

1

2,930,685

EXPLOSIVE COMPOSITION

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9 Claims. (Cl. 52—11)

This invention relates to an explosive composition.

This is a continuation in part of application Ser. No. 701,330, filed December 9, 1957, now abandoned.

It has previously been customary scrupulously to avoid the presence of moisture in explosives. Therefore, extensive precautions have been taken both in formulating and storing explosives to exclude moisture. In the composition provided in accordance with this invention, a fundamental departure has been made from previous theory and practice in that the presence of water is not merely permissible but is an essential contributing element. Thus, an explosive composition in accordance with this invention has greater sensitivity than its solid ingredients.

An explosive composition in accordance with this invention has the further advantage of being particularly suitable for application in which it is difficult or impossible to exclude water at the site of the explosion such as for example wet bore holes in mining operation.

The explosive composition provided in accordance with this invention comprises a slurry of trinitrotoluene, ammonium nitrate and water and may additionally include aluminum and/or a "water-flow retardant." Specifically, the explosive composition of the invention comprises an aqueous slurry of solid explosive containing at least 5 percent by weight of water, the solids consisting essentially of 15 to 95 percent by weight of trinitrotoluene and 5 to 85 percent by weight of ammonium nitrate, said trinitrotoluene having a particle size greater than 30 standard Tyler mesh size.

It has been found that a composition in accordance with this invention has highly unexpected and unusual initiation and propagation characteristics. The detonation wave in its early stages lags behind a shock wave radiated forward from the detonation front. This shock wave by outrunning the detonation wave is able to create a new detonation wave once and sometimes twice or more in propagating a distance of only a few, and at the most about six, charge diameters. As a typical example, an initial detonation was observed to propagate about two charge diameters, then at about one charge diameter ahead of the detonation wave a new more intense, i.e. higher velocity, detonation wave suddenly developed and finally at about two more charge diameters a new, still more intense, faster detonation wave formed about one charge diameter ahead of the second stage detonation. The multi-stage detonation reaction appears to occur only in the first four to six charge diameters of propagation. After the final, most intense wave has been created there is no further tendency for the multi-stage process to take place. The foregoing phenomenon will be referred to as "multiple-jump detonation." The "multiple-jump detonation" results in increased sensitivity and self sustaining detonation characteristics. For example, where compositions in accordance with this invention are boosted with the pentolite and tetryl boosters which will be referred to below, the composition does not usually show high order detonation immediately, but there is nearly

2

always a low-order detonation which radiates a non-reactive shock ahead into the unexploded charge. This non-reactive shock itself then initiates chemical reactions ahead of the region of the booster and the initial low-order wave. Then after a period of time which may amount to as much as 30 to 100 microseconds, a new high-order, or a higher order, detonation suddenly commences at the front of the non-reactive shock wave that has previously run away from the low-order wave front. This is made possible by the continuous medium provided by the slurried condition of the mixture and the peculiar characteristics of the coarse trinitrotoluene distributed within this slurry. That is, the inert shock actually travels in the slurry at a higher velocity than the initial low-order wave.

Owing to the favorable influence of high pressure and reduced temperature on the "coke oven" reaction, $2\text{CO} \rightleftharpoons \text{C} + \text{CO}_2$ which is very important in the detonation reaction of TNT and various TNT-AN mixtures, in preventing dissociation of energetic products of detonation, such as H_2O and CO_2 , and promoting the formation of such energetically favorable molecules as CH_4 , NH_3 , and CH_3OH , under suitable formulations water actually increases the (dry basis) energy of TNT and AN-TNT mixtures in spite of the energy loss of nearly 0.6 Kcal./g. incurred by the vaporization of the water during explosion. If water were to exert no influence whatever on the composition of the products of detonation, an explosive generating say 1.0 Kcal./g. would for small percentages have its (dry basis) strength or available energy reduced about 0.6 percent by each percent water incorporated in it. Thus, an 80/20 explosive-water mixture under this condition would still have about 85 percent (dry basis) as much available explosive energy as the corresponding dry explosive. Therefore, if water were to exert a beneficial influence in tending to promote the formation of more energetic products of detonation, which is shown below to be the case in the explosives described in this invention, the relatively small energy loss associated with vaporization of the water may be more than off-set by the increased production of the more energetic products of detonation.

