AMMONIUM NITRATE-CHROMATE SALT EXPLOSIVE COMPOSITIONS

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11 Claims.

(41 40 44)

This invention relates to improved ammonium nitrate explosive compositions and, more particularly, it relates to ammonium nitrate explosive compositions containing a chromate salt. This invention also relates to a novel ammonium nitrate composition suitable for use in explosives.

One of the objects of the present invention is to provide ammonium nitrate explosive compositions which can be handled safely in transport with little danger of shock initiation and which can be detonated effectively by means of an electric blasting cap or nitrate in a detonation of useful magnitude and force upon proper initiation. Another object of this invention is to provide ammonium nitrate explosive compositions of greatly increased power. Another object of this invention is to provide ammonium nitrate explosive compositions containing a chromate salt. Another object of this invention is to provide an improved ammonium nitrate composition suitable for use in explosives.

In the first step of preparing the novel explosive compositions of this invention, a chromate salt is admixed with molten ammonium nitrate at a temperature from about 170°C to about 200°C, to form a melt containing from about 0.5 to about 10 percent of the chromate salt based on the weight of the ammonium nitrate. In the second step the novel ammonium nitrate composition of this invention is formed by converting the ammonium nitrate-chromate salt melt into a solid particulate material. This can be accomplished by allowing the melt to solidify and subjecting the solid material so produced to a size reducing process such as grinding or prilling, or the melt can be sprayed in small droplets in a tower high enough to allow solidification of the droplets during free fall thus forming prills or granules. In the case of the prilled product a coating of clay, diatomaceous earth, chalk, etc., can be applied to reduce caking. In the third and final step, a hydrocarbon oil is admixed with the ammonium nitrate composition in particulate form in an amount such that the resulting explosive composition contains from about 3 to about 8 percent of oil based on the weight of the particulate material.

In making explosive compositions containing the novel ammonium nitrate composition, prepared as described herein, a particle size range of from about 3 to about 100 mesh can be utilized. The use of the ammonium nitrate composition of this invention is not limited to the novel explosive compositions described herein since it can be used to replace granular ammonium nitrate in a wide variety of the ammonium nitrate-type explosives.

Suitable chromates for use in the novel explosive compositions of this invention include ammonium chromate, potassium chromate, sodium chromate, and lithium chromate, together with the corresponding dichromates such as ammonium dichromate, potassium dichromate, sodium dichromate, etc. The chromate salt can be conveniently added to the molten ammonium nitrate in the form of the granular material having a mesh size of from about 4 to about 200 mesh. The solid product formed on solidification of the ammonium nitrate-chromate salt melt can be reduced to a granular material by any of the methods well known to the art, for example, by means of a hammer mill or a rotary crushe. In addition, prills or granules can be prepared from the ammonium nitrate-chromate salt melt in conventional prilling equipment.

Suitable hydrocarbon oils are those which are liquid at room temperature and pressure. Such liquids have little or no solubility on ammonium nitrate. Useful hydrocarbon oils include crude oil, fuel oil, lubricating oil fractions and mixtures thereof, kerosene, etc. Hydrocarbon oils can be admixed with the ammonium nitrate-chromate salt material in a wide variety of equipment such as in a ribbon mixer, a tumbling barrel or in a double cone mixer.

In general, ammonium nitrate of any desired particle size which can be charged conveniently to the melting apparatus can be used with equal ease to prepare the novel ammonium nitrate compositions of this invention.

