

PATENT SPECIFICATION

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(54) IMPROVEMENTS IN AND RELATING TO WOOD TREATMENT

- (71) We, TAKEJI MOTAI a Japanese subject of 1-37-4, Irima-cho, Chofu-shi, Tokyo, Japan and SHIN-ASAHIKAWA KABUSHIKI KAISHA a Japanese company of Tokyo Kaijo Bldg. 1-2-1 Marunouchi, Chiyoda-ku, Tokyo, Japan, do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is to be performed to be particularly described in and by the following statement:-
- The present invention relates to a process for treating wood to eliminate defects thereof.
- Wood is extensively used in modern society particularly for building materials and furniture. Defects such as warp, spiral grain, crook, break, stain and rot are often found and for those who are in the business of using wood, such defects are an extremely serious problem.
- Wood has a variety of differences, even though it is of the same species and of the same origin; for example:
- 1) differences in heartwood, sapwood and defective wood;
 - 2) differences in wood structure,
 - 3) differences in physical processing machinability;
 - 4) differences in thickness, width and length;
 - 5) differences in the water content of the wood itself; and
 - 6) differences in ability to withstand drying and keeping qualities.
- Thus, the elimination of defects has become an extremely important world-wide problem.
- According to the present invention, there is provided a process for improving the quality of wood which comprises the steps of:
- a) steeping the wood at an elevated temperature in a solution of a surface active agent for a first predetermined period,
 - b) removing the steeped wood to a pressure vessel, adding thereto an aqueous solution of a surface active agent and an alkali and treating the steeped wood at an elevated temperature and pressure for a second predetermined period,
 - c) removing the aqueous solution and subjecting the said treated wood to a sub-atmospheric pressure to further remove excess moisture, and
 - d) drying the resultant product.
- In case of species having a relatively small number of defects (Japan cedar, silver fir and Japanese cypress), the steeping time in step a) can be shortened by about 1/2 that normally required, and the concentration of the surface active agent solution and dilute alkali solution of step b) can be reduced by about 1/2 that usually required. In such circumstances the pressure and heating conditions of step b) alkali solution can be lowered to 2.0 kg/cm² and 120°C over 2 hours.
- Furthermore, the surface active agent solution in the steeping tank can be used repeatedly by adjusting the concentration thereof, thus ensuring economy in the treatment of the invention.
- There are cases where the conditions of treatment such as species, moisture content, dimensions are required to be changed to a certain degree, but except for the use of special woods for precision utilizations, the sufficiency of treatment can be secured by the foregoing treating method.
- There is a relationship between the moisture content of the wood to be treated and the treatment condition of the wood, for instance:-
- (1) In wood whose moisture content is below 30%, unless step a) includes a surface active agent whose concentration is about 0.5%, it is difficult to remove the defects of the wood even if step b) is carried out for a period as set out.

(2) In wood whose moisture content is above 30% and below 60%, the concentration of the surface active agent can be set lower, 0.1% to 0.3%. In this case too, unless the wood is treated in step a) irregularities in the wood are generated even if step b) is correctly effected.

(3) In wood whose moisture content is above 60% the concentration of the solution in step a) may be as low as 0.01%.

When the process of the present invention is applied to larch, separation of resin, spiral grain, crook, warp, break which are drawbacks of the larch can be eliminated, and its excellent features such as strength, durability, beauty of grain can be utilized, and moreover its advantageous points such as growth speed, good bonding properties and adaptability to poor land can be fully utilized.

Thus, the larch which had heretofore been used only as temporary scaffolding lumber for civil engineering work, supports for trees and low value wood such as pulp material can now be used in diversified situations such as high class decorative woods for use as alcove posts, and rafters, and also as the wood of choice for main structural components for wood frame construction houses such as square studs for headers, collar frames, rafters and joists. It may also be used as a decorative material such as for high class wood furniture or wood for toys, floors or walls.

Following is a description by way of example only of methods of carrying the invention into effect.

