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EXPLOSIVE SLURRY CONTAINING PULPY FIBROUS MATTER, FINELY DIVIDED CARBONACEOUS MATERIAL AND POWERFUL INORGANIC OXIDIZER SALT

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ABSTRACT OF THE DISCLOSURE

An explosive slurry of high potency and low cost is made up of water, sugar beet pulp coated with finely divided carbonaceous material when needed, and/or combined with aluminum in some cases, an aqueous solution of strong oxidizer salt, such as ammonium nitrate, which may contain sodium nitrate or other oxidizer, and a thickener. Wood pulp, dried cactus fiber, finely divided dry alfalfa, dried castor bean pomace, etc., may be used in lieu of or with sugar beet pulp, provided the oxidizer solution can penetrate into the fiber while trapping air bubbles there.

BACKGROUND AND PRIOR ART

It has been proposed by various explosives makers and investigators in the past, to make explosive slurries or blasting materials which comprise organic matter of various types. The use of gilsonite, coal, etc., has been suggested many times, as in U.S. Patents 3,153,606, 3,249,474 and others. In U.S. Patent No. 3,378,415 it has been suggested further that an explosive slurry might be made which includes an aqueous solution of inorganic nitrate and solid carbonaceous fuel of vegetable origin. The latter, it is said, may include powdered coal and/or various granular or fibrous materials, such as bagasse, woodmeal, etc. Materials such as flour, bran, pecan meal and the like are mentioned also. It is known also as in U.S. Reissue No. 25,695 that aluminum powder and other heat producing metals can be used as fuels and metal compounds, such as ferro-silicon, have been suggested for use in these slurries, along with various materials, e.g. stabilizers such as zinc oxide, etc.

According to U.S. Patent No. 3,361,604 an explosive blasting slurry can be made up also of wet fibrous pulpy matter. According to this reference, such matter is said to be distinguishable from various dry or relatively dry carbonaceous plant derivatives described above. The reference suggests that wet fibrous material which ferments, such as apple pulp, vegetables and fruits such as peaches, potatoes, bananas, pears, plums, apples, sugar beets, tomatoes, lemons, grapefruit berries of various types beans, cabbage, lettuce, and numerous other wet pulpy materials can be used with advantage. This patent makes reference also to slurries containing self-explosives of the type described in Cook and Farnam U.S. Patent No. 2,930,685. Mention is made of various other references of similar type.

Materials of vegetable origin, such as the pulpy or fibrous types described in Patent No. 3,361,604 as being useful are very high in water content. For example, sugar beets contain about 84% water in their normal, freshly harvested state. Slurries which are made up of significant proportions of materials of this type not only are likely to have excessive water content but they tend to be unstable since they decompose and/or gas or ferment excessively. While such fermentation may produce small quantities of alcohol, etc., the resulting products have not

been found satisfactory for the present purposes. The present inventors have made attempts to prepare compositions having some similarity to those described in the patent just mentioned by adding to dry beet pulp enough water to restore it to the pulpy stage and using this in a slurry. However, the resulting compositions have not been at all satisfactory for use as explosives. Commercial beet pulp, after extraction of the juices and most but preferably not all of the sugar content, contains relatively little water, usually around five percent, based on total weight. This is relatively dry fibrous material which according to the present invention, can be used much more satisfactorily as an ingredient of a blasting slurry than wet beet pulp, provided it is properly combined with the oxidizer salt and other ingredients. In order to prepare a sound and dependable explosive slurry, the present applicants have found it necessary to do much more than merely use as an ingredient a pulpy material. A greatly superior explosive product can be obtained, according to this invention, (1) by saturating the pulpy material with a strong solution of oxidizer salt, and (2) doing this in such a manner that even when immersed in an oxidizer solution the fibrous material will retain in finely divided condition at least a small amount of air or other gases entrapped within it. That is to say, even after the fibrous matter is mixed into an aqueous solution of oxidizer, such as concentrated aqueous solution of ammonium nitrate or sodium nitrate, active sites for initiating detonation such as are formed when gases are entrapped in tiny bubbles should be available. These entrapped gas bubbles which contact both the carbonaceous fuel and the oxidizer salt are effective sites for initiating and propagating detonation.

