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T. E. NIKIFOROVA ET AL: "Copper ion sorption by cellulose sorbents modified with hydrophilic nitrogen-containing polymers", RUSSIAN JOURNAL OF APPLIED CHEMISTRY, vol. 83, no. 7, 1 July 2010 (2010-07-01), pages 1170-1175, XP055051671, ISSN: 1070-4272, DOI: 10.1134/S1070427210070025

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DESCRIPTION

[0001] The present invention relates to wood preservative formulations and methods of treating wood and other cellulosic material. In particular it relates to formulations which contain a positively charged polymer which enhances the penetration of the active ingredients also present in the formulation into the wood or other cellulosic material.

[0002] Many types of wood preservative treatments exist on the market today. These can be applied directly to the surface, paint-on, or by vacuum pressure immersion treatments. During industrial application of preservatives, timber is typically impregnated with the treatment solution to achieve either shell or full cell type penetration into the substrate.

[0003] Depending on the wood species being treated and the end use, the depth of penetration of the preservative solution into the timber can have a significant bearing on the useful service life of the treated timber.

[0004] A typical industrial treatment plant will consist of a storage tank to hold the treatment solution and an autoclave. Timber is charged into the autoclave and this is then flooded with treatment solution. Combinations of vacuum and pressure are applied to achieve the required penetration of preservative into the timber.

[0005] During the treatment process, an amount of preservative solution is consumed by way of being absorbed into the timber. This typically represents a relatively small amount of the total volume of solution used to flood the autoclave. This generates a scenario whereby treatment solution is repeatedly exposed to timber. The average treatment solution age increases as a function of solution refresh rates. This can extend from several days to many months. Therefore the solution is repeatedly exposed to timber.

[0006] It has been observed that the ability of the preservative to penetrate into the timber substrate as the solution is repeatedly exposed to timber can deteriorate very significantly. This can have significant consequences to the useful service life of the treated article.

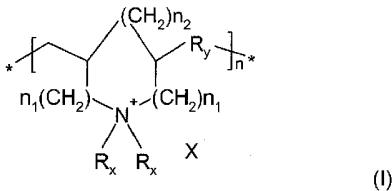
[0007] Wood preservatives tend to be neutral or alkaline and the high pHs can solubilise chemical substances found in timber and during the impregnation process the timber generates anionic by-products. This combination of anionic by-products and timber extractives can then hinder penetration of the wood preservatives through the timber.

[0008] It has been found that addition of certain highly cationic polymers to the wood preservative solutions can significantly improve preservative solution uptakes and penetration into the wood being treated.

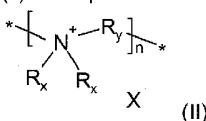
[0009] WO 2011/080051, WO 2009/092775 and Nikiforova et al. in the Russian Journal of Applied Chemistry (2010) vol. 83, no 7, pp 1170-1175 describe formulations with one or more of the components of the formulations of the present invention, but they do not describe or suggest the formulations of the present invention or their ability to enhance uptake of biocides contained therein.

[0010] Thus, in a first aspect, the present invention provides a wood preservative formulation comprising a biocidal agent which is a copper or zinc ion complexed with an amino compound selected from the group consisting of ammonia, a water soluble amine or alkanolamine and an aminocarboxylic acid, and a cationic polymer selected from the group consisting of:

1. (i) a compound of formula (I)

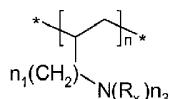


2. (ii) a compound of formula (II)



; and

3. (iii) a compound of formula (III)



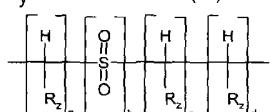
(III)

in which:

 $n = 3$ to 5000; $n_1 = 0, 1$ or 2; $n_2 = 0$ or 1; $n_3 = 2$ or 3 and when $n = 3$ the nitrogen atom carries a positive charge and a counter ion X^- is present;

R_x groups, which can be identical or different, are hydrogen or a straight chain, branched or cyclic alkyl, alkenyl, alkynyl, alkoxy, aryl, $-(\text{C}=\text{O})\text{H}$, $-(\text{C}=\text{O})\text{R}_n$, $-\text{CO}_2\text{H}$ - CO_2R_n , $-\text{CH}_2\text{CO}_2\text{H}$, $-\text{CH}_2\text{CO}_2\text{R}_n$, $\text{CH}_2\text{NR}_n\text{R}_n$, $-(\text{C}=\text{O})\text{NR}_n\text{R}_n$, $-\text{CN}$, $-(\text{CH}_2)n_4\text{O}$ - R_n , in which;

R_n groups, which can be identical or different, are hydrogen or a straight chain, branched or cyclic alkyl, alkenyl, alkynyl, alkoxy or aryl;

 $n_4 = 2$ or 3; R_y is of the formula (IV)

(IV)

in which;

 $\text{R}_z = \text{H}$ or OH ; $a = 0$ to 10; $b = 0$ or 1; $c = 0$ to 10; $d = 0$ to 10;

X^- is any anion selected from chloride, bromide, iodide, fluoride, sulphate, phosphate, carboxylate especially propionate and lactate, carbonate, bicarbonate, nitrate, nitrite, hydroxide, cyanide; and

* represents the bonds connecting the repeating units within the backbone of the polymer.

[0011] R_x groups are preferably C1-22, more preferably C1-16, e.g. C1-8 alkyl, alkenyl, alkynyl or alkoxy, or C5-22, more preferably C6-10 aryl.

