A composite pyrotechnic product, especially a propellant powder for barrel weapons, has a composition, expressed as weight percentages, that contains from 78% to 90% of organic energetic charges, and from 10% to 22% of a polymeric gum, chosen from polyurethane-polyester gums, polyurethane-polyether gums and mixtures thereof, the number-average molecular weight of which is greater than 20,000 g/mol and the Mooney viscosity of which is between 20 and 70 ML (5+4) at 100°C.
COMPOSITE PYROTECHNIC PRODUCT WITH NON-CROSSLINKED BINDER AND METHOD FOR PREPARING SAME

The present invention relates to composite pyrotechnic products, which are suitable especially as propellant powders for barrel weapons (more particularly for tank artillery). It concerns composite pyrotechnic products, containing a high content of energetic charges in a binder. Said products are particularly advantageous, especially in terms of force (of energetic power), of vulnerability (see below a reminder regarding this notion, which is familiar to those skilled in the art), and of field of application as regards the nature of the charges they may contain. They may conveniently be optimized in terms of erosivity.

A subject of the present invention is also a process for preparing said composite pyrotechnic products. Said process is particularly easy to perform.

“Homogeneous” propellant powders constituted by one or more gelatinized energetic bases having a homogenous appearance (whence their name) are known. Among the most widely known homogeneous propellant powders, mention may be made of “smokeless” powders based on nitrocellulose alone or based on a nitrocellulose-nitroglycerine mixture. In order to improve the energy performance of these “homogeneous” powders, it is sought to incorporate therein organic (pulverulent) energetic charges. These charged powders no longer have a homogeneous appearance, but a heterogeneous appearance in which are distinguished, on the one hand, the energetic binder and, on the other hand, the charges. Such charged powders are referred to as “composite” or “heterogeneous” powders. Such charged powders are described, for example, in French patent application FR 2 488 246.

Use of the energetic binder nitrocellulose however has the drawback of making these powders vulnerable. The term “vulnerability” refers to the property that the powders have of being able to ignite and deflagrate under the effect of an undesired, random physical phenomenon, for instance the impact of a projectile. Vulnerability is a major defect for powders intended to be transported on combat tanks. The development of modern combat machines thus led those skilled in the art to seek sparingly vulnerable propellant powders.

With this in mind, composite powders with an inert binder were proposed (constituted mainly of organic energetic charges in a synthetic resin). Such powders are markedly less vulnerable than homogeneous or composite powders with an energetic binder (nitrocellulose). However, since they contain an inert binder, these powders must, in order to deliver the necessary energy during their ignition, contain very high levels of charges, often in the region of 80% of the total weight of the powder. Composite powders with an inert binder thus have the characteristic of containing very little binder relative to their pulverulent charge. The precursor mixtures of these powders must, however, be able to be worked (in particular be able to be calendered or drawn through a die of relatively small diameter, usually comprising pins intended to create channels present in the final powder strand), and the powders must conserve their geometrical shape over time. It is particularly in reference to the production of these composite propellant powders with an inert binder for barrel weapons that those skilled in the art came up against and are still coming up against serious difficulties.

The inert binders, of synthetic origin, that may be used in the preparation of composite pyrotechnic products and that are present in their composition exist to date as thermoplastic binders and as thermosetting binders (thermosetting binders obtained from oligomers).

Those skilled in the art first turned toward the use of thermoplastic inert binders. Specifically, such thermoplastic binders allow, in theory, while raising temperature, mechanical working of the product to give it the desired geometry. Obviously, however, the working temperature (at which the binder is deformable) should be compatible with the stability of the charges present and, in reference to this unavoidable requirement, it is often necessary to use a solvent. The use of such a solvent complicates the implementation of the process. Patent application EP 0 036 481 describes a process for manufacturing composite explosives with a thermoplastic binder. Patent application IN 498/DEL/2001 describes a process for preparing propergol containing hexogen charges (RDX) in a thermoplastic binder. Composite products with a thermoplastic binder are generally not entirely satisfactory, since their mechanical properties are too sensitive to thermal variations.

