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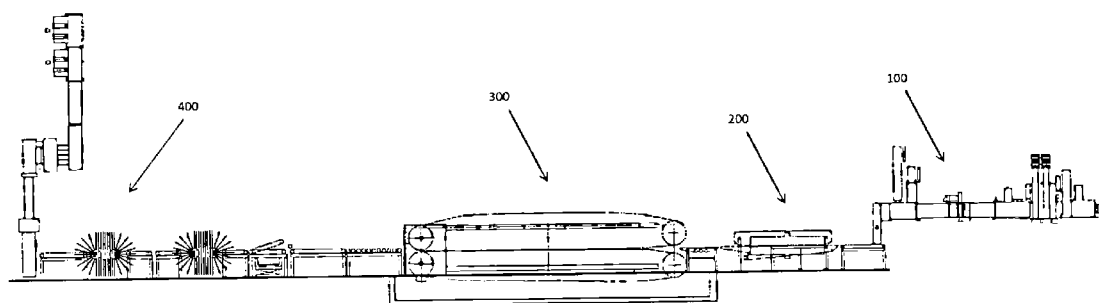
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[FIG. 1]

(57) Abstract: A manufacturing equipment and manufacturing method of the polyurethane plywood are provided according to the present disclosure. The manufacturing equipment of a polyurethane plywood comprises: a preprocessing device configured to provide veneers conforming to a preset specification; a lay-up and glue spreading device configured to divide the veneers into multiple types, wherein a plurality of types of the veneers are sequentially joined to form a continuous veneer strip, and the single-sided glue spreading process is performed on the continuous veneer strip; and the plurality of types of veneers being processed with single-sided glue spreading are stacked in sequence to form a pile of veneers; a conveying and preheating device configured to transport the pile of veneers from the lay-up and glue spreading device to the hot pressing device, and preheating the pile of veneers during the conveying process; a hot pressing device configured to perform a continuous flat pressing process on the pile of veneers with heat transfer medium to form a semi-finished board; and a raw board handling device configured to perform one or more of the following processes: to perform detection on semi-finished board, to deal with the disqualified semi-finished board, to cool the semi-finished board, and to clip the semi-finished board. This present disclosure makes it possible to apply polyurethane adhesive on a large scale in the polyurethane plywood industry and to improve product quality as well as the environmental performance.

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MANUFACTURING EQUIPMENT, MANUFACTURING METHOD OF POLYURETHANE PLYWOOD AND POLYURETHANE PLYWOOD PRODUCED THEREOF

FIELD OF THE INVENTION

[0001] The present application relates to the field of manufacturing polyurethane plywood, and more particularly to a manufacturing equipment, a manufacturing method of polyurethane plywood and polyurethane plywood produced thereof.

BACKGROUND OF THE INVENTION

[0002] Polyurethane plywood is the most important type of wood-based panel production and consumption in China. In 2017, China produced 180.94 billion cubic meters of polyurethane plywood products, accounting for 64.1% of the production of all wood-based panel products, with an output value of about 438 billion yuan. China's polyurethane plywood products include: polyurethane plywood for producing furniture and decoration, polyurethane plywood for concrete formwork, polyurethane plywood for packaging, polyurethane plywood for parquet floor substrate, polyurethane plywood for container bottom plate, laminated veneer lumber, special polyurethane plywood, block veneer and so on.

[0003] At present, urea-formaldehyde resin and phenolic resin are used as main adhesives for China's plywood products. Most of them use process line including four-roller gluing or glue spreading, manual or manual auxiliary lay-up, pre-pressure, intermittent hot pressing (multi-lamination pressing machine), stacking and veneer clipping.

[0004] In recent years, the society has put forward higher requirements for formaldehyde emission from wood-based panels and corresponding products thereof. After the implementation of the newly revised GB18580-2017 "Limited formaldehyde emission of wood-based panels and corresponding products thereof for interior decoration materials" on May 1, 2018, the indoor application of wood-based panel products completely banned the E2 level limited formaldehyde emission, and the formaldehyde-free and low-formaldehyde products became an important development direction of the industry, the consumption demand for ultra-low formaldehyde emission wood-based panels and formaldehyde-free wood-based panel products is rising,

especially in recent years, with the rapid rise of geothermal flooring in the Chinese market, higher requirement of the floor performance in geothermal environment is proposed.