We have applied reliable thermo-hydrodynamic methods (J. Chem. Phys. 15, 518 (1947); 16, 1081 (1947)) to predict the influence of water on various mixtures of AN-TNT. Using a coarse (approximately 4 to 6 mesh) TNT we have found that about 27 parts water are required for 73 parts TNT to form a complete slurry mixture. At room temperature, moreover, approximately 15 ± 3 percent water is required to form a slurry with AN-TNT mixtures for AN/TNT ratios above 0.5. Calculated heats of explosion and approximate maximum available work potentials for several of these mixtures and the corresponding dry mixtures were as follows:

COMPUTED MAXIMUM AVAILABLE WORK POTENTIAL A AND HEATS OF EXPLOSION Q FOR SOME AN/TNT/WATER MIXTURES

AN	0	0	50	40	76.5	65
TNT	100	73	50	40	23.5	20
Water	0	27	0	20	0	15
Density (g./cc.)	1.02	1.40	1.0	1.41	1.0	1.41
Q (K cal./kg.)	870	715	870	710	975	760
Q (dry basis)	870	980	870	900	975	895
A ¹ (dry basis)	835	980	860	900	965	895

¹ Based on the assumption that only half of the heat in the condensed products of detonation at the "explosion" temperature is available energy.

From these results it is evident that the (dry basis) strength of AN-TNT water mixtures (containing enough water to fluidize them) is greater than that of the corresponding dry mixture for AN-TNT ratios between zero and about 1.5, falling slowly with increasing AN/TNT

to only 7 percent lower strength at AN/TNT=3.25, and about 10 percent lower strength at AN/TNT=5.0. The 68/17/15 mixture represents about the highest AN/TNT ratio for a practical, large diameter explosive owing to rapid decrease in sensitivity as this ratio is further increased. This 68/17/15 mixture, however, still has a weight strength comparable to that of 94/6 AN-fuel oil, but develops a detonation pressure more than three times greater than for the 94/6 AN-fuel oil mixture. It is therefore much better suited for blasting even in dry holes under hard shooting conditions, such, for example, as in hard magnetite. The AN-fuel oil mixtures are, of course, not suitable for underwater use without resorting to special water-proofing methods. The theoretical detonation velocities of these slurry mixtures are 6000 ± 500 m./sec. compared with about 4300 m./sec. for 94/6 AN-fuel oil. Experimental results in 5" diameter charges showed (stable) velocities from 5000 to 6000 m./sec. for the AN/TNT-water slurries compared with 2500 ± 500 m./sec. for prilled AN-fuel oil mixtures with 2 to 10 percent fuel oil. The difference between theory and observation is due to slow reaction rate.

The explosive compositions described in this invention when detonated with a suitable booster such as cast or pressed pentolite, pressed tetryl, pressed RDX or other high pressure explosives, provides a convenient and effective blasting agent. The trinitrotoluene (TNT) should be in the form of a coarse formulation. Suitable formulations include uniform pellets of TNT of approximately 3 to 8 standard Tyler mesh particle size. The samples tested during the experimentation leading up to the development of this invention and used in the examples had a density of about 1.0 g./cc., a critical diameter (or minimum diameter in which detonation propagates) of 2" to 3" in the dry state and required at least a 2" diameter-100 gram pressed tetryl booster to detonate it. The measured velocity in 5" diameter was 4050 meters per second.

It is an important feature of this invention that the TNT be coarser than 30 mesh, standard Tyler mesh size. The curve of sensitivity plotted against mesh size starts moving abruptly upwards towards increased sensitivity at about 30 mesh so that some advantage is obtained using TNT coarser than 30 mesh. An inflection point is reached at about 20 mesh and the curve levels off at about -10 +14 mesh which is the preferred mesh size. Example X, XI and XII may particularly be referred to as demonstrating the improvement achieved by using coarse TNT. Where -35 mesh TNT is used the maximum AN/TNT ratio for detonation in 5" diameter with a 160 gm. pentolite booster is AN/TNT 1.5 corresponding to more than 35% TNT in the final slurry as compared to an AN/TNT ratio of 4.0 corresponding to about 15% coarse TNT in the final slurry.

