United States Patent

[11] 3,566,790

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[21] Appl. No. 784,211
[22] Filed Dec. 16, 1968
[45] Patented Mar. 2, 1971
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Continuation-in-part of application Ser. No. 694,097, Dec. 28, 1967, now Patent No. 3,442,729.

[54] PACKAGED AQUEOUS SLURRY TYPE EXPLOSIVES
18 Claims, No Drawings

[52] U.S. Cl. 102/24, 86/20
[51] Int. Cl. F42b 3/00
[50] Field of Search ..... 86/20 (.3); 102/22—24; 149/60

[56] References Cited

UNITED STATES PATENTS

3,097,121	7/1963	Bowkley et al.	149/60
3,199,399	8/1965	Gardner	86/20(.3)
3,303,738	2/1967	Clay et al.	86/20(.3)

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ABSTRACT: A packaged, and thickened, but generally pourable, inorganic oxidizer salt explosive of the aqueous slurry type is provided which contains a "release" agent to preclude adhesion of the mass of explosive to the inner wall of the container during gravitation of the mass therefrom. The agent is disposed so as to be in direct contact with said mass and the container inner wall across the mass-inner wall interface during the gravitation. In certain embodiments the agent serves as a fuel for the subsequent detonation.

PACKAGED AQUEOUS SLURRY TYPE EXPLOSIVES

This application is a continuation-in-part of my copending application Ser. No. 694,097,filed Dec. 28, 1967 now U.S. Pat. No. 3,442,729.

This invention relates to a packaged inorganic oxidizer salt explosive of the aqueous slurry type containing an agent at the interface of the explosive mass and container inner wall to facilitate release of the explosive from the package by gravitation. In one aspect this invention relates to packaged slurry explosives, above described, in which the explosive is pourable and is flowable from the container without substantially any adhesion of residual slurry to the container inner wall. Other aspects of the invention will be apparent from the accompanying disclosure and the appended claim.

Inorganic oxidizer salt blasting compositions of the aqueous slurry type have had extensive use in the explosives industry in recent years. These compositions comprise inorganic or oxidizer salt, water, a sensitizer, and generally a thickener in a least an amount to impart sufficient consistency to the slurry to prevent settling of any of the various ingredients. Optionally these compositions contain one or more additional solid and/or liquid fuels, any of which may be water soluble.

The degree of thickening of the above-described slurry-type explosive is regulated over a broad e range by choice, and amount, of thickener component, and the particular conditions for regulating the thickening action. For example, with thickeners of the polyacrylamide type, pourability of the slurry can be retained over a broad range of ambient winter temperatures. Other thickeners include such as cereal flour, carboxymethylcellulose, galactomannans and the like, some of which, as in the case of some polyacrylamides, undergo cross linking to impart the desired degree of thickening. Of these, guar gum is most generally utilized in thickening cross linked form, and is readily cross linked by any of numerous well known cross linking agents.

Dependent on the particular need at the blasting site, the slurry is either pumped directly into the borehole, or is packaged at the time of manufacture, and transported to the blasting site where the entire package is charged into the borehole; or alternatively, the contents of the package are transferred directly from the package into the borehole. When utilizing a packaged slurry it is advantageous that the contents be removed from the container rather than that the entire package be charged into the borehole, inasmuch as slurry freed from the container is more readily adaptable to fill the cross section of the borehole and thus afford a corresponding increase in loading density. In preferred practice, the slurry is sufficiently flowable that it can be poured from the package directly into the borehole and flow therein to fill the entire cross section of the borehole at maximum loading density.

Generally, the degree of thickening of the slurry to be transferred from the package container is somewhat greater than the minimum required for stability of the suspension, in order to preclude loss of slurry by flow into cracks and crevices in the earth structure forming the borehole walls. In most instances when pouring slurry from the container, as described, the thickening action has been carried to such an extent that portions of the slurry, during the pouring operation, adhere to the container wall with which it has been in contact and hence that portion of the slurry mass is lost, often in a proportion up to 10 percent or more of the entire packaged mass.

This invention is concerned with aqueous slurry explosives, above described, packaged in a container, and the resulting package being associated with an agent providing for ready release of the explosive from the container by gravitation. The release agent in preferred practice, also functions as a fuel for the subsequent detonation.

