METHOD OF PREVENTING YELLOWSING IN FABRICS AND GARMENTS

Inventors: Robert Dewhurst, Gloucester (GB); Stephen P. Jones, Gloucester (GB)

Correspondence Address:
INVISTA NORTH AMERICA S.A.R.L.
THREE LITTLE FALLS CENTRE/1052, 2801 CENTERVILLE ROAD
WILMINGTON, DE 19808 (US)

Assignee: INVISTA NORTH AMERICA S.A.R.L., Wilmington, DE (US)

Publication Classification

Int. Cl.  
D06M 13/256  (2006.01)  
A41C 3/00  (2006.01)

U.S. Cl. 8/115,56; 524/589; 450/93

Abstract

The invention relates to methods of preventing yellowing of textiles comprising polyurethane foam and at least one phenolic antioxidant by contacting the textile with at least one aryl alkyl sulfonic acid salt and to textiles obtained by such methods.
METHOD OF PREVENTING YELLOWING IN FABRICS AND GARMENTS

FIELD OF THE INVENTION

[0001] The invention concerns, inter alia., use of aryl alkyl sulfonic acid salts to reduce yellowing caused by phenolic antioxidants in textile fabrics and garments.

BACKGROUND OF THE INVENTION

[0002] While polyurethane foam has been extensively utilized in the manufacture of brassiers and other garment parts, it has a disadvantage of yellowing as it ages. One reason for yellowing is the presence of phenolic antioxidants such as butylated hydroxyl toluene (BHT). These antioxidants can cause yellow color when exposed to environmental nitrogen oxide (NOx) gases. Such gases can result from, for example, air pollution, coal emissions, and gas furnaces. The reaction is promoted by alkaline conditions and retarded by acidic environments. The formation of the yellow colored chromophores is reversible. The BHT can revert to a colorless form if treated with an acidic rinse such as dilute acetic or citric acid. Some reports indicate that this yellow color is caused by the formation of 2,6-di-tert-butyl-1,4-quinone methide. Because the color can be aesthetically displeasing, methods of avoiding such yellow coloring are needed in the art.

SUMMARY OF THE INVENTION

[0003] In some embodiments are methods of preventing yellowing of textiles including polyurethane foam and at least one phenolic antioxidant by contacting said textile with at least one aryl alkyl sulfonic acid salt. In some embodiments, the aryl alkyl sulfonic acid salt is of Formula I:

\[ \begin{array}{c}
\text{O} \\
\text{R} \quad \text{S} \quad \text{O} \quad Z^+ \\
\text{O} 
\end{array} \]

where R is an aryl group substituted with at least one C\textsubscript{6} to C\textsubscript{18} alkyl group, such as a C\textsubscript{8} to C\textsubscript{16} alkyl group, and Z\textsuperscript{+} is a cationic counter ion. Suitable Z\textsuperscript{+} ions include alkali metal cations and alkyl ammonium salts.

[0004] Examples of aryl alkyl sulfonic acid salts that are useful in some embodiments include adducts of dodecylbenzenesulfonic acid with N,N-bis(2-hydroxyethyl)-N-methyl-(z)-9-octadecene-1-ammonium chloride, an adduct of dodecylbenzenesulfonate with 2-aminoethanol or an adduct of dodecylbenzenesulfonate with 2,2,2-nitrilotris(ethanol).

[0005] Some methods additionally comprising contacting said textile with a compound of Formula II:

\[ \begin{array}{c}
\text{O} \\
\text{R}_a \quad \text{S} \quad \text{O} \quad \text{M}^+ \\
\text{O} 
\end{array} \]

where R\textsubscript{a} and R\textsubscript{b} are each, independently, C\textsubscript{1} to C\textsubscript{18} alkyl and M is K, Na, or Li.

[0006] In some embodiments, the aryl alkyl sulfonic acid salt is contacted with the textile by applying a solution of aryl alkyl sulfonic acid salt to the textile. Some solutions have a concentration 5-30 g/l of the aryl sulfonic acid salt in an aqueous solution at pH 4-6. The solution can be applied to the textile by any known method. These methods include immersing the textile in the solution, spraying the solution onto the textile, and padding the solution onto the textile.

