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# POLYMER COMPOSITIONS

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U.S. Cl. 260—80.78 12 Claims

## ABSTRACT OF THE DISCLOSURE

An antistatic agent composition for polymeric materials comprises a major proportion by weight of an alkyl or aryl or alkaryl sulphonate and a minor proportion by weight of an alkyl alkanolamide or a hydroxypolyalkoxyamide.

This invention relates to antistatic agent compositions for polymeric materials, and to polymer compositions containing them.

It is known to reduce the tendency of polyolefines to acquire charges of static electricity by incorporating into the polyolefine from 0.01% to 5% by weight of the polyolefine of an hydroxy polyalkoxyamide antistatic agent such as

(i) an N-(hydroxyalkylated) fatty acid amide,
(ii) an alkylene oxide condensate of a fatty acid amide,
(iii) an alkylene oxide condensate of an N-(hydroxyalkylated) fatty acid amide, or
(iv) a mixture of two or more compounds selected from the first three classes,

the fatty acid amide containing from 6 to 22 carbon atoms. It is also known to reduce the tendency of polyethylene to accumulate electrostatic charges by the incorporation of an ethanolamide of lauric acid.

It is also known that an alkyl sulphonate having an alkyl chain length of 4–30 carbon atoms or an alkyl benzene sulphonate having an alkyl chain length of 4–30 carbon atoms or a sulphonate of a polynuclear or condensed aromatic ring system with 1–2 alkyl groups having a chain length of 1–4 carbon atoms or a mixture of said sulphonates can act as antistatic agents for styrene polymers.

It has been found that the use of the above mentioned antistatic agents has certain disadvantages. For example, antistatic agents such as lauric diethanolamide when used in a sufficient loading to achieve the desired antistatic properties bring about a substantial reduction in the softening point of polystyrene. This reduction in softening point necessitates an increase in the time required for injection moulding articles owing to the necessity of increasing the cooling time in the injection moulding cycle. The heat resistance of the moulded articles is also reduced. The use of an antistatic agent such as sodium dodecyl benzene sulphonate, although giving the desired antistatic properties, often leads to discoloured mouldings. This latter type of antistatic additive is usually less effective as a lubricant, that is, in promoting the flow of the molten material during moulding operations, than an additive such as lauric diethanolamide.

An object of the present invention is to provide antistatic agent compositions which overcome the disadvantages of the antistatic agents referred to above.

A particular object of the present invention is to provide antistatic compositions which achieve an excellent balance between the conflicting requirements of short injection moulding cycle times, easy flow of the compositions during the moulding operations and high heat resistance of the moulded articles.



In accordance with the present invention there is provided an antistatic agent composition for polymeric materials, which composition comprises a major proportion by weight of an alkyl or aryl or alkaryl sulphonate and a minor proportion by weight of an alkyl alkanolamide or a hydroxypolyalkoxyamide. As used herein the term "a major proportion" means "greater than 50%" and "a minor proportion" means "50% or less." The invention further comprises polymer compositions containing these antistatic agent compositions.

The preferred alkyl or alryl or alkaryl sulphonates are:

(a) The alkyl sulphonates having an alkyl chain length of from 6 to 22 carbon atoms,

(b) The alkyl benzene sulphonates having an alkyl chain length of from 6 to 22 carbon atoms,

(c) The alkyl naphthalene sulphonates with one or two alkyl groups said alkyl groups each having a chain length of from 1 to 4 carbon atoms, and

(d) The sulphonate of a dinaphthyl methane, optionally bearing one or two alkyl groups each of said alkyl groups having a chain length of 1 to 4 carbon atoms.

The antistatic agent composition contains an alkanolamide or a hydroxypolyalkoxyamide of an organic acid. This acid may be aliphatic or aromatic. Preferably it is an aliphatic acid containing 6 to 22 carbon atoms, e.g. lauric acid. The alkanolamide may be a mono- or di-alkanolamide and is conveniently a mono- or di-ethanolamide. Lauric diethanolamide is the preferred alkanolamide.

