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(71) Applicant: **NIPPON ELECTRIC GLASS CO., LTD**
Otsu-shi,
Shiga 520-8639 (JP)

(72) Inventor: **NISHIE, Satoshi**
OTSU-SHI, SHIGA, 520-8639 (JP)

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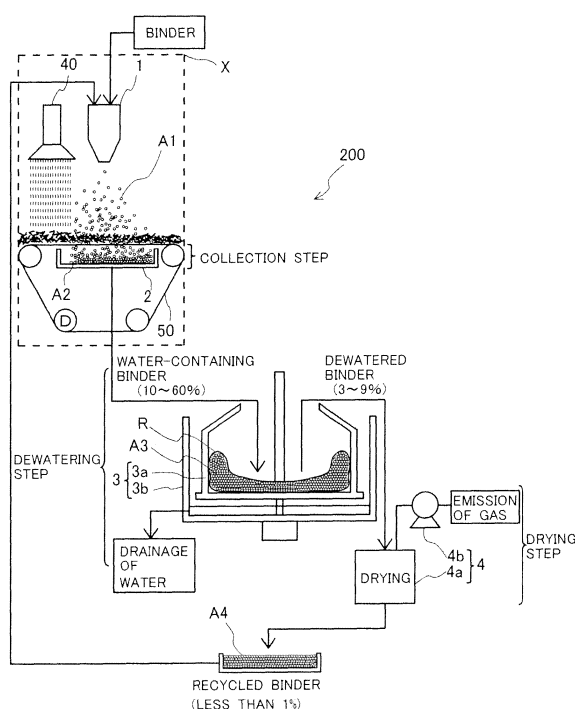
(74) Representative: **Berbinau, Pierre Jean Marie et al**
Cabinet Beau de Loménie
158, rue de l'Université
75340 Paris Cedex 07 (FR)

(54) **Method for processing binder used in manufacture of glass chopped strand mat, method for recycling binder, and apparatus for manufacturing glass chopped strand mat**

(57) A method for treating a binder is provided in which a binder containing a large amount of water which is collected during manufacture of a glass chopped strand mat can be stably treated. The method is one for treating a binder A1 used in manufacturing a glass chopped strand mat M by shaping glass chopped strands

S into a sheet. A water-containing binder A2 having a water content of 10 to 60% which is collected without adhering to the glass chopped strands S when the binder A1 is sprayed to the glass chopped strands S which have been wetted with water, is to be treated. The water content of the water-containing binder A2 is adjusted to 3 to 9% by centrifugation.

[Figure 2]



Description

TECHNICAL FIELD

[0001] The present invention relates to methods for processing a binder used in manufacturing a glass chopped strand mat by shaping glass chopped strands into a sheet, methods for recycling the binder, and apparatuses for manufacturing the glass chopped strand mat.

BACKGROUND ART

[0002] A glass chopped strand mat is conventionally used as a reinforcement member in a glass fiber reinforced plastic (GFRP) molded product, such as a bathtub or a septic tank. The glass chopped strand mat is also employed as a reinforcement base in a car molded ceiling material. The car molded ceiling material in which the glass chopped strand mat is attached to both sides of a foamed polyurethane sheet has been developed. In recent years, advances in car weight reduction have led to a demand for a reduction in the weight of the car molded ceiling material. Therefore, there is an increasing demand for a glass chopped strand mat having light weight (as used herein, the term "weight" with respect to a glass chopped strand mat refers to mass per unit area) which contains a reduced amount of glass chopped strands which are a material for the glass chopped strand mat (a glass chopped strand mat having light weight is also referred to as a "lightweight glass chopped strand mat").

[0003] The glass chopped strand mat is manufactured as follows. Initially, a glass fiber is cut into pieces having a predetermined length to obtain glass chopped strands. Next, the glass chopped strands are distributed and deposited on conveying means such as a conveyor to form a sheet. The glass chopped strands are subjected to a plurality of steps while being conveyed by the conveyor. For example, the steps include spraying water to the glass chopped strands, spraying a binder to the glass chopped strands, heating the glass chopped strands to which the binder adheres, and cooling and pressing the glass chopped strands after the heating, and the like. The step of spraying water is performed so that the glass chopped strands are previously wet with water before the step of spraying the binder to the glass chopped strands, whereby the binder is allowed to easily adhere to the surfaces of the glass chopped strands due to the action of the surface tension of the water. As a result, the glass chopped strands can stick together more firmly in the subsequent step of heating the glass chopped strands, and therefore, excellent strength can be imparted to the glass chopped strand mat. The glass chopped strand mat produced by these steps is wound around a core into a roll by a winding machine or the like before shipment.

[0004] However, in the step of spraying the binder to the glass chopped strands, not all the binder necessarily

adheres to the glass chopped strands. Part of the binder passes through gaps between the glass chopped strands and drops through meshes of the net-like conveyor. In particular, when a lightweight glass chopped strand mat is manufactured, the density and thickness of the glass chopped strands are small, and therefore, the gaps between the glass chopped strands are large. As a result, the proportion of the binder which has dropped below the conveyor without adhering to the glass chopped strands tends to increase.

[0005] If all the binder which has dropped below the conveyor is discarded, a large amount of industrial waste occurs. Therefore, a collection container is provided below a surface of the conveyor on which the glass chopped strands are placed, to collect the binder which has passed and dropped through the gaps between the glass chopped strands and the meshes of the conveyor, and the collected binder is reused in the manufacturing process of the glass chopped strand mat. As a result, the amount of the industrial waste can be reduced, which contributes to environmental protection. Also, the amount of the binder used in the manufacturing process can be reduced, whereby the manufacturing cost of the glass chopped strand mat can be reduced.

