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(54) Title: WOOD TREATMENT

(57) Abstract: A method of protecting wood which comprises treating the wood with a fluid treatment agent chosen from at least one of, liquid wood smoke, wood smoke vapour and a plurality of biologically active compounds comprised in liquid wood smoke.

WO 2005/018889 A1

WOOD TREATMENT

Field of the Invention

This invention relates to methods for the treatment of wood to protect it against degradation as well as compositions suitable for providing such protection.

Background of the Invention

Stored logs, lumber and milled timber can all suffer deterioration over time. Whilst such deterioration can arise from a number of causes, the most common forms of deterioration are caused by a number of different fungi types. As a result of this deterioration, the value of the wood can be substantially reduced. Add to this the fact that saw mills as part of their normal operating requirements often need to have large log inventories and it can be seen that the economic effect of deterioration of wood during storage can be quite significant.

There are three basic types of fungal damage from which wood may suffer in storage. The fungi are minute thread-like organisms which use wood as a food source to grow and multiply. Typically they require reasonably warm temperatures and water as well as access to air to be able to grow. The fungi produce enzymes which digest the wood and ultimately cause discoloration and/or decay of the wood.

The most common fungal damage is called "sap stain". As the name suggests, this is caused by fungi which affect the sapwood. Often, the discoloration caused by sap stain results in a blue stain on the wood. Fortunately, sap stain does not usually affect its strength but in some instances, its hardness or shock resistance may be affected.

Decay is a form of deterioration which is caused by decay fungi. Because the decay fungi can attack the entire log, apart from staining, it can also cause significant structural weakness of the wood. Thus, decay fungi represent a particularly undesirable cause of damage to wood although the structural damage they cause is generally likely to take longer than deterioration in the form of staining or discoloration.

Another type of fungi which causes discoloration is represented by molds. These can cause visible discoloration. However, the more serious aspect of structural damage is not of such concern as it is in the case of decay fungi.

Currently, various types of chemical sprays have been used to guard against deterioration by fungi. Examples of the chemicals used include pentachlorophenol, sodium pentachlorophenate and mixtures of sodium pentachlorophenate with borax.

Whilst such chemical treatments have a degree of effectiveness, the environmental hazards which they pose mean there must be restrictions on their use.

Water spray systems are also commonly used, the water spray acting to prevent proliferation of fungi by restricting their access to air. However, the cost of running water spray systems combined with the fact that the runoff from such systems can represent an environmental hazard again means that there are also restrictions on their use.

Thus, there is a need for development of an alternative approach which obviates or ameliorates one or more of the foregoing drawbacks of the prior art wood protection processes.

Disclosure of the Invention

The invention provides in one aspect a method of protecting wood which comprises treating the wood with a fluid treatment agent chosen from at least one of liquid wood smoke, wood smoke vapour and a plurality of biologically active compounds comprised in the liquid wood smoke and wood smoke vapour. The biologically active compounds may be active against at least one of fungi, stain and decay.

Liquid wood smoke is an aqueous condensate produced by absorbing in water the smoke vapour obtained from roasting or burning of wood. It may optionally be filtered to remove particulates.

Suitably, wood smoke vapour may be produced from hard woods under controlled roasting conditions such as pyrolysis and it may be absorbed in water using a wet scrubber system.

Some of the biologically active compounds in liquid wood smoke and wood smoke vapour comprise syringol, guaiacol, eugenol, p-cresol, m-cresol, o-cresol, phenol, pyrocatechol, 2, 3 xylenol, 2, 4-xylenol, 2, 6-xylenol, 3,5-xylenol, formaldehyde, acetaldehyde, benzaldehyde, anisaldehyde, acetic acid, formic acid, butyric acid, valeric acid, fumaric acid, benzoic acid, salicyclic acid, methanol, ethanol and allyalcohol.

The concentration of the wood smoke used in relation to the invention is suitably determined by an acidity range. Typically, the liquid wood smoke may have a concentration range of 2% to 16% acidity. Example 1 shows how to test the level of acidity of liquid wood smoke.

Some of the compounds which are comprised in the liquid wood smoke are listed in Table 1 attached hereto. It is to be appreciated that this is not a complete listing of the compounds. There may be other compounds in liquid wood smoke as well.

Treatment of wood with liquid wood smoke or compounds comprised in liquid wood smoke may be applied by dipping the wood in the liquid wood smoke or liquid mixture containing active compounds comprised in wood smoke.

