2 hours. On rolling on a board, a tough, pliable sheet was formed.

In the examples different proportions of sodium chloride were used as the velocities of detonation of ¾" wide by ⅛" thick by 10" long portions of the plastic explosive product were measured. Initiation was by means of a No. 6 ASA detonator. Details of the compositions of examples and their velocities are given in the following table.

TABLE 1

Example	Mixture	Velocity of detonation (km./sec.)
3	90 parts PETN, 10 parts NaCl, 5 parts PTFE.	4.9
4	80 parts PETN, 20 parts NaCl, 5 parts PTFE.	4.5
5	70 parts PETN, 30 parts NaCl, 5 parts PTFE.	4.6
6	60 parts PETN, 40 parts NaCl, 5 parts PTFE.	2.9
7	50 parts PETN, 50 parts NaCl, 5 parts PTFE.	2.0

Example 8

97 parts cyclotrimethylene trinitramine (RDX), wetted with 15 parts water, were mixed with 5 parts of a 60% aqueous dispersion of PTFE as used in Example 1 and the mixture was stirred for a few minutes. After drying for 2 hours at 70° C., the RDX/PTFE product had an Abel heat test (170° F.) of 40+ minutes.

The product was very easily converted into a plastic mass on light compression. A 3.5 oz. shaped charge pressed at 2 tons/sq. in. gave, on detonation, a penetration of 4½" in mild steel.

Example 9

95 parts of molten TNT at 90° C. were vigorously stirred and 8.3 parts of an aqueous dispersion of PTFE as used in Example 1 were added and the stirring continued for a short time until the moisture was evolved. The molten mixture was then cooled to form a plastic material which was sheeted by rolling on a board.

Example 10

95 parts of PETN were mixed for 15 minutes with 5 parts of dry PTFE (coagulated dispersion). The powder obtained was then crushed by rolling on a wooden board with a wooden roller to give a reasonably strong plastic sheet. The Abel heat test (170° F.) of the product was 40+ minutes and when a portion of this sheet ⅛" thick by ¾" wide and 10" long was initiated to detonation with a No. 6 ASA detonator, it propagated at a velocity of 4.6 km./sec.

Example 11

95 parts of black powder were mixed with 10 parts of water and 8.3 parts of a 60% aqueous dispersion of PTFE, as used in Example 1, added and the mixture stirred for a few minutes. After drying the mixture was rolled to form a sheet. From this sheet strips were cut and used to form the central core in a safety fuse which burned at a rate of 1.5 feet per minute. A portion of the sheet was diced to give a granular powder of uniform particle size which was glazed by tumbling with graphite to improve its flow properties. The resultant material was a satisfactory blasting powder.

Example 12

95 parts of finely powdered pentolite (50/50 PETN/TNT) were wetted with 15 parts of water and 8.3 parts of a 60% aqueous dispersion of PTFE were added. The mixture was stirred for a few minutes and dried to give a mixture which had a heat test of 40+ minutes. The mixture was rolled on a board to give a tough plastic sheet. A strip 10" long by ⅛" thick by 1" wide, when initiated to detonation with a No. 6 ASA detonator, propagated at 5.4 km./sec. A further plastic explosive of the same composition, except that the PTFE content of the mixture was increased to 10% by weight, was prepared and similarly sheeted and cut into strips which propagated detonation at 4.5 km./sec. Strips of the same dimensions and of similar composition, but in which sodium chloride was incorporated, were prepared in the same manner and the velocity of detonation was measured. The following results show the effect of PTFE and sodium chloride on the velocity of detonation.

TABLE 2

Composition of sheet (parts):	V.O.D. (km./sec.)
95/5 pentolite/PTFE	5.4
95/5/5 pentolite/NaCl/PTFE	5.2
90/10/5 pentolite/NaCl/PTFE	4500
80/20/5 pentolite/NaCl/PTFE	failed to propagate.

Example 13

80 parts of potassium perchlorate were mixed with 33 parts of a 60% aqueous dispersion of PTFE as used in Example 1 for 10 minutes. The mixture was dried and pressed to form a plastic propellent charge which had a burning speed of 0.10 inch/second at 1000 p.s.i.

Example 14

95 parts of 79/21 ammonium nitrate/TNT explosive

mixture were mixed with 5 parts of dry PTFE (coagulated dispersion) for 15 minutes and the mixture then rolled on a board to form sheets. Strips 1" and 10" long and of various thicknesses were made up and the velocity of detonation (V.O.D.) when initiated with a No. 8 star detonator was measured. The following results were obtained.

TABLE 3

Sheet thickness:	V.O.D. (km./sec.)
¼"	3.0
½"	3.4
¾"	4.1
1"	4.3

⅛"—Failed to propagate.

I claim:

1. An explosive composition consisting essentially of particulate explosive material comprising a member of the group consisting of pentaerythritol tetranitrate, cyclotrimethylene trinitramine, black powder, trinitrotoluene, pentolite, N-methyl-N, 2,4,6-tetranitroaniline, styphnic acid and explosive mixtures thereof with chlorate, perchlorate, or nitrate of sodium, potassium, calcium or ammonia coated with solid polytetrafluoroethylene in discrete particles of average size of 0.1 to 5 microns and constituting 1 to 5% by weight of the coated particles.

2. An explosive as claimed in claim 1 wherein the particles of explosive material are completely coated with polytetrafluoroethylene.

3. A composition as claimed in claim 1 wherein said particulate explosive material comprises a powdered mixture of trinitrotoluene and ammonium nitrate.

4. An explosive composition as claimed in claim 1 wherein said particulate explosive material contains a particulate non-explosive solid which varies the velocity of detonation of the explosive composition.

5. An explosive composition as claimed in claim 1 wherein the average particle size of said particulate explosive material is within the range of 1 to 1,000 microns.

6. An explosive composition as claimed in claim 1 wherein the polytetrafluoroethylene is in the form of a coagulated dispersion.

References Cited

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149—6, 7, 11, 19, 46, 47, 55, 56, 57, 61, 62, 69, 73, 75, 77, 78, 82, 83, 85, 88, 92, 93, 105, 110

Notice of Adverse Decision in Interference

In Interference No. 100,878, involving Patent No. 3,455,749, R. S. Gow, PARTICULATE EXPLOSIVE COATED WITH DISCRETE PARTICLES OF POLYTETRAFLUOROETHYLENE, final judgment adverse to the patentee was rendered Nov. 5, 1982, as to claims 1 and 6.

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