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3,423,259

AMMUNITION PRIMING COMPOSITION OF DRY PARTICULATE INGREDIENTS WITH KARAYA GUM BINDER

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ABSTRACT OF THE DISCLOSURE

Ammunition priming compositions having improved handling properties, including enhanced safety during handling, are obtained through the use of karaya gum as binding agent. Such mixtures permit the use of higher and more effectively distributed contents of water during the handling stages than the natural or synthetic gums of the prior art, while avoiding the undesired flow of the fixture or the settling thereof and caking of the primer ingredients. Preferably, the karaya gum is initially subjected to a chemical modification corresponding to a partial deacetylation, as accomplished by heating the powdered gum and removing the evolved vapor constituents.

CROSS-REFERENCE

This application is a continuation-in-part of my co-pending application Ser. No. 537,699 filed Mar. 28, 1966, now U.S. Patent 3,321,343 issued May 23, 1967.

BACKGROUND OF THE INVENTION

This invention relates to priming compositions for ammunition, as exemplified by priming mixtures for center-fire and rim-fire ammunition.

Generally, priming compositions are prepared and handled in water-wet condition in order to reduce the possibility of unintended explosion, as water is known to decrease the sensitivity to impact and friction of the explosive ingredients and also of the priming mixtures of such explosives with the other ingredients commonly used, such as the sensitizer, oxidizer, fuel and abrasive materials

In common practice, a dry mixture of the inert ingredients, or optionally a water-wet mixture thereof, is suitably mixed with the water-wet explosive, and the moist priming mixture is stored for later use in charging shells or primer cups. Such charging may be carried out by spreading the moist mixture back and forth over a plate provided with rows of openings of the proper volume. After the openings have been filled to the level of the plate surfaces, empty shells or primer cups are placed thereunder and each is charged with a primer pellet liberated from the appropriate opening by a knock-out pin. In the case of rim-fire shells, the primer is then spun into the hollow rim of the shell and dried. In the case of primer cups intended for use in shot-shell or center-fire ammunition, the charged cup is combined with other elements such as the anvil and cover to complete the assembled primer.

In order to obtain adhesion of the particles of the dried primer ingredients to each other and to the metal container, it has been customary to utilize a water-soluble natural gum or synthetic gum as a component of the primer composition. For example, the use of metal caseinates as binder was disclosed in U.S. 1,718,358; starch

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esters in U.S. 2,095,333; and polyvinyl alcohol in U.S. 2,341,262. However, gum arabic, as disclosed in U.S. 2,662,818 to Schuricht, has probably been the most widely used binder for priming compositions.

The use of prior art priming compositions wherein the binder ingredient consisted of gum arabic or other water-soluble gums has involved a number of problems. While these have been partly overcome by the practice of certain precautions and extra procedures by the operators, there remained a need for improvement in order to avoid the extra effort and the potentially dangerous situations that were necessarily involved.

The main disadvantage arose from the need for meticulous control of the water content. If insufficient water were present to wet the particle surfaces thoroughly, the danger of premature explosion of the composition during the mixing and charging operations was greatly increased. However, the presence of excess water in the composition could lead to a similarly dangerous situation at one stage and introduce other difficulties in the operations.

During storage of a priming mixture containing an appreciable excess of water, the particles of solid ingredients tend to settle and deposit a dense clay-like mass at the bottom of the container, a layer of fluid is present at the surface, and some stratification of ingredients is inevitable. If the settling has occurred to the extent that hardened cakes of material have formed, the mixture is scrapped because of the danger and difficulty of the reclaiming process. In the absence of such caking, the settled composition must be thoroughly re-mixed before it can be successfully used in the charging operation.

In the charging operation, the priming mixture is manually spread over the surface of the charge plate and rubbed into the openings until they have been filled. Then, the excess mixture is scraped away from the plate surface and collected in a pile on the charging table. In mixtures in which the binder consists of gum arabic or other prior art gums, the collected piles slump and spread rather than retain the compact mass shape and the mixture often tends to smear and creep on the plate and table. This results in the loss of moisture through evaporation, and the operator must be alert to add water and re-mix the mass to continue the charging operation properly. However, such adjustments are made in accordance with the judgment and skill of the operator and may at times result in sufficient variation of the texture, flow characteristics or tackiness of the mixture to bring about non-uniformity of the charging. This may be due to the incomplete filling of the charge plate openings, for example because of the presence of voids in the charge. At times, also, the knock-out operation is not cleanly effected, so that some of the primer cups or shells may receive an incomplete charge.