The term trinitrotoluene as used in the claims includes not only pellets of coarse TNT but also tols, that is to say TNT-solid slurries such as amatol (AN-TNT), Sodamol (sodium nitrate-TNT), Cyclotol (RDX-TNT), Ednotol (EDNA-TNT), tetrytol (tetryl-TNT) and pentolite (PETN-TNT). These tols should preferably be in the form of shot tower products.

The trinitrotoluene may also be in the form of the product known in the industry as "flaked" TNT. The "flaked" TNT has practically the same sensitivity as the 3 to 8 mesh pelleted TNT when used in the form of a slurry in accordance with this invention but has the disadvantages of being much more sensitive (even cap sensitive) when dry, having a lower density and providing a slurry which is more difficult to handle than where 3 to 8 mesh pelleted TNT is used. The use of TNT in the normal fine grained form, e.g., minus 35 mesh particle size, should be avoided as the fine grained particles are able to detonate in the dry state in diameters as low as 1/4" with ordinary blasting caps. A further disadvantage of fine grained TNT is that owing to its relatively

weak wetting properties, fine grained TNT is not easily slurried with water. Furthermore, the fine TNT water slurry had a critical diameter of 6" and a 2" diameter, 360 gram cast 50/50 pentolite minimum booster sensitivity. This pentolite booster is a detonator composed of 50% TNT and 50% PETN.

The ammonium nitrate (AN) may be fine, a coarse, or a blend of fine and coarse material. The fine material should preferably be from about 48 to 150 mesh (Tyler standard screens) and finer, and the coarse material should range from about 10 to 30 standard Tyler mesh screen size. Since there is an economic advantage in replacing as large a proportion of the TNT by low cost ammonium nitrate as possible under some conditions, particularly when aluminum is also present, it is advantageous to use blended AN to reduce the water content and thus permit the maximum substitution of the TNT by AN.

It has furthermore been found that for AN/TNT ratios below 1.0 the sensitivity of the water-TNT mixture increases steadily with an increasing AN/TNT ratio. The sensitivity passes through a maximum at an AN/TNT ratio of about 1.5 and as the AN/TNT ratio is further increased the sensitivity then drops steadily until at about an AN/TNT ratio above 5.0 the sensitivity becomes too low for practical use in AN-TNT water mixtures. However, the AN/TNT ratio may be increased to infinity (zero TNT) when 20 to 40 percent fine grained or fine-coarse blends of aluminum is used.

The proportion of trinitrotoluene to ammonium nitrate in practical slurry mixtures without aluminum may range from 18 percent TNT and 82 percent AN to 100 percent TNT with no AN. Thus, the minimum TNT in the AN-TNT-water slurries that will propagate unconfined in diameters less than 9" is about 15 percent. But while the critical percentage of TNT is only slightly sensitive to the amount of water in aluminum free mixtures, it may be materially reduced in slurries containing aluminum, to the extent that AN-Al-water (no TNT) slurries may be detonated in long 9" diameter charges (unconfined) even without TNT. When aluminum is included in the compositions of this invention, it may advantageously be used as a strength enhancing ingredient in percentages up to 40 percent. It is preferable again as regards minimizing the percentage water required to slurry the mixture also to blend the Al, using preferably a 50 percent coarse, 50 percent fine Al mixture. The coarse Al, for example, may be in the range minus 3 to plus 30 standard Tyler mesh size, while the fine grade aluminum is preferably more than 80 percent through 100 mesh, and more than 30 percent through 325 standard Tyler mesh size. The aluminum may be added in the amount up to 100 parts for each 80 parts of the mixture of TNT and AN, with a steadily increasing heat of explosion Q with Al content for maximum possible AN/TNT ratio.