Alternatively or additionally, the wood may be treated with a spray shower or atomized treatment liquid applied to the timber surface. The spray may typically be applied for a period of 20 to 60 seconds.

Application rates may typically be in excess of 0.25 litre/sqm more preferably 0.5 litre/sqm and even in excess of 1 litre/sqm.

After treatment the wood should be allowed to dry before stacking.

In another application technique, the liquid wood smoke may be infused into the wood. It may be infused by allowing the wood to be submerged in the liquid or by creating pressure differential between the interior of the wood and outside air so as to cause liquid around the surface of the wood to be sucked into the wood as is known in the art.

In an alternative form of the invention, hot wood smoke vapor may be applied directly to the wood. The hot wood smoke may be generated by heating wood smoke liquid to produce hot wood smoke vapour. It may be applied for a period of 10 minutes to 60 minutes. It may be applied under conditions which cause the hot wood smoke vapour to be sucked into the wood. For this purpose, the wood may be subjected to an evacuation procedure so as to create a sub atmospheric pressure within the wood prior to the treatment with hot wood smoke vapour or liquid treatment agent. In a variation of this process, a feedstock wood may be roasted or pyrolysed to produce hot wood smoke which is then directly contacted with the surface wood being treated.

In another aspect of the invention, a combination of liquid treatment and wood smoke vapour treatment may also be used.

The method of the invention may be used to protect wood against the deleterious effects of fungi. In particular, it may be used to protect the wood against sap stain and decay. Examples of such sap stain fungi are Alteraria sp, Diplodia sp, Ophiostomum floccosum, Leptographium procerum. Examples of such decay fungi are Fibroporia vaillantii, Scizophyllum commune, Phlebiopsis gigantean.

The invention is particularly suitable for treatment of soft woods although there are instances where it is also applicable to hardwoods affected by fungi. Examples of woods to which the invention applies include radiate pine, white meranti, falcute and xylampayan.

Preferred aspects of the invention will now be described with reference to the following example.

Example 1

The acidity of liquid wood smoke can be determined using standard titration techniques as outlined below:

Reagents required: Sodium Hydroxide (1.000 Normal)
Distilled Water (200mls)

Materials required: 1 - 0-25ml burette
1 - pipettor (6mls) or (2 x 3 mls)
1 - pH meter and probe
1 - 400 ml beaker and stirrer

- Turn on pH Meter and Mixer (gentle stir)
- Add 200 mls of Distilled Water to Beaker
- Place Beaker onto Mixer plate
- Place pH Meter Probe and Stirrer into Beaker
- Fill the 0-25ml Burette with Sodium Hydroxide ++ to Level 0
- From the sample of Smoke Mix measure 6 mls into the pipettor and place in the Distilled Water
- The reading on the pH Meter is the pH Result
  (To obtain an accurate pH result wait a couple of minutes and check against readings as per sample sheet from Store and MSDS)

- For Acid Result – Pipette the Sodium Hydroxide slowly into the beaker until a pH reading of "5" to let the mixture catch up
- Continue slowly pouring the Sodium Hydroxide until the pH meter reads "7"
- The acidity is taken as the number of mls of Sodium Hydroxide required to give pH 7 eg. 10.6mls is equivalent to 10.6% acidity.

Example 2

The following table shows a typical specification showing the major components for an aqueous wood smoke condensate.

Acidity	%	10.0 – 12.0
Staining index		68 -78
Carbonyl level	g/100ml	15.0 – 25.0
Phenol level	mg/ml	13.0 – 23.0
Specific gravity	25 deg C	1.080 – 1.090
Density	Lbs/gal	9.00 – 9.08
Benzopyrene		Less than 1 part/billion
pH level	Ph	2.65
Colour		Dark amber

Example 3

Debarked radiata pine surfaces were treated with liquid wood smoke having the composition specified in Example 2 by spraying for a period of 20 seconds. Various strengths of liquid wood smoke namely 25%, 50% and 100% were applied. The amount of liquid wood smoke applied per square metre of wood surface was about 0.85 litre/m^2. The liquid wood smoke was provided in the form of two commercially available brands of liquid wood smoke with the commercial names "Regen" and "Logon"

The results of treatments with different concentrations of liquid wood smoke over a period of 1 to 3 weeks as against a control are shown numerically in Tables 2 and 3 and graphically in Table 4.

It can be seen that treatment was most effective for prevention of decay. It was also effective to a lesser extent against stain and seemed to have little effect on mold.

Whilst the above description includes the preferred embodiments of the invention, it is to be understood that many variations, alterations, modifications and/or additions may be introduced into the constructions and arrangements of parts previously described without departing from the essential features or the spirit or ambit of the invention.