SUMMARY OF THE INVENTION

In accordance with the present invention, generally stated, ammunition priming compositions are provided wherein the binder ingredient is comprised of karaya gum. The disadvantages and deficiencies of prior art priming mixtures, as above outlined, are thereby overcome. Priming compositions in accordance with the present invention are characterized by enhanced safety during the mixing, storage and charging operations, by increased ease of handling, by simplification of the required operations and by the ready attainment of improved uniformity.

The karaya gum binder is effective in providing increased safety in the handling of priming compositions by enabling the mixing, storage and charging operations to be effected in the presence of sufficient water to wet the particle surfaces thoroughly and, in addition, to fill the interstitial spaces between the particles with viscous gel-

like fluid. Thus, compositions having a water content of about 25%, or higher, of the dry weight of the composition may be advantageously handled throughout the mixing, storing and charging sequence, this content being significantly higher than the approximately 15% content generally characteristic of prior practice.

In addition to the enhanced safety of operation thus provided by priming compositions having karaya gum as binder, this ingredient exerts profound and advantageous effects on the texture, fluidity, and other essential handling qualities of the composition. It is compatible with the usual ingredients of priming compositions, displays excellent stability and adhesive power, and is free of adverse hygroscopicity effects. The effective range of the karaya gum binder content is generally between about 0.2% and 4% of the total dry ingredients, and preferably between about 0.5% and 3%.

Karaya gum is prepared by the physical purification, grinding and blending of the exudate of trees belonging to the genus *Sterculia*, usually of the species *Sterculia urens*, as described in "Encyclopedia of Chemical Technology" (2nd ed.), Kirk-Othmer, vol. 10, pp. 746-48 (1966). It is a complex partially acetylated polysaccharide of high molecular weight, the main constituents being L-rhamnose, D-galactose, and D-galacturonic acid. The purer grades of the gum, meeting the specifications set in the National Formulary for food and pharmaceutical uses are preferred for use in accordance with this invention.

For some percussion primer applications, a primary explosive may be used as the sole or preponderant ingredient, the particles being mixed, while wet with water, with the karaya gum binder, charged into the primer housing and dried. In the completed primer, the particles of explosive are adhered as a pellet which is bonded to the housing. As suitable explosives, use may be made of a primary explosive, or mixture, such as lead styphnate, double salts of lead styphnate as with lead nitroaminotetrazole ("Stabanate") or with lead hypophosphite or with lead propionate, lead azide, lead picrate or its double salts, lead dinitroresorcinate, diazodinitrophenol and the like.

It may be desirable to include with such primary explosive up to about 5% of its weight of a sensitizing explosive such as tetrazene (guanylnitrosamino-guanyltetrazene).

In ammunition priming compositions, an oxidizing agent, or mixture, is generally included in the range of 5% to 60%, preferably 15% to 30% (percentages being by weight of the total dry ingredients). Suitable oxidizing agents are generally metal nitrates, metal oxides or peroxides and metal chromates or permanganates, such as barium nitrate, potassium nitrate, potassium permanganate, barium chromate, lead chromate, the peroxides of lead, barium or strontium, manganese dioxide, or ferric oxide.

Another commonly used class of primer ingredient is that of combustible fuels such as antimony sulfide, lead thiocyanate, aluminum, calcium silicide, carbon, nitro compounds such as di- or trinitrotoluene, and nitrate esters such as pentaerythritol tetranitrate. The content of such fuel ingredient or mixture thereof is in the range of about 5% to 25% of the total dry weight of the composition.

In addition to the above-listed ingredients, rim-fire primer compositions usually are provided with a "frictionator" ingredient such as ground glass or a granulated amorphous carbon which exhibits conchoidal fracture, such as ground anthracite coal. Such ingredient may be present in the range of about 4% to 40%, preferably between 10% and 25% by weight of the dry mixture.