Those skilled in the art then turned toward the use of thermosetting inert binders (obtained from oligomers), such as (crosslinkable) polyurethane binders, making it possible, after crosslinking, to constitute a three-dimensional network (in which the charges are found coated), i.e. to definitively set the geometry of the powder grain (finally obtained). The industrial scale manufacture of powders (in general composite pyrotechnic products) with a crosslinked inert binder (thus essentially constituted of a high content of charges in a minimum amount of binder) remains very difficult firstly due to the minimum cohesion and mechanical strength required for the product before crosslinking (in order to form it) and secondly due to the limited “pot life” of thermosetting resins (the term “pot life” means the period of commencement of crosslinking of the resin during which it may be worked like a plastic). Furthermore, obviously, the crosslinking temperature must be compatible with the stability of the charges and the crosslinking agent used must itself also be compatible with said charges.

Confronted with these difficulties, in the context of using thermosetting binders:

those skilled in the art proposed to work in the presence of solvents. A solvent-based process was especially described in French patent application FR 2 686 770. Such processes are, however, difficult and expensive to implement, and unsatisfactory at the industrial scale;

to work without solvent, with thermosetting binders, said persons skilled in the art have widely resorted to the “casting” or “global” technique, which consists in simultaneously mixing in a blender the liquid elementary constituents of the resin and the energetic charges and in casting, before polymerization, the mixture thus obtained in a mold in order to perform the actual polymerization therein. This technique, which has been widely described, for example in French patent applications FR 2 109 102, FR 2 196 998, FR 2 478 623 and FR 2 491 455, may be suitable for manufacturing composite solid propellants for rocket or missile engines, or alternatively for manufacturing composite explosives for device heads, which are usually used in the form of wide-diameter products, but
proves to be entirely unsuitable for the industrial manufacture of large, medium and small caliber composite powders and more generally for that of certain composite pyrotechnic products;

[0012] for the solvent-free manufacture of composite pyrotechnic products with a thermosetting inert binder, especially of small diameters, said persons skilled in the art have available, at the present time, only the following two techniques:

[0013] a) the first which consists in mixing in a blender the constituents of the resin with the energetic charges, in initiating crosslinking of the resin and, during crosslinking, in forming the product, within a very short space of time, as described, for example, in French patent applications FR 1 409 203 and FR 2 159 826. This technique requires precise control of the crosslinking kinetics in order to be able to work the paste and, as a result, it is difficult to manage at the industrial scale;

[0014] b) the second, which is much more efficient, including at the industrial scale, described in patent application EP 0 194 180. The composite pyrotechnic products obtained via this second technique are constituted mainly, on the one hand, by a polymeric binder (for example polyurethane) obtained by reaction of a polyhydroxylated prepolymer (polymer) (with a number-average molecular weight of between 2000 and 5000 and a mean functionality of hydroxyl groups (OH) greater than 2 and less than 3) (PHHT, polyether or polyester, for example) with a crosslinking agent (diisocyanate), and, on the other hand, by an energetic charge, preferentially of octogen (HMX) or of hexogen (RDX), in a content of about 80% by weight. Said second technique consists:

[0015] in a first step, in mixing said polyhydroxylated prepolymer with said energetic charge and with an amount of diisocyanate of between 50% and 90% by weight of the stoichiometric amount required for total polymerization (reaction) of all the hydroxyl groups (OH) of said prepolymer and in performing the condensation reaction of the isocyanate groups (NCO) on the hydroxyl groups (OH) so as to obtain a partially polymerized (crosslinked) paste;

[0016] in a second step, in mixing with said partially polymerized (crosslinked) paste thus obtained the remainder of the diisocyanate required to achieve said stoichiometric amount required for total polymerization (crosslinking) and in extruding the pasty mixture thus obtained; and then

[0017] in a third step, in completing, by hot curing, the condensation reaction of the isocyanate groups (NCO) added during the second step to the hydroxyl groups (OH) that are still free.

[0018] The technique under consideration thus comprises two polymerization or crosslinking steps, more precisely a first step of pre-crosslinking (or first crosslinking phase) with an amount of isocyanate that allows the production of a partially polymerized (crosslinked) paste, having mechanical strength and cohesion suitable for the implementation of the rest of the process (especially extrusion) and a second step of crosslinking leading to the final product with the desired crosslinked binder. In this, said technique overcomes the two types of difficulty mentioned above (difficulty due to the lack of mechanical strength and cohesion of the product to be extruded and problem of the “pot life”).