It will be also understood that where the word "comprise", and variations such as "comprises" and "comprising", are used in this specification, unless the context requires otherwise such use is intended to imply the inclusion of a stated feature or features but is not to be taken as excluding the presence of other feature or features.

The reference to any prior art in this specification is not, and should not be taken as, an acknowledgment or any form of suggestion that such prior art forms part of the common general knowledge in Australia.

Table 1. Compounds Identified in Wood Smoke

Acids
- Formic (methanoic)
- Acetic (ethanoic)
- Glycolic (hydroxyethanoic)
- Propionic (propanoic)
- Isobutyric (2-methylpropanoic)
- Acrylic (propenoic)
- Methacrylic (methylpropenoic)
- Butyric (butanoic)
- α-Methylbutyric
- Isovaleric (3-methylbutanoic)
- Crotonic (2-butenoic)
- *trans*-Crotonic (*trans*-2-butenoic)
- *cis*-Crotonic (*cis*-2-butenoic)
- 3-Butenoic
- Tiglic (2-methyl-2-butenoic)
- Angelic (*cis*-2-methyl-2-butenoic)
- *trans*-2-Methyl-2-butenoic
- Valeric (pentanoic)
- α-Methylvaleric (2-methylpentanoic)
- 3-Methylpentanoic
- Isocaproic (4-methylpentanoic)
- 4-Methyl-2-pentenoic
- 2-Pentenoic
- 3-Pentenoic
- Levulinic (4-oxopentanoic)
- Caproic (hexanoic)
- Enanthic (heptanoic)
- 5-Heptenoic
- Caprylic (octanoic)
- Dehydroxycaprylic

Acids (continued)
- Pelargonic (nonanoic)
- Capric (decanoic)
- Lauric (dedecanoic)
- Myristic (tetradecanoic)
- Pentacecylic (pentadecanoic)
- Palmitic (hexadecanoic)
- Stearic (octadecanoic)
- Oleic (9-octadecanoic)
- Arachidic (eicosanoic)
- Behinic (docosanoic)
- Benzoic
- Salicylic (*O*-hydroxybenzoic)
- 3-Methoxy-4-hydroxybenozic
- Sorbic (2-4-hexadienoic)
- Vanillic (4-hydroxy-3-methoxybenzoic)
- Abietinic
- Pimaric
- Lignoceric

Alcohols
- Methyl (methanol)
- Ethyl (ethanol)
- Propyl (1-propanol)
- Isopropyl (2-propanol)
- Isobutyl (2-methyl-1-propanol)
- Allyl (2-propen-1-ol)
- Propan-2-on-1-ol
- Amyl (2-methyl-2-butanol)
- Isoamyl (3-methyl-2-butanol)
- Butan-2-on-1-ol
- Butan-3-on-2-ol
- 2-Buten-1-ol
- Pentan-2-on-1-ol
- Pentan-3-on-2-ol
- 1-Penten-3-ol
- 1-Nonanol
- Phenylethylalcohol
- Cyclohexanol
- Benzylalcohol
- *p*-Hydroxybenzylalcohol
- Fenchyl (6-fenchanol)
- Isofenchyl (iso-6-fenchanol)

(continued)

Table 1. (Continued)

Carbonyls (continued)
- Anisaldehyde (4-hydroxybenzaldehyde)

- Dihydroxybenzaldehyde
- 1,2-Dihydroxy-3-methylbenzaldehyde

- 2-Hydroxy-3-methoxybenzaldehyde

- 4-Hydroxy-2-methoxybenzaldehyde

- 4-Hydroxy-3-methoxybenzaldehyde (vanillin)

- 4-Hydroxy-3,5-dimethoxybenzaldehyde (syringaldehyde)

- 3,5-Dimethoxybenzaldehyde
- Sinapaldehyde (3-(4′-hydroxy-3′,5′-dimethoxyphenyl)-2-propenal)

- Coniferaldyhyde (3-(4′-hydroxy-3′-methoxyphenyl)-2-propenal)
- 3-(4′-Hydroxy-3′,5′-dimethoxyphenyl)-1-propanal
- 3-(4′Hydroxy-3′-methoxyphenyl)-1-propanal
- Cyclopentanone
- Methylcyclopentanone
- Dimethylcyclopentanone
- Trimethylcyclopentanone
- 3,3,5-Trimethylcyclopentanone
- 1,2-Cyclopentanediol
- 3-Methyl-1,2,4-cyclopentanetrione

