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TRINITROTOLUENE EXPLOSIVE COMPOSITIONS CONTAINING A POLYCYCLIC AROMATIC HYDROCARBON

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This invention relates to explosives and explosive compositions and more particularly to explosive compositions containing trinitrotoluene which exhibit improved physical properties under variations of temperature and pressure.

Trinitrotoluene is well-known for properties which make it especially useful in making cast explosives. It is relatively insensitive to shocks and blows, highly stable over extended periods of storage and forms no sensitive explosive compounds by reaction with metals. The relatively low melting temperature of trinitrotoluene makes it well adapted for forming cast explosive charges, since fusion may be brought about by the use of hot water or steam.

Although trinitrotoluene, hereinafter referred to as TNT, enjoys the foregoing desirable properties, TNT and explosive compositions containing TNT exhibit three distinct objectionable characteristics which are especially deleterious and evident under storage conditions and in handling and manufacturing. TNT and TNT compound explosives such as tritonal, torpex, Composition B, baratol, and baronex exhibit (1) irreversible dimensional instability, (2) exudation and (3) poor thermal shock resistance.

The objectionable behavior referred to hereinbefore may be typified by cast TNT (grade 1, having a set point of approximately 80.2° C.). In the course of normal temperature variation under uncontrolled storage conditions or in thermal cycling from approximately 70° F. to 140° F. the cast charge or grains of TNT grow irreversibly each time the temperature undergoes a cycle. Thus, a rise in temperature increases the dimensions of the cast charge but the subsequent decrease in temperature does not produce an equal amount of contraction, so that there is a steady and graduated growth in the dimensions of the cast charge.

TNT also exudes products known to be composed of dinitrotoluene and certain other impurities normally found in commercial TNT. The dinitrotoluene along with these other impurities form eutectic mixtures with TNT which exhibit very low melting points. The presence of these eutectic mixtures in the grain, or charge, makes it possible for the material to liquefy and exude at the more elevated temperatures of storage. The exudation and irreversible growth is frequently sufficiently adverse under military storage conditions as to render the ammunition or explosive unsafe or unsuitable for military use.

Explosive compositions, such as those mentioned hereinbefore which contain TNT as one of the components, exhibit surveillance properties similar to those of TNT; that is, cast charges of these explosives will undergo irreversible dimensional changes or distortion and will exhibit exudation when exposed under confinement to thermal cycles in the same manner as cast charges of TNT. In general, the magnitude of growth of the binary explosive charges such as baratol greatly exceeds that of cast TNT, although exudation tendencies are lessened due to adsorption on the fine barium nitrate crystals. Increases in volume of the order of three to five percent are frequently observed where binary explosive charges are made with TNT having a set point as high as 80.4° C. In general, the

magnitude of irreversible growth also increases with the percentage by weight, or total surface area, of the infusible dispersed component of the binary explosive mixture. Accordingly, baratol containing 71 percent barium nitrate grows less than baratol containing 76 percent barium nitrate when the same TNT is used as the fusible component.

The third deleterious effect encountered in cast TNT and cast explosive compounds containing TNT is poor thermal shock resistance leading to the formation of cracks or fissures in the cast or poured charge or grain of the explosive. The appearance of cracks, fissures and cavities is especially prevalent and objectionable during manufacturing when machining of a charge is necessary after casting.

It is an object of the present invention to provide explosive compositions containing TNT which have physical properties superior to TNT-containing explosives heretofore known to the art.

It is another object of the present invention to provide explosive compositions which exhibit no objectionable, irreversible dimensional growth, exudation or cracking.

It is a further object of the present invention to provide a class of additives for TNT and explosive compositions containing TNT which form high melting temperature eutectic mixtures with TNT to prevent cracking of cast charges without increasing exudation or irreversible dimensional growth.

It is a still further object of the present invention to provide a class of additives for TNT and explosive compositions containing TNT which form molecular compounds with TNT which in turn form high melting temperature eutectic mixtures with TNT to prevent cracking of cast charges without increasing exudation or irreversible dimensional growth.

The present invention achieves the foregoing and other objects by the incorporation of proportionately small amounts of anthracene, or other polycyclic aromatic compounds of the class disclosed herein, into a molten mixture of high purity TNT or explosive composition containing high purity TNT.