Thus, a dry, fibrous beet pulp which is first mixed with a finely divided carbonaceous material, such as bituminous coal or gilsonite to inhibit its complete wetting by the aqueous solution of oxidizer, is an extremely effective component of a blasting slurry of the aqueous ammonium or ammonium-sodium nitrate type. By "ammonium nitrate type" the present applicants mean to describe a large class of active oxidizer compounds which may or may not actually contain ammonium nitrate as the principal oxidizer salt. Other materials such as the ammonium and alkali metal chlorates and perchlorates, may be substituted for part or all of the ammonium nitrate. Likewise, sodium nitrate, potassium nitrate, calcium nitrate, barium nitrate, or mixtures may be substituted for all or at least for a part of the ammonium nitrate.

In general, a highly satisfactory slurry is made, according to the present invention, by using as oxidizer salt a combination of ammonium nitrate and sodium nitrate. A concentrated oxidizer solution is prepared preferably by dissolving one or both of these components in hot water, to which the relatively dry fuels and other ingredients are subsequently added. These particulate and/or fibrous fuels, or at least some of them, should be insoluble in the liquid solution just described. The fuel particles are suspended or slurried in the solution which thus forms a continuous or substantially continuous liquid phase, the solid particle phase, of course, being discontinuous. According, then, to the present invention, a slurry of good blasting qualities can be made up of ground beet pulp or of analogous fibrous material such as certain types of wood pulp, dehydrated and ground alfalfa, etc., some of which may require treatment, such as mixing with water repellent material, to prevent complete liquid saturation and thus to establish tiny gas or air pockets which serve as active initiation sites or centers. Some materials such as cacti and alfalfa have this property inherently. Numerous fibrous materials of vegetable origin which have been essentially dehydrated, or which have at least a major part of their water content removed, are useful; some must be combined with other ingredients described below. Appropriate quantities of the fibrous material, properly treated when necessary to insure that such material will entrap air in tiny bubbles, even when soaked in the solution of oxidizer-salt, make excellent sensitizers for a slurry blasting agent. This is true especially of aqueous slurries based primarily on ammonium nitrate, but the principle is applicable to slurries containing other salts mentioned above or containing mixtures thereof with ammonium nitrate.

The invention will be more fully understood by reference to descriptions of specific examples and preferred general embodiments which follow.

DESCRIPTION OF PREFERRED EMBODIMENT

Examples I to V

(I) A composition was made up starting with an aqueous solution containing 42 parts by weight of ammonium nitrate and 15 parts of sodium nitrate dissolved in 15 parts of water. To this solution were first added 0.25 part of guar gum dispersed in 0.50 part of ethylene glycol. The latter was used primarily to disperse the guar gum which is a thickener, but the glycol is useful as a fuel as well as a liquid extender and dispersing agent. The resulting solution was a somewhat syrupy liquid of considerably greater viscosity than the ordinary unthickened salt solution.

A dry so-called "pre-mix" was made up, consisting of 2.2 parts by weight, based on the final slurry, of starch, 0.2 part of guar gum in the solution of the type mentioned above, and 8.23 parts of dry sugar beet pulp containing about 5% of moisture and a trace of residual sugar, or molasses. This pre-mix of solid particles was stirred into the solution and 12.22 parts, or percent by weight, of dry particulate ammonium nitrate was added. The cellulose content seemed to dry up some of the water and thicken the slurry but it could still be poured. This beet pulp was analyzed for its energy content and was found to have a fuel value of about 6,880 B.t.u. per pound. It had a nitrogen content of about 1.66%, a carbon content of 40.1%, a hydrogen content of 5.55%, the balance of 52.69% being primarily oxygen.

This composition was tested by attempting to detonate a charge of it placed in a tube of four inches diameter, using a No. 3 booster to set it off. It failed completely.

(II) A slurry was made up of an oxidizer solution, generally similar to that of Example I, see the table below. Instead of using only the untreated dry beet pulp, the pulp was first mixed intimately with powdered gilsonite. In a third Example (IV) the beet pulp was reduced from 10 to 8 parts.