- 3-Methylcyclopenta-1,2-dione
- 3-Ethylcyclopenta-1,2-dione
- 3,4-Dimethylcyclopenta-1,2-dione
- 2-Cyclopentenone

- 2-Methyl-2-cyclopentenone

- 4-Methyl-2-cyclopentenone
- 5-Methyl-2-cyclopentenone
- 2-Ethyl-1-cyclopentenone
- 3-Ethyl-2-cyclopentenone
- 2-Ethyl-3-methyl-2-cyclopentenone

Carbonyls (continued)
- 2-Ethyl-4-methyl-2-cyclopentenone

- 2-Ethyl-5-methyl-2-cyclopentenone

- 3-Ethyl-2-methyl-2-cyclopentenone

- 2,3-Dimethyl-2-cyclopentenone

- 2,4-Dimethyl-2-cyclopentenone
- 2,5-Dimethyl-2-cyclopentenone
- 3,4-Dimethyl-2-cyclopentenone
- 3,5-Dimethyl-2-cyclopentenone
- 2,3,4-Trimethyl-2-cyclopentenone
- 2,3,5-Trimethyl-2-cyclopentenone
- 3-*n*-Propyl-2-cyclopentenone
- 3-Isopropyl-2-cyclopentenone
- 3-Methyl-2-cyclopenten-2-ol-1-one

- 3,4-Dimethyl-2-cyclopenten-2-ol-1-one
- 3-Ethyl-2-cyclopenten-2-ol-1-one

- 2-Hydroxy-3-methylcyclopent-2-ene-1-one (cyclotene)

- Cyclohexanone
- 2,4,4-Trimethylcyclohexanone
- 2-Cyclohexenone
- 2,4-Dimethyl-4-cyclohexenone
- 1-Methyl-2-cyclohexen-5-one
- 5,5-Dimethyl-1,3-cyclohexanedione

- Cyclohexanecarboxaldehyde
- Cyclohexanepropionaldehyde

Esters
- Methyl formate
- Methyl acetate
- Methyl propionate
- Methyl butyrate
- Methyl isobutyrate
- Methyl crotonate
- Methyl valerate
- Methyl caproate
- Methyl enanthate
- Methyl myristate

(continued)

Table I. (Continued)

Phenols
- Phenol
- *o*-Cresol (2-methylphenol)
- *m*-Cresol (2-methylphenol)
- *p*-Cresol (4-methylphenol(
- 2-Ethylphenol
- 3-Ethylphenol
- 4-Ethylphenol
- 2-Ethyl-5-methylphenol
- 3-Ethyl-5-methylphenol
- 2,3-Xylenol (2,3-dimethylphenol)
- 2,4-Xylenol (2,4-dimethylphenol)
- 2,5-Xylenol (2,5-dimethylphenol)
- 2,6-Xylenol (2,6-dimethylphenol)
- 3,4-Xylenol (3,4-dimethylphenol)
- 3,5-Xylenol (3,5-dimethylphenol)
- Diethylphenol
- 2,3,5-Trimethylphenol
- 2,3,6-Trimethylphenol
- 2,4,6-Trimethylphenol
- 4-Propylphenol
- 4-Isopropylphenol
- 2-Methyl-5-isopropylphenol
- 4-Butylphenol
- 2-Isobutylphenol
- 2-Allylphenol
- 3-Allylphenol
- 4-Allylphenol
- 4-Vinylphenol
- 3-Methoxyphenol

Phenols (continued)
- 4-Methoxyphenol
- Dimethoxyphenol
- Methoxyethylphenol
- 3,4-Dimethoxyphenol
- Syringol (2,6-dimethoxyphenol)
- 4-Methylsyringol (2,6-dimethoxy-4-ethylphenol)
- 4-Ethylsyringol (2-dimethoxy-4-ethylphenol)
- 4-Propylsyringol (2,6-dimethoxy-4-propylphenol)
- 4-Isopropylsyringol (2,6-dimethoxy-4-isopropylphenol)
- 4-Propenylsyringol (2,6-dimethoxy-4-propenylphenol)
- 4-*trans*-Propenylsyringol (2,6-dimethoxy-4-*trans*-propenylphenol)
- 4-*cis*-Propenylsyringol (2,6-dimethoxy-4-*cis*-propenylphenol)
- 4-Allylsyringol (2,6-dimethoxy-4-allylphenol)
- 4-Vinylsyringol (2,6-dimethoxy-4-vinylphenol)
- 4-Isobutylsyringol (2,6-dimethoxy-4-isobutylphenol)
- 2,4-Dimethoxy-4-allylphenol
- 1,2-Dihydroxy-4-methylphenol
- 2-Methoxy-4-acetic acid phenol
- 3-Methoxy-4-propan-2-one phenol
- Acetophenol
- 4-Isopropylacetophenol
- 4-Hydroxy-3-methoxyacetophenol
- 3,4-Dimethoxyacetophenone