It is possible to substantially eliminate irreversible dimensional growth or to reduce such irreversible growth to an order of magnitude that is no longer found to be deleterious by the utilization of TNT of high purity. For example, when TNT which has been purified by recrystallization from alcohol followed by a second recrystallization from a mixture of ethylene dichloride and carbon tetrachloride and finally water washed and dried to give a set point of 80.7°±0.1° C., is used for the preparation of a poly component explosive containing a dispersed phase, it is found that the full scale cast charges do not show irreversible changes in volume exceeding 0.9 of one percent. Frequently the growth is of a considerably lower order of magnitude, i.e., 0.5 of one percent. Also, when TNT having a similarly high set point produced by purification processes other than recrystallization from solvent is employed similar results are obtained. For example, when TNT of high purity having a set point of 80.70° C. or higher produced by rigorous nitration coupled with double Sellite treatment and water wash is employed, the resulting cast charges show a growth of the order of 1.0 percent. Also, due to the absence of impurities and lower order nitrotoluenes in such relatively pure TNT, exudation is avoided. Thus, two of the three objectionable characteristics of TNT and TNT compound explosives may be avoided by the use of sufficiently pure TNT. However, such TNT when in the form of cast explosive charges has especially poor resistance to thermal shock and such charges are accordingly subject to extensive crack failure during thermal cycling or normal storgiven herein. Such limits range from 0.1 percent to one percent of the TNT present in the explosive mixture.

In addition to those compounds discussed hereinbefore, it has also been found that the incorporation of trinitrometaxylene or 1,3,8-trinitronaphthalene to TNT or TNT-containing explosives in an amount equal to 0.1 to one percent by weight of the TNT present will eliminate objectionable crack failure without promoting irreversible growth or exudation of the cast explosive. These compounds directly form high melting eutectic mixtures with the TNT of the composition. The use of TNT of high purity, i.e., TNT having a set point of approximately 80.70° C. is essential however to the satisfactory performance of explosives containing either of these two compounds.

Inasmuch as anthracene and the polycyclic aromatics of the class described form equimolecular compounds with lower nitrotoluenes which in turn form high melting eutectic mixtures with the TNT it is possible to vary the process for obtaining the final explosive mixture. Although the process described herein of adding the proper amount of anthracene or the selected compound to a molten slurry of the explosive is preferable, it is also possible to first form the equimolecular compound of anthracene and nitrotoluene and add the compound to the TNT or TNT-base explosive to form the eutectic mixture. Thus, the alternative process includes forming an equimolecular compound of anthracene, or one of the polycyclic aromatics described herein, and dinitrotoluene and adding the molecular compound to a molten slurry of high purity TNT explosive composition in an amount within the limits of operability described herein.

While there have been described what are considered to be preferred embodiments of the present invention, it is to be understood that the invention of this application is not limited to the specific examples herein recited but that numerous modifications and variations thereof may be made without departing from the scope of the invention as set forth in the appended claims.

What is claimed is:

1. The process of preparing cast trinitrotoluene and trinitrotoluene-base high explosives resistant to cracking, exudation and irreversible dimensional growth comprising heating the explosive to a molten condition, adding thereto an amount of polycyclic aromatic hydrocarbon of the class consisting of anthracene, naphthalene, dihydroanthracene, acenaphthene, phenanthracene, fluorene, chrysene and pyrene, the amount of said polycyclic aromatic hydrocarbon being from about 0.1 percent to about one percent of the trinitrotoluene present, mixing the explosive and added compound and casting the resulting melt into the desired shape.

2. The process according to claim 1 wherein the polycyclic aromatic hydrocarbon is anthracene.

3. Trinitrotoluene and trinitrotoluene-base explosive comprising from about 0.1 percent to about one percent based on the weight of the trinitrotoluene present of a polycyclic aromatic hydrocarbon of the class consisting of anthracene, naphthalene, dihydroanthracene, acenaphthene, phenanthracene, fluorene, chrysene and pyrene.

4. The trinitrotoluene and trinitrotoluene-base explosive according to claim 3 wherein the polycyclic aromatic hydrocarbon is anthracene.

5. Trinitrotoluene and trinitrotoluene-base explosive comprising trinitrotoluene having a set point of about 80.7° C.±0.1° C., and anthracene in an amount equal to about 0.5 percent by weight of said trinitrotoluene whereby said explosive is rendered resistant to thermal shock, exudation and irreversible thermal growth.

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