In the case of percussion primers utilized for purposes where corrosive effects of combustion residues are immaterial, it should be noted that mercury fulminate may be used in place of the primary explosives listed above, in whole or in part. Likewise, in such applications, the primer composition may be based on a potassium chlorate or perchlorate mixture with one or more fuels such as anti-

mony sulfide or lead thiocyanate or others as listed above. In such compositions, the karaya gum binder of this invention is found to provide advantageous safety and improved handling qualities, as described herein with respect to other specific formulations.

PREFERRED EMBODIMENTS

Preferred percussion priming compositions embodying the present invention are tabulated below, the numerals representing percentages by weight of the dried mixture.

	Examples		
	1	2	3
Lead styphnate.....	20	45	—
Stabanate ¹	25	—	30
Tetrazene.....	3	3	3
Barium nitrate.....	36.25	22.25	46.25
Lead peroxide.....	—	7	—
Ground glass.....	—	22	—
Ground anthracite coal (Conchoidal Fracture).....	15	—	20
Karaya gum.....	0.75	0.75	0.75

¹ Double salt of lead nitroaminotetrazole and lead styphnate U.S. 3,310,569.

	Examples		
	4	5	6
Lead styphnate.....	40	40	37
Tetrazene.....	4	4	4
Barium nitrate.....	29.5	29.5	29.5
Antimony sulfide.....	16	15	25
PETN ¹	5	5	—
Aluminum.....	5	6	4
Karaya gum.....	0.5	0.5	0.5

¹ Pentaerythritoltetranitrate.

	Examples		
	7	8	9
Stabanate ¹	20	25	20
Tetrazene.....	4	4	4
Barium nitrate.....	61.5	52.5	48.5
Antimony sulfide.....	—	10	16
Calcium silicide.....	—	8	—
Aluminum.....	5	—	10
Ground anthracite coal (Conchoidal Fracture).....	9	—	—
Karaya gum.....	0.5	0.5	0.5

¹ Double salt of lead nitroaminotetrazole and lead styphnate U.S. 3,310,569.

In the above percussion primer compositions for ammunition, Examples 1-3 are for rim-fire, Examples 4-6 are for use in centerfire, and Examples 7-9 are for use in shotshells. It will be understood by those skilled in the art that the proportions may be varied somewhat and that other explosives, oxidizers and fuels, as listed previously, may be substituted in whole or in part in the tabulated compositions.

The above priming mixtures comprising karaya gum as the binder ingredient may be mixed, stored and charged readily, uniformly and without handling difficulties at water contents of about 20% to 25%. In identical compositions differing only in the substitution of gum arabic or other gums of the prior art, even at somewhat higher contents, the water content must be maintained at about 12% to 16% in order to avoid the problems of settling and caking during storage, and non-uniform charging because of insufficient fluidity of the mixture if inadequately moist and excessive fluidity at higher water contents. Such mixtures frequently undergo a segregation of the lighter and heavier ingredients when water is added for the adjustment of fluidity, particularly a tendency for the fine lighter particles to "float off" the mixture surface. As pointed out above, such difficulties are overcome or avoided by the use of karaya gum as the binder in accordance with this invention.

Karaya gum differs in a number of pertinent properties from gum arabic and other primer binder gums of the prior art. When dispersed in water at equal concentrations, karaya gum yields aqueous dispersions of much higher viscosity which display a gel-like structure. While priming compositions containing gum arabic are

frequently difficult to distinguish in appearance, texture and fluidity from identical mixtures from which the gum has been omitted, the effect of the presence of karaya gum is immediately evident in each of these qualities.

The gel-like structure of mixtures containing karaya gum is illustrated by the resistance to penetration of a mass of mixture by a gently falling stream of water. In contrast, with mixtures using gum arabic and other prior art gum binders, such streams readily enter and dilute the mass. The presence of a structured surface in mixtures in accordance with this invention, thus indicated, is likewise believed to be effective in reducing the evaporation of moisture from masses of the composition.

