

A Device and Method for Assisting the Formation of Alumina Chopped Fiber Felt by Air-laying

Technical Field

5 The invention relates to an air-laying device and method for auxiliary alumina chopped fiber mat formation, belonging to the technical field of textile accessories.

Technical Background

Alumina fiber has the advantage of lightweight, high temperature resistance (operating
10 temperature is 1300-1700°C), good thermal stability, etc. Alumina fiber mat can be used as a heat-resistant material for heat insulation and bonding components in high-temperature furnaces and high-temperature pipelines. The conventional preparation method of alumina fiber mat is high-temperature sintering. However, alumina fiber shrinks by more than 30% during high-temperature heating, resulting in problems such as fibers being cut during the manufacturing process, uneven
15 thickness/volume density, insufficient strength, and easy fiber entanglement and knotting.

The method of preparing alumina fiber into a web and then needling it can be used to avoid the adverse effects of high temperature sintering during the preparation of alumina fiber mat. However, due to the brittleness of alumina fiber, the conventional combing method causes the fibers to break and comb into pieces easily during the combing process, and the basis weight is in the range of 100-
20 800g/m², which cannot meet the subsequent needle punching conditions and cannot meet the requirements of high thickness web formation.

Summary of the Invention

[Technical Problem]

25 Alumina fibers are very brittle and have a high shrinkage rate when heated at high temperatures. The conventional combing method causes the fibers to break and become crumbs during the combing process. The basis weight is in the range of 100-800g/m², which cannot meet the subsequent needling conditions and cannot meet the requirements of high-thickness web formation. The conventional method of preparing alumina fiber mat will result in waste of raw materials and many defects and
30 unstable performance in the final product.

[Technical Solutions]

In order to solve the above problems, the present invention provides an air-laying device and method for assisting the formation of alumina chopped fiber mats. Based on the premise that the air-laying method causes less damage to the fibers and is applicable to a wide range of raw materials, the present invention avoids the damage to the fibers caused by the conventional combing method by introducing the air-laying method, so as to meet the needling conditions of the needle punching machine and the requirements for high-thickness web forming, thereby ensuring high-quality and stable preparation of alumina chopped fiber mats. The present invention can effectively improve the production efficiency and production quality of alumina chopped fiber mats.

The first object of the present invention is to provide an auxiliary alumina chopped fiber mat forming air web-forming device, comprising a cotton feeding trolley, the cotton feeding trolley is connected to a combing machine, the combing machine is connected to a high cotton box through a fan duct, a corridor device is arranged below the high cotton box, a multi-row needle roller group composed of a plurality of needle rollers is arranged in the corridor device, a negative pressure fan is arranged below the corridor device, a conveying device is arranged between the negative pressure fan and the corridor device, a pressure roller is arranged at the outlet of the corridor device, and a needle punching machine is arranged on one side of the conveying device.

In one embodiment of the present invention, the conveying device is a belt drive, the belt drive includes a conveyor, and the conveyor is a belt with a plurality of mesh holes formed thereon.

In one embodiment of the present invention, the cotton feeding trolley is equipped with a precise weighing mechanism, the cotton feeding trolley comprises a cotton feeding bin and a cotton feeding roller, the cotton feeding bin of the cotton feeding trolley is connected to the combing machine, and the alumina chopped fiber is fed into the combing machine through the cotton feeding roller of the cotton feeding trolley.

In one embodiment of the present invention, the bell mouth of the combing machine is connected to the fan duct to convey the alumina chopped fiber combed by the combing machine to the high cotton box; the pressure roller is arranged at the outlet of the corridor device and located above the conveying device, and the conveying device is connected to the inlet of the needle machine.

In one embodiment of the present invention, the rotation directions of two adjacent needle rollers in the channel device are opposite.

In one embodiment of the present invention, the needle roller comprises a roller shaft, a roller

cylinder and needles, the roller shaft is inserted into the roller cylinder, and a plurality of needles are evenly arranged on the outer surface of the roller.

