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(54) **Title:** A CONCRETE FORMWORK CASTING PANEL, A METHOD OF MANUFACTURING THE SAME, AND USE THEREOF

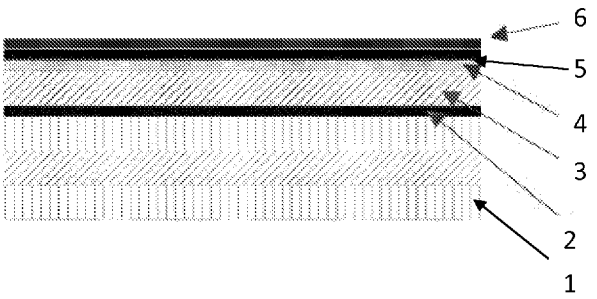

Fig. 1

(57) **Abstract:** A method of manufacturing a concrete formwork casting panel and a panel thus obtained. The panel is multiply wood-veneer panel having a coating layer which forms a casting surface. The method comprising the steps of stacking a plurality of wood-veneer layers on top of each other to form a stack with a top wood-veneer layer having an upper surface facing the casting surface and an opposite lower surface facing the other wood-veneer layers of the stack; providing layers of an adhesive resin between the wood-veneer layers; and in optional order coating the upper surface of the top wood-veneer layer to provide a coated stack and pressing the stack using increased pressure and temperature in order to form a multiply wood-veneer product with a coating layer. According to the invention, on the upper surface of the top wood-veneer a hydrophobic agent is applied before coating of the upper surface and on the lower surface of the top wood-veneer an impregnation resin is applied, such that the top wood-veneer of the formwork casting panel becomes at least partially saturated with the hydrophobic agent and impregnated with the impregnation resin.

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A concrete formwork casting panel, a method of manufacturing the same, and use thereof

Field of Invention

The present invention relates to concrete formwork casting panels. Such panels typically comprise a multiply panel with a coating layer which defines a casting surface. In particular the present invention concerns a method of manufacturing a casting panel comprising the steps of stacking a plurality of wood-veneer layers on top of each other to form a stack with a top wood-veneer layer having an upper surface facing the casting surface and an opposite lower surface facing the other wood-veneer layers of the stack; providing layers of an adhesive resin between the wood-veneer layers; and in optional order coating the upper surface of the top wood-veneer layer and pressing the stack using increased pressure and temperature.

The invention also relates to a method of improving the resistance against rippling of a concrete formwork casting panel perforated by mechanical fastening means, such as nails or screws or clamps.

Background

Wood panels and solid wood are commonly used as casting surfaces ("form panels"), for example when concrete casting is carried out. An untreated wood surface adheres tightly to the material that is cast. Because of this adherence, it is very difficult to release the wood, which is used in the casting forms, from the concrete surface, without damaging the casting surface or the wood material that is used as the casting form. The adherence significantly increases the work required for detaching the casting surfaces, causing material loss and repair work on the casting surfaces.

It is therefore known in the art to treat the wood surface with distillates of fossil-derived crude oil, and mixtures thereof to improve release properties thereof. In known solutions, wood surfaces are treated, for example, with a mixture of two different commercial products: Nynäs Nytex 810 (Distillates petroleum, hydrotreated heavy naphthenic) and Neste engine fuel oil -5/-15.

Published Patent Application WO 2008154421 describes a coating composition, which comprises a fluorine-containing compound and a polycarbodiimide. The composition is applied onto the surface of a substrate such as wood.

US Patent Specification No. 3,497,375 describes a method of treating a wooden form which is used in concrete casting, by coating the surface of the wood. The coating is formed of two layers, in which case, first, a mixture is applied which comprises wax and ethylene-vinyl acetate copolymer, and this mixture forms a layer having a thickness of 0.5 to 5 mm. The wax and paraffin oil components of the compositions do not migrate into the wood.

It is also known to provide various coatings (or "film facings") consisting of paper, resin and different additives. Typically, phenolic resin, amino resin or equivalent resins or their mixtures in different mixture ratios are used as the resin. Such a coating provides a durable release surface which allows for the use of the form panel a plurality of times.

However, the service value of coated plywood of the above kind is reduced if holes appear in the coating. In such a case, the top veneer easily absorbs moisture from the air, water or e.g. from wet concrete in connection with casting. From the holes, the moisture would easily spread in the direction of the wood grains and cause local swelling of the grains, i.e. rippling, and thereby blistering of the surface of the wood board.

It is therefore known in the art to treat the surface of the wood board with a hydrophobic agent before coating of the top veneer with a paper or film impregnated with phenolic resin (WO2009/156594). By such treatment, the swelling of the wood grains can be reduced and improved anti-rippling attained.

There is still need for further improvements of the resistance against rippling in coated form panels for use in particularly demanding application for example in cases wherein the surface of the form panel has become mechanically damaged by shearing or piercing tools.

Summary of the Invention

It is an aim of the present invention to provide a method of producing a multiply wood-veneer panel having a coating layer which forms a casting surface, which panel is capable of use as a casting surface in a formwork.

It is another aim of the invention to provide novel concrete formwork casting panels.

It is still a further aim to provide uses of the method and the panel.

The present invention is based on the idea of applying onto the upper surface of the top wood-veneer a hydrophobic agent and onto the lower surface of the top wood-veneer an impregnation resin so as to at least partially saturate the top wood-veneer of the formwork casting panel with the hydrophobic agent from one surface while impregnating with the top wood-veneer from the opposite surface with the impregnation resin.