In accordance with the invention a packaged inorganic oxidizer salt explosive of the aqueous slurry type is provided which comprises a container, a mass of said explosive in said container, and a thickener in said explosive mass to prevent settling of the ingredients thereof; a lubricant-type release agent within the package of explosive to preclude adhesion of said explosive mass to the inner wall of said container during gravitation of said mass therefrom, and disposed so as to be in direct contact with said mass and with said inner container wall across the mass-inner wall interface during said gravitation.

Generally, the consistency of the slurry-type mass is such that time for flow of the mass through an orifice of circular cross section, 2 inches in diameter, as measured by funnel test is not greater than about 2 minutes, more often in the range of from about 5 to 50 seconds. In carrying out the funnel test, 2,000 cc. of slurry is poured into an aluminum funnel having the 2 inch diameter orifice. When the orifice is opened to permit flow, the timing period is begun. When light is visible through the orifice (looking down into the funnel), timing is stopped. The time difference is designated as the flow time.

The release agent can be disposed within the package assembly in any suitable manner, such as by direct application to the inner wall of the container prior to packaging, or by incorporation into the mass with other ingredients, during manufacture, with subsequent migration of the release agent throughout the mass to the exterior mass surface for contact with the container inner wall across the mass-wall interface. In all embodiments the release agent is present, to an extent, in the slurry mass. Thus, when applied directly to the container wall, as above described, the release agent upon contact with the mass, is absorbed, often to a limited degree into an outer peripheral mass portion; and is of course distributed throughout the mass when added directly thereto during manufacture. It is often advantageous to utilize both of the above-described procedures for disposing the release agent within the package. Advantageously, any portion, generally a topmost portion, of the container inner wall not initially in contact with the slurry mass in the package is coated with a release agent in anticipation of its contact with the slurry during subsequent gravitation of the slurry from the container.

The proportion of release agent, in the package assembly based on the finished slurry explosive mass is generally from about 0.1 to 1.0 weight percent. Thus, when the release agent is added to the slurry during manufacture, it is often added in an amount from about 0.1 to 1.0 weight percent of the total slurry; and when the release agent is directly applied to the inner wall of the container for the package slurry, from about 100 to 500 grams of release agent per 100 pounds of slurry mass is added.

Any suitable packaging material, i.e. for forming the container for the packaged slurry mass can be utilized. For example, the container can advantageously be fabricated from a thin gauge metal, and from solid polymeric materials, such as polyethylene, polypropylene and the like.

Exemplary release agents in accordance with the invention are saturated hydrocarbon oils, such as a paraffin oil, silicone-type oils, fuel oils and the like. Generally, the release agent is one which also serves as a fuel for the subsequent detonation, of which paraffin oil and fuel oil are now preferred.

In now-preferred practice, the release agent is a paraffin oil, and the container for the package is formed from polyethylene, and although the paraffin oil can be applied as the release agent, either to the polyethylene container wall or incorporated into the mass, it is advantageously applied utilizing both routes, i.e. it is applied directly to the inner wall of the container and is also added directly to the slurry during its manufacture.

The slurry-type explosive composition mass, independently of the relatively small proportion of absorbed, or residual, release agent therein, generally contains on a weight basis from 0.2 to 5 percent of the thickener component, from 8 to 25 percent water, from 20 to 75 percent inorganic oxidizer salt and from 3 to 50 percent sensitizer. The proportion of release agent absorbed by the explosive mass, i.e. absorbed from the container inner wall after direct application of the release agent thereto, or present as residue following addition of the release agent to the slurry during slurry manufacture

and migration of same to the container wall, is generally in the order of from about 0.05 to 0.2 weight percent.

The inorganic oxidizer salt component, in preferred practice, is generally ammonium nitrate or sodium perchlorate or both, often together with sodium nitrate. Further exemplary of suitable inorganic oxidizer salts that can be used alone or with any one or more of the above inorganic oxidizer salts, are other alkali metal and alkaline earth metal nitrates and perchlorates (including ammonium) as for example magnesium nitrate, calcium nitrate, potassium nitrate, barium nitrate, ammonium perchlorate, potassium perchlorate, calcium perchlorate and magnesium perchlorate. When ammonium nitrate and sodium perchlorate constitute the inorganic salt component, they are utilized in any suitable relative proportions. Often, when either, or both, of ammonium nitrate and sodium perchlorate, is utilized with sodium nitrate, each is utilized in a weight ratio the sodium nitrate within the range of from about 1:1 to 10:1.

Particle size and type of the oxidizer salt ingredient are not generally critical. For example ammonium nitrate can consist of prills such as used in fertilizers, and which are substantially all on 20 mesh, or it can be granular and in that form, very from coarse to fine. Other oxidizer salt ingredients are generally of comparable particle size. However, when desired, any or all of the oxidizer salt component can be added to the formulation in aqueous solution.