The amount of water may vary from 5 parts of water for each 100 parts of AN and TNT solids to an excess of water. Preferably the amount of water is just sufficient to provide an easily pourable slurry and will usually be about 13 to 18 parts of water. However, when more than 18 percent water is used, AN solution will settle out at the top of the charge. With excess (more than 18 percent) water it is desirable to use about 25 percent TNT in the AN-TNT mixture to maintain the proper level of sensitivity, although the sensitivity increases with an excess of water because the ammonium nitrate, being highly soluble in water, tends then to leach out and increase the percentage of TNT in the remaining slurry. To prevent loss of AN and therefore total energy, it may be desirable to include a "water-flow retardant" where the explosive is to be used in the presence of an excess of water. Examples of suitable "water-flow retardants" are wheat flour, cereal products, pre-gelatinized starch products and similar cellulose and fibrous materials. These materials should preferably be used in the amount of 1 to 10 percent.

It has furthermore been found to be advantageous to include substances such as urea or metal nitrate such as sodium nitrate in the amount of about 1 to 25% by weight of the total composition including water. These substances lower the melting point and reduce the water needed for slurrying.

EXAMPLE I

A mixture of 25 percent ammonium nitrate (prilled) and 75 percent TNT (pellets of 3 to 8 mesh) had a density of 0.87 g./cc. as a dry mixture and detonated in a minimum diameter of 2" with a minimum booster of 2" diameter-100 g. pressed tetryl. On the other hand, when slurried with 15 percent by weight of water it had a density of 1.4 g./cc. and detonated at a critical diameter of 1" with a minimum booster consisting of 1" diameter 20 g./pressed tetryl. The detonation velocity in 5" diameter was 5800 meters per second.

EXAMPLE II

A mixture of 75 percent ammonium nitrate (prilled) and 25 percent TNT (pellets of 3 to 8 mesh) had a density in the dry state of 0.86 and a critical diameter of 5". It also has a minimum booster of a 2" diameter, 160 g. cast pentolite. (The pentolite booster is considerably stronger than a tetryl booster of comparable size.) When slurried with 15 to 18 percent of water which was in this case the minimum required to produce a slurry, the mixture had a density of 1.41 with a critical diameter of 4" and detonated with a minimum booster of 2" diameter-100 g. pressed tetryl and exhibited a detonation velocity of 5" diameter of 5150 meters per second.

EXAMPLE III

A mixture of 80-20 AN (prilled) and TNT (pellets of 3 to 8 mesh) required about 15 percent water to form a slurry, had a critical diameter of 5" and detonated with a minimum booster of 2" diameter-160 g. cast pentolite.

The results obtained in Examples I to III inclusive together with results obtained with a different grade of ammonium nitrate and also results using "flaked" TNT are summarized below in Table I.

Table I

(a) AN (PRILL)-TNT (PELLETS OF 3 TO 8 MESH)

	AN/TNT	Percent Water	Density, g./cc.	Critical Diameter, inches	Minimum Booster	Velocity in 5" dia., meters per sec.
1.....	25/75	zero	0.87	2	2"-100 g. T	
		15	1.4	1	1"-20 g. T	5,800
2.....	75/25	zero	0.86	5	2"-160 g. P	
		18	1.41	4	2"-100 g. T	5,150
3.....	80/20	15		5	2"-160 g. P	

(b) MIXED (COARSE AND FINE) AN/TNT (PELLETS OF 3 TO 8 MESH)

	AN/TNT	Percent Water	Density, g./cc.	Critical Diameter, inches	Minimum Booster	Velocity in 5" dia., meters per sec.
4.....	25/75	zero	0.97	2	2"-100 g. T	
		15	1.4	1.25	1"-20 g. T	
5.....	50/50	12.5-15	1.41	1.25	1"-20 g. T	
6.....	25/25	zero		F-4	2"-160 g. P	
		11.5-15	1.38-1.4	4	2"-100 g. T	

(c) PRILL AN/"FLAKED" TNT

	AN/TNT	Percent Water	Density, g./cc.	Critical Diameter, inches	Minimum Booster	Velocity in 5" dia., meters per sec.
7.....	25/75	19.5	1.4	1	1"-20 g. T	5,950
8.....	50/50	19	1.4	1	1"-20 g. T	5,550
9.....	70/30	18	1.41	1.25	1"-20 g. T	
10.....	75/25	18	1.41	3-4	2"-100 g. T	

(T=pressed tetryl, P=cast 50/50 pentolite.)

