

UNITED STATES PATENT OFFICE

2,674,543

PROCESS FOR TREATING WOOD AND
RESULTING ARTICLE

Arthur Khndzorian-Iablokoff, Fontainebleau,
Andre Delord, Wissembourg, Marie Falinski,
Paris, and Raymond Lautie, Toulouse, France,
assignors to Office National d'Etudes et de Re-
cherches Aeronautiques, Paris, France

No Drawing. Application March 4, 1949,
Serial No. 79,734

Claims priority, application France March 5, 1948

2 Claims. (Cl. 117-57)

1

The invention relates to a chemico-physical process for treating wood, whether cut out or not, whether leaf wood or coniferous wood, with a view to modify conveniently their physical qualities and to adapt them best to a determined use.

The said process consists in chemically destroying substantially all of the intercellular bindings of wood, such as lignine, and the diaphragms of bordered pits in coniferous wood, then entirely filling the voids left by the destruction of intercellular bindings in the bulk constituted by remaining cellular elements, with an appropriate matter which is particularly selected for the considered use.

The invention relates also to the new industrial products which are thus obtained. In order that the process according to the present invention may be well understood, it seems to be necessary to remind the structure of leaf wood firstly, and then that of coniferous wood.

It is known that leaf wood is essentially constituted by cells of a cellulosic substance joined together by lignine which serves as a binder. There are really several kinds of cellulose (α , β and γ) which co-exist with various lignines such as the lignine impregnating the cellulosic walls. In this assembly of constitutive matters, cellulose sustains tensile strains and lignine sustains compressive strains.

With regard to coniferous wood, its constitution is quite different. It is known, indeed, that this wood is constituted by tightly closed tracheids with bordered pits, except for latest annual rings. The tracheid can be schematically compared with a thin-walled tube, having sharp extremities, the walls of which are provided with said bordered pits constituted by the mean lamina forming a diaphragm and are strengthened in the middle (the torus).

The bordered pits connect the tracheids with one another as long as they are in peripheral annual rings, then they are clogged by the diaphragm when the annual ring of which they form a part passes into the heart area.

In a wood belonging to either of the kinds described above, the first operation of the process according to the present invention (chemical operation) has for its object chemically to destroy substantially all of the elements of intercellular bindings such as lignine as well as the diaphragms of bordered pits in coniferous wood, so that voids may be created in wood or that voids already existing may be opened; these empty spaces will be filled in a second operation (physi-

2

cal operation) with foreign matter of any kind such as silicones, metallic powders in suspension, various resins, plastic materials, graphite powder metals or alloys having a low melting point, etc., according to the properties which are to be given to the final product.

But, whereas the chemical operation of the treatment according to the invention consists in destroying a part of intercellular elements, it is necessary, in the case of coniferous wood, to take care that this chemical action be carried out in a more radical manner so as to open, by destroying the diaphragms, the bordered pits of tracheids in order to bring into communication the interior empty spaces of tracheids which will be filled, totally or partially, as indicated above, with an appropriate matter during the second operation.

The first operation for treating, according to the present invention, either of the woods of the kinds indicated above, consists in subjecting the wood to the action of an acid or basic chemical agent in order to create the voids indicated above, the second operation consisting in introducing into the wood thus treated, by means of any known process not particularly described as not forming a part of the invention, an appropriate product which fills the created voids. A preferred agent for effecting the delignification is represented by sodium chlorite.

The advantage of the process according to the present invention and other characteristics will appear from the following description.

By immersing the wood to be treated into a bath of the kind indicated above, for instance into a bath of sodium hypochlorite having a degree of causticity properly selected according to the sort of wood to be treated, all the constituents which are desired to be destroyed are dissolved, except the cellulose which remains totally or partially and which allows to keep the cellulosic skeleton of the wood showing voids left by the soluble constituents, other than cellulose, dissolved by the chemical action which can be eventually hastened by using high frequency currents.

This chemical action, the purpose of which is to create voids in the elements of wood, is advantageously accompanied or followed by a secondary chemical action such as hydrolysis, or oxidation, in order to modify, if desired, the structure of the kept cellulosic chains or the constitution of the cellulose of cells, and (or) by a physical action such as ultrasounds, a conveniently directed electric field, directed and continuous vibrations etc., with a view to give the fibres of the support

such an orientation as to grant the final product physical characteristics different from those the wood initially possessed, and more particularly adapted to its future use.