The second object of the present invention is to provide a method for assisting the formation of alumina chopped yarns, wherein the method adopts the auxiliary alumina chopped yarns forming air-laid device, comprising the following steps:

(1) The alumina chopped fiber is accurately weighed by the cotton feeding trolley and sent to the combing machine for combing;

(2) The combed yarn is sent to the cotton box through the fan duct;

(3) It is then dispersed in the tunnel device by an array of needle rollers and sucked down by a negative pressure fan to the bottom belt to form a net;

(4) After being shaped by a pressure roller, the fiber is transferred by a conveying device to a needling machine for needling to obtain alumina chopped fiber mat.

In one embodiment of the present invention, the rotation speed of the needle roller in step (3) is 200-600rpm; and the speed at which the conveying device in step (4) conveys the alumina chopped fiber web is 10 mm/min.

In one embodiment of the present invention, the frequency of the negative pressure fan in step (3) is 5-20Hz, and the length of the alumina chopped fiber in step (1) is 10-90mm.

In one embodiment of the present invention, the alumina chopped fiber mat in step (4) has a thickness of 8-23mm, an area density of 800-1800 g/m², and an area density fluctuation value of 1%-3%.

Beneficial Effects

(1) Based on the premise that the air web forming method causes less damage to the fibers and is applicable to a wide range of raw materials, the present invention is provided with a negative pressure fan below the tunnel device, and a conveying device is provided between the negative pressure fan and the tunnel device. The conveying device is belt-driven and the conveyor is a belt with a plurality of mesh holes. The negative pressure fan can suck air into the tunnel device through the belt, so that the alumina chopped fibers in the tunnel device fall onto the belt to form a web. The present invention avoids the damage to the fibers caused by the conventional combing web forming method by introducing the air web forming method, in order to meet the needling conditions of the needling machine and the high thickness web forming requirements,

thereby ensuring high-quality and stable preparation of alumina chopped fiber mat.

(2) The alumina chopped fibers of the present invention are webbed through the needle roller group and the negative pressure belt, which can effectively reduce the problem of alumina fibers being broken and squeezed into powder during the web-forming process, thereby solving the difficulty of alumina fibers being webbed.

(3) The device and method for assisting the formation of alumina chopped fiber mat proposed in the present invention can effectively improve the production efficiency and production quality of alumina chopped fiber mat and can increase the production efficiency by 10-20% compared with the conventional preparation method. The product's basis weight can reach up to 1800g/m² and the uniformity and stability of the product are significantly improved.

Brief Description of Drawings

FIG1 is a schematic structural diagram of an auxiliary alumina chopped fiber mat forming air-laid device according to the present invention;

FIG2 is a perspective view of the air-laid device of the present invention (excluding the cotton feeding trolley, combing machine, fan duct and needle punching machine);

FIG3 is a perspective view of the needle roller of the present invention.

FIG4 is a flow chart of the auxiliary alumina chopped fiber mat forming method of the present invention.

Among them: 1. Cotton feeding trolley; 2. Combing machine; 3. Fan duct; 4. Cotton box; 5. Needle roller; 51, roller shaft; 52, roller; 53, needles; 6. Channel device; 7. Pressing roller; 8, Conveying device; 9, Negative pressure fan; 10, Needling machine.

Detailed Description

The following will be combined with the drawings in the embodiments of the present invention to clearly and completely describe the technical solutions in the embodiments of the present invention. Obviously, the embodiments described are part of the embodiments of the present invention, not all of the embodiments. Based on the embodiments of the present invention, all other embodiments obtained by ordinary technicians in this field without creative work are within the scope of protection of the present invention.

In the present invention, unless otherwise clearly specified and limited, the terms "connected",

"connection", and "fixed" should be understood in a broad sense, for example, it can be a fixed connection, a detachable connection, or an integral connection; it can be a mechanical connection or an electrical connection; it can be a direct connection or an indirect connection through an intermediate medium, it can be the internal connection of two elements or the interaction

relationship between two elements. For ordinary technicians in this field, the specific meanings of the above terms in the present invention can be understood according to specific circumstances.