[0019] With reference to this second technique, it should, however, be noted that the operations for metering out the crosslinking agent (diisocyanate) to perform the pre-crosslinking are difficult. They require great precision. Moreover, the field of application of said technique is limited, in view of the nature of the crosslinking agent involved (of isocyanate type, to react with hydroxyl functions), as regards the nature of the energetic charges present, insofar as certain energetic charges (having intrinsic acidity) are capable of reacting, in a spurious reaction, with said crosslinking agent (of isocyanate type) present. The presence of such charges (EDNA, nitropyrazoles, for example) thus poses a problem for managing the complementary pre-crosslinking and crosslinking steps. Now, this presence is far from trivial, in the context of the present invention, that of composite pyrotechnic products, especially propellant powders for barrel weapons. Specifically, in this context, the use of high contents of energetic charges (see above), especially high contents of charges of RDX type, is targeted. Now, a person skilled in the art knows the negative impact of a high content of such charges on the erosivity of the powder containing it. Replacing at least part of the RDX with other energetic charges (such as EDNA), which are less erosive, is thus desirable. It would therefore be highly advantageous to have available a novel type of binder, which removes the need to use isocyanate crosslinking agents.

[0020] In such a context, the inventors propose composite pyrotechnic products that are especially suitable as propellant powders for barrel weapons, of novel type. These (novel) composite pyrotechnic products contain a high content of charges in a binder of a novel type (this binder is neither a thermoplastic binder, nor a thermoset (thermo-crosslinked) binder). Said (novel) composite pyrotechnic products are particularly valuable in terms of force (they contain a high content of energetic charges), of vulnerability (they do not contain any nitrocellulose and may advantageously contain sparingly vulnerable energetic charges) and of production process (their production process is particularly easy to perform (in particular, it comprises no crosslinking step and therefore does not involve the use of crosslinking agent(s)) and they may also be optimized in terms of erosivity (they may advantageously contain EDNA charges in total or partial replacement for RDX charges). They are in fact liable to contain any type of energetic charge (see the broad field of application of the products of the invention as regards the nature of the charges mentioned above) insofar as, in the absence of crosslinking agent, no spurious reactions need to be feared (charges/ crosslinking agent(s)).

[0021] According to its first subject, the present invention thus relates to novel composite pyrotechnic products. Characteristically, their compositions, expressed as weight percentages, contain:

[0022] from 78% to 90%, advantageously from 80% to 86%, of organic energetic charges, and

[0023] from 10% to 22% of a polymeric gum, chosen from polyurethane-polyester gums, polyurethane-polyether gums and mixtures thereof, the number-average molecular weight of which is greater than 20
000 g/mol and the Mooney viscosity of which is between 20 and 70 ML (5+4) at 100° C.

[0024] As indicated above, the composite pyrotechnic products of the invention thus contain a high content of organic energetic charges in a binder of a novel type: a binder, of non-crosslinked gum (“raw rubber”) type. It is seen later that said binder may contain a plasticizer.

[0025] The composite pyrotechnic products of the invention thus contain a high content of organic energetic charges: from 78% to 90% by weight, advantageously from 80% to 86% by weight.

[0026] The charges under consideration (organic charges of any type, as selected, as in the context of thermocrosslinkable binders, taking into account the crosslinking reaction to ultimately by implemented); mineral charges having been set aside insofar as they generate solid particles) are not per se original. They are organic energetic charges that are known per se and, for the most part, are already conditioned according to the prior art in a conventional organic polymeric binder (such as PBHT), especially crosslinked. The charges are advantageously hexogen (RDX), octogen (HMX), nitroguanidine (NGU), ethylene dinitramine (EDNA), N-guanidurea dinitramide (FOX 12 (GUDN)), 1,1-diamino-2,2-dinitroethylene (FOX 7 (DADE)), bis(tri-

[0027] Within the composite pyrotechnic products of the invention there is thus a type of energetic charges, advantageously chosen from the above list, or a mixture of at least two types of energetic charges, advantageously chosen from the above list. EDNA organic energetic charges are particularly preferably found therein. A mixture of EDNA charges and of RDX charges is particularly preferably found therein. It is in no way excluded to find only RDX charges or only EDNA charges, but, as indicated above, mixtures of EDNA charges and of RDX charges make it possible to achieve an optimum with reference to the force/erosivity compromise. It has been understood that the more said mixtures contain RDX, the more energetic they are, but the more erosive they are.

