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(54) Title: A METHOD OF TREATING A POROUS SUBSTRATE OF WOOD TO INHIBIT OR REDUCE MICROBIAL GROWTH

(57) Abstract: The present invention relates to a method of treating a porous substrate of wood to inhibit or reduce microbial growth in the porous substrate, comprising the step of applying an anti-microbial composition, wherein the anti-microbial composition comprises one or more quaternary ammonium compounds and does not comprise a binder polymer or resin. The invention further relates to a wood preservative composition comprising one or more quaternary ammonium compounds, to an article comprising a porous substrate of wood treated by such method, to use of one or more quaternary ammonium compounds to inhibit or reduce microbial growth in a porous substrate of wood, and to a kit of parts comprising such wood preservative composition and a coating composition comprising a binder polymer or resin.



**A METHOD OF TREATING A POROUS SUBSTRATE**  
**OF WOOD TO INHIBIT OR REDUCE MICROBIAL GROWTH**

**Field of Invention**

5 The present invention relates to a method of treating a porous substrate of wood to inhibit or reduce microbial growth in the porous substrate by applying an anti-microbial composition, an anti-microbial composition, an article comprising a porous substrate of wood treated by such method, use of one or more quaternary ammonium compounds to inhibit or reduce microbial growth in a porous substrate of wood, and to a kit of part  
10 comprising an anti-microbial composition and a coating composition.

**Background**

Porous substrates may be susceptible to microbial growth within the substrate due to the pores of the substrate providing a suitable environment for supporting the  
15 microbes. A porous substrate treatment composition may be used to reduce or inhibit microbial growth e.g. growth of micro-organisms including but not limited to fungi (for example rot, mold or mildew), bacteria and/or viruses.

An example of a porous substrate treatment composition is a wood preservative  
20 formulation. A problem with untreated wood is the susceptibility towards blue stain fungi and wood rot. Wood rot may be caused by various fungi. Propiconazole and iodopropynyl butylcarbamate (IPBC) are currently used as active ingredients in wood preservative formulations.

25 Propiconazole is an azole fungicide, also known as a DMI, or demethylation inhibiting fungicide due to its binding to the 14-alpha demethylase enzyme and therewith inhibiting demethylation of a precursor to ergosterol. Without such demethylation step, ergosterol is not incorporated into the growing fungal cell membrane, and cellular growth is stopped. Propiconazole is used in agriculture as a systemic fungicide. It is  
30 also used in combination with permethrin in wood preservation formulations.

IPBC is a water-soluble preservative used in paints and coatings, wood preservatives, and personal care and cosmetic products. IPBC is a member of the carbamate family of biocides. IPBC was developed in the 1970s and has a long history of effective use  
35 as antifungicide. IPBC was initially developed for use in the paint and coatings industry

as a dry-film preservative to protect interior and exterior coatings from mold, mildew, and fungal growth, while also offering cost performance and sustainability benefits. Today, IPBC is incorporated into a wide variety of paint formulations around the world.

- 5    Use of propiconazole and/or IPBC is restricted in some countries due to its toxicity. Existing alternatives to propiconazole and IPBC suffer from similar toxicity issues. Wood preservative formulations comprising a combination of azole fungicides and copper compounds are also known to be effective. A disadvantage of these formulations, however, is that large quantities of toxic azoles still have to be used.

10

There is therefore a need for a porous substrate treatment composition which inhibits or reduces microbial growth in porous substrates (such as fungal growth in wood) and overcomes one or more disadvantages of the prior art.

## 15    **Summary of the Invention**

- The present invention is based in part on the recognition that an anti-microbial composition comprising a quaternary ammonium compound (also referred to as a 'quat') selected from the group of aminoalkyl(meth)acrylate polymer quats, alkoxy-  
20    lated quats, and mixtures thereof, wherein the quaternary ammonium compound comprises a C8 to C16 alkyl chain, may advantageously penetrate a porous substrate to a suitable depth to inhibit or reduce microbial growth in the porous substrate.

- Penetration of the porous substrate may be improved by the absence of a binder or resin component in the anti-microbial composition. The quaternary ammonium  
25    compound may function effectively as a biocide and/or fungicide within the porous substrate without the need for a further biocide to be present.

- In a first aspect, the invention provides a method of treating a porous substrate of wood to inhibit or reduce microbial growth in the porous substrate comprising the step of  
30    applying an anti-microbial composition to the porous substrate, wherein the anti-microbial composition comprises:

- a.    one or more quaternary ammonium compounds selected from aminoalkyl(meth)acrylate polymer quats and alkoxy-  
35    lated quats, wherein the one or more quaternary ammonium compounds comprise an aliphatic C8 to C16 alkyl group;

- b. at least one solvent selected from water and organic solvents; and
- c. optionally other additives;

wherein the anti-microbial composition does not comprise a binder polymer or resin and wherein the one or more quaternary ammonium compounds penetrate the pores of the porous substrate to inhibit or reduce microbial growth in the porous substrate.

In a second aspect the invention provides an anti-microbial composition comprising:

- a. 0.1 to 15 wt%, based on the total weight of the composition, of one or more quaternary ammonium compounds as defined in connection with the first aspect of the invention;
- b. 60 to 99.9 wt%, based on the total weight of the composition, of water;
- c. 0 to 25 wt%, based on the total weight of the composition, of organic solvent; and
- d. optionally other additives;

wherein the composition does not comprise a binder polymer or resin, and wherein the composition is a wood preservative composition suitable for treating a porous substrate of wood to inhibit or reduce microbial growth in the porous substrate, and wherein the composition does not comprise any further anti-microbial compounds in addition to the quaternary ammonium compound(s).

In a third aspect the invention provides an article comprising a porous substrate of wood to an article comprising a porous substrate of wood treated by a method according to the first aspect of the invention.

In a fourth aspect the invention provides use of one or more quaternary ammonium compounds as defined in connection with the first aspect of the invention to inhibit or reduce microbial growth in a porous substrate of wood, wherein the one or more quaternary ammonium compounds are applied to the porous substrate in a composition which does not comprise a binder polymer or resin.

In a fifth aspect, the invention provides a kit of part comprising a wood preservative composition according to the second aspect of the invention and a coating composition comprising a binder polymer or resin.

Any aspect of the invention may include any of the features described herein with regard to that aspect of the invention or any other aspects of the invention.

### **Detailed Description of the Invention**

- 5 It will be understood that any upper or lower quantity or range limit used herein may be independently combined.

10 It will be understood that, when describing the number of carbon atoms in a substituent group (e.g. 'C1 to C6'), the number refers to the total number of carbon atoms present in the substituent group, including any present in any branch group. Additionally, when describing the number of carbon atoms in for example fatty acids, this refers to the total number of carbon atoms including the one at the carboxylic acid, and any present in any branch group.

- 15 Many of the chemicals which may be used to produce the present invention are obtainable from natural sources. Such chemicals typically include a mixture of chemical species due to their natural origin. Due to the presence of such mixtures, various parameters defined herein can be an average value and may be non-integral.

20 The term "biocide" or "anti-microbial" refers to the capability of killing, inhibiting the growth of, or controlling the growth of microorganisms. The term "microorganism" includes, for example, fungi (such as rot fungi, mold, mildew or yeast), bacteria, viruses and algae.

25 Reference herein to a wood preservation composition is to a product used for the preservation of wood, from and including the saw-mill stage, or wood products by the control of wood-destroying or wood-disfiguring organisms (in particular fungi such as wood-rot fungi or mildew), including insects. This definition is in accordance with the definition of 'wood preservative' in regulation (EU) No 528/2012 of the European  
30 Parliament of the council of 22 May 2012 concerning the making available on the market and use of biocidal products (see page L167/106). Product-type 8 of this regulation concerns wood preservatives. This product-type includes both preventive and curative products.

35 (Meth)acrylate means methacrylate or acrylate.

Method of treating a porous substrate

The method according to the invention is a method of treating a porous substrate of wood to inhibit or reduce microbial growth in the porous substrate and comprises

- 5 applying an anti-microbial composition to the porous substrate. The anti-microbial composition (also referred to as wood preservative composition) comprises:
- a. one or more quaternary ammonium compounds selected from aminoalkyl(meth)acrylate polymer quats and alkoxyated quats, wherein the one or more quaternary ammonium compounds comprise an aliphatic C8 to C16  
10 alkyl group;
  - b. at least one solvent selected from water and organic solvents; and
  - c. optionally other additives.

15 The anti-microbial composition to be applied may be in any suitable form, for example in the form of an aqueous solution, an emulsion, an oil agent, or a paste.

The anti-microbial composition may be applied to the porous substrate in any suitable way. Suitable ways of application include, but are not limited to, spraying, dipping, soaking, immersing, vacuum impregnation, pressure treatment, brushing, and rolling.

20

The anti-microbial composition may be applied in a so-called pressure process, in which pressure or vacuum is applied. In a pressure process, a deeper and more uniform penetration and a higher absorption of the anti-microbial composition is typically achieved. Another advantage is that the treating conditions can be controlled  
25 so that retention and penetration can be varied. These pressure processes can be adapted to large-scale production. The high initial costs for equipment and the energy costs are the biggest disadvantages. The various pressure processes that are used today are carried out in cylinders. The timbers are loaded into the cylinder comprising the anti-microbial composition. These cylinders are then set under pressure often at  
30 elevated temperature. As final treatment, a vacuum is often applied to extract excess anti-microbial composition. These cycles can be repeated to achieve better penetration.

Preferably, the anti-microbial composition is applied by a pressure injection method, since in such method the anti-microbial composition can penetrate deeper into the wood and thus results in a better protection of the wood.

- 5 Preferably, the one or more quaternary ammonium compounds penetrate the porous substrate of wood to a depth of at least 0.2 mm, e.g. at least 0.4 mm, 0.6 mm, 0.8 mm or even at least 1.0 mm. More preferably, the quaternary ammonium compound(s) penetrate the porous substrate of wood to a depth of at least 1.4 mm, even more preferably at least 1.6 mm, still more preferably particularly at least 2.0 mm, desirably  
10 at least 2.2 mm. In one embodiment, the one or more quaternary ammonium compounds may have penetrated the porous substrate of the article to a depth of at least 2.4 mm, e.g. at least 3.0 mm, preferably at least 4.0mm.

- Penetration of the one or more quaternary ammonium compounds into the pores of the  
15 porous substrate can be achieved by allowing the anti-microbial composition to enter the pores under atmospheric pressure or by applying a vacuum or elevated pressure to enhance penetration (achieve deeper penetration).

- In order to obtain proper protection, the anti-microbial composition should penetrate the  
20 substrate and hence not form a continuous solid film layer on the surface of the porous substrate. This is in contrast with paint or lacquers compositions that comprise a film-forming binder polymer or resin to form a coating film. Therefore, the anti-microbial composition does not comprise a binder polymer or resin. As a consequence, the anti-microbial composition does not form a continuous solid film layer on the surface of the  
25 porous substrate.

- Preferably the method further comprises the step of applying a coating composition after applying the anti-microbial composition, wherein the coating composition comprises a binder polymer or resin. More preferably, the coating composition is  
30 applied after allowing the anti-microbial composition to dry. The coating composition may advantageously reduce the rate of leaching of the one or more quaternary ammonium compounds out of the substrate. The coating composition may form a protective coating on the substrate. The coating composition may cure to form a protective coating on the substrate.

35

The coating composition comprises a binder polymer or resin. Any suitable binder polymer or resin may be used, preferably a binder polymer or resin selected from:

(i) Crosslinkable polymers derived from aldehydes on the one hand and phenols, ureas and melamines on the other hand, such as phenol/formaldehyde resins,

5 urea/formaldehyde resins and melamine/formaldehyde resins;

(ii) Drying and nondrying alkyd resins;

(iii) Unsaturated polyester resins derived from copolyesters of saturated and unsaturated dicarboxylic acids with polyhydric alcohols and vinyl compounds as crosslinking agents, and also halogen-containing modifications thereof of low

10 flammability;

(iv) Crosslinkable acrylic resins derived from acrylates, acrylamides or substituted acrylates, for example epoxy acrylates, urethane acrylates or polyester acrylates, preferably comprising no quaternary ammonium groups;

(v) Crosslinkable alkyd resins, polyester resins, polyether resins and acrylate resins

15 crosslinked with melamine resins, urea resins, polyisocyanates or epoxy resins; and

(vi) Crosslinkable epoxy resins derived from polyepoxides, for example from bisglycidyl ethers or from cycloaliphatic diepoxides.

Preferably, the coating composition comprises a polyurethane, epoxy, alkyd and/or  
20 acrylic binder, more preferably an alkyd and/or acrylic binder. Preferably the acrylic binder comprises no quaternary ammonium groups.

The coating composition may be applied at any suitable temperature, preferably at a temperatures ranging from about 0°C to about 50°C, more preferably from 10°C to  
25 40°C. Preferably the coating composition is curable at ambient temperature (e.g. 20°C to 30°C).

Preferably the coating composition forms a continuous solid film layer on the surface of the porous substrate.

30

Preferably the step of applying the anti-microbial composition to the porous substrate comprises applying at least 0.1 grams of quaternary ammonium compound per m<sup>2</sup> of substrate (g/m<sup>2</sup>), more preferably applying at least 0.5 g/m<sup>2</sup>, particularly applying at least 1 g/m<sup>2</sup>, desirably applying at least 1.5 g/m<sup>2</sup>. Preferably the step of applying the  
35 anti-microbial composition to the porous substrate comprises applying at most 20

grams of quaternary ammonium compound per m<sup>2</sup> of substrate (g/m<sup>2</sup>), more preferably applying at most 15 g/m<sup>2</sup>, particularly applying at most 10 g/m<sup>2</sup>, desirably applying at most 5 g/m<sup>2</sup>. In one embodiment of the invention, the step of applying the anti-microbial composition to the porous substrate comprises applying between 1.1 and 3.1 grams of quaternary ammonium compound per square meter of substrate.

In one embodiment the step of applying the anti-microbial composition to the porous substrate comprises applying at least 40 g/m<sup>2</sup> (grams of composition per square meter of porous substrate), e.g. applying at least 60 g/m<sup>2</sup> or at least 90 g/m<sup>2</sup>. In still another embodiment less than 200 grams of composition, e.g. less than 180 grams or even less than 150 grams is applied per square meter of substrate. Preferably, the anti-microbial composition is applied to the porous substrate in an amount between 80 and 200 g/m<sup>2</sup>, more preferably between 100 and 180 g/m<sup>2</sup>, even more preferably between 120 and 170 g/m<sup>2</sup>.

15

#### Quaternary ammonium compound

The anti-microbial composition comprises one or more quaternary ammonium compounds (also referred to as 'quats') comprising an aliphatic C8 to C16 alkyl group. The one or more quaternary ammonium compounds are selected from aminoalkyl(meth)acrylate polymer quats and alkoxylated quats.

20

#### *Aminoalkyl(meth)acrylate polymer quat*

The aminoalkyl(meth)acrylate polymer quat is obtainable from one or more aminoalkyl(meth)acrylate monomers at least partially quaternized by a quaternizing agent. Quaternization of at least part of the monomers preferably takes place prior to polymerization of the monomers to an aminoalkyl(meth)acrylate polymer. The aliphatic C8 to C16 alkyl group in the aminoalkyl(meth)acrylate polymer quat are preferably provided by the quaternizing agent.

25

The aliphatic C8 to C16 alkyl group preferably has at least 9 carbon atoms, more preferably at least 10, even more preferably at least 11, desirably at least 12 carbon atoms. The aliphatic C8 to C16 alkyl group preferably has at most 15 carbon atoms, preferably at most 14 carbon atoms. The alkyl group preferably is linear. The alkyl group preferably is saturated.

30  
35

The quaternizing agent used to form the aminoalkyl(meth)acrylate polymer quat may be selected from organic sulphates, nitrates, phosphates, acetates or halides comprising an aliphatic C8 to C16 alkyl group. Preferably the quaternizing agent is an aliphatic C8 to C16 alkyl halide, more preferably a C8 to C16 alkyl chloride or bromide.

- 5 Even more preferably the quaternizing agent is a C11 to C15 alkyl bromide. A particularly preferred quaternizing agent comprises or is bromo-tetradecane.

- The aminoalkyl(meth)acrylate polymer quats may be formed from one or more aminoalkyl(meth)acrylate monomers. The aminoalkyl(meth)acrylate monomer are  
10 preferably selected from tert-butylaminoethyl(meth)acrylate (tBAEMA), dimethylaminoethyl(meth)acrylate (DMAEMA), diethylaminoethyl(meth)acrylate (DEAEMA), dimethylaminopropyl(meth)acrylate (DAPMA) and diethylaminopropyl(meth)acrylate (DEAPMA). More preferably the monomers are selected from tert-butylaminoethyl(meth)acrylate (tBAEMA),  
15 dimethylaminoethyl(meth)acrylate (DMAEMA) and diethylaminoethyl(meth)acrylate (DEAEMA), even more preferably from dimethylaminoethyl(meth)acrylate (DMAEMA) and diethylaminoethyl(meth)acrylate (DEAEMA). The aminoalkyl(meth)acrylate polymer quat may be formed from one or more types of monomer (copolymer), preferably from one type of monomer (homopolymer). The aminoalkyl(meth)acrylate  
20 polymer quat thus may be a homopolymer or a copolymer, preferably a homopolymer. The aminoalkyl(meth)acrylate polymer quat is preferably a homopolymer obtainable by polymerizing at least partially quaternized DMAEMA.

- The aminoalkyl(meth)acrylate polymer quat preferably does not comprise monomers  
25 other than aminoalkyl(meth)acrylate monomers or quaternized aminoalkyl(meth)acrylate monomers. The percentage of amine groups in the aminoalkyl(meth)acrylate polymer quat that have been quaternized into quaternary ammonium cations (% cationic active) is preferably at least 30%, more preferably at least 40%, even more preferably at least 50%, particularly at least 52%. The %  
30 cationic active is preferably at most 80%, more preferably at most 75%, even more preferably at most 70%, particularly at most 68%. The % cationic active may be measured according to ISO 2871- part 1.

- The aminoalkyl(meth)acrylate polymer quat is not a binder polymer or resin, i.e. it has  
35 no film-forming properties.

The molecular weight of the aminoalkyl(meth)acrylate polymer quat may be measured by gel permeation chromatography (GPC). Suitable GPC settings are described in the Examples. The weight average molecular weight (Mw) of the aminoalkyl(meth)acrylate polymer quat preferably is at least 20,000 g/mole, more preferably at least 50,000, even more preferably at least 75,000, particularly preferably at least 100,000, desirably at least 120,000, especially at least 150,000 as measured by GPC. The weight average molecular weight of the aminoalkyl(meth)acrylate polymer quat preferably is at most 300,000 g/mol as measured by GPC. The number average molecular weight (Mn) of the aminoalkyl(meth)acrylate polymer quat preferably is at least 10,000 g/mole, more preferably at least 20,000, even more preferably at least 40,000, particularly preferably at least 60,000, as measured by GPC. The number average molecular weight of the aminoalkyl(meth)acrylate polymer quat preferably is at most 150,000 g/mole as measured by GPC. The polydispersity index (PDI) of the aminoalkyl(meth)acrylate polymer quat (calculated as Mw/Mn) preferably is at least 1.5, more preferably at least 1.8, even more preferably at least 2, particularly at least 2.2, desirably at least 2.4. The polydispersity index of the aminoalkyl(meth)acrylate polymer quat preferably is at most 10, more preferably at most 8, even more preferably at most 6.

#### 20 *Alkoxyated quat*

The alkoxyated quat preferably comprises a core quaternary ammonium group which has pendant groups which comprise:

- i) an aliphatic C8 to C16 alkyl group; and
- ii) a hydroxyl terminated group, wherein the hydroxyl terminated group comprises from 1 to 10 alkylene oxide residues.

The aliphatic C8 to C16 alkyl group may have at least 9 carbon atoms, preferably at least 10, more preferably at least 11, desirably at least 12 carbon atoms. The aliphatic C8 to C16 alkyl group may have at most 15 carbon atoms, preferably at most 14. The group may be linear. The group may be saturated. The aliphatic C8 to C16 alkyl group may be R<sup>1</sup> in formula (I).

The alkoxyated quat may comprise a core quaternary ammonium group which has pendant groups which comprise two independent hydroxyl terminated groups ii),

wherein each hydroxyl terminated group ii) independently comprises from 1 to 10 alkylene oxide residues.

The or each hydroxyl terminated group ii) comprises from 1 to 10 alkylene oxide  
 5 residues. The alkylene oxide residues in each group are typically present as a polyalkylene oxide chain. Each polyalkylene oxide chain preferably has the formula: - $(C_rH_{2r}O)_q$ - where q is the number of alkylene oxide residues in the chain; and r is 2, 3 or 4, preferably 2 or 3 - i.e. an ethyleneoxy (-C<sub>2</sub>H<sub>4</sub>O-) or propyleneoxy (-C<sub>3</sub>H<sub>6</sub>O-) group. There may be different alkylene oxide residues along each polyalkylene oxide chain. It  
 10 is desirable that each polyalkylene oxide chain is a homopolymeric ethylene oxide chain. Alternatively, the chain is a homopolymeric chain of propylene oxide residues or a block or random copolymer chain containing both ethylene oxide and propylene oxide residues. The amount of ethylene oxide residues based on the total alkylene oxide residues in the alkoxyated quat preferably is at least 50 mole%, more preferably at  
 15 least 70 mole%, even more preferably at least 80 mole%. The amount of ethylene oxide residues based on the total alkylene oxide residues in the alkoxyated quat may be up to 100 mole%.

The average number of alkylene oxide residues in each polyalkylene oxide chain of the  
 20 quaternary ammonium compound, i.e. the value of parameter q, or the independent values of m and n in formula (I), is preferably in the range from 1 to 10, more preferably from 1 to 8, particularly from 2 to 6, desirably from 2 to 4.

The total number of alkylene oxide residues in the alkoxyated quat, i.e. the sum of m+n  
 25 in formula (I), is preferably at least 2, more preferably at least 3, even more preferably at least 4, still more preferably at least 5. The total number of alkylene oxide residues in the alkoxyated quat is preferably at most 16, more preferably at most 14, even more preferably at most 12, still more preferably at most 10, especially at most 8.

30 In a preferred embodiment, the alkoxyated quat comprises from 2 to 20 alkylene oxide residues in total in the compound and the alkylene oxide residues are selected from ethylene oxide and propylene oxide.

The alkoxyated quat preferably comprises from 1 to 4 quaternary ammonium groups.  
 35 The alkoxyated quat may comprise from 2 to 4 quaternary ammonium groups. Two

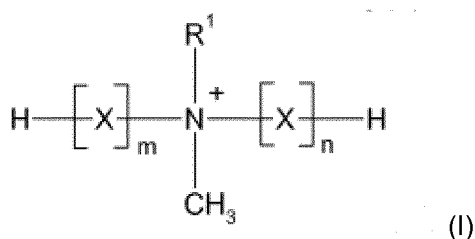
quaternary ammonium groups in the alkoxyated quat may be connected via a divalent linking group which is pendant to both quaternary ammonium groups.

The core quaternary ammonium group of the alkoxyated quat preferably has a further  
 5 pendant group iii) which comprises a C1 to C8 hydrocarbonyl group, more preferably a C1 to C6 alkyl group, even more preferably a C1 to C4 alkyl group, still more preferably a methyl group.

The quaternising agent used to form the alkoxyated quat may be selected from organic  
 10 sulphates, nitrates, phosphates, acetates or halides, preferably organic halides, particularly alkyl halides. The quaternising agent may comprise methyl chloride or bromide, preferably methyl chloride.

Preferably, the alkoxyated quat is of formula (I):

15



wherein:

20 R<sup>1</sup> is an aliphatic C8 to C16 alkyl group;  
 m and n independently have a value from 1 to 10, preferably from 1 to 8, particularly preferably from 2 to 6;  
 the sum of m + n is from 2 to 16; and  
 each X is independently selected from an ethylene oxide residue terminating at -O and a propylene oxide residue terminating at -O; such that the compound of  
 25 formula (I) comprises two terminal hydroxyl groups.

The features and preferences described herein for the alkoxyated quat are also features and preferences applicable to formula (I).

30 The % cationic active of the alkoxyated quat may be measured according to ISO 2871-part 1. The % cationic active preferably is at least 50%, more preferably at least 60%,

even more preferably at least 70%, still more preferably at least 80%. The % cationic active preferably is at most 95%.

5 The anti-microbial composition preferably comprises at least 0.1 wt% of the one or more quaternary ammonium compounds, more preferably at least 0.2 wt%, even more preferably at least 0.5 wt%, still more preferably at least 1 wt%, desirably at least 2 wt%, especially at least 3 wt% on the basis of the total weight of the anti-microbial composition. The anti-microbial composition preferably comprises at most 10 wt% of the one or more quaternary ammonium compounds, more preferably at most 8 wt%,  
10 even more preferably at most 6 wt%, still more preferably at most 4 wt%, desirably at most 2 wt% on the basis of the total weight of the composition.

The anti-microbial composition preferably comprises at least one quaternary ammonium compound selected from aminoalkyl(meth)acrylate polymer quats and at  
15 least one quaternary ammonium compound selected from alkoxylated quats, wherein each quaternary ammonium compound comprises an aliphatic C8 to C16 alkyl group.

The weight ratio of aminoalkyl(meth)acrylate polymer quats to alkoxylated quats in the anti-microbial composition preferably is at most 10:1, more preferably at most 8:1, even  
20 more preferably at most 4:1, particularly at most 2:1, desirably at most 1:1. The weight ratio of aminoalkyl(meth)acrylate polymer quats to alkoxylated quats in the anti-microbial composition preferably is at least 0.1:1, more preferably at least 0.2:1, even more preferably at least 0.4:1, particularly at least 0.8:1, desirably at least 1:1.

#### 25 Solvent

The anti-microbial composition comprises at least one solvent selected from water and organic solvent.

30 Preferably, the anti-microbial composition comprises at least 50 wt% water, more preferably at least 60 wt% water, even more preferably at least 75 wt% water, still more preferably at least 80 wt% water, especially at least 85 wt% water, based on the total weight of the composition.

35 The weight ratio of water to quaternary ammonium compound in the anti-microbial composition preferably is at most 40:1, more preferably at most 30:1, even more

preferably at most 20:1, particularly at most 10:1. The weight ratio of water to quaternary ammonium compound in the anti-microbial composition preferably is at least 1:1, more preferably at least 2:1, even more preferably at least 4:1, particularly at least 6:1, desirably at least 8:1, especially at least 10:1.

5

The anti-microbial composition may comprise one or more organic solvents. The organic solvent preferably is a polar solvent. More preferably, the organic solvent is selected from the group consisting of glycols, esters and alcohols, even more preferably selected from glycols and alcohols, still more preferably selected from glycols.

10

The weight ratio of organic solvent to quaternary ammonium compound in the anti-microbial composition may be at most 10:1, preferably at most 5:1, more preferably at most 4:1, particularly at most 3:1. The weight ratio of organic solvent to quaternary ammonium compound in the anti-microbial composition may be at least 0.5:1, preferably at least 1:1, more preferably at least 1.2:1, particularly at least 1.4:1, desirably at least 1.5:1.

15

Preferably the organic solvent comprises one or more glycols. Preferably the organic solvent comprises a polyalkylene glycol, more preferably polyethylene glycol. Preferably the organic solvent comprises an alkyldiglycol, more preferably butyldiglycol.

20

The glycol solvent may be selected from the group consisting of ethylene glycol, diethylene glycol, triethylene glycol, polyethylene glycol (PEG), propylene glycol, dipropylene glycol, tripropylene glycol, polypropylene glycol (PPG) and alkyldiglycols, preferably selected from polyethylene glycol, polypropylene glycol and alkyldiglycols, more preferably selected from polyethylene glycol and alkyldiglycols.

25

The weight ratio of polyalkylene glycol to quaternary ammonium compound in the anti-microbial composition may be at most 10:1, preferably at most 5:1, more preferably at most 4:1, particularly at most 3:1. The weight ratio of organic solvent to quaternary ammonium compound in the anti-microbial composition may be at least 0.5:1, preferably at least 1:1, more preferably at least 1.2:1, particularly at least 1.4:1, desirably at least 1.5:1.

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The ester solvent may be selected from the group consisting of amyl acetate, dibasic ester, ethyl acetate, 2-ethyl hexyl acetate, ethyl propionate, acetate esters, isobutyl acetate, isobutyl isobuterate, isopropyl acetate, n-butyl acetate, n-butyl propionate, n-pentyl propionate, and n-propyl acetate.

5

The alcohol solvent may be selected from the group consisting of amyl alcohol, benzyl alcohol, cyclohexanol, ethyl alcohol, 2-ethyl hexanol, isooctyl alcohol, isodecyl alcohol, tridecyl alcohol, furfuryl alcohol, isobutyl alcohol, methanol, methyl amyl alcohol, methyl isobutyl carbinol (MIBC), n-butyl alcohol, n-propyl alcohol, secondary butyl alcohol, tertiary butyl alcohol, and tetrahydrofurfuryl alcohol.

10

The anti-microbial composition preferably comprises from 0 to 24.9 wt%, based on the total weight of the composition, of organic solvent. The anti-microbial composition may comprise at least 0.1 wt% of organic solvent, preferably at least 1 wt%, more preferably at least 2 wt%, particularly at least 4 wt%, desirably at least 8 wt% based on the total weight of the composition. The anti-microbial composition may comprise at most 24.9 wt% of organic solvent, preferably at most 22 wt%, more preferably at most 20 wt%, particularly at most 15 wt%, desirably at most 10 wt%.

15

The anti-microbial composition may consist of the one or more quaternary ammonium compounds, water and the organic solvent.

20

#### No binder polymer or resin

The anti-microbial composition does not comprise a binder polymer or resin. The one or more quaternary ammonium compounds used in the method according to the invention do not have film-forming properties and are not a binder polymer or resin.

25

#### Optional other additives

The anti-microbial composition may comprise one or more optional other additives.

30

These additives may be selected from pigments, dyes, catalysts, rheology modifiers, wetting agents, defoamers, stabilisers, fillers, emulsifiers, dispersants and other surfactants.

The anti-microbial composition may comprise a pigment. Examples of organic pigments are azo pigments, phthalocyanine, quinacridone. Examples of inorganic pigments are iron oxide pigments, titanium dioxide and carbon black.

- 5 The anti-microbial composition may comprise a dye. Examples of dyes are azo, azine, anthraquinone, acridine, cyanine, oxazine, polymethine, thiazine and triarylmethane dyes. These dyes may be employed as basic or cationic dyes, metal complex, reactive, acid, sulfur, coupling or substantive dyes.

- 10 The anti-microbial composition may comprise at least one pigment or dye. In an alternative embodiment, the anti-microbial composition may comprise no pigment or dye.

- The anti-microbial composition may comprise a stabiliser. Suitable stabilizers include
- 15 materials which stabilize the viscosity of the anti-microbial composition during its production, storage and application, and include monofunctional carboxylic acid chlorides and non-corrosive inorganic acids. Examples of such stabilizers are benzoyl chloride, phosphoric acid or phosphorous acid. In addition, suitable hydrolysis stabilizers include for example the carbodiimide type. Stabilizers which are
- 20 antioxidants or UV absorbers may also be used. Examples of such stabilizers are HALS hindered amine light stabilisers, hydrogen-donating antioxidants such as hindered phenols and secondary aromatic amines, benzofuranone, oxanilides, benzophenones, benzotriazoles and UV absorbing pigments.

- 25 The anti-microbial composition may comprise a surfactant. Suitable surfactants include silicone surfactants such as dimethylpolysiloxane, polyoxyalkylene polyol-modified dimethylpolysiloxane and alkylene glycol-modified dimethylpolysiloxane; and anionic surfactants such as fatty acid salts, sulphuric acid ester salts, phosphoric acid ester salts and sulphonates. Preferably the anti-microbial composition comprises at least
- 30 one surfactant selected from anionic surfactants and non-ionic surfactants.

The anti-microbial composition may comprise a filler. Suitable fillers include inorganic fillers such as clay, chalk, and silica.

The anti-microbial composition may comprise at least 0.5 wt%, preferably at least 1 wt%, particularly at least 2 wt% of such other additives, based on the total weight of the composition. The anti-microbial composition may comprise at most 15 wt%, preferably at most 10 wt%, particularly at most 6 wt%, desirably at most 4 wt% of such other  
 5 additives, based on the total weight of the composition.

#### Anti-microbial composition

Preferably the anti-microbial composition comprises:

- a. 0.1 to 15 wt%, based on the total weight of the composition, of one or  
 10 more quaternary ammonium compounds as defined hereinabove;
  - b. 60 to 99.9 wt%, based on the total weight of the composition, of water;
  - c. 0 to 25 wt%, based on the total weight of the composition, of organic solvent; and
  - d. optionally other additives
- 15 wherein the composition does not comprise a binder polymer or resin and wherein the composition is suitable for treating a porous substrate to inhibit or reduce microbial growth in the porous substrate. Preferably the composition does not comprise any further anti-microbial compounds in addition to the one or more quaternary ammonium compounds.

20

#### Porous substrate of wood

The term "porous substrate of wood" refers to a wooden substrate (e.g. to a wooden material such as timber, lumber, logs of wood, wooden planks or other wooden articles such as poles, stakes or fencing material) or to an engineered wood product (also  
 25 referred to as wood-based composite material) such as for example plywood, glulam (glued laminated timber), laminated veneer lumber, medium density fiber board, particle board (also referred to a low density fiber board or chipboard).

Wooden materials and engineered wood products are known to have pores. A pore is a  
 30 minute opening in the substrate through which small molecules like gases, liquids, or microscopic particles may pass. A solution that is applied to the wood may enter into the pores of a wooden substrate or of an engineered wood product. Compounds dissolved in the solution may enter the wood pores simultaneously. Penetration may be enhanced by applying pressure or vacuum as discussed elsewhere herein.

35

Any porous substrate of wood may benefit from treatment with the method of the invention. The porous substrate of wood may be made of any type of wood. The method according to the invention is particularly suitable for porous substrates of wood which are made of types of wood that are susceptible to blue stain fungi and /or wood  
 5 rot, in particular pine, larch, meranti, and spruce.

#### Treated article

The present invention also provides an article comprising a porous substrate of wood treated by a method according to the first aspect of the invention.

10

The article may be any article of wood, of engineered wood or comprising wood or engineered wood. Preferred articles are sawn timber, planks, building material, doors, door frames, window frames, garden furniture, fence poles or other fence materials, decking, cladding, telegraph poles, or wooden stakes.

15

#### Use of the quats to inhibit or reduce microbial growth in a porous substrate

The invention provides the use of one or more quaternary ammonium compounds as defined hereinabove to inhibit or reduce microbial growth in a porous substrate and wherein the one or more quaternary ammonium compounds are applied to the porous  
 20 substrate in a composition which does not comprise a binder polymer or resin.

As explained above, a coating composition being applied to the porous surface after the application of the anti-microbial composition may reduce or prevent leaching of the quat from the porous material. Accordingly, in another aspect the invention relates to a  
 25 kit of parts comprising the wood preservative composition of the invention and comprising a coating composition comprising a binder polymer or resin.

In one embodiment, the reference to "inhibit or reduce microbial growth" as referred to in the method or use of the invention refers to an inhibition or reduction of growth of  
 30 *Aureobasidium pullulans* (SCC015) and *Sydowia polyspora* (DSMZ). Likewise, a reference to "antimicrobial" as referred to in the composition of the invention, refers to anti *Aureobasidium pullulans* (SCC015) and anti *Sydowia polyspora* (DSMZ) (i.e. inhibiting or reducing the growth of *Aureobasidium pullulans* (SCC015) and *Sydowia polyspora* (DSMZ).

35

Any or all of the features described herein, and/or any or all of the steps of any method or process described, may be used in any combination in any aspect of the invention.

### Examples

5 The invention is illustrated by the following non-limiting examples.

All test procedures and physical parameters described herein have been determined at atmospheric pressure, room temperature (i.e. about 20°C) and a relative humidity of 50% unless otherwise stated herein, or unless otherwise stated in the referenced test  
10 methods and procedures.

All parts and percentages are given by weight unless otherwise stated.

Compounds used in the examples are identified as follows:

- 15
- BLX Pro (TM) – a coating composition (ex AkzoNobel) comprising a combination of acrylic binder and alkyd binder and modified to include no biocide.
  - PEG400 – polyethylene glycol with an average molecular weight of 400.

### 20 Test Methods

In this specification, the following test methods have been used:

- (i) Number average molecular weight and weight average molecular weight were determined by GPC using hexafluoroisopropanol as the solvent and measured against a set of polymethylmethacrylate standards using a third order polynomial. The  
25 following GPC apparatus was used:
- Alliance 2690 system consisting of a pump, auto sampler and degasser.
  - Waters 410 Refractive index (RI) detector
  - Data processing system with Millennium 32 Chromatography manager from Waters.
  - PFG (Polar Flouro Gel) 7 µm linear gel column (300 x 8 mm), Polymer Standards  
30 Services (PSS)
  - Flow: 0.6 ml/min
  - Sample concentration: 1.5-1.8 mg/ml (solid polymer)
  - Injection volume: 50 µl

(ii) The hydroxyl value (OH-value) is defined as the number of mg of potassium hydroxide equivalent to the hydroxyl content of 1g of sample, and was measured by acetylation followed by hydrolysis of excess acetic anhydride. The acetic acid formed was subsequently titrated with an ethanolic potassium hydroxide solution.

5

(iii) The acid value is defined as the number of mg of potassium hydroxide required to neutralise the free fatty acids in 1 g of sample, and was measured by direct titration with a standard potassium hydroxide solution.

10 (iv) The % cationic active in a cationic quaternary ammonium compound with known molecular weight was determined using a titration with anionic solution according to ISO 2871-1. The % cationic active is equivalent to the percentage of tertiary nitrogen groups in the sample which have been quaternized.

15 (v) Substrate penetration and bluestain fungi inhibition in wood substrate samples was determined using a modified version of NEN-EN 152 with a shortened incubation time and without artificial or natural weathering. The test fungi used in all blue stain tests were *Aureobasidium pullulans* (SCC015) and *Sydowia polyspora* (DSMZ). The test fungi were used as a mixed culture in the form of a spore suspension. The basic  
20 principles of the test method used, was to provide the conditions for infection by blue-stain fungi into the treated face of the substrate and into the cut surface behind the treated face and observe the development of infection into the treated face. A series of wood samples of *Pinus sylvestris* (Scotch pine) were treated on one face with the anti-microbial composition (the equivalent of 2.1 g/m<sup>2</sup> of quat being applied). Dimensions of  
25 the wood samples were 55x35x4 mm. Test specimens were exposed in the laboratory to the action of a mixed culture of two fungi causing blue-stain in service. For purposes of comparison, an appropriate reference product of known performance was included in the test; one positive (blue stain growth) and one negative (no blue stain growth / no treatment with fungi). Two replicates per sample were used. At the end of the test,  
30 when the positive control shows clear signs of blue stain (Rating +++), and the negative control is still free of blue stain (Rating 0), samples were examined visually for the presence of blue stain.

Samples were rated as follows:

| Rating |                              |                                                                                                                                           |
|--------|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| 0      | not blue stained             | no blue stain can be detected visually on the surface                                                                                     |
| +      | insignificantly blue stained | the surface exhibits only individual small blue stained spots                                                                             |
| ++     | blue stained                 | The surface is continuously blue stained up to a maximum, of one third, or blue stained partially or in streaks up to half the total area |
| +++    | Strongly blue stained        | More than one third of the surface is continuously blue stained or more than half is partially blue stained                               |

As a negative control, the wood panels may be treated with propiconazole. Penetration of the substrate by the anti-microbial composition was determined by measuring the depth at which no blue stain had developed (the blue stain inhibition zone) measured from the surface onto which the anti-microbial composition was applied (in other words, the distance from the treated surface to the inside the wood panel where the blue stain had developed). This was done by making a cross section of the wood panel and measuring the distance between the blue stain that had developed closest to the top and the surface onto which the product under test was applied (in other words, the distance from the treated surface to the inside the wood panel where the blue stain had developed).

(vi) Leaching of the treated wood samples prior to fungal test was performed by applying the anti-microbial composition to the wood sample surface, allowing the samples to dry for 24h, followed by placing the samples in glass jars, filled with 300 ml of demineralised water with the treated face of the samples facing downwards, into the water. After 24 h, the samples were removed from the glass jars and allowed to dry (at least 24h) prior to the blue stain test.

#### Example 1

An aminoalkyl(meth)acrylate polymer quat was synthesised as follows using the ingredients listed in Table 1.

**Table 1**

| <b>Compound</b>               | <b>Function</b>            | <b>Wt% in Poly-quat product</b> |
|-------------------------------|----------------------------|---------------------------------|
| Bromo-tetradecane             | Quaternising agent         | 5.8                             |
| PEG400                        | Solvent & Carrier          | 18.5                            |
| DMAEMA                        | Amino-methacrylate monomer | 5.4                             |
| Butyldiglycol (BDG)           | Solvent                    | 2.4                             |
| Di-tert-butyl peroxide (DTBP) | Polymerisation Initiator   | 0.3                             |
| Water                         | Diluent                    | 67.6                            |

The dimethylaminoethylmethacrylate (DMAEMA) monomer, PEG400 and bromo-tetradecane were mixed in suitable apparatus and heated at 120 °C for 2 hours to quaternize the DMAEMA with the bromo-tetradecane. Once the desired amount of quaternisation to achieve a % cationic active of about 60% determined by ISO 2871-1 was obtained, the mixture was cooled to allow addition of the polymerisation initiator. The BDG solvent and DTBP initiator were added to the mixture to initiate polymerisation of the DMAEMA. The polymerisation reaction was continued for about 1 hour at 120 °C and then 15 minutes at 140 °C to achieve the desired weight average molecular weight of the aminoalkyl(meth)acrylate polymer quat, measured by GPC as defined herein. The weight average molecular weight was measured as 196,000 g/mol and the number average molecular weight was measured as 68,000 g/mol, giving a polydispersity index of 2.88. The product was then diluted with water.

15

The resulting product is referred to herein as the Poly-quat Product and it comprised 11.5wt% of the aminoalkyl(meth)acrylate polymer quat, 18.5wt% of PEG400, 2.4wt% of butyldiglycol and the remainder water (67.6wt%).

## 20 Example 2

An alkoxylated quat was synthesised as follows.

100 parts by weight of cocoamine-2EO (the cocoamine-2EO is an amine derived from coconut fatty acid which comprises C12 alkyl amine which has then been ethoxylated with 2 mols of ethylene oxide – hence 2EO) and 0.17 parts by weight catalyst (caustic

25

potash, 45wt% in water) were charged to a pressurized reactor (Parr). With agitation and nitrogen sweep on the temperature was slowly raised to 150 - 160 °C. Upon reaching this temperature, ethylene oxide was fed to the reactor. The reactor was held at this temperature for 2 hours after the addition until the desired acid and hydroxyl values were obtained. The resulting product contained 5 ethylene oxide residues (5EO) in total. This intermediate is referred to as cocoamine-5EO. 100 parts by weight (1 mol) of the cocoamine-5EO was charged to a pressurised reactor (Parr) with agitation and nitrogen sweep on. The temperature was raised to 75-80 °C at 1 psi pressure with N<sub>2</sub> for 30 minutes. 8.6 parts by weight (1 mol) of methyl chloride was added to the reactor to quaternize the cocoamine-5EO. The reaction was continued until the desired amount of quaternization was obtained.

The resulting product is referred to herein as the Coco-5EO-quat Product. The % cationic active of the Coco-5EO-quat Product was tested according to ISO 2871-1 and determined to be at least 90%.

### Example 3

The Poly-quat Product of Example 1 and the Coco-5EO-quat Product of Example 2 were tested in anti-microbial compositions for penetration of a wood substrate and inhibition of bluestain fungi growth before and after leaching with water. The anti-microbial composition for the Poly-quat Product was the neat Poly-quat Product as prepared in Example 1. The anti-microbial composition for the Coco-5EO-quat Product was the Coco-5EO-quat Product as prepared in Example 2 diluted with water: 50wt% Coco-5EO-quat Product and 50 wt% water. The equivalent of 2.1 g/m<sup>2</sup> of quat was applied to the top surface of the test panels.

In the first set of tests, no further coating composition was applied after the anti-microbial composition had been applied to the wood substrate. One group of the treated wood samples was leached as described in the Test Methods above and another group was not leached.

In the second set, a coating of BLX Pro (as described above) was applied after the anti-microbial composition had been applied, but before the samples were leached.

The results of the tests are given in Table 2. Substrate penetration depth was measured as described in the Test Methods above.

**Table 2**

| Anti-microbial composition comprising | Substrate depth penetrated & protected from bluestain growth (mm) |         |              |         |
|---------------------------------------|-------------------------------------------------------------------|---------|--------------|---------|
|                                       | Without BLX Pro coating                                           |         | With BLX Pro |         |
|                                       | No leaching                                                       | Leached | No leaching  | Leached |
| Poly-quat Product                     | 0.7                                                               | 0.6     | 0.7          | 0.4     |
| Coco-5EO-quat Product                 | 3.3                                                               | 1.1     | 3.4          | 3.4     |

5

It can be seen from the results in Table 2 that both Poly-quat and Coco-5EO-quat are successful in penetrating the porous substrate of the wood sample and inhibiting bluestain fungi growth. The Poly-quat has a lower penetration but resists leaching better than the Coco-5EO-quat. Application of the BLX Pro coating composition after applying the antimicrobial composition comprising Coco-5EO-quat completely prevents leaching of the Coco-5EO-quat.

10

**CLAIMS**

1. A method of treating a porous substrate of wood to inhibit or reduce microbial growth in the porous substrate comprising the step of applying an anti-microbial composition to the porous substrate, wherein the anti-microbial composition comprises:
- 5
- a. one or more quaternary ammonium compounds selected from aminoalkyl(meth)acrylate polymer quats and alkoxyated quats, wherein the one or more quaternary ammonium compounds comprise an
- 10 aliphatic C8 to C16 alkyl group;
- b. at least one solvent selected from water and organic solvents; and
- c. optionally other additives;
- wherein the anti-microbial composition does not comprise a binder polymer or resin and wherein the one or more quaternary ammonium compounds
- 15 penetrate the pores of the porous substrate to inhibit or reduce microbial growth in the porous substrate.
2. A method according to claim 1 further comprising the step of applying a coating composition to the porous substrate after applying the anti-microbial
- 20 composition, wherein the coating composition comprises a binder polymer or resin.
3. A method according to any one of the preceding claims, wherein the anti-microbial composition comprises an aminoalkyl(meth)acrylate polymer quat,
- 25 and wherein the aminoalkyl(meth)acrylate polymer quat is obtainable from one or more aminoalkyl(meth)acrylate monomers at least partially quaternized by a quaternizing agent comprising an aliphatic C8 to C16 alkyl group, wherein the quaternizing agent is selected from organic sulphates, nitrates, phosphates, acetates or halides comprising an aliphatic C8 to C16 alkyl group.
- 30
4. A method according to claim 3, wherein the quaternizing agent comprising an aliphatic C8 to C16 alkyl group is an aliphatic C8 to C16 alkyl halide, preferably a C11 to C15 alkyl bromide, more preferably bromo-tetradecane.

5. A method according to claim 3 or 4, wherein the one or more aminoalkyl(meth)acrylate monomers are selected from dimethylaminoethyl(meth)acrylate (DMAEMA) and diethylaminoethyl(meth)acrylate (DEAEMA).
- 5 6. A method according to any one of claims 3 to 5, wherein the aminoalkyl(meth)acrylate polymer quat is a homopolymer of an aminoalkyl(meth)acrylate monomer.
- 10 7. A method according to any one of claims 3 to 6, wherein the percentage of amine groups in the aminoalkyl(meth)acrylate polymer quat that have been quaternized into quaternary ammonium cations (% cationic active) is at least 30%, preferably at least 40%, more preferably in the range of from 50 to 80%.
- 15 8. A method according to any one of the preceding claims, wherein the anti-microbial composition comprises an alkoxylated quat, and wherein the alkoxylated quat comprise from 2 to 20 alkylene oxide residues in total in the compound and wherein the alkylene oxide residues are selected from ethylene oxide and propylene oxide.
- 20 9. A method according to any one of the preceding claims, wherein the anti-microbial composition comprises an alkoxylated quat, and wherein the alkoxylated quat comprises from 1 to 4 quaternary ammonium groups.
- 25 10. A method according to any one of the preceding claims, wherein the anti-microbial composition comprises at least one quaternary ammonium compound selected from aminoalkyl(meth)acrylate polymer quats and at least one quaternary ammonium compound selected from alkoxylated quats, wherein each quaternary ammonium compound comprises an aliphatic C8 to C16 alkyl
- 30 group.
11. An anti-microbial composition comprising:
  - a. 0.1 to 15 wt%, based on the total weight of the composition, of one or more quaternary ammonium compounds as defined in any one of claims
  - 35 1 and 3 to 10;

- b. 60 to 99.9 wt%, based on the total weight of the composition, of water;
  - c. 0 to 25 wt%, based on the total weight of the composition, of organic solvent; and
  - d. optionally other additives;
- 5 wherein the composition does not comprise a binder polymer or resin, and wherein the composition is a wood preservative composition suitable for treating a porous substrate of wood to inhibit or reduce microbial growth in the porous substrate, and wherein the composition does not comprise any further anti-microbial compound in addition to the one or more quaternary ammonium
- 10 compounds.
12. A composition according to claim 11, wherein the organic solvent comprises a polyalkylene glycol.
- 15 13. An article comprising a porous substrate of wood treated by a method according to any one of claims 1 to 10.
14. Use of one or more quaternary ammonium compound as defined in any one of claims 1 and 3 to 10 to inhibit or reduce microbial growth in a porous substrate
- 20 of wood, wherein the one or more quaternary ammonium compounds are applied to the porous substrate in a composition that does not comprise a binder polymer or resin.
15. A kit of parts comprising a wood preservative composition according to claim 11
- 25 or 12 and a coating composition comprising a binder polymer or resin.

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2019/063416

A. CLASSIFICATION OF SUBJECT MATTER  
INV. A01N33/02 A01P1/00  
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
A01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, CHEM ABS Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                                             | Relevant to claim No. |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| X         | US 5 041 275 A (MILLER ALEX E [US])<br>20 August 1991 (1991-08-20)<br>column 3, line 4 - line 6; claims;<br>examples; tables<br>column 4, line 23 - column 5, line 40<br>----- | 1-15                  |
| X         | US 2017/238550 A1 (IJAZ MOHAMMAD KHALID<br>[US] ET AL) 24 August 2017 (2017-08-24)<br>paragraphs [0039] - [0045], [0063] -<br>[0070], [0140]; claims; examples<br>-----        | 1-15                  |



Further documents are listed in the continuation of Box C.



See patent family annex.

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2019/063416

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date         |
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