[0006] The binder which has dropped below the conveyor without adhering to the glass chopped strands have passed through the gaps between the wet glass chopped strands, and therefore, are wetted with water. The water-wetted binder which has dropped below the conveyor (hereinafter also referred to a "water-containing binder") aggregates to form masses (flocs). The flocs of the water-containing binder are not easy to distribute. Therefore, even if the water-containing binder (flocs) are directly returned to a binder spraying device, it is difficult to spray the water-containing binder uniformly to the glass chopped strands. Even if the water-containing binder is forcibly blasted using high-pressure air or the like, it is difficult to perfectly distribute the water-containing binder, so that the water-containing binder adheres unevenly to the glass chopped strands. Therefore, in order to reuse the water-containing binder, water needs to be removed from the water-containing binder.

[0007] Conventionally, there has been a glass chopped strand mat manufacturing method in which a wet binder which has been sprayed to the glass chopped strands but has not adhered to the glass chopped strands is collected, the collected binder is directly dried under reduced pressure, and the resulting binder is reused as a binder to be sprayed to the glass chopped strands (see, for example, Patent Document 1). Patent Document 1 describes that the drying under reduced pressure softens the binder particles, which therefore do not aggregate into masses.

CITATION LIST

PATENT DOCUMENT

[0008] Patent Document 1: Japanese Unexamined Patent Application Publication No. 2009-256866

DISCLOSURE OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0009] In the glass chopped strand mat manufacturing method of Patent Document 1, the wet binder is directly dried under reduced pressure. Therefore, although the time required to dry the binder is not very long if the total amount of water contained in the binder is small, the drying time is relatively long if the total amount of water contained in the binder is large. In other words, the drying time varies depending on the water content or the amount of the binder to be dried. Therefore, in the manufacturing method of Patent Document 1, it is difficult to perform a stable drying treatment. If the water content of the binder before the drying varies, the water content of the binder after the drying is also likely to vary. In particular, when a lightweight glass chopped strand mat is manufactured, the binder is likely to drop below the conveyor without adhering to the glass chopped strand mat as described above. In this case, a large amount of the binder to be dried is collected, and therefore, it takes a long time to dry the collected binder under reduced pressure. Note that the drying under reduced pressure costs relatively high in terms of energy, and therefore, it is desirable to reduce the total amount of water contained in the binder before the drying to the extent possible.

[0010] Water may be removed from the wet binder by sun drying. In this case, it takes a long time to completely dry the binder. In sun drying, the speed of drying varies depending on the arrangement of the binder or the way in which the binder is irradiated with sunlight, and is significantly affected by weather. Therefore, sun drying is not stable or efficient.

[0011] Thus, at present, a technique of treating a binder used in manufacture of a glass chopped strand mat to efficiently and reliably adjust the water content of the binder to a constant level, has not yet been developed. The present invention has been made in view of the above-described problems. It is an object of the present invention to provide a method for stably treating a binder containing a large amount of water which has been collected during manufacture of a glass chopped strand mat. It is also an object of the present invention to provide a method for recycling a binder using the treatment method, and an apparatus for manufacturing a glass chopped strand mat.

MEANS FOR SOLVING PROBLEM

[0012] To achieve the object, a method for treating a

binder used in manufacture of a glass chopped strand mat according to the present invention is a method for treating a binder used in manufacturing a glass chopped strand mat by shaping glass chopped strands into a sheet. A water-containing binder having a water content of 10 to 60% which is collected without adhering to the glass chopped strands when the binder is sprayed to the glass chopped strands which have been wetted with water, is to be treated. The method includes a dewatering step of adjusting the water content of the water-containing binder to 3 to 9% by centrifugation.

[0013] As described in the PROBLEM TO BE SOLVED BY THE INVENTION section, conventionally, a time-consuming drying treatment is required for recycling of a water-containing binder occurring in the manufacturing process of a glass chopped strand mat into a reusable binder (hereafter also referred to as a "recycled binder"), and it is also difficult to obtain a high-quality recycled binder whose water content is low and falls within a predetermined range. This is because the binder whose water content is high and varies significantly is directly dried without any pretreatment. In other words, the conventional art does not teach or suggest that the drying is performed after the water content of the binder is adjusted to a predetermined range.

In this regard, in the method for treating a binder used in manufacture of a glass chopped strand mat of this configuration, a water-containing binder having a water content of 10 to 60% which is collected without adhering to the glass chopped strands when the binder is sprayed to the glass chopped strands which have been wetted with water, is to be treated, and the dewatering step of adjusting the water content of the water-containing binder to 3 to 9% by centrifugation is performed. Thus, even when the water content of the collected water-containing binder is high and varies, the water content can be adjusted to a constant and low level before the drying. Here, the dewatering step is performed at high speed by centrifugation, and therefore, can be completed quickly. The binder (hereinafter also referred to as a "dewatered binder") whose water content has been adjusted to 3 to 9% by the dewatering step is then dried using drying means such as a low-pressure dryer, whereby a recycled binder having a water content of less than 1% which can be reused as a binder is obtained.

Thus, according to the binder treatment method of this configuration, the water content of the water-containing binder can be efficiently and reliably adjusted to a constant level. The present invention is effective particularly to manufacture of a lightweight glass chopped strand mat. Although a large amount of a binder to be recycled is collected and the amount of water contained in all the binder is large, the dewatering step is previously performed, and therefore, the subsequent drying step is facilitated.