[0028] Energetic charges are in the form of solid grains homogeneously distributed in the binder. These solid grains advantageously have, in a manner known per se, several particle size distributions.

[0029] The organic energetic charges are thus present in a novel binder. Said novel binder is based on a gum of the type mentioned. According to one variant, it consists essentially of said gum (at least one additive being present in small amount), or even it consists of said gum. According to another variant, it consists essentially of said gum and at least one plasticizer (at least one additive being present in small amount), or even it consists of said gum and at least one plasticizer.

[0030] Said gum:

[0031] is chosen from polyurethane-polyester gums (i.e. of polyurethane nature with flexible segments of polyester type), polyurethane-polyether gums (i.e. of polyurethane nature with flexible segments of polyether type) and mixtures thereof;

[0032] it has a number-average molecular weight of greater than 20 000 g/mol (advantageously greater than 50 000 g/mol, very advantageously greater than 75 000 g/mol (very particularly with reference to the ageing resistance of the final product), and

[0033] it has a Mooney viscosity of between 20 and 70 ML (5+4) at 100° C. This parameter is widely used in the rubber industry. “ML (5+4) at 100° C.” is understood as “M—the viscosity in Mooney units (or points); L or S (in this instance L) corresponding to the size of the rotor, 5 indicating the preheating time of the product and 4 is the time in minutes after starting the motor at which the reading is taken, 100° C. being the measuring temperature.” The value “x” is generally given as “xy”; it is that value “x” which, according to the invention, must be within the range 20-70 (limit values included).

[0034] Such a gum is perfectly suitable for the purposes of the invention, insofar as, in the proportions indicated (from 10 to 22% only, remembering that products with a high charge rate are under consideration), 1) it allows the (charges+gum) mixture to be mechanically worked at low temperature, i.e. at a temperature below 120° C., or even below 100° C. (which is entirely compatible with the stability of the charges present), and does so without the use of solvent; and 2) it gives the final product the required mechanical hold and cohesion.

[0035] The inventors have, to their credit, identified (selected) this type of gum, which is perfectly suitable for the purposes of the invention. Other types of gum were tested and do not give satisfactory results (as regards the possibility of working the mixture at low temperature and/or as regards the properties of the final product).

[0036] A person skilled in the art has already understood that, with reference to the first of the two stipulations of the requirement recalled above, the result may be further improved by incorporating at least one plasticizer.

[0037] Said gum generally consists of a polyurethane-polyester or a polyurethane-polyether gum, but mixtures of at least two gums (at least two polyurethane-polyester gums, at least two polyurethane-polyether gums or at least one polyurethane-polyester gum and at least one polyurethane-polyether gum; such mixtures of gums (gums within the meaning of the invention) constituting a gum within the meaning of the invention) having the required properties (recalled above) may be used. Said gum advantageously consists of a polyurethane-polyester gum.

[0038] The composition of the composite pyrotechnic products of the invention is thus liable to contain at least one plasticizer. Such an at least one (energetic or non-energetic) plasticizer is generally present in a proportion of from 2% to 8% by weight (of the total composition). Such an at least one plasticizer advantageously consists, with reference to the force of the product, of at least one energetic plasticizer.

[0039] The composition of the composite pyrotechnic products of the invention thus advantageously contains at least one energetic plasticizer (one energetic plasticizer, at least two energetic plasticizers, or at least one energetic plasticizer and at least one non-energetic plasticizer), and very advantageously contains one energetic plasticizer.

[0040] The energetic plasticizer(s) under consideration are advantageously of nitrate and/or nitramine type.

[0041] The energetic plasticizer(s) under consideration are very advantageously chosen from diethylene glycol dinitrate (DEGDN), triethylene glycol dinitrate (TEGDN), butanetriol trinitrate (1317N), trimethylolethane trinitrate (TMETN), a mixture of 2,4-dinitro-2,4-diazapentane, 2,4-
dinitro-2,4-diazahexane and 3,5-dinitro-3,5-diazaheptane (and most particularly DNDA 5.7), nitratoethylnitramines (especially methyl-2-nitrosoethyl nitramine (methylINENA) and ethyl-2-nitrosoethyl nitramine (ethylINENA)), and mixtures thereof.