The wood so transformed into a support, the fibres of which have been eventually oriented at will by either the means indicated above or by their combination shows voids left by the destroyed intercellular bindings as well as voids existing in the wood and which have been opened by the chemical action. All these voids are then filled with a product suitable to the intended use of the treated wood, for instance with silicones, plastic materials, resins of any kind, graphite, metallic or graphite powder in a proper suspension, metals or alloys having a low melting point, separately or in combination. As it has been said above, the filling can be performed by any of known processes, and it is preferably carried out with the use of a wetting agent facilitating the penetration into the empty spaces of the support of the filling substances to which will be advantageously added colouring matters which allow to give the final product any desired physical appearance.

The wood will be preferably cut out in laminas, veneers, before being treated, or it will be treated in the shape of plywood obtained in a manner known per se by assembling several veneers properly stuck together, and its thickness will be variable although, when it is very thick, the technical difficulties encountered in trying to obtain a complete filling are evidently superior, but not unsurmountable to those encountered in the similar filling of thin elements.

In difficult cases, the filling operation will be preferably performed in autoclaves whence air has been exhausted and into which compressed air is delivered in order to introduce the filling substances into the voids created or opened in the wood by the chemical treatment indicated above.

The choice of the filling product is determined by the physical qualities which the finished material is intended to have. Tests carried out by the applicants permitted to obtain a material of which the compressive strength was equal to 16 kg./mm.² and even 20 kg./mm.² whereas this material, before being subjected to a treatment according to the invention, resisted only to a compressive strain of the order of 2 kg./mm.².

According to the selected impregnation product, one can obtain a material showing a high flexibility, a material resisting to the action of high temperatures, water, bad weather, a material showing unctuousness qualities to constitute a friction surface or, in a general way, a material having any desired physical quality to be suitable to a determined use.

It is possible particularly to fill the voids created in this veneer with a thermoplastic resin and to obtain a plywood simply by heating a pile of such plywoods, without any need of a layer of glue between two superposed veneers, because the glue is constituted by the filling thermoplastic resin itself.

The use of special thermoplastic resins permits to obtain also elements capable of being welded with one another, that is to say suitable for a kind of self-soldering similar to that used for the soldering of metallic elements by a oxyhydrogen blow-pipe or by electric welding, without interposition of any material, the jointing being realized either by juxtaposition or superpositions of the parts to be assembled by their edges and

a mere pressure which causes the intermeshing of the cellular elements, so that there is no increase in thickness requiring a cleaning operation.

Moreover, by heating a wood element impregnated with such a resin up to the temperature of polymerisation, it is easy to dish or form the new material in a mould, while hot. The forming effort is small enough to be able to perform the operation by using a plaster mould or a mould made of any other similar material, thence reducing considerably the cost of manufacture of such formed articles.

By way of example, certain new products obtained by treating wood according to the invention will be described hereinafter, while setting off the particular properties compared with those of the wood itself constituting the base material.

(1) Poplar wood, which is a soft wood, badly resisting to compressing strain, is cut out into 1 mm. thick veneers, subjected to the action of a chlorite for completely destroying the intercellular bindings.

The voids thus obtained in these veneers are then entirely filled with melamine, the quantity of melamine being equal to about 70% of the weight of the treated and dried wood.

The new product thus obtained has a specific weight less than 1, which makes it suitable for industries where the weight of materials is of great importance (aircraft industry for instance).

Further, this material resists very well to compressing strains. Whereas poplar wood resists only to a compressive force of 2 kg./mm.² the new material resists to a compressive force of 20 kg./mm.². Lastly, the veneers of the new product can be formed, while hot, in a press separately or piled, to give a material of any desired thickness. The effort required for the forming is relatively low: about 10 kg./cm.².

(2) Spruce veneers (the spruce is a wood of the coniferous kind) are treated by a chlorite for a disignification of 85% and for destroying the diaphragms of bordered pits. The empty spaces thus obtained, and the opened cavities which were clogged by these diaphragms are filled with melamine, the quantity of melamine used being equal about to 70% of the weight of the treated and dried wood. The new material thus obtained has qualities similar to those of the preceding one and it is possible to manufacture, by forming with a press, while hot, and with a pressure of the order of 4 kg./cm.², hemispheric calottes without crack by star superposition of three veneers of the new material.

