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(54) **HYDROPHOBIC, ANTI-MICROBIAL INSULATION PRODUCTS AND A HYDROPHOBIC, ANTI-MICROBIAL COATING COMPOSITION FOR PREPARING THE SAME**

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(57) **ABSTRACT**

A coating composition is provided for obtaining a hydrophobic, antimicrobial product, particularly fiberglass products, wherein the coating composition contains a compound having at least one hydrophobic group and at least one group capable of interacting with a group on the surface of the product substrate, particularly with Si or OH groups on the glass fibers of the fiberglass product, and the coated products obtained thereby.

HYDROPHOBIC, ANTI-MICROBIAL INSULATION PRODUCTS AND A HYDROPHOBIC, ANTI-MICROBIAL COATING COMPOSITION FOR PREPARING THE SAME

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to insulation products having easy-release, hydrophobic and anti-microbial properties by virtue of a coating placed on the insulation material, particularly fiberglass products.

[0003] 2. Discussion of the Background

[0004] Recent studies have shown that it is possible to disinfect air by photocatalytic techniques similar to those proven successful in killing microorganisms in water. Goswandi et al, *J. Solar Energy Eng.,* 119, 92-96 (1997); Jacoby et al, *Environ. Sci. Technol.,* 32, 2650-2653 (1998). These studies are described, particularly with respect to the reaction chemistry of titanium dioxides, in a 1997 review article by Mills et al, *J. Photochem. Photobiol. A:Chem.,* 108, 1-35 (1997).

[0005] Many indoor air quality problems have been associated with bioaerosols of more than 60 different types, including bacteria, viruses and fungi causing a host of diseases and conditions, such as tuberculosis, Legionnaires' disease, influenza, mumps, measles, pneumonia and meningitis. These types of bioaerosols are also implicated in increasing incidence of asthma, upper respiratory distress syndromes and the common cold. One factor in this increase is that conventional insulation materials, filter materials, or duct liner materials are thought to provide a medium for growth of these microorganisms, thus providing a means for the bioaerosols to generate and spread throughout the HVAC system of a building. Additinoally, even when the duct surfaces are disinfected, the dead or destroyed microbes are not easily removed due to adherence to the duct liner surfaces.

[0006] Unfortunately, the use of the titanium dioxide based coatings described above in insulation materials, duct liner materials or filter materials cannot readily take advantage of the photocatalytic properties of the titanium dioxide described in the papers, since most insulation materials, duct liners and filter materials are enclosed in areas away from any suitable UV light source. Accordingly, there is a need for coatings that provide anti-microbial properties to such materials in the absence or presence of light, and which also provide the material with an easy release, hydrophobic surface to prevent adherence of the microorganisms to the surface of the material.

SUMMARY OF THE INVENTION

[0007] Accordingly, one object of the present invention is to provide a coating for insulation materials, duct liners or filter materials that reduces or prevents adherence of microorganisms to the material surface and that provides anti-microbial properties to the material surface.

[0008] A further object of the present invention is to provide a fiberglass batt having an anti-microbial coating that gives the fiberglass batt easy release and hydrophobic characteristics.

[0009] A further object of the present invention is to provide a fiberglass duct board having easy-release, hydrophobic and anti-microbial properties.

[0010] Another object of the present invention is to provide a fiberglass duct liner that prevents or reduces adherence of microorganisms onto the duct liner surface and provides anti-microbial properties.

[0011] Another object of the present invention is to provide a method for improving indoor air quality by use of the fiberglass batts, fiberglass duct boards, or fiberglass duct liners of the present invention.

[0012] These and other objects of the present invention have been satisfied by the discovery of a coated fiberglass product comprising:

[0013] a fiberglass substrate having coated at least partially thereon a coating comprising an organic silane group or long chain organic acid

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0014] The present invention relates to a coating composition for application to insulation materials, duct liner materials or filter materials, which provides the materials with easy-release, hydrophobic and anti-microbial properties, and the materials obtained by application of the coating.

[0015] The coating composition of the present invention comprises a compound having at least one hydrophobic group and at least one group having functionality capable of interacting with a group present on the surface of the substrate being coated. Suitable substrates include glass, metal or plastics, with glass substrates being preferred, and fiberglass being most preferred. Metal substrates include, but are not limited to, surfaces of metal HVAC systems, metal fiber media, etc. Glass substrates include, but are not limited to, windows, glass containers, car windows, fiberglass batts, duct board, duct liners and fiberglass filtering media. Other filtering media include the above noted metal filtering media, such as steel fiber media. When the substrate is fiberglass, the at least one group having functionality capable of interacting with a group present on the surface of the fiberglass is preferably capable of interacting with the Si or OH groups on the fiberglass substrate. Preferably, the hydrophobic group is a long chain organic group having from 14-22 carbon atoms which can be saturated or unsaturated, more preferably an alkyl group having from 16-20 carbon atoms, most preferably a C-18 alkyl group (octadecyl). Preferably, the group having functionality capable of interacting with the Si or OH groups on the fiberglass substrate is a member selected from the group consisting of halides, amino groups, hydroxy, and alkoxy. More preferably, the functional group is a halide group, most preferably chloro. The compound of the coating composition is more preferably an alkyl silyl halide, most preferably a compound selected from alkyl trihalosilanes, dialkyl dihalosilanes and trialkyl halosilanes.

[0016] In preferred embodiments, the coating composition comprises octadecyl trichlorosilane ($C_{18}H_{37}SiCl_3$), dimethyldichlorosilane $Si(CH_3)_2Cl_2$ or octadecyl acid $C_{18}H_{37}COOH$, either neat or in a suitable carrier.

[0017] The coating composition of the present invention is applied to the surface of the substrate material. While the

substrate material can be any suitable material needing antimicrobial protection, including but not limited to glass, metal and plastics, the present invention will be further described referring to fiberglass materials as the substrate. However, it is to be understood that this is exemplary only and not intended to limiting.

[0018] The coating composition is applied to the surface of the fiberglass material by any conventional application method, including, but not limited to, spraying, dipping, applicator (or kiss) roller. As noted above, the compound of the coating composition can be applied either neat or as a solution in a suitable carrier. Suitable carriers include, but are not limited to, water, organic solvents or binder compositions conventionally used in the fiberglass industry. The application of the coating composition to the fiberglass material can be performed at any stage along the fiberglass production line, so long as there are no later steps that would adversely affect the coating. The coating composition of the present invention can be added prior to the addition of binder to the fiberglass, at the same time as the binder composition, post binder addition or after curing of the binder. Preferably, the coating composition is added at the same time as the binder during the formation of fiberglass batts, between spinning of the fiberglass fibers and formation of the batts. Additionally, depending on the end use, the coating composition can be applied in the field, for example by spraying, particularly when applied to fiberglass duct liners or duct boards. The present coating composition can also be periodically reapplied in the field if desired.

[0019] The coating composition of the present invention helps prevent the attachment of microbes to the surface of the substrate, such as fiberglass fibers, duct liners or duct boards, by lowering the bio-adhesion ability of the microbe. Additionally, the hydrophobicity of the coating helps prevent the entry of water into the substrate material. This provides an additional reduction in the ability of the microbes to grow, since the microbes generally need a moist environment for growth.

[0020] The coating composition is applied to the fiberglass materials in an amount sufficient to prevent microbial attachment or growth and reduce moisture entry into the material. Preferably, the coating is applied in amount sufficient to provide the coating compound in an amount of from 1 to 20 mg/m^2, more preferably from 2 to 10 mg/m^2, most preferably about 5 mg/m^2. While it is most preferred that the coating composition cover the entire surface of the glass fibers, the present invention coating can also be effective in preventing microbial growth by covering a substantial portion of the exposed exterior surface of the fibers, preferably at least 50% of the fiber surface area, more preferably at least 75%, most preferably between 90 and 100%.

[0021] Application of the coating composition of the present invention to fiberglass materials such as fiberglass batts, fiberglass duct board or fiberglass duct liner inhibits the growth of microbes compared to uncoated fiberglass products. Accordingly, the use of the coated fiberglass products prepared with the coating of the present invention provides a method for improving indoor air quality by reducing the proliferation of microbes in HVAC systems, thereby providing safer indoor environments. This is a particular advantage in new construction, where the buildings are more well insulated and airtight.

[0022] The present invention also relates to the coated fiberglass products produced with the coating composition of the present invention. These products are preferably fiberglass, in any desired form, such as fiberglass batts, duct board, duct liners, as well as other fiberglass structures, such as filtering media, as noted above. Most preferably, the products are coated fiberglass insulation batts, duct boards or duct liners.

[0023] Obviously, additional modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described herein.

1. A coated fiberglass product, comprising:

glass fibers having thereon a coating obtained by application of a coating composition comprising a compound having at least one hydrophobic group and at least one group capable of interacting with Si or OH groups present on the glass fibers.

2. The coated fiberglass product of claim 1, wherein said at least one hydrophobic group is a long chain organic group having from 14-22 carbon atoms.

3. The coated fiberglass product of claim 2, wherein said at least one hydrophobic group is an alkyl group having from 16-20 carbon atoms.

4. The coated fiberglass product of claim 3, wherein said at least one hydrophobic group is a C-18 alkyl group.

5. The coated fiberglass product of claim 1, wherein said at least one group capable of interacting with Si or OH groups of the glass fibers is a member selected from the group consisting of halides, amino groups, hydroxy, and C1-4 alkoxy groups.

6. The coated fiberglass product of claim 5, wherein said at least one group capable of interacting with Si or OH groups of the glass fibers is a halide group.

7. The coated fiberglass product of claim 1, wherein said compound is a member selected from the group consisting of monoalkyl silyl trihalides, dialkyl silyl dihalides and trialkyl silyl monohalides.

8. The coated fiberglass product of claim 1, wherein said compound is a member selected from the group consisting of octadecyl silyl trichloride, dimethyl silyl dichloride and octadecanoic acid.

9. The coated fiberglass product of claim 1, wherein said glass fibers are in a form selected from the group consisting of fiberglass batts, fiberglass boards and fiberglass duct liners.

10. The coated fiberglass product of claim 1, wherein said coating is present in an amount of from 1 to 20 mg/m^2.

11. The coated fiberglass product of claim 10, wherein said coating is present in an amount of from 2 to 10 mg/m^2.

12. The coated fiberglass product of claim 11, wherein said coating is present in an amount of about 5 mg/m^2.

13. A method for preparation of an antimicrobial product, comprising:

applying to a surface of a substrate a coating composition comprising a compound having at least one hydrophobic group and at least one group capable of interacting with a group on said surface of said substrate.

14. The method of claim 13, wherein said substrate comprises a member selected from the group consisting of metal, glass and plastic.

15. The method of claim 14, wherein said substrate comprises glass.

16. The method of claim 15, wherein said glass is a member selected from the group consisting of fiberglass batts, fiberglass duct liners and fiberglass boards.

17. The method of claim 15, wherein said coating composition comprises a compound having at least one hydrophobic group and at least one group capable of interacting with Si or OH groups present on the glass.

18. The method of claim 13, wherein said coating composition further comprises a suitable carrier.

19. The method of claim 13, wherein said at least one hydrophobic group is a long chain saturated or unsaturated organic group having from 14-22 carbon atoms.

20. The method of claim 19, wherein said at least one hydrophobic group is an alkyl group having from 16-20 carbon atoms.

21. The method of claim 20, wherein said at least one hydrophobic group is a C-18 alkyl group.

22. The method of claim 17, wherein said at least one group capable of interacting with Si or OH groups present on the glass is a member selected from the group consisting of halides, amino groups, hydroxy, and C1-4 alkoxy groups.

23. The method of claim 22, wherein said at least one group capable of interacting with Si or OH groups present on the glass is a halide group.

24. The method of claim 13, wherein said compound is a member selected from the group consisting of monoalkyl silyl trihalides, dialkyl silyl dihalides and trialkyl silyl monohalides.

25. The method of claim 13, wherein said compound is a member selected from the group consisting of octadecyl silyl trichloride, dimethyl silyl dichloride and octadecanoic acid.

26. The method of claim 13, wherein said coating is applied in an amount of from 1 to 20 mg/m^2.

27. The method of claim 23, wherein said coating is applied in an amount of from 2 to 10 mg/m^2.

28. The method of claim 24, wherein said coating is applied in an amount of about 5 mg/m^2.

29. A method for improving air quality, comprising:

coating a fiberglass duct liner with a coating composition comprising a compound having at least one hydrophobic group and at least one group capable of interacting with Si or OH groups present on the glass fibers.

30. The method of claim 29, wherein said coating composition further comprises a suitable carrier.

31. The method of claim 29, wherein said at least one hydrophobic group is a long chain saturated or unsaturated organic group having from 14-22 carbon atoms.

32. The method of claim 31, wherein said at least one hydrophobic group is an alkyl group having from 16-20 carbon atoms.

33. The method of claim 32, wherein said at least one hydrophobic group is a C-18 alkyl group.

34. The method of claim 29, wherein said at least one group capable of interacting with Si or OH groups present on the glass fibers is a member selected from the group consisting of halides, amino groups, hydroxy, and C1-4 alkoxy groups.

35. The method of claim 34, wherein said at least one group capable of interacting with Si or OH groups present on the glass fibers is a halide group.

36. The method of claim 29, wherein said compound is a member selected from the group consisting of monoalkyl silyl trihalides, dialkyl silyl dihalides and trialkyl silyl monohalides.

37. The method of claim 29, wherein said compound is a member selected from the group consisting of octadecyl silyl trichloride, dimethyl silyl dichloride and octadecanoic acid.

38. The method of claim 29, wherein said coating composition is applied in an amount of from 1 to 20 mg/m^2.

39. The method of claim 38, wherein said coating composition is applied in an amount of from 2 to 10 mg/m^2.

40. The method of claim 39, wherein said coating composition is applied in an amount of about 5 mg/m^2.

41. The method of claim 29, wherein said coating step is performed prior to installation of said fiberglass duct liner in a HVAC system.

42. The method of claim 29, wherein said coating step is performed on a fiberglass duct liner previously installed in a HVAC system.

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