Example 1

Treatment of logs of species having relatively large defects (representative species: beech, oak, larch and hemlock).

A Larch log with bark having a moisture content above 60% a central diameter of 15 cm, and a length of 4m was placed in a 6 meter square boiling tank with a 2 metre depth. The log was then heated for about 12 hours in hot water containing a surface active agent at a temperature of 92 - 98°C (aqueous solution of anion active agent having high permeation, dispersion, cleaning and solubility). The so treated log was then shifted to a pressure boiler having a diameter of 1.5 metres and length of 6 metres. An aqueous solution of 0.1% concentration of the surface active agent (anion active agent sodium dodecylbenzene sulfonate was used) and dilute alkali solution (soda ash = Na_2CO_3 was used) having an aqueous alkali solution concentration 4% were added in an amount at least equal to the volume of the log, and the log was then treated for 3 hours at a temperature of about 130°C and at a pressure of 3 kg/cm². Then the solution was drained. After drain-

ing, the moisture content (28% - 32%) of the log was subjected to dehydration under reduced pressure of up to 500 mm/Hg until it reached fibre saturation point. The log was removed from the pressure boiler, and then either immediately subjected to kiln drying for more than 48 hours at 55°C $\pm$ 5°C or was subjected to air drying for 10 - 15 days, or was subjected to air drying for 10 - 15 days and then was subjected to the kiln drying for more than 24 hours at a temperature of 55°C $\pm$ 5°C to obtain a log having a moisture content below 10%.

When treated as described in the foregoing the log obtained was almost free of defects whether used as it was or utilized as sawn timber.

Example 2

Treatment of lumber of species having relatively large defects (representative species: beech, oak, larch and hemlock)

The lumber (2" $\times$ 4" sawn lumber for wood frame construction) having a moisture content above 30% and below 60% a thickness of 44 mm width of 94 mm and length of 3,640 mm was placed in a 4 metre square boiling tank whose depth was 2 metres. The lumber was then heated for 8 hours at 92 - 98°C in an aqueous 0.3% solution of the surface active agent. Thereafter the lumber was shifted immediately to a 1.5 metre diameter pressure boiler which had a length of 6 metres and heat treated at 120°C for 2 hours at 2 kg/cm² pressure in a treatment solution consisting of a 0.05% aqueous solution of surface active agent and a 0.2% aqueous solution of soda ash. The solution was then drained. The surface active agent used was similar to the agent used in Example 1. After draining, dehydration was effected under reduced pressure until the moisture content of the lumber reached the fibre saturation point (28% - 32%). The lumber was then removed from the pressure boiler and was stored indoors under good ventilation for several days so as to air-dry the sample. The resultant lumber was almost free of defects when used as it was or when used after effecting kiln drying to obtain a moisture content of below 10% by heat treatment at 55°C $\pm$ 5°C.

Hemlock obtained according to Example 2 had almost no defects on treatment by the present invention, untreated conventional hemlock has a low yield because of the many defects resulting particularly from the drying of defective lumber. Therefore by use of the invention it becomes possible to effect an improvement in raw material utilization of about 20% in sawn lumber and of about 50% of lumber sawing expenses. Also the utilization of compression wood which had not been heretofore utilized because of the defects therein, became

possible thereby adding about 15% in value thereto.

Example 3

5 Treatment of planks of species having relatively large defects (representative species: beech, oak, larch, hemlock, lamin, lumbayao, kempas, ebony, black ebony and rosewood).

10 A rosewood plank (note: furniture wood) having a moisture content below 30% a thickness of 20 mm a width of 250 mm and a length of 1,000 mm was placed in a 4 metre square boiling tank whose depth was 2
15 meters and was heated for 4 hours in an aqueous solution of 0.5% surface active agent at 92°C to 98°C. After treatment it was shifted immediately to a pressure boiler whose diameter was 500 mm and length was
20 2 metres and was treated for 2 hours at 2 kg/cm² pressure and 120°C in 0.1% aqueous solution of surface active agent and 0.2% aqueous solution of soda ash; the solution then being drained.

25 After draining at reduced pressure dehydration was effected to a degree such that the moisture content of the plank reached fibre saturation point. The plank was then removed from the pressure boiler, and was
30 subjected immediately to the kiln drying for more than 48 hours at 55°C ± 5°C, and consequently excellent results were obtained.

35 The rosewood according to the Example 3 did not produce spiral grain, warp, crook or season cracks which are prevalent in this hardwood (yield of the wood improved by 20% on the average by the treatment), and
40 also as resin in the wood was properly effused adhesive bonding of the planks was regular. Furthermore, adhesive bonding properties were improved by 20-30% as compared with the untreated wood, and
45 consequentially machining was made easier.

Moreover, the surface hardness improved by 15 - 25% as compared with the untreated wood, whereby the treated wood became a good high-class furniture wood.

Example 4

50 Treatment of lumber of those species containing a relatively large amount of resin and having large defects (representative species: larch, pine, douglas fir, apitong and kapur.)

60 Douglas fir lumber (note: door frame and molding) having a moisture content above 30% and below 60%, a thickness of 35 mm and a width of 300 mm and a length of 2 metres and was heated for 4 hours in an aqueous 0.3% solution of surface active agent at a temperature of 92 - 98°C. The
65 lumber was then shifted immediately to a pressure boiler whose diameter was 500 mm

and length was 2 metres and was treated for 2 hours at 2 kg/cm² and 120°C in a 0.1% aqueous solution of surface active agent and 0.2% aqueous solution of soda ash. The solution was then drained. After draining, reduced pressure dehydration was effected until the moisture content of the lumber reached fibre saturation point. The lumber was then removed from the pressure boiler and was either subjected for kiln drying for more than 24 hours at 55°C ± 5°C to reduce the moisture content to below 10% or was subjected to air drying for 5 - 7 days and was then subjected for kiln drying for more than 24 hours at 55°C ± 5°C. Almost the same result was obtained in both instances.

The Douglas Fir prior to treatment according to the Example 4 was highly resinous but with the resin unevenly distributed in the lumber

Thus conventionally it has been difficult to render the resin homogeneous to such a degree that it did not pose problems in utilization. For this reason, various efforts have previously been made to overcome this by using various combinations of air drying kiln drying, and boiling for long period, but until now the special features of the Douglas fir were not fully utilized.

However by treatment according to the invention excessive or maldistributed resin the the wood was diffused, and the remaining resin was evenly distributed in the wood. Also, it was found that deterioration of wood colour with time which is a serious defect of the Douglas fir could be prevented. As a result, it has become possible to provide wood of a quality which can be effectively utilized in doors windows or furniture.

In this treatment of Douglas fir the resin was forced out by the pressure and heat treatment in the aqueous solution of surface active agent and aqueous solution of soda ash in the pressure boiler. The evaporated resin was then recovered and liquefied and the resultant turpentine oil was extracted.

Example 5

115 Treatment of lumber of species where the wood colour of the sapwood and the heartwood are unsightly as well as exhibiting other defects (representative species: beech, monkey pot, walnut and rosewood).

120 Beech wood (note: for furniture) having a moisture content above 30% and below 60% a thickness of 20 mm a width of 150 mm and a length 2 metres was placed in a 4 metre square boiling tank whose depth was 2 metres, and was heated for 4 hours in an aqueous solution of 0.3% concentration surface active agent at a temperature of 92 - 98°C. The wood was then immediately shifted to a separately prepared pressure boiler having a diameter of 500 mm and a
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length of 2 metres. An amount of previously prepared 0.03% aqueous dispersion of brown red pigment was added to a mixture of 0.1% aqueous solution of surface active agent and 0.2% aqueous solution of soda ash and the mixture was stirred so that the beech wood was pigmented a desired colour, eg: heartwood colour or birch wood colour. The wood was then treated for 2 hours at 2 kg/cm² pressure and 120°C. and the solution was then drained. After draining, reduced pressure dehydration was effected until the moisture content of the wood fell to about the fibre saturation point, and the wood was then shifted from the pressure boiler, and was subjected to kiln drying for more than 24 hours at a temperature of 55°C ± 5°C to reduce the moisture content to below 10%.

The beech wood before being treated by the method of the Example 5 had many defects and showed an irregular pattern of dark brown heartwood which greatly detracted from the commercial value of the wood. However, by treatment according to the present invention, the defects were eliminated, and the wood was coloured as desired. When the wood was subjected to resawing, cutting or boring, the wood resolutely exposed has a uniform wood colour and hence the commodity value thereof was much improved.

As clearly described in the foregoing examples, the treatment according to the present invention, provides an improvement in the quality and economical use of wood.

Typical advantages are:-

(1) Softwoods and hardwoods can be treated and significant improvements in quality achieved. Hence hitherto unutilizable wood can now be properly utilized.

(2) The method of this invention can be applied to wood sections of all shapes such as dowel, thick and thin planks.

(3) Even if the initial moisture content of the wood is great, it can be treated to provide a wood having a uniform quality.

(4) By the treatment of the invention the moisture content of a wood sample can be reduced to less than 10% and age changes in wood colour can be prevented. Further resin contents of wood can be adjusted in a period of from 2-4 days from the raw wood state.

(5) The products of the invention are obtained with very little wastage due to the improvements in raw wood utilization, and this leads to significant economies both in wood supply and in processing time.

(6) The treated wood can be subjected to complicated machining, rebating and boring, even if the wood has been preserved for a long period since there are almost no defects. Thus, treated wood can be used for the manufacture of goods for which there is

a fluctuating demand and which are required to have a high quality (eg: moldings furniture woods and door and window woods).

(7) The treated wood becomes of the alkaline type and is therefore resistant to discolouring and corroding bacteria; a moth proofing effect is automatically obtained.

(8) Low value woods such as larch can be used as the high class decorating wood as previously explained.

The present invention can thus utilize larch which at the moment is little used, and is easily obtained, for such high class uses at an economical price.

(9) Generally a 20% improvement in the reduction of sawing costs yields can be obtained as compared with sawing woods untreated by the method of the invention.

(10) The bonding power of the treated wood is improved by 10-30% as compared with untreated wood.

(11) Cutting and polishing properties of the treated wood are improved, and have the consumption of cutting materials such as sand paper is reduced.

(12) Treatment of Hemlock in accordance with the present invention can produce a frame wood of excellent quality and as a result, the effective yield can be improved by more than 20% over conventional processes.

(13) Turpentine oil can be extracted from resin evaporated from resin which is obtained as a by-product from the process of the present invention.

(14) Since the surface hardness of the treated wood improves by 15 - 25% (1) relatively soft woods can be utilized as harder woods such as for tables or other furniture and (2) efficient utilization of wood such as poplar and eucalyptus can be obtained. These woods grow fast but which have not hitherto been suitable for general use because they are too soft.

WHAT WE CLAIM IS:-

1. A process for improving the quality of wood which comprises the steps of:

a) steeping the wood at an elevated temperature in a solution of a surface active agent for a first predetermined period,

b) removing the steeped wood to a pressure vessel, adding thereto an aqueous solution of a surface active agent and an alkali and treating the steeped wood at an elevated temperature and pressure for a second predetermined period,

c) removing the aqueous solution and subjecting the said treated wood to a sub-atmospheric pressure to further remove excess moisture, and

d) drying the resultant product.

2. A process for treating wood as claimed in claim 1 wherein the wood is one or more of beech, oak, larch, pine, hem-



length of 2 metres. An amount of previously prepared 0.03% aqueous dispersion of brown red pigment was added to a mixture of 0.1% aqueous solution of surface active agent and 0.2% aqueous solution of soda ash and the mixture was stirred so that the beech wood was pigmented a desired colour, eg: heartwood colour or birch wood colour. The wood was then treated for 2 hours at 2 kg/cm² pressure and 120°C. and the solution was then drained. After draining, reduced pressure dehydration was effected until the moisture content of the wood fell to about the fibre saturation point. and the wood was then shifted from the pressure boiler, and was subjected to kiln drying for more than 24 hours at a temperature of 55°C ± 5°C to reduce the moisture content to below 10%.