In the present invention, unless otherwise clearly specified and limited, a first feature being "above" or "below" a second feature may include that the first and second features are in direct contact or may include that the first and second features are not in direct contact but are in contact through another feature between them. Moreover, a first feature being "above", "over" and "on" a second feature includes that the first feature is directly above and obliquely above the second feature, or simply indicates that the first feature is higher in level than the second feature. A first feature being "below", "under" and "beneath" a second feature includes that the first feature is directly below and obliquely below the second feature, or simply indicates that the first feature is lower in level than the second feature.

Example 1

Figures 1-3 , this embodiment provides an auxiliary alumina chopped fiber mat forming air web forming device, including a cotton feeding trolley 1, the cotton feeding trolley 1 is connected to a combing machine 2, the combing machine 2 is connected to a high cotton box 4 through a fan duct 3, a corridor device 6 is arranged below the high cotton box 4, a multi-row needle roller group composed of a plurality of needle rollers 5 is arranged in the corridor device 6, a negative pressure fan 9 is arranged below the corridor device 6, a conveying device 8 is arranged between the negative pressure fan 9 and the corridor device 6, a pressure roller 7 is arranged at the outlet of the corridor device 6, and a needling machine 10 is arranged on one side of the conveying device 8 .

Furthermore, the conveying device 8 is a belt drive, which includes a conveyor. The conveyor is a belt with a plurality of mesh holes. The negative pressure fan 9 can suck air into the channel device 6 through the belt, so that the alumina chopped fiber in the channel device 6 falls onto the belt to form a net.

Optionally, the cotton feeding trolley 1 is equipped with a precise weighing mechanism, and the cotton feeding trolley 1 includes a cotton feeding bin (not shown in the figure) and a cotton feeding

roller (not shown in the figure). The cotton feeding bin of the cotton feeding trolley 1 is connected to the combing machine 2, and the alumina chopped fiber is fed into the combing machine 2 through the cotton feeding roller of the cotton feeding trolley 1.

Optionally, the bell mouth of the combing machine 2 is connected to the fan duct 3 to transport the alumina chopped fiber combed by the combing machine 2 to the high cotton box 4.

Optionally, the pressing roller 7 is arranged at the outlet of the tunnel device 6 and located above the conveying device 8, and the conveying device 8 is connected to the inlet of the needling machine 10.

Optionally, the rotation directions of two adjacent needle rollers 5 in the channel device 6 are opposite. Specifically, the rotation directions of two adjacent needle rollers 5 in the horizontal direction in the channel device 6 are opposite, and the rotation directions of two adjacent needle rollers 5 in the vertical direction are also opposite. Optionally, the rotation speed of the needle roller 5 is 200-600rpm, preferably 300-400rpm.

Optionally, the needle roller group composed of a plurality of needle rollers 5 in the tunnel device 6 has four rows.

Optionally, the needle roller 5 comprises a roller shaft 51, a roller 52 and needles 53, the roller shaft 51 is inserted into the roller 52, and a plurality of needles 53 are evenly arranged on the outer surface of the roller 52.

Optionally, the length of the alumina chopped fiber is 10-90mm, preferably 30-60mm; the raw material is domestic F72, C82 or M99 alumina fiber, preferably F72 and C82 domestic alumina fibers.

The working principle of this embodiment is as follows: the alumina chopped fiber is accurately weighed by the cotton feeding trolley 1 and sent to the combing machine 2 for combing. The combed yarn is sent to the high cotton box 4 through the fan pipe 3, and then dispersed and falls to the bottom belt 9 in the channel device 6 through an array of needle rollers 5 to form a mesh. After being shaped by the pressure roller 7 at the outlet, it is conveyed by the conveying device 8 to the needling machine 11 for needling to obtain the alumina chopped fiber mat.

Example 2

FIG 4, this embodiment provides a method for forming an auxiliary alumina chopped fiber mat, wherein the method adopts an auxiliary alumina chopped fiber mat forming air-laid device provided in Example 1, and comprises the following steps:

(1) The alumina chopped fiber is accurately weighed by the cotton feeding trolley and sent to the combing machine for combing;

(2) The combed yarn is sent to the cotton box through the fan duct.

(3) It is then dispersed in the tunnel device by an array of needle rollers and sucked down by a negative pressure fan to the bottom belt to form a net;

(4) After being shaped by a pressure roller, the fiber is transferred to a needling machine by a conveying device for needling to obtain alumina chopped fiber mat.

The device and method for auxiliary alumina chopped fiber mat forming air web forming of the present invention realizes the preparation of heavy and thick alumina chopped fiber mat and improves the uniformity and stability in the preparation process of alumina chopped fiber mat.

Example 3

A process for preparing alumina chopped fiber mat:

Specifically, 50kg of domestic F72 alumina fiber (85Tex) was taken out and put into the cotton feeding cart at a feeding amount of $300 \pm 1\text{g/ time}$, feeding accuracy of $\pm 1\text{g/ time}$, and at every 20s interval. Furthermore, the length of the chopped fibers sent to the high cotton box through the fan pipe is 50mm, the speed of the needle roller group is 400rpm, the frequency of the negative pressure fan is 20Hz, and the speed of the belt moving forward is 10mm/min. Furthermore, the conveying device conveys the alumina chopped fiber web at a speed of 10mm/min, and it is sent to the needle machine for shaping by the pressure roller and then rolled up, so as to obtain the alumina chopped fiber mat of Example 3.

Comparative Example 1

A process for preparing alumina chopped fiber mat:

Specifically, 50kg of domestic F72 alumina fiber (85Tex) was taken out and put into the cotton feeding cart at a feeding amount of $300 \pm 1\text{g/ time}$, a feeding accuracy of $\pm 1\text{g/ time}$, and every 20s. Furthermore, the length of the chopped fibers sent to the high cotton box through the fan pipe is 80mm, the speed of the needle roller group is 400rpm, the frequency of the negative pressure fan is 20Hz, and the speed of the belt moving forward is 10mm/min. Furthermore, the conveying device conveys the alumina chopped fiber web at a speed of 10mm/min, and it is sent to the needling shaping after the pressing roller shaping and then rolled up, so as to obtain the alumina chopped fiber mat of Control

Example 1.

Comparative Example 2

A process for preparing alumina chopped fiber mat:

5 Specifically, 50kg of domestic F72 alumina fiber (85Tex) was taken out and put into the cotton feeding cart at a feeding amount of $200 \pm 1\text{g/ time}$, a feeding accuracy of $\pm 1\text{g/ time}$, and every 25s. Furthermore, the length of the chopped fibers sent to the high cotton box through the fan pipe is 50mm, the speed of the needle roller group is 200rpm, the frequency of the negative pressure fan is 20Hz, and the speed of the belt moving forward is 10mm/min. Furthermore, the conveying device conveys
10 the alumina chopped fiber web at a speed of 10mm/min, and it is sent to the needling setting after the pressure roller is set and then rolled up, so as to obtain the alumina chopped fiber mat of Control Example 2.

Comparative Example 3

15 A process for preparing alumina chopped fiber mat:

Specifically, 50kg of domestic F72 alumina fiber (85Tex) was taken out and put into the cotton feeding cart at a feeding amount of $200 \pm 1\text{g/ time}$, a feeding accuracy of $\pm 1\text{g/ time}$, and every 20s. Furthermore, the length of the chopped fibers sent to the high cotton box through the fan pipe is 80mm, the speed of the needle roller group is 200rpm, the frequency of the negative pressure fan is 20Hz,
20 and the speed of the belt moving forward is 10mm/min. Furthermore, the conveying device conveys the alumina chopped fiber web at a speed of 10mm/min, and it is sent to the needling shaping after the pressing roller shaping and then rolled up, so as to obtain the alumina chopped fiber mat of Control Example 3.