By the treatment, a panel is achieved which exhibits less splintering when subjected to sawing and nailing. It has also been found that in the described way a considerable improvement of the resistance to rippling of a concrete formwork casting panel can be reached even when the panel is perforated.

More specifically, the present invention is characterized by what is stated in the characterizing portion of the independent claims.

According to a first aspect of the present invention, there is provided a method of manufacturing a concrete formwork casting panel comprising a multiply wood-veneer panel having a coating layer which forms a casting surface, said method comprising the steps of: stacking a plurality of wood-veneer layers on top of each other to form a stack with a top wood-veneer layer having an upper surface facing the casting surface and an opposite lower surface facing the other wood-veneer layers of the stack; providing layers of an adhesive resin between the wood-veneer layers; and in optional order coating the upper surface of the top wood-veneer layer to provide a coated stack; and pressing the stack using increased pressure and temperature, so as to form a multiply wood-veneer product with a coating layer, comprising: applying on the upper surface of the top wood-

veneer a hydrophobic agent before coating of the upper surface and applying to the lower surface of the top wood-veneer an impregnation resin, the top wood-veneer of the casting panel being at least partially impregnated with said hydrophobic agent and with said impregnation resin.

Various embodiments of the first aspect may comprise at least one feature from the following bulleted list:

- The wood-veneer layers are impregnated with an impregnation resin, the molecular mass of which is less than the molecular mass of the adhesive resin, and the impregnation resin is absorbed at least partly in the fibres of the top wood veneer.
- 1–75 % by weight, in particular 20 to 60 % by weight of the dry matter of the impregnation resin applied on the lower surface of the top wood-veneer is absorbed in said top wood-veneer.
- The top wood-veneer is impregnated with said impregnation resin so as to achieve a concentration of impregnation resin in the top wood-veneer of at least 5 wt-%, in particular 10 to 40 wt-%, of the dry matter of the wood-veneer.
- The impregnation resin is introduced between the top wood-veneer and the layer below the top wood-veneer impregnated in a carrier, such as a carrier in the form of a sheet, plate, fabric, tissue or web.
- A paper or board sheet, a paper or board web, or dry paper, a textile, such as a fabric, felt, or non-woven fabric, or a polymer film or sheet is used as a carrier.
- The amount of impregnation resin is about 10–500 parts by weight, especially 20–350 parts by weight, relative to 100 parts by weight of the carrier.
- Impregnation of the top wood-veneer is carried out separately.
- Impregnation of the top wood-veneer is carried out using an impregnation film in conjunction with pressing, in particular hot-pressing of the stack.
- The hydrophobic agent is applied on the top veneer from a composition which contains the hydrophobic agent in an amount of 10 to 100 % by weight, in particular 60 to 100 % by weight.
- The hydrophobic agent is selected from the group of waxes, oils, fats, fatty acids, alkanes, alkenes, their derivatives and their mixtures.
- Paraffin wax, silicone oil or alkene ketene dimer is used as the hydrophobic agent.

- Paraffin wax or alkene ketene dimer is used as the hydrophobic agent, said paraffin wax or alkene ketene dimer being molten before or during application on the top veneer.
- The amount of the hydrophobic agent applied on the surface of the wood board is 10 to 100 g/m^2.
- The hydrophobic agent is applied on the top veneer such that the wood fiber cavities are filled with hydrophobic agent.
- The hydrophobic agent is applied on the top veneer such that at least a part of the hydrophobic agent will migrate from the top veneer to the next veneer below it, and preferably such that at least the top veneer and the veneer below it will be at least partly saturated with the hydrophobic agent.
- The coating comprises at least one phenolic coating layer having a surface weight of about 100 to 500 g/m^2, for example 120 to 220 g/m^2.
- The phenolic coating layer comprises a paper substrate impregnated with a phenolic resin, said paper substrate having a grammage of 40 to 80 g/m^2 and containing 80 to 140 g/m^2 phenolic resin.
- The coating comprises a paper substrate impregnated with a phenolic resin which has been applied on the surface of the top veneer of the multiply panel by pressing, in particular by hot pressing.
- The coating is attached to the top veneer using a separate layer of a phenolic resin, in particular a heat-activated phenolic resin, impregnated in a substrate, such as a non-woven substrate.
- By the effect of the pressure and temperature of the pressing-stage the impregnation resin on will be absorbed into the top wood-veneer from the lower surface and the hydrophobic agent will be impregnated into the top wood-veneer from the upper surface so as to achieve at least partial saturation of the top wood-veneer

According to a second aspect of the present invention, there is provided a concrete formwork casting panel manufactured according to the first aspect.

According to a third aspect of the present invention, there is provided a concrete formwork casting panel which comprises a multiply panel formed by a plurality of wood veneers and a coating, which coating is bonded to the top veneer of the panel and forms a casting

surface of the panel, wherein the top veneer of the multiply panel is impregnated with a hydrophobic agent and at least partially impregnated with an impregnation resin; and the coating is bonded to the top veneer using a heat-activated phenolic resin impregnated in a substrate.