[0042] The composition of the composite pyrotechnic products of the invention is thus constituted essentially, even constituted, of the energetic charges and of the binder, based on said gum (binder—said gum or binder—said gum at least one plasticizer). It may be constituted to 100% by weight of said energetic charges and of said binder. It is generally thus constituted to at least 95% by weight, more generally to at least 98% by weight. In effect, it cannot be excluded for it to contain in addition at least one additive. Such an at least one additive, when it is present, is generally present in a proportion of from 0.1% to 2% by weight. It may especially be at least one formulation agent (candelilla wax and/or paraffin wax, for example), and/or at least one stabilizer.

[0043] The composite pyrotechnic products of the invention, as described above, are entirely suitable as propellant powders for barrel weapons. Said composite pyrotechnic products of the invention thus consist advantageously of such powders. The composite pyrotechnic products of the invention, as described above, are also suitable, especially, as tactical propelgels, explosive composition and gas generator.

[0044] The major advantage of the products of the invention becomes apparent from the foregoing text. The products are advantageous per se (in terms of force, vulnerability and wide field of application with reference to the nature of the charges) and insofar as they may be obtained via a process that is simple to perform (much easier to perform than the processes of the prior art).

[0045] Said process constitutes the second subject of the present invention. It comprises:

[0046] a) the provision of the ingredients below;
organic energetic charges,
a polymeric gum, chosen from polyurethane-polyester gums, polyurethane-polyether gums and mixtures thereof,
the number-average molecular weight of which is greater than 20 000 g/mol and the Mooney viscosity of which is between 20 and 70 ML (5+4) at 100°C;
[0047] b) the mixture of these in suitable proportions relative to the desired composition of the final product, to produce a pasty mixture;
[0048] c) the production, from said pasty mixture, of the composite pyrotechnic product(s) in the desired form.

[0049] It thus comprises the provision of the essential constituent ingredients of the desired composite pyrotechnic products: the charges+the gum. In addition to said essential ingredients, it has been seen that at least one plasticizer and at least one additive (especially such as a formulation agent and/or stabilizer) may be used.

[0050] With reference to each of the ingredients used for performing the process, reference may be made to the first part of the text relating to the product.

[0051] In a first stage, using the ingredients identified above (charges+gum+optionally, at least one plasticizer+optionally, at least one additive), a pasty mixture is thus prepared, which is the precursor of the targeted final product. Such a pasty mixture is advantageously prepared with a twin-screw extruder (by extrusion) or with a two-roll mill, depending on the amounts to be used. It is generally prepared at a temperature of between 60°C and 120°C (inclusive of extreme values). It is often prepared at a temperature of 80°C. It is understood that this mixing temperature depends on the type of gum and the presence or absence of at least one plasticizer.

[0052] Starting with said pasty mixture, in the third step of the process of the invention, the product in the desired form is prepared (a products are thus generally prepared). Said third step is thus analyzed as a step of forming the paste. This forming may especially comprise spinning or calendering. After such spinning (performed in a press cylinder, having an outlet orifice of more or less substantial diameter), the spun product is generally chopped into strands (of the desired length). Such strands, which are suitable as propellant powders for barrel weapons, generally have a length of from 2 to 20 mm, for a diameter of from 1 to 20 mm (more generally for a diameter of from 2 to 15 mm). On conclusion of such calendering, the calendered product, in the form of a plate (such a plate generally has a thickness of from 10 to 20 mm), is generally chopped into platelets.

[0053] According to implementation variants of the process of the invention, steps b and c of said process may comprise:

[0054] blending with a twin-screw extruder (or extrusion) and spinning;
[0055] blending with a two-roll mill and spinning, or
[0056] blending (with a twin-screw extruder or a two-roll mill) and calendering.

[0057] It is now proposed to illustrate the invention, in a manner that is not in any way limiting, in its product and process aspects, via the examples below.

1) Starting materials used

[0058] a) Commercial products
Gums: Millathane® 76, sold by the company TSE Industries (product of polyaddition of a urethane and a polyester). It has the characteristics below:
Number-average molecular weight: 40 000 g/mol
Mooney viscosity: 35 (±10) ML (1+4) at 100°C;
[0059] UREPan® 641 G: sold by the company Rheinalchemie (product of polyaddition of diphenylmethane diisocyanate and of a polyester). It has the characteristics below:
Number-average molecular weight: 80 000 g/mol
Mooney viscosity: 45 (±10) ML (5+4) at 100°C;
[0060] UREPan® 643 G: sold by the company Rheinalchemie (product of polyaddition of diphenylmethane diisocyanate and of a polyester). It has the characteristics below:
Number-average molecular weight: 80 000 g/mol
Mooney viscosity: 40 (±10) ML (5+4) at 100°C.