[0012] Likewise R_n groups are preferably C1-22, more preferably C1-16, e.g. C1-8 alkyl, alkenyl, alkynyl or alkoxy, or C5-22, more preferably C6-10 aryl. Aryl groups may be heteroaromatic.

[0013] The molecular weight of the above polymers is typically up to 1,000,000, preferably up to 500,000, preferably at least 1,000, more preferably between 1,000 and 50,000.

[0014] As discussed in more detail below, many wood preservatives contain biocidal metal compounds, such as copper compounds, in which the metal ion acts as the primary fungicide. It is known in the art to use nitrogen containing compounds, such as monoethanolamine, as a complexing agent for the metal ion to enhance delivery of the metal into the wood. In such

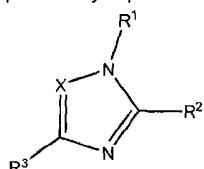
systems the complexing nitrogen compound is typically present at between 5 and 25% by weight of ingredients in the concentrated wood preservative formulation which is manufactured. In contrast, according to the present invention, where the cationic polymers are not included for the purposes of complexing a copper or other metal ion but to manage negatively charged extractives and by-products, the wood preservative formulation preferably contains 0.01 to 4%, more likely 0.05 to 2% by weight of a cationic polymer as defined above, more preferably 0.1 to 1%, most preferably 0.15 to 0.6%. These values refer to the amount of cationic polymer present in the wood preservative concentrate as manufactured and supplied to the treatment site. Such formulations are typically diluted with water to form treatment solutions which are 2-6% solutions on a m/v basis. The amount of cationic polymer applied to the wood will thus be correspondingly less in terms of the weight percentage of the impregnation solution.

[0015] The wood preservative formulations of the invention may comprise one or more of the following active agents; boron containing biocides such as boric acid, oxides and salts thereof and organic fungicides including fungicidal amides such as prochloraz, penthiopyrad, dichlofuanid and tolylfluanid; anilide fungicides such as sedaxane and penflufen; anilinopyrimidine fungicides such as pyrimethanil, cyprodinil or mepanipyrim; fungicidal aromatic compounds such as chlorthalonil, cresol, dicloran, pentachlorophenol, sodium pentachlorophenol, 2-(thiocyanatomethylthio)-1,3-benzothiazole (TCMBC), dichlorophen, fludioxonil and 8-hydroxyquinoline; fungicidal heterocyclic compounds such as dazomet, fenpropimorph, bethoxazin and dehydroacetic acid; strobilurins such as azoxystrobin; quaternary ammonium compounds; azoles; isothiazolones; Potassium HDO (cyclohexylhydroxydiazene 1-oxide, potassium salt); pyron compounds such as sodium pyrithione, zinc pyrithione, copper pyrithione, 1-hydroxy-2-pyridinone and pyron disulfide and mixtures thereof. Particularly preferred organic fungicidal agents are quaternary ammonium compounds, azoles, and mixtures thereof.

[0016] Preferred quaternary ammonium compounds are trimethyl alkyl quaternary ammonium compounds such as cocotrimethyl ammonium chloride; dialkyldimethyl quaternary ammonium compounds such as didecyl dimethyl ammonium chloride, didecyl dimethyl ammonium carbonate, didecyl dimethyl ammonium bicarbonate, dioctyl dimethyl ammonium chloride and octyl decyl dimethyl ammonium chloride, or mixtures thereof; alkyl dimethyl or diethyl benzyl ammonium salts such as benzalkonium chloride and benzalkonium hydroxide; polyethoxylated quaternary ammonium compounds such as N,N-didecyl-N-methyl-poly(oxyethyl) ammonium propionate (Bardap 26) or N,N-didecyl-N-methyl-poly(oxyethyl) ammonium lactate; and N-substituted pyridinium compounds such as cetyl pyridinium chloride.

[0017] Particularly preferred quaternary ammonium compounds are benzalkonium chloride, didecyl dimethyl ammonium chloride and didecyl dimethyl ammonium carbonate, with didecyl dimethyl ammonium chloride and didecyl dimethyl ammonium carbonate being the most preferred.

[0018] The azole compound, i.e. a compound comprising an azole group, may be an imidazole or a 1,2,4-triazole and is preferably represented by the general formula (V)



(V)

wherein

X denotes CR⁴ or N;

R¹ denotes hydrogen or a linear, branched, cyclic, aromatic or any combination thereof, saturated or unsaturated, substituted or unsubstituted C₁ to C₄₀ group

wherein any of the carbon atoms other than those bound to the nitrogen atom shown in formula (V) may be replaced with an Optionally substituted hetero atom;

R² denotes hydrogen, C₁-C₈ alkyl, C₂-C₈ alkenyl, C₆-C₁₀ aromatic, C₅-C₁₀ heteroaromatic or C₁-C₄ alkyl carbamate; and

R³ and R⁴ denote hydrogen; or

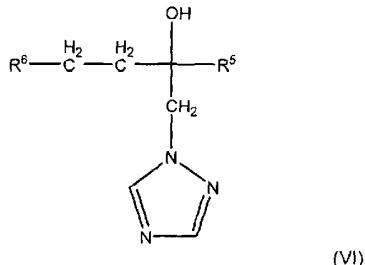
together R³ and R⁴ may provide a benzimidazole group (i.e. R³ and R⁴ may combine to form -(CH₂)₄-).