Various embodiments of the third aspect may comprise at least one feature from the following bulleted list:

- The coating is formed by a phenolic coating layer.
- The coating comprises a paper substrate impregnated with a phenolic resin which has been applied on the surface of the top veneer of the multiply panel by pressing, in particular by hot pressing.
- The coating is attached to the top veneer using a heat-activated phenolic resin impregnated in a non-woven substrate.
- The top wood-veneer has a concentration of impregnation resin of at least 5 wt-%, in particular 10 to 40 wt-%, of the dry matter of the top wood-veneer.
- The hydrophobic agent is selected from the group of paraffin wax and alkene ketene dimer, said hydrophobic agent having been used in solid form and molten before or during application on the top veneer.
- The top wood-veneer has a content of 20 to 100 g/m^2 of said hydrophobic agent.
- The wood fiber cavities of the top wood-veneer are filled with hydrophobic agent.
- The panel exhibits resistance to rippling even when perforated by mechanical fastening means.

According to a fourth aspect of the present invention, there is provided use of a method according to the first aspect for improving the resistance to rippling of a concrete formwork casting panel perforated by mechanical fastening means, such as nails, screws, clamps or rivets.

According to a fifth aspect of the present invention, there is provided use of a panel according to the second or third aspect as concrete formwork casting panel which is perforated by mechanical fastening means, such as nails, screws, clamps or rivets.

Considerable advantages are obtained by the invention. A panel manufactured as described is durable, has excellent nailing properties and does not exhibit any rippling effect even at nailing apertures. Surface hardness and durability is improved. Furthermore, the panels can be cleanly cut, leaving no rough edges or splintering of the edges.

The hydrophobic agent can be applied on the top veneer by conventional applications means, and after impregnation, penetration and drying of the hydrophobic agent, the overlay can be attached to the thus treated top veneer layer by using a separate glue layer or by means of glue migrating from the overlay into the top veneer during conventional plywood hot pressing.
It has been found that the bond between the overlay and the top veneer is not impaired by hydrophobic agent provided that it penetrates into the wood grains.

The panel exhibits less splintering and improved rippling resistance even when the surface of the panel is pierced by mechanical fastening means, such as nails, screws, clamps or rivets for example for fastening the panel to supporting constructions of the formwork.

Further features and advantages of various embodiments of the present invention will appear from the following detailed description.

Brief Description of the Drawing

The attached drawing shows in side-view the cross-section of a panel according to one embodiment of the present invention.

Embodiments

Turning first to the attached drawing, it can be noted that the following reference numerals are used:

Reference numeral 1 designates a multiply panel comprising a plurality of overlapping wood layers, such as layers of wood veneer. Reference numeral 3 designates the top wood-veneer, which is impregnated with a hydrophobic agent applied on the upper surface of the veneer in the form of a layer 4, as will be discussed more closely. Reference numeral 6

relates to a coating which has an upper surface (a moulding face of the panel) and an opposite lower surface against the panel. Reference numeral 2 designates a layer of an impregnation resin, reference numeral 5 refers to a glue layer for bonding of the coating 6 to the top wood-veneer layer 3.

"Concrete formwork casting panel" refers to a wood panel, such as that of the present kind, for use as or used as casting panel either on its own or preferably in conjunction with a supporting structure such as a frame. Typically, the present casting panels are used as facings in a "formwork", i.e. a temporary or permanent mould into which concrete or similar materials are poured in order to form an object, such as a concrete slab, of predetermined shape.

"Impregnate" refers to the action of causing the material (such as the veneer, at least the top veneer of the panel) to be permeated with the hydrophobic agent. "Saturate" is used for designating that the impregnation is carried out to a point at which the veneer will not be capable of taking up more hydrophobic agent at the prevailing conditions.

In the present context, the term "wood panel" refers to a board comprising a plurality of overlapping and/or superimposed wood layers (in the following also referred to as a "multiply panel" of "multiply structure").

"Multiply panel", for example as depicted in the attached drawing and designated the numeral 1, stands for boards which comprise a plurality of layers of overlapping and/or superimposed sheet-like material. There are at least 2, preferably at least 3 layers, of such material. There can be up to about 250 overlapping and/or superimposed layers, although in practice the maximum number is typically less than 100. The sheet-like material can be continuous or it can consist of several sheets orientated in the same plane; conventionally at least a majority of the layers of sheet-like material is formed by wood veneer or wood strands.

The term "wood based layers" covers, e.g., wood veneers and wood strands.

In one embodiment, the multiply panel comprises or consists of or consists essentially of a plurality of layers of wood veneer.

There can, however, be a number of layers formed by material capable of conferring preselected mechanical or chemical properties in the board, as well. Such materials are exemplified by metal foils, such as aluminium foils and films, textile layers, for example non-woven sheets, polymeric films and sheet, such as polyolefin, polyamide and EVOH films for barrier purposes, and polyamide and polyaramid films and fabrics for structural purposes.

Typically, in the present multiply panels, the majority of the layers are of or comprise wood material.

The sheet-like materials are typically bonded together using intermittent and/or intralayer layers of adhesive.

The term "board" is used interchangeably with "panel" and stands for a piece of material which has at least one planar surface. Preferably the "board" has two opposite planar surfaces which are generally orientated in parallel.

Typically, in the present context, the board 1 is an elongated planar structure. It has dimensions in the range from 10…15,000 mm times 10…20,000 mm. In particular the present board has a width of 50…2,500 mm and a length of 300…13,500 mm. The thickness of the "board" is generally between 3 and 250 mm, in particular 4 to 120 mm.

In the present context, a stack, which is formed by overlapping and/or superimposed layers of structural material and adhesive, is pressed by a pressing operation, typically carried out at one pressing station, until a predetermined compression strength of the board is obtained. The pressing can be carried out applying continuously increased compression or by applying compression at successive stages of different pressures. As will be explained below in more detail, in embodiments of the present technology, there can be a succession of at least one stage with a first pressure and a second stage of a second pressure, the first pressure being lower than the second pressure.

"Stack" stands for an organized pile of overlapping and/or superimposed layers.

"Hot pressing" stands for pressing at increased temperature and surface pressure (in comparison to ambient conditions) over a period of time.

According to embodiments of the present technology, methods are provided for producing boards suitable for formwork uses.

One embodiment comprises in combination the steps of

- providing a wood based material in the form of a plurality of layers of such material and an adhesive suitable for bonding said layers to each other;
- arranging the layers of the wood based material into a stack with layers adhesive on between the wood based material layers; and optionally
- pressing the stack.

Pressing is typically carried out at a temperature of 120 to 225 °C, for example 120 to 160 °C for a time of approximately 4 to 90 minutes and at a pressure of 1 to 2.5 MPa, for example 1.1 to 1.7 MPa. At pressures higher than about 2.5 (or 3) MPa, there will be some permanent compression of the wood-veneer plies. In particular pre-impregnated plies will be earlier and more strongly compressed than non-impregnated plies.

The wood based material used for forming the core board is obtained by peeling or cutting of a suitable wood raw-material.

Typically, the wood layers or strands are produced from softwood or hardwood, such as spruce, pine, larch, birch, poplar, aspen, alder, maple, eucalyptus or mixed tropical hardwood or from mixtures thereof.

Particularly preferred embodiments comprise using hardwood, such as birch, at least as top veneer, in particular the panel comprises only hardwood, such as birch, as wood veneer layers.

The thickness of the wood based layers is generally from about 0.5 to 5 mm, in particular about 0.9 to 3.5 mm.

In one embodiment, the wood based layers of the board 1 consist of wood veneer. The core board is typically a multi-ply veneer panel or laminated veneer lumber.

In one embodiment, the concrete formwork casting panel comprises or consists of or consists essentially of hardwood, in particular birch, veneer.

In another embodiment, there are one or more layers of a non-wood material in the stack. Such layers will provide improve mechanical, chemical, biological and acoustic properties to the final product. The thickness of such non-wood layers is about 0.01 to 5 mm. For metal foils, the thickness is typically 0.01 to 0.5 mm, for polymeric layers typically 0.1 to 3 mm, for cork layers about 0.5 to 5 mm.

The wood based layers and optionally non-wood layers are bonded together with an adhesive (not shown in the drawing). The adhesive can be an adhesive resin. The adhesive resin can be provided in the form or a dry powder, for example as a hot melt adhesive, or as a liquid or as a combination thereof. The adhesive can be applied so as to form adhesive layers which uniformly cover at least a part, in particular all or essentially all, of the adjacent surfaces. The adhesive can also or alternatively be applied in the form of discontinuous spots or stripes.

The adhesive is in particular a thermosetting polymer. Such polymers can be selected from the groups of phenol-formaldehyde adhesives, melamine-formaldehyde adhesives, urea-formaldehyde adhesives, polyurethane adhesives and lignin based resins and combinations thereof. The adhesive can be applied on the layers of wood based material and non-wood material in manners known per se, for example by coating or spraying. In one embodiment, the adhesive is applied in the form of fibrous sheets which are impregnated with adhesive.

In a first embodiment, the top wood-veneer layer 3 is impregnated with an impregnation resin, the molecular mass of which is less than the molecular mass of the adhesive resin, and the impregnation resin is absorbed at least partly in the fibres of the top wood veneer.

The veneer can be used in the form of a pre-impregnated veneer, i.e. a veneer which has been separately impregnated with the impregnation resin, in particular in fluid form.

The top wood-veneer can be separately impregnated with such a resin, and optionally allowed to dry, to produce a pre-impregnated wood-veneer which can be used as such in the stack. The pre-impregnated wood-veneer typically contains the impregnation resin in uncured form.

Alternatively, the veneer can be contacted in the stack with an impregnation resin which is introduced in the stack with the aid of a carrier (to be discussed below) which is placed next to the top wood-veneer on the side opposite to the face of the wood-veneer. The drawing shows the use of an impregnation resin on a carrier 2.

Typically, 1–75 % by weight, in particular 20 to 60 % by weight of the dry matter of the impregnation resin applied on the lower surface of the top wood-veneer is absorbed in said top wood-veneer.

In one embodiment, the top wood-veneer is impregnated with said impregnation resin so as to achieve a concentration of impregnation resin in the top wood-veneer of at least 5 wt-%, in particular 10 to 40 wt-%, of the dry matter of the wood-veneer. The impregnation resin thus penetrates into the wood material and forms upon cross-linking a wood-polymer-composite layer.

In the present context, the term ”impregnation resin” refers to a resin, the molar mass of which is less than the molar mass of the resin adhesive, so that the impregnation resin is absorbed at least partly in the fibres of the wood veneers of the wood-veneer layers.

In one preferred embodiment, the same basic type of resin, which is used in the adhesive resin, but which has a smaller molar mass than the corresponding polymer of the adhesive resin, is used as the impregnation resin. This being the case, an impregnation resin consisting of phenol resin or particularly phenol-formaldehyde resin is used with the adhesive resin consisting of phenol resin or particularly phenol-formaldehyde resin, and correspondingly an impregnation resin consisting of melamine-formaldehyde resin is used as the impregnation resin with an adhesive resin consisting of melamine-formaldehyde resin.

Generally the molar mass (weight-centred molar mass) is at least 20 %, most suitably at least 40 %, particularly at least 60 %, possibly at least 90 % smaller than the molar mass of the adhesive resin.

