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EXPLOSIVE COMPOSITION

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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, 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 barley meal or flour as an ingredient in explosive compositions containing at least one water-soluble salt, said barley meal being included in the explosive composition in pulverulent form and capable of functioning as a protective agent against water for said salt.

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 agent sensitized with materials such as aluminum or other finely divided metals. Likewise, certain ammonium nitrate explosives are sensitized with various forms of carbon and nitrated hydrocarbons, for example, paraffin, charcoal, 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.

As specific embodiments of my invention, the following will serve, in which A and B represent ammonia dynamites of similar compositions, A containing wheat flour while B contains barley flour:

Example

	A	B
Nitroglycerin	14.0	14.0
Ammonium nitrate	36.5	36.5
Calcium stearate	0.3	0.3
Sodium nitrate	34.5	34.5
Wood pulp	2.7	2.7
Wheat flour	6.0	
Barley flour		6.0
Sulfur	5.5	5.5
Chalk	0.5	0.5
	100.0	100.0
Ctgs./50 lbs.—1¼ x 8"	110	110
Water resistance:		
1 hr.	4D	
2 hrs.	2D, 2F	
7 hrs.	4F	
216 hrs.		4D

The improvement in water resistance through the presence of barley flour in contrast to wheat flour, as shown above, is very remarkable. 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 means of a blasting cap. In the case of the ammonia dynamite containing wheat flour, 4 failures to detonate resulted after 7 hours' immersion of the explosive, whereas with the dynamite containing barley flour, 4 successful and strong detonations were obtained even after 216 hours.

The barley flour, when present in explosives of the type described, is capable of forming a co-

hesive and protective paste with the more or less dilute solutions produced when water comes in contact with the outer or exposed portion 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. Barley flour acts differently in that the greater part of the material remains colloidally dispersed and suspended, on dilution of a relatively dry material with dilute nitrate solution, even though no heat has been applied at any time. I may, however, use a barley that has been steam-exploded or otherwise preheated and thereby obtain a paste of even higher viscosity.

When barley 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 barley 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 barley meal is included in the explosive composition in pulverulent form during the manufacture of the explosive composition, no paste being formed at that time. Since the barley meal must be present in pulverulent form in order to function when water is encountered in the field, it will be appreciated that my invention has nothing to do with powders so completely filled with nitroglycerin that a paste would be formed by the nitroglycerin with any meal present. 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 barley meal, gives very beneficial results. The barley meal is effective, however, without the presence of the water-insoluble soap. Preferably, said barley meal 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 barley kernel or portions of said kernel, for example, certain barley polishings which have a higher protein content or other fractions of the barley.

The invention is applicable with great advantage in ammonia dynamites containing ammonium nitrate and nitroglycerin in amounts not exceeding 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.

In addition to its effective use for the protection of explosives containing water-soluble salts, the presence of barley meal according to my invention will prove desirable also in the case of the semi-gelatinous type of explosive, in order to decrease the tendency of the ammonium nitrate to set or become hard. It will be appreciated that even in this type of powder the barley meal is only effected when present in powder form. The barley meal may be employed alone for this purpose or in the presence of a lubricating agent therefor, for example, a vegetable oil such as castor oil, olive oil, and the like, a petroleum fraction, or a solid lubricant.

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 oxygen-supplying inorganic salt, a sensitizing agent, and barley meal in pulverulent form.

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

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

4. An explosive composition comprising ammonium nitrate, a liquid nitric ester, and barley meal in pulverulent form.

5. The explosive composition of claim 4, wherein the liquid nitric ester comprises nitroglycerin.

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

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

8. The explosive composition of claim 6, wherein the sensitizing agent comprises a carbonaceous material.

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

10. An explosive composition comprising ammonium nitrate, a sensitizing agent, and barley meal of such a degree of fineness that more than 50% thereof will pass a 60-mesh screen, said meal being maintained in pulverulent form.

11. An explosive composition comprising ammonium nitrate, a sensitizing agent, and between 1% and 9% barley meal in pulverulent form.

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