[0014] In the method for treating a binder used in manufacture of a glass chopped strand mat of the present invention, the centrifugation is preferably performed at

500 to 3000 rpm in the dewatering step.

[0015] In the method for treating a binder used in manufacture of a glass chopped strand mat of this configuration, the centrifugation is performed at 500 to 3000 rpm in the dewatering step. If the centrifugation is performed at less than 500 rpm, the dewatering of the water-containing binder is likely to be inadequate. In this case, even if the dewatering is possible, it takes a long time to complete the dewatering step. Even if the centrifugation is performed at more than 3000 rpm, the dewatering effect is not significantly improved. The centrifugation at the high rotational speed requires a high-speed motor, likely leading to an increase in apparatus cost. Therefore, the centrifugation is preferably performed at 500 to 3000 rpm. As a result, the water content of the water-containing binder can be quickly and reliably adjusted to 3 to 9%.

[0016] To achieve the object, in a binder recycling method according to the present invention, the binder obtained by the dewatering step in the binder treatment method is dried to produce a recycled binder having a water content of less than 1%.

[0017] In the binder recycling method of this configuration, the binder obtained by the dewatering step in the binder treatment method is dried to produce a recycled binder having a water content of less than 1%. The recycled binder thus obtained can be easily distributed without aggregating into a mass. Therefore, the recycled binder can be sprayed to uniformly adhere to the glass chopped strands.

[0018] To achieve the object, an apparatus for manufacturing a glass chopped strand mat according to the present invention is an apparatus for manufacturing a glass chopped strand mat by shaping glass chopped strands into a sheet, including spraying means for spraying a binder to the glass chopped strands which have been wetted with water, collecting means for collecting the binder which has not adhered to the glass chopped strands, as a water-containing binder having a water content of 10 to 60%, dewatering means for adjusting the water content of the water-containing binder to 3 to 9% by centrifugation, and drying means for drying the dewatered binder to obtain a recycled binder having a water content of less than 1%. The recycled binder obtained by the drying is reused as the binder used in the spraying means.

[0019] The glass chopped strand mat manufacturing apparatus of this configuration performs the above-described binder treatment method and recycling method. Therefore, even when the water content of the collected water-containing binder is high and varies, the water content can be adjusted to a constant and low level before the drying. Here, the dewatering means performs high-speed dewatering by centrifugation, and therefore, can complete the dewatering quickly. The water-containing binder having a water content of 10 to 60% is adjusted to 3 to 9% by the dewatering means, and thereafter, is dried using the drying means, whereby a recycled binder having a water content of less than 1% which can be

reused as the binder is obtained.

Thus, in the glass chopped strand mat manufacturing apparatus of this configuration, the water content of the water-containing binder can be efficiently and reliably adjusted to a constant level. The present invention is effective particularly to manufacture of a lightweight glass chopped strand mat. Although a large amount of a binder to be recycled is collected and the amount of water contained in all the binder is large, the dewatering is previously performed by the dewatering means, and therefore, the subsequent drying is facilitated.

[0020] In the glass chopped strand mat manufacturing apparatus of the present invention, when the centrifugation is performed by the dewatering means, a filter for accelerating the dewatering of the water-containing binder is used in combination.

[0021] In the glass chopped strand mat manufacturing apparatus of this configuration, when the centrifugation is performed by the dewatering means, a filter for accelerating the dewatering of the water-containing binder is used in combination. Therefore, clogging can be prevented from occurring in the dewatering means. Also, the dewatered binder obtained by the centrifugation can be easily collected only by extraction from the filter, resulting in a high collection rate. Moreover, the dewatering means is not contaminated and therefore is easily maintained.

[0022] In the glass chopped strand mat manufacturing apparatus of the present invention, the filter has a pore size of 2 to 500 μm .

[0023] In the glass chopped strand mat manufacturing apparatus of this configuration, the filter has a pore size of 2 to 500 μm . If the pore size of the filter is less than 2 μm , it is difficult for water separated from the water-containing binder to pass through the filter, and therefore, it takes a long time to dewater or the dewatering is inadequate. If the pore size of the filter is more than 500 μm , the binder is likely to pass through the filter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024]

[FIG. 1] FIG. 1 is a diagram schematically showing an overall configuration of a glass chopped strand mat manufacturing apparatus.

[FIG. 2] FIG. 2 is a diagram showing steps of treating and recycling a binder used in manufacture of a glass chopped strand mat.

DESCRIPTION OF EMBODIMENTS

[0025] A method for treating a binder used in manufacture of a glass chopped strand mat M, a method for recycling the binder, and an apparatus for manufacturing the glass chopped strand mat M, according to the present invention, will be described hereinafter with reference to FIGS. 1 and 2. Note that, for the sake of convenience, a method for manufacturing the glass chopped strand mat

M as well as the apparatus for manufacturing the glass chopped strand mat M of the present invention will be described before the description of the method for treating the binder used in manufacture of the glass chopped strand mat M and the method for recycling the binder. Note that the present invention is not intended to be limited to the embodiments described below or the configurations shown in the drawings.