The molar mass varies according to the type of resin and for an adhesive resin it is typically about 500–15,000 g/mol.

Bisphenol-F epoxy resin can be given as a particular example of an impregnation resin.

Generally the impregnation resin has a relatively low viscosity (dynamic viscosity of 500–3,000 mPa s), and it is used in a solvent-free form or at large solids contents.

For the purpose of introducing the impregnation resin 2 between the top wood-veneer and the layer below the top wood-veneer impregnated in a carrier, a carrier selected from the group of sheets, plates, fabrics, tissues and webs is typically used. In a preferred embodiment, a paper or board sheet, a paper or board web, or dry paper, a textile, such as a fabric, felt, or non-woven tissue or fabric, or a polymer film or sheet is used. The amount of impregnation resin is about 10–500 parts by weight, especially 20–350 parts by weight, relative to 100 parts by weight of the carrier.

In one embodiment, impregnation of the top wood-veneer 3 is carried out using an impregnation film 2 to achieve impregnation during pressing, in particular hot-pressing, of the stack of overlapping wood veneers.

The top wood-veneer 3 is also treated with a hydrophobic agent 4.

In one embodiment, the hydrophobic agent is selected from the group of waxes, oils, fats, fatty acids, alkanes, alkenes, their derivatives and their mixtures.

In particular, the hydrophobic agent is selected from paraffin wax, silicone oil or alkene ketene dimer. The alkene ketene dimer (abbreviated AKD) is particularly preferred since it has an affinity to the hydroxyl groups present in wood. The AKD will penetrate into the wood veneer and even penetrate into the grains of the wood fibers. As a result of the bonding of the AKD to the hydroxyl groups of the wood fibers, the wood fibers will

become modified and it would appear that this makes them resistant to shrinking upon drying or swelling upon water contact, which both are typical for unmodified wood fibers, although this is merely one explanation and the scope is not limited to it.

In one embodiment, the hydrophobic agent is applied from a composition which contains the hydrophobic agent in an amount of 10 to 100 % by weight, for example 60 to 100 % by weight. Thus, the hydrophobic agent can be used in the form of a dispersion, in particular an aqueous dispersion, or as a solid material.

Preferably, paraffin wax or alkene ketene dimer is used as the hydrophobic agent, and the paraffin wax or alkene ketene dimer is used in solid form. The solid material is then molten before or during application on the top veneer.

Generally, in order to achieve a thorough treatment of the top veneer, the hydrophobic agent is applied on the surface of the wood board in an amount of at least 5 g/m^2, in particular at least 10 g/m^2 and preferably from 15 to 300 g/m^2, for example 17 to 100 g/m^2 or 20 to 100 g/m^2 of 20 to 75 g/m^2. In one embodiment the amount of hydrophobic agent is about 20 to 55 g/m^2.

The hydrophobic agent can be applied by spraying or coating, in particular roller coating. The hydrophobic agent can be applied in 1 to 5 portions on the veneer. Thus, in one embodiment, about 15 to 25 g of hydrophobic agent is applied 1 to 3 times. The interval between the applications will be sufficient to allow the hydrophobic agent migrate at least partially into the wood before the application of the next portion of the hydrophobic agent.

Typically, the hydrophobic agent is applied on the top veneer and allowed to penetrate into the wood material such that the wood fiber cavities are filled with the hydrophobic agent. In one embodiment, the hydrophobic agent is applied on the top veneer such that at least a part of the hydrophobic agent will spread throughout the top veneer.

In one embodiment, the hydrophilic agent will penetrate to a depth of at least 50 % of the total thickness of the top veneer, in particular at least 75 %, in particular at least 90 % of the total thickness of the top veneer.

Thus, in one embodiment, the hydrophobic agent is applied such that at least a part of it migrates to the next veneer below the top veneer. In this way, the top veneer will be at least partly saturated, with the hydrophobic agent. At least some saturation of the next ply can also be achieved.

The hydrophobic agent is preferably applied on the top veneer such that the wood fiber cavities of at least the top veneer are at least partly filled with hydrophobic agent.

In one embodiment, the veneer which will form the top veneer of the panel, is separately impregnated with the hydrophobic agent before incorporating said veneer into a stack.

In one embodiment, the method of manufacturing a panel having a coating comprises the steps of

- stacking a plurality of wood-veneer layers on top of each other to form a stack with a top wood-veneer layer having an upper surface facing the casting surface and an opposite lower surface facing the other wood-veneer layers of the stack; and
- providing layers of an adhesive resin between the wood-veneer layers;

wherein, in optional order, the upper surface of the top wood-veneer layer is coated; and the stack is compressed using increased pressure and temperature, so as to form a multiply wood-veneer product with a coating layer.

Thus, in an embodiment, a coating is applied on the upper surface of the top wood-veneer layer before pressing of the stack.

In another embodiment, the stack is first pressed to form a panel, as described above. The panel thus obtained is then coated, optionally after sanding.

In both embodiments, the upper surface of the top wood-veneer is treated with the hydrophobic agent before a coating is applied, as explained in the fore-going.

Typically, the coating comprises at least one polymer resin coating layer having a surface weight of about 100 to 500 g/m^2, for example 120 to 250 g/m^2. There can be 1 to 10, typically 1 to 5 coating layers of the indicated kind.

