The present invention relates to a non-toxic primer powder composition for small caliber ammunition characterized by comprising potassium nitrate coated with shellac as an oxidizer, and particularly characterized by comprising 25-40 wt % of an initiating explosive, 10-30 wt % of nitrate ester as a fuel, 32-40 wt % of a shellac-coated potassium nitrate (KNO₃) as an oxidizer, 5-10 wt % of tetracene as a first sensitizer, 3-9 wt % of a borosilicate powder as a second sensitizer and 0.1-0.2 wt % of a chemical binder.
Fig. 1
NON-TOXIC PRIMER POWDER COMPOSITION FOR SMALL CALIBER AMMUNITION

TECHNICAL FIELD

[0001] The present invention relates to a non-toxic primer powder composition for small caliber ammunition characterized by comprising potassium nitrate coated with shellac as an oxidizer, and particularly characterized by comprising an initiating explosive, nitrate ester as a fuel, a shellac-coated potassium nitrate (KNO₃) as an oxidizer, tetracene as a first sensitizer, a borosilicate powder as a second sensitizer and a chemical binder.

BACKGROUND ART

[0002] A primer powder composition is generally comprised of an initiating explosive, a fuel, an oxidizer, a sensitizer and a chemical binder. Reviewing each function of said components, the initiating explosive initiates detonation of the primer powder by impact caused by a stroke of a hammer; the fuel generates flame by which a propellant can be combusted, in which the combustion is initiated by the detonation of the initiating explosive; the oxidizer provides oxygen required for combustion of the fuel, i.e., serves as an oxygen provider; the sensitizer helps the detonation of the initiating explosive so to respond to very subtle impact; and the chemical binder conglomerates the components of the primer powder composition hard so as to prevent the loss of said components.

[0003] The bullet firing is carried out by following mechanism: when a hammer of a gun strikes the primer, an initiating explosive is ignited and detonated, and then a propellant inside the bullet is combusted by the explosive power of a fuel as the detonation occurs, to fire the bullet.

[0004] Conventional primer powder compositions commonly make use of lead stynphate as an initiating explosive, antimony sulfide as a fuel, barium nitrate as an oxidizer. However, those conventional compositions have problems of, when the primer powder composition is detonated, generation of hazardous oxide-containing flying dust such as lead oxide (PbO) due to oxidation of lead stynphate, antimony oxide (Sb₂O₅) due to oxidation of antimony sulfide, barium oxide (BaO) due to reduction of barium nitrate. Such oxide-containing flying dust is a toxic material, which is taken and accumulated in the human body, thus to disturb the human body function, thereby being very harmful to a shooter, particularly in indoor shooting ranges. The oxide-containing dust also causes environmental hazards.

[0005] Regarding the toxic problem, there is a registered Korean Patent concerning a non-toxic primer powder composition, however, it has problems such that a lot of sparks are generated when firing, thereby being dangerous, and a corrosive salt, potassium chloride (KCl) is accumulated to the gun, thereby causing corrosion in the gun.

[0006] U.S. Pat. No. 5,417,160 disclose a use of potassium nitrate instead of barium nitrate, in order to prevent the generation of such hazardous oxide compounds; however it has a problem such that the sensitivity and performance of the primer is lowered, due to hygroscopicity of potassium nitrate (water solubility of 31.6 g/100 ml, at 20°C), which is a property of absorbing moisture in the air.

[0007] Another U.S. Pat. No. 6,620,267 disclose a technique of coating potassium nitrate with an insoluble material, nitrocellulose, in order to solve the problem of hygroscopicity of potassium nitrate; however, it does not sufficiently overcome said hygroscopicity problem of potassium nitrate and also has a risk of explosion of nitrocellulose which can be caused by any impact or abrasion, thereby having a serious problem in safety during working.

[0008] In order to solve such problems, the present invention uses a shellac resin that is an animal-originated natural resin, for coating potassium nitrate with, instead of nitrocellulose so to improve the lowered sensitivity and performance problems of a primer due to hygroscopicity of the primer powder as well as prevent explosion problem of conventional arts.

[0009] Therefore, the object of the invention is to improve above-mentioned problems in conventional arts, specifically to provide a non-toxic primer powder composition for a small caliber ammunition which does not generate heavy metal oxides upon ignition of the primer powder composition when bullet firing, so to protect the shooter and environment from harmful heavy metal compounds, and solve the problems in conventional non-toxic primer powder including spark generation and accumulation of corrosive salt, and to solve the problems caused by hygroscopicity of potassium nitrate.