Any suitable thickener component for the slurry explosive mass can be utilized as for example a polyacrylamide-type thickener, carboxymethylcellulose, methyl cellulose, water-soluble starches, cereal flour, and galactomannans such as guar gum. Generally, the proportion of thickener in the slurry composition is within the range of from about 0.2 to 5 weight percent and more often from about 0.3 to 2 percent, the now-preferred polyacrylamide thickener component, described hereinbelow, being generally present in a proportion of from about 0.4 to 1.5 weight percent.

Now-preferred thickener components of the slurry mass are those two component polyacrylamide-type thickeners disclosed and claimed in my parent application, above referred to. Thus, as disclosed in my parent application, the now-preferred thickener component is a combination of polymers I and II in a polymer I to polymer II weight ratio within the range of 10:1 to 1:1. The polymer I is a partially hydrolyzed acrylamide polymer having a degree of hydrolysis such that 15 to 40 percent of the monomeric units therein have been converted to the hydrolyzed form, and the polymer having a molecular weight such that a 1 percent solution of the polymer in distilled water will have a viscosity in the range of 1,500 to 7,000 centipoises at 25° C.; and said polymer II being a cross linked product formed by copolymerizing acrylamide with at least one acrylate of the group consisting of ammonium an alkali metal acrylates, in an acrylamide to total acrylate weight ratio within the range of 40:1 to 2:1 in an aqueous solvent medium containing from 30 to 65 weight percent water and selected from the group s consisting of water-tertiary butanol, water-acetone, and water-tertiary butanol-acetone, at a temperature of 0 to 60° C., and cross linking the resulting copolymer as an ingredient of the thickener component during formation of the slurry explosive, by action of from 0.001 to 0.1 percent of a polyvalent metal salt cross linking agent therefor based on the weight of the finished slurry explosive. The polymeric I ingredient above described is that set forth in U.S. Pat. No. 3,341,383, and in preferred practice contains from about 20 to 35 percent of the monomeric units therein converted to the hydrolyzed form, often in the order of about 22 percent together with a polymer viscosity of about 4,000 centipoises.

The polymeric II copolymer ingredient, above described, is disclosed in most of the monomeric unit proportions contemplated in practice of this invention in the copending application of Harrison et al. Ser. No. 594,500, filed Nov. 15, 1966; and in preferred practice has an acrylamide to total acrylate weight ratio not exceeding 20:1 and often within the range of about 6:1 to 12:1, a weight ratio of about 9:1 being advantageously employed in many instances.

The polymeric II ingredient, a copolymer, is prepared by only one known process, i.e., which will produce the polymer II ingredient having the properties applicable in the present invention. This process is referred to as a precipitation polymerization and comprises polymerizing a solution of acrylamide and acrylate monomers in aqueous tertiary butanol, aqueous acetone or aqueous tertiary butanol-acetone in the substantial absence of air while agitating the solution to give a copolymer product that can be isolated by filtration, the aqueous tertiary butanol and aqueous acetone being solvents for the monomers but nonsolvents for the copolymer product.

Solvent and temperature conditions of this precipitation polymerization process are critical. Thus, the solvent for the monomers must be aqueous tertiary butanol, aqueous acetone, or aqueous tertiary butanol-acetone i.e., mixtures of water with tertiary butanol or acetone alone or with both). The concentrations of water in said mixtures must be 30 to 65 percent, preferably 45 to 60 percent, by weight of said mixtures. The polymerization reaction temperature must be 0° C. to 60° C., preferably 0° C. to 40° C.

The polymerization may be carried out either in the presence or absence of a polymerization catalyst (initiator), but preferably a polymerization initiator will be used. Both the types and amounts of free radical initiator applicable are well known in this art. Peroxygen compounds are quite suitable, including, e.g., ammonium persulfate, potassium persulfate and hydrogen peroxide. Other free radical initiators include, e.g., a, a'-azo-bis-isobutyronitrile. The peroxygen initiators may be used alone or in combination with activators (also well known in this art) including, e.g., sodium bisulfite, sodium thiosulfate, tetramethylethylenediamine, thiourea and and ferrous chloride, said combination forming a redox system. The amount of initiator usually will not exceed 0.5 percent, preferably is 0.05 to 0.2 percent, 0.05 percent being specifically preferred by weight of the combined weight of monomers.

