Existing sheets also exhibit poor durability when measured by their resistance against biological attack, when compared to sheets produced from acetylated wood elements.

It is therefore an object of the ~~invention~~embodiments disclosed herein to provide a wood based composite which does not exhibit the aforementioned disadvantages, but rather will show favourable and reduced swelling behaviour under the effect of varying climatic conditions.

Another object of the ~~invention~~embodiments disclosed herein is to provide a wood based composite that has a long life span and is durable, ie that will not rot, decay or disintegrate under the influence of weather or biological attack.

Still another object of the ~~invention~~embodiments disclosed herein is to provide a wood based composite that after being immersed in water at ambient temperature and in equilibrium therewith, for a significant period of time, will show substantially less reduction in mechanical strength properties such as a modulus of rupture and modulus of elasticity, when compared with existing composites. By 'significant period of time' is meant for several weeks or months.

Another object of the ~~invention~~embodiments disclosed herein is to provide a wood based composite which possesses a surface that remains smooth after wetting or priming with substantially no fibres or wood elements coming loose or standing up from the surface. This enables coatings and paints to be more efficiently, and thereby cost effectively, applied. In addition this property in combination with improved dimensional stability results in a substantially longer service life for the coating and thereby lower maintenance costs. Typically, fibres or wood elements may stand up from the surface of the composite by 1 to 2 mm, giving the surface a 'hairy feel'.

A further object of the ~~invention~~embodiments disclosed herein is the provision of a process for producing acetylated wood elements as basic raw material for producing the wood based composites according to the ~~invention~~disclosure. Typically, wood elements suitable for acetylation according to the present ~~invention~~disclosure are described in the table I below:-

Table I

Wood Element	Length (mm)		Width (mm)		Thickness (mm)	
	From	To	From	To	From	To
Chips	25	75	25	75	1.50	15
Flakes	15	75	15	75	0.25	0.50
Strands	15	75	5	25	0.25	0.50
Splinters (slivers)	5	75	0.15	0.50	0.15	0.50
Particles	1.5	15	0.15	1.30	0.15	1.25
Fibrebundles	1.5	25	0.15	0.50	0.15	0.50
Fibres	1.0	5	0.05	0.10	0.05	0.10

Suitably acetylated wood elements may be prepared either by acetylating large geometry elements, eg wafers which are then further size reduced to the desired final geometry, or by first converting green wood directly to the desired final geometry before acetylation.

Thus, the present ~~invention~~disclosure comprises a composite wood product containing acetylated wood elements characterised by an average value in thickness swelling not exceeding 5% after subjection to 25 wet-dry/freeze-thaw test cycles as described in Table II.

In a first aspect, there is provided a composite wood product containing acetylated wood elements characterised by an average value in thickness swelling not exceeding 5% after subjection to 25 wet-dry/freeze-thaw cycles measured according to DIN EN 12467/12, wherein one wet-dry cycle consists of storage of the test samples with dimensions 500 mm×500 mm×12 mm in water at a temperature of 20° C for 18 hrs, followed by drying of the test samples in an oven for 6 hrs at a temperature of 60° C and a relative humidity of 20% and wherein one freeze-thaw cycle consists of storage of the test samples with dimensions 500 mm×500 mm×12 mm in water at a temperature of 20° C for 3 hrs, followed by freezing of the test samples at a temperature of −20° C for 3 hrs.

Alternatively, the composite containing acetylated wood elements may be characterised by retaining an average value of at least 90% of its modulus of elasticity after subjection to 25 wet-dry/freeze-thaw test cycles as described in Table II.

In a second aspect, there is provided a composite wood product containing acetylated wood elements characterised by retaining an average value of at least 90% of its modulus of elasticity after subjection to 25 wet-dry/freeze-thaw cycles measured according to DIN EN 12467/12, wherein one wet-dry cycle consists of storage of the test samples with dimensions 500 mm×500 mm×12 mm in water at a temperature of 20° C for 18 hrs, followed by drying of the test samples in an oven for 6 hrs at a temperature of 60° C and a relative humidity of 20% and wherein one freeze-thaw cycle consists of storage of the test samples with dimensions 500 mm×500 mm×12 mm in water at a temperature of 20° C for 3 hrs, followed by freezing of the test samples at a temperature of −20° C. for 3 hrs.