The "polymer resin" layer is preferably a layer formed by a resin selected from phenol-formaldehyde adhesives, melamine-formaldehyde adhesives, urea-formaldehyde adhesives, polyurethane adhesives and lignin based resins and combinations thereof. In particular, the overlay comprises phenol-formaldehyde resin.

The panel can have a film-facing. For example, the resin coating layer, in particular phenolic coating layer, can comprise a paper substrate impregnated with the resin. The paper substrate typically has a grammage of 40 to 80 g/m^2 and contains 80 to 140 g/m^2 of a resin, in particular a phenolic resin.

In one embodiment, wherein the coating comprises a paper substrate impregnated with a resin, the coating is applied on the surface of the top veneer of the multiply panel by pressing, in particular by hot pressing.

In another embodiment, the coating is attached to the top veneer using a separate layer 5 of a phenolic resin, in particular a heat-activated phenolic resin, impregnated in a substrate, such as a non-woven substrate. Such a glue layer (or adhesive layer) 5, will firmly bind the coating layer to the surface of the top wood-veneer layer even when the wood-veneer layer has been saturated with a hydrophobic agent.

By the combined effect of the pressure and temperature of the pressing-stage the impregnation resin will be absorbed into the top wood-veneer from the lower surface. This can take place during the pressing of the stack of overlapping and/or superimposed wood veneers or when the coating is pressed against the top wood-veneer.

The hydrophobic agent will be subjected to pressure and heat and thus be impregnated into the top wood-veneer from the upper surface so as to achieve at least partial saturation of the top wood-veneer.

Further, at least a part of the resin of the coating layer and/or of any glue layer will further advance or push the hydrophobic agent into the wood-veneer thus further enhancing impregnation of the top wood-veneer with the hydrophobic agent.

By the migration and impregnation of adhesives from both opposite surfaces into the top wood-veneer, the hydrophobic agent will be squeezed firmly into the wood material and wood fibers of the wood-veneer.

Pressing of the coated panel or stack is typically carried out at a temperature of 120 to 225 °C, for example 120 to 200 °C for a time of approximately 30 to 900 seconds and at a pressure of 1.1 to 3 MPa, for example 1.5 to 2.4 MPa.

When using hydrophobic agents which are capable of bonding with hydroxy groups, such as phenolic groups, at least some modification of the resin components, such as phenolic adhesive components, in the wood veneer may also take place. It can be stipulated that the hydrophobic agent in such a case has at least some plasticizing effect on the curing of the resin or on the cured resin itself, in particular when the resin has phenolic groups. Such plasticizing will reduce brittleness of the cured resin.

As will appear from the above, a concrete formwork casting panel of the present kind comprises a multiply panel formed by a plurality of wood veneers and a coating, which coating is bonded to the top veneer of the panel and forms a casting surface of the panel. The coating is preferably formed by a phenolic coating layer, typically comprising a paper substrate impregnated with a phenolic resin which has been applied on the surface of the top veneer of the multiply panel by pressing, in particular by hot pressing, to form a film facing.

The top veneer of the multiply panel is saturated with a hydrophobic agent, for example selected from the group of paraffin wax and alkene ketene dimer, said hydrophobic agent having been used in solid form and molten before or during application on the top veneer. Further the top veneer is impregnated with an impregnation resin, the concentration of which is at least 5 wt-%, in particular 10 to 40 wt-%, of the dry matter of the top wood-

veneer. The coating is preferably bonded to the top veneer using a heat-activated phenolic resin impregnated in a substrate, such as a non-woven substrate.

Example

A panel of the kind shown in Figure 1 was manufactured as follows:

An 18 mm birch ply panel was manufactured in a conventional way and hot pressed into a multiply panel. The top wood-veneer was bonded to the next veneer using an impregnated non-woven adhesive film comprising a low-molecular PF resin. The film had a grammage of 600 g/m^2. The PF resin was heat-activated, i.e. it is capable of curing upon heating.

During hot-pressing at 128 °C for 15 minutes at a pressure of 1.7 MPa during the high-pressure section of a hot pressing schedule, a part of the resin of the adhesive film penetrated into the top veneer before curing to achieve a wood modification zone comprising impregnation resin cured in the wood material.

The top wood-veneer of the multiply panel was sanded after pressing to smoothen out the surface. Then solid AKD wax was molten and spread upon the surface at about 25 g/m^2.

An impregnated non-woven adhesive film comprising a low-molecular PF resin, the film having a grammage of 600 g/m^2, was applied upon the surface treated with the AKD wax. On the uncured adhesive film, a second film comprising a 220 g/m^2 phenol formaldehyde (PF) film was placed. The stack formed by the multiply panel with the PF resin film and the coating film were then overlaid by hot-pressing 130 °C for 11 minutes at 2.2 MPa during the high-pressure section of the hot pressing schedule.

Coated panels manufactured as described above were assembled and attached to a standard formwork system using rivets. It was found that drilling the pilot holes was done easily and left a clean hole. The formwork was used more than 20 times on a construction sites. After the formwork panels were returned, the surfaces were faultless and could be reused. No rippling could be found. Further, upon sawing, screwing, drilling and nailing, the performance of panel was impeccable: no splinters or breakouts group could be found on the surfaces; the cuts were clean with no roughing at edges or splintering.

Industrial Applicability

The present panels exhibit enhanced resistance to rippling even when perforated by mechanical fastening means, and it can be used in concrete formworks wherein the panels are perforated by mechanical fastening means, such as nails, screws, rivets or clamps. The panels can also be cut to shape while leaving smooth edges of the panel.