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(2) The method of this invention can be applied to wood sections of all shapes such as dowel, thick and thin planks.

(3) Even if the initial moisture content of the wood is great, it can be treated to provide a wood having a uniform quality.

(4) By the treatment of the invention the moisture content of a wood sample can be reduced to less than 10% and age changes in wood colour can be prevented. Further resin contents of wood can be adjusted in a period of from 2-4 days from the raw wood state.

(5) The products of the invention are obtained with very little wastage due to the improvements in raw wood utilization, and this leads to significant economies both in wood supply and in processing time.

(6) The treated wood can be subjected to complicated machining, rebating and boring, even if the wood has been preserved for a long period since there are almost no defects. Thus, treated wood can be used for the manufacture of goods for which there is

a fluctuating demand and which are required to have a high quality (eg: moldings furniture woods and door and window woods).

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WHAT WE CLAIM IS:-

1. A process for improving the quality of wood which comprises the steps of:

a) steeping the wood at an elevated temperature in a solution of a surface active agent for a first predetermined period,

b) removing the steeped wood to a pressure vessel, adding thereto an aqueous solution of a surface active agent and an alkali and treating the steeped wood at an elevated temperature and pressure for a second predetermined period,

c) removing the aqueous solution and subjecting the said treated wood to a sub-atmospheric pressure to further remove excess moisture, and

d) drying the resultant product.

2. A process for treating wood as claimed in claim 1 wherein the wood is one or more of beech, oak, larch, pine, hem-



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lock, lamin, lumbayao, kempas, ebony, black ebony, rosewood, Douglas fir, apitong, kapur, monkeypot or walnut.

5 3. A process as claimed in claim 1 or claim 2 wherein the surface active agent is present in the solution of step a) in an amount of 0.1 to 0.5% by weight.

10 4. A process as claimed in any preceding claim wherein the first predetermined period is from 4 to 12 hours.

15 5. A process as claimed in any preceding claim wherein step (b) includes applying an aqueous solution containing 0.05 - 0.1% by weight of the surface active agent and 0.2 - 0.4% by weight of the alkali to the wood for a period of 2-3 hours in at a pressure of 2 kg/cm² - 3 kg/cm² and at a temperature of 120°C - 130°C.

20 6. A process as claimed in any preceding claim wherein the surface active agents are anion active agents.

7. A process as claimed in any preceding claim wherein the alkali is soda ash

25 8. A process as claimed in any preceding claim wherein step (c) is continued until the moisture content of the wood reaches fibre saturation point (moisture content 28 - 32%).

30 9. A process as claimed in any preceding claim wherein the wood is sawn hemlock.

35 10. A process as claimed in claim 9 which comprises in step (a) applying the surface active agent solution having 0.5% concentration to the hemlock and steeping the hemlock for 8 hours.

11. A process as claimed in any preceding claim which includes colouring the treated wood to a desired wood colour.

40 12. A process according to any one of claims 1 to 11 wherein the drying step (d) is effected by air and/or kiln drying.

13. A process according to claim 12 wherein kiln drying is effected for at least 48 hours.

45 14. A process according to claim 12 wherein air drying is effected for 10 to 15 days; optionally followed by kiln drying for at least 24 hours.

50 15. A process according to any one of claims 1 to 8 and 11 to 14 wherein the wood treated is Douglas fir, and wherein the treating solution from step (b) is recovered, and terpentine is separated therefrom.

55 16. A process as claimed in claim 1 and substantially as described in any one of the specific examples herein before set forth.

17. Treated wood whenever obtained by the process as claimed in any preceding claim.

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