Further, in the alternative the composite containing acetylated wood elements may be characterised by retaining an average value of at least 90% of its bending strength after subjection to 25 wet-dry/freeze-thaw test cycles as described in Table II.

In a third aspect, there is provided a composite wood product containing acetylated wood elements characterised by retaining an average value of at least 90% of its bending strength after subjection to 25 wet-dry/freeze-dry cycles measured according to DIN EN 12467/12, wherein one wet-dry cycle consists of storage of the test samples with dimensions 500 mm×500 mm×12 mm in water at a temperature of 20° C for 18 hrs, followed by drying of the test samples in an oven for 6 hrs at a temperature of 60° C and a relative humidity of 20% and wherein one freeze-thaw cycle consists of storage of the test samples with dimensions 500 mm×500 mm×12 mm in water at a temperature of 20° C for 3 hrs, followed by freezing of the test samples at a temperature of −20° C. for 3 hrs.

In a fourth aspect, there is provided ~~Additionally,~~ the composite wood product containing acetylated wood elements ~~may be~~ characterised by retaining at least 70% of its modulus of rupture after soaking for 48 hours in water at ambient temperature.

The composite containing acetylated wood elements may also be characterised by having two or more of the above product properties.

In a fifth aspect, there is provided a composite wood product containing acetylated wood elements characterised by two or more of an average value in thickness swelling not exceeding 5% after subjection to 25 wet-dry/freeze-thaw cycles as described in Table II, retaining an average value of at least 90% of its modulus of elasticity after subjection to 25 wet-dry/freeze-thaw cycles measured according to DIN EN 12467/12, wherein one wet-dry cycle consists of storage of the test samples with dimensions 500 mm×500 mm×12 mm in water at a temperature of 20° C for 18 hrs, followed by drying of the test samples in an oven for 6 hrs at a temperature of 60° C and a relative humidity of 20% and wherein one freeze-thaw cycle consists of storage of the test samples with dimensions 500 mm×500 mm×12 mm in water at a temperature of 20° C for 3 hrs, followed by freezing of the test samples at a temperature of −20° C. for 3 hrs, retaining an average value of at least 90% of its bending strength after subjection to 25 wet-dry/freeze-dry cycles or retaining at least 70% of its modulus of rupture after soaking for 48 hours in water at ambient temperature.

The present ~~invention~~disclosure also comprises a two stage process for the acetylation of wood elements in which the elements are (a) treated with acetic anhydride at a temperature of 30°C to 190°C at a pressure of atmospheric to 15 barg for up to 80 minutes and thereafter (b) heated with an inert gas which may be mixed with acetic anhydride or a mixture of acetic anhydride and acetic acid to a temperature of 150°C to 190°C at a pressure of 1 to 5 barg for a period of 5 to 300 minutes.

The stages (a) and (b) may readily be carried out in a suitable pressure reactor.

Preferably, the wood elements prior to acetylation are dried to a moisture content of 2% to 10% by weight of water by conventional methods.

Desirably, prior to stage (a) a vacuum is applied to the elements to remove resident gases.

Following acetylation the elements may conveniently be allowed to dry at atmospheric pressure or be vacuum dried or both.

In stage (a) acetic anhydride at a temperature of 60°C to 130°C is preferred, at a pressure of 8 to 12 barg for 5 to 20 minutes, while in stage (b) it is preferred to use an inert gas (e.g. nitrogen) at a temperature of 130°C to 145°C for 2 to 4 hours. In this stage the pressure in the reactor may rise to 1 to 3 barg, and the inert gas become fully saturated with acetic anhydride and acetic acid.

In a sixth aspect, there is provided a process for the manufacture of a composite wood product from wood elements, comprising treating the wood elements with acetic anhydride at a temperature of 30° C to 190° C at a pressure of atmospheric to 15 barg for up to 80 minutes and thereafter heating with an inert gas which may be mixed with acetic anhydride or a mixture of acetic anhydride and acetic acid to a temperature of 150° C to 190° C at a pressure of 1 to 5 barg for a period of 5 to 300 minutes to make acetylated wood elements, and forming the acetylated wood elements into the composite wood product.