[Glass Chopped Strand Mat Manufacturing Apparatus]

[0026] FIG. 1 is a diagram schematically an overall configuration of an apparatus 100 for manufacturing the glass chopped strand mat M (hereinafter simply referred to as a "manufacturing apparatus"). In FIG. 1, a region X enclosed by a dashed line is a main portion of the manufacturing apparatus 100 which includes a binder spraying device 1 which sprays a binder A1 described below and a collection container 2 into which a water-containing binder A2 falls. FIG. 2 shows the main portion X of the manufacturing apparatus 100 and procedures for treating and recycling the water-containing binder A2 extracted from the collection container 2 of the main portion X. The manufacturing apparatus 100 is an apparatus for manufacturing the glass chopped strand mat M from glass chopped strands. The manufacturing apparatus 100 includes a chamber 10, a cutting device 20, a distribution conveyor 30, a water sprayer 40, the binder spraying device 1, a first conveyor 50, the collection container 2, a second conveyor 60, a heating furnace 70, a cold press roller 80, a winding machine 90, and the like. The manufacturing apparatus 100 also includes a centrifuge 3 and a low-pressure dryer 4 which are used to treat and recycle the water-containing binder A2 extracted from the collection container 2. Of these components, the binder spraying device 1, the collection container 2, the centrifuge 3, and the low-pressure dryer 4 are characteristic features of the present invention and are essential to the present invention.

[0027] A direction in which the glass chopped strands are conveyed is defined as a flow direction. The distribution conveyor 30, the first conveyor 50, and the second conveyor 60 are successively positioned in this stated order from upstream to downstream. These conveyors each have a belt. At least the first conveyor 50 has a net-like belt. These conveyors are drive by respective motors D. The conveying speeds (the movement speeds of the belts) of the conveyors are controlled by a computer (control means) 11. Note that a worker may manually adjust the conveying speed of each conveyor as appropriate.

[0028] The distribution conveyor 30 includes a belt on which glass chopped strands are distributed and put. The distribution conveyor 30 is positioned below the chamber 10 which accommodates glass chopped strands. A cutting device 20 which cuts a glass fiber F described below is attached to a glass fiber inlet 10a provided at a ceiling portion of the chamber 10. The cutting device 20 includes

a cutter roller 21 and a rubber roller 22. The glass fiber F which has been pulled out of a glass cake 1 is fed into between the rotating cutter roller 21 and rubber roller 22 to be continually cut, whereby glass chopped strands S having a length of about 50 mm are produced. The glass chopped strands S fall by their own weight in the chamber 10 and are substantially uniformly distributed and put on the belt of the distribution conveyor 30. Note that a suction device 33 including a suction duct 31 and a blower 32 is provided below the belt on which the glass chopped strands S are deposited so that a negative pressure is applied to the belt. As a result, the glass chopped strands S are attracted to a surface of the belt while being substantially uniformly distributed and put on the belt of the distribution conveyor 30, and therefore, are settled without being scattered around. The glass chopped strands S are moved from the distribution conveyor 30 to the first conveyor 50.

[0029] The water sprayer 40 is provided above the first conveyor 50. The water sprayer 40 sprays water toward the glass chopped strands S on the belt of the first conveyor 50. The binder spraying device 1 is provided above the first conveyor 50 and downstream of the water sprayer 40. The binder spraying device 1 sprays the binder (resin powder) A1 toward the glass chopped strands S on the belt of the first conveyor 50. The binder A1 is preferably a powder of thermoplastic resin (e.g., powdered polyester resin (NEW TRACK 514 manufactured by Kao Corporation)). Other examples of the available thermoplastic resin powder include resin powders of nylon, polyethylene, polystyrene, polypropylene, and polyvinyl chloride. The binder A1 preferably has a size (diameter) of 10 μm to 500 μm . The glass chopped strands S are wetted with water sprayed by the water sprayer 40 before the binder A1 is sprayed, and therefore, the binder A1 easily adheres to the glass chopped strands S due to surface tension.

[0030] Here, when the glass chopped strand mat M is a product having light weight (as used herein, the term "weight" with respect to a glass chopped strand mat refers to mass per unit area, and a glass chopped strand mat having light weight is also referred to as a "lightweight glass chopped strand mat"), the density and thickness of the glass chopped strands S are small, and therefore, gaps between the glass chopped strands S are large. As a result, the binder A1 sprayed by the binder spraying device 1 is likely to drop through the net-like belt without adhering to the glass chopped strands S. Therefore, the collection container 2 is provided below a surface of the first conveyor 50 on which the glass chopped strands S are placed. The collection container 2 collects the water-containing binder A2 which has dropped through meshes of the net-like belt of the first conveyor 50 without adhering to the glass chopped strands S. The water-containing binder A2 has passed through the gaps between the wet glass chopped strands, and therefore, is wetted with water and contains 10-60% water. Note that the amount of water contained (water content) is represented by per-

cent by weight throughout the present specification. The collection container 2 is water-resistant and in the shape of a box and is open at an upper portion thereof. The collection container 2 has a width which is substantially the same as or slightly larger than that of the first conveyor 50 so that as large a portion of the water-containing binder A2 as possible can be collected, and has a length which sufficiently covers a region in which the binder A1 is sprayed by the binder spraying device 1.

[0031] The heating furnace 70 is provided halfway through the second conveyor 60, surrounding the belt. The heating furnace 70 performs a heating treatment on an object on the second conveyor 60 which is being moved through the heating furnace 70. The temperature of atmosphere in the heating furnace 70 is controlled by the computer 11 to be appropriately adjusted to a temperature higher than or equal to the melting point of the synthetic resin included in the binder A1, depending on the type of the sprayed binder A1. Note that the temperature of the heating furnace 70 may be manually adjusted by a worker. Because the belt of the second conveyor 60 is exposed to high temperature, the belt is formed of a heat resistant material, such as a metal.