(continued)

Table 1. (Continued)

Esters (continued)
- Methyl palmitate
- Methyl acrylate
- Ethyl myristate
- Ethyl benzoate
- Cresyl acetate
- Hydroxy-2-butanone acetate
- Hydroxy-2-propanone propionate
- Salcylic acid methyl ester
- 4-Methoxybenzoic acid methyl ester

- 4-Hydroxy-4-methoxybenzoic acid methyl ester
- 4-Hydroxy-3,5-dimethoxybenzoic acid methyl ester
- 3-Methoxy-4-hydroxyphenylacetic acid methyl ester

Furans
- Furfuryl alcohol

- 2-Furfuryl methyl alcohol
- Furan
- 2-Methylfuran
- 2,5-Dimethylfuran
- 2,4-Dimethylfuran
- 2-Ethylfuran
- 2-Acetylfuran
- Propylfuran
- 2-Isopropylfuran
- 2-Propenylfuran
- 2-Acetyl-5-methylfuran
- 2,5-Dimethyl-3-acetylfuran
- Amylfuran
- 2,3,5-Trimethylfuran
- 2-Vinylfuran
- 2-Vinyl-3-methylfuran
- Benzofuran
- 2-Methylbenzofuran
- Dimethylbenzofuran
- Dibenzofuran
- Bis-(furfuryl)-2-furan
- 2,3-Dimethyl-5-ethylfuran
- 3,4-Dimethyl-5-ethylfuran
- 2-Ethyl-2,3-dihydro-5-methylfuran

- 2,5-Tetrahydrodimethylfuran

Furans (continued)
- 2-Methyltetrahydrofuran-3-one
- 2,5-Dimethyltetrahydrofuran-3-one

- 2-Acetyltetrahydrofuran-3-one
- 2-Furoic acid
- 4-Methyl-2-furoic acid
- Methyl-2-furoate
- Furfuryl methyl ether
- 2-Furfuryl methyl ketone

- 3-Furfuryl methyl ketone
- 2-Furfuryl propyl ketone
- 2-Furfuryl butyl ketone
- 2-(5-Methyfuryl)-methyl ketone
- 2-Furfural

- 3-Furfural
- 4-Methylfurfural
- 5-Methylfurfural

- 2-Methyl-3-furfural
- 3-Methyl-2-furfural
- 5-Hydroxymethyl-2-furfural

- 2,5-Difurfuryledine-1-cyclopentanone

Lactones
- γ-Butyrolactone
- β-Angelica lactone
- γ-Crotonolactone
- γ-Hydroxyvalerolactone
- δ-Hydroxyvalerolactone
- α-Hydroxy-γ-hydroxyvalerolactone

- 2-Butenolide
- 2-Methyl-2-butenolide
- 4-Methyl-2-butenolide
- 2,3-Dimethyl-2-butenolide
- 2,4-Dimethyl-2-butenolide
- 3,4-Dimethyl-2-butenolide
- 2,3,4-Trimethyl-2-butenolide
- 4-Ethyl-2-methyl-2-butenolide
- 4-Ethylidiene-2-methyl-2-butenolide
- Methylvinyl-2-butenolide

Table 1. (Continued)

Phenols (continued)
- 2-Acetovanillone (4′-hydroxy-3′-methoxyacetophenone)
- Guaiacol (2-methoxyphenol)
- 4-Methylguaiacol (2-methoxy-4-methylphenol)
- 6-Methylguaiacol (2-methoxy-6-methylphenol)
- 5-Methylguaiacol (2-methoxy-5-methylphenol)
- 3-Methylguaiacol (2-methoxy-3-methylphenol)
- 4-Ethylguaiacol (2-methoxy-4-ethylphenol)
- 4-Propylguaiacol (2-methoxy-4-propylphenol)
- 4-Isopropylguaiacol (2-methoxy-4-isopropylphenol)
- 4-Vinylguaiacol (2-methoxy-4-vinylphenol)
- 5-Vinylguaiacol (2-methoxy-5-vinylphenol)
- 3,5-Dimethylguaiacol (2-methoxy-3,5-dimethylphenol)
- Eugenol (2-methoxy-4-allylphenol)
- *trans*-Isoeugenol (2-methoxy-4-*trans*-propenylphenol)
- *cis*-Isoeugenol (2-methoxy-4-*cis*-propenylphenol)
- Pyrocatechol (1,2-benzenediol)
- 3-Methylpyrocatechol
- 4-Methylpyrocatechol
- 5-Methylpyrocatechol