To demonstrate the properties of the novel explosive compositions of this invention a variety of compositions were prepared and detonated in the field. Detonation was achieved by means of an electric blasting cap, such as an Engineer Special Blasting Cap. The charges as tested were packaged in cylindrical paper or plastic tubes having a firing diameter of about 2.5 inches. The container with the charge was placed in a suitable hole in such a manner that in each instance the top of the container was flush with the ground. A blasting cap, which in each test was an Engineer Special Blasting Cap or equivalent, was placed in the explosive charge through the open top of the container and the composition detonated by closing the firing switch. The magnitude of the detonation obtained in each test was determined by measuring the size of the crater produced. Although it is true that the crater size alone is not indicative of the amount of earth formation that is broken up, it does give an indication of the work potential of the mixture detonated. In a like manner ammonium nitrate-oil explosive compositions containing 5.0 percent No. 2 Diesel oil based on the weight of the ammonium nitrate but without a chromate salt were prepared from fused ammonium nitrate and detonated under the same conditions for comparison. Results of these tests showed that the novel compositions of this invention exhibit substantially greater work potential than those compositions not containing a chromate material.

For example, on detonation of a composition containing ammonium nitrate containing 3 percent potassium dichromate based on the weight of the ammonium nitrate and having 5 percent No. 2 Diesel oil based on the combined weight of the ammonium nitrate and potassium dichromate a crater having a volume of 1270 cubic inches was formed as compared to a crater volume of 1390 cubic inches when an ammonium nitrate explosive composition containing 5 percent of No. 2 Diesel oil based on the weight of the ammonium nitrate was detonated under the same conditions.

The novel explosive compositions of this invention can be charged directly into a borehole and detonated by means of an electric blasting cap. If desired, these novel compositions can be packaged in a shell of waterproof material such as plastic film, paper treated with paraffin oil other waterproofing materials, or in metal cans.

The following examples illustrate various embodiments of this invention and are to be considered not limiting.

EXAMPLE I

Granular ammonium nitrate in the amount of 300 grams (particle size, 100 percent through 40 mesh) was added to a casserole and then heated on an electric heater until molten. As soon as the ammonium nitrate had all melted, the temperature was raised to 180°C. In the next step 9.0 grams of granular potassium dichromate (particle size, 100 percent through 40 mesh) was added.
to the molten ammonium nitrate with stirring. During the addition of the potassium dichromate the melt turned brown and there was some evolution of gas. As soon as a homogeneous melt system had been achieved, the melt was poured into a casseole and allowed to cool. The solid ammonium nitrate containing potassium dichromate was ground in a mortar, passed through a series of standard screens to determine the size distribution of the particles and then the sieved fractions were mixed with those from two other batches prepared in the same manner. For the combined batch the particle size distribution was as follows.

Mesh size: | Percent
---|---
3–14 | 59
14–24 | 16
24–100 | 2
Fines | 2

To seven hundred grams of the particulate material prepared as described above there was slowly added, with tumble mixing, 35 grams of No. 2 Diesel oil. The oil-dusted material so produced was then made into three charges containing 400 grams, 200 grams and 100 grams, respectively. The results of firing tests conducted with these materials are shown in Table 1.

EXAMPIES II and III

Two explosive compositions containing ammonium nitrate, potassium dichromate and No. 2 Diesel oil (see Examples II and III, Table 1) were prepared in the manner described in Example I. The results of firing tests carried out with these explosive compositions are reported in Table 1.

EXAMPIES IV–XXII

A number of other explosive compositions were prepared in which the quantity of potassium dichromate was varied from 0 to 6 percent by weight based on the weight of the ammonium nitrate. The method of preparation was the same as that described in Example I. The results of the firing tests conducted with these materials are also recorded in Table 1.