[0061] a) Prepared products
Charges: EDNA

[0062] The synthesis of ethylene dinitramine (EDNA) was performed in two stages via the isolation of an intermediate: dinitroethylenurea (DNUE), in wet form, which was then transformed into EDNA.

[0063] Concentrated nitric acid was introduced into a jacketed 50 cm³ reactor. The nitrating bath was then cooled to a reaction temperature at 0°C. Once the bath reached at 0°C, the introduction of imidazolidone was commenced. This reagent was introduced slowly so as not to exceed 20°C. The DNUE precipitated as soon as its concentration in the medium was greater than 23% by weight. The introduction
of imidazolidone into the heterogeneous medium (nitrating bath-solid DNNU) was continued.

[0064] After the end of introduction of the imidazolidone, the medium was left stirring for 30 minutes at room temperature.

[0065] At the end of reaction, the mixture was poured into a bath of cold water at about 5°C with stirring. The solid was then separated from the mother liquors by filtration, and washed several times with distilled water to neutral pH, then drained by suction. It was then taken up, in wet form, for the synthesis of EDNA.

[0066] The decarboxylation step was performed by addition of DNEU to a hot aqueous solution buffered with sodium acetate. Evolution of gas (of CO2) was observed, which necessitates portionwise introduction of the powder.

[0067] Once the introduction of the DNEU was complete, the mixture was maintained at a stage of 95°C to complete the formation of EDNA.

[0068] The reaction medium was then cooled to make the EDNA precipitate. The suspension was then filtered and then dried. A yield of 85% was obtained.

[0069] The production of EDNA was confirmed by infrared.

[0070] IR: 2936 cm⁻¹ aliphatic CH, 1593 cm⁻¹ NO₂, 1448 cm⁻¹ N—N, 1360 cm⁻¹ C—H. The EDNA crystals obtained are coarse crystals (they have a D₅₀ of greater than or equal to 100 μm (D₅₀=diameter for which the cumulative volume percentage is 50%)). To use them, they are ground in a SWECO® mill. On conclusion of said grinding, they have a D₅₀ of 30 μm.

[0071] Plasticizer: TEGDN

[0072] Trioxethylene glycol dinitrate (TEGDN) was obtained by nitration in sulfonitrile medium of trioxethylene glycol.

2) Process for preparing composite pyrotechnic products of the invention

[0073] Composite pyrotechnic products of the invention of three types (Examples 1, 2 and 3) were prepared and tested. Their weight composition and their force (measured or calculated) are given, respectively, in Tables 1, 2 and 3 below. Below each of said Tables 1, 2 and 3, other characteristics of said products are indicated.

[0074] These composite pyrotechnic products of the invention were obtained from the starting materials identified above.

[0075] Step b of the process of the invention: the pasty mixtures were obtained in a two-roll mill, in a manner known per se. The gum was first introduced between the rollers of the two-roll mill (rolling mill), brought to a temperature of 65°C. It was then softened. Next, a charges-plasticizer mixture (prepared beforehand in a container) was added. Candelilla wax was then subsequently added to the resulting mixture.

[0076] Step c of the process of the invention: the pasty mixtures obtained were introduced into a press cylinder heated to 80°C to perform spinning at a pressure of between 280 and 320 bar. After chopping, powder strands were obtained (diameter: 10 mm, length: 11 mm).

### Example 1

<table>
<thead>
<tr>
<th>Binder</th>
<th>Millathane @ 76</th>
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<tr>
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<tr>
<td>Candelilla wax</td>
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<td></td>
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<tr>
<td>Charge EDNA</td>
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<td>F (measured)</td>
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### TABLE 1

<table>
<thead>
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<tr>
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<td>Candelilla wax</td>
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<td>Charge EDNA</td>
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<tr>
<td>F (measured)</td>
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</table>

