This invention relates to a high explosive mixture incorporating a finely divided metal, and relates in particular to such a mixture incorporating aluminum powder.

It has been proposed to employ aluminum powder in admixture with dry oxidizing salts as an explosive. Such compositions entail difficulties in handling because, after the aluminum powder and salt have been mixed, the mixture becomes sensitive to shock and must be carefully handled. Furthermore, as the oxidizing salt must be finely divided and must be intimately mixed with the aluminum powder, the grinding and mixing must be performed at the factory. Long storage of the mixture may cause caking, and renders the mixture difficult to detonate.

It is an object of the present invention to provide a metal powder high explosive mixture which is safe to handle.

A further object is to provide a metal powder explosive mixture that can be mixed and stored safely prior to the time of detonation.

A further object is to provide a metal powder explosive mixture which is easy to mix, so that the mixture may be made up at the site where it is to be used.

According to the present invention we provide a high explosive comprising an aqueous mixture, or dispersion of finely divided aluminum powder and a stable oxidizing salt. Other combustible solids or liquids may be present. The presence of water renders the explosive mixture safer to handle and increases the power of the explosive as compared to the dry mixture heretofore proposed.

Aluminum powder is available commercially in various mesh sizes and in the form of flakes and granules. We prefer to employ a mixture of granular and flake powders having a mesh size of 120 or finer in order to obtain a good consistency in the final mixture. The flake powder favorably influences the explosive properties of the mixture. The salts suitable for use in the present invention include ammonium nitrate, ammonium nitrate and ammonium perchlorate. Although the alkaline metal salts of some of these acid radicals are stable and can be used, the brisance of mixtures employing alkaline metal salts is not as great as where the ammonium salts are used. In addition, the compositions may contain dispersing, emulsifying agents, or wetting agents, which help to maintain the aluminum powder in suspension or improve the ease of dispersing the aluminum powder.

In dry mixtures of aluminum powder and oxidizing salts the amount of oxidizing salt required for high brisance is in excess of the theoretical amount required on the basis of available oxygen. However, in the aqueous mixtures of the present invention the proportion of oxidizing salt may be considerably lowered. This is believed to be related in some way to the reaction of the metal with water under the conditions of the explosive. In general, the weight proportion of aluminum in the mixture may vary within the range of about 38 to 49% and the proportion of oxidizing salt may vary within the range of about 20 to 43%. The most effective mixtures contain a ratio of aluminum to oxidizing salt in the range of about 1.5 to 2 by weight, and a ratio of aluminum to water in the range of about 1.4 to 1.5 by weight. The mixtures may contain gelatine, in the proportion of about 1 to 3/4% per cent, or commercial surface active agents, such as "Magsol," "Naconol," or the like, in suitable amounts, as for example, about 5%, to reduce settling of the aluminum powder.

The invention is illustrated by the following examples:

Example 1

A charge of 150 grams was prepared containing the following proportion of ingredients by weight:

- 42% aluminum powder (a mixture of equal weights of 400 mesh granular and 100 mesh flake)
- 30% ammonium nitrate
- 28% water

The charge was prepared by dissolving the ammonium nitrate in the water, and then adding the resulting solution to the aluminum powder in an iron cylinder with constant stirring. This cylinder, two inches in diameter and four inches high was used in the following brisance test.

The charge was initiated by a primed cord on a steel plate one-eighth inch thick, and the explosion punctured a hole in the 10.5 cm diameter, leaving fragmentation traces on the plate.

Example 2

For the purpose of comparative tests, mixtures were made up as follows:

<table>
<thead>
<tr>
<th>Sample</th>
<th>Density (lg/cm³)</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.18</td>
<td>Punctured hole 8 cm diam. Numerous fragmentation marks on plate which was hot and partly melted. Plate slightly dented over area of about 6 cm. diameter at a depth of about 3 cm.</td>
</tr>
<tr>
<td>B</td>
<td>1.09</td>
<td>Plate not dented.</td>
</tr>
<tr>
<td>C</td>
<td>1.15</td>
<td></td>
</tr>
</tbody>
</table>

The rate of detonation of sample A, by the D'Autriche method, having a loading density of one gram per cubic centimeter, is about 4000 to 4200 meters per second, as compared to a rate of detonation of about 1500 meters per second for dry mixtures of ammonium nitrate and aluminum powder.

We claim as our invention:

1. An aqueous explosive mixture comprising: 38 to 49% by weight of finely divided aluminum; 20 to 43% by weight of a stable salt selected from the group composed of nitrates, nitrites and perchlorates; and a quantity of water to provide an aluminum to water ratio by weight which is in the range of 1.4 to 1.5.
2. An aqueous explosive mixture as specified in claim 1 wherein said salt is ammonium nitrate.
3. The explosive mixture of claim 1 including a small amount of gelatine.
4. An aqueous explosive mixture comprising by weight: 42 to 49% finely divided aluminum; 30 to 31% water; and 28 to 23% of a stable salt selected from the group composed of nitrates, nitrites, and perchlorates.

5. An aqueous explosive mixture as specified in claim 4 wherein said salt is ammonium nitrate.

6. An aqueous explosive mixture as specified in claim 5 wherein the aluminum is present as a powder of about 400 mesh.

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