Example 4

A process for preparing alumina chopped fiber mat:

Specifically, 30kg of domestic C82 alumina fiber (120Tex) was taken out and put into the cotton feeding cart at a feeding amount of $100 \pm 1\text{g/ time}$, a feeding accuracy of $\pm 1\text{g/ time}$, and every 30 seconds. Furthermore, the length of the chopped fibers sent to the high cotton box through the fan
30 duct is 30mm, the speed of the needle roller group is 600rpm, the frequency of the negative pressure fan is 20Hz, and the speed of the belt moving forward is 20mm/min. Furthermore, the conveying

device conveys the alumina chopped fiber web at a speed of 20mm/min, and after being shaped by the pressure roller, it is sent to the needling shaping and then rolled up in order to obtain the alumina chopped fiber mat of Example 4.

5 **Comparative Example 4**

A process for preparing alumina chopped fiber mat:

Specifically, 30kg of domestic C82 alumina fiber (120Tex) was taken out and put into the cotton feeding cart at a feeding amount of $100 \pm 1\text{g/ time}$, a feeding accuracy of $\pm 1\text{g/ time}$, and every 30 seconds. Furthermore, the length of the chopped fibers sent to the high cotton box through the fan pipe is 60mm, the speed of the needle roller group is 400rpm, the frequency of the negative pressure fan is 20Hz and the speed of the belt moving forward is 10mm/min. Furthermore, the conveying device conveys the alumina chopped fiber web at a speed of 10mm/min and it is sent to the needling shaping after the pressing roller shaping and then rolled up so as to obtain the alumina chopped fiber mat of Control Example 4.

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Comparative Example 5

A process for preparing alumina chopped fiber mat:

Specifically, 30 =kg of domestic C82 alumina fiber (120Tex) was taken out and put into the cotton feeding cart at a feeding amount of $200 \pm 1\text{g/time}$, a feeding accuracy of $\pm 1\text{g/time}$, and in 20-second intervals. Furthermore, the length of the chopped fibers sent to the high cotton box through the fan pipe is 60mm, the speed of the needle roller group is 400rpm, the frequency of the negative pressure fan is 20Hz, and the speed of the belt moving forward is 10mm/min. In addition, the conveying device conveys the alumina chopped fiber web at a speed of 10mm/min, and it is sent to the needle punching shaping after the pressing roller shaping and then rolled up, so as to obtain the alumina chopped fiber mat of Control Example 5.

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Five samples were taken from each of the alumina chopped fiber mats obtained in Examples 3-4 and Comparative Examples 1-5 at 50cm from the head and tail sections and 25cm from the middle and divided into test groups 15. The basis weight was tested under the same conditions and the thickness was tested using a thickness meter according to the National Standard of the People's Republic of China GB/T 9914.3 2013/ISO 3374:2000 "Test methods for reinforced products - Part 3: Determination of mass per unit area". The test results are shown in Table 1 below:

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Table 1 Test results of Examples 3-4 and Comparative Examples 1-5Test group		Implementation Example 3	Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4	Comparative Example 4	Comparative Example 5
Alumina chopped fiber mat basis weight (g/m ²)	1	1682	1732	1533	1622	1080	993	1032
	2	1573	1703	1503	1608	998	972	1097
	3	1630	1695	1473	1611	1030	1006	1112
	4	1608	1694	1493	1573	1042	990	1104
	5	1593	1752	1518	1592	1019	1013	1073
	Average value	1617.2	1715.2	1504.0	1601.2	1033.8	994.8	1083.6
	CV (%)	2.31	1.34	1.37	1.07	2.64	1.42	2.67
Alumina chopped fiber mat thickness (mm)	1	21.40	22.30	20.40	21.00	9.60	10.40	11.70
	2	21.70	21.80	20.60	20.80	9.10	9.80	12.30
	3	21.70	22.00	20.00	20.20	8.70	9.70	11.90
	4	21.00	22.50	19.90	20.60	9.1	10.2	11.4
	5	20.80	21.30	20.30	20.60	8.8	9.5	12.1
	Average value	21.32	21.98	20.24	20.64	9.06	9.92	11.88
	CV (%)	1.71	1.90	1.27	1.29	3.46	3.34	2.63

From Table 1, the device and method for auxiliary alumina chopped fiber mat forming air web forming of the present invention can prepare alumina chopped fiber mats of different surface densities and thicknesses by selecting raw materials and adjusting process parameters. The basis weight and thickness of the alumina chopped fiber mat prepared by the present invention exceed 800g/m² and 12mm prepared by the conventional method, and the preparation of large and heavy alumina chopped fiber mat is achieved. The basis weight fluctuation value (CV) is much lower than the basis weight fluctuation value of the existing process, indicating that the preparation method provided by the present invention improves the uniformity and stability of the mesh felt.