Example	I	II	III	IV	V
Solution:					
Ammon. nitrate	42	52	52	42	42
Water	15	15	15	15	15
Sodium nitrate	15			15	15
Guar gum	0.25	0.3	0.3	0.25	0.25
Ethylene glycol	0.5			0.5	0.5
(Propylene glycol)		(0.6)	(0.6)		
Pre-mix drys:					
Guar gum	0.2	0.5	0.5	0.2	0.3
Sulfur	4.0			4.0	4.0
Beet pulp	8.23	10.0	8.0	8.0	8.0
Gilsonite		1.3	2.1	1.0	2.6
Tapioca flour	2.2			1.0	
Supplemental oxidizer, Ammon. nitrate	12.22	20.3	21.5	13.05	13.25

Examples II and III were tested for penetration or viscosity and were stored for a time to determine stability. Like Example I, these materials were quite insensitive and difficult to detonate. Differential thermal analyses showed that these compositions were stable at temperatures up to about 170° C. Example IV, which included 4% of sulfur, detonated in a 4″ diameter charge, using a standard No. 3 booster.

Example IV had an initial density of 1.23 g./cc. when mixed, but this increased to 1.31 after cooling. It failed in a 3-inch column when a standard blasting cap was used, but detonated in 4-inch and 5-inch columns at 25° C. with a No. 3 booster. Detonation velocity was 2110 m./sec. in the 4-inch booster detonated charge and 3170 m./sec. in the 5-inch charge. This is considered satisfactory for many applications. The composition of Example V, which was otherwise like Example IV, failed to detonate when the starch (tapioca flour) thickener was replaced by a small amount of guar gum.

Another composition was made up, starting with a solution consisting of 53.5 parts of ammonium nitrate, 15 parts sodium nitrate, 15 parts water, 0.25 part of guar gum and 0.50 part of ethylene glycol, the latter being used first to disperse the gum and then mix it into the aqueous solution. To this liquid solution was added the following ingredients in the form of a dry pre-mix: 4.0 parts of sulfur, 2.2 parts of tapioca flour, as in the previous example, 0.2 part of guar gum, and 9.35 parts of dry beet pulp (not exceeding about 5% water content). The resulting slurry composition was found to have an oxygen balance of −1.76 wt. percent and good water resistance. This was a fairly viscous slurry but one which could be pumped, thuogh it flowed rather heavily.

The slurry was placed in a 6-inch tube for detonation test but failed completely at 20° C., using a standard No. 3 booster.

In slurries of the type to which the present invention relates, several factors are significant. The particle size of the fibrous pulpy matter can become important. In some cases a finely screened dry pulpy material properly incorporated in the slurry, such as ground dry alfalfa or sugar beet pulp treated and then saturated in part, as described above, is a sufficiently powerful fuel-sensitizer that ammonium nitrate slurry entirely free of a usual sensitizer, such as fine aluminum, can be fired. Slurry containing a different or coarser grade of the same fibrous matter, in the same proportions, may not be detonable unless another sensitizer is present, such as a small amount of flaked paint grade aluminum.

It can make an important difference, too, if all of the oxidizer salt is in solution. Slurries of this type, containing undissolved ammonium nitrate prills (fertilizer grade) appear to be more sensitive than those containing the same total quantity of oxidizer with all of it in solution.

The beet pulps used in the examples above were molasses dried pulp having moisture content of 8 to 9% and about 5 to 6% unextracted sugar, in addition to molasses solids which were present. The molasses itself is a useful ingredient, imparting some added energy to the composition.

Example VI

A blasting slurry was made up using finely ground dry alfalfa hay as a fuel-sensitizer. Alfalfa has a gum or gel content which appears to resist complete water penetration enough to trap some fine air bubbles, making use of a coating agent unnecessary in many cases. The oxidizer solution was identical with that of Example IV in the table above. The dry "pre-mix" consisted of 3.0% by weight, based on total composition, of sulfur, 14.0% of the alfalfa, 0.3% of guar gum (in addition to the 0.25% in the solution) and 0.2% of borax as a cross-linking agent. This was stirred into the essentially saturated solution, along with 9.75% of prilled ammonium nitrate which remained substantially undissolved but suspended in the slurry.

The dry pre-mix had a density of 0.627 g./cc. and slurry, immediately after mixing had a density of 1.17. It was a fairly stiff slurry. It failed to detonate in a 3-inch diameter column with a standard blasting cap but detonated completed with a booster in columns of 3″, 4″ and 5″ diameter. The latter had a detonation velocity of 2,235 meters per second.

Example VII

A comparative test was made using freshly cut and ground alfalfa. A composition was made up of 74.7 parts by weight of ground ammonium nitrate, 24 parts of the green hay, 16 parts of water and 0.3 part of guar gum as a thickener. Total parts were 115 by weight so the percentages are about one-seventh less. Attempts to fire this material in columns as large as 6" in diameter were unsuccessful.