[0005] A polyurethane adhesive refers to an adhesive containing a urethane group or an isocyanate group in a molecular chain. Formaldehyde-free polyurethane plywood can be produced using an formaldehyde-free polyurethane adhesive. However, most of the polyurethane plywood producers are small-scale companies, which highly depend on manual production processes. The polyurethanes are slightly volatilized before they are reacted. If there is no strong ventilation system and personal safety protection products on site, the operators is a safety hazard. At the same time, there are problems such as low hot pressing efficiency of polyurethane adhesives. Therefore, polyurethane adhesives are rarely used in the field of polyurethane plywood.

[0006] Based on the disclosure above, how to provide a manufacturing equipment and a manufacturing method of a polyurethane plywood capable of solving the aforementioned problems has become a technical problem to be solved.

SUMMARY OF THE INVENTION

[0007] In view of this, the present disclosure provides a manufacturing equipment and a manufacturing method of polyurethane plywood for realizing efficient and automated production of polyurethane plywood, present disclosure also provides a polyurethane plywood produced thereof.

[0008] In order to achieve at least one object of the present application, according to an aspect of the present application, a manufacturing equipment of a polyurethane plywood is provided, which comprises: a preprocessing device configured to provide veneers conforming to a preset specification; a lay-up and glue spreading device configured to divide the veneers into multiple types, wherein a plurality of types of the veneers are sequentially joined to form a continuous veneer strip, and the single-sided glue spreading process is performed on the continuous veneer strip; and the plurality of types of veneers being processed with single-sided glue spreading are stacked in sequence to form a pile of veneers; a conveying and preheating device configured to transport the pile of veneers from the lay-up and glue spreading device to the hot pressing device, and preheating the pile of veneers during the conveying process; a hot

pressing device configured to perform a continuous flat pressing process on the pile of veneers with heat transfer medium to form a semi-finished board; and a raw board handling device configured to perform one or more of the following processes: to perform detection on semi-finished board, to deal with the disqualified semi-finished board, to cool the semi-finished board, and to clip the semi-finished board.

[0009] In order to achieve at least one object of the present application, according to another aspect of the present application, a manufacturing method of a polyurethane plywood is further provided, comprising: a preprocessing step for providing veneers conforming to a preset specification; a lay-up and glue spreading step for dividing the veneers into multiple types, wherein a plurality of types of the veneers are sequentially joined to form a continuous veneer strip, and the single-sided glue spreading process is performed on the continuous veneer strip; and the plurality of types of veneers being processed with single-sided glue spreading are stacked in sequence to form a pile of veneers; a conveying and preheating step for transporting the pile of veneers from the lay-up and glue spreading device to the hot pressing device, and preheating the pile of veneers during the conveying process; a hot pressing step for performing a continuous flat pressing process on the pile of veneers with heat transfer medium to form a semi-finished board; and a raw board handling step for performing one or more of the following processes: to perform detection on semi-finished board, to deal with the disqualified semi-finished board, to cool the semi-finished board, and to clip the semi-finished board.

[0010] In order to achieve at least one object of the present application, according to an aspect of the present application, a polyurethane plywood is provided by using the aforementioned manufacturing method.

[0011] According to the manufacturing equipment and manufacturing method of the polyurethane plywood of the present application, by sequentially providing a series of devices including a preprocessing device, a lay-up and glue spreading device, a conveying and preheating device, a hot pressing device and a raw board handling device and performing the corresponding operation method, automated production of the polyurethane plywood is realized. As a result, the glue spreading process is performed automatically in a relatively closed environment without the need of workers, avoiding

the direct contact with the adhesive by workers, thereby preventing the safety hazard. In addition, the arrangement of hot pressing device for performing the continuous flat pressing process also solves the problem of the hot pressing efficiency of polyurethane plywood. This makes it possible to apply polyurethane adhesive on a large scale in the polyurethane plywood industry and to improve product quality as well as the environmental performance.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The present disclosure will be more fully understood from the following detailed description of the specific embodiments of the present disclosure with reference to the accompanying drawings, in which identical parts are denoted by identical reference signs, wherein:

FIG. 1 shows a schematic view of an embodiment of a manufacturing equipment of polyurethane plywood.