Although the present invention has been disclosed as above in the preferred embodiment,

it is not intended to limit the present invention. Anyone familiar with this technology can make various changes and modifications without departing from the spirit and scope of the present invention. Therefore, the scope of protection of the present invention should be based on the definition of the claims.

Claims

1. An auxiliary alumina chopped fiber mat forming air-laid device, characterized in that it comprises a cotton feeding trolley, the cotton feeding trolley is connected to a combing machine, the combing machine is connected to a high cotton box through a fan duct, a tunnel device is arranged
5 below the high cotton box, a multi-row needle roller group composed of a plurality of needle rollers is arranged in the tunnel device, a negative pressure fan is arranged below the tunnel device, a conveying device is arranged between the negative pressure fan and the tunnel device, a pressure roller is arranged at the outlet of the tunnel device, and a needle machine is arranged on one side of the conveying device.

10 2. The auxiliary alumina chopped fiber mat forming air-laid device according to claim 1, characterized in that the conveying device is a belt drive, the belt drive includes a conveyor, and the conveyor is a belt with a plurality of mesh holes formed thereon.

3. The auxiliary alumina chopped fiber mat forming air-laid device according to claim 2, characterized in that the cotton feeding trolley is equipped with a precise weighing mechanism, the
15 cotton feeding trolley comprises a cotton feeding bin and a cotton feeding roller, the cotton feeding bin of the cotton feeding trolley is connected to the combing machine, and the alumina chopped fiber is fed into the combing machine through the cotton feeding roller of the cotton feeding trolley.

4. The auxiliary alumina chopped fiber mat forming air-laid device according to claim 3, characterized in that the bell mouth of the combing machine is connected to the fan duct, and the
20 alumina chopped fiber combed by the combing machine is transported to the high cotton box; the pressure roller is arranged at the outlet of the channel device and is located above the conveying device, and the conveying device is connected to the inlet of the needle machine.

5. The auxiliary alumina chopped fiber mat forming air-laid device according to claim 4, characterized in that the rotation directions of the two adjacent needle rollers in the tunnel device are
25 opposite.

6. The auxiliary alumina chopped fiber mat forming air-laid device according to claim 5, characterized in that the needle roller comprises a roller shaft, a roller and needles, the roller shaft is inserted into the roller, and a plurality of needles are evenly arranged on the outer surface of the roller.

7. A method for assisting the formation of alumina chopped fiber mat, characterized in that the
30 method adopts the air-laid device for assisting the formation of alumina chopped fiber mat according to claim 6, comprising the following steps:

(1) the alumina chopped fiber is accurately weighed by the cotton feeding trolley and sent to the combing machine for combing;

(2) the combed yarn is sent to the cotton box (4) through the fan duct (3);

(3) the particles are then dispersed in the tunnel device by an array of needle rollers and sucked
5 by a negative pressure fan to fall to the bottom belt to form a mesh;

(4) after being shaped by a pressing roller, the fiber is transferred by a conveying device to a needling machine for needling to obtain an alumina chopped fiber mat.

8. The method for assisting the formation of alumina chopped fiber mat according to claim 7,
characterized in that the rotation speed of the needle roller in step (3) is 200-600rpm; the speed of the
10 conveying device in step (4) conveying the alumina chopped fiber web is 10mm/min.

9. The method for assisting the formation of alumina chopped yarns according to claim 7,
characterized in that the frequency of the negative pressure fan in step (3) is 5-20Hz, and the length
of the alumina chopped yarns in step (1) is 10-90mm.

10. The method for assisting the formation of alumina chopped fiber mat according to claim 7,
15 characterized in that the alumina chopped fiber mat in step (4) has a thickness of 8-23mm, an area
density of 800-1800g/m², and an area density fluctuation value of 1% -3%.