Example VIII

A composition exactly like Example VII was prepared, except that a similar weight proportion of ground dry alfalfa was used. The slurry had a density of only 0.965 g./cc. because of its high pulp content. It failed in a 3-inch column but detonated in 4-inch and 6-inch columns with detonating velocities respectively of 2755 and 3455 meters per second. Total water content was about 15.6% as compared with 32.39% for Example VII. Interestingly enough, this detonated without use of either sulfur or gilsonite. Alfalfa of this type is somewhat harder to saturate with liquid than beet pulp because of its gum or gelling agent content and some fine air bubbles no doubt were entrained or trapped in the fibers.

Example IX(a, b, c)

Three compositions were made up using wood pulp as the fibrous sensitizer. In the first no water was used; in the second and third water content was 7 and 15% by weight, respectively.

Wood pulp from the Pacific Northwest was passed repeatedly through a grinder and ground until the fibers were well separated and the whole material became light and fluffy. The ammonium nitrate prills also were ground to make fine particles. Example IX(a) contained no water and consisted only of 15% by weight of wood pulp and 85% ammonium nitrate. It detonated in a 3-inch column at a velocity of 2755 m./sec. Example IX(b) contained 14% pulp, 79% oxidizer, and 7% water, while Example IX(c) contained 12.8% pulp and 72.2% ammonium nitrate and 15% water. These two compositions also detonated successfully in 3-inch columns, using standard boosters. In 6-inch columns, detonation velocities were 3170 and 3455 meters per second, respectively. It should be noted there that the composition with higher water content had the higher velocity. Wood pulp from Douglas fir, spruce or pine, as used to manufacture egg cartons was used in these tests.

Example X(a, b)

Wood pulp is very bulky and hard to mix into a slurry in large percentages. For this reason, a test slurry was made up, using a combination of dry sugar beet pulp and dry wood pulp, the latter being ground to a fine fluffy condition as described in Example IX. Another slurry was made up using only 2% of wood pulp and no beet pulp. These had the following compositions, percentage by weight:

	Solution					Pre-mix						Dry oxidizer, AN
	AN	SN	H_2O	Gum	Glycol	S	Gil.	TF	Gum	BP	WP	
(a)	42	15	15	0.25	0.5	4	1	0.8	0.2	6.2	2.0	13.05
(b)	42	15	15	0.25	0.5	4	3.25	1.2	----	----	2.0	16.8

The dry ingredients were added to the solution while its temperature was 45° C. Resulting temperature was about 36° C. Both compositions failed to detonate in 3-inch columns but detonated in 4-inch columns at 20° C. with standard boosters. The sulfur (S) and gilsonite (Gil.) undoubtedly contribute to sensitivity. The tapioca flour thickener (TF) also aids sensitivity because it helps to trap air bubbles in the fiber in intimate association with the oxidizer.

A third composition like Example X(b) was made except that wood pulp was replaced by wood flour, which is more dense. The resulting slurry failed in a 6-inch diameter column, indicating that wood flour is inferior to wood pulp in these compositions. Wood pulp is a low density material which can be used for density control in slurries of this type.

Example XI(a, b)

Dried pulp from the prickly pear cactus Opuntia was used as fibrous vegetable matter in several tests. The compositions were as follows:

	Solution					Pre-mix				Supp. Oxidizer, Dry AN
	AN	SN	H_2O	Gum	Glycol	S	PGAl	Cactus	Borax	
(a)	42	15	15	0.2	0.4	3	0.4	13	0.05	10.95
(b)	31.5	13.5	15	0.17	0.34	3	0.4	13	0.05	23.0

The first batch (a) was too small for operational testing, but it showed that the cactus itself is an excellent thickener. Cactus contains gum which apparently functions as well as guar gum for this purpose. As to sample (b), it was known beforehand, from numerous tests, that gilsonite could be used to impart sensitivity and oxygen balance. It was felt that cactus could replace the gilsonite and the starch and/or gum that is usually employed as a thickener in aluminum-gilsonite sensitized slurries. The use of paint grade aluminum (PGAl) would be expected to increase sensitivity.