Reference signs:

100	lay-up and glue spreading device
200	conveying and preheating device
300	hot pressing device
400	raw board handling device

DETAILED DESCRIPTION OF THE EMBODIMENT(S) OF THE INVENTION

[0013] An embodiment of a manufacturing equipment of polyurethane plywood is described herein in connection with Fig.1 by the present application. The polyurethane is used as an adhesive, and the processes like single-sided glue spreading, automatic lay-up, preheating, continuous flat pressing are respectively performed by the preprocessing device, the lay-up and glue spreading device 100, the conveying and preheating device 200, the hot pressing device 300 and the raw board handling device 400. As a result, the automatic production of polyurethane plywood is realized. The glue spreading process is performed automatically in a relatively closed environment without the need of workers, avoiding the direct contact with the adhesive by workers, thereby preventing the safety

hazard. In addition, the arrangement of hot pressing device 300 for performing the continuous flat pressing process also solves the problem of the hot pressing efficiency of polyurethane plywood. This makes it possible to apply polyurethane adhesive on a large scale in the polyurethane plywood industry and to improve product quality as well as the environmental performance. At the same time, by directly using the polyurethane as an adhesive, the resultant products are free of formaldehyde except for the wood itself. The high water resistance and stability are suitable for high temperature, humidity and other environmental conditions, meeting the market demand for non-added formaldehyde-based wood-based panels.

[0014] Embodiments of the respective devices in the manufacturing equipment will be described in detail as follows to clarify the structure and function thereof.

[0015] Firstly, the manufacturing equipment includes a pre-processing device configured to provide veneers conforming to a preset specification wherein the preset specifications of the veneer can be considered and provided from the following aspects. For example, the length and width of the veneer should be at least larger than the size of a finished board in order to reserve the processing space. As another example, the size of the veneer should not exceed the maximum machinable size of the equipment. As an implementation way, the pre-processing device may include a veneer sorting line and a veneer dryer, wherein the veneer sorting line is used for sorting the veneer with qualified moisture content and the veneer with unqualified moisture content, and dividing the veneer with qualified moisture content into the long grain veneer and the short grain veneer; while the veneer dryer is used to dry the veneer with unqualified moisture content.

[0016] Specifically, the veneer as a basis to be sorted may be a rotary cut veneer, and the veneer sorting line includes a long grain veneer inspecting and sorting line having an operating width of 2600 mm and an operating speed of 40 m/min. It divides the veneer into front veneer, long inner veneer, back veneer and veneer with unqualified moisture content, and stacks them accordingly. Trays can also be provided to assist in stacking, with a height of approximately 1000mm. The veneer sorting line further comprises a short grain veneer inspecting and sorting line having an operating width of 2600 mm and an operating speed of 40 m/min. It divides the veneer into veneer with

unqualified moisture and veneer with qualified moisture content, and stacks them accordingly. Trays can also be provided to assist in stacking, with a height of approximately 1000mm. On the other hand, a veneer dryer is also provided to dry the rotary cut veneer with unqualified moisture content. The moisture content of a veneer is controlled to 12%, and the tolerance is $<1\%$, thereby improving the uniformity and stability of the moisture content of the dried veneer.

[0017] In addition, the pre-processing device may further include a veneer clipper and a second veneer turner, wherein the veneer clipper is used to clip the veneer so that it conform to preset specification; and the second cooling turner is used to turn over and stack the veneer.

[0018] Specifically, the veneer clipper can accurately clip the length and width of a veneer. For example, the length of a veneer equals to the length of a finished board plus 100 mm; and the width of a veneer equals to the width of a finished veneer plus 50 mm. After the veneer is inspected, sorted, dried and clipped into qualified specification, it could be divided into front veneer, back veneer, long inner veneer and core veneer, and then it could be turned over, stacked and stored separately by using the second cooling turner.

[0019] In addition, the manufacturing equipment further includes a lay-up and glue spreading device 100 configured to divide the veneers into multiple types, wherein a plurality of types of the veneers are sequentially joined to form a continuous veneer strip, and the single-sided glue spreading process is performed on the continuous veneer strip; and the plurality of types of veneers being processed with single-sided glue spreading are stacked in sequence to form a pile of veneers. As an implementation way, the lay-up and glue spreading device 100 may comprise a first cooling turner, a lay-up machine, and a glue spreading machine; wherein the first cooling turner is used to divide the veneers into a plurality of types; the lay-up machine is used to sequentially join a plurality of types of veneers to form a continuous veneer strip; the glue spreading machine is used to perform a single-sided glue spreading process on the continuous veneer strip; and the lay-up machine is further used to stack a plurality of types of veneers being processed with single-sided glue spreading to in sequence form a pile of veneers.