BRIEF DESCRIPTION OF THE DRAWING

[0010] FIG. 1 is a cross-sectional view of a typical primer of small caliber ammunition

[0011] Symbols Used in FIG. 1

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>anvil</td>
</tr>
<tr>
<td>20</td>
<td>foiling paper</td>
</tr>
<tr>
<td>30</td>
<td>primer powder</td>
</tr>
<tr>
<td>40</td>
<td>Cup</td>
</tr>
</tbody>
</table>

DETAILED DESCRIPTION OF THE INVENTION

[0012] The primer powder composition for small caliber ammunition of the present invention is characterized by comprising a shellac-coated potassium nitrate as an oxidizer.

[0013] According to one preferred embodiment of the present invention, provided is a primer powder composition for small caliber ammunition which comprises 25-40 wt % of an initiating explosive, 10-30 wt % of nitrate ester as a fuel, 32-40 wt % of a shellac-coated potassium nitrate (KNO₃) as an oxidizer, 5-1 wt % of tetracene as a first sensitizer, 3-9 wt % of a borosilicate powder as a second sensitizer and 0.1-0.2 wt % of a chemical binder.

[0014] Based on above preferred embodiment, the present invention is described further in detail, hereinafter.

[0015] Although lead stynphate, which generates lead oxide that is hazardous compound to the human body by the following oxidation reaction:

$$ \left( C_{6}H_{4}NO_{3} \right)_{2}Pb + \frac{11}{2} O_{2} \rightarrow 2PbO + 12CO_{2} + 3N_{2} + H_{2}O $$

...
DDNP may be included in the primer powder composition of the present invention, preferably with an amount of 25-40 wt %. When being used less than 25 wt %, the explosive power will be not sufficient enough, and when more than 40 wt %, the explosive power will be so great to cause deterioration in performance of the warhead.

Other than said DDNP, one or more initiating explosive selected from the group consisting of a diazo compound, a triazole compound, a tetrazole compound and a nitrobenzene compound such as potassium dinitrobenzofuroxane and monopropellant stibophosphate can be used in the primer powder composition of the present invention.

Antimony sulfide which was used as a fuel in many conventional arts, generates a hazardous antimony oxide (Sb₂O₃) and sulfurous acid gas by the following oxidation reaction:

\[
\text{Sb}_2\text{O}_3 + \frac{9}{2}\text{O}_2 \rightarrow \text{Sb}_2\text{O}_5 + 3\text{SO}_2
\]

Therefore, in order to prevent generation of such hazardous components, the present invention uses nitrate ester being free of heavy metal, instead of such conventional fuel.

The nitrate ester is included in the primer powder composition of the present invention, preferably with an amount of 10-30 wt %. When being used less than 10 wt %, flame of the primer will not be sufficient enough to provide active combustion of a propellant, and when more than 30 wt %, the flame will be so great to cause abnormal combustion rate of the propellant, thereby having a risk of generating an abnormal pressure.

As for said nitrate ester, any nitrate ester which is produced by a general method well-known in this field of the art, for example a spherical propellant (PMC/WG544 manufactured by Poongsan Corp.) with a particle size of 0.25-0.35 mm, containing 10.5 wt % of nitroglycerin, 84 wt % of nitrocellulose, 4.5 wt % of a retardant and 1 wt % of a stabilizer is preferably used.

Barium nitrate which was used as an oxidizer in many conventional arts, generates a hazardous barium oxide (BaO) by the following reducing reaction:

\[
\text{Ba(NO}_3\text{)}_2 \rightarrow \text{BaO} + \text{N}_2 + \frac{5}{2}\text{O}_2
\]

Therefore, in order to prevent generation of such hazardous components, the present invention uses potassium nitrate being free of heavy metal and generating a salt with no corrosiveness as follows:

\[
\text{KNO}_3 \rightarrow \text{K}_2\text{O} + \text{N}_2 + \frac{5}{2}\text{O}_2
\]

The potassium nitrate is coated with a shellac to be used in the present invention, wherein the shellac is a animal-originated natural resin which is obtained from an insect in tropical regions, has relatively low melting point, heat-conductivity and coefficient of expansion, and is durable to UV light, non-toxic and excellent in moisture proof, thereby commonly being applied as a finishing material in a coating process.

Since the conventional potassium nitrate is not suitable for a component of a primer powder due to its great hygroscopicity, the present invention has solved the problem by coating the potassium nitrate with said shellac.

The weight ration of shellac and potassium nitrate is preferably 0.007:1-0.025:1, when the ratio of shellac to potassium nitrate is less than 0.007, moisture proofing will not be sufficient enough, and when being more than 0.025, it will disadvantageously affect the sensitivity.