Although not necessary, preferably the precipitation polymerization is carried out in the presence of a salt dissolved in the polymerization reaction mixture. By polymerizing in the presence of a salt, or a buffer system comprising one or more salts in combination with another material to complete the buffer system, recovery of the copolymer product is substantially facilitated. These salts and buffer systems include, e.g. (1) alkali metal and ammonium acetates, carbonates, bicarbonates, chlorides, phosphates, sulfates, bisulfates, borates; (2) buffer systems comprising (*a*) mixtures of weak acid or weak base and their salts including (*b*) phthalates, citrates, borates, phosphates, acetates, ammonium hydroxide, ammonium acetate, ammonium chloride, (*c*) specific combinations including mixtures of boric acid-borax, citric acid-sodium acid phosphate, sodium carbonate-sodium bicarbonate, ammonium-ammonium hydroxide, ammonium acetate-ammonium hydroxide, or (3) any combination of (1) and (2).

The amount of salt which may be used is about 0.1 to 2.0 percent, preferably about 0.2 to 0.7 percent, by weight of the reaction mixture. If the amount of salt exceeds about 2.0 percent, usually there is a tendency for the granules of the polymeric product to agglomerate in the polymerization reaction mixture. The manner of adding the salt and the point at which it is added are not critical.

Further exemplary of well-known polyvalent metal salt cross linking agents for the formation of the polymer II ingredient are alum, chromium acetate and ferric citrate. Trivalent metal salt cross linking agents are generally preferred.

Other polyacrylamide type thickeners, particularly applicable in the packaged aqueous slurries, in practice of the invention, are well known in the art, as for example those described in several U.S. Pats. viz., U.S. Pat. Nos. 3,097,120; 3,097,121; 3,321,344; 3,341,383 and 3,355,336.

The slurry mass of the package assembly of the invention is in most instances insensitive to detonating action of a commercial No. 8 blasting cap but detonatable by convention "booster" charges of PETN (pentaerythritol tetranitrate), RDX (cyclotrimethylenetrinitramine), Pentolite (PETN-TNT), tetryl, Composition B (RDX-TNT), and the like. One booster advantageously employed is a dispersion of a crystalline high explosive e.g., PETN or RDX, in a plastic carrier such as described in U.S. Pat. No. 2,965,466 and which is detonated by either a commercial blasting cap or detonating fuse.

Any of the various known sensitizer materials for inorganic oxidizer salt blasting compositions of the aqueous slurry type, above described, can be utilized as such, in the compositions of the invention. Exemplary of now preferred sensitizer components are smokeless powder as disclosed and claimed in the above said U.S. Pat. No. 3,235,425 and TNT and/or particulate aluminum as disclosed and claimed in the above said U.S. Pat. No. 2,930,685. Other suitable sensitizers include particulate aluminum, particulate magnesium-alumninum alloys, and high explosives such as PETN, tetryl, and the like.

Often the use of particulate metal fuels such as aluminum, silicon, and the like, is advantageous in the present compositions, in any suitable amount, say, up to about 40 weight percent, often up to about 25 percent, but generally at least 1 percent. Formulations based on nonexplosive fuels are advantageously employed in the practice of the invention exemplary of which are the soluble polyalcohols such as ethylene glycol and carbohydrates such as cane sugar. Nonsoluble fuels such as ground coal, powdered sulfur, fuel oil and other hydrocarbons are also useful when suitably dispersed. Generally, the amount of fuel present in the formulation is selected so as to provide an overall oxygen balance of 0 or less.

The invention is, in preferred practice, applied to pourable slurry type explosives in which sodium perchlorate is at least 75 percent of the inorganic oxidizer salt component and the thickener is of the above described polyacrylamide type, preferably the polymer I-polymer II thickener component described hereinabove. Such pourable slurry compositions, in which sodium perchlorate is at least 75 percent of the total inorganic oxidizer salt, are disclosed and claimed in my copending application Sr. No. 784,210 filed Dec. 16, 1968.