In a seventh aspect, there is provided a composite wood product obtained by the process as defined above.

In an example of the process of the present ~~invention~~disclosure wood chip (approx. 40mm x 40mm x 10mm) derived from spruce and having a moisture content of 4% - 10% by weight of water was placed in wire mesh walled baskets (to allow the easy passage of fluids), and placed in a pressure reactor. A vacuum of -0.95 barg was then applied to the chip for 5 minutes. Thereafter, pre-heated acetylation fluid (comprising of a mixture of acetic

Claims

1. A composite wood product containing acetylated wood elements characterised by an average value in thickness swelling not exceeding 5% after subjection to 25 wet-dry/freeze-thaw cycles as described in Table II.

2. A composite wood product containing acetylated wood elements characterised by retaining an average value of at least 90% of its modulus of elasticity after subjection to 25 wet-dry/freeze-thaw cycles as described in Table II.

3. A composite wood product containing acetylated wood elements characterised by retaining an average value of at least 90% of its bending strength after subjection to 25 wet-dry/freeze-dry cycles as described in Table II.

4. A composite wood product containing acetylated wood elements characterised by retaining at least 70% of its modulus of rupture after soaking for 48 hours in water at ambient temperature.

5. A composite wood product containing acetylated wood elements characterised by having two or more of the properties of the products of claims 1 to 4.

6. A composite as claimed in any one of the preceding claims characterised by the use of polymeric di-phenylmethane diisocyanate adhesive.

7. Use of polymeric di-phenylmethane diisocyanate as an adhesive in the manufacture of a composite wood product containing acetylated wood elements.

8. A two stage process for the acetylation of wood elements characterised in that the elements are (a) treated with acetic anhydride at a temperature of 30°C to 190°C at a pressure of atmospheric to 15 barg for up to 80 minutes and thereafter (b) heated with an inert gas which may be mixed with acetic anhydride or a mixture of acetic anhydride and

acetic acid to a temperature of 150°C to 190°C at a pressure of 1 to 5 barg for a period of 5 to 300 minutes.

9. A process as claimed in claim 8 characterised in that the wood elements comprise spruce or pine.

10. A process as claimed in claims 8 or 9 characterised in that the wood elements prior to acetylation are dried to a moisture content of 2% to 10% by weight of water.

11. A process as claimed in any one of claims 8 to 10 characterised in that prior to stage (a) a vacuum is applied to the elements to remove resident gases.

12. A process as claimed in any one of claims 8 to 11 characterised in that the temperature in stage (a) is 60°C to 130°C, the pressure 8 to 12 barg and time 5 to 20 minutes.

13. A process as claimed in any one of claims 8 to 12 characterised in that the temperature in stage (b) is 130°C to 145°C, the pressure 1 to 3 barg and time 2 to 4 hours.

14. A process as claimed in claim 13 characterised in that the pressure is 1 to 2 barg.

15. A process as claimed in any one of claims 8 to 14 characterised in that the inert gas is nitrogen.

16. A process as claimed in claim 15 characterised in that the nitrogen is fully saturated with acetic anhydride and acetic acid.

Claims

1. A composite wood product containing acetylated wood elements characterised by an average value in thickness swelling not exceeding 5% after subjection to 25 wet-dry/freeze-thaw cycles measured according to DIN EN 12467/12, wherein one wet-dry cycle consists of storage of the test samples with dimensions 500 mm×500 mm×12 mm in water at a temperature of 20° C for 18 hrs, followed by drying of the test samples in an oven for 6 hrs at a temperature of 60° C and a relative humidity of 20% and wherein one freeze-thaw cycle consists of storage of the test samples with dimensions 500 mm×500 mm×12 mm in water at a temperature of 20° C for 3 hrs, followed by freezing of the test samples at a temperature of −20° C for 3 hrs.

2. A composite wood product containing acetylated wood elements characterised by retaining an average value of at least 90% of its modulus of elasticity after subjection to 25 wet-dry/freeze-thaw cycles measured according to DIN EN 12467/12, wherein one wet-dry cycle consists of storage of the test samples with dimensions 500 mm×500 mm×12 mm in water at a temperature of 20° C for 18 hrs, followed by drying of the test samples in an oven for 6 hrs at a temperature of 60° C and a relative humidity of 20% and wherein one freeze-thaw cycle consists of storage of the test samples with dimensions 500 mm×500 mm×12 mm in water at a temperature of 20° C for 3 hrs, followed by freezing of the test samples at a temperature of −20° C. for 3 hrs.

3. A composite wood product containing acetylated wood elements characterised by retaining an average value of at least 90% of its bending strength after subjection to 25 wet-dry/freeze-dry cycles measured according to DIN EN 12467/12, wherein one wet-dry cycle consists of storage of the test samples with dimensions 500 mm×500 mm×12 mm in water at a temperature of 20° C for 18 hrs, followed by drying of the test samples in an oven for 6 hrs at a temperature of 60° C and a relative humidity of 20% and wherein one freeze-thaw cycle consists of storage of the test samples with dimensions 500 mm×500 mm×12 mm in water at a temperature of 20° C for 3 hrs, followed by freezing of the test samples at a temperature of −20° C. for 3 hrs.

4. A composite wood product containing acetylated wood elements characterised by retaining at least 70% of its modulus of rupture after soaking for 48 hours in water at ambient temperature.

5. A composite wood product containing acetylated wood elements characterised by two or more of an average value in thickness swelling not exceeding 5% after subjection to 25 wet-dry/freeze-thaw cycles as described in Table II, retaining an average value of at least 90% of its modulus of elasticity after subjection to 25 wet-dry/freeze-thaw cycles measured according to DIN EN 12467/12, wherein one wet-dry cycle consists of storage of the test samples with dimensions 500 mm×500 mm×12 mm in water at a temperature of 20° C for 18 hrs, followed by drying of the test samples in an oven for 6 hrs at a temperature of 60° C and a relative humidity of 20% and wherein one freeze-thaw cycle consists of storage of the test samples with dimensions 500 mm×500 mm×12 mm in water at a temperature of 20° C for 3 hrs, followed by freezing of the test samples at a temperature of −20° C. for 3 hrs, retaining an average value of at least 90% of its bending strength after subjection to 25 wet-dry/freeze-dry cycles or retaining at least 70% of its modulus of rupture after soaking for 48 hours in water at ambient temperature.

6. The composite of claim 1 characterised by the use of polymeric di-phenylmethane diisocyanate adhesive.

7. A process for the manufacture of a composite wood product from wood elements, comprising treating the wood elements with acetic anhydride at a temperature of 30° C to 190° C at a pressure of atmospheric to 15 barg for up to 80 minutes and thereafter heating with an inert gas which may be mixed with acetic anhydride or a mixture of acetic anhydride and acetic acid to a temperature of 150° C to 190° C at a pressure of 1 to 5 barg for a period of 5 to 300 minutes to make acetylated wood elements, and forming the acetylated wood elements into the composite wood product.

8. The process as claimed in claim 7 characterised in that the wood elements comprise spruce or pine.

9. The process as claimed in claim 7 characterised in that the wood elements prior to acetylation are dried to a moisture content of 2% to 10% by weight of water.

10. The process as claimed in claim 7 characterised in that prior to stage (a) a vacuum is applied to the elements to remove resident gases.

11. The process as claimed in claim 7 characterised in that the temperature in stage (a) is 60° C to 130° C, the pressure 8 to 12 barg and time 5 to 20 minutes.

12. The process as claimed in claim 7 characterised in that the temperature in stage (b) is 130° C to 145° C, the pressure 1 to 3 barg and time 2 to 4 hours.

13. The process as claimed in claim 12 characterised in that the pressure is 1 to 2 barg.

14. The process as claimed in claim 7 characterised in that the inert gas is nitrogen.

15. The process as claimed in claim 14 characterised in that the nitrogen is fully saturated with acetic anhydride and acetic acid.

16. A process according to claim 7, wherein the wood elements have a length of 1.0-75 mm, a width of 0.05-75 mm and a thickness of 0.05-15 mm.

17. A composite wood product obtained by the process according to claim 7.