Phenols (continued)
- 4-Ethylpyrocatechol
- 3-Methoxypyrocatechol
- Resorcinol (1,3-dihydroxybenzene)
- 4-Ethylresorcinal

Miscellaneous
- Methylamine
- Dimethylamine
- Trimethylamine
- Pyrazine
- Methylpyrazine
- 2,5-Dimethylpyrazine
- Pyrrole
- 2-Acetylpyrrole
- 2-Formylpyrrole
- α-Methyl pyrryl ketone
- α-Ethyl pyrryl ketone
- Pyridine
- 4-Hydroxy-6-methyl-2,4-pyran-2-one
- Maltol (3-hydroxy-2-methylpyrone)
- Dimethoxymethane
- Dimethoxyethane
- Methoxybenzene
- Thymol
- Ethanediol
- 1-Naphthol
- Toluene
- Styrene
- Benzene
- Ethylbenzene
- 5-Propyl-1,2,3-benzenetriol
- 1,2-Dimethoxybenzene (veratrol)
- 1,2-Dimethoxy-4-methylbenzene (methylveratrol)
- 1,2-Dimethoxy-4-ethylbenzene (ethylveratrol)
- 1,4-Dimethoxybenzene
- *n*-Pentadecane
- 2,6,10,14-Tetramethylpentadecane
- 1-Indanone

Table 1. (Continued)

Carbonyls
Methanal
Ethanal
Hydroxyethanal
Phenylethanal
2-Pyrroaldehyde
Propanal
2-Propanal (acrolein)
2-Methylpropanal
2,2-Dimethylpropanal
2-Methylpropenal
Acetone (2-propanone)

Acetylacetone
3-Methylacetylacetone
1-Hydroxypropanone (acetol)

2-Hydroxypropanone
Acetoxypropanone
1,3'-Dimethoxy-4-phenyl-1-propanone

1,3'-Dimethoxy-4-phenyl-2-propanone

1,5'-Dimethoxy-4-phenyl-2-propanone

α-Methyl-β-ethylpropenal
Butanal
2-Butenal
3-Methylbutanal

2-Methyl-2-butenal
2-Butanone
3-Methyl-2-butanone
1-Hydroxy-2-butanone
3-Hydroxy-2-butanone
1-Phenyl-2-butanone
3,3-Dimethyl-2-butanone
Diacetyl (2,3-butanedione)

Pentanal
α-Methylpentanal
2-Methyl-2-pentenal
2-Pentanone
3-Pentanone
4-Hydroxy-2-pentanone
4-Hydroxy-4-methyl-2-pentanone
2-Methyl-3-pentanone

Carbonyls (continued)
2,4-Dimethylpentanone
Pentadiene
Methylpentadiene
2,3-Pentanedione
4-Pentanedienal
2,4-Pentanedienal
Hexanal
2-Hexenal
2-Hexanone
3-Hexanone
5-Methyl-2-hexanone
2-Methyl-3-hexanone
3-Hexen-2-one
5-Hexen-2-one
2,4-Hexadienal
2,4-Hexanedione
2,5-Hexanedione
3-Methyl-2,5-hexanedione
2-Heptanone
4-Heptanone
3,6-Octanedione
Methyl ethyl ketone
Methyl isopropyl ketone
Methyl isopropenyl ketone
Methyl butyl ketone
Methyl vinyl ketone
Butyl methyl ketone
Allyl methyl ketone
1-Cyclohexyl methyl ketone
Cyclic ketone
Acetophenone (methyl phenyl ketone)

m-Methylacetophenone
p-Methylacetophenone
Acetosyringone (4'-hydroxy-3',5'-dimethoxyacetophenone)

Propiosyringone (4'-hydroxy-3',5'-dimethoxypropioacetophenone)

4'-Hydroxy-3'-methoxyacetophenone

Benzaldehyde
Salicylaldehyde (2-hydroxybenzaldehyde)

Table 1. (Continued)