EXAMPLE IV

The inclusion of a low cost "run-of-the-mill" ground wheat product obtained as "sweepings" in a flour mill and also refined white flour were investigated as flow retardants with results shown in Table II.

Table II

AN-"FLAKED" TNT-WATER-WATER-FLOW RETARDANT

AN/TNT	Water, Percent	"Run-of-Mill" Wheat Grind, percent	White Flour	Density	Critical Diameter, inches	Min. Booster
80/20.....	22	1.6		1.35	6	2"-160 g. P
75/25.....	21	1.5		1.36	5	2"-200 g. T
70/30.....	21	2.6		1.2	4	2"-100 g. T
70/30.....	25	5.0		1.3	6	2"-100 g. T
70/30.....	27	4.8		1.3	4	2"-100 g. T
62/38.....	16		10	1.4	3	1"-80 g. T

It will be noted that with the use of a "water-flow retardant" a larger proportion of water was needed. Also, some, but not excessive, desensitization was caused.

EXAMPLE V

Experiments were conducted in which a dry composition of 40/30/30 AN-Al-TNT (minus 4, plus 6 mesh) was poured into a clear saturated AN solution. The aluminum was either a blend of equal parts of coarse and fine aluminum or was all coarse aluminum. The AN was a 50/50 fine (-48 mesh), coarse (prill) mixture. The final explosive charge had a final density of 1.59 and the following typical composition:

	Percent
AN	42
Al	32
TNT	16
Water	10(±2)

In each case the composition detonated completely and powerfully using a 160 g. cast pentolite booster at the bottom of 9" diameter (d) x 50" long (l) (±5") charges.

EXAMPLE VI)

A composition having 35 percent ammonium nitrate, 30 percent coarse TNT and 20 percent fine aluminum with 15 percent water, loaded by introducing a slurry at the bottom of a tube so as not to mix with water, had

75 a density of 1.7 g./cc. and a velocity of detonation of 5000 m./sec. The critical diameter of a composition similarly loaded and having 45 percent AN (coarse and fine blend) 40 percent coarse TNT and 15 percent water was less than 2" and the minimum booster was less than

7

1"-20 g. pressed tetryl. With a similarly loaded formulation of 35/30/20/15 AN (prill)-TNT (pellets of 3 to 8 mesh)-coarse aluminum-water the minimum booster was 1"-60 g. tetryl, the critical diameter 4" and the velocity of detonation 5750 m./sec.

EXAMPLE VII

Sodium nitrate (SN) may also be used in the slurries described in this invention. For example, the slurried mixture 37/20/10/25/10 AN-SN-TNT-Al-water using coarse TNT and fine, mostly through 200 mesh, Al had a density of 1.79 g./cc., and detonated in 9" size with a 160 g. cast 50/50 pentolite booster. (Smaller boosters and charge diameters were not investigated with this composition.)

EXAMPLE VIII

A mixture of 58/35/9 AN-Al-water comprising 50/50 fine-coarse AN and 50/50 fine-coarse Al, employing here "fine and coarse" as defined above, detonated in 9" diameter x 50" long buried charges using 2" diameter-160 g. cast 50/50 pentolite boosters. The 9" x 50" buried charges produced approximately hemispherical craters 6 to 8 feet deep and 20 to 22 feet in diameter.

EXAMPLE IX

For purposes of comparison a composition consisting of 94% ammonium nitrate and 6% fuel oil was made by pouring the requisite amount of fuel oil onto 85 lbs. of prill ammonium nitrate arranged in a 3 foot column. Analyses showed that in a short time the fuel oil penetrated relatively uniformly. Thus, a good distribution was obtained in 1 hour and the distribution remained uniform after three days. The composition was successfully detonated using a 2" diameter 160 gm. 50/50 pentolite booster located on top of the charge. It was ascertained in further tests that the critical diameter of the 94/6 prilled AN-fuel oil mixture was 4 inches and the minimum booster 1" diameter, 40 grams pressed tetryl. The measured velocity at 5" diameter was 2800 meters/sec.