[0019] The formulations of the invention may contain one or more azole compounds, such as mixtures of an imidazole and a 1,2,4-triazole, or mixtures of two or more 1,2,4-triazoles. However, it is preferred to use 1,2,4-triazoles in the formulations of the invention.

[0020] The imidazole compound incorporates a five-membered diunsaturated ring composed of three carbon atoms and two nitrogen atoms at non-adjacent positions. The imidazole compound may be a benzimidazole. Preferred compounds include thiabendazole, imazalil, carbendazim and prochloraz.

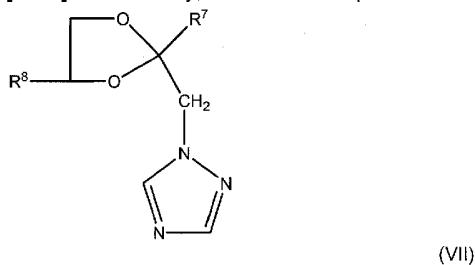
[0021] The 1,2,4-triazole compound incorporates a five-membered diunsaturated ring composed of three nitrogen atoms and two carbon atoms at non-adjacent positions.

[0022] Preferred triazole compounds include a triazole compound selected from compounds of formula (VI):



wherein R⁵ represents a branched or straight chain C₁₋₅alkyl group (e.g. t-butyl) and R⁶ represents a phenyl group optionally substituted by one or more substituents selected from halogen (e.g. chlorine, fluorine or bromine) atoms or C₁₋₃ alkyl (e.g. methyl), C₁₋₃alkoxy (e.g. methoxy), phenyl or nitro groups.

[0023] Alternatively, the triazole compound is advantageously selected from compounds of formula (VII):



wherein R⁷ is as defined for R⁶ above and R⁸ represents a hydrogen atom or a branched or straight chain C₁₋₅alkyl group (e.g. n-propyl).

[0024] Particularly preferred triazoles include, but are not limited to, triadimefon, triadimenol, triazbutil, propiconazole, cyproconazole, difenoconazole, fluquinconazole, tebuconazole, flusilazole, uniconazole, diniconazole, bitertanol, hexaconazole, azaconazole, flutriafol, epoxyconazole, tetriconazole, penconazole, ipconazole, prothioconazole and mixtures thereof.

[0025] Particularly preferably the wood preservative formulation comprises a biocidal copper ion. The biocidal copper may advantageously be incorporated into the formulation in the form of inorganic copper salts, such as carbonate, bicarbonate, sulphate, nitrate, chloride, hydroxide, borate, fluoride or oxide. Alternatively, the copper may be in the form of a simple organic salt, such as formate or acetate, or as a complex such as N-nitroso-N-cyclohexyl-hydroxylamine-copper (copper-HDO) or copper pyrithione (bis(2-pyridylthio)copper 1,1'-dioxide, CAS number 14915-37-8).

[0026] Preferably, the biocidal copper ion is a copper (II) ion. Preferred forms of copper (II) include basic copper carbonate (CuCO₃.Cu(OH)₂), copper (II) acetate, copper (II) hydroxide, copper (II) oxide and copper (II) sulphate pentahydrate, with basic copper carbonate being the most preferred. Preferred copper (I) compounds that can be used are copper (I) oxide and copper-HDO.

[0027] Particularly preferred biocidal copper compounds are selected from basic copper carbonate, copper (II) acetate, copper (II) sulphate pentahydrate, copper (II) hydroxide, copper (II) oxide, copper (I) oxide, and copper-HDO.

[0028] In alternative preferred embodiments, the biocidal metal ion may be a biocidal zinc ion. The biocidal zinc may

advantageously be incorporated into the formulation in the form of inorganic zinc salts, such as carbonate, bicarbonate, chloride, hydroxide, borate, oxide or phosphate. Alternatively, the zinc may be in the form of a an organozinc compound such as a simple organic salt, such as formate or acetate, or as a complex such as N-nitroso-N-cyclohexyl-hydroxylamine-zinc (zinc-HDO), zinc naphthenate or zinc pyrithione (bis(2-pyridylthio)zinc 1,1'-dioxide - CAS number 13463-41-7).

[0029] Preferred zinc compounds include zinc oxide, zinc carbonate, zinc chloride, zinc borate and zinc pyrithione, with zinc oxide, zinc carbonate and zinc borate being the most preferred.

[0030] The metal is present in the formulation of the invention as a solubilised metal ion. Suitable methods for solubilising metal ions such as copper and zinc are known in the art, for example from WO93/02557. Suitable complexing agents for the copper or zinc ion are ammonia; water soluble amines and alkanolamines capable of complexing with copper or zinc cations and aminocarboxylic acids such as glycine, glutamic acid, ethylenediaminetetraacetic acid (EDTA), hydroxyethyldiamine triacetic acid, nitrilotriacetic acid and N-dihydroxy ethylglycine. Where the complexing agents are acidic in nature they may be employed either as free acids or as their alkali metal or ammonium salts. These complexing agents may be used either alone or in combination with each other. Preferred complexing agents are selected from alkanolamines, such as monoethanolamine, diethanolamine, triethanolamine, monopropanolamine, dipropanolamine, and tripropanolamine. Ethanolamines are preferred, with monoethanolamine being particularly preferred.