Any suitable procedure can be utilized in the manufacture, and packaging, of aqueous slurry explosives of the invention. One such procedure is directed to preparation of slurry compositions containing the above described combination of polymers I and II as the thickener component, and a paraffin oil as the release agent. In carrying out that procedure, the required mixture of polymer I and II ingredients is dispersed in a nonaqueous liquid, generally ethylene glycol, and then added to a hot aqueous solution of the inorganic oxidizer salt in an amount to permit sufficient thickening to retain subsequently added ingredients, including the paraffin oil, in suspension. After the addition of all ingredients, during which time the mixture is under constant agitation, a suitable cross linking agent for the polymer II is added such as a polyvalent metal salt. Although the cross linking agent is often advantageously the last added ingredient, it can be added at any time during formation of the explosive slurry. The resulting slurry mixture is then packaged in a bag formed from polyethylene generally of the high-density type and of wall thickness of from about 4 to 15 mils. When desired, the inner wall of the bag is coated with paraffin oil prior to the packaging step to supplement release activity of the paraffin oil added during manufacture.

The invention is further illustrated with reference to the following examples each of which shows a formulation made up in accordance with procedure described herein involving use of the polyacrylamide thickener system of polymers I and II, and then promptly packaged in bags of 18 inch length formed from 6 mil ×6.25 inches diameter layflat polyethylene (high-density type) tubing. The resulting packaged explosive, in each instance, was stored for 24 hours after which each bag was opened at the top, inverted, and the slurry content permitted to gravitate therefrom until all slurry, that would gravitate, was removed therefrom.

Example	Weight percent								
	1	2	3	4	5	6	7	8	9
Water	18.0	18.0	18.0	18.0	18.0	17.9	17.9	17.8	18.0
Smokeless powder [1]	35.0	35.0	35.0	35.0	35.0	34.9	34.8	34.7	
Aluminum									15.0
Ammonium nitrate	22.0	22.0	22.0	22.0	22.0	21.9	21.9	21.8	40.0
Sodium nitrate	13.0	13.0	13.0	13.0	13.0	13.0	12.9	12.8	
Sodium perchlorate									15.0
Ethylene glycol	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.8	3.0
Hexamethylene tetramine mononitrate									7.5
Pine oil	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Thickener [2]	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Release agent:									
Added to formulation during manufacture	None	None	None	None	None				
Paraffin oil						0.3	0.5	1.0	0.5
Funnel Test,[3] seconds	20	15	20	15	31	37		31	45
Release agent:									
Added to container inner wall, grams/10 lbs. slurry	None				None	None	None	None	
Paraffin oil		20							20
Fuel oil			12						
Silicone oil				41					
Wt. percent of total slurry remaining in bag	8.6	0.0	0.2	0.2	9.5	0.6	0.5	0.5	<1.0

[1] Single base 40 mm.

[2] In Examples 1–9 incl. the thickener (basis entire formulation) was formed from 0.8 percent polymer I and 0.2 percent polymer II as described herein; the polymer II was a copolymer of acrylamide and sodium acrylate in an acrylamide: sodium acrylate weight ratio of 9:1. In Examples 1–8 the cross-linking agent for polymer II was 0.004 and 0.006 wt. percent ferrous ammonium sulfate, resp. for Examples 1–4 incl. and Examples 5–8 incl. The cross-linking agent in Example 9 was 0.002 weight percent basic aluminum acetate.

[3] Funnel test—Approximately 2 liters of slurry is poured into an aluminum funnel having an orifice of 2" diam. When the orifice is opened to permit flow, the timeing is started. When light is visible through the orifice (looking down into the funnel), timing is stopped. The time difference is designated as the flow time.

As shown by examples 1—4, without release agent, a substantial proportion (8.6 percent) of the total slurry remained adhered to the container wall whereas with release agent applied to the container inner wall, adhesion of the slurry to the wall was substantially eliminated, there being 0 percent of adhered slurry in the one instance and 0.2 percent in the other two. Similarly, as shown by examples **5—9**, without release agent a substantial proportion of the slurry remained adhered to the container inner wall whereas by the presence of release agent added to the slurry during slurry manufacture, there was a substantial reduction in the amount of adhered slurry, i.e. in the order of not more than 0.5 to 1.0 percent of the total slurry.

The invention provides the basic advantage of economy inasmuch as it provides for substantially eliminating the loss of slurry resulting from tendency of slurry portions to remain adhered to the interior of the slurry package. Further, the invention, in addition to the economic advantages, reduces the hazards involved in handling and destroying the used slurry packages which would otherwise contain portions of adhered slurry explosive.

As will be evident to those skilled in the art, various modifications can be made or followed, in the light of the foregoing disclosure and discussion, without departing from the spirit or scope of the disclosure or from the scope of the claims.

I claim:

1. In a packaged explosive assembly comprising a container, and a pourable mass of an inorganic oxidizer salt explosive of the aqueous slurry type contained therein, said explosive containing a thickening amount of a polyacrylamide-type thickener component, and part of said mass adhering to an inner wall of said container during gravitation of same therefrom, the improvement comprising a lubricant-type release agent within said container for precluding adhesion of portions of said mass to the inner wall of said container during said gravitation, and disposed in direct contact with said mass and with said inner container wall across the mass-inner wall interface.

2. A packaged explosive of claim 1 wherein said mass, exclusive of said lubricant, contains from 0.2 to 5 percent of said thickener component, from 8 to 25 percent water, from 20 to 75 percent inorganic oxidizer salt, and from 3 to 50 percent of a sensitizer.

3. A packaged explosive of claim 2 wherein said container is formed from a plastic.

4. In a packaged explosive of claim 3, said container having said release agent on said inner wall thereof prior to containing said explosive mass.

5. In a packaged explosive of claim 3, said mass containing said release agent, prior to being packaged in said container.

6. A packaged explosive of claim 3 wherein said release agent is a lubricant selected from the group consisting of a fuel oil, a paraffin oil, and a silicone oil.

7. A packaged explosive of claim 3 wherein the amount of said release agent disposed within said container is from 0.1 to 1.0 percent, based on the weight of said explosive mass.

8. A packaged explosive of claim 1 wherein said thickener is a mixture of polymers I and II in a polymer I to polymer II weight ratio within the range of from 10:1 to 1:1, as a thickener component imparting thickening action to said slurry while maintaining same pourable; said polymer I being a partially hydrolyzed acrylamide polymer having a degree of hydrolysis such that 15 to 40 percent of the monomeric units therein have been converted to the hydrolyzed form, and the polymer having a molecular weight such that a 1 percent solution of the polymer in distilled water will have a viscosity in the range of 1,500 to 7,000 centipoises at 25° C., and said polymer II being a cross linked product formed by copolymerizing acrylamide with at least one acrylate selected from the group consisting of ammonium and alkali metal acrylates in an acrylamide to total acrylate weight ratio within the range of from 40:1 to 2:1 in an aqueous solvent medium containing from 30 to 65 weight percent water and selected from the group consisting of water-tertiary butanol, water-acetone, and water-tertiary butanol-acetone, at a temperature of from 0 to 60° C., and cross linking the resulting copolymer as an ingredient of said thickener component during the formation of said explosive composition by action of from 0.001 to 0.1 percent of a polyvalent metal salt cross linking agent therefor, based on the weight of said explosive.

9. A packaged explosive of claim 8 containing from 0.4 to 1.5 weight percent of said thickener component.

10. A packaged explosive of claim 9 containing sodium perchlorate as at least 75 weight percent of the total inorganic oxidizer salt.

11. A packaged explosive of claim 9 wherein said plastic is a polyethylene.

12. In a packaged explosive of claim 2 said container having a portion of said release agent on said inner wall thereof prior to containing said explosive mass, and said explosive mass containing the remaining portion of said release agent, prior to being packaged in said container.

13. In a method for packaging a pourable mass of aqueous slurry-type inorganic oxidizer salt explosive containing a thickening amount of a polyacrylamide type thickener, in a container, and part of said mass adheres to the inner wall of said container when gravitated therefrom, the improvement comprising emplacing a lubricant-type release agent within said container in direct contact with said inner wall and with said mass across the mass-inner wall interface for precluding adhesion of portions of said mass to said inner wall when said mass is gravitated from said container.

14. In a packaging method of claim 13, emplacing said release agent by at least one of the following routes (1) and (2):

1. introducing said release agent into said container as an ingredient of said explosive mass with subsequent migration of said release agent to the external mass surface and into contact with said container wall across said mass-inner wall interface, and
2. applying said release agent to said container inner wall prior to introducing said explosive mass into said container with subsequent contact of said release agent with said mass across said interface.

15. A method of claim 14 wherein said container is formed from a plastic.

16. A method of claim 15 wherein said release agent is a lubricant selected from the group consisting of a fuel oil, a paraffin oil, and a silicon oil.

17. A method of claim 16 wherein said container is formed from a polyethylene plastic.

18. In a method of claim 14, emplacing said release agent in a total amount of from about 0.1 to 1.0 weight percent of said mass.

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,566,790 Dated March 2, 1971

Inventor(s) Herbert G. Knight, Jr.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Claim 2, line 2, "lubricant" should read -- release agent --.

Signed and sealed this 9th day of November 1971.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Acting Commissioner of Paten