EXAMPLE X

Percent 3 to 8 mesh pelleted TNT.....	72-73		
Percent flaked TNT.....		63	
Percent fine (-35 mesh) TNT.....			63
Percent Water.....	28-27	38	37
Density (g./cc.).....	1.37	1.24	1.30
M.B. (minimum booster—grams pressed tetryl (T) or cast 50/50 pentolite (P) required for detonation of slurring).....	40 T	20 T	320 P
d _c (critical diameter), inches.....	1.25	1.0	6

This example shows that at practically the same TNT/water ratio the flaked TNT slurry (without ammonium nitrate) is phenomenally more sensitive than the fine (-35 mesh) TNT/water slurry. The latter had barely the threshold sensitivity for detonation with one of the

8

most powerful boosters available and in large diameter; the former had relatively very high sensitivity; and the pelleted TNT of 3 to 8 mesh/water slurry products had the further advantage of requiring less water for slurring and attained higher densities with comparable sensitivity to the flaked TNT/water slurry.

EXAMPLE XI

Percent prilled AN.....	65	69	59
Percent pelleted 3 to 8 mesh TNT.....	20		
Percent flaked TNT.....		25	
Percent fine grained (-35 mesh) TNT.....			25
Percent Water.....	15	16	17
Density.....	1.40	1.40	1.36
M.B.....	40 T	40 T	>320 P
d _c (inches).....	4	3	Failed—6

This example shows again that at the same TNT content in the AN/TNT/water slurry the flaked TNT is phenomenally better than the fine grained TNT. The slurries containing 25 percent fine TNT will not even propagate, where those containing 25 percent flaked TNT detonated with only 40 grams of pressed tetryl and propagated in diameters as small as 3". Even with only 20 percent pelleted TNT of 3 to 8 mesh in the AN/TNT/water slurry the sensitivity is sufficiently high that one could detonate and propagate the slurry in 4" diameter with only 40 grams of pressed tetryl as a booster.

EXAMPLE XII

Prilled AN.....	64.5	50.5	50
-10 +14 mesh pelleted TNT.....	16.2		
Flaked TNT.....		31.5	
Fine grained (-35 mesh) TNT.....			31
Water.....	19.3	18.0	19
Density.....	1.37	1.41	1.26
M.B.....	320 P	20 T	320 P
d _c (inches).....	6	1.75	6

This example shows (1) that the same sensitivity is achieved with only 16.2 percent of the optimum size (-10 +14 mesh) pelleted TNT as with nearly twice as much (31 percent) fine grained TNT, (2) by comparison with Example X, the minimum percentage of fine grained TNT required to detonate the AN/TNT/water slurries is between 25 and 31 percent. However, with 10 to 14 mesh pelleted TNT one can detonate these slurries with only 16 percent TNT, and (3) at the same percentage TNT, flaked TNT is far more effective as a sensitizer for the slurry mixtures than fine grained TNT.

EXAMPLE XIII

Tables 3 and 4 below show comparative experiments using various "tois" in place of standard TNT in coarse-pellet form.

Table III

MINIMUM BOOSTER (M.B.) AND CRITICAL DIAMETER (d_c) MEASUREMENTS WITH PENTOLITES IN AN-COARSE EXPLOSIVE-WATER SLURRIES

Explosive.....	50/50 Pentolite.....	10/90 Pentolite.....	10/90 Pentolite.....	(Standard)
Preparation.....	shot tower.....	shot tower.....	shot tower.....	10 to 14 mesh pelleted TNT.
Particle Size.....	-4 +14.....	-4 +14.....	-4 +14.....	
Percent Pentolite.....	16.5.....	16.....	18.2.....	Percent 17.2, 17.7, 18.2,
Percent AN.....	66.0.....	64.....	63.4.....	10 to 14 mesh TNT.
Percent Water.....	17.5.....	20.....	18.4.....	Percent AN (prill) 66.0,
density (g./cc.).....	1.4.....	1.4.....	1.4.....	66.6, 64.6.
M.B.....	2" x 1" T ¹	2" x 2" P.....	2" x 2" P.....	Percent Water 15.9, 15.7,
d _c (inches).....	(1D, 2F-3").....	5.....	4.....	17.2,
				density 1.4, 1.37, 1.36.
				M.B. 2" x 2" P, 2" x 2" P,
				1" x 2" T.
				d _c , F-6", 9", 4

¹ T=pressed tetryl; P=50/50 cast pentolite.

Table IV

M.B. AND d. MEASUREMENTS WITH AMATOLS IN AN-COARSE EXPLOSIVE-WATER SLURRIES

Amatol (AN/TNT) Preparation	70/30	50/50	50/50	50/50
	Broken down from slurry of AN prills and TNT.	Shot tower into sat'd AN soln.	Shot tower into sat'd AN soln.	cast into 3/8" slabs and cracked.
Particle Size (mesh)	-4 +14	-4 +14	-4 +14	-4 +14
Percent Amatol	60.	32.5	52.5	34.2
(Percent TNT in final slurry)	(18)	(16.5)	(26.5)	(17.1)
Percent AN Prills	20.	39.2	26.2	48.2
Percent Water	20.	21.5	21.5	17.6
Density	1.38	1.33	1.38	1.42
Booster	2 x 2 P	2 x 2 P	2 x 2 P	2 x 2 P
Charge Size	5" (d) x 30" (L)	6" (d) x 36" (L)	5" (d) x 30" (L)	6" (d) x 36" (L)
Results	Failed	Failed 3/4 down tube	Failed -4" from bottom -nearly complete.	Detonated heavily. ¹

¹ 5" (d) x 30" (L)—2 x 2 P booster—failed.

We claim:

1. An explosive composition consisting essentially of an aqueous slurry of solid explosives, said slurry containing at least 5% by weight of water, said solids consisting essentially of 15 to 95% by weight of trinitrotoluene and 5 to 85% by weight of ammonium nitrate, said trinitrotoluene having a particle size greater than 30 standard Tyler mesh size.

2. A blasting agent comprising an explosive composition as in claim 1 in combination with a booster provided by a substance selected from the group consisting of cast pentolite, pressed pentolite, pressed teteryl, and pressed trinitrotrimethylenetriamine-wax mixtures.

3. An explosive composition as set forth in claim 1 wherein said trinitrotoluene has a particle size in the range of 10 to 14 mesh.

4. An explosive composition as set forth in claim 1 containing 5 to 20% of water.

5. An explosive composition as set forth in claim 1 containing 1 to 10% by weight of said solids of ground wheat flour.

6. An explosive composition set forth in claim 1 wherein a portion of the ammonium nitrate is replaced

by sodium nitrate in an amount from 1% to 25% by weight of the total slurry composition.

7. An explosive composition consisting essentially of an aqueous slurry of solids, said slurry containing at least 5% by weight of water, said solids consisting essentially of 5-90% by weight of trinitrotoluene, 10-95% by weight of ammonium nitrate and particulate aluminum in an amount of from 5 to 100 parts for each 100 parts of the trinitrotoluene and ammonium nitrate, said trinitrotoluene having a particle size greater than 30 standard Tyler mesh size.

8. An explosive composition as set forth in claim 7 wherein said trinitrotoluene has a particle size in the range of 10 to 14 mesh.

9. An explosive composition as set forth in claim 7 containing 5 to 20% of water.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

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Melvin A. Cook et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the heading to the printed specification, line 7, for "October 13, 1953" read -- October 13, 1958 --.

Signed and sealed this 15th day of November 1960.

(SEAL)

Attest:

KARL H. AXLINE

Attesting Officer

ROBERT C. WATSON
Commissioner of Patents

UNITED STATES PATENT OFFICE
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