[0007] Another aspect of some embodiments are articles including polyurethane foam, at least one phenolic antioxidant, and at least one aryl alkyl sulfonic acid salt. Some articles form a component of a brassiere. Suitable antioxidants and aryl alkyl sulfonic acid salts include those described herein. Some compositions additionally include a compound of Formula II.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0008] In some embodiments are methods for preventing yellowing of textiles including polyurethane foam and at least one phenolic antioxidant by contacting the textile with at least one aryl alkyl sulfonic acid salt.

[0009] In some embodiments, the aryl alkyl sulfonic acid salt is of Formula I:

\[ \begin{array}{c}
\text{O} \\
\text{R} \quad \text{S} \quad \text{O} \quad Z^+ \\
\text{O} 
\end{array} \]

where R is an aryl group substituted with at least one C\textsubscript{3} to C\textsubscript{28} alkyl group, and Z\textsuperscript{+} is a cationic counter ion. Examples of R groups are aryl groups substituted with at least one C\textsubscript{3} to C\textsubscript{16} alkyl group.

[0010] Suitable Z\textsuperscript{+} ions include alkali metal cations. The alkali metal includes lithium, sodium, and potassium. In some embodiments, sodium is chosen as the alkali metal. Other suitable Z\textsuperscript{+} ions include alkyl ammonium salts. Some alkyl ammonium salts are of Formula III where R\textsubscript{c}, R\textsubscript{d}, R\textsubscript{e}, and R\textsubscript{f} are each independently H or C\textsubscript{1} to C\textsubscript{16} optionally substituted alkyl and X\textsuperscript{-} is a counter ion for the ammonium cation.

[0011] One commercial product useful in the present invention is Cibafast\textsuperscript{®} CT which is includes 2.5-5% — N,N-bis(2-hydroxyethyl)-N-methyl-(z)-9-Octadecene-1-amin chloride (EC no 242-332-0); 20-30%-Benzenesulfonic acid, dodecyl-, compound with 2-aminoethanol (1:1), and 20-30%-Benzenesulfonicacid,dodecyl-, compound, with 2,2',2'-nitrilotris (ethanol)(1:1).

[0012] Examples of useful aryl alkyl sulfonic acid salts include adducts of dodecylbenzenesulfonic acid with N,N-
bis(2-hydroxyethyl)-N-methyl-(Z)-9-octadecene-1-aminium chloride, an adduct of dodecylbenzenesulfonate with 2-aminopropanol or an adduct of dodecylbenzenesulfonate with 2,2,2-nitrotris(ethanol). Examples of combinations of useful compositions with aryl alkyl sulfonic acid salts include N,N-bis(2-hydroxyethyl)-N-methyl-(Z)-9-octadecene-1-aminium chloride benzenesulfonic acid dodecyl-compound with 2-aminoethanol (1:1); benzenesulfonic acid dodecyl-compound with 2,2,2-nitrotris (ethanol) (1:1); sulfonic acid monon(2-ethoxyethyl) ester, sodium salt; alkylbenzenesulfonic acid, triethanolamine salt; and combinations thereof.

Commercially available compositions including aryl alkyl sulfonic acid salts are available under the trade names Desperol LG available from Zschimmer and Schwarz, Cibafast® CT, available from Huntsman, Ultraphor® AUC-NV available from BASF, CHT-FASERSCHUTZ RPY SPEZ available from CHT, Umkol APR lyq, available from Clariant, Levasalt AY available from Tanax, Rucolan VG1 available from Rudolf Chemicals, and combinations thereof.

Some methods additionally include contacting the textile with a compound of Formula II:

\[
\text{II}
\]

where \( R_a \) and \( R_b \) are each, independently, \( C_1 \) to \( C_{18} \) alkyl and \( M \) is K, Na, or Li. The compound of Formula II can be in the same solution as the compound of Formula I or may be in a separate solution.

The aryalkyl sulfonic acid salt compositions (the anti-BHT compositions) may be added to polyurethane foam in any suitable manner. One useful process includes preparing a solution of about 0.1-60 g/litre equivalent to 0.01 to 6 g on weight of foam of the anti-BHT composition in water. The solution may be made up slightly acid to neutral pH 4.0-7 with any suitable acid such as citric acid or tartaric acid (a non-volatile organic acid). The solution may be applied to the foam by dipping, padding, spraying, or by combinations thereof. In the dipping process, the solution may be added to a trough, a roll of prepared foam is then passed over guide rollers and dipped through the solution and dried. In a padding application, the solution may be added to a tank that is then added or metered into a trough foam is passed through guide rollers into the trough then through squeegee rollers the amount picked up by the foam is controlled by the pressure applied by the main rollers, the amount picked up can be measured by taking simple weight measurements before and after application, the formulation concentration can be adjusted to meet the efficiency of the pick-up in the trough. In a spraying process, controlled spray units fed by storage tanks apply the anti-BHT composition evenly over the surface of the foam.

The foam is then dried by any suitable method including air drying, by heated rollers, heated air through perforated drums, infrared dryers, and combinations thereof.

In some embodiments, the aryalkyl sulfonic acid salt is contacted with the textile by applying a solution of aryalkyl sulfonic acid salt to the textile. Some solutions have a concentration 5-30 g/l of the aryalkyl sulfonic acid salt in an aqueous solution at pH 4.6. In some embodiments, the compound of Formula II is present in an amount of 1-20 g/l. The solutions are made by dissolving the aryalkyl sulfonic acid salt and optionally the compound of Formula II in water by techniques well known to those skilled in the art. The water may be used as is or purified prior to forming the solution.

In some embodiments, the phenolic antioxidant is 2,6-di-tert-butyl-4-methylphenol, also known as butylated hydroxytoluene (BHT). This product is sold commercially as an antioxidant food additive and in cosmetics, pharmaceuticals, jet fuels, rubber, petroleum products, and emulsifying fluid.

Some or more antioxidants may be used in the combination with the textiles of some embodiments. Suitable antioxidants include 2,6-di-tert-butyl-4-methylphenol, 2,6-di-tert-butyl-4-ethylphenol, 2,6-di-tert-butyl-4-hydroxyphenol, 2,2'-methylenebis(4-ethyl-6-tert-butylphenol), 2,2'-methylenebis(6-cyclohexyl-4-methylphenol), 2,2'-methylenebis(4,6-di-tert-butylphenol), 2,2'-ethylidenecbis(4,6-di-tert-butylphenol), 4,4'-methylenebis(2,6-di-tert-butylphenol), 4,4'-bisthiazolidinebis(3-methyl-6-tert-butylphenol), 2,2'-methylenebis(4-methyl-6-tert-butylphenol), 1,3,5-trimethyl-2,4,6-tris(3,5-di-tert-butyl-4-hydroxybenzyl)benzene, 4,4'-dithio(3-methyl-6-tert-butylphenol), 1,3,5-tris(4-tert-butyl-3-hydroxy-2,6-dimethylbenzyl) isocyanate and 1,3,5-tris(3,5-di-tert-butyl-4-hydroxybenzyl) isocyanate. Amongst others, 1,3,5-tris(4-tert-butyl-3-hydroxy-2,6-dimethylbenzyl) isocyanate, 1,3,5-tris(3,5-di-tert-butyl-4-hydroxybenzyl) isocyanate, 4,4'-bisthiazolidinebis(3-methyl-6-tert-butylphenol), 1,3,5-trimethyl-2,4,6-tris(3,5-di-tert-butyl-4-hydroxybenzyl) benzene and combinations thereof.

The solutions may additionally comprise additional compositions that might be useful to a particular application. Such compositions include surfactants, stabilizers, other antioxidants (such as those that prevent heat damage), softeners, finishes, and combinations thereof.

The solution can be applied to the textile by any known method. These methods include immersing the textile in the solution, spraying the solution onto the textile, and padding the solution onto the textile.

As used herein, the term "arylalkyl" unless otherwise indicated, refers to both straight- and branched-chain saturated aliphatic hydrocarbon groups having at least one carbon atom, e.g., 1 to 18 carbon atoms.

The term "aryl" refers herein to an aromatic system, e.g., of 6 to 14 carbon atoms, which may be a single ring or multiple aromatic rings fused or linked together as such that at least one part of the fused or linked rings forms the conjugated aromatic system. The aryl groups include but not limited to phenyl, naphthyl, biphenyl, anthryl, tetrahydronaphthyl, and phenanthryl.

Alkyl and aryl groups can be optionally substituted. One or more substituents may be utilized. Typical substituents include halogen, CN, OH, NO₂, amino, alkyl, cycloalkyl, alkenyl, alkynyl, alkoxy, aryloxy, substituted alkoxy, alkylcarbonyl, alkylcarboxy, alkylamino, or arylthio.

In another embodiment are articles including polyurethane foam, at least one phenolic antioxidant, and at least one aryalkyl sulfonic acid salt. Some articles may be included as components of a brassiere. Suitable antioxidants and aryalkyl sulfonic acid salts include those described herein. Some compositions additionally include a compound of Formula II.
Polyurethane is used in a wide variety of products such as for garments and in the automotive industry. The products that will benefit most from the treatment described in some embodiments are those products where the polyurethane foam is visual, in other words, where yellowing of the foam is readily apparent. Examples of such uses of polyurethane foam include garments such as brassieres and shoulder pads in ready to wear garments.

The features and advantages of the present invention are more fully shown by the following examples which are provided for purposes of illustration, and are not to be construed as limiting the invention in any way.

**EXAMPLE**

**[0027]** Test method:

**[0028]** The extensive acknowledgement of the problem concerning yellowing of polyurethane foam, Courtaulds Textiles developed a test to determine the potential of white or pastel textiles to yellow due to contamination by sterically hindered phenols (phenolic antioxidants). This text has been adopted by Marks and Spencer (a UK retailer) as well as by other retailers/garment makers as “Method C20B Elusive/Reversible Yellowing.” The textile sample to be tested is inserted between layers of a folded sheet of paper impregnated with a solution of about 0.01% DTNB. The sandwich obtained is placed on a glass plate and covered with a second glass plate. The assembly consisting of five (5) samples is wrapped airtight in polyethylene film free of BHT. The package is placed in a drying oven for 16 hours at 50°C ± 3°C, then removed and cooled to room temperature before unwrapping.

**[0029]** Since the color may fade on certain substrates, the degree of yellowing is immediately assessed with the gray scale for staining used for the determination of fastness (rating 1-5). A rating of 4 to 5 should ensure complete protection against phenolic yellowing. A result of 4 is believed to be acceptable.

**[0030]** The foam samples were obtained under the trade name BULFAST available from Recitnel Belgium. The foam samples were BULFAST T35H/4 mm compressed to 1 mm (35 kg/m²)—for harder firmer cups; BULFAST TO 51H/4 mm compressed to 1 mm (51 kg/m²)—for breathable stretch/support garments; BULFAST TO 45F/4 mm-firm cup shape; BULFAST TO 45S/4 mm-soft version of 45F; BULFAST Texo MS-high light stability and improved NOx: Optical White SS180W-50 kg m² easy to mold/reduced yellowing).

**[0031]** The Courtaulds test was performed twice for each sample, once with the untreated foam and once with a treatment described below:

**[0032]** Each sample of polyurethane foam containing BHT antioxidant was contacted with Cibafast® CT by immersing the foam in a tray of a 5-30 g/l aqueous solution of Cibafast® CT and water, neutral pH 4-7. The foam is removed from the solution and allowed to air dry.

**[0033]** For improved accuracy of the measurement, we have measured the CIE and Ganz whiteness values as all the untreated samples do not meet the standards by achieving a rating of 2.

**[0034]** The inventive articles each meet the expectations set forth in the Courtaulds test by achieving a rating of 4-5 to 5.

**[0035]** While there have been described what are presently believed to be the preferred embodiments of the invention, those skilled in the art will realize that changes and modifications may be made thereto without departing from the spirit of the invention, and it is intended to include all such changes and modifications as fall within the true scope of the invention.

What is claimed is:

1. A method of preventing yellowing of textiles comprising polyurethane foam and at least one phenolic antioxidant, said method comprising contacting said textile with at least one aryl alkyl sulfonic acid salt.

2. The method of claim 1, wherein the aryl alkyl sulfonic acid salt is of the formula:

   \[
   R - \overline{\text{O}} \rightarrow Z^+ \]

   where \( R \) is an aryl group substituted with at least one \( C_3 \) to \( C_{20} \) alkyl group; and \( Z^+ \) is a cationic counter ion.

3. The method of claim 2, wherein \( R \) is aryl group substituted with at least one \( C_3 \) to \( C_{16} \) alkyl group.

4. The method of claim 2, wherein \( Z^+ \) is an alkali metal cation or an alkyl ammonium salt.

5. The method of claim 1, wherein the aryl alkyl sulfonic acid salt is an adduct of dodecylbenzenesulfonic acid with N,N-bis-(2-hydroxyethyl)-N-methyl-1-(z)-9-octadecene-1-amin chloride, an adduct of dodecylbenzenesulfonate with 2-aminoethanol or an adduct of dodecylbenzenesulfonate with 2,2,2-nitroethanol (ethanol), and combinations thereof.

6. The method of claim 1, wherein the textile comprises at least two antioxidants.

7. The method of claim 6, wherein said antioxidant is 2,6-di-tert-butyl-4-methylphenol.

8. The method of claim 1, wherein said aryl alkyl sulfonic acid salt is contacted with said textile by applying a solution of aryl alkyl sulfonic acid salt to said textile.

9. The method of claim 9, wherein said solution has a concentration 3-50 g/l in an aqueous solution at pH 4-6.

10. The method of claim 9, wherein said textile is immersed in said solution.

11. The method of claim 9, wherein said solution is applied to said textile by spraying said solution onto said textile.

12. The method of claim 9, wherein said solution is applied to said textile by padding said solution onto the textile.

13. The method of claim 1, additionally comprising contacting said textile with a compound of the formula:

   \[
   \text{O} \rightarrow \text{M}^+ \]

   where \( R_a \) and \( R_b \) are each, independently, \( C_1 \) to \( C_{18} \) alkyl and \( M \) is \( K \), \( Na \), or \( Li \).

14. An article comprising polyurethane foam, at least one phenolic antioxidant, and at least one aryl alkyl sulfonic acid salt.

15. The article of claim 14, where the aryl alkyl sulfonic acid salt is wherein the aryl alkyl sulfonic acid salt is of the formula:

   \[
   R - \overline{\text{O}} \rightarrow Z^+ \]
where R is an aryl group substituted with at least one C₃ to C₂₀ alkyl group; and Z⁺ is a cationic counter ion.

16. The article of claim 15, wherein R is an aryl group substituted with at least one C₄ to C₁₈ alkyl group.

17. The article of claim 15, wherein Z⁺ is an alkali metal cation or an alkyl ammonium salt.

18. The article of claim 14, wherein the aryl alkyl sulfonic acid salt is an adduct of dodecylbenzenesulfonic acid with N,N-bis(2-hydroxyethyl)-N-methyl-(z)-9-octadecene-1-aminium chloride; an adduct of dodecylbenzenesulfonate with 2-aminoethanol or an adduct of dodecylbenzenesulfonate with 2,2,2-nitriltris(ethanol), and combinations thereof.

19. The article of claim 14 additionally comprising a compound of the formula:

\[
\begin{align*}
R & \quad \text{O} \\
& \quad \text{O} \\
& \quad \text{O} \\
& \quad \text{O} \\
& \quad \text{Z}^+ \\
& \quad \text{M}^+ 
\end{align*}
\]

where R is an aryl group substituted with at least one C₃ to C₂₀ alkyl group; and Z⁺ is a cationic counter ion.

20. The article of claim 14 that comprises a component of a brassiere.

21. A brassiere comprising at least one foam component, said foam component comprising polyurethane foam, at least one phenolic antioxidant, and at least one aryl alkyl sulfonic acid salt.

22. The brassiere of claim 21, wherein the aryl alkyl sulfonic acid salt is wherein the aryl alkyl sulfonic acid salt is of the formula: