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PROCESS FOR MANUFACTURING BUILDING PANELS OR OTHER ARTICLES FROM PLANT MATTER AND A PRODUCTION LINE FOR CARRYING OUT THE SAID PROCESS.

The process involves the following steps: humidification of the material through exposure to saturated steam; crushing; drying out during preliminary heating until thermoplasticity is attained while the material is being transported in a closed vessel; pressing in an extrusion press; and gradual cooling with preliminary seasoning in an insulated vessel. The production line comprises the following elements: a hopper (1); a device in the form of a steam pipe (2) for humidification; a crushing device (4); a means of transport (5) comprising two continuous conveyors (8 and 9) arranged in housings (10 and 11), in one of which water is removed from the material, while the other is used for drying and heating until thermal plasticity is attained; and an extrusion press (24) including a heating zone, a neutral zone and a cooling zone.

FIG.1
FIELD OF THE INVENTION

The present invention relates to construction, namely, to a method of manufacturing building boards or articles of vegetable materials and a production line for realization of this method.

The invention will find broad application in making of a furniture in the woodworking industry.

DESCRIPTION OF THE PRIOR ART

The technology of wood-particle board manufacture is known (N. G. Romanov, Production Process of Wood Plastics and Boards, 1965, publishing office Lesnaya Promyshlennost, Moscow, p. 447-449), this technology includes milling of wood, drying a ground material, preparation of a binding agent and application it on surfaces of wood particles as well moulding.

A wood is milled with hammer breaker, cam crusher and so on, thereafter the ground material is dried in pneumatic, drum, continuous-belt or other driers. A binding agent is prepared in the form of urea formaldehyde, phenol-formaldehyde and other resins. Continuous or batch-operated mixers, for example, drum and paddle mixer, are used for mixing of chips and binding resins together. Mixed with the binder wood particles are moulded with continuous caterpillar presses or batch-operated hydraulic multiopening presses.

The said method of manufacturing wood-particles boards has the following drawbacks. Applied binding resins pollute an environment with toxic gases both during moulding and during use of the articles.

An extrusion method of manufacturing wood-particle boards (SU, A, 10216310) is well known. This method consists in feeding resin coated wood particles into a press receiving bin. Then particles are fed into a moulding channel formed by heating plates and void-formers. Moulded wood-particle board removes a press channel as a continuous band under the influence of punch pressure and heat of heating plates and external surfaces of void-formers.

However, use of resins causes pollution of an environment with toxic formaldehyde both during moulding and during use of finished articles. A method of manufacturing building boards or articles of vegetable materials without addition of binding agents (A. N. Minin, Production of Articles and Materials of Ground Wood by Moulding, 1960, BSSR Governmental Publishing Office, Minsk, p. 123-127) is known. The method consists in humidification of a source material and transmission of a waste into chipping machines for milling. Ground waste is sized, hereupon coarse portions are fed for repeated milling and the remaining wood pulp is received into a bin. The mass is fed automatically from a bin into driers(pneumogas, drum and other driers) with a dosing feeder. Dry material is received into other bin, from which it is uniformly loaded with a dosing feeder into chain pulsating conveyer placed dies and the material is fed to a single daylight hydraulic press for preheating to thermal fluidity. After moulding material preheating in high-frequency field the dies with compacted material are fed with the same conveyer onto a charging device of a hydraulic multiopening press. Cooling, opening press plates and unloading of the dies with finished articles are carried out after moulding. However, this process is laborious and expensive due to large energy consumption. Stage-by-stage operations and moulding with a multiopening press cause low process productivity.

DISCLOSURE OF THE INVENTION

An object of the invention is a method of manufacturing building boards or other articles of vegetable materials as well as a production line of this method ensuring ecological cleanliness of building boards or other articles with improved physical-mechanical characteristics together with high manufacturing productivity due to coincidence of operations and usage of an extrusion moulding without application of binding resins and because of rational design in order to make this operations.

An object of the invention is the method of manufacturing building boards or other articles of vegetable materials including: milling, drying, conveying of ground mass, preheating of the ground mass in a close space to thermal plasticity and moulding followed by cooling of the article, according to the invention drying is carried out during ground mass preheating to thermal plasticity, said preheating being executed during conveying and moulding is performed with an extrusion press.

Simultaneous ground mass drying and preheating to thermal plasticity during conveying ensures short-term preparation of a moulding material, namely, bringing it to maximum fluidity with formation of resins.

It reduces the term of further moulding and ensures application of continuous extrusion moulding without use of phenol-formaldehyde and other resins because manufacturing productivity of ecologically clean building boards or other articles with improved physical-mechanical characteristics is increased.

Preferably, humidification of vegetable materials is carried out by the saturated steam. It facilitates milling of the material in a breaker and reduces energy consumption.
Preferably, rarefaction is created in a close space during ground material conveying. It ensures moisture and volatile gases removal from the material in the hermetic space. This phenomenon promotes all sizing agent conservation formed during material heating, facilitating to a process of moulding thereafter.

Preferably, the finished article is seasoned before cooling in a close space for removal of internal stresses, it increases a strength and reduces water absorption of the finished articles.

Other object of the invention is a production line for manufacturing of building boards or other articles of vegetable materials which consists of at least one breaker for milling of a material, a vehicle, a device for moulding, the vehicle includes two continuous conveyers, each of them is arranged in a housing, the housing of the first continuous conveyer is provided with a loading trough connected with a breaker and a cone portion having some openings on its surface and a lesser base of the cone is connected with a receiving apparatus of the housing of the second continuous conveyer, said housing is provided with double inner and outer walls; between these walls there is a space filled with heat-transfer agent as well with pipes for moisture and volatile gases removal and with a pipe for unloading of the mass connected with a moulding device as an extrusion press containing heating plates forming a heating zone, a collector with void-formers consisting of outer and inner tubes for heat-transfer agent supply and a punch.

This constructive embodiment of the vehicle ensures continuity of drying and preheating during conveying in the close space and it promotes increase of process productivity and ensures moulding material preparation, namely, state of its maximum fluidity with the extrusion press without addition of toxic synthetic resins polluting an environment.

Preferably, the apparatus for humidification of the material is carried out as a steam line. It facilitates subsequently milling of the material with a breaker and reduces energy consumption.

Preferably, the steam line is arranged between the bin and the breaker connected with the vehicle by means of a pipe-line and a cyclone. It will ensure removal of a free steam before drying in the vehicle and promote reducing of energy consumption.

Preferably, the steam line is placed within the bin. It simplifies production line construction to a great extent.

Preferably, vehicle pipes for removal of moisture and volatile gases are provided with an apparatus for creation of rarefaction at the gas outlet. This promotes effective removal of moisture and volatile gases from the ground material with conservation of hermetic sealing and all sizing agents, being formed during heating of mass which agents facilitate process of moulding.

Preferably, heating plates of the extrusion press are provided with a cooling zone performed with channels for a coolant and placed after the heating zone, a neutral zone being placed between the plate heating zone and the cooling zone. Channels of the neutral zone are filled with insulator and void-formers additionally are provided with an interior pipe for a heat-transfer agent and external and internal pipes for a coolant, the last pipes being placed in a space of interior pipes for supply of heat-transfer agent of the heating zone, and are insulated from the latter with insulator; and a collector additionally is provided with pipes for coolant insulated from pipes for heat-transfer agent with insulator. Length of the void-former external coolant pipe must be larger than length of the heat-transfer agent pipes by length of the neutral zone and a cooling zone of the heating plates.

This constructive embodiment of extrusion press elements permits after heating of the moulding material to 17-225 °C to ensure seasoning of formed article in the neutral zone for removal of internal stresses with subsequent slow cooling to the temperature lower than 100 °C in the close space. It promotes increase of article physical-mechanical characteristics. Seasoning time in the neutral zone depends on the type of a source vegetable material.

The invention is explained further by detailed description of its embodiment specific version and appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 represents a diagram of a production line for manufacturing building boards or other articles of vegetable materials;
Fig. 2 also represents a diagram of a production line for manufacturing building boards or other articles of vegetable materials;
Fig. 3 represents a vehicle of a production line in longitudinal section;
Fig. 4 represents construction of an extrusion press in longitudinal section.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The method of manufacturing building boards or other articles of vegetable materials according to the invention comprises humidification of a source material with saturated steam at temperatures between, 170° and 200°C, milling, drying of a
ground mass carried out during preheating it to thermal fluidity and during conveying in a closed space, moulding with an extrusion press; in addition, rarefaction is created during conveying in the closed space and finished article is seasoned before cooling in the insulated closed space for removal of internal stresses.

The production line for manufacturing building boards or other articles of vegetable materials comprises: a bin I, an apparatus for humidification of a material accomplished as a steam line 2 and placed interior to a chamber 3 mounted between the bin I and a breaker 4 (fig. 1) or interior to the bill I connected immediately with the breaker 4 (fig. 2). The breaker 4 is connected with a vehicle 5 by means of a pipe-line 6 and a cyclone 7 (fig. 1) or directly with the vehicle 5 (fig. 2). The vehicle 5 comprises two continuous conveyers 8, 9, each of them being arranged in a housing 10, 11, correspondingly. The housing 10 is provided with a charging trough 12 connected with the cyclone 7 (fig. 1) or directly with the breaker 4 (fig. 2). Also the housing 10 is provided with a cone portion 13 having openings 14 and lesser base of the cone 13 is connected with a charging trough 15 of the housing 11. Also the cone portion 13 is connected with a collector 16 mounted on the outside of the housing 10. The housing 11 is provided with double inner and outer walls 17, 18, correspondingly; there is a space 19 between these walls filled with heat-transfer agent. Also the housing 11 has pipes 20 for removal moisture and volatile gases. These pipes providing with an apparatus 21 for creating rarefaction at the outlet of gases, and a pipe 22 for unloading of mass, which the pipe 22 is connected with a dosing unit 23 of all extrusion press 24. The extrusion press 24 comprises: heating plates 25, side guides 26, a collector 27 with void-formers 28 and a punch 29. The heating plates 25 are provided with channels 30 for heat-transfer agent which channels form a heating zone, and channels 31 for coolant forming a cooling zone of the plates 25 a neutral zone being placed between the heating zone and the cooling zone of the plates 25, as well channels 32 filled with insulator. The void-former 28 consists of interior pipes 33 and 34 and exterior pipe 35 for the heat-transfer agent as well internal and external pipes 36, 37, correspondingly for coolant placed inside pipe 33 and insulated from the latter by means of insulator 38. The collector 27 consists of pipes 39, 40 for the heat-transfer agent and pipes, 41, 42 for the coolant separated from the pipes 39, 40 by means of insulator 43. The housing 22 is provided with external insulator 44.

The production line for manufacturing building boards or other articles of vegetable materials operates as follows.

A source vegetable materials, for example, ground wood, awnchaff, club rush, etc, is loaded into the bin I from which the material is fed into the chamber 3 for humidification with steam from the steam line 2 at temperatures between 120°C and 170°C. Humidified material is fed into the breaker 4 for milling. The ground mass is fed with the pipeline into the cyclone 7 for separation of steam and then the mass is fed into the charging trough 12 of the vehicle 5 (fig. 1). In the second version of embodiment (fig. 2) humidification is took place in the bin I at temperatures between 100°C and 170°C with steam from the steam line 2 placed in the bin I. Separation of steam from the ground mass is occurred in the bin too. After humidification the mass is fed into the breaker 4 for milling and then the mass is received immediately into the charging trough 12 of the vehicle 5. From the charging trough 12 the mass is came onto the continuous conveyer 8 which moves it into the cone portion 13 of the housing 10. Moisture is removed from the mass into the collector 16 through the openings 14. The mass is moved with the continuous conveyer 9 within the housing II from the cone portion 13 which prevents hit of moisture into the mass fed into the charging trough 15 of the housing II.

The mass is heated to temperature 120-170°C with the heat-transfer agent, as a result drying of the material is carried out with removal of moisture and volatile gases through pipes 20; since rarefaction is created with the apparatus 21 at the outlet from the pipes 20 and hermetic sealing is maintained in the housing II these circumstances contribute to maintain of all sizing agents which is formed as a result softening of the mass during heating with the heat-transfer agents. The softened mass is fed through the pipe 22 into the dosing unit 23 of the extrusion press 24. The mass is fed by means of the dosing unit 23 along the side guides 26 into a forming channel formed by the heating plates 25 and exterior pipes 35 of the void-formed 28. A moulded board or other article goes out from the channel of the press 24 as a continuous band under the influence of pressure created by punch 29 and heat from the exterior pipes 35 heated with the heat-transfer agent which is fed through the collector 27 into the space between exterior pipe 35 and interior pipes 33, 34 of the void-former 28. The moulded article is fed into the neutral zone in which heating and rapid cooling are absent and owing to this fact removal of internal stresses is occurred in the article. Then the article is received into the cooling zone for gradual cooling during its motion to temperature lower than 100°C with the coolant fed through the pipe 37 of the collector 27 into the space between the external pipe 37 and internal pipe 36.
INDUSTRIAL APPLICABILITY

The proposed invention concerned to method of manufacturing building boards or other articles of vegetable materials and production line for realization of this method can find broad application in the woodworking industry and in other branches of industry for manufacturing building articles with employment of chips, wood shavings, bark, club rush, awnchaff and other vegetable materials without adding toxic binding agents. By use of the invention it can obtain cheap ecologically clean material with high physical-mechanical properties.

Claims

1. A method of manufacturing building boards or articles of vegetable materials comprising humidification of source material, milling, drying, conveying of groundmass, preheating said ground mass in closed space to thermal plasticity and moulding with subsequent cooling, characterized in that drying of said humidified material is executed during preheating of the ground mass to thermal plasticity which preheating is carried out during conveying and moulding of said mass is performed with extrusion press.

2. The method according to to claim I, characterized in that humidification of vegetable material is carried out with saturated steam.

3. The method according to claim I, characterized in that rarefaction is created in said closed space during conveying of said ground mass.

4. The method according to claim I, characterized in that finished article is seasoned after heating during moulding before cooling in the closed space for removal of internal stresses.

5. A production line for realization of the method according to claim I, said line comprising a bin (1), an apparatus (2) for humidification of the material, at least one breaker (4), a vehicle (5) for ground mass, a device for moulding, characterized in that said vehicle (5) includes two continuous conveyers (8, 9) each of them is arranged in a housing (10, 11), the housing (10) of the continuous conveyor (8) being provided with a charging trough (12) connected with the breaker (4) and cone portion (13) having openings (14) on its surface, and lesser base of the cone is connected with a charging trough (15) of the housing (11) of the second continuous conveyor (9), said housing (11) being provided with double, inner and outer walls (17, 18, correspondingly) and there is a space (19) between these walls filled with heat-transfer agent as well pipes (20) for removal of moisture and volatile gases and pipe (22) for unloading of said mass connected with a moulding device performed as an extrusion press (24) comprising heated plates (25) forming a heating zone, a collector (27) with void-formers (28) consisting of interior and exterior pipes (33,34,35) for heat-transfer agent, and apunch.

6. The line according to claim 5, characterized in that said apparatus (2) for humidification of the material is carried out as a steam line.

7. The line according to claim 5, characterized in that said steam line (2) is placed between said bin (1) and said breaker (4) connected with the vehicle (5) by means of a pipe-line (6) and acyclone (7).

8. The line according to claim 5, characterized in that said steam line (2) is placed within said bin (1).

9. The line according to claim 5, characterized in that said pipes (20) for removal moisture and volatile gases of the housing (II) of the vehicle (5) are provided with an apparatus (21) for creating rarefaction at the outlet of gases.

10. The line according to claim 5, characterized in that said heating plates (25) of the extrusion press (24) are provided with a cooling zone made with channels (31) for a coolant and placed after said heating zone of the plates (25) and a neutral zone is placed between said heating zone of the plates (25) and said cooling zone, channels (32) of said neutral zone are filled with insulator, void-formers (28) additionally being provided with external pipe (37) and internal pipes (36) for the coolant which pipes are placed within interior pipe (33) for heat-transfer agent of the heating zone and insulated from the latter by insulator (38), and the collector (27) also additionally is provided with pipes (41,42) for the coolant, these pipes (41,42) being separated from pipes (39,40) for the heat-transfer agent by insulator (43), and length of said internal pipe (38) for the coolant of the void-former (28) larger than length of the interior pipe (34) for the heat-transfer agent by length of the neutral zone and cooling zone of the heating plates (25).
INTERNATIONAL SEARCH REPORT  

PCT/BY93/00001

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. 5 B27N 3/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum document searched (classification system followed by classification symbols)

Int.Cl. 5 B27N 3/28

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>SU, A1, 1311940 (Belorusskii Teknologicheskii Institut im. S.M.Kirova), 23 May 1987 (23.05.87)</td>
<td>1-4,5,10</td>
</tr>
<tr>
<td>A</td>
<td>DE, A1, 4018102 (SCHOLLMAYER, VALENTIN), 12 December 1991 (12.12.91)</td>
<td>1,5,10</td>
</tr>
<tr>
<td>A</td>
<td>DE, A1, 3931593 (JOURDAN, KLAUS), 4 April 1991 (04.04.91)</td>
<td>1,5,10</td>
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</tbody>
</table>

Further documents are listed in the continuation of Box C. See patent family annex.

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Date of mailing of the international search report: 16 June 1994 (16.06.94)

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