[0020] Specifically, the first cooling turner can turn over the qualified veneer, and stack the veneer according to six different types of front veneer stack, the back veneer stack, the long inner veneer stack (face up), the long inner veneer stack (face down), the core veneer stack (face up) and core veneer stack (face down). According to the requirements of the lay-up, the veneer of these types are respectively transported to the veneer stack transporter in front of the lay-up machine and the glue spreading machine. The lay-up machine automatically joins the veneers like back veneer, core veneer, long inner veneer in a sequence of the pile of veneers. Polyurethane plywood products usually have 3 layers, 5 layers, 7 layers or 9 layers construction. Taking a 7-layer structure as an example, it includes front veneer (long grain), core veneer (face up short grain), long inner veneer (face up long grain), core veneer(face down short grain), long inner veneer (face down long grain), core veneer (face down short grain) and back veneer (long grain) from top to bottom. Taking a 9-layer structure as another example, it includes front veneer (long grain), core veneer (face up short grain), long inner veneer (face up long grain), core veneer(face down short grain), long inner veneer (face up long grain), core veneer (face down short grain), long inner veneer (face down long grain), core veneer (face down short grain) and back veneer (long grain) from top to bottom. The joining length between veneers is about 10 mm, thereby forming a continuous veneer strip passing through the glue spreading machine. The glue spreading machine performs single-sided glue spreading process, with a distance of 1 to 4 mm between glue lines, wherein the width of glue spreading equals to the length of a veneer minus (10 to 30) mm $\times$ 2. In this case, a glue spreading line monitoring device is additionally provided. If the gluing nozzle is blocked, it can be automatically switched to ensure continuous production, instead of stopping the production line due to the interruption of the glue spreading. Further, the speed of passing veneer strip is adjustable from 0 to 60 m/min, and the amount of applied polyurethane glue is 30-80g/m². If the length of the veneer to be glued is different, the single-sided positioning mode can be adopted to pass the veneer through the glue spreading machine. Finally, the front veneer stack is located downstream of the glue spreading machine, and the front veneer is placed on the top of the pile of veneers by the automated lay-up machine, wherein veneers of the pile of veneers are glued and stacked in a required sequence.

[0021] Alternatively, two sets of automatic lay-up machines and glue spreading machines can be provided symmetrically for more efficient and automated lay-up and glue spreading.

[0022] Alternatively, the glue spreading machine could be replaced by a glue spraying machine. The veneers are joined transversely to form a continuous veneer strip passing through the glue spraying machine with a speed adjustable from 0 to 60 m/min.

[0023] The gluing nozzles of the glue spraying machine are switched automatically to spray the glue on the surface of the veneer within the defined range according to the process requirements, wherein the width of glue spreading equals to the length of a veneer minus $(10-30) \text{ mm} \times 2$, and the amount of applied polyurethane glue is $30-80 \text{ g/m}^2$.

[0024] The glue spraying machine further comprises a conveying platform, and the top of the conveying table is provided with a mounting frame. There are 2-10 high-pressure gluing nozzles uniformly located at the mounting frame, wherein these high-pressure gluing nozzles are divided into 1-6 rows, which depends on the production and Process requirements.

[0025] In addition, as an example, the main technical properties of the polyurethane adhesive used in the glue spreading machine are: appearance: brown liquid; viscosity at (25°C) : $200-4000 \text{ mPa}\cdot\text{s}$; Solid content: 100%; The polyurethane adhesive can be stored in a storage tank, and a glue filtration device is provided. Specifically, the storage tank for storing the adhesive communicates to the transfer tank. The adhesive is transferred from the transfer tank to the gluing nozzle of a glue spreading machine via pipes. Optionally, there is no need for a transfer tank if the gluing nozzle is located close to the storage tank.

[0026] Further, a glue constant temperature heating system can be configured to stabilize the viscosity. Specifically, the glue constant temperature heating system is arranged around the pipes connecting the transfer tank to the gluing nozzle of a glue spreading machine. It heats the heat transfer medium with electrical power or the other power to keep or adjust the temperature of the polyurethane adhesive flowing through

the pipes, and thus stabilizing the viscosity. As a result, the continuity of the glue spraying and the process is ensured.

[0027] Further, there is a gas source connected to the gluing nozzle via a high pressure pump. The gas source could be chosen from air, nitrogen or other kinds of gases. After passing through the high-pressure pump, the gas pressure is adjusted to 0.1-2 Mpa, ensuring that the gas out of the gluing nozzle is atomized and in the form of sector shape. As a result, the uniformity of glue spraying is ensured. In addition, the amount of sprayed glue is adjusted by altering the pressure of the gas and the type of the gluing nozzle.

[0028] Still further, the conveyor belt is driven by a motor, e.g a geared motor. The motor drives the chain or the roller to drive the veneer passing through the glue spraying machine. The running speed of the veneer on the conveyor belt is controlled by the PLC system of the processing line.