When the karaya gum of this invention is used as a binder or adhesive, in place of the usual gum arabic or other adhesive yielding a low viscosity dispersion, the viscous aqueous karaya gel obtained provides a matrix in which the solid particles of the priming mixture are suspended. Because of the high viscosity of this matrix, solids will not settle out of the mixture even though interstitial spaces are entirely filled with the fluid dispersion. It is possible to increase the water content of the mixture well beyond the point at which separation of solids and the fluid medium would occur with a low viscosity adhesive. Typically, mixtures prepared with a low viscosity adhesive such as gum arabic are mixed at a water content of 10-15% by weight depending on how bulky the ingredients are. Additional water is added at the time of charging to increase fluidity so that the holes in the charge plate may be filled with less manual effort. Generally the water content as charged is about 14-19%. When karaya gum is used there is no specific limit to the percentage of water used in the mixture as separation of solids and the fluid medium does not occur. A logical amount of water to use is the amount required to fill the interstitial spaces. Any further addition of water will add to the bulk of the mixture but is otherwise not objectionable. The mixture may be mixed at the water content that is desirable for charging so that the later steps of adding water and blending preparatory to charging can be eliminated. Mixtures containing karaya gum (0.2%-4%) have been prepared with a water content of about 15% to 30%. The larger amount of water that can be added to mixtures containing karaya gum greatly increases the handling safety.

Supplementing the effect of a larger percentage of water in enhancing the handling safety of priming mixtures, karaya gum dispersions provide another safety advantage. The manner in which water, oil, or other liquids desensitize primary explosives is believed to involve the heat absorbing action of the liquid which tends to limit the temperature rise caused by friction or percussion. In addition to the heat absorbing effect, liquids provide lubricity which tends to minimize the heating effect of interparticle friction as the mixture is handled. If one visualizes the crystals of primary explosive as being covered with a film of liquid which tends to absorb heat developed by mechanical means, it is seen that the thickness of the film of liquid is an important factor in the desensitizing effect. The thickness of the film of liquid on crystal surfaces when gum arabic or other low viscosity dispersion is used is similar to that obtained with water alone. When a karaya gum dispersion is used, however, a substantially thicker film of liquid on crystal surfaces is obtained due to the effect of viscosity. The well known profound desensitizing effect of lubricating oil on primary explosives is probably due to the viscosity which results in a thicker film. Even though the specific heat of oil is substantially lower than that of water, the greater amount present due to the thicker film provides a greater heat capacity. Karaya gum dispersions possess the advantage of oil in forming a thick film plus the added advantage of the higher heat capacity of water.

As described above, the viscous dispersion of karaya gum forms a lubricating and protective film of substan-

tial thickness over the surface of the solid particles. Particles slide by each other more readily, and thus less manual effort is required to rub the mixture across the surface of the charge plate and fill the cavities therein. Yet because of the viscosity of the medium in which the solid particles are suspended, unintentional movement or flow of the wet priming mass on the charge table, due to effects of gravity, does not occur. The priming mass molds readily with very little manual effort to achieve any desired disposition or mass shape, but will not slump, creep, or otherwise change shape. Manual charging involves spreading the priming mixture over the surface of the charge plate and rubbing it into the holes therein. After the holes have been filled, the excess mixture is scraped off the charge plate and collected in a pile on the charging table. The lubricity provided by karaya gum dispersions and the cohesiveness of the gel cause the mixture to scrape cleanly off the metal charge plate surfaces without leaving a smear of solid constituents of the mixture, as frequently occurs with mixtures containing gum arabic or other low viscosity binders. Portions of mixture that are scattered during the rubbing operation are easily and quickly brought together into a compact pile as the excess is scraped off the filled charge plate. This helps reduce the drying rate, and consequent need for frequent rewetting, as loss of water is much more rapid if the mixture is spread out than when the mixture is in a compact pile. The effect of the advantageous charging characteristics is to permit greater productivity due to the greater ease and speed with which the charging operation may be performed.

Priming mixtures prepared with karaya gum can be wetter sufficiently, without encountering separation of the solid and liquid phases to provide the fluidity required for the extrusion of the bulk material. The mixture is sufficiently plastic and flows readily enough to permit feeding the bulk material into a pellet forming mechanism capable of charging primers mechanically.

