A flame colorant composition, device and method incorporate inorganic metal salt particles as flame colorants, and a drying agent. The metal salts are preferably selected from among copper chloride, lithium chloride, copper sulphate, calcium chloride, potassium chloride, strontium chloride, sodium chloride and magnesium chloride, each producing a flame of a characteristic color. The drying agent is Micro-Cell E silica, prevents particle aggregation. Preferably, the components are similarly sized particles which do not exceed 0.16 centimeters (0.0625 inches) in diameter. There is also provided a dual layer envelope containing the flame colorant mixture, the inner layer a vapour barrier and the outer layer easily combustible. The device of the present invention will produce a colored flame lasting up to thirty minutes without additional components.
LONG-LASTING FLAME COLORANT COMPOSITION, DEVICE, AND METHOD OF PRODUCTION

FIELD OF THE INVENTION

[0001] The present invention relates to flame colorant devices. In particular, the present invention relates to a flame colorant device incorporating a mixture of one or more inorganic metal salt colorants and a drying agent, as well as a method for producing the flame colorant device.

BACKGROUND OF THE INVENTION

[0002] It is known to provide devices and methods for flame coloration. For example, U.S. Patent Application Publication No. 2002/0148540 A1 to Hiskey et al. published on Oct. 17, 2002 relates to pyrotechnic compositions and, more particularly, to low-smoke producing pyrotechnic compositions which employ various metal salts as flame colorants.

[0003] Metals are known to have an associated spectrum when burned. Hiskey teaches that among the metal salts that may be employed are sodium salts for the color orange-yellow, copper salts for the color blue, potassium salts for the color violet, and antimony salts for the color white. Further, combinations of metal salts will produce other colors.

[0004] Hiskey et al. is also the inventor of U.S. Pat. No. 6,312,537 B1 which issued on Nov. 6, 2001. This patent also relates to a low-smoke pyrotechnic composition which includes a colorant. The colorant is a metal salt of a high-nitrogen, low carbon content energetic material. The Hiskey et al. patents are directed to the object of smoke reduction for pyrotechnics, not to a safe device for adding color to recreational fire flames.

[0005] U.S. Pat. No. 4,309,189 issued on Jan. 5, 1982 to Oberhardt relates to a method and means for increasing the duration of flame coloration. This patent teaches a multichamber pouch having two constituents, a flame colorant, usually a metal salt, such as copper chloride, copper sulphate, potassium halides, sodium halides, lithium sulphate, strontium chloride, barium chloride, a combination of copper sulphate and ammonium chloride, or a combination of copper chloride and ammonium chloride, and a non-burning or slow burning non-volatile matrix material. The matrix, selected from the group consisting essentially of borax, or a source thereof, barium chloride, magnesium chloride, lithium sulphate and aluminim sulphate, is used to extend the duration of flame coloration. No drying agent is employed.

[0006] It is known to provide flame colorants for use in adding colour to otherwise invisible flames, for safety purposes. U.S. Pat. No. 6,521,364 B1 to Autenreith was published on Feb. 18, 2003. This application relates to a flame colorant additive for methanol for the operation of a fuel cell system, which includes either sodium chloride or an organic compound of an element of the first principal group, the second principal group, the third secondary group, or the ninth secondary group of the periodic table of elements.

[0007] U.S. Pat. No. 5,858,031, which issued to Perlman on Jan. 12, 1999, relates to a method for enhancing the visibility of a flame produced during burning of an aqueous alcohol-based fuel composition in air. The fuel composition is substantially free of skin-irritants, corrosive salts and agents which produce air pollution when burned in air. The fuel includes water and a mixture of alcohols, including ethanol and isopropanol. The method includes providing an alcohol mixture in which the volume ratio of isopropanol to ethanol in the fuel does not exceed 2:1. Neither Autenreith nor Perlman teaches a composition or method for adding color to a wood fire flame for recreational purposes. Further, Perlman teaches a flame colorant composition which does not use inorganic metal salts.

[0008] It is known in the prior art to incorporate a flame colorant into a fuel composition. U.S. Pat. No. 6,419,713 to Durand et al. issued on Jul. 16, 2002 discloses a solid or liquid fuel composition which includes triethanolamine and a color-forming agent, such as boric acid derivatives, copper, thallium, lithium, sodium, lanthanum or strontium compounds, or copper halides to produce a colored flame. The invention also teaches a method for making a candle with a colored flame by incorporating triethanolamine and a color-forming agent.