[0029] Alternatively, there is a shield surrounding the whole gluing processing line to prevent the glue from being splashed.

[0030] According to the arrangement of foregoing embodiments, the single-sided glue spreading process performed by the glue spreading machine has a lot of advantages, including: glue spreading on the surface of a veneer is uniformed, the amount of spread glue is easy to be controlled, and the amount of spread glue can be saved up to 40% compared with four-roller gluing or normal gluing process. In addition, the glue spreading process can be performed automatically, which brings a safety environment during the production. The automatically continuous lay-up process performed by the lay-up machine reduces the workers, and saves labor by more than 60% compared with manual or manual auxiliary lay-up at the same scale. At the same time, the glue spreading process is integrated to the automatic lay-up line, which greatly improves the production efficiency and product quality.

[0031] Further, the manufacturing equipment includes a conveying and preheating device 200 configured to transport the pile of veneers from the lay-up and glue spreading device 100 to the hot pressing device 300, and preheating the pile of veneers during the conveying process. As an implementation way, the conveying and preheating device 200 comprises: a conveyor and a pile of veneers preheating device

disposed in a closed passage, and the closed passage has a forced ventilation system. Specifically, the conveyor is used to transport the pile of veneers from the lay-up and glue spreading device 100 to the hot pressing device 300 through the pile of veneers preheating device. The pile of veneers preheating device performs a preheating process on the pile of veneers during the conveying process so that it is heated to 60℃—90℃. The preheating device could be a microwave preheating device which automatically adapt to the change of the different operating speeds of the hot pressing device 300 when producing the finished plates with different thicknesses, and adapt fluctuation in the moisture content of a veneer. In addition, in order to facilitate the controlling and the automated adjustment of the process, a pile of veneers moisture content online monitoring device is provided. Further, glass walls and a forced ventilation system are provided around the processing section of the conveying and preheating device 200 to ensure constant temperature and heat dissipation performance.

[0032] In the arrangement according to the foregoing embodiment, heating the pile of veneers with microwave increases the initial temperature of the pile of veneers during hot pressing, has a significant effect on shortening the hot pressing factor, and effectively reduces the time required for the curing of the glue. When compared to a normal heating process, the heat transfer rate of the veneer in microwave heating process is improved, and the time for producing a qualified pile of veneers is saved by 30s-60s, which greatly improves the production efficiency.

[0033] Additionally, the manufacturing equipment further includes a hot pressing device 300 configured to perform a continuous flat pressing process on the pile of veneers with heat transfer medium to form a semi-finished board. As an implementation way, the hot pressing device 300 comprises a continuous flat pressing machine, a heat transfer medium circulation system, and a pressure sectional control system; wherein the continuous flat pressing machine is used to perform a continuous flat pressing process on the pile of veneers; the heat transfer medium circulation system is configured to recycle the applied heat transfer medium when the pile of veneers is subjected to the continuous flat pressing process, and configured to perform sectional control of the hot pressing temperature; and the pressure sectional control system is used for sectional control of the pressure when the pile of veneers is subjected to the continuous flat pressing process. Optionally, the pressure sectional control system adjusts the pressure step-by-step on the

pile of a compression section, a pressure maintaining section and a thickness determining section on the continuous flat pressing machine, wherein the pressure applied upon these different sections decreases gradually.

[0034] Specifically, the continuous flat pressing machine can be chosen as a 4-9 foot wide continuous flat pressing machine, and the operating width satisfies the requirement of the maximum length of a finished board of 1240mm to 2800mm. The continuous flat pressing machine uses oil as a heat transfer medium and is equipped with an oil circulation system. The continuous flat pressing machine is divided into five sections to control the hot-pressing temperature. Further, the continuous flat pressing machine is also equipped with pressure sectional control, including the compression section, the pressure maintaining section and the thickness determining section, wherein the unit pressure applied upon them are reduced gradually and regulated in the range between 1.0MPa-3.0MPa.

[0035] In the arrangement according to the foregoing embodiment, the continuous hot pressing process performed by the continuous flat pressing machine provided with the heat transfer oil reduces the pile of veneers pressurization zone pressure of the initial heating section of the pile of veneers, reducing the operating cost. When compared to the intermittent hot pressing (by multi-lamination machine) process, it could effectively reduce the thickness tolerance of the pile of veneers, reduce the thickness of the pre-cured layer, reduce the subsequent workload of the processing of semi-finished board, and ensure the stability of the product quality. At the same time, the production process can meet the various specification requirement of the finished board.

[0036] Further, the manufacturing equipment further includes a raw board handling device 400 configured to perform one or more of the following processes: to perform detection on semi-finished board, to deal with the disqualified semi-finished board, to cool the semi-finished board, and to clip the semi-finished board. As an implementation way, the raw board handling device 400 comprises one or more of the following devices: a system for detecting the semi-finished board, a bubble detecting device, a cooling turner, and an trimming; wherein the system for detecting the semi-finished board is configured to detect the thickness of the semi-finished board and give a feed back to the hot pressing device 300 so that it could perform pressure adjustment

applied at the thickness determining and pressure maintaining section; the bubble detecting device is used to detect the disqualified semi-finished board with bubbles so that it could be transported to the stacker for disqualified semi-finished board; the cooling turner is used to turn over and cool down the semi-finished board to a temperature below e.g. 60°C; and the trimming is used to clip the semi-finished board into the specification of a finished board. Subsequently, the pile of veneers can be stacked to a height of 1200 mm by a stacker and stored in a specific area to be further processed.

[0037] The process in the foregoing embodiment can reduce the thickness tolerance of the veneer, reduce the amount of the disqualified veneer, effectively reduce the production cost, and reduce the subsequent processing workload.

[0038] Thereafter, optionally, a sanding line can be provided. Determining the thickness of the clipped veneer with sanding to the thickness of the finished board, the sanding margin is 0.2 mm-0.3 mm, and the thickness tolerance of the finished board is <0.01 mm. Then, the finished board is ready for inspection and coding and packaging.

[0039] In addition, although not shown in the drawing, there is also provided a manufacturing method of polyurethane plywood, which comprises a preprocessing step, lay-up and glue spreading step, a conveying and preheating step, a hot pressing step and a raw board handling step, and actions to be performed in each step correspond to the operations of respective devices of the manufacturing equipment in foregoing embodiments, respectively, thereby realizing the entire automation of the manufacturing process of polyurethane plywood, reducing the costs of workers, ensuring safety during production and improving efficiency.

[0040] The production process of the polyurethane plywood will be described in conjunction with the manufacturing equipment and method according to the foregoing embodiments as follows. Firstly, before performing the process, the logs can be peeled off and cut off, and the cut logs are transported to the log cooking soft section to be softened, and then sent to the veneer rotary cut section for further processing. The wood segment is cored by the core machine after laser scanning, and sent to the rotary cut machine for rotary cutting. The qualified veneers after rotary cutting are manually adjusted and sent to a veneer dryer for drying. After that, the process in present

application is performed. The dried veneer is divided into long grain veneer and the short grain veneer and processed with the moisture content test by the veneer sorting line. The disqualified veneer is marked by on-line ink jet, and is stacked individually for further drying. The first cooling turner is used to turn over and divide the dried veneer into six different types like front veneer stack, the back veneer stack, the long inner veneer stack (face up), the long inner veneer stack (face down), the core veneer stack (face up) and core veneer stack (face down). The veneers are transported to the automatic lay-up machine for lay-up according to the requirements, and the veneers are sequentially passed through the automatic glue spreading machine for spreading glue. After that, the veneer moves forward to be preheated by the microwave heating device, and then enters the continuous flat pressing machine for hot pressing. With the help of temperature and pressure, the adhesive is cured, and the polyurethane plywood pile of veneers is pressed into a polyurethane plywood semi-finished board. After the hot pressing period is completed, the polyurethane plywood semi-finished board is transported to the next process via the discharge conveyor and the unloading conveyor. The polyurethane plywood semi-finished board is sawed and divided into the polyurethane plywood with preset specification. The polyurethane plywood with preset specification after sanding becomes the finished polyurethane plywood. Then the finished product of the polyurethane plywood is inspected and classified. Further, it is transported to a film packaging machine for packaging. The packaged product is bundled by the baler and transported to the finished product warehouse for storage.

[0041] In the description, examples are used to disclose the present application, including the best mode, with the purpose of enabling any person skilled in the art to practice the application, including making and using any device or system and performing any of the methods covered. The scope of protection of the present application is defined by the claims, and may include other examples that can be conceived by those skilled in the art. If such other examples have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements that do not substantively differ from the literal language of the claims, these examples are also intended to be included in the scope of the claims.