Rather specific, stable, rheological properties are required to permit mechanical charging as defined above. Separation of the solid and liquid phase must not occur, even on rather prolonged storage. The fluidity must remain fairly constant despite effects of storage, temperature changes, moderate variation in water content, and agitation or mechanical manipulation. The interstitial spaces must be filled with the liquid medium, so that the priming mass is homogeneous and not interrupted by air-filled voids. This characteristic is required to permit dispensing accurate unit priming charges by volumetric means. The karaya gum of this invention provides mixtures which fulfill these requirements. In contrast, when gum arabic or other low viscosity binder is used, the mixture is clay-like and is not amenable to charging by such mechanical techniques.

Comparative tests were carried out in order to obtain quantitative data showing the effects on flow characteristics and on settling behavior when a typical prior art binder, gum arabic, is replaced in a representative priming composition by karaya gum.

The priming composition was Mix "C" (CNG-35) of Table I, page 7, of my copending application Ser. No. 537,699 now U.S. Patent 3,321,343, as follows:

Stabanate	35
Tetrazene	3
Barium nitrate	51
Ground coke	10
Gum binder	1

A batch of the above ingredients except gum was prepared containing 198 grams total of solids (dry basis). The explosive materials in this batch were weighed wet in a pycnometer and mixing was conducted manually to minimize loss of material. After the blending of the 198 gram batch had been completed, the wet batch was weighed and divided into two portions of equal weight.

identical composition, and especially having equal water. In this manner, two 99 gram portions of Mix "C" of identical composition, and especially having equal water content, were obtained. To one portion of mixture, a 1 gram portion (1%) of dry powdered gum arabic was added and blended in; to the other an equal quantity of dry powdered karaya gum was added and blended in. In this manner, two equal portions of Mix "C" composition were obtained which differed only with respect to the gum binder.

The procedure following in making the slump test was essentially as presented in the ASTM test procedure C143-66, but using a mold consisting of the frustrum of a cone having a base 34 millimeters in diameter, a top diameter of 24.5 millimeters, and a height of 50 millimeters. The mold specified in the ASTM procedure has base, top and height dimensions of 8, 4, and 12 inches, respectively. The smaller size of the mold used for slump tests on priming was desirable for reasons of safety.

The slump tests were conducted by adding mixture to the top end of the cone frustrum with the base resting on a smooth steel surface. Successive portions were packed with a tamping rod to permit thorough filling of the mold. The excess mixture was removed from the top as prescribed in the ASTM procedure and the mold was removed carefully to minimize deformation of the molded mass due to manipulation. A measurement of the average height of the top surface was obtained promptly. After a slump determination was completed all of the priming was carefully gathered together, an additional gram of water was blended into it, and another slump determination was conducted. In this manner successive slump determinations were conducted on each of the two batches of priming at each increment of added water. The operation was conducted in a room humidified to near the dew point to minimize error due to evaporative loss of water. The process of making repetitive slump determinations as each increment of water was added was continued until a profound slump effect was obtained. The degree of slump at each level of wetness obtained with each mixture portion is presented in Table I.

TABLE I.—SLUMP TESTS ON MIX "C" COMPOSITION CONTAINING GUM ARABIC COMPARED TO THE SAME MIX CONTAINING KARAYA GUM AT VARIOUS LEVELS OF WETNESS

Water Content of Mixture	Degree of Slump in Millimeters	
	Gum Arabic Mix	Karaya Gum Mix
8.6	16	0
9.5	26	0
10.4	34	0
11.3	39	0
12.2	-----	2
13.8	-----	8
15.4	-----	14
16.9	-----	19
18.4	-----	25

At the conclusion of the slump tests the two portions of Mix "C" were utilized to determine the comparative rates of separation of solids and water. At the conclusion of the slump tests the water content of the mix containing gum arabic was 11.3% (88.7% solids) and the water content of the mix containing karaya gum was 18.4% (81.6% solids). Although the mix containing karaya gum had considerably more water in it, it appeared drier and exhibited less fluidity than the mix containing gum arabic. These mixtures were used without further adjustment of water content for the initial settling tests.