The shellac-coated potassium nitrate particles may be partially exposed to the moisture during a sieving process, however the majority of the potassium nitrate particles are at least partially or completely coated so to contribute to block moisture present in the air. In particular, when using non-coated potassium nitrate, the resulted primer will absorb moisture in the air, since the solubility of the non-coated potassium nitrate is higher than that of the coated potassium nitrate in a process of mixing primer powder components, on working for mixing the primer explosive powder components. Accordingly, the sensitivity of the primer may be lowered so that the sensitivity of the primer could not satisfy the standard level required for a primer, depending on the use environment.

The shellac-coated potassium nitrate is included in the primer powder composition of the present invention, preferably with an amount of 32-40 wt %, when being less than 32 wt %, the explosive combustion properties becomes lower since the amount of oxygen provided is not enough, and when more than 40%, other components becomes relatively reduced so that generation of energy for igniting a propellant is likely to reduced.

The present invention also preferably makes use of a borosilicate powder as a second sensitizer, other than tetracene that is conventionally used as a first sensitizer.

Each tetracene and borosilicate powder is included in the primer powder composition of the present invention, preferably with an amount of 5-10 wt % and 3-9 wt %, respectively. When tetracene is used less than 5 wt %, the impact sensitivity of the primer could be so lowered to cause a misfire, and when more than 10 wt %, the sensitivity will become too keen to handle the gun safely. When the borosilicate powder is less than 3 wt %, the sensitivity could be so lowered to cause a misfire, and when more than 9 wt %, the sensitivity will become too keen to handle the gun safely.

As for the chemical binder, a mixture of arabian gum, tragacanth and gelatin may be preferably used in the present invention.
The mixture of acacia, tragacanth and gelatin mixed with a weight ratio of 9:5:1, is used preferably with an amount of 0.1-0.2 wt %, when being less than 0.1 wt %, the adhesiveness of the primer powder will become weak to cause loss of primer powder, and when more than 0.2 wt %, the sensitivity of the primer will be lowered.

For preparing the primer powder composition according to above preferred embodiment of the present invention, mixing a certain amount of wet DDNP and tetracene which have been weighed on a dry basis, adding a shellac-coated potassium nitrate powder, nitrate ester and a borosilicate powder with agitation to prepare a wet explosive powder mix.

The present invention will be further understood by the following examples, which is provided for illustrative purposes without any intention to restrict the scope of the present invention.

COMPARATIVE EXAMPLE 2

A primer powder composition was prepared by the same method as represented in the example 1, except that uncoated potassium nitrate, instead of the shellac-coated potassium nitrate was used in an amount of 37.5 wt %.

SENSITIVITY TEST

With those primers obtained from example 1 and comparative examples 1 and 2, test on sensitivity was carried out, and the results were represented in Table 1. The sensitivity test on a small pistol primer was based on the national defense specification. 20 bullets were used for each example and comparative examples and average data thereof were used in Table 1.

<table>
<thead>
<tr>
<th>Standard</th>
<th>Comparative Example 1</th>
<th>Comparative Example 2</th>
<th>Example 1</th>
<th>Weight of a Ball</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>example 1</td>
<td>example 2</td>
<td>1st</td>
<td>2nd</td>
</tr>
<tr>
<td>H + 4s</td>
<td>11</td>
<td>8.60</td>
<td>11.30</td>
<td>7.98</td>
</tr>
<tr>
<td>H - 2s</td>
<td>1</td>
<td>3.62</td>
<td>2.91</td>
<td>2.70</td>
</tr>
<tr>
<td>H</td>
<td>5.28</td>
<td>5.25</td>
<td>4.46</td>
<td>4.10</td>
</tr>
<tr>
<td>S</td>
<td>0.83</td>
<td>1.39</td>
<td>0.88</td>
<td>0.98</td>
</tr>
</tbody>
</table>

EXAMPLES

Example 1

On a dry basis, 30 wt % of DDNP and 7.5 wt % of tetracene was mixed together, to the resulted mixture, 37.5 wt % of a shellac-coated potassium nitrate and 17 wt % of nitrate ester were added and mixed, and then tetracene 7.8 wt % of a borosilicate powder and 0.2 wt % of a chemical binder which is a mixture of arabian gum, tragacanth and gelatin with a mixing ratio of 9:5:1 were added and mixed thoroughly, in a mixer.

The shellac-coated potassium nitrate was prepared by adding 2 liter of ethyl alcohol to 1 kg of dried potassium nitrate to wet, adding 80 ml of a shellac resin solution, stirring the mixture sufficiently for one hour or more, allowing to stand it for 12 hours or more, removing the excessive ethyl alcohol, drying and sieving the resulted product.

The resulted mixture, as a primer powder, was charged into a cup (40) represented in FIG. 1, sealed with a foiling paper (20) and compressed. The cup (40) charged with the primer powder (30) was coupled with an anvil (10) in a coupler, covered with a lacquer and dried at 45-55° for 72 hours to finally give a primer.

Comparative Example 1

A primer powder composition was prepared by the same method as represented in the example 1, except that 36 wt % of lead styphnate and 4 wt % of tetracene were mixed together, and thereto 39.8 wt % of barium nitrate, 16 wt % of antimony sulfide, 4 wt % of an aluminum powder and 0.2 wt % of a chemical binder were added and mixed.
dividing the distance between said screens with the time. The pressure was measured with a PCB transducer, and the piezoelectric effect was plotted to P-T for determination. The precision was measured with a test barrel by firing 5 bullets per each trial for five times to a target provided at a distance of 25 yard front, and determined by the average value of the maximum distribution.

[0051] The performance test was carried out by checking out the deterioration in performances, after being stored samples at high temperature such as 52°, at a room temperature 21° and at a low temperature such as −40° respectively for 4 hours.

<table>
<thead>
<tr>
<th>Test (unit)</th>
<th>Standard level</th>
<th>Comparative example 1</th>
<th>Example 1 (21° C.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed (ft/sec)</td>
<td>1,125 ± 50</td>
<td>1,124</td>
<td>1,161</td>
</tr>
<tr>
<td>Pressure (psi)</td>
<td>35,700 or less</td>
<td>24,100</td>
<td>30,900</td>
</tr>
<tr>
<td>Precision (inch)</td>
<td>3 or less</td>
<td>1.8</td>
<td>0.8</td>
</tr>
<tr>
<td>Performance</td>
<td>No adverse effect on the performance</td>
<td>No adverse effect on the performance</td>
<td>No adverse effect on the performance</td>
</tr>
<tr>
<td>At room temperature (21° C.)</td>
<td>No adverse effect on the performance</td>
<td>No adverse effect on the performance</td>
<td>No adverse effect on the performance</td>
</tr>
<tr>
<td>At low temperature (−40° C.)</td>
<td>No adverse effect on the performance</td>
<td>No adverse effect on the performance</td>
<td>No adverse effect on the performance</td>
</tr>
<tr>
<td>At high temperature (52° C.)</td>
<td>No adverse effect on the performance</td>
<td>No adverse effect on the performance</td>
<td>No adverse effect on the performance</td>
</tr>
</tbody>
</table>

[0052] As represented in above table 2, the primer powder composition of example 1 satisfies the standard level in each speed, pressure, precision and performance test, and does not show great differences in test results, with the primer powder composition of comparative example 1.

[0053] The primer which contains the primer powder composition for small caliber ammunition according to the present invention: is a non-toxic primer being free of hazardous heavy metal, thereby having effects of protecting the health of an individual shooter and the environment, thus being environmentally friendly; satisfies the standard level concerning explosion sensitivity of a bullet, bullet properties including speed, pressure and precision and performances: and prevents sparks generated upon firing and contaminants which cause corrosion in the arms.

What is claimed is:

1. A primer powder composition for small caliber ammunition which comprises an initiating explosive, a fuel, an oxidizer, a sensitizer and a chemical binder, characterized by comprising a shellac-coated potassium nitrate as the oxidizer.

2. The primer powder composition for small caliber ammunition according to claim 1, wherein the shellac-coated potassium nitrate has the weight ratio of shellac to potassium nitrate being 0.007:1--0.025:1.

3. The primer powder composition for small caliber ammunition according to claim 1, wherein the composition consists of 25-40 wt % of an initiating explosive, 10-30 wt % of nitrate ester as a fuel, 32-40 wt % of a shellac-coated potassium nitrate as an oxidizer, 5-10 wt % of tetracene as a first sensitizer, 3-9 wt % of a borosilicate powder as a second sensitizer and 0.1-0.2 wt % of a chemical binder.

4. The primer powder composition for small caliber ammunition according to claim 1, wherein the initiating explosive is one or more selected from the group consisting of a diazo compound including diazodinitrophenol, a triazole compound, a tetrazole compound and a nitrobenzene compound such as potassium dinitrobenzofroxane and monopotassium stypmate.

5. The primer powder composition for small caliber ammunition according to claim 1, wherein the chemical binder is a mixture of Arabian gum, tragacanth and gelatin mixed with a weight ratio of 9:5:1.