(3) A veneer of poplar wood is soaked for 12 hours in a bath consisting in a 10% solution of sodium chlorite, at a temperature of about 60° C. After such a treatment the object of which is to destroy the intercellular bindings, the veneer is removed from the bath and the voids left in the structure by the destroyed bindings are filled with melamine formaldehyde at a rate corresponding to 70% of the weight of the dried treated wood.

The new article thus obtained has a specific weight less than 1 and has the following distinguishing features: it is self-soldering, easy moldable and dishable.

The self-soldering, easy moldable and dishable features may be explained as follows:

After impregnation, the matter obtained is not subjected to heating. Thus when two veneers of wood treated according to the invention are assembled edgewise and are submitted at the joint to a slight pressure and to heat, the melamine

5

mine formaldehyde which is a thermosetting resin causes a self-binding of the veneers while the pressure produces a slight intermeshing of the cellulosic fibers at the joint which becomes reinforced.

When a veneer of wood treated according to the invention is to be molded in an article of a given shape, the only stresses to overcome are that of the fibers. As they are highly flexible, the mass of melamine formaldehyde, when heated, can easily be bent under a pressure which is so low that the molding can be performed in a mold made of plaster. Such molding operation is consequently very cheap.

Instead of using melamine, one can also advantageously use polystyrolene as filling substance, the material thus obtained showing like those indicated above superior mechanical qualities.

Although the examples given above mention the treatment of cut out woods, it must be noted that the process according to the present invention can be applied as well to wood pieces of any volume and any dimensions, for instance to railway sleepers, mine props, etc.

In a general manner, the new material can be used for instance, for manufacturing armours of tanks, aircraft fuselages, ships or more generally vehicles travelling in air or water, bodies for cars, and the like.

Accordingly, there has been described a process for the preparation of a novel structural element comprising substantially 60% by weight of wood delignified to approximately 85% and having its cellular and inter-cellular cavities substantially free of naturally-occurring non-cellulosic constituents, and substantially 40% of polymerized melamine-formaldehyde filling substantially all of said cellular and inter-cellular cavities, said element being produced by soaking the wood for 12 hours in a solution of sodium chlorite at a temperature of about 60° C. and having a concentration not exceeding 10%, whereby cellular and intercellular voids are created in the wood by the destruction of the lignin, removing thereafter the treated wood from the bath.

The treated wood is then impregnated with a suspension of melamine formaldehyde whereby the cellular and intercellular voids are filled up with melamine formaldehyde at a rate corresponding to at least 70% of the weight of the dried treated wood, followed by setting the melamine formaldehyde by heating the treated and impregnated wood to a temperature corresponding to the temperature of polymerization of melamine formaldehyde.

6

Having thus fully described our invention, what is claimed as new and desired to be secured by Letters Patent, is:

1. The process for the manufacture of a reinforced plate material having a reinforcement of wood delignified to about 85% while maintaining the cellulose in substantially unchanged condition, and melamine formaldehyde filling up the cellular and intercellular voids of said wood reinforcement at a rate of at least 70% of the weight of the dried treated wood, comprising soaking the wood for 12 hours in a solution of sodium chlorite at a temperature of about 60° C. and having a concentration not exceeding 10%, whereby cellular and intercellular voids are created in the wood by the destruction of the lignite, removing thereafter the treated wood from the bath, impregnating the treated wood with a suspension of melamine formaldehyde whereby the cellular and intercellular voids are filled up with melamine formaldehyde at a rate corresponding to at least 70% of the weight of the dried treated wood, and setting the melamine formaldehyde by heating the treated and impregnated wood to a temperature corresponding to the temperature of polymerization of melamine formaldehyde.
2. A structural element comprising substantially 60% by weight of wood delignified to approximately 85% and having its cellular and inter-cellular cavities substantially free of naturally-occurring non-cellulosic constituents, and substantially 40% of polymerized melamine-formaldehyde filling substantially all of said cellular and inter-cellular cavities, said element being produced by the process steps of claim 1.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,328,656	Fish	Jan. 20, 1920
1,876,329	Loetscher	Sept. 6, 1932
1,933,573	Wilmowsky	Nov. 7, 1933
2,045,350	Griffin	June 23, 1936
2,140,981	Booty	Dec. 20, 1938
2,376,200	Smidth	May 15, 1945
2,391,489	Stamm	Dec. 25, 1945
2,452,200	Kvalnes	Oct. 26, 1948

OTHER REFERENCES

- Mellor, "A Complete Treatise on Inorganic and Theoretical Chemistry," Longmans, Green & Co., N. Y., 1922, vol. 2, page 283, line 19.