WHAT IS CLAIMED IS:

1. A manufacturing equipment of a polyurethane plywood, characterized in comprising:

a preprocessing device configured to provide veneers conforming to a preset specification;

a lay-up and glue spreading device configured to divide the veneers into multiple types, wherein a plurality of types of the veneers are sequentially joined to form a continuous veneer strip, and the single-sided glue spreading process is performed on the continuous veneer strip; and the plurality of types of veneers being processed with single-sided glue spreading are stacked in sequence to form a pile of veneers;

a conveying and preheating device configured to transport the pile of veneers from the lay-up and glue spreading device to the hot pressing device, and preheating the pile of veneers during the conveying process;

a hot pressing device configured to perform a continuous flat pressing process on the pile of veneers with heat transfer medium to form a semi-finished board; and

a raw board handling device configured to perform one or more of the following processes: to perform detection on semi-finished board, to deal with the disqualified semi-finished board, to cool the semi-finished board, and to clip the semi-finished board.

2. The manufacturing equipment according to claim 1, wherein the lay-up and glue spreading device comprises: a first cooling turner, a lay-up machine, and a glue spreading machine; wherein the first cooling turner is used to divide the veneers into a plurality of types; the lay-up machine is used to sequentially join a plurality of types of veneers in a horizontal direction to form a continuous veneer strip; the glue spreading machine is used to perform a single-sided glue spreading process on the continuous veneer strip; and the lay-up machine is further used to stack a plurality of types of veneers being processed with single-sided glue spreading to in sequence form a pile of veneers.

3. The manufacturing equipment according to claim 1, wherein the hot pressing device comprises a continuous flat pressing machine, a heat transfer medium circulation system, and a pressure sectional control system; wherein the continuous flat pressing

machine is used to perform a continuous flat pressing process on the pile of veneers; the heat transfer medium circulation system is configured to recycle the applied heat transfer medium when the pile of veneers is subjected to the continuous flat pressing process, and configured to perform sectional control of the hot pressing temperature; and the pressure sectional control system is used for sectional control of the pressure when the pile of veneers is subjected to the continuous flat pressing process.

4. The manufacturing equipment according to claim 3, wherein the pressure sectional control system gradually decreases the pressure applied on the pile of the compression section, the pressure maintaining section and the thickness determining section on the continuous flat pressing machine.

5. The manufacturing equipment according to any one of claims 1 to 4, wherein the conveying and preheating device comprises: a conveyor and a pile of veneers preheating device disposed in a closed passage, and the closed passage has a forced ventilation system; wherein the conveyor is used to transport the pile of veneers from the lay-up and glue spreading device to the hot pressing device through the pile of veneers preheating device; the pile of veneers preheating device performs a preheating process on the pile of veneers during the conveying process.

6. The manufacturing equipment according to any one of claims 1 to 4, wherein the raw board handling device comprises one or more of the following devices: a system for detecting the semi-finished board, a bubble detecting device, a cooling turner, and an trimming; wherein the system for detecting the semi-finished board is configured to detect the thickness of the semi-finished board and give a feed back to the hot pressing device so that it could perform pressure adjustment applied at the thickness determining and pressure maintaining section; the bubble detecting device is used to detect the disqualified semi-finished board with bubbles so that it could be transported to the stacker for disqualified semi-finished board; the cooling turner is used to cool down the semi-finished board; and the trimming is used to clip the semi-finished board into the specification of a finished board.

7. A manufacturing method of a polyurethane plywood, characterized in comprising:

a preprocessing step for providing veneers conforming to a preset specification;

a lay-up and glue spreading step for dividing the veneers into multiple types, wherein a plurality of types of the veneers are sequentially joined to form a continuous veneer strip, and the single-sided glue spreading process is performed on the continuous veneer strip; and the plurality of types of veneers being processed with single-sided glue spreading are stacked in sequence to form a pile of veneers;

a conveying and preheating step for transporting the pile of veneers from the lay-up and glue spreading device to the hot pressing device, and preheating the pile of veneers during the conveying process;

a hot pressing step for performing a continuous flat pressing process on the pile of veneers with heat transfer medium to form a semi-finished board; and