The slurry (b) was mixed at a solution starting temperature of 32° C. and had a final temperature of 30° C. Its initial density was 1.33 g./cc. and density after cooling was 1.36. It had a penetration of 2.40. It fired successfully in a 3-inch diameter column, which is considered very satisfactory. In general, it appears that plant fibers which contain gums, as cactus does, are very useful. This appears to apply to the dry fibers of most succulents (i.e. cacti) as well as alfalfa, etc.

Example XII

Castor bean pomace (residue from castor oil production) is known to have a high lignin content. This material was ground finely enough to pass a 65-mesh Tyler screen. It was used in proportions of 12.5% along with 1.3% of tapioca flour, 1.2% of guar gum, and 3% of sulfur as a dry pre-mix, to add to a solution like that of Example IV. Finally, 10.15% of prilled ammonium nitrate was added. This composition had an initial density of 1.27 and a final density of 1.30 g./cc. It failed to detonate in a 6-inch column, apparently because it had a residual oil content which retarded its absorption of the oxidizer solution. It was fired successfully in a 6½-inch diameter column when it showed 86% of the seismic strength of TNT. It appears that if this material is more finely ground and/or if residual oil content is reduced further this is an excellent fuel, comparable with gilsonite and possibly superior. It shows good temperature stability, in fact a differential thermal analysis showed slight smoking at 185° C., heavier smoking at 230° C., but no pronounced exotherm until temperature reached 285° C. Some of the other materials tested above showed ignition below 200° C.

In general, it is found that the more finely ground fibrous or pulpy materials are better than the coarser products. They should soak up the oxidizer solution quite readily but should not become so completely saturated as to eliminate the very fine air bubbles which should be trapped. Sites where a tiny air bubble, a concentrated solution of oxidizer and a particle of fuel meet appear to be essential to acceptable sensitivity.

Those materials which contain natural gum type thickeners, such as cactus and alfalfa can be used with lesser quantities or often in complete absence of starch or gum thickeners which otherwise appear to be necessary. It is noted further that both cactus fiber and alfalfa lend stability to thickened and cross-linked slurry. Beet pulp and wood pulp, on the other hand, appear to give only a mechanical thickening effect.

Tests comparing ground whole sugar beets (with original water content) with beet pulp show that the latter is much more satisfactory. A composition containing 8% of ground whole sugar beets instead of beet pulp, but otherwise exactly like Example IV failed to detonate even in a 6-inch diameter column. Other tests showed further that ground whole sugar beets were by no means equivalent to beet pulp for use in these explosive slurries, even with the same pulp solids equivalent.

In general, the use of sulfur and sodium nitrate in slurries based primarily on ammonium nitrate solutions and fuels helps to impart sensitivity, as is known from U.S. Patents Nos. 3,249,477 and 3,282,752. In the case of the fibrous vegetable derivatives used as fuels or sensitizers, in the present invention, use of sulfur and sodium nitrate is often very helpful. However, it is not always necessary.

Furthermore, the use of a powerful sensitizer such as a small amount of finely divided aluminum metal, is often advisable, especially where sensitivity is marginal. However, many of the compositions of this invention have satisfactory sensitivity without aluminum and it is not necessary that it be used, except for low temperature blasting.

In the latter connection, some of these slurries seem to lose sensitivity rapidly with declining temperatures. The reasons for this are not fully understood but in cases where low temperature operations are contemplated it may be advisable either to add small amounts of potent sensitizers such as paint grade aluminum, or combinations of fine aluminum with ground gilsonite or bituminous coal; on the other hand, increased use of a well balanced combination of sodium nitrate and sulfur can be helpful. In fact, sulfur itself has some sensitizing value. All these fuels can and should be used in suitable proportions, from 0 up to a total of 10% by weight of total composition or more, to bring the whole composition into good oxygen balance. In many cases they are not needed at all; in others they can contribute very substantially to sensitivity and blasting power.

In some experiments sugar was added as a carbonaceous fuel, replacing the gilsonite, for example, in Example X(b) which contained 2% of fine fluffy wood pulp. Gilsonite appears to be superior to sugar for use with wood pulp.

EXAMPLE XIII

A further attempt was made to use higher proportions of wood pulp than in some of the examples given above. A solution was made up of 51.2 parts by weight of ammonium nitrate, 18.3 sodium nitrate, 17.3 water, 0.3 guar gum, and 0.6 part propylene glycol. To this was added a dry pre-mix of 3.0 parts sulfur, 2.9 parts ground gilsonite, 0.4 part of paint grade fine flaked aluminum, and 6.0 parts wood pulp passed through a grinder several times.

The resulting composition had an initial density of 1.15 g./cc. and a final density of 1.19. It failed in a 3-inch column set off with a standard blasting cap but detonated at 25° C. in a similar column when a booster was used. A 4-inch column was detonated at 20° C. with a booster, having a detonation velocity of 2535 m./sec. In a 5-inch column at 25° C., the detonation velocity was 3800 m./sec., highly satisfactory for powerful blasting. At 15° C. a 6-inch column detonated at 3170 m./sec. All samples were quite stiff or semi-solid when fired. It was difficult to disperse as much as 6% of wood pulp in this case, but a fairly uniform stiff mix was obtained.

EXAMPLE XIV

Another composition was made up quite similar to Example XIII but containing 5% by weight of wood pulp, kraft waste, bleached, (instead of 6%) and 18.3% of water instead of 17.3%. This was a stiff, rather lumpy slurry. It failed to detonate in a 3-inch column at 25° C., but detonated successfully in a 4-inch at the same temperature. In a 5-inch column, also at 25° C., it detonated with a velocity of 2460 m./sec. In a 6-inch column at 15° C. it detonated with a velocity of 2535 m./sec. Initial density of the slurry was 1.12 g./cc., increasing to 1.17 on standing.

EXAMPLE XV

A composition identical with Example XIV was made up, except that a fluffy unbleached sulfate pulp (as used in paper making) was used instead of bleached kraft waste. This formed a rather thick slurry but was not excessively sticky. It had an initial density of 1.24 g./cc. and a final density of 1.30. It failed to detonate in a 3-inch diameter column with a standard blasting cap as primer. A 4-inch column also failed at 25° C. Both 5-inch and 6-inch columns detonated completely at 25° C., with velocities of about 2535 m./sec.

From the above, it clearly appears that dry vegetable fiber, such as beet pulp, wood pulp, and the like, can be used in relatively large proportions, bulkwise, as a fuel in inexpensive slurries, provided it is coated or mixed with a material that will resist complete wetting by the slurry and thereby entrap large numbers of very small air bubbles, well and preferably quite uniformly distributed throughout the slurry. Gilsonite in finely ground form is a particularly effective coating or mixing agent, but finely ground bituminous coal, asphalt, or petroleum waxes, resins and residues, acids, tars, etc., also can be used. The slurries of this invention may contain as little as 0.5% by weight of the fibrous matter of vegetable origin, when supplementary fuels are present, such as sulfur, aluminum, carbonaceous solids and the like. In some cases as much as 15% or more of the fibrous material may be added. With the more bulky fibrous materials, such as wood pulp, it is difficult to incorporate more than a few percent into an aqueous slurry without increasing the water content to 20% or more. This is not desirable in most cases. Total proportions of fibrous material are preferably between 2 and 10%. It is better to keep the water content between about 12 and 20%, preferably 14 to 18%. With wood pulp 2% pulp content appears to be about optimum, as compared with an optimum of about 14% for alfalfa. The water can be extended moderately by adding water miscible organic extender liquids having some fuel value, such as water soluble alcohols, glycols, amines, amides, aldehydes, ketones, etc. Ethylene glycol, propylene glycol, methyl, ethyl and isopropyl alcohols, acetaldehyde, acetone, formamide, ethanolamines, and the like may be used for this purpose in proportions up to 5% or more. Supplemental fuels, if needed, are employed in suitable proportions to bring oxygen balance between about +10 and −20 weight percent.

The quantity of coating material on the fibrous material may vary considerably with its fineness of grind, liquid repellency and intimacy of mixing with the fibrous material, as well as with the character of the latter. It is important that the fibrous carbonaceous material be sufficiently hydrophilic to absorb the oxidizer solution into intimate contact with the fibers but it must have sufficient resistance to complete wetting that numerous air bubbles will be trapped and held stably distributed in large numbers throughout the fibrous material. Such resistance may be inherent in fibers which contain their own gelling or thickening agent; in other cases water repellent material such as gilsonite, etc., is to be added.

The thickeners used when the fibrous material does not supply its own thickener are preferably either guar gum (or equivalent natural gum well known in the art) or starch, or both, in proportions of 0.05 to 5%, preferably about 0.15 to 3.0% of the total composition by weight. Tapioca flour is particularly suitable for use with wood pulp and beet pulp. Guar gum is preferred for use with alfalfa and cactus. These fibrous materials, as noted above, have some thickener properties of their own. Guar gum ordinarily is used in proportions of 0.05 to 0.5%; proportions of starches when used as thickeners vary from 0.5 to 4%.

The oxidizer salt, containing usually a substantial amount of ammonium nitrate or sodium nitrate, or preferably both, normally constitutes at least 40% of the total. As a rule 50 to 70% is preferred and the total oxidizer may go as high as 80%. While mixtures of ammonium nitrate and sodium nitrate are preferred, either or both can be replaced in toto by other inorganic nitrates, including calcium nitrate, or by one or more of the ammonium, alkali metal or alkaline earth metal chlorates and/or perchlorates. Presently preferred compositions comprise 20 to 65% of ammonium nitrate combined with 5 to 50% of sodium nitrate, to make a total of 50 to 70 or 75% oxidizer, by weight.

Supplemental or primary sensitizers, such as "paint grade" aluminum may be used in small quantities (0.05 to 2%). Other and coarser aluminums may be used in larger proportions, up to 10% or more. Use of such supplemental sensitizers may be recommended for explosives to be used in columns of 4-inch diameter or less, especially if they are to be used in cold weather. Self-explosive sensitizers such as TNT, RDX, Composition B, and/or smokeless powder, may be used in proportions of 0.1 to 20%, with or in lieu of fine aluminum, as described in U.S. Patent No. 2,930,685, for example. Use of a small amount of paint grade flaked aluminum is particularly desirable for low temperature detonation.

What is claimed is:

1. A viscous or thickened explosive slurry blasting composition which comprises, in combination, an aqueous solution of a powerful inorganic oxidizer salt selected from the group which consists of the ammonium and metal nitrates, chlorates and perchlorates and mixtures of any two or more thereof, said oxidizer salt constituting at least 35% of the total composition weight, a finely divided fibrous carbonaceous fuel of vegetable origin in proportions of 0.5 to 25% by weight, said fibrous material being sufficiently water receptive to absorb said aqueous solution but being sufficiently water-repellent to cause entrapment and stabilization of numerous finely divided air bubbles distributed widely through the fibers, said composition containing also a supplemental fuel in proportions from zero to a quantity sufficient, when combined with said fibrous carbonaceous material, to bring overall oxygen balance between +10% and −20% by weight.

2. Composition according to claim **1** wherein the fibrous carbonaceous material supplies also a thickener or gelling agent.

3. Composition according to claim **1** wherein the fibrous carbonaceous material is beet pulp.

4. Composition according to claim **1** wherein the fibrous carbonaceous material is alfalfa.

5. Composition according to claim **1** wherein the fibrous carbonaceous material is wood fiber.

6. Composition according to claim **1** which further includes 0.05 to 2% paint grade flaked aluminum metal particles to increase sensitivity to detonation.

7. Composition according to claim **1** which contains a combination of ammonium nitrate and sodium nitrate as the oxidizer salt.

8. Composition according to claim **7** wherein the total amount of oxidizer salt present exceeds that soluble in the total liquid present.

9. Compositon according to claim **1** wherein the carbonaceous material is a finely divided wood pulp.

10. Composition according to claim **1** wherein the carbonaceous material is a dehydrated cactus fiber.

11. Composition according to claim **1** wherein the carbonaceous material is castor bean pomace.

12. Composition according to claim **1** which includes 2 to 10% by weight of vegetable fiber and 15 to 60%, based on vegetable fiber, of finely divided water-repellent carbonaceous material intimately mixed with and coated on said fiber.

13. Composition according to claim **12** wherein the coating material is finely divided gilsonite.

14. Composition according to claim **12** wherein the fibrous material is ground beet pulp and the coating material is gilsonite.

15. Composition according to claim **1** which contains a thickening agent in proportions sufficient to inhibit gravitational segregation of the ingredients thereof.

16. Composition according to claim **1** wherein the thickening agent comprises 0.05 to 1.5% by weight of guar gum.

17. Composition according to claim **1** wherein the thickening agent comprises 0.5 to 4% by weight of a starch.

18. Composition according to claim **17** wherein the starch comprises tapioca flour.

19. Composition according to claim **1** wherein the fibrous carbonaceous material acts as a stabilizer to a cross-linked gelling agent.

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