The antistatic agent compositions often consist of a solution or dispersion of the sulphonate in the alkanolamide. The components thereof can however be added separately to the polymer with which they are to be used and thus the antistatic compositions are formed in situ.

The antistatic agent composition of the present invention may advantageously be used with thermoplastic polymeric materals such as those obtained by the addition polymerisation and copolymerisation of compounds containing ethylenic unsaturation. Examples of such polymeric materials are the polyolefines such as the homopolymers of ethylene and propylene and the copolymers of ethylene and propylene among themselves or with higher aliphatic $\alpha$-olefines, and the polymers derived from vinyl aromatic compounds. The antistatic agent compositions are particularly valuable when used with the latter polymers. Examples of these are polystyrene and copolymers of styrene with methyl methacrylate or acrylonitrile, including such ploymers when prepared in the presence of or subsequently mixed with rubber reinforcing materials such as for example polybutadiene and rubbery butadine/styrene copolymers.

In the preferred antistatic compositions according to the present invention the ratio of the weight of the sulphonate component to that of the amide component lies in the range 6:1 to 2:1.

The sulphonate component of the antistatic compositions may be present in the thermoplastic polymeric material over a wide range of concentrations but it is preferred that it is present in the range 0.1 to 3.0% by weight of the polymer with which the compositions is to be used. For polyethylene a preferred range is 0.1 to 0.5% whereas for polystyrene a preferred range is 1.0 to 3.0%.

The loading of antistatic additive that is necessary in an antistatic moulding composition is known to vary with such factors as the degree of protection required, the characteristics of the particular moulding operation in which it is to be used and the humidity of the atmospheric environment. However, when employing antistatic additives of the present invention for general applicability compositions based on vinyl aromatic polymers usually contain not less than about 2% by weight of the mixture of antistatic additives. An unnecessarily high loading of

the antistatic additives is to be avoided in order to minimise the changes produced in the basic properties of the thermoplastic material. Overall loadings of the antistatic additive between 2.0 and 3.5%, more particularly between 2.5 and 3.0%, are preferred.

In copending British patent application No. 46,728/66, an antistatic agent composition comprising an alkanolamide of an organic acid and, as discolouration suppressor, an oxide, hydroxide, carbonate, bicarbonate or carboxylate of ammonium or a Group I–A or Group II–A metal of the Periodic Table according to Mendeleef is disclosed. Such discolouration suppressors may be present in the antistatic agents according to the present invention in a preferred proportion by weight of 1 to 20% based on the weight of amide present. The preferred discolouration suppressors are hydroxides, carbonates, bicarbonates and stearates of sodium potassium, magnesium and calcium.

A polymeric material compounded with the antistatic agent composition of the present invention may also contain any of the conventional polymer additives for example lubricants, antioxidants, pigments and dyes.

The incorporation of the antistatic agent composition in a thermoplastic polymer is conveniently carried out by adding the antistatic agent composition when the polymer is in a molten state. When the antistatic agent composition is to be formed in situ in the polymer with which it is to be used, either component of the antistatic agent composition can be incorporated into the polymer before the other component. Suitably both components can be blended with the polymer in a mixer or in the barrel of an extruder from which the final polymer composition is to be extruded. The antistatic agent composition or any of the components thereof may be added to the polymer as a solution in a volatile solvent, e.g. water, which may be removed later e.g. at an extruder vent.

Polymer compositions containing the antistatic agent compositions according to the present invention have excellent antistatic properties and can be injection moulded at high temperatures without discolouration of the resultant mouldings. Moreover it is found that polystyrene compositions containing the antistatic agent compositions have excellent flow properties and that therefore there is no need to add conventional lubricants such as mineral oils or butyl stearate. This is a particular advantage of the compositions according to the present invention because the addition of such conventional lubricants tends to depress the softening point of the polystyrene whereas the antistatic agent compositions according to the present invention do not cause a significant reduction in the softening point of polystyrene.