[0032] The cold press roller 80 is provided downstream of the second conveyor 60. The cold press roller 80 presses a heated object while cooling the object. The cold press roller 80 includes a pair of rollers. The glass chopped strands S' (the glass chopped strands S after being heated are referred to as "glass chopped strands S'" to discriminate from those before being heated) with the melted binder A1 are conveyed to the cold press roller 80 and passed through the nip. The glass chopped strands S' are cooled and pressed by being passed through the cold press roller 80, whereby the glass chopped strands S' are bound together. As a result, the glass chopped strand mat M is produced. Here, the cold press roller 80 air-cools the glass chopped strands S'. Alternatively, the glass chopped strands S' may be actively cooled with cooling water flowing inside the cold press roller 80.

[0033] The glass chopped strand mat M produced by passing the glass chopped strands S' through the cold press roller 80 is wound around the core of the winding machine 90 to form a roll product. Instead of winding the glass chopped strand mat M around the core, the winding machine 90 may wind the glass chopped strand mat M on surface rollers while the glass chopped strand mat M is being rotated on the surfaces of the surface rollers.

[0034] In addition to the above components, the manufacturing apparatus 100 includes the centrifuge 3 as dewatering means and the low-pressure dryer 4 as drying means. The centrifuge 3 includes an internal drum 3a and an external drum 3b. An object containing water is placed in the internal drum 3a. Water removed from the object by the rotating internal drum 3a can be temporarily stored in the external drum 3b. The water-containing binder A2 which has dropped in the collection container 2 is dewatered by the centrifuge 3. The initial water con-

tent of the water-containing binder A2 is 10 to 60%. By the dewatering, a dewatered binder A3 having a water content of 3 to 9% is obtained.

[0035] When centrifugation is performed, a filter R is preferably used in combination to accelerate the dewatering of the water-containing binder A2. The water-containing binder A2 collected in the collection step is accommodated in the bag-shaped filter R, which is in turn placed in the centrifuge 3. The use of the filter R in combination can prevent clogging of the centrifuge 3 caused by the water-containing binder A2. The dewatered binder A3 resulting from the centrifugation can be easily collected only by extraction from the filter R, resulting in a high collection rate. Moreover, the centrifuge 3 is not contaminated and therefore is easily maintained. The filter R may be formed of polypropylene, polyester, nylon, cotton, cellulose acetate, nitrocellulose, a metal, PTFE, or the like. Note that centrifugation may be performed while filter paper or filter fabric is attached to the internal drum 3a of the centrifuge 3 instead of the bag-shaped filter R.

[0036] The binder A1 is a powder of thermoplastic resin and therefore its water absorption is not very high. Therefore, the collected water-containing binder A2 has substantially the same size as that of the binder A1. Therefore, the size (diameter) of the water-containing binder A2 is about 10 to 500 μm . In this case, the pore size of the filter R is preferably 2 to 500 μm . If the pore size of the filter R is less than 2 μm , it is difficult for water separated from the water-containing binder A2 to pass through the filter R, and therefore, it takes a long time to dewater or the dewatering is inadequate. If the pore size of the filter R is more than 500 μm , the water-containing binder A2 is likely to pass through the filter R.

[0037] After the dewatering has been completed, the dewatered binder A3 is extracted from the centrifuge 3 and then dried with the low-pressure dryer 4. The low-pressure dryer 4 includes a drying chamber 4a and a pump 4b. The internal pressure of the drying chamber 4a is reduced using the pump 4b, thereby performing drying. After the drying, the recycled binder A4 having a water content of less than 1% is finally obtained. The recycled binder A4 can be put into the binder spraying device 1 along with the binder A1 which has not been used, i.e., the recycled binder A4 can be reused as the binder A1.

[Glass Chopped Strand Mat Manufacturing Method]

[0038] The glass chopped strand mat M is manufactured by a glass chopped strand preparation step, a distribution and putting step, a water spraying step, a binder spraying step, a heating step, a cold press step, and a winding step. The manufacturing method is also applicable to manufacture of a lightweight glass chopped strand mat, for which there has in recent years been an increasing demand. These steps will be described hereinafter.

<Glass Chopped Strand Preparation Step>

[0039] As a preliminary step of the manufacture of the glass chopped strand mat M, the glass chopped strands S are prepared from the glass fiber F. The glass fiber F extracted from a glass cake C is cut into pieces having a length of about 50 mm (i.e., the glass chopped strands S) by the cutting device 20 provided at the ceiling portion of the chamber 10. The glass chopped strands S do not necessarily need to be prepared immediately before the manufacture of the glass chopped strand mat M, and alternatively, may be previously prepared. In this case, the glass chopped strands S which are accommodated in a container (e.g., a flexible container) are put directly into the chamber 10.

<distribution and putting step>

[0040] The glass chopped strands S obtained by the glass chopped strand preparation step are distributed and put on the belt of the distribution conveyor 30. The glass chopped strands S which have been deposited on the belt of the distribution conveyor 30 to form a sheet are conveyed to a downstream point for the next step.

<Water Spraying Step>

[0041] The glass chopped strands S which have been deposited to form a sheet are moved to the first conveyor 50. Water is sprayed toward the glass chopped strands S on the belt of the first conveyor 50. In FIG. 1, water is sprayed from above the first conveyor 50. Alternatively, water may be sprayed from below the first conveyor 50. If the glass chopped strands S are previously wetted with water, the action of the surface tension of the water allows the binder A1 to easily adhere to the surfaces of the glass chopped strands S, so that the glass chopped strands S stick together more effectively.

<Binder Spraying Step>

[0042] Next, on the first conveyor 50, the binder A1 is sprayed toward the glass chopped strands S which have been wetted in the water spraying step. The addition of the binder A1 to the glass chopped strands S allows the glass chopped strands S to stick together by a heating treatment described below, so that the mat shape can be maintained. However, in the binder spraying step, not all the binder A1 necessarily adheres to the glass chopped strands S. Part of the binder A1 passes through the gaps between the glass chopped strands S and drops through the meshes of the net-like first conveyor 50. The binder dropped below the first conveyor 50 contains 10 to 60% water. The water-containing binder A2 is subjected to a "collection step" in a "binder treatment method" described below. The glass chopped strands S on the first conveyor 50 to which the binder A1 uniformly adheres are conveyed to the downstream second conveyor

60.

<Heating Step>

[0043] The glass chopped strands S with the binder A1 on the second conveyor 60 are subjected to a heating treatment when the glass chopped strands S are passed through the heating furnace 70, so that the binder A1 is softened and melted. As a result, the glass chopped strands S stick together (the resulting glass chopped strands S are referred to as the "glass chopped strands S").

<Cold Press Step>

[0044] The glass chopped strands S' after the heating treatment are passed through the cold press roller 80 which is provided downstream of the second conveyor 60 (cold press step). The glass chopped strands S' are cooled and pressed by the cold press roller 80 into the glass chopped strand mat M.

<Winding Step>

[0045] Finally, the glass chopped strand mat M is wound by the winding machine 90 which is provided downstream of the cold press roller 80 (winding step). The glass chopped strand mat M is wound around the core of the winding machine 90 to form a roll product.

[Binder Treatment Method]

[0046] The binder A1 which has passed through the gaps between binder the glass chopped strands S without adhering to the glass chopped strands S and dropped through the meshes of the net-like first conveyor 50 in the spraying step, are subjected to a collection step and a dewatering step described below. Of these steps, the dewatering step has a characteristic feature of the present invention and is essential to the present invention.

<Collection Step>

[0047] The collection container 2 is provided below a surface of the first conveyor 50 on which the glass chopped strands S are placed. Of the binder A1 sprayed in the binder spraying step, the water-containing binder A2 which has passed through the gaps between the glass chopped strands S on the first conveyor 50 without adhering to the glass chopped strands S, drops through the meshes of the net-like first conveyor 50 into the collection container 2, i.e., is collected in the collection container 2. The water-containing binder A2 has passed through the gaps between the glass chopped strands S wetted with water sprayed by the water sprayer 40, and therefore, contains water. The water content of the water-containing binder A2 is 10 to 60%. While only a small portion

of the water contained in the water-containing binder A2 is absorbed by the particles of the water-containing binder A2, the most portion thereof is attached to a surface of the water-containing binder A2. When the water-containing binder A2 has been accumulated in a predetermined amount in the collection container 2, the water-containing binder A2 is extracted from the collection container 2 and is subjected to the next step (dewatering step). Note that the collection step may be performed a plurality of times, and the collections of the water-containing binder A2 corresponding to the plurality of times may be temporarily stored in another container, and all the collections may be subjected at once to the dewatering step.

<Dewatering Step>

[0048] The water content of the collected water-containing binder A2 is adjusted in the dewatering step. When the lightweight glass chopped strand mat M is manufactured as in this embodiment, the density and thickness of the glass chopped strands S are small, and therefore, the gaps between the glass chopped strands S are large. As a result, the proportion of the water-containing binder A2 which drops below the first conveyor 50 without adhering to the glass chopped strands S tends to increase, i.e., a larger amount of the water-containing binder A2 to be recycled is collected. As a result, the amount of water contained in all the binder is large. Therefore, the dewatering step is previously performed to adjust the water content to 3 to 9%, whereby a drying step in a "binder recycling method" described below is facilitated. The dewatering step is performed by the centrifuge 3 (dewatering means). The centrifuge 3 can perform high-speed dewatering, and therefore, quickly completes the dewatering step. Even when the water content of the water-containing binder A2 is as high as 10 to 60% and varies as in this embodiment, the water content of the water-containing binder A2 can be adjusted to a constant level efficiently and reliably by performing the dewatering step by centrifugation. Note that water removed from the water-containing binder A2 is drained, and the drained water may be reused in the water spraying step.

[0049] In the dewatering step, the centrifugation is performed at a rotational speed of 500 to 3000 rpm. If the rotational speed of the centrifugation is less than 500 rpm, the dewatering of the water-containing binder A2 is likely to be inadequate. In this case, even if the dewatering is possible, it takes a long time to complete the dewatering step. Even if the rotational speed of the centrifugation is more than 3000 rpm, the dewatering effect is not significantly improved. The centrifugation at the high rotational speed requires a high-speed motor, likely leading to an increase in apparatus cost. Therefore, the centrifugation is preferably performed at 500 to 3000 rpm. As a result, the water content of the water-containing binder A2 can be quickly and reliably adjusted to 3 to 9%. More preferably, the centrifugation is performed at 1000

to 2000 rpm.

[0050] As described above, the water-containing binder A2 having a water content of 10 to 60% which has been collected in the collection step is subjected to the dewatering step to obtain the dewatered binder A3 having a water content of 3 to 9%. The dewatered binder A3 is extracted from the centrifuge 3 and thereafter subjected to the "drying step" described in the "binder recycling method" which is next described.

[Binder Recycling Method]

[0051] The binder recycling method of this embodiment includes the drying step which is performed after the binder treatment method.

<Drying Step>

[0052] In the drying step, the dewatered binder A3 after the dewatering step which has a water content of 3 to 9% is adjusted to a still lower water content. As a result, the recycled binder A4 having a water content of less than 1% is obtained which can be reused as the binder A1 used in the method for manufacturing the glass chopped strand mat M. In this embodiment, the drying step is performed using the low-pressure dryer 4. Alternatively, the drying step may be performed by sun drying or the like. Drying using the low-pressure dryer 4 or by sun drying or the like typically takes a relatively long time and is likely to cause variations in the water content of the dried binder. However, in the present invention, the dewatering step is previously performed to obtain the dewatered binder A3 having a low water content within a predetermined range (3 to 9%), whereby the recycled binder A4 having a water content of less than 1% can be reliably produced. The particles of the recycled binder A4 thus produced do not aggregate into a mass and can be easily distributed, and therefore, can be allowed to uniformly adhere to the glass chopped strands. The recycled binder A4 is comparable in quality to the binder A1 which has not been used.

INDUSTRIAL APPLICABILITY

[0053] The binder treatment method and the binder recycling method used in manufacture of the glass chopped strand mat of the present invention are particularly effective to a treatment and recycling of a water-containing binder occurring during manufacture of a lightweight glass chopped strand mat, for which there has in recent years been an increasing demand. These methods are, of course, also applicable to a treatment and recycling of a water-containing binder occurring during manufacture of a typical glass chopped strand mat having a weight of, for example, 300 g/m² or more. A glass chopped strand mat obtained by the glass chopped strand mat manufacturing apparatus of the present invention is applicable to, for example, car molded ceiling materials,

interior materials for other vehicles, interior materials for buildings and other structures

DESCRIPTION OF REFERENCE CHARACTERS

[0054]

1	BINDER SPRAYING DEVICE	5
2	COLLECTION CONTAINER	10
3	CENTRIFUGE	
4	LOW-PRESSURE DRYER	
10	CHAMBER	15
20	CUTTING DEVICE	
30	DISTRIBUTION CONVEYOR	20
40	WATER SPRAYER	
50	FIRST CONVEYOR	25
60	SECOND CONVEYOR	
70	HEATING FURNACE	
80	COLD PRESS ROLLER	30
90	WINDING MACHINE	
100, 200	GLASS CHOPPED STRAND MAT MANUFACTURING APPARATUS	35
F	GLASS FIBER	
S, S'	GLASS CHOPPED STRAND	
A1	BINDER (RESIN POWDER)	40
A2	WATER-CONTAINING BINDER	
A3	DEWATERED BINDER	45
A4	RECYCLED BINDER	
M	GLASS CHOPPED STRAND MAT	50

Claims

1. A method for treating a binder (A1) used in manufacturing a glass chopped strand mat (M) by shaping glass chopped strands (S, S') into a sheet, **characterized in that** a water-containing binder (A2) having a water con-

tent of 10 to 60% which is collected without adhering to the glass chopped strands (S, S') when the binder (A1) is sprayed to the glass chopped strands (S, S') which have been wetted with water, is to be treated, and the method includes a dewatering step of adjusting the water content of the water-containing binder (A2) to 3 to 9% by centrifugation.

2. The method of claim 1, wherein in the dewatering step, the centrifugation is performed at 500 to 3000 rpm.
3. The method of claim 1 or 2, wherein the binder obtained by the dewatering step is dried to produce a recycled binder (A4) having a water content of less than 1%.
4. An apparatus (100, 200) for manufacturing a glass chopped strand mat by shaping glass chopped strands (S, S') into a sheet, **characterized in that** it comprises:

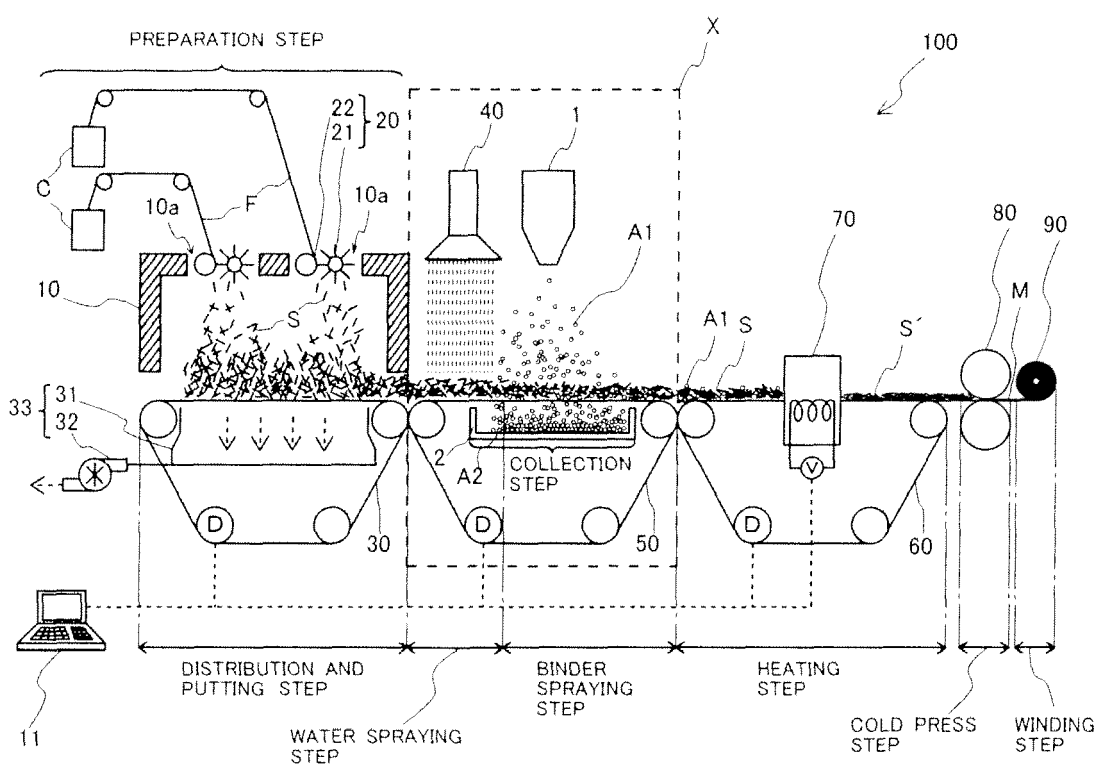
spraying means for spraying a binder (A1) to the glass chopped strands (S, S') which have been wetted with water;
collecting means for collecting the binder which has not adhered to the glass chopped strands, as a water-containing binder (A2) having a water content of 10 to 60%;
dewatering means for adjusting the water content of the water-containing binder (A2) to 3 to 9% by centrifugation; and
drying means for drying the dewatered binder (A3) to obtain a recycled binder (A4) having a water content of less than 1%,

