Claims 2010-10-03

1. Method for treatment of wooden materials to improve the flame retardant properties and also the resistance to rot, fungus, mold and insects of the wooden material, wherein a wooden material is treated with a water based formulation, comprising the steps:

a) Providing a wooden material

b) Providing a water based formulation which is stable in room temperature or in temperatures ranging from 15-35 °C, and consisting essentially of;

-an alkali metal silicate
-water
- an insolubilization agent which is selected from an organic acid, an inorganic acid or an inorganic polyvalent ion, added in an amount which is at least 10 weight % lower than~~lower than~~ the amount of insolubilization agent needed for the formulation to reach the gelling point; and

c) Applying the water based formulation on the wooden material by impregnating the wooden material with the formulation by using vacuum and/or pressure; and

d) Drying the wooden material treated with said water based formulation at 15-70 °C ~~any given temperature~~ wherein the wooden material, after the drying step, has a dryness of 70% or more~~in order to remove excess of water~~; and

e) Curing the dried wooden material at an ~~elevated~~ temperature between 70 °C to 120 °C in order to insolubilize the alkali metal silicate.

Kommentar [HP1]: Stöd för ändring se ursprungligt krav 11

Kommentar [HP2]: Stöd för ändring se ursprungligt krav 19

Kommentar [HP3]: Stöd för ändring se ursprungligt krav 13

Kommentar [HP4]: Stöd för ändring, se ursprungligt krav 16.

2. A method according to any of the previous claims wherein the weight % of alkali metal silicate compared to the total weight % of the water based formulation can be from 1 % w/w to 50 % w/w, more preferably from 5 % w/w to 30 % w/w and most preferably from 10 % w/w to 20 % w/w.

3. A method according to any of the previous claims wherein the molar ratio between alkali metal, for example sodium or potassium and silicate ($XMe^{+}:SiO_4^{4-}$) in the water based formulation will be in the range from 0,1:1 to 2:1, more preferably from 0.5:1 to 0.8:1, or most preferably a molar ratio of 0.6:1.

Kommentar [HP5]: Korrigering av fel, stöd för ändring se beskrivning sid 3, rad 25 och sid 4, rad 8

4. A method according to any of the previous claims wherein the insolubilization agent is an organic acid with a molecular weight of for example between 40-500 g/mol or between 40-300 g/mol.

5. A method according to any of the previous claims wherein the insolubilization agent is an organic acid selected from acetic acid, mandelic acid, citric acid, tartaric acid, aspartic acid, glutamic acid, formic acid, propionic acid, butanoic acid, pentanoic acid, oxalic acid, maleic acid, succinic acid or glutaric acid,methanesulfonic acid (or mesylic acid, CH_3SO_3H), ethanesulfonic acid (or esylic acid, $CH_3CH_2SO_3H$), benzenesulfonic acid (or besylic acid, $C_6H_5SO_3H$), p-toluenesulfonic acid (or tosylic acid, $CH_3C_6H_4SO_3H$) or trifluoromethanesulfonic acid (or triflic acid, CF_3SO_3H).

6. A method according to any of claims 1-3 wherein the insolubilization agent is an inorganic acid , for example a mineral acid selected from any of hydrogen halides: hydrochloric acid (HCl), hydrobromic acid (HBr), hydroiodic acid (HI) or the halogen oxoacids: hypochloric acid, chloric acid, perchloric acid, periodic acid and corresponding compounds for bromine and iodine, or from any of sulfuric acid (H_2SO_4), fluorosulfuric acid, nitric acid (HNO_3), phosphoric acid (H_3PO_4), fluoroantimonic acid, fluoroboric acid, hexafluorophosphoric acid, chromic acid (H_2CrO_4) or boric acid (H_3BO_3).

7. A method according to any of the previous claims 1-3 wherein the insolubilization agent is an inorganic polyvalent ion selected from Al^{3+}, Mg^{2+}, Fe^{2+}, Fe^{3+}, Ca^{2+}, Ba^{2+}, or with counter ions $CaCl_2$, $MgCl_2$, $FeCl_2$ or combinations thereof.

8. A method according to any of claims 5 wherein the alkali metal silicate is sodium silicate.

9. A method according to claim 8 wherein the suitable molar ratios between the organic acid and sodium silicate may be from 1:18 to 1:100.

10. A method according to claim 9 wherein the sodium silicate has a molar ratio of Na^+ to SiO_4^{4-} of 0,6:1 and wherein said formulation has a pH above 11.

~~11. A method according to any of the previous claims wherein the amount insolubilization agent used is at least 10 weight % lower than the amount of insolubilization agent needed for the water based formulation to reach the gelling~~

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~~point.~~

~~12.~~11. A method according to any of the previous claims wherein the amount of insolubilization agent used in the water based formulation is chosen or adjusted depending on the acidity the wooden material to be treated; higher acidity in the wooden material requires lower amount of insolubilization agent in the formulation.

~~13. A method according to any of the previous claims wherein the wooden material, after the drying step, has a dryness of 70% or more before entering the curing step in the wood treatment process.~~

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~~14.~~12. A method according to any of the previous claims wherein a stable formulation is a formulation which has a shelf life of more than 1 month in room temperature or lower or in temperatures ranging from 15-35 °C.

~~15.~~13. A method according to any of the previous claims wherein the drying step is performed in room temperature or lower or in slightly elevated temperature such as 15-70 °C or especially at 20-50 °C.

~~16. A method according to any of the previous claims wherein the curing step is performed at a temperature of 40 °C or more or between 50 °C and 250 °C or in the range of 70 °C to 120 °C or in the range of 75 °C to 100 °C.~~

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~~17.~~14. A method according to any of the previous claims wherein the curing step is performed during 10 – 60 minutes.

~~18.~~15. A method according to any of the previous claims wherein the wooden materials is selected from spruce, pine, birch, oak, redwood, cedar or composite materials such as plywood, fibre boards, particle boards, or pulp based materials such as paperboard, corrugated board, gypsum grade paperboard, specialty paper for example filter paper or printing paper or moulded pulp products.

~~19.~~16. A method according to any of the previous claims wherein the water based formulation is applied on the wooden material by ~~soaking or dipping the wooden material into the formulation, spraying, painting or brushing wooden surfaces with the formulation or~~ impregnating the wooden material with the formulation by using

vacuum and/or pressure according to normal vacuum-pressure impregnation protocols.

~~20.~~17. A method according to any of the previous claims wherein the water based formulation further comprises a wetting agent in concentration between 0,05 % to 5 % (w/w) and / or a rheology modifier in concentratio0,05 % to 5 % (w/w).

~~21.~~18. A wooden material with improved flame retardant properties and also improved resistance to rot, fungus, mold and insects treated with the method described in any of claims 1-~~20~~17.