[0031] Formulations of the invention comprise a biocidal agent which is a copper or zinc ion complexed with an amino compound selected from the group consisting of ammonia, a water soluble amine or alkanolamine and an aminocarboxylic acid. Preferred amino compounds are discussed herein and particularly preferred amino compounds are ammonia, monoethanolamine and primary, secondary or tertiary amines incorporating a C₈-14 alkyl, preferably C₁₂ alkyl, e.g. laurylamine or dimethyl laurylamine.

[0032] Alternatively viewed, preferred formulations contain a zinc or copper compound and an amino compound selected from the group consisting of ammonia, a water soluble amine or alkanolamine and an aminocarboxylic acid. The amino compound complexes with the metal ion to solubilise it.

[0033] In some embodiments, particularly where the formulation contains zinc, it may be advantageous to have two solubilising and/or complexing agents, for example an amino compound as discussed above and a gluconate salt such as sodium gluconate.

[0034] Preferred wood preservative formulations of the invention are known as alkaline copper quaternary systems, comprising a copper compound and a quaternary ammonium compound, for example as defined above. Further preferred wood preservative formulations contain an azole as defined above. More preferred formulations contain a copper compound and a triazole, preferably together with an alkanolamine. Particularly preferred formulations contain copper carbonate present as an ethanolamine complex and tebuconazole, e.g. as sold under the Tanalith® brands.

[0035] Preferred cationic polymers for use in the formulations of the invention include:

Poly vinyl formamides,

Poly amides,

Poly vinyl amides,

Polyamines, branched and linear, specifically polyamines derived from epihalohydrin,

Poly vinyl amines (PVAm),

Poly DADMAC's,

Poly allyl amines (PAAm),

Poly DADMAC Sulphones, and

Vinyl amine/ vinyl formamide copolymers.

[0036] Particularly preferred are polyvinylamines, poly DADMAC and poly DADMAC-sulphone and polyamines (both high and low MW polyamines). Most preferred is a polyamine, in particular a polyamine with a molecular weight of about 1,000 to 10,000, for

example 2,000 to 4,000.

[0037] In some instances it is preferable to prepare the wood preservative formulation from two or more products shortly before administration, thus in a further aspect, the present invention provides a combined wood preservative product comprising,

1. (a) a biocidal agent which is a copper or zinc ion complexed with an amino compound selected from the group consisting of ammonia, a water soluble amine or alkanolamine and an aminocarboxylic acid; and
2. (b) a cationic polymer as defined herein.

[0038] The product will typically contain a first compartment or container containing a formulation comprising (a) and a second compartment or container containing the polymer (b). The product may be supplied with written instructions for mixing and diluting (in any order) the two parts.

[0039] The formulation or product is typically diluted prior to application to the timber as an impregnation or treatment solution, the copper or zinc biocidal agent containing part may be diluted first before addition of the polymer. Dilution is preferably with water, e.g. at a ratio of water:concentrate v/v of 10:1 to 200:1, preferably 20:1 to 100:1, more preferably 20:1 to 50:1.

[0040] The treatment solution will preferably contain 10 or 50 to 1000 ppm of cationic polymer, more preferably 50 or 100 to 500 ppm (ppm = parts per million by weight).

[0041] In a further aspect, the invention provides a method of preserving wood or other cellulosic material which comprises applying to the wood or other cellulosic material a formulation of the invention as described above or applying the individual components to the wood/material such that the wood/material effectively receives a formulation of the invention as described.

[0042] Reference to "individual components" is not to be understood as requiring separate application of each active ingredient but as indicating that the whole complement of active and other ingredients are not simultaneously applied. Thus, the material is treated in such a way which means that it effectively receives a wood preservative formulation of the invention.

[0043] Types of wood which can benefit from treatment with the formulations of the invention include sawn timber, logs, glulam, plywood, laminated veneer lumber (LVL), wood based composite products such as oriented strand board (OSB), medium density fibreboard (MDF), fibreboard, hardboard and particle board.

[0044] It will be understood that "wood" in the context of this invention does not encompass living trees or other plants.

[0045] Other cellulosic materials which can benefit from treatment with the formulations of the invention are lignocellulosic substrates, wood plastic composites, cardboard and cardboard faced building products such as plasterboard, and cellulosic material such as cotton. Also, leather, textile materials and even synthetic fibres, hessian, rope and cordage as well as composite wood materials. For convenience, the invention is described with reference to the treatment of wood but it will be appreciated that other cellulosic materials may be treated analogously. The reference to treatment of "wood" or "timber" applies mutatis mutandis to such substrates, unless it is clear from the context. Preferably, though not exclusively, the formulations are applied to sawn timber, logs or laminated veneer lumber, OSB or MDF. Most preferably, the formulations are applied to unseasoned timber.

[0046] Conveniently, the formulations of the present invention are applied as a liquid composition. They may also be applied as a solid implant or paste. Preferably, the formulations are applied as a liquid composition, e.g. in the form of an emulsion made up of solubilised liquid droplets. Preferably, the emulsions are in the form of a micro-emulsion. The person skilled in the art of making emulsions knows how to make an emulsion according to the invention by the use of suitable solvents and emulsifying agents.

[0047] Preferably, when applied in liquid form, this is in an aqueous solution, but one or more organic solvents or a mixture of water and an organic solvent could also be used. Suitable organic solvents include both aromatic and aliphatic hydrocarbon solvents such as white spirit, petroleum distillate, kerosene, diesel oils and naphthas. Also, glycol ethers, benzyl alcohol, 2-phenoxy ethanol, methyl carbitol, propylene carbonate, benzyl benzoate, ethyl lactate and 2-ethyl hexyl lactate.

[0048] The application of these formulations may be by one or more of dipping, deluging, spraying, brushing or other surface coating means or by impregnation methods, e.g. high pressure or double vacuum impregnation into the body of the wood or other material, all being techniques well known to the man skilled in the art. Impregnation under pressure is particularly advantageous when the substrate is wood or a wood composite material which is made to become wet during its life, for example, wood for

window frames, timber used above ground in exposed environments such as decking and timber used in ground contact or fresh water or salt water environments.

[0049] The formulations of the invention are preferably used in immersion treatments of wood, in particular immersion treatments which utilise a vacuum and/or pressure. Thus, in a further aspect, the present invention provides a wood treatment system comprising a storage tank adapted to receive the wood to be treated and in said tank a volume of treatment solution comprising a biocidal agent comprising a copper or zinc ion as defined herein and a cationic polymer as defined herein. Optionally the system further comprises an autoclave. Optionally the system comprises means to apply a vacuum or pressure, e.g. 25-95% of a full vacuum and 8-12 Bar pressure.

[0050] Substrates made of wood or cellulosic material which have been treated with a formulation or product or by a method according to the invention as described herein, comprise further aspects of the present invention. Additionally, substrates made of wood or other cellulosic material containing a biocidal agent comprising a copper or zinc ion as defined herein and a cationic polymer (e.g. a formulation) according to the invention comprise a further aspect of the present invention.

[0051] Also described is the use of formulations and products of the present invention in the treatment or preservation of wood or other cellulosic material.

[0052] In yet a further aspect, the invention provides a method of making a wood preservative formulation which comprises admixing a biocidal agent comprising a copper or zinc ion as defined herein and a cationic polymer as defined herein.

[0053] As described above, the cationic polymers defined herein improve the penetration of biocidal agents into the treated wood; thus in a further aspect, the present invention provides the use of a cationic polymer as defined herein to enhance the penetration into wood or other cellulosic material of biocidal agents comprising a copper or zinc ion as defined herein which are co-administered to the wood or other material in a method of preservation. "Preservation" (and preserving) refers to the protection of wood or other material against fungal decay, borers and termites. Also described is the use of a cationic polymer as defined herein to ameliorate the impact on penetration into wood (or other cellulosic material) of biocidal agents which is caused by anionic by-products and timber extractives, as part of a method of preserving wood or other cellulosic material. Preferred methods of application and biocides are described above.

[0054] The invention will now be further described with reference to the following non-limiting Examples and Figures in which:

Figure 1 is a graph showing % gains in solution uptake achieved during impregnation of a copper MEA solution into *Pinus sylvestris* with various cationic polymer additives of the invention.

Figure 2 is a graph showing % gains in solution uptake achieved during impregnation of a copper MEA solution into *Pinus sylvestris* with various concentrations of a cationic polymer additive of the invention.

Figure 3 is a graph showing % gain in solution uptake achieved during impregnation of a zinc/gluconate/MEA solution into *Pinus sylvestris* with a cationic polymer additive of the invention.

Example 1

Materials and methods

[0055] An aqueous solution of copper 2^{+} ions was prepared by reacting basic copper carbonate with mono ethanolamine (MEA) to give a copper concentration of 5%w/w and MEA concentration of 19.2%w/w, equivalent to an MEA:Copper molar ratio of 4:1.

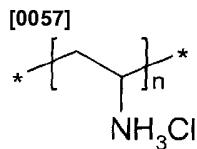
[0056] 3%w/v aqueous solutions of the copper amine complex were prepared with separate solutions dosed with 200ppm of the cationic polymeric additives of the present invention. Additives 1 to 6 as incorporated are as follows:

Additive No.	Chemical Group	CAS No.	Product Solution Strength, %	Viscosity, cps, 22°C Sp 2, Sp 60	Approximate Mw	Physical Properties			
						pH	S.G., g/cm ³	Freeze point, °C	Flash point, °C
1	Poly vinyl amine	913068-94-7	24	10	1,000-4,000*	4-6	1.12-1.14	<0	N/A
2	Low Mw Poly amine	25988-97-0	50	12	2,000-4,000*	4-7	1.12-1.16	-3	>100
3	High Mw Poly amine	25988-97-0	55	147	500,000-1,000,000*	4-7	1.12-1.16	-3	>100
4	poly DADMAC	26062-79-3	40	45	30,000-50,000	3-4	1.1	-3	N/A
5	poly DADMAC Sulphone	26470-16-6	40	6	4,000	3	1.14	-5	N/A
6	Poly allyl amine	30551-89-4	20	15	3,000	12	1.03	-5	N/A

* are estimates based on viscosity

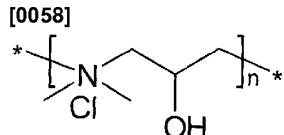
Additive 1

Polyvinylamine, CAS 913068-94-7, 2-propen-1-aminium, N,N-dimethyl-N-2-propen-1-yl-, chloride (1:1), polymer with 2-propenamide, decarboxylated, hydrochlorides



Additive 2

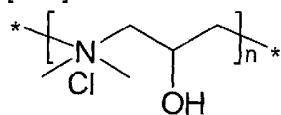
Polyamine, Poly(2-hydroxypropyltrimethylammonium chloride) CAS 25988-97-0, low MW