Citation List

WO 2008154421
US 3,497,375
WO2009/156594

Claims:

1. A method of manufacturing a concrete formwork casting panel comprising a multiply wood-veneer panel having a coating layer which forms a casting surface, said method comprising the steps of

- stacking a plurality of wood-veneer layers on top of each other to form a stack with a top wood-veneer layer having an upper surface facing the casting surface and an opposite lower surface facing the other wood-veneer layers of the stack;
- providing layers of an adhesive resin between the wood-veneer layers; and in optional order
- coating the upper surface of the top wood-veneer layer to provide a coated stack; and
- pressing the stack using increased pressure and temperature,

so as to form a multiply wood-veneer product with a coating layer,

characterized by

- applying on the upper surface of the top wood-veneer a hydrophobic agent before coating of the upper surface and applying to the lower surface of the top wood-veneer an impregnation resin,

the top wood-veneer of the casting panel being at least partially impregnated with said hydrophobic agent and with said impregnation resin.

2. The method according to claim 1, wherein the wood-veneer layers are impregnated with an impregnation resin, the molecular mass of which is less than the molecular mass of the adhesive resin, and the impregnation resin is absorbed at least partly in the fibres of the top wood veneer.

3. The method according to claim 1 or 2, wherein 1–75 % by weight, in particular 20 to 60 % by weight of the dry matter of the impregnation resin applied on the lower surface of the top wood-veneer is absorbed in said top wood-veneer.

4. The method according to any of the preceding claims, wherein the top wood-veneer is impregnated with said impregnation resin so as to achieve a concentration of impregnation

resin in the top wood-veneer of at least 5 wt-%, in particular 10 to 40 wt-%, of the dry matter of the wood-veneer.

5. The method according to any one of the above claims, wherein the impregnation resin is introduced between the top wood-veneer and the layer below the top wood-veneer impregnated in a carrier, such as a carrier in the form of a sheet, plate, fabric, tissue or web.

6. The method according to claim 5, wherein a paper or board sheet, a paper or board web, or dry paper, a textile, such as a fabric, felt, or non-woven fabric, or a polymer film or sheet is used as a carrier.

7. The method according to claim 5 or 6, wherein the amount of impregnation resin is about 10–500 parts by weight, especially 20–350 parts by weight, relative to 100 parts by weight of the carrier.

8. The method according to any of the preceding claims, wherein impregnation of the top wood-veneer is carried out separately.

9. The method according to any of claims 1 to 7, wherein impregnation of the top wood-veneer is carried out using an impregnation film in conjunction with pressing, in particular hot-pressing of the stack.

10. The method according to any of the preceding claims, wherein the hydrophobic agent is applied on the top veneer from a composition which contains the hydrophobic agent in an amount of 10 to 100 % by weight, in particular 60 to 100 % by weight.

11. The method according to any of the preceding claims, wherein the hydrophobic agent is selected from the group of waxes, oils, fats, fatty acids, alkanes, alkenes, their derivatives and their mixtures.

12. The method according to any of the preceding claims, wherein paraffin wax, silicone oil or alkene ketene dimer is used as the hydrophobic agent.

13. The method according to claim 12, wherein paraffin wax or alkene ketene dimer is used as the hydrophobic agent, said paraffin wax or alkene ketene dimer being molten before or during application on the top veneer.

14. The method according to any of the preceding claims, wherein the amount of the hydrophobic agent applied on the surface of the wood board is 10 to 100 g/m^2.

15. The method according to any of the preceding claims, wherein the hydrophobic agent is applied on the top veneer such that the wood fiber cavities are filled with hydrophobic agent.

16. The method according to any of the preceding claims, wherein the hydrophobic agent is applied on the top veneer such that at least a part of the hydrophobic agent will migrate from the top veneer to the next veneer below it, and preferably such that at least the top veneer and the veneer below it will be at least partly saturated with the hydrophobic agent.

17. The method according to any of the preceding claims, wherein the coating comprises at least one phenolic coating layer having a surface weight of about 100 to 500 g/m^2, for example 120 to 220 g/m^2.

18. The method according to claim 17, wherein the phenolic coating layer comprises a paper substrate impregnated with a phenolic resin, said paper substrate having a grammage of 40 to 80 g/m^2 and containing 80 to 140 g/m^2 phenolic resin.

19. The method according to any of the preceding claims, wherein the coating comprises a paper substrate impregnated with a phenolic resin which has been applied on the surface of the top veneer of the multiply panel by pressing, in particular by hot pressing.

20. The method according to any of the preceding claims, wherein the coating is attached to the top veneer using a separate layer of a phenolic resin, in particular a heat-activated phenolic resin, impregnated in a substrate, such as a non-woven substrate.

21. The method according to any of the preceding claims, wherein by the effect of the pressure and temperature of the pressing-stage the impregnation resin on will be absorbed

into the top wood-veneer from the lower surface and the hydrophobic agent will be impregnated into the top wood-veneer from the upper surface so as to achieve at least partial saturation of the top wood-veneer.

22. A concrete formwork casting panel manufactured according to any one of the above claims.

23. A concrete formwork casting panel which comprises a multiply panel formed by a plurality of wood veneers and a coating, which coating is bonded to the top veneer of the panel and forms a casting surface of the panel, wherein

- the top veneer of the multiply panel is impregnated with a hydrophobic agent and at least partially impregnated with an impregnation resin; and
- the coating is bonded to the top veneer using a heat-activated phenolic resin impregnated in a substrate.

