United States Patent Office 2,736,262 Patented Feb. 28, 1956

2,736,262

LOW DENSITY SAFETY AMMONIUM NITRATE BLASTING EXPLOSIVE AND PROCESS FOR PRODUCING SAME

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No Drawing. Application March 5, 1951, Serial No. 214,029

Claims priority, application Great Britain March 29, 1950

5 Claims. (Cl. 102—24)

The present invention relates to improvements in low density safety ammonium nitrate blasting explosive compositions of powder consistency of the kind comprising sodium chloride as a flame-quenching ingredient.

In the manufacture of low density powder blasting explosives the low density characteristics are ordinarily attained by the use in the composition of a dried vegetable carbohydrate constituent that is itself of unusually low density characteristics even in its comminuted form, for instance balsa woodmeal, ground cork, bagasse or certain low density peat preparations. It is also the custom in the manufacture of these explosives to employ forms of ammonium nitrate of a low range of bulk density; but it is nevertheless a matter of inconvenience or difficulty to obtain a low density ammonium nitrate safety blasting explosive of a desirable composition.

Thus the employment of a relatively high proportion of the low density vegetable carbohydrate ingredient has the disadvantage that it will necessitate the simultaneous employment of a correspondingly high proportion of an oxidizing salt of high available oxygen content, usually sodium nitrate, which has the effect of limiting the proportion of the flame-quenching ingredient that can be used in the composition. It is also known to employ ammonium nitrate in special forms of exceptionally low bulk density to assist the attainment of a low density ammonium nitrate safety blasting explosive composition, but exceptionally low density forms of ammonium nitrate are composed of hollow crystal clusters of a fragile nature and because of their fragility or changes in crystal form on storage, especially under moist conditions, difficulty may be experienced in transporting them undamaged to the site of the explosive manufacture, or the crystal clusters may tend to break up in the resulting explosive composition on storage or transport.

The use of sodium chloride as a flame-quenching constituent in safety blasting explosives is well known and hitherto the sodium chloride employed has been in the form of a well dried relatively fine powder of high bulk density, that is to say about 1.2 to 1.3 gms./cc. at 1.7 atmospheres pressure. Such material can be obtained directly by evaporation of brine in a vacuum evaporation apparatus or by grinding coarser material such as open pan grades of salt.

According to the present invention a low density safety ammonium nitrate blasting powder explosive composition of the kind including sodium chloride as a flame-quenching ingredient is characterized in that the sodium chloride included has a bulk density not exceeding 0.9 gm./cc. at 1.7 atmospheres pressure.

The use of sodium chloride of said bulk density permits said powder explosives to be obtained of lower bulk density for a given composition, or permits smaller quantities of low density vegetable carbohydrate material to be employed and consequently enables the oxygen deficiency of the detonation gases to be minimized, or the amount of

sodium nitrate or the like salt of high oxidizing value in the explosive composition to be minimized and hence enables the proportion of flame-quenching salt to be increased with obvious advantage to its safety characteristics, or renders it possible to employ forms of ammonium nitrate of more convenient bulk density in the explosive composition.

Low density sodium chloride suitable for the carrying out of the present invention may be formed by rapidly adding potassium nitrate to a boiling solution of equimolecular proportions of sodium nitrate and potassium chloride saturated with respect to the resulting sodium chloride.

There may also be employed dendritic forms of sodium chloride by which we mean crystal clusters with at least three main spiky or needle shaped arms lying in more than one plane, in some cases with subsidiary arms growing from the main arms. In co-pending application Serial No. 140,143, filed January 23, 1950, now Patent No. 2,642,335 there are claimed dendritic crystals of this kind having a pouring density not exceeding 0.7 gm./cc., which corresponds to a packing density under 1.7 atmospheres pressure of approximately 0.8 gm./cc.

Unlike ammonium nitrate, sodium chloride has no crystal transition point at 32.3° C. or indeed at any temperature, and its density characteristics, unlike those of ammonium nitrate, are not liable to variation when stored even under slightly moist conditions.

The invention is illustrated in the following examples in which the parts and percentages are by weight except where otherwise indicated.

Example I

A low density powder explosive composition consisting of—

	Per cent
80:20 mixture of nitroglycerine and ethyleneglycol dinitrate	10
Peat (of bulk density 0.20 gm./cc. under a packing pressure of 1.7 atmospheres)	12
Ammonium nitrate (of bulk density 0.71 gm./cc. under a packing pressure of 1.7 atmospheres)	55.5
Sodium nitrate	10
Sodium chloride	12
Diammonium hydrogen phosphate	0.2
Natural resin	0.3

in which the sodium chloride used consists of dendritic crystals, has a bulk density of 0.82 gm./cc. at 1.7 atmospheres pressure and of which 98% passes a 30 mesh, 48% passes a 60 mesh and 16% passes a 100 mesh B. S. S. screen, is prepared by mixing the ingredients together in known manner in an Atlas mixer. The resulting powder explosive composition has a bulk density of 0.63 gm./cc. under a packing pressure of 1.7 atmospheres. The explosive is cartridged to a density of 0.62 gm./cc. into cartridges of 32 mm. diameter and 200 mm. long. The power is 59% of that of blasting gelatine. The velocity of detonation is 1450 metres per second. The oxygen deficiency is 1.4 gm. oxygen per 100 gm. of unwrapped explosive.

A comparative powder explosive composition not in accordance with the invention is prepared wherein the method employed is the same and the composition is the same except that the sodium chloride is ordinary vacuum dried material consisting of cubicle crystals of bulk density 1.3 gm./cc. at 1.7 atmospheres pressure whereof all pass a 30 mesh, 86% passes a 60 mesh and 57% passes a 100 mesh B. S. S. screen. The bulk density of the resulting powder explosive composition is 0.72 gm./cc. at 1.7 atmospheres and when cartridged under the same conditions as the composition made in accordance with the

invention the cartridge density is 0.67 gm./cc. The velocity of detonation is 1500 metres per second. The oxygen deficiency is 1.4 gm./100 gm. of unwrapped explosive.

If the dendritic salt in the explosive powder composition prepared according to the invention is replaced by salt of the same bulk density prepared by rapidly adding potassium nitrate to a boiling solution of equimolecular proportions of sodium nitrate and potassium chloride saturated with respect to the resulting sodium chloride an explosive powder composition is obtained having a bulk density of 0.63 gm./cc. under a packing pressure of 1.7 atmospheres.

Example II

A powder explosive composition having the same explosive properties as the powder explosive compositions described in Example I can be produced by raising respectively the percentages of dendritic sodium chloride and ammonium nitrate to 14% and 65%, by reducing the peat content to 10% and by omitting the sodium nitrate. The resulting explosive composition has a bulk density of 0.65 gm./cc. under 1.7 atmospheres pressure and when cartridged to a density of 0.70 gm./cc. its velocity of detonation is 1600 metres per second. Its power as measured in the ballistic mortar is 62% of that of blasting gelatine, and the oxygen deficiency is 1.4 gm./100 gm. of unwrapped explosive.

Example III

A powder explosive composition is prepared by the same manner of mixing and having the same composition as the powder explosive of Example I except that the percentage of peat is reduced to 10% and the percentage of ammonium nitrate is increased to 57.5%. The resulting powder explosive composition has a bulk density of 0.68 gm./cc. at 1.7 atmospheres pressure and has an oxygen excess of 1.8 gm./100 gm. of unwrapped explosive.

Example IV

A powder explosive composition is prepared as described in Example I except that the percentage of peat and the ammonium nitrate are reduced to 7% and 45% and the percentage of dendritic salt is increased to 37.5%. The bulk density of the resulting powder explosive composition is 0.78 gm./cc. at 1.7 atmospheres pressure and when cartridged to a density of 0.75 gm./cc. its velocity of detonation is 1450 metres per second. The power is 39% of that of blasting gelatine and the oxygen deficiency is 1.4 gm./100 gm. of unwrapped explosive.

Example V

For comparison purposes two powder explosive compositions each consisting of—

	Per cent
80:20 mixture of nitroglycerine and ethylene glycol dinitrate	10
Peat (of bulk density 0.20 gm./cc. under a packing pressure of 1.7 atmospheres)	12
Ammonium nitrate	55.5
Sodium nitrate	10
Sodium chloride	12
Diammonium hydrogen phosphate	0.2
Natural resin	0.3

and each having a bulk density of 0.68 gm./cc. at 1.7 atmospheres pressure are prepared, one according to the invention wherein the ammonium nitrate is of bulk density 0.82 gm./cc. under a packing pressure of 1.7 atmospheres and the sodium chloride is of bulk density of 0.82 gm./cc. at 1.7 atmospheres pressure and the other not according to the invention wherein the ammonium nitrate is of bulk density of 0.71 gm./cc. under a packing pressure of 1.7 atmospheres and the sodium chloride is of bulk density 1.3 gm./cc. at 1.7 atmospheres pressure.

The two powder explosive compositions are each cartridged to a density of 0.68 gm./cc.

The explosive properties of the two powder compositions are substantially the same but whereas a 227 gm. cartridge of the composition not in accordance with the invention when suspended in a methane-air mixture containing 9% methane by volume ignites the atmosphere when initiated by a No. 6 mercury fulminate-chlorate electric detonator having a copper alloy casing, in contradistinction thereto a similar cartridge having the powder composition prepared according to the invention tested under these conditions does not ignite such an atmosphere.

What I claim is:

1. A low density safety ammonium nitrate blasting powder explosive composition of the kind including sodium chloride as the sole flame-quenching ingredient characterized in that the sodium chloride is dendritic and has a bulk density not exceeding 0.9 gm./cc. at 1.7 atmospheres pressure.

2. A low density safety ammonium nitrate blasting powder explosive composition as claimed in claim 1 wherein the sodium chloride comprises dendritic crystals and has a packing density of about 0.8 g./cc. under 1.7 atmospheres pressure.

3. In a process for the production of a low density safety ammonium nitrate blasting powder explosive composition, the step of adding to said composition dendritic sodium chloride having a density not exceeding 0.9 g./cc. at 1.7 atmospheres pressure as the sole flame-quenching ingredient.

4. A process as claimed in claim 3 wherein the sodium chloride comprises dendritic crystals and has a packing density of about 0.8 g./cc. under 1.7 atmospheres pressure.

5. A blasting cartridge containing a low density safety ammonium nitrate blasting powder explosive composition including dendritic sodium chloride having a bulk density not exceeding 0.9 g./cc. at 1.7 atmospheres pressure as the sole flame-quenching ingredient.

References Cited in the file of this patent

UNITED STATES PATENTS

2,087,285 Handforth et al. ---------- July 20, 1937

FOREIGN PATENTS

595,443 Great Britain ---------- Dec. 4, 1947