### Example 2

### Table 3
1. A composite pyrotechnic product whose composition, expressed as weight percentages, contains:
   from 78% to 90% of organic energetic charges, and
   from 10% to 22% of a polymeric gum, chosen from
   polyurethane-polyester gums, polyurethane-polyether
gums and mixtures thereof, a number-average molecular
weight of which is greater than 20,000 g/mol and a
Mooney viscosity of which is between 20 and 70 ML
(+4) at 100°C;

2. The composite pyrotechnic product as claimed in claim
   1, wherein said organic energetic charges consist of hexo-
gen, octogen, nitroglycerine, ethylene dinitramine, N-gua-
nylurea dinitramide, 1,1-diamino-2,2-dinitroethylen, bis
(triaminoquazinidinium) 5,5'-azotetrazolate, dihydradzinum
5,5'-azotetrazolate, 5,5'-bis(tetrazolyly)hydrazine, bis(2,2-
dinitropropyl)nitramine, a nitropyrazole, or a mixture of
such charges.

3. The composite pyrotechnic product as claimed in claim
   1, wherein said organic energetic charges contain ethylene
dinitramine charges.

4. The composite pyrotechnic product as claimed in claim
   1, wherein said polymeric gum has a number-average
molecular weight of greater than 50,000 g/mol.

5. The composite pyrotechnic product as claimed in claim
   1, wherein said gum is a polyurethane-polyester gum or a
polyurethane-polyether gum.

6. The composite pyrotechnic product as claimed in claim
   1, wherein the composition also contains at least one ener-
ggetic or non-energetic plasticizer; said plasticizer represent-
ing from 2% to 8% by weight of the composition of said
pyrotechnic product.

7. The composite pyrotechnic product as claimed in claim
   6, wherein said at least one plasticizer is an energetic
plasticizer of nitrate and/or nitramine type.

8. The composite pyrotechnic product as claimed in claim
   7, wherein said at least one plasticizer is chosen from
diethylene glycol dinitrate, triethylene glycol dinitrate, buta-
etriol trinitrate, trimethylethylene trinitrate, a mixture of
2,4-dinitro-2,4-diazepantane, 2,4-dinitro-2,4-diazahexane
and 3,5-dinitro-3,5-diazahexane, nitratoethyltrinitrines,
and mixtures thereof.

9. The composite pyrotechnic product as claimed in claim
   1, wherein the composition also contains from 0.1% to 2%
by weight of at least one additive.

10. The composite pyrotechnic product as claimed in claim
    1, wherein the composite pyrotechnic product consists
    of a propellant powder for barrel weapons.

11. A process for preparing at least one composite pyro-
technic product as claimed in claim 1, the process compris-
ing:
    a) providing the ingredients below:
    organic energetic charges,
    a polymeric gum, chosen from polyurethane-polyester
gums, polyurethane-polyether gums and mixtures thereof,
    a number-average molecular weight of which is greater
    than 20,000 g/mol and a Mooney viscosity of which is
    between 20 and 70 ML (+4) at 100°C;
    b) mixing the ingredients in suitable proportions relative
to the desired composition of the final product, to
produce a pasty mixture; and
    c) producing, from said pasty mixture, said at least one
composite pyrotechnic product in a desired form.

12. The process as claimed in claim 11, further comprising
providing at least one energetic or non-energetic plasticizer
and/or at least one additive, and mixing of said charges and
gum with said at least one plasticizer and/or at least one
additive to obtain a pasty mixture.

13. The process as claimed in claim 11, wherein said
mixture is prepared with a twin-screw extruder or a two-roll
mill.

14. The process as claimed in claim 11, wherein said
mixture is prepared at a temperature of between 60°C and
120°C.

15. The process as claimed in claim 11, wherein at least
one composite pyrotechnic product is obtained by
spinning or calendaring.

16. The composite pyrotechnic product as claimed in
claim 1, wherein the composition, expressed as weight
percentages, contains from 80% to 96% of organic energetic
charges.

17. The composite pyrotechnic product as claimed in
claim 3, wherein said organic energetic charges contain
hexogen charges and ethylene dinitramine charges.

18. The composite pyrotechnic product as claimed in
claim 4, wherein said polymeric gum has a number-average
molecular weight of greater than 75,000 g/mol.

19. The composite pyrotechnic product as claimed in
claim 5, wherein said gum is a polyurethane-polyester gum.

20. The composite pyrotechnic product as claimed in
claim 6, wherein the composition further contains an ener-
ggetic plasticizer.