Patented Mar. 23, 1943 2,314,809

UNITED STATES PATENT OFFICE

2,314,809

EXPLOSIVE COMPOSITION

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No Drawing. Application January 7, 1941, Serial No. 373,421

11 Claims. (Cl. 52—11)

This invention relates to explosive compositions containing a water-soluble inorganic salt, and more particularly to ammonium nitrate explosives.

This application is a continuation-in-part of my copending applications Serial No. 288,131, filed August 3, 1939, now Patent Number 2,231,043, and Serial No. 354,825, filed August 30, 1940.

Ammonium nitrate is a very extensively used ingredient in present day high explosives of the dynamite type. It replaces nitroglycerin in increasingly larger proportions for a variety of reasons, particularly because it possesses high explosive strength, has outstanding safety properties, and is economically attractive. Ordinarily it is used with some particular sensitizing agent, either explosive or non-explosive in nature. While ammonium nitrate explosives have been used with great success, one disadvantage of this ingredient has always been evident, namely, that it has a great affinity for water. Because of this fact, there is a tendency for explosive compositions high in ammonium nitrate to become hard and set on storage in the presence of even small amounts of moisture. This brings about a decreased sensitiveness of the explosive and a lesser degree of uniformity in performance. The water resistance of ammonium nitrate explosives is generally low because of the presence of this very soluble salt.

An object of the present invention is an explosive composition containing at least one water-soluble salt and having improved water resistance. A further object is an ammonium nitrate explosive of enhanced water resistance. A still further object is an explosive containing ammonium nitrate wherein an ingredient is present which tends to prevent the harmful penetration of water. Additional objects will be disclosed as the invention is described more at length hereinafter.

I have found that the foregoing objects are accomplished by including oat flour as an ingredient in explosive compositions containing at least one water-soluble salt, said oat flour or meal desirably being included in the explosive composition in pulverulent form and being capable of functioning as a protective agent against water for said salt. By the term oat flour or oatmeal, I intend to designate both the finely divided, untreated meal resulting from the grinding of the oat kernel and the pretreated and preheated material such as is commonly employed as a cereal food. My invention does not include the use of oat hulls, however, except as small amounts may be present fortuitously in the meal. Oat hulls comprise largely the chaff and such portions of the whole oats, and do not give the advantageous results desired, whether in coarse or fine condition.

My invention is applicable with advantage to all explosive compositions containing a water-soluble salt, whether this salt is ammonium nitrate, sodium nitrate, a chlorate or perchlorate, or other soluble salt. I find it particularly important in the case of ammonium nitrate explosives, and especially in such compositions containing an explosive nitric ester, nitroglycerin for example. It should be understood, however, that the invention is applicable as well to explosive compositions which contain no ingredient which is itself an explosive, for example compositions containing non-explosive sensitizing agents. Many compositions, for instance, contain ammonium nitrate or other oxidizing agents sensitized with materials such as aluminum or other finely divided metals. Likewise, certain ammonium nitrate explosives are sensitized with various forms of carbon, hydrocarbons, and explosive and non-explosive nitrated hydrocarbons, for example charcoal, paraffin, dinitrotoluene, and the like. My invention is equally applicable to these compositions, since they contain the water-soluble salt which must be protected from wet conditions in the field.

The advantages of my invention are illustrated by the following specific embodiments, in which A and B represent ammonia dynamites of similar compositions, A containing ordinary carbonaceous combustibles and B oat flour.

	A	B
Nitroglycerin ---- percent	14.0	14.0
Ammonium nitrate ---- do	36.5	36.5
Calcium stearate ---- do	0.3	0.3
Sodium nitrate ---- do	35.8	35.8
Wood pulp ---- do	1.0	1.9
Prior art meals ---- do	5.9	----
Oat flour ---- do	----	5.0
Sulfur ---- do	6.0	6.0
Chalk ---- do	0.5	0.5
	100.0	100.0
Density—ctgs./50 lbs	109	108
Water resistance:		
½ hr	4D	----
1 hr	4F	----
5 hrs	----	4D

The improvement in water resistance, due to the introduction of oat flour into the explosive, is very striking, as shown in the above examples. The test consisted in immersing the partly opened dynamite cartridge in water in a metal tube for

the time designated, detonation then being attempted by a blasting cap. In the case of the dynamite containing the meals of the prior art, four failures to detonate resulted after immersion of the explosive for 1 hour, whereas, with the dynamite containing oat flour, four successful detonations were obtained after 5 hours' immersion.

Additional evidence of the improved water resistance properties was given by the results of a leaching test, under pressure, of cartridges of 4" by 10" dimensions. In each cartridge tested, four holes were made of 3/8" diameter in the side wall at each end. The cartridges were then subjected to a water pressure of 15 lbs. per square inch for 24 hours. At the end of the test, the dynamite A, containing meals of the prior art, had been reduced to a column of highly wet material, of 3 x 6½" size. The weight of the cartridge had been reduced by leaching from 2700 to 1473 grams, some of the latter weight being due to the water present. In the case of dynamite B, containing oat flour, only a very small portion had been leached away at the ends, and the weight had increased from 2743 to 3000 grams. The bulk of the composition was capable of propagation of explosion from a blasting cap.