24. The panel according to claim 22 or 23, wherein the coating is formed by a phenolic coating layer.

25. The panel according to claim 22 to 24, wherein the coating comprises a paper substrate impregnated with a phenolic resin which has been applied on the surface of the top veneer of the multiply panel by pressing, in particular by hot pressing.

26. The panel according to any of claims 22 to 25, wherein the coating is attached to the top veneer using a heat-activated phenolic resin impregnated in a non-woven substrate.

27. The panel according to any of claims 22 to 26, wherein the top wood-veneer has a concentration of impregnation resin of at least 5 wt-%, in particular 10 to 40 wt-%, of the dry matter of the top wood-veneer.

28. The panel according to any of claims 22 to 27, wherein the hydrophobic agent is selected from the group of paraffin wax and alkene ketene dimer, said hydrophobic agent having been used in solid form and molten before or during application on the top veneer.

29. The panel according to any of claims 22 to 28, wherein the top wood-veneer has a content of 20 to 100 g/m^2 of said hydrophobic agent.

30. The panel according to any of claims 22 to 29, wherein the wood fiber cavities of the top wood-veneer are filled with hydrophobic agent.

31. The panel according to any of claims 22 to 30, wherein the panel exhibits resistance to rippling even when perforated by mechanical fastening means.

32. Use of a method according to any of claims 1 to 21 for improving the resistance to rippling of a concrete formwork casting panel perforated by mechanical fastening means, such as nails, screws, clamps or rivets.

33. Use of a panel according to any of claims 22 to 30 as concrete formwork casting panel which is perforated by mechanical fastening means, such as nails, screws, clamps or rivets.

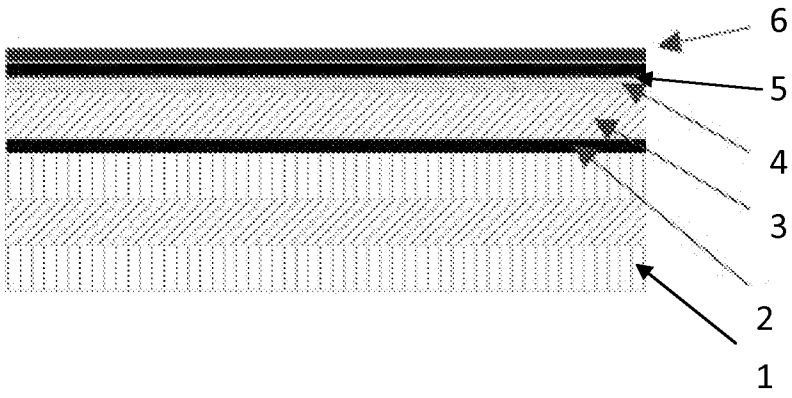

Fig. 1

INTERNATIONAL SEARCH REPORT

International application No
PCT/FI2019/050857

A. CLASSIFICATION OF SUBJECT MATTER
INV. B27K3/02 B05D7/06 B27K3/08 B27K3/15 B27K3/34
B32B21/00 C08L61/06 E04G11/00
ADD.
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)
B27K C23D B05D E04G B32B C09J C08L

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)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2006/172118 A1 (HAN KIE-SUN [KR] ET AL) 3 August 2006 (2006-08-03)	1,3-10, 14-19, 21-25, 27,29-32
Y	paragraph: [0025], [0028], [0029], [0031-0036], [0038]; figure: 2	1,13
X	JP 4 996110 B2 (MATSUSHITA ELECTRIC WORKS LTD) 8 August 2012 (2012-08-08)	1,4, 10-12, 14,22, 27,29
	paragraph: [0033], [0034], [0035]	

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[X] Further documents are listed in the continuation of Box C.

[X] 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

"E" earlier application or patent but published on or after the international filing date

"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)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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

"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

"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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 April 2020	11/05/2020

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Nania, Manuela

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/FI2019/050857

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 3 100 857 A1 (FLOORING TECHNOLOGIES LTD [MT]) 7 December 2016 (2016-12-07) paragraph: [0008-0010], [0019], [0022]; claims: 8, 11, 13 -----	1,2,4, 10,11, 14,27,29
X	WO 2009/156594 A1 (DYNEA OY [FI]; METSAELIITTO OSUUSKUNTA [FI] ET AL.) 30 December 2009 (2009-12-30) cited in the application	1,13,22, 28
Y	page 2: line 4-15, line 36; page 3: line 1-3, line 15-16, line 23-31 -----	1,13

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2019/050857

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☒ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

1-19, 21-25, 27-32

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-12, 14-19, 21-25, 27, 29-32

   wooden panel comprising multiple veneers joined together by an adhesive, with the top veneer being impregnated with a resin and hydrophobic agent and coated with an overlay, wherein the overlay comprises paper impregnated with a phenolic resin

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2. claims: 13, 28

   wooden panel comprising multiple veneers joined together by an adhesive, with the top veneer being impregnated with a resin and hydrophobic agent and coated with an overlay, wherein the hydrophobic agent is selected among alkene ketene dimer and paraffin wax

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3. claims: 20, 26

   wooden panel comprising multiple veneers joined together by an adhesive, with the top veneer being impregnated with a resin and hydrophobic agent and coated with an overlay, wherein the overlay comprises a non-woven substrate impregnated with phenolic resin

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4. claim: 33

   wooden panel comprising multiple veneers joined together by an adhesive, with the top veneer being impregnated with a resin and hydrophobic agent and coated with an overlay, wherein the panel is perforated by mechanical fastening means

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/FI2019/050857

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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