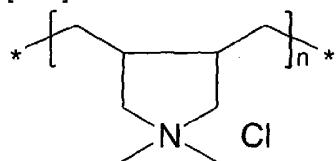
Additive 3

Polyamine, Poly(2-hydroxypropyltrimethylammonium chloride) CAS 25988-97-0, High MW

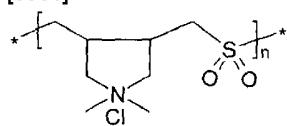
[0059]

**Additive 4****PolyDADMAC (Diallyldimethylammoniumchloride), CAS 26062-79-3**

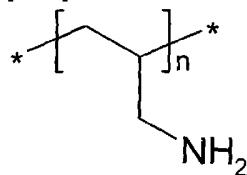
[0060]

**Additive 5****PolyDADMAC-Sulphone, CAS 26470-16-6**

[0061]

**Additive 6****Polyallylamine, CAS 30551-89-4**

[0062]



[0063] The 3%w/v aqueous solutions of the copper amine complex containing active substance were aged, to replicate commercial treatment plant solutions, by the addition of *Pinus Sylvestris* sapwood sawdust, 3.5%w/v, and stirred for 1 hour. The sawdust was filtered from the aqueous the copper amine solution prior to treatment of matched blocks being undertaken.

[0064] Sections of kiln dried *Pinus Sylvestris* (12cmx12cmx2.75cm) were then impregnated with a 3%w/v solution of the copper amine complex, using a double vacuum process.

Treatment Process:**[0065]**

- Weigh timber sample prior to treatment.
- Place timber sample in vacuum desiccator, apply vacuum to timber, 760 mm Hg, hold under vacuum for 20 minutes.
- Flood vessel under vacuum.
- Release vacuum, and soak at atmospheric pressure for 1 hour.
- Remove sample from solution, remove residual surface solution, then re-weigh timber sample.

[0066] Uptakes were determined and these expressed as a weight gain for the timber section. Retentions were also calculated as Kg/m³, (Weight of treatment solution per m³ of pine sapwood).

[0067] The depth of penetration was observed by cross cutting the samples and spraying with a reagent that reacts with copper to generate a dark coloration (dark blue to black).

Copper Spray reagent:**[0068]**

5% Sodium acetate solution

0.5% Alcoholic Rubianic acid (Dithio-oxamide) solution

Dissolve 5g of sodium acetate in 100ml of deionised water.

Dissolve 0.5g of Rubianic acid in 100ml of ethanol or methanol.

[0069] The sodium acetate solution was sprayed onto a fresh cross cut face of timber and then the Rubianic acid solution was sprayed onto the fresh cross cut face of timber. The copper penetrated timber turns a dark blue to black colour instantly.

Results**[0070]**

Chemical Group	Pre Treatment Wt, g	Post Treatment wt/g	Uptake/g	Uptake Kg/m ³	% Uptake vs no additive
No additive	162.83	225.85	63.02	204.0	0
Polyvinylamine	161.09	348.05	186.96	605.3	197
Polyamine	156.37	286.96	130.59	422.8	107
Polyamine	161.83	246.19	84.36	273.1	34
PolyDADMAC	156.46	295.36	138.9	449.7	120
PolyDADMAC-Sulphone	158.29	282.61	124.32	402.5	97
Poliallylamine	158.62	243.70	85.08	275.4	35

[0071] For all products tested, gains in solution uptake (also reflected in the depth of penetration of the preservative in the timber) increased ~20-200% vs a solution with no additive. Results are also shown in Figure 1.

Example 2

[0072] The copper²⁺ MEA solution, with 5%w/w copper concentration and an MEA:Copper molar ratio of 4:1 was prepared in accordance with the method in example 1.

[0073] Six 3%w/v aqueous solutions of the copper amine complex were prepared, with separate solutions dosed with 0, 10, 20, 30, 50 and 200 ppm of the cationic polymeric additive, additive no. 1 of the present invention, respectively.

[0074] The methods for aging the solution and treating matched blocks of *Pinus Sylvestris* was in accordance with those given in example 1.

[0075] Results are shown in Figure 2.

Example 3

[0076] An aqueous solution of zinc²⁺ ions was prepared by reacting zinc chloride with sodium gluconate and mono ethanolamine to give a zinc concentration of 0.50%w/v and a Gluconate:Zn molar ratio of 2:1, and an MEA:Zn molar ratio of 2:1.

[0077] To separate aqueous solutions of the zinc gluconatelamine complex prepared was dosed 0 and 200 ppm of the cationic polymeric additive, additive no. 1 of the present invention, respectively.

[0078] The methods for aging the solution and treating matched blocks of *Pinus Sylvestris* was in accordance with those given in example 1.

[0079] Results are shown in Figure 3.

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- [WO2011080051A \[0009\]](#)
- [WO2009092775A \[0009\]](#)
- [WO9302557A \[0030\]](#)

Non-patent literature cited in the description

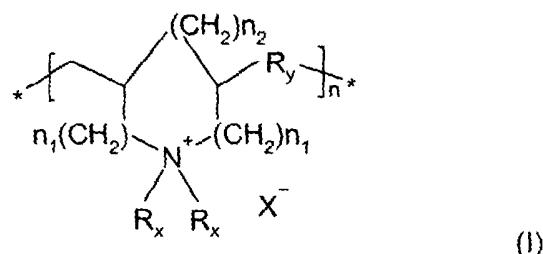
- **NIKIFOROVA et al.** the Russian Journal of Applied Chemistry, 2010, vol. 83, 71170-1175 [\[0009\]](#)

ADDITIVER TIL ANVENDELSE I TRÆBESKYTTELSE

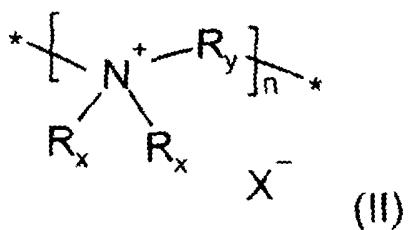
PATENTKRAV

1. Træbeskyttelsesformulering omfattende et biocidholdigt middel, der er en kobber- eller zinkion, der er kompleksbundet med en aminoforbindelse udvalgt fra gruppen bestående af ammoniak, et vandopløseligt amin eller alkanolamin og en aminocarboxylsyre, og en kationisk polymer udvalgt fra gruppen bestående af:

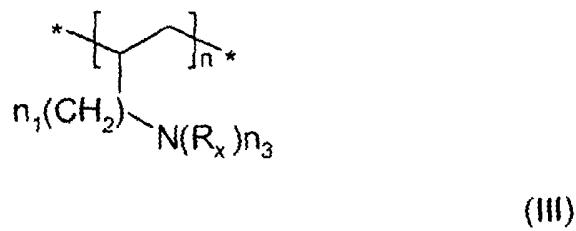
(i) en forbindelse med formel (I)



(ii) en forbindelse med formel (II)



og (iii) en forbindelse med formel (III)



i hvilken: $n = 3$ til 5000;

$n_1 = 0, 1$ eller 2;

$n_2 = 0$ eller 1;

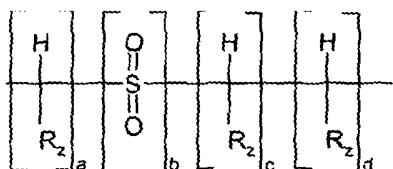
$n_3 = 2$ eller 3, og når $n = 3$ bærer nitrogenatomet en positiv ladning og en modion X^- er til stede;

R_x -grupper, der kan være identiske eller forskellige, er hydrogen eller en lige kæde, forgrenet eller cyklistisk alkyl, alkenyl, alkynyl, alkanoxyl, aryl, $-(C=O)H$, $-(C=O)R_n$, $-CO_2H$, $-CO_2R_n$, $-CH_2CO_2H$, $-CH_2CO_2R_n$, $CH_2N R_n R_n$, $-(C=O)_n R_n R_n$, $-C_N$, $-(CH_2)_n O R_n$, i hvilken;

R_n -grupper, der kan være identiske eller forskellige, er hydrogen eller en lige kæde, forgrenet eller cyklist alkyl, alkenyl, alkynyl, alkanoxyl eller aryl;

$n_4 = 2$ eller 3 ;

Ry er med formlen (IV)



(IV)

i hvilken;

$R_z = H$ eller OH ;

$a = 0$ til 10 ;

$b = 0$ eller 1 ;

$c = 0$ til 10 ;

$d = 0$ til 10 ;

X^- er en hvilken som helst anion udvalgt fra chlor, brom, iodid, fluor, sulfat, phosphat, carboxylat især propionat og lactat, carbonat, bicarbonat, nitrat, nitrit, hydroxid, cyanid; og

* repræsenterer bindingerne, der forbinder de gentagne enheder inde i polymerens skelet.

2. Træbeskyttelsesformulering ifølge krav 1, hvor polymeren har en molekylvægt på mellem 1.000 og 100.000 , fortrinsvis mellem 1.000 og 50.000 .

3. Træbeskyttelsesformulering ifølge krav 1 eller krav 2, hvor formuleringen indeholder $0,01$ til 4 vægt-% af den kationiske polymer, fortrinsvis $0,1$ til 1 vægt-%.

4. Træbeskyttelsesformulering ifølge et hvilket som helst af de foregående krav, hvor aminoforbindelsen er monoethanolamin eller ammoniak.

5. Træbeskyttelsesformulering ifølge et hvilket som helst af kravene 1 til 3, hvor aminoforbindelsen er laurylamin eller dimethyllaurylamin.

6. Træbeskyttelsesformulering ifølge et hvilket som helst af de foregående krav, der endvidere omfatter en azolforbindelse.

7. Træbeskyttelsesformulering ifølge et hvilket som helst af de foregående krav, der endvidere omfatter didecyldimethylammoniumchlorid eller carbonat.

8. Træbeskyttelsesformulering ifølge et hvilket som helst af de foregående krav, hvor den kationiske polymer er udvalgt fra gruppen bestående af:

polyvinylformamider,

polyamider,

polyvinylamider,

polyaminer,

polyvinylaminer (PVAm),

poly-DADMAC,

polyallylaminer (PAAm),

poly-DADMAC-Sulphoner, og

Vinyl-amine/vinylformamidcopolymere.

9. Træbeskyttelsesformulering ifølge krav 8, hvor den kationiske polymer er en polyamin, fortrinsvis med en molekylvægt på 2.000 til 4.000.

10. Kombineret træbeskyttelsesprodukt, der omfatter

(a) et biocidholdigt middel, der er en kopper- eller zinkion, der er kompleksbundet med en aminoforbindelse, hvor aminoforbindelsen er som defineret ifølge et hvilket som helst af kravene 1, 4 eller 5; og

(b) en kationisk polymer som defineret ifølge et hvilket som helst af de foregående krav.