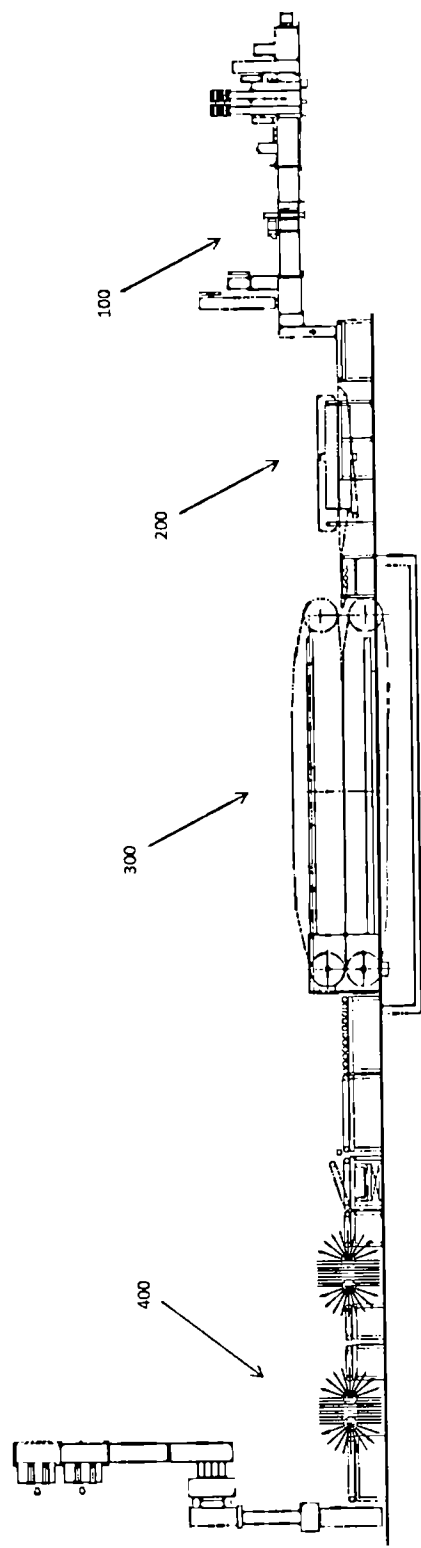
a raw board handling step for performing one or more of the following processes: to perform detection on semi-finished board, to deal with the disqualified semi-finished board, to cool the semi-finished board, and to clip the semi-finished board.

8. The manufacturing method according to claim 7, wherein the hot pressing step comprises: performing temperature sectional control of the heat transfer medium and pressure sectional control during the continuous flat pressing process of the pile of veneers; and/or circulating the heat transfer medium during the continuous flat pressing process of the pile of veneers.

9. The manufacturing method according to claim 8, wherein the pressure sectional control step comprises: gradually decreases the pressure applied on the pile of the compression section, the pressure maintaining section and the thickness determining section on the continuous flat pressing machine.

10. The manufacturing method according to claim 7, wherein the raw board handling step comprises one or more of the following steps: detecting whether or not the thickness of the semi-finished board is qualified, and giving a feed back to the hot pressing device so that it could perform pressure adjustment applied at the thickness determining and pressure maintaining section; detecting and filtering the disqualified semi-finished board with bubbles; turning over and cooling down the semi-finished board; and clipping the semi-finished board into the specification of a finished board.

11. The polyurethane plywood produced by using the manufacturing method according to claims 7 to 10.



[FIG. 1]

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2020/127700

A. CLASSIFICATION OF SUBJECT MATTER

B32B 21/08(2006.01)i; B27D 1/04(2006.01)i

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)

B27D1, B32B21/08

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)

EPODOC;WPI;CNABS;CNKI;POLYWOOD, ARTIFICIAL, SYNTHETIC, BOARD, FORMALDEHYDE, FREE, CONTINUOUS, PROCESS, PRODUC+, AUTOMATED, MECHANIZED

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Qu Guofu, et al. "Solution of Automatic Continuous Press Line for Plywood" <i>China Wood-based Panels</i> , Vol. 27, No. 2, 29 February 2020 (2020-02-29), pages 8-12	1, 2, 4-7, 9-11
Y	Qu Guofu, et al. "Solution of Automatic Continuous Press Line for Plywood" <i>China Wood-based Panels</i> , Vol. 27, No. 2, 29 February 2020 (2020-02-29), pages 8-12	3, 8
Y	CN 108381692 A (FUZHOU HANYANG ENVIRONMENTAL SCI & TECHN) 10 August 2018 (2018-08-10) paragraphs 0024-0026	3, 8
A	JP 03254902 A (DAINIPPON INK & CHEMICALS et al.) 13 November 1991 (1991-11-13) the whole document	1-11
A	JP 04327902 A (UNIE KU KK) 17 November 1992 (1992-11-17) the whole document	1-11
A	DE 3914107 A1 (SIEMPELKAMP GMBH & CO) 31 October 1990 (1990-10-31) the whole document	1-11



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2020/127700

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				JP	H04327902	A	17 November 1992
DE	3914107	A1	31 October 1990	DE	3914107	C2	26 January 1995
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