The oat flour, when present in explosives of the type described, is capable of forming a cohesive and protective paste with the more or less dilute solutions produced when water comes in contact with the outer or exposed portions of explosives containing water-soluble salts. Ordinary flours, meals, and starches do not disperse satisfactorily and do not form protective pastes. As examples of these latter materials, I may mention untreated wheat flour, corn meal, tapioca starch, and the like.

The dispersions formed by mixture of ordinary starch products with relatively small amounts of either water or dilute nitrate solutions, without application of heat, are such that there is a rapid separation of the flour, meal, starch, or the like. Oat flour acts differently in that the greater part of the material remains colloidally dispersed and suspended on dilution of a relatively dry paste with dilute nitrate solution, even though no heat has been applied at any time.

When oat flour according to my invention is used in compositions such as ammonia dynamites, it appears that the entrance of the first traces of water brings about a paste or gel formation. This gelatinization in the outer portion of the explosive retards the rate of water penetration toward the interior of the explosive column. The gelatinous structure formed also prevents segregation of liquid or solid ingredients of the explosive such as would be caused by water penetration and softening of the composition. The cohesive gel or paste also decreases the loss of solid or liquid ingredients from partly opened cartridges by reason of gravity flow. The leaching of soluble salts is likewise lessened by the presence of the paste.

It will be understood that, in order to obtain the most favorable results, the oat meal or flour should be in finely divided condition. Preferably said meal should be in a state of subdivision such that the major portion, that is more than 50%, will pass a 60-mesh screen. Furthermore, the oat flour is desirably included in the explosive composition in pulverulent form during the manufacture of the explosive composition, no paste being formed at that time. I do not intend to be limited to meal of this degree of fineness, however. Likewise, I may wish to introduce into the explosive composition a small amount of a water-insoluble metal soap, such as calcium stearate, which will have a protective and coating effect on the ammonium nitrate against water or moisture. The presence of this latter ingredient, together with the oat flour, gives very beneficial results. The oat flour is effective, however, without the presence of the water-insoluble soap. Preferably, said oat flour will be used in an amount not greater than 15%, and I find a quantity between 1% and 9% to be advantageous.

It will be understood that I may use a meal made from the entire oat kernel or portions of said kernel which have a higher protein content, or other fractions of the oat. As previously stated, the ground untreated oat flour gives satisfactory results in improving the resistance of explosives containing water-soluble salts to the penetration of water. I may prefer, however, to use an oat flour or meal that has been given a preheating treatment or other prior treatment that would bring about a substantial pregelatinization.

The invention is applicable with great advantage in ammonia dynamites containing ammonium nitrate and nitroglycerin in amounts not exceeding 25%, for example between 3% and 25%. It has important applications also in the case of compositions containing other high explosive compounds, such as nitrostarch, trinitrotoluene, and the like, in the presence of ammonium nitrate or other water-soluble salt. Furthermore, it is effective in the case of compositions in which the ammonium nitrate is sensitized by means of paraffin, dinitrotoluene, carbon, aluminum, other powdered metals and alloys, and many other materials.

The oat flour, according to my invention, has been stated to be present preferably in pulverulent form during the manufacture of the explosive, since in this form the meal or flour functions in the peculiarly effective manner desired in protecting the explosive against water penetration.

My invention has been described in detail in the foregoing. It will be apparent, however, that many variations may be introduced in methods of application or in compositions without departure from the scope of the invention. I intend to be limited therefore only by the following patent claims.

I claim:

1. An explosive composition comprising a water-soluble inorganic salt selected from the group consisting of ammonium nitrate, sodium nitrate, the chlorates and the perchlorates, a sensitizing agent, and oat flour in pulverulent form.

2. An explosive composition comprising ammonium nitrate, a sensitizing agent, and oat flour in pulverulent form.

3. An explosive composition comprising ammonium nitrate, an explosive sensitizing agent, and oat flour in pulverulent form.

4. The explosive composition of claim 3, wherein the sensitizing agent comprises nitroglycerin.

5. The explosive composition of claim 3, wherein the sensitizing agent comprises an aromatic nitrocompound.

6. An explosive composition comprising ammonium nitrate, a non-explosive sensitizing agent, and oat flour in pulverulent form.

7. The explosive composition of claim 6, where-

in the sensitizing agent comprises a carbonaceous material.

8. The explosive composition of claim 6, wherein the sensitizing agent comprises a powdered metal.

9. An explosive composition comprising ammonium nitrate, between 3% and 25% nitroglycerin, and not more than 15% oat flour in pulverulent form.

10. The explosive composition of claim 9, in which the oat flour is present in a degree of fineness such that more than 50% thereof will pass a 60-mesh screen.

11. The explosive composition of claim 9, in which the oat flour is present in an amount between 1% and 9%.

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