11. Vandig træbeskyttelsesbehandlingsopløsning, der omfatter en træbeskyttelsesformulering som defineret ifølge krav 1 eller 2 eller et hvilket som helst af kravene 4 til 9, hvilken opløsning indeholder 10 til 1000 ppm kationisk polymer.

12. Træbeskyttelsesbehandlingsopløsning som defineret ifølge krav 11, der indeholder 50 til 1000 ppm kationisk polymer.

13. Fremgangsmåde til beskyttelse af træ eller andet cellulosemateriale, der omfatter påføring på træet eller andet cellulosemateriale af en formulering eller oplosning som defineret ifølge et hvilket som helst af de foregående krav eller påføring af

(a) et biocidholdigt middel, der er en kobber- eller zinkion, der er kompleksbundet med en aminoforbindelse, hvor aminoforbindelsen er som defineret i et hvilket som helst af kravene 1, 4 eller 5; og

(b) en kationisk polymer som defineret ifølge et hvilket som helst af de foregående krav på træet/materialet, således at træet/materialet effektivt modtager en formulering som defineret ifølge et hvilket som helst af de foregående krav.

14. Træbehandlingssystem, der omfatter en opbevaringstank tilpasset til modtagelse af det træ, der skal behandles, og i hvilken beholder et volumen af behandlingsopløsningen omfatter

(a) et biocidholdigt middel, der er en kobber- eller zinkion, der er kompleksbundet med en aminoforbindelse, hvor aminoforbindelsen er som defineret i et hvilket som helst af kravene 1, 4 eller 5; og

(b) en kationisk polymer som defineret ifølge et hvilket som helst af kravene.

15. Substrat af træ eller andet cellulosemateriale, der indeholder

(a) et biocidholdigt middel, der er et kobber- eller zinkion, der er kompleksbundet med en aminoforbindelse, hvor aminoforbindelsen er som defineret i et hvilket som helst af kravene 1, 4 eller 5; og

(b) en kationisk polymer som defineret ifølge et hvilket som helst af de foregående krav.

16. Fremgangsmåde til fremstilling af en træbeskyttelsesformulering, der omfatter blanding

(a) af et biocidholdigt middel, der er en kobber- eller zinkion, der er kompleksbundet med en aminoforbindelse, hvor

aminoforbindelsen er som defineret i et hvilket som helst af kravene 1, 4 eller 5; og

(b) en kationisk polymer som defineret ifølge et hvilket som helst af de foregående krav.

17. Anvendelse af en kationisk polymer som defineret ifølge et hvilket som helst af kravene til at forøge penetrationen i træet eller andet cellulosemateriale af et biocidt middel, der er en kobber- eller zinkion, der er kompleksbundet med en aminoforbindelse, hvor aminoforbindelsen er som defineret ifølge et hvilket som helst af kravene 1, 4 eller 5, der samtidig anvendes på træet eller andet cellulosemateriale i en fremgangsmåde til beskyttelse.

DRAWINGS

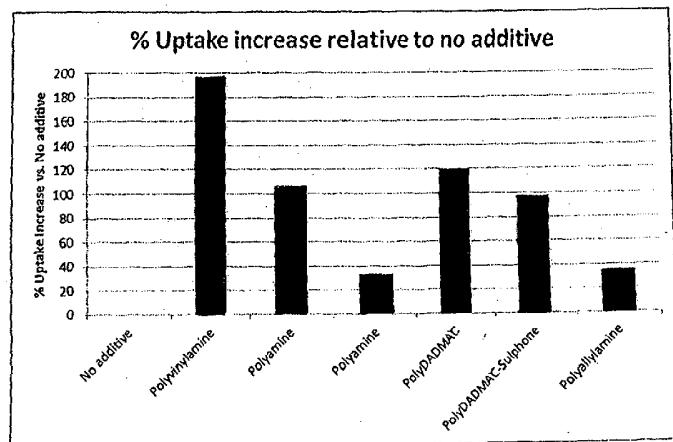


Figure 1

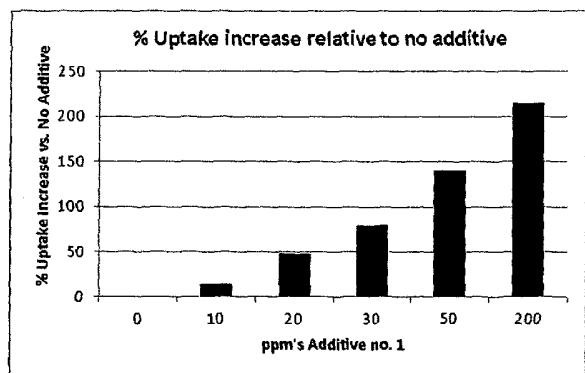


Figure 2

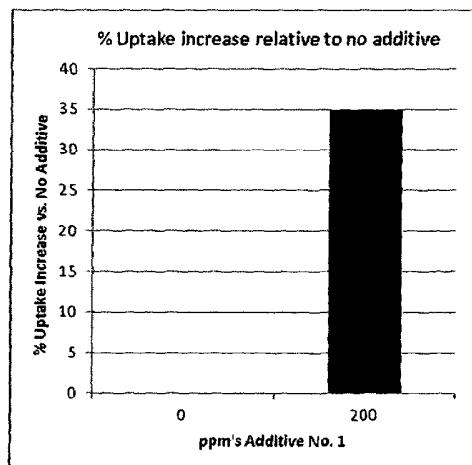


Figure 3