[0009] U.S. Pat. No. 5,127,922 issued to Benson on Jul. 7, 1992 relates to a candle with a flame having a color other than the yellow characteristic of a conventional paraffin candle. The candle comprises a thermoplastic material shell, 10-30% of a fire retardant; a fuel consisting of 70-100% polyoxyethylene, 0-30% of a binder, and 0-20% of a solvent. The candle also comprises 1-10% of a flame-coloring agent, such as a salt or an oxide of lithium, boron, sodium, calcium, copper, potassium, strontium, indium or barium.

[0010] Publication No. 2003/0009929 A1, filed by Newton et al. and published on Jan. 16, 2003, relates to a composition and method of making a combustible organic mixture used to generate a colorful flame that is environmentally safe and non-toxic. The flame colorant employed is in the form of an organometallic complex such as acetyl acetone complexes of alkaline, alkaline earth or transition metals such as lithium, cesium, sodium, and copper acetyl acetone complexes. Newton does not teach the use of inorganic metal salt flame colorants.

SUMMARY OF THE INVENTION

[0011] According to one aspect of the present invention, there is provided a flame colorant composition having at least one inorganic metal salt selected from the group comprising copper chloride, lithium chloride, copper sulphate, calcium chloride, potassium chloride, strontium chloride, sodium chloride and magnesium chloride; and a drying agent.

[0012] In another aspect of the present invention, there is provided a flame colorant device having a mixture of at least one inorganic metal salt selected from the group comprising copper chloride, lithium chloride, copper sulphate, calcium chloride, potassium chloride, strontium chloride, sodium chloride and magnesium chloride; and a drying agent; and a sealable package enclosing the mixture.

[0013] In one embodiment of the invention, the at least one inorganic metal salt comprises three inorganic metal salts, preferably potassium chloride, sodium chloride and copper sulphate. In a preferred embodiment, the relative composition of the metal salts and drying agent is in the ranges of 45 to 57% potassium chloride, 29.5 to 43.5% sodium chloride, 11 to 15% copper sulphate and 0.3 to 0.7% drying agent. In one preferred embodiment, the relative composition is 45% potassium chloride, 41.5% sodium chloride, 13% copper sulphate and 0.5% drying agent. In another, the relative composition is 55% potassium chloride, 31.5% sodium chloride, 13% copper sulphate and 0.5% drying agent.

[0014] In other of its embodiments, the metal salts are in the form of similarly sized particles and the drying agent is
Micro-Cell E silica. Preferably, the particles do not exceed a diameter of 0.16 centimeters (0.0625 inches).

In one embodiment, the sealable package has an easily combustible outer layer, preferably paper, and an inner vapour-barrier layer, preferably a polyethylene liner.

In another of the aspects of the invention, there is provided a method of producing a flame colorant device. The method includes the steps of:

1. Obtaining industrial quantities of one or more of the at least one inorganic metal salts;
2. Grinding the inorganic metal salts in a grinder to obtain a desired average particle size;
3. Creating a mixture by combining the inorganic metal salt particles and a drying agent according to desired percentages by weight;
4. Using a sealing machine to insert portions of the mixture into a sealable package; and
5. Sealing the sealable package.

In one embodiment of the method of the invention, the desired average particle size does not exceed 0.16 centimeters (0.0625 inches).

**BRIEF DESCRIPTION OF THE DRAWINGS**

The invention will be better understood when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings wherein:

**FIG. 1** is a perspective top view of an unsealed version of the preferred embodiment of the flame colorant device of the invention, indicating the manner of enclosing the flame colorant composition within the envelope;

**FIG. 2** is a perspective top view of the flame colorant device of the invention;

**FIG. 3** is a perspective bottom view of the flame colorant device of the invention; and

**FIG. 4** is a cross sectional view through line 4-4 of FIG. 2 of the flame colorant device of the invention.

The same reference numerals refer to the same parts throughout the various figures.

**DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

The present invention provides a composition having one or more flame colorant components and a drying agent. The flame colorant components are one or more inorganic metal salts. The flame colorant components are preferably selected from the group consisting of copper chloride, lithium chloride, copper sulphate, calcium chloride, potassium chloride, strontium chloride, sodium chloride and magnesium chloride. Each of these metal salts will produce a flame of a characteristic color when burned. The color corresponding to the flame produced by each salt is set out in the table below:

**TABLE I-continued**

<table>
<thead>
<tr>
<th>Flame Color</th>
<th>Salt</th>
</tr>
</thead>
<tbody>
<tr>
<td>purple</td>
<td>potassium chloride</td>
</tr>
<tr>
<td>red</td>
<td>strontium chloride</td>
</tr>
<tr>
<td>yellow</td>
<td>sodium chloride</td>
</tr>
<tr>
<td>white</td>
<td>magnesium chloride</td>
</tr>
</tbody>
</table>

The composition according to the invention also comprises a drying agent mixed with the flame colorant components. In a preferred embodiment, the drying agent is Micro-Cell E silica, commonly available from industrial chemical suppliers. The presence of a drying agent helps to prevent moisture from causing the particles to adhere together, which would reduce the effectiveness of the flame colorant composition.

Preferably, the inorganic metal salts are in the form of particles which do not exceed 0.16 centimeters (0.0625 inches) in diameter. Preferably, the particles are of similar size to permit effective mixing.

In one embodiment of the invention, a mixture of three metal salts, namely, potassium chloride, sodium chloride and copper sulphate, and a drying agent, are employed. The composition of the mixture may comprise 43 to 57% potassium chloride, 29.5 to 43.5% sodium chloride, 11 to 15% copper sulphate and 0.3 to 0.7% drying agent. More preferably, the mixture may comprise 45% potassium chloride, 41.5% sodium chloride, 13% copper sulphate and 0.5% drying agent. In another preferred embodiment, the mixture may comprise 55% potassium chloride, 31.5% sodium chloride, 13% copper sulphate and 0.5% drying agent. All percentages indicated in the specification and claims herein are percentages by weight.

By selecting inorganic metal salts corresponding to particular desired colors, a wide variety of color specific flame colorant devices may result. In addition to the eight individual colors listed in Table I, numerous color combinations of two, three, four, five, or seven colors are possible.

According to another embodiment of the present invention, as depicted in FIGS. 1, 2, 3 and 4, there is provided a flame colorant device comprising a dual layer envelope containing a composition of one or more flame colorants and a drying agent.

The dual layer envelope 2 comprises an outer layer 4 and an inner layer 6. The outer layer 4 of the envelope is of a flexible material which is easily combustible. The outer surface 8 of the outer layer 4 is preferably of a material which permits the printing thereon of labeling information, such as trademarks, usage instructions, product features, safety notices and machine readable product codes. The outer layer is preferably manufactured of paper.

The inner layer 6 of the envelope 2 is of a material which acts as a vapour barrier to prevent the transmission of water vapour into the envelope, as well as discoloration of the outer layer 4. The presence of moisture from water vapour or otherwise may cause the flame colorant particles 10 to aggregate, which may interfere with the proper functioning of the device. Such moisture, if permitted to encounter the metal salts in the envelope, may cause the salts to cause discoloration of the envelope. The inner layer is preferably a polyethylene paper sealing liner.
The flame colorant device of the present invention will produce a colored flame which endures up to 30 minutes, depending on fire conditions including the size and temperature of the fire, and the timing and location of placement of the device into the fire. Ideally, the device is to be placed on the fire after some coals have formed. No additional components are required to be added to the device to extend the duration of flame coloration.

While many other inorganic metallic salts will produce characteristic color upon burning, the salts comprising the combustible mixture of the present invention have been selected for their capacity for safe consumer use in the volumes contemplated by the invention.

According to another embodiment of the present invention there is provided a method of production of a flame colorant device comprising a dual layer envelope containing a composition of one or more flame colorants and a drying agent. The method of production comprises the steps of obtaining an industrial supply of one or more inorganic metal salts as flame colorants, grinding the inorganic metal salts until a desired particle size is obtained, mixing together one or more of the ground metal salts and a drying agent, placing the resultant mixture into a dual layer envelope, and sealing the dual layer envelope. The envelope is sealable in the manner indicated by the arrows 12 shown in FIG. 1.

Preferably, the inorganic metal salts are ground to form particles which do not exceed 0.16 centimeters (0.0625 inches) in diameter. Preferably, the particles are substantially all of similar diameter to permit effective mixing.

Ideally, the production of the flame colorant device is designed to prevent contact of the inorganic metal salts with workers’ skin.

Throughout this specification, unless the context requires otherwise, the word “comprise” or variations such as “comprises” or “comprising” or the term “includes” or variations, thereof or the term “having” or variations, thereof, will be understood to imply the inclusion of a stated element or integer or group of elements or integers but not the exclusion of any other element or integer or group of elements or integers. In this regard, in construing the claim scope, an embodiment where one or more features is added to any of the claims is to be regarded as within the scope of the invention given that the essential features of the invention as claimed are included in such an embodiment.

Those skilled in the art will appreciate that the invention described herein is susceptible to variations and modifications other than those specifically described. It is to be understood that the invention includes all such variations and modifications which fall within its spirit and scope.

1. A flame colorant composition comprising:
   at least one inorganic metal salt selected from the group comprising copper chloride, lithium chloride, copper sulphate, calcium chloride, potassium chloride, strontium chloride, sodium chloride and magnesium chloride;
   and
   a drying agent.

2. The flame colorant composition of claim 1 wherein the at least one inorganic metal salt comprises three inorganic metal salts.

3. The flame colorant composition of claim 2 comprising 43 to 57% potassium chloride, 29.5 to 43.5% sodium chloride, 11 to 15% copper sulphate and 0.3 to 0.7% drying agent.

4. The flame colorant composition of claim 3 comprising 45% potassium chloride, 41.5% sodium chloride, 13% copper sulphate and 0.5% drying agent.

5. The flame colorant composition of claim 3 comprising 55% potassium chloride, 31.5% sodium chloride, 13% copper sulphate and 0.5% drying agent.

6. The flame colorant composition of claim 3 wherein the one or more inorganic metal salts are in the form of similarly sized particles having an average diameter not exceeding 0.16 centimeters (0.0625 inches).

7. The flame colorant composition of claim 3 wherein the drying agent is Micro-Cell E silica.

8. A flame colorant device comprising:
   a mixture of at least one inorganic metal salt selected from the group comprising copper chloride, lithium chloride, copper sulphate, calcium chloride, potassium chloride, strontium chloride, sodium chloride and magnesium chloride, and a drying agent;
   and
   a sealable package enclosing the at least one inorganic metal salt and the drying agent.

9. The flame colorant device of claim 8 wherein the at least one inorganic metal salt comprises three inorganic metal salts.

10. The flame colorant device of claim 9 wherein the mixture comprises 43 to 57% potassium chloride, 29.5 to 43.5% sodium chloride, 11 to 15% copper sulphate and 0.3 to 0.7% drying agent.

11. The flame colorant device of claim 10 wherein the mixture comprises 45% potassium chloride, 41.5% sodium chloride, 13% copper sulphate and 0.5% drying agent.

12. The flame colorant device of claim 11 wherein the mixture comprises 55% potassium chloride, 31.5% sodium chloride, 13% copper sulphate and 0.5% drying agent.

13. The flame colorant device of claim 10 wherein the one or more inorganic metal salts are in the form of similarly sized particles.

14. The flame colorant composition of claim 13, wherein the average diameter of each particle does not exceed 0.16 centimeters (0.0625 inches).

15. The flame colorant device of claim 10, wherein the drying agent is Micro-Cell E silica.

16. The flame colorant device of claim 10, wherein the sealable package comprises an easily combustible outer layer and an inner vapour-barrier layer.

17. The flame colorant device of claim 16, wherein the outer layer comprises paper.

18. The flame colorant device of claim 17 wherein the inner layer comprises a polyethylene liner.

19. A method of producing the flame colorant device of claim 8 comprising the following steps:
   obtaining industrial quantities of one or more of the at least one inorganic metal salts;
   grinding the inorganic metal salts in a grinder to obtain a desired average particle size;
   creating a mixture by combining the inorganic metal salt particles and the drying agent according to desired percentages by weight;
   using a sealing machine to insert portions of the mixture into a sealable package;
   and
   sealing the sealable package.

20. The method of claim 19, wherein the desired average particle size does not exceed 0.16 centimeters (0.0625 inches).

* * * * *