The invention is further illustrated by the examples that follow:

## EXAMPLE I

A mixture (93.4 parts) of toughened polystyrene ("Styron 492D," manufactured by Distrene Limited) and a concentrate of ultramarine blue pigment in polystyrene was shaken with molten lauric diethanolamide (0.7 part). The coated polymer granules were then shaken with a powder mixture comprising sodium dodecyl benzene sulphonate (S.D.D. powder No. 1; Associated Chemical Companies Ltd.; 2.0 parts), calcium carbonate (0.2 part) silica (Manosil VN.3; Fullstoff G.m.b.H., 0.2 part) and titanium dioxide (3.5 parts). The mixture thus obtained was extruded and pelletized. By way of comparison, three polymer compositions containing, respectively, lauric diethanolamide as the sole antistatic additive (2.7 parts), sodium dodecyl benzene sulphonate as the sole antistatic additive (2.7 parts) and no anistatic additive were prepared.

The flow properties and softening points of these polymer compositions are shown in the following table:

| | | | | |
|---|---|---|---|---|
| Antistatic additive:. | | | | |
| Lauric diethanolamide, percent | 0 | 0.7 | 0 | 2.7 |
| Sodium dodecyl benzene sulphonate, percent | 0 | 2.0 | 2.7 | 0 |
| Melt flow index, A.S.T.M. D1238, condition G, grams/10 mins | 3.5 | 6.3 | 5.8 | 6.5 |
| Softening point, B.S. 2782-102C, ° C | 95.5 | 94 | 95.5 | 85.5 |

The excellent combination of ease of flow and heat resistance achieved by the use of the antistatic agent composition according to the present invention is apparent.

The polymer compositions were used to prepare wedge-shaped articles by injection moulding using a screw preplasticising machine, the barrel of which was maintained at a temperature of 260° C. Mouldings of the compositions which contained, respectively, the antistatic composition according to the present invention, lauric diethanolamide alone and no antistatic additive were all white. By contrast, the mouldings which contained sodium dodecyl benzene sulphonate as the sole antistatic additive were off-white in colour.

Subsequently, the compositions were used to prepare beaker mouldings using the same machine. The beakers were sprayed with carbon black to determine the extent of static charge on their surfaces. The beakers containing the antistatic additive mixture and sodium dodecyl benzene sulphonate as the sole antistatic additive were free from attracted dust patterns. The beakers containing lauric diethanolamide as the sole antistatic additive showed very limited dust attraction, whereas the beakers which contained no antistatic additive were covered with strong patterns of attracted dust.

## EXAMPLE 2

Using a similar technique to that described in the previous example, the same components were used to prepare a range of compositions which contained differing proportions of sodium dodecyl benzene sulphonate and lauric diethanolamide. However, in this instance, a conventional lubricant (dimethyl phthalate) was included at a loading of 1% by weight of the final composition. The properties of these compositions are shown in the following table:

TABLE

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Antistatic additive: | | | | | | | |
| Lauric diethanolamide, percent | 0 | 2.5 | 0.5 | 1.0 | 0 | 0.5 | 0 |
| Sodium dodecyl benzene sulphonate, percent | 0 | 0 | 1.5 | 1.5 | 2.0 | 2.0 | 2.5 |
| Melt flow index, A.S.T.M. D1238, condition G, grams/10 mins | 5.9 | 11.2 | 8.2 | 9.6 | 7.2 | 8.8 | 7.9 |
| Softening point, B.S. 2782 method 102C | 92.5 | 82 | 91 | 89.5 | 92 | 91.5 | 92 |
| Extent of dust pick-up (see below) | A | B | C | C | C | C | C |

NOTE.—A=Severe; B=Slight; C=Negligible.

The excellent combination of ease of flow and high heat resistance achieved by the use of the antistatic composition according to the present invention is apparent.

The polymer compositions were used to mould beaker-shaped articles under the conditions described in the previous example. The beakers were sprayed with a fine red

dye to determine the extent of static charge on their surfaces.

The extent of dust pick-up is shown in the above table.

Effective antistatic compositions with an excellent combination of ease of flow and high heat resistance are thus obtainable according to the present invention.

The use of antistatic composition according to the present invention thus leads to excellent antistatic properties without the occurrence of discolouration.

We claim:

**1.** A polymer composition consisting essentially of a member selected from the group consisting of polyolefins; polymerized vinyl aromatic compounds; polystyrene; copolymers of styrene and methylmethacrylate; copolymers of styrene and acrylonitrile, including polymerized vinyl aromatic compounds in admixture with rubber reinforcing materials in intimate admixture with an antistatic agent, the antistatic agent consisting of

(1) a sulphonate selected from the group consisting of
  (A) alkyl sulphonates having an alkyl chain length of from 6 to 22 carbon atoms;
  (B) alkyl benzene sulphonates having an alkyl chain length of from 6 to 22 carbon atoms;
  (C) alkyl naphthalene sulphonates with up to two alkyl groups, said alkyl groups each having a chain length of from 1 to 4 carbon atoms;
  (D) dinaphthyl methane sulphonates containing up to two alkyl groups, each group having a chain length of from 1 to 2 carbon atoms; and

(2) an amide, the amide being a member selected from the group consisting of amides of aliphatic acids containing from 6 to 22 carbon atoms, alkanol amides, monoalkanol amides, wherein the weight ratio of the sulphonate to the amide is from about 6:1 to about 2:1 and the sulphonate is present in an amount from about 0.1 to 3 percent by weight, based on the weight of the polymer.

**2.** A composition as claimed in claim **1** wherein the sulphonate employed is an alkyl sulphonate having an alkyl chain length of from 6 to 22 carbon atoms.

**3.** A composition as claimed in claim **1** wherein the sulphonate employed is an alkyl benzene sulphonate having an alkyl chain length of from 6 to 22 carbon atoms.

**4.** A composition as claimed in claim **1** wherein the sulphonate employed is an alkyl naphthalene sulphonate, with one or two alkyl groups, said alkyl groups each having a chain length of from 1 to 4 carbon atoms.

**5.** A composition as claimed in claim **1** wherein the sulphonate employed is a dinaphthyl methane, optionally bearing one or two alkyl groups, each of said alkyl groups having a chain length of from 1 to 4 carbon atoms.

**6.** A polymer composition as claimed in claim **1** wherein the polymer is selected from the group consisting of homopolymers of ethylene or propylene, copolymers of ethylene with propylene, and copolymers of ethylene and propylene with an aliphatic olefine having more than 3 carbon atoms.

**7.** A polymer composition as claimed in claim **1** wherein the polymer is selected from the group consisting of polystyrene or copolymers of styrene with methyl methacrylate and acrylonitrile.

**8.** A polymer composition as claimed in claim **7** wherein the polymer contains a reinforcing material selected from the group consisting of polybutadiene or rubbery copolymers of styrene and butadiene.

**9.** A polymer composition as claimed in claim **1** wherein the antistatic agent composition is present in an amount of from 2.0 to 3.5% by weight of the polymer.

**10.** A polymer composition as claimed in claim **9** wherein an oxide, hydroxide, carbonate, bicarbonate or carboxylate of ammonium or a Group I–A or Group II–A metal of the Periodic Table according to Mendeleef is present as a discolouration suppressor.

**11.** A method for preparing a polymer composition as claimed in claim **1** which method comprises adding the antistatic agent composition to the polymer while the polymer is in the molten state.

**12.** A method for preparing a polymer composition as claimed in claim **2** wherein the polymer and the antistatic agent composition are blended in a mixer, or in the barrel of an extruder from which the final polymer composition is to be extruded.

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