Miscellaneous (continued)
- 2-Methyl-1-indanone
- 3-Methyl-1-indanone
- 6-Methyl-1-indanone
- Indene
- 3-Methylindene
- Trimethylindene
- 2,3-Dihydroindene
- Dimethylindane
- Naphthalene

Miscellaneous (continued)
- 1-Methylnaphthalene
- 2-Methylnaphthanlene
- 2-Ethylnaphthalene
- Trimethylnaphthalene
- Methylethylnaphthalene
- Methylvinylnaphthalene
- Allylnaphthalene
- 6-Methyl-1,2-dihydronaphthalene
- Methyldihydronaphthalene

Table 2

	Decay	**Sapstain**	**Mould**
Treatment	**MSC(%) 3wk**	**MSC(%) 3wk**	**MSC(%) 3wk**
Logon (25%)	34.5	34.7	88
Logon (50%)	0	1	88
Logon (100%)	0	0	88
Regen (25%)	6.2	71.3	88
Regen (50%)	0	3	88
Regen (100%)	0	1	88
Control	88	88	88

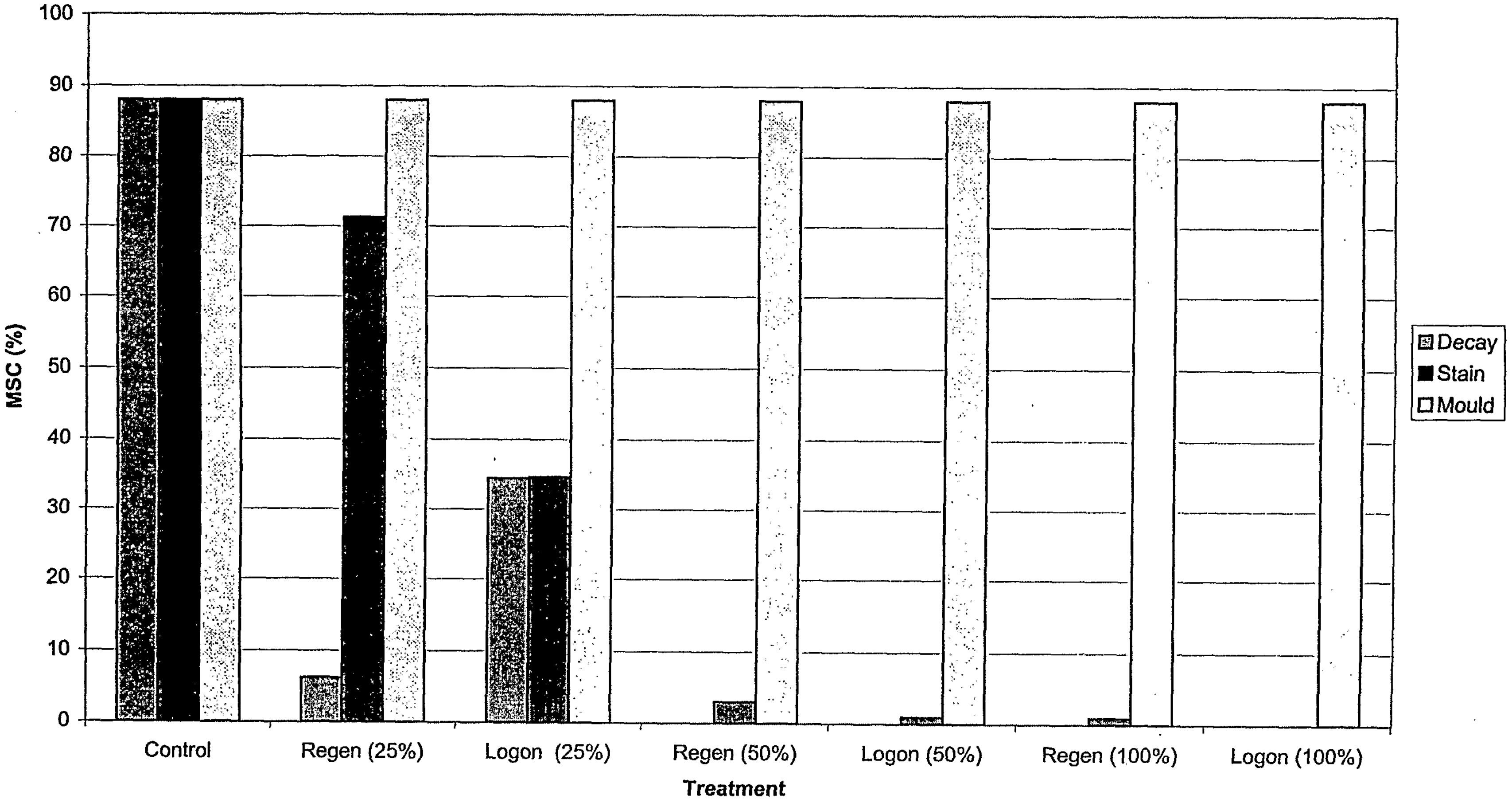
NB: MSC = Microbial Surface Coverage

Table 3

Treatment	Decay	Stain	Mould
Control	88	88	88
Regen (25%)	6.2	71.3	88
Logon (25%)	34.5	34.7	88
Regen (50%)	0	3	88
Logon (50%)	0	1	88
Regen (100%)	0	1	88
Logon (100%)	0	0	88

Table 4

Fungal coverage (MSC%) of test fungi on antisapstain treated radiata pine using Logon 100



Claims

1. A method of protecting wood which comprises treating the wood with a fluid treatment agent chosen from at least one of, liquid wood smoke, wood smoke vapour and a plurality of biologically active compounds comprised in liquid wood smoke.

2. A method according to any one of the preceding claims wherein the wood is allowed to dry before stacking.

3. A method according to claim 1 or claim 2 wherein the wood is chosen from a wood species affected by sap stain.

4. A method according to claim 3 wherein the wood is chosen from radiata pine, white meranti, falcate and xylampayan.

5. A method according to any one of the claims 1 to 4 wherein the wood is contacted with liquid wood smoke.

6. A method according to claim 5 wherein the liquid wood smoke has an acidity greater than 2%.

7. A method according to claim 6 wherein the liquid wood smoke has an acidity in the range 2% to 16%.

8. A method according to claim 7 wherein the liquid wood smoke has an acidity in the range 10% to 12%.

9. A method according to any one of the preceding claims wherein the wood is treated with the fluid treatment agent by at least one of spraying, dipping, direct contact and infusion.

10. A method according to any one of the preceding claims wherein the liquid treatment agent is applied at the rate of 0.25 litre/sqm.

11. A method according to any one of the preceding claims wherein the liquid treatment agent contains effective levels of the biologically active compounds for treatment against sap stain.