The settling rate tests were conducted by packing the mixtures into cylindrical precision bore calibrated glass tubes, with a closed end, which had a bore of 20 mm. and were calibrated to 45.0 ml. The mixtures were packed carefully to prevent voids. After filling, the tubes were supported with open end uppermost in a wooden block having close fitting bored cavities. The time was noted and the tubes were allowed to stand undisturbed while the presence of any water separating at the surface was ob-

served and its volume was estimated by means of the milliliter scale on the cylinder. After making an appropriate number of observations with the cylinders in an undisturbed condition, the wooden block was clamped to the table to prevent movement and the assembly was subjected to vibration. The source of vibration was a primer cup plate shaker to which the table was affixed. The type of vibration developed was quite similar to that encountered when priming mixture is hand trucked from one plant location to another. Observations made before and after vibration was started are presented in Table II.

TABLE II.—SETTLING RATE OF MIX "C" CONTAINING GUM ARABIC COMPARED WITH THE SAME MIX CONTAINING KARAYA GUM

Time Interval, Minutes	Volume of Separated Water (ml.)	
	Mix Containing Gum Arabic (mix contained 11.3% water) Vol. 41.5 ml.	Mix Containing Karaya Gum (mix contained 18.4% water) Vol. 44.2 ml.
12	1.0	0.0
32	1.2	0.0
52 (vibrator started)	1.2	0.0
57	2.0	0.7
67	2.1	0.7
77	2.5	0.9
87	2.9	1.1
97	3.1	1.2
137	4.0	1.4
177 (vibrator stopped)	5.0	1.7
197 (vibrator started)	5.0	1.7
227	5.1	1.7

After the test data presented in Table II were obtained, the mixture containing gum arabic was removed from the tube used for the settling test, and additional water was blended into the batch so that the water content would equal that of the mixture containing karaya gum (18.4%). The calibrated glass tube was refilled and another settling test was conducted with the mixture in a wetter condition. Results of this test are presented in Table III below. Initially the tube was allowed to stand and then the vibrator was started.

TABLE III.—SETTLING RATE OF MIX "C" CONTAINING GUM ARABIC—MIXTURE, WATER 18.4%

Time interval, minutes:	Volume of separated fluid, ml.
30	6.0
60 vibrator started	6.7
95	8.0
140	8.1

It is clear from the above data that karaya gum has a significant beneficial effect on the flow and settling characteristics of wet priming mixtures. The stability to change in priming slump characteristics as successive increments of water are added, indicates that mixtures containing it may be charged successfully through a comparatively wide range of actual water content. Such latitude is decidedly beneficial in improving charge weight uniformity, and with less frequent replacement of water lost through evaporation as charging progresses, productivity is improved.

The comparative slump test data establish much lower degree of slump at a given moisture content for the mixture containing karaya gum. The tests results obtained at 9.5% and 18.4% water content show that the karaya gum mixture showing a slump of 25 mm. contained almost twice the water content of the gum arabic mixture with the 26 mm. slump.

The settling test results likewise establish far less settling and separation of solids and fluid for the mixture with karaya gum, even though it had a much higher water content. At the same water content, the gum arabic mix showed the separation of a still higher amount of fluid in a given time. It is further noteworthy that in the mix containing karaya gum, the separated fluid could easily be redistributed in the mixture by gentle stirring.

In accordance with a further embodiment of the invention, which results in additional significant advantages

and is therefore highly preferred, karaya gum which has been chemically modified through heat treatment is used as the binder ingredient in percussion priming compositions. The chemical modification effected by the heat treatment is a partial deacetylation and dehydration of the karaya gum. The beneficial effect of such chemical modification is to eliminate difficulties arising from the tackiness of some compositions using unmodified karaya gum, when handled in conventional charging and spinning equipment.

Such difficulties may be significantly decreased by the use of equipment having non-adherent surfaces, as obtainable for example by coating the surfaces with polytetrafluoroethylene or silicone polymers. Likewise, the karaya gum content of such compositions may be reduced or it may be in part replaced by gum arabic or other water-soluble gum.

However, the above expedients are not required when the karaya gum has been subjected to the indicated chemical modification. The desired modification is readily accomplished by heating the raw powder gum under ventilated conditions at a suitable elevated temperature for the required period of time.

When the chemical modification is effected by heating, excellent results are obtained at temperatures ranging from about 120° C. to 180° C. for a period of about 4 to 48 hours, the time of treatment being shorter as the temperature is increased. The powdered unmodified karaya gum may be spread as a rather shallow layer in an open tray and heated in a well-ventilated oven, thus permitting the removal of the evolved vapors which include water vapor and acetic acid. The temperature and time of treatment are selected to cause the partial elimination of acetic acid to the extent of at least about 20% and up to about 80% of the total that could be removed by heating for longer periods. Preferably, the partial deacetylation is carried out to the extent of 50% to 75% as the resulting modified karaya gum is found to be an excellent binder, in all respects, for percussion priming compositions. Such compositions are characterized by all the advantageous features, described above in detail, including freedom from any difficulty due to tackiness.

The following temperatures-time schedules have been found effective for the modification of karaya gum, for example, "Superior III N.F. grade" karaya gum (Morningsstar-Paisley Co.), and may be considered illustrative:

Temperature, ° C.:	Time (at temperature), hrs.
(A) 130-135	24
(B) 130-135	48
(C) 148-152	24

In each case, a shallow layer of the powdered gum was placed in a tray and heated in a well-ventilated oven maintained at the indicated temperature. At the end of the heating period, the modified gum which was essentially unchanged in appearance and texture was transferred to suitable containers and sealed.

The desired chemical modification may be effected by other procedures. For example, a uniform partly deacetylated karaya gum can be obtained by suspending the gum in a solvent of high boiling point, such as xylene, and boiling the mixture under reflux, while separating the condensed aqueous phase and returning the condensed solvent to the mixture. The treatment may then be stopped at a desired extent of deacetylation as soon as a predetermined volume of aqueous phase has been collected.

Analytical tests were carried out on karaya gum, both before and following treatment (heating at 148°-152° C. in open tray for 24 hours). The unmodified gum had an acid number of 24.3 (mg. KOH per gram) and saponification number (corrected for acid number) of 161.6 (mg. KOH per gram), while the modified gum had an acid number of 42.7 and saponification number of 182.1. Thus, both values were substantially increased as a result of the modification.

In a further analytical test, 50 gram samples were suspended in 100 ml. of xylene and heated under reflux for an hour after the first condensate appeared. The condensed aqueous layer was separated in a Dean-Stark trap. The measured volumes of the aqueous layers and determination of their acid content yielded the following values:

	Unmodified gum	Modified gum
Percent water evolved.....	15.6	5.4
Percent acetic acid evolved.....	0.12	0.038

It can be concluded that this effective treatment causes the liberation of volatile acid, mainly acetic acid, as well as of water, and further, that the number of available carboxyl groups and of saponifiable groups was increased.

As the partly deacetylated karaya gum is advantageous as binder for percussion priming compositions in all the essential functional aspects, it is preferred for use in accordance with the invention. It is readily dispersed in water to yield a highly viscous gel-like fluid which is readily mixed with the particles of the solid priming ingredients to yield homogeneous compositions of excellent storage and handling qualities, as described.

Accordingly, it will be understood that the binder ingredient comprising karaya gum is widely applicable with advantage to percussion priming compositions of a variety of components and proportions, as indicated above. Modifications may therefore be made in the specified illustrative details within the spirit and scope of the appended claims.

What is claimed is:

1. Ammunition priming composition consisting essentially of a charge of dry particles of solid substantially water-insoluble priming ingredients, said particles being adhered together by a minor proportion of karaya gum, and said ingredients consisting essentially of at least about 15% by weight of primary explosive selected from the group consisting of percussion-sensitive explosive metal salts, diazodinitrophenol and tetrazene, and substantially any balance thereof of up to 25% by weight of a combustible fuel, up to 40% by weight of a frictionator, and up to 60% by weight of an oxidizing agent.

2. A priming composition according to claim 1, wherein the proportion of said karaya gum is about 0.2% to 4% of the composition.

3. A priming composition according to claim 1, wherein said karaya gum has been partly deacetylated.

4. A priming composition according to claim 1, wherein said karaya gum has been deacetylated to the extent of about 50% to 75%.

5. A priming composition according to claim 1, wherein said charge includes an explosive lead salt.

6. A priming composition according to claim 1, wherein said charge includes lead styphnate.

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