### Table 1

<table>
<thead>
<tr>
<th>Example</th>
<th>Potassium Dichromate (Percent)</th>
<th>No. 2 Diesel Oil (Percent)</th>
<th>Addition Temperature of Potassium Dichromate (°C)</th>
<th>Weight of Explosive Charge (Grams)</th>
<th>Total Volume of Explosive (Cubic Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>0.0</td>
<td>5.0</td>
<td>180</td>
<td>185</td>
<td>175</td>
</tr>
<tr>
<td>V</td>
<td>0.5</td>
<td>5.0</td>
<td>185</td>
<td>225</td>
<td>190</td>
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<tr>
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<td>260</td>
<td>1,600</td>
</tr>
<tr>
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<td>5.0</td>
<td>180</td>
<td>300</td>
<td>0,000</td>
</tr>
<tr>
<td>VIII</td>
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<td>5.0</td>
<td>180</td>
<td>340</td>
<td>0,030</td>
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<tr>
<td>IX</td>
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<td>5.0</td>
<td>180</td>
<td>380</td>
<td>0,000</td>
</tr>
<tr>
<td>X</td>
<td>1.0</td>
<td>5.0</td>
<td>185</td>
<td>380</td>
<td>1,750</td>
</tr>
<tr>
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<td>5.0</td>
<td>180</td>
<td>420</td>
<td>1,750</td>
</tr>
<tr>
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<td>5.0</td>
<td>180</td>
<td>460</td>
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<tr>
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<td>175</td>
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<tr>
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<td>5.0</td>
<td>180</td>
<td>180</td>
<td>2,000</td>
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<tr>
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<td>2.0</td>
<td>5.0</td>
<td>180</td>
<td>180</td>
<td>2,000</td>
</tr>
</tbody>
</table>

What is claimed is:

1. A process for preparing an explosive composition which comprises (A) forming an ammonium nitrate-chromate salt melt by admixing a chromate salt selected from the group consisting of the monochromates and dichromates of ammonia, sodium, potassium and lithium with molten ammonium nitrate at a temperature of from about 170° C. to about 200° C., the amount of the said chromate salt being from about 0.5 to about 10 percent by weight of the ammonium nitrate, (B) forming from the said melt a solid particulate material, and (C) admixing with the said solid particulate material a hydrocarbon oil which is a liquid at room temperature and atmospheric pressure.

2. The process of claim 1 wherein the said solid particulate material is formed by reducing the solid produced on solidification of the said melt to a particulate material.

3. The process of claim 1 wherein the chrome salt is potassium dichromate.

4. The process of claim 1 wherein the chrome salt is sodium dichromate.

5. The process of claim 1 wherein the amount of hydrocarbon oil admixed with the said solid particulate material is from about 3 to about 8 percent by weight of the said solid particulate material.

6. The process of claim 1 wherein the hydrocarbon oil is No. 2 Diesel oil.

7. A process for preparing an explosive composition which comprises (A) forming an ammonium nitrate-potassium dichromate salt melt by admixing potassium dichromate with molten ammonium nitrate at a temperature of from about 170° C. to about 200° C., the amount of the said potassium dichromate being from about 0.5 to about 10 percent by weight of the ammonium nitrate, (B) reducing in size the solid produced on solidification of the said melt to a particulate material, and (C) admixing with the said particulate material a hydrocarbon oil which is a liquid at room temperature and atmospheric pressure in an amount of from about 3 to about 8 percent by weight of the particulate material.

8. An explosive composition consisting essentially of a hydrocarbon oil and a fused ammonium nitrate-chromate salt particulate composition produced by forming an ammonium nitrate-chromate salt melt by admixing a chrome salt selected from the group consisting of the...
monochromates and dichromates of ammonia, sodium, potassium and lithium with molten ammonium nitrate at a temperature of from about 170° C. to about 200° C., forming from the said melt a solid particulate material and admixing with the particulate material a hydrocarbon oil which is liquid at room temperature and atmospheric pressure, said hydrocarbon oil being present in an amount of from about 5 to about 8 percent by weight of the said particulate composition, said chromate salt being present in the said particulate composition in an amount of from about 0.5 to about 10 percent by weight of the ammonium nitrate.

9. The explosive composition of claim 8 wherein the chromate salt is potassium dichromate.

10. The explosive composition of claim 8 wherein the chromate salt is sodium dichromate.

11. The explosive composition of claim 8 wherein the hydrocarbon oil is No. 2 Diesel oil.

References Cited in the file of this patent

UNITED STATES PATENTS

2,434,872 Taylor et al. 2,995,767 Berl et al. 2,997,377 Proell

FOREIGN PATENTS

6,327 Great Britain Apr. 27, 1895