wherein

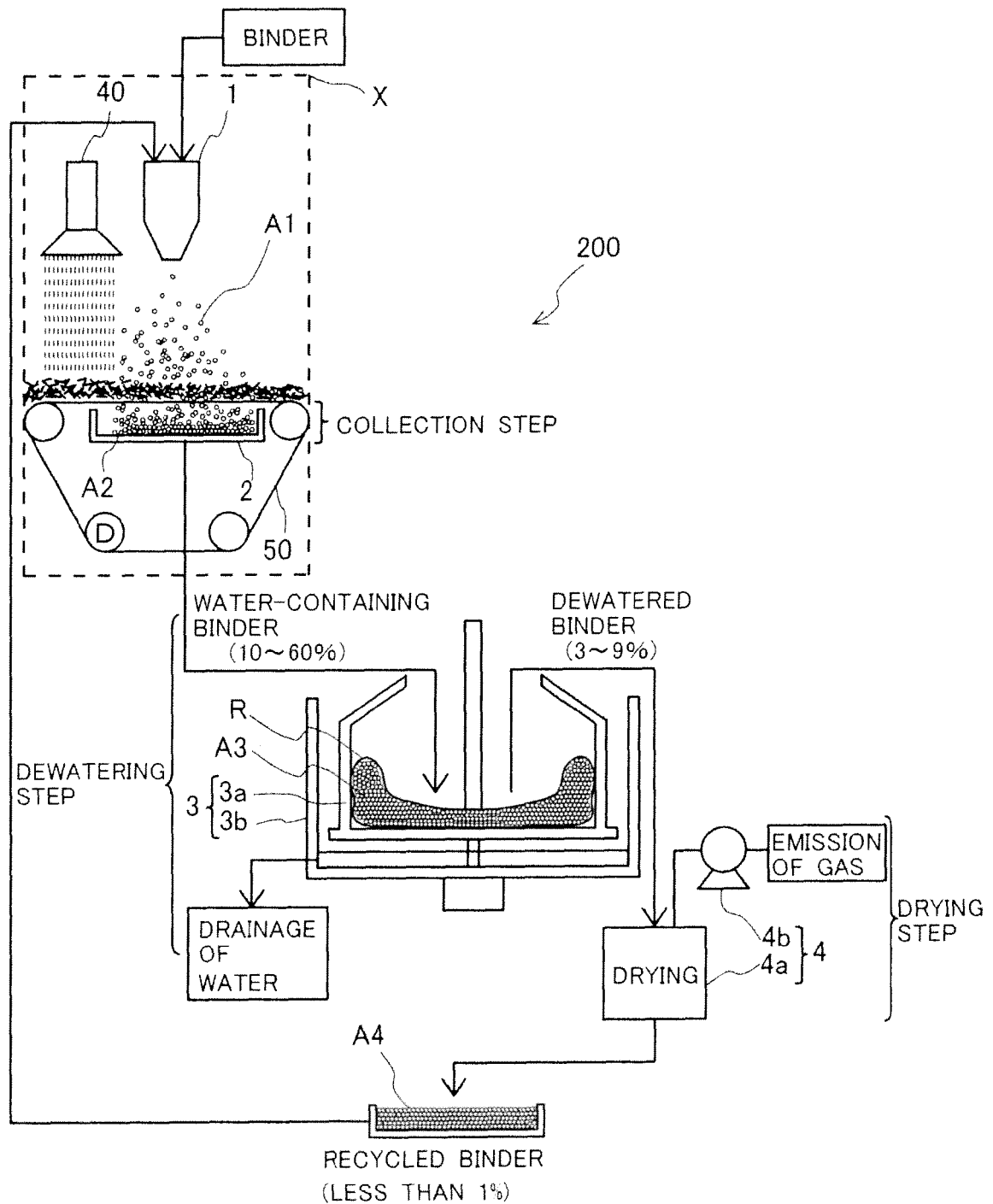
the recycled binder (A4) obtained by the drying is reused as the binder used in the spraying means.

5. The apparatus of claim 4, wherein when the centrifugation is performed by the dewatering means, a filter for accelerating the dewatering of the water-containing binder (A2) is used in combination.
6. The apparatus of claim 5, wherein the filter has a pore size of 2 to 500 μm .

[Figure 1]



[Figure 2]





EUROPEAN SEARCH REPORT

Application Number
EP 12 19 5827

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Place of search The Hague		Date of completion of the search 24 January 2013	Examiner Barathe, Rainier
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