12. A method according to claim 11 wherein the plurality of biologically active compounds are chosen from, syringol, guaiacol, eugenol, p-cresol, m-cresol, o-cresol, phenol, pyrocatechol, 2, 3 xylenol, 2, 4-xylenol, 2, 6-xylenol, 3,5-xylenol, formaldehyde, acetaldehyde, benzaldehyde, anisaldehyde, acetic acid, formic acid, butyric acid, valeric acid, fumaric acid, benzoic acid, salicyclic acid, methanol, ethanol and allyalcohol.

13. A method according to claim 12 wherein the liquid treatment agent comprises at least three different biologically active compounds.

14. A method according to claim 9 wherein the wood is treated by heating wood smoke to produce wood smoke vapour and contacting the wood with the wood smoke vapour.

15. A method according to claim 14 wherein the wood smoke vapour is contacted with the wood for a period of 10 to 60 minutes.

16. A method according to claim 14 or claim 15 wherein the wood smoke vapour is contacted with the wood after the wood has been subjected to evacuation.

17. A method according to claim 9 wherein a wood is pyrolysed to produce hot wood smoke vapour and the wood smoke vapour is directly contacted with the wood being treated.

18. A method according to claim 1 substantially as hereinbefore described.

19. Wood which has been treated in accordance with the method of any one of claims 1 to 18.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2004/001106

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. 7: B27K 3/50

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)

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)
Derwent DWPI: IPC B27K 3/- and keyword SMOK+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Derwent Abstract Accession No. 15880 K/07, Class C03, JP 58001508 A (NORIINSHO KK) 6 January 1983	1-19
X	Derwent Abstract Accession No. 2000-353402/31, Class C07 D22 F09, JP 2000094406 A (KASHIMA J) 4 April 2000	1-19
X	Derwent Abstract Accession No. 93-364605/46, Class P14, JP 05269706 A (EBINA RINGYO KK) 19 October 1993	1-19

☐ Further documents are listed in the continuation of Box C ☒ See patent family annex

* Special categories of cited documents:

"A"	document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E"	earlier application or patent but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 22 October 2004	Date of mailing of the international search report - 3 NOV 2004
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **MATTHEW FRANCIS** Telephone No : (02) 6283 2424

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU2004/001106

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member
JP	58001508	NIL
JP	2000094406	NIL
JP	5269706	NIL

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX