

A Multi-Row Blowing Device and Method for Assisting the Formation of Continuous Alumina Fiber Blanket

Technical Field

5 The invention relates to a multi-row blowing device and method for assisting in forming continuous alumina fiber blanket, belonging to the technical field of textile accessories.

Technical Background

10 In recent years, with the increasing demand for high-temperature resistant insulation materials and reinforcement materials in the military, aerospace and civilian industries, alumina fiber, as a new type of high-performance inorganic non-metallic fiber material, not only has extraordinarily high-temperature oxidation resistance, but also considerable mechanical properties, thus becoming the focus of research in this field.

15 Alumina fibers can be prepared from metal oxide powders, polymers and inorganic salts of aluminum by melting, electrospinning, impregnation and sol-gel methods, among which the sol-gel method is the most common, which can obtain precursor gel alumina fibers with uniform components, high purity and uniform performance. After appropriate heat treatment, the final polycrystalline alumina continuous fibers are obtained.

20 Continuous alumina fiber blanket, as a refractory partition material that all countries are currently focusing on developing, faces many difficulties in the preparation process. Alumina fiber is relatively brittle and has a very low elongation at break. If the conventional short felt forming method is used, the alumina fiber is easily affected by lateral shear force, and the breakpoints appear to form powdery short fibers, which will affect the forming strength of the continuous alumina fiber blanket, reducing the overall mechanical properties and affecting the final practical
25 application.

 Therefore, designing a device and method that can assist in the forming of continuous alumina fiber blankets is a technical problem that urgently needs to be solved.

Summary of the Invention

30 [Technical problem]

 Alumina fibers are very brittle and have a very low elongation at break. If the conventional short

felt forming method is used, the alumina fibers are easily affected by lateral shear force, resulting in breakpoints and powdery short fibers. This will affect the forming strength of the continuous alumina fiber blanket, reduce the overall mechanical properties and affect the final practical application.

5 [Technical solutions]

In order to solve the above problems, the present invention provides a multi-row blowing device and method for assisting the formation of continuous alumina fiber blanket. The multi-row blowing device for assisting the formation of continuous alumina fiber blanket of the present invention can ensure that when the alumina fiber blanket is formed, the powdered alumina fibers formed by shearing and damaging the alumina fibers during the processing and forming will not reduce the strength of the continuous alumina fiber blanket. Compared with other continuous alumina fiber blanket forming methods or devices, the present invention can ensure that the alumina fibers are not damaged during the preparation process, eliminate the existence of powdered alumina fibers, and ensure the forming strength and quality of the continuous alumina fiber blanket. In addition, the device of the present invention can simplify the preparation process of the continuous alumina fiber blanket and improve the preparation efficiency.

The first object of the present invention is to provide a multi-row blowing device for assisting the formation of continuous alumina fiber blanket, comprising a storage tank, a multi-row blowing mechanism and a hollow cylinder, wherein the storage tank is connected to the multi-row blowing mechanism through a pipeline, a hollow cylinder is arranged below the multi-row blowing mechanism and is connected to the hollow cylinder, a negative pressure fan is connected below the hollow cylinder, a negative pressure net and a conveyor belt are also arranged between the hollow cylinder and the negative pressure fan, the negative pressure net is located above the conveyor belt, and the conveyor belt drives the negative pressure net to move; wherein, the upper and lower surfaces of the multi-row blowing mechanism are provided respectively with a first layer of spinneret holes and a second layer of spinneret holes, and a plurality of the first layer of spinneret holes correspond one to one with a plurality of the second layer of spinneret holes.

In one embodiment of the present invention, the interior of the multi-row blowing mechanism is hollow. The first layer of spinneret holes and the second layer of spinneret holes have the same size; and a plurality of ventilation holes is provided on the side of the multi-row blowing mechanism.

In one embodiment of the present invention, the radius of the first layer spinneret holes and the

second layer spinneret holes of the multi-row blowing mechanism is 0.3-0.6mm, and the spacing between the spinneret holes is 2-15mm; the ratio of the radius of the spinneret holes to the spacing between the first layer spinneret holes and the second layer spinneret holes is 1:10-1:80.

5 In one embodiment of the present invention, a safety valve and a metering pump are provided on the pipeline; mesh holes are provided on the conveyor belt and the negative pressure net, and the negative pressure fan is located inside the conveyor belt; the multi-row blowing mechanism is integrally formed of stainless steel, ceramic or silicon carbide.

The second object of the present invention is to provide a method for forming an auxiliary continuous alumina fiber blanket, wherein the method adopts the auxiliary continuous alumina fiber
10 blanket forming multi-row blowing device, comprising the following steps:

(1) Place the prepared alumina spinning solution in a storage tank and transport it through a safety valve and a metering pump;

(2) introducing the alumina spinning solution in step (1) into a multi-row blowing mechanism;

(3) In step (2), the upper and lower surfaces of the multiple-row blowing mechanism are arranged
15 with spinneret holes according to actual needs, and the side surfaces of the multiple-row blowing mechanism are arranged with ventilation holes;

(4) The spinning solution passes through the multi-row blowing mechanism described in step (3), is drawn into filaments through the spinneret holes, is cooled through the ventilation holes, and is then blown off by a negative pressure fan to form alumina short fibers;

20 (5) The alumina short fibers obtained in step (4) are adsorbed into a net by a negative pressure net, and the conveyor belt drives the negative pressure net to move forward at a speed of 1-5 mm/s to form a precursor continuous alumina fiber blanket with a thickness of 1-100mm;

(6) The continuous alumina fiber blanket preform obtained in step (5) is heat treated to form a final continuous alumina fiber blanket.

25 In one embodiment of the present invention, the radius of the spinneret hole in step (3) is 0.25-1 mm, and the spinneret hole spacing is 2-15mm; the radius of the ventilation hole in step (3) is 1-20 mm, and the ratio of the spinneret hole diameter to the distance between the first layer of spinneret holes and the second layer of spinneret holes is 1:10-1:80.

In one embodiment of the present invention, the operating frequency of the negative pressure
30 fan described in step (3) is 0.5-2Hz, and the rotation speed of the negative pressure fan is 200-300rpm.

In one embodiment of the present invention, the speed of the metering pump in step (1) is 0.1-

0.2rpm.

In one embodiment of the present invention, the heat treatment in step (6) is to heat the blanket to 700°C at a relatively low rate and keep the temperature for 30 minutes; then, the blanket is heated from 700°C to 800, 900, 1000, 1100 and 1200°C in sequence at a relatively high heating rate, kept at the temperature for 30 minutes, taken out, and cooled at room temperature to obtain an continuous alumina fiber blanket with a final thickness of 5-150mm.

In one embodiment of the present invention, the spinneret holes in step (3) have a lateral spacing of 2-15mm and a longitudinal spacing of 2-15mm.

Beneficial Effects

(1) The multi-row blowing mechanism of the present invention can be integrally formed of materials such as stainless steel and ceramic materials. The multi-row blowing mechanism is hollow and contains evenly distributed spinneret holes, which can ensure that the alumina precursor fibers are evenly cooled and blown off by a negative pressure fan to form short fibers, thereby avoiding damage to the alumina precursor fibers during the preparation process.

(2) The spinneret hole radius, arrangement distance and spacing between two layers of spinneret holes of the multi-row blowing mechanism of the present invention can be adjusted according to the actual needs of the continuous alumina fiber blanket, so as to obtain a suitable alumina fiber radius, length, and thickness and strength of the final continuous alumina fiber blanket.

(3) The multi-row blowing device and method for assisting the formation of continuous alumina fiber blanket of the present invention has a reasonable process flow. The configured spinning solution is pumped at a suitable speed through a multi-row blowing mechanism to obtain ideal and undamaged alumina precursor short fibers, which are adsorbed into a net by a negative pressure net and sintered to obtain the final continuous alumina fiber blanket product, which simplifies the process flow and improves the preparation quality and efficiency.

(4) The multi-row blowing device for assisting the formation of the continuous alumina fiber blanket of the present invention can ensure that when the alumina fiber blanket is formed, the powdered alumina fibers formed by shearing the alumina fibers during the processing and forming will not reduce the strength of the continuous alumina fiber blanket. Compared with other continuous alumina fiber blanket forming methods or devices, the present invention can ensure that the alumina fibers are not damaged during the preparation process, eliminate the existence of powdered alumina

fibers, and ensure the forming strength and quality of the continuous alumina fiber blanket.

(5) The device of the present invention can simplify the preparation process of continuous alumina fiber blanket and improve the preparation efficiency.

5 (6) When the negative pressure blower of the present invention is in operation, air passes through the side ventilation holes of the multiple rows of blowing mechanisms to cool and shape the filamentary spinning solution. In addition, the negative pressure blower can also blow off the alumina precursor fibers that have passed through the second layer of spinneret holes to form alumina short fibers.

10 (7) The conveyor belt and the negative pressure net of the present invention are both provided with mesh holes, and the falling precursor oxidation fibers can be adsorbed by the negative pressure net into a net through the negative pressure fan. The conveyor belt drives the negative pressure net to move forward, and a precursor continuous alumina fiber blanket with a thickness of 1-100mm can be formed.

15 **Brief Description of Drawings**

FIG1 is a schematic structural diagram of a multi-row blowing device for assisting in forming continuous alumina fiber blanket according to the present invention;

FIG2 is a top view of a multi-row blowing mechanism of the present invention, wherein R is the radius of the spinneret hole, Tx is the transverse spacing of the spinneret holes, and Ty is the
20 longitudinal spacing of the spinneret holes;

FIG3 is a side view of the multi-row blowing mechanism of the present invention, wherein r is the radius of the ventilation holes, Tx is the lateral spacing of the ventilation holes, Ty is the longitudinal spacing of the ventilation holes, the spacing between the first layer of spinneret holes and the second layer of spinneret holes is Y, and the ratio of the spinneret hole radius R to the
25 spacing Y (R/Y) is called the aperture ratio.

Among them: 1. Storage tank; 2. Safety valve; 3. Metering pump; 4. Multi-row blowing mechanism; 5. Negative pressure net; 6. Negative pressure fan; 7. Conveyor; 8. Hollow cylinder; 9. First layer spinneret hole; 10. Second layer spinneret hole; 11. Ventilation hole.

30 **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 described embodiments 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

As shown in Figures 1-3, this embodiment provides a multi-row blowing device for assisting the formation of continuous alumina fiber blanket, including a storage tank 1, a multi-row blowing mechanism 4 and a hollow cylinder 8, the storage tank 1 is connected to the multi-row blowing mechanism 4 through a pipeline, a hollow cylinder 8 is arranged below the multi-row blowing mechanism 4 and is connected to the hollow cylinder 8, a negative pressure fan 6 is connected below the hollow cylinder 8, a negative pressure net 5 and a conveyor belt 7 are also arranged between the hollow cylinder 8 and the negative pressure fan 6, the negative pressure net 5 is located above the conveyor belt 7, and the conveyor belt 7 drives the negative pressure net 5 to move; wherein, the

upper and lower surfaces of the multi-row blowing mechanism 4 are provided respectively with a first layer of spinneret holes 9 and a second layer of spinneret holes 10, and a plurality of the first layer of spinneret holes 9 correspond one to one with a plurality of the second layer of spinneret holes 10.

Optionally, the interior of the multi-row blowing mechanism 4 is hollow, and the upper and lower surfaces of the multi-row blowing mechanism 4 are provided respectively with a first layer of spinneret holes 9 and a second layer of spinneret holes 10. The first layer of spinneret holes 9 and the second layer of spinneret holes 10 have the same size, that is, the upper and lower surfaces of the multi-row blowing mechanism 4 are arranged with completely identical spinneret holes.

Optionally, a plurality of ventilation holes 11 is provided on the side of the multi-row blowing mechanism 4 and the ventilation holes 11 are used to cool the alumina precursor fibers between the first layer of spinneret holes 9 and the second layer of spinneret holes 10.

Optionally, the multi-row blowing mechanism 4 is integrally formed of stainless steel, ceramic or silicon carbide.

Optionally, the radii of the first layer of spinneret holes 9 and the second layer of spinneret holes 10 of the multi-row blowing mechanism 4 are 0.3-0.6mm, and the spacing between the spinneret holes is 2-15mm.

Optionally, the number of spinneret holes of the multi-row blowing mechanism 4 is arranged in a configuration of 2×5 - 20×100 .

As shown in Figures 2 and 3, R is the radius of the spinneret hole, Tx is the lateral spacing of the spinneret holes, and Ty is the longitudinal spacing of the spinneret holes; r is the radius of the ventilation hole, Tx is the lateral spacing of the ventilation holes, Ty is the longitudinal spacing of the ventilation holes, the spacing between the first layer of spinneret holes and the second layer of spinneret holes is Y, and the ratio of the spinneret hole radius R to the spacing Y (R/Y) is called the aperture ratio. The ratio of the spinneret hole radius to the spacing between the first layer of spinneret holes 9 and the second layer of spinneret holes 10 is called the aperture ratio, and the aperture ratio is 1:10-1:80.

Furthermore, the operating frequency of the negative pressure fan 6 is 0.5-2Hz, and the rotation speed of the negative pressure fan is 200-300rpm. Further, the rotation speed of the negative pressure fan 6 is preferably 250rpm. When the negative pressure fan 6 is working, the air passes through the side ventilation holes 11 of the multiple rows of blowing mechanisms 4 to cool and shape the

filamentous spinning liquid. In addition, the negative pressure fan 6 blows off the alumina precursor fibers that have passed through the second layer of spinneret holes 10 to form alumina short fibers.

Optionally, the pipeline is provided with a safety valve 2 and a metering pump 3, which can observe and adjust the capacity and flow rate of the material in the pipeline at any time. Optionally, the speed of the metering pump 3 is 0.1-0.2rpm; the safety valve 2 is a solenoid valve or an electric valve.

Furthermore, the storage tank 1 is connected to a screw extruder, and the screw extruder is used to transport the material in the storage tank 1 to the multi-row blowing mechanism 4 through the pipeline.

Optionally, mesh holes are provided on the conveyor belt 7 and the negative pressure net 5, and the negative pressure fan 6 is located inside the conveyor belt 7. The negative pressure fan 6 can make the falling precursor oxidation fibers be adsorbed by the negative pressure net 5 into a net (the wind speed is 100-200r/s), and the conveyor belt 7 drives the negative pressure net 5 to move forward at a speed of 1-5mm/s to form a precursor continuous alumina fiber blanket with a thickness of 1-100mm.

The working principle of this embodiment is as follows: the raw materials required for the sol-gel method are added to the storage tank, and the spinning solution in the storage tank is transported to the multi-row blowing mechanism through the metering pump at an appropriate speed (0.1-0.2rpm). The radius of the first layer of the multi-row blowing mechanism is 0.3-0.6mm, and the second layer of the spinneret is located directly below the first layer of the spinneret. The ratio of the radius of the spinneret to the spacing between the two layers of the spinneret is 1:10-1:80. The spinnerets are arranged in a 2*5-20*100 manner, and the hole spacing is 2-15mm. The negative pressure fan works at a frequency of 0.5-2Hz. On the one hand, it can cool the precursor alumina fibers between the two layers of spinnerets, and on the other hand, it can blow off the precursor alumina fibers with the ventilation holes on the side. The falling precursor oxidation fibers are adsorbed into a net by a negative pressure net (wind speed is 100-200r/s), and the conveyor belt drives the negative pressure net to move forward at a speed of 1-5mm/s to form a precursor continuous alumina fiber blanket with a thickness of 1-100mm, and then sintering begins. The specific sintering process is: heating to 700°C at a lower rate and keeping warm for 30min; then heating the blanket from 700°C to 800, 900, 1000, 1100 and 1200°C in sequence at a higher heating rate, taking it out after keeping warm for 30min, and cooling it at room temperature to obtain a final continuous alumina fiber blanket with a thickness of 5-150mm.

Example 2

This embodiment provides a method for forming an auxiliary continuous alumina fiber blanket, which adopts a multi-row blowing device for forming an auxiliary continuous alumina fiber blanket provided in Example 1, and comprises the following steps:

(1) Place the prepared alumina spinning solution in a storage tank and transport it through a safety valve and a metering pump;

(2) introducing the alumina spinning solution in step (1) into a multi-row blowing mechanism;

(3) In step (2), the upper and lower surfaces of the multi-row blowing mechanism are arranged with spinnerets according to actual needs, the spinneret hole radius is 0.25-1mm, the spinneret hole spacing is 2-15mm, and ventilation holes are arranged on the side surface of the multi-row blowing mechanism, the ventilation hole radius is 1-20mm, and the ratio of the spinneret hole diameter to the distance between the first layer of spinneret holes and the second layer of spinneret holes (aperture ratio) is 1:10-1:80;

(4) The spinning solution passes through the multi-row blowing mechanism described in step (3), is drawn into filaments through the spinneret holes, is cooled through the ventilation holes, and is then blown off by a negative pressure fan to form alumina short fibers;

(5) The alumina short fibers obtained in step (4) are adsorbed into a net by a negative pressure net, and the conveyor belt drives the negative pressure net to move forward at a speed of 1-5mm/s to form a precursor continuous alumina fiber blanket with a thickness of 1-100mm;

(6) The continuous alumina fiber blanket preform obtained in step (5) is heat treated to form a final continuous alumina fiber blanket.

Example 3

This example is a process flow explored to obtain a thinner (<20 mm) continuous alumina fiber blanket.

The storage tank mainly stores alumina spinning solution synthesized according to the formula. Furthermore, the alumina spinning solution is provided by China Steel Luoyang Refractory Material Research Institute Co., Ltd. Aluminum powder is poured into hot crystalline aluminum chloride aqueous solution in batches and stirred evenly to obtain polyaluminum chloride mother liquor, and then the mother liquor is mixed with silica sol in proportion, and then PEG is added and distilled

under reduced pressure to obtain a gel spinning solution with a certain viscosity.

The alumina spinning solution passes through a safety valve and reaches a metering pump, the speed of which is 0.1-0.5rpm, and preferably 0.15rpm.

5 The alumina spinning solution reaches the multi-row blowing mechanism through a metering pump. The interior of the multi-row blowing mechanism is hollow and the upper and lower surfaces are arranged with completely identical spinnerets. As shown in FIG2, the radius R of the spinneret is 0.25-1mm. Further, the radius R of the spinneret is preferably 0.5mm. The transverse and longitudinal spinnerets are arranged in 9*2. The transverse spacing Tx of the spinnerets is 2-15mm, and the longitudinal spacing Ty is 2-15mm. Further, the transverse spacing Tx of the spinnerets is preferably 4mm, and the longitudinal spacing Ty is preferably 8mm.

The side surface of the multi-row blowing mechanism is arranged with ventilation holes, as shown in FIG3, the radius r of the ventilation hole is 1-20mm, further, the radius r of the ventilation hole is preferably 2mm, the number of ventilation holes is preferably arranged in 18*2, the ratio of the radius of the ventilation hole to the spacing Y between the first layer of spinneret holes and the second layer of spinneret holes (aperture ratio) is 1:10-1:80, further, the aperture ratio is preferably 1:20, and the spacing Y between the first layer of spinneret holes and the second layer of spinneret holes is 10mm.

The negative pressure fan arranged beside the multiple rows of blowing mechanisms operates at a frequency of 0.5Hz-2Hz, and further, the frequency of the negative pressure fan is preferably 1Hz. 20 The speed of the negative pressure fan is 200-300rpm, and further, the speed of the negative pressure fan is preferably 250rpm. When the negative pressure fan is working, the air passes through the side ventilation holes of the multiple rows of blowing mechanisms to cool and shape the filamentous spinning solution. In addition, the negative pressure fan blows off the alumina precursor fibers that have passed through the second layer of spinnerets to form alumina short fibers.

25 The alumina short fibers obtained by the multi-row blowing mechanism are adsorbed onto the negative pressure net by the negative pressure fan, and the rotation speed of the negative pressure fan is 100-200rpm. Further, the rotation speed of the negative pressure fan is preferably 150rpm, and the negative pressure net moves forward at a speed of 1-5mm/s. Further, the forward movement speed of the negative pressure net is preferably 4mm/min.

30 The thickness of the continuous alumina fiber blanket preform obtained by the above steps reaches 15mm. Further, sintering is started, the temperature is raised to 700°C at a lower rate, and the

temperature is kept for 30min; then the blanket is heated from 700°C to 800, 900, 1000, 1100 and 1200°C in sequence at a higher heating rate, and taken out after being kept for 30min, and cooled at room temperature to obtain an continuous alumina fiber blanket with a final thickness of 10mm.

The continuous alumina fiber blanket obtained by the above process is well formed and has a tensile strength of 5.78MPa.

Comparative Example 1

R of the spinneret in Example 3 was adjusted to 0.2mm in order to obtain alumina precursor short fibers with lower fineness and enhance the bonding strength of the continuous alumina fiber blanket. The rest remained the same as in Example 3.

During the preparation process, it was found that due to the small radius of the spinneret, the alumina spinning solution with a certain viscosity was difficult to pass through the spinneret, and continuous alumina precursor fibers could not be formed. The alumina short fibers obtained on the negative pressure net were of different lengths, and the length uniformity could not meet actual needs.

Comparative Example 2

R of the spinneret in Example 3 is adjusted to 1mm, in order to obtain alumina precursor short fibers with higher fineness, and the forming uniformity of the short fibers will be improved. Others remain the same as in Example 3.

During the preparation process, it was found that because the fibers were relatively thick, the existing negative pressure fan speed was unable to blow off the alumina precursor fibers to form short fibers. However, after increasing the speed of the negative pressure fan, the wind speed between the first layer of spinneret holes and the second layer of spinneret holes was too large, causing the fibers to be blown off before they were formed. The uniformity of the short fiber length was not improved, and the actual needs could not be met.

Comparative Example 3

The aperture ratios in Example 3 were adjusted to 1:10, 1:30, 1:40, 1:50, 1:60, 1:70 and 1:80 respectively. The other operation steps were kept consistent with Example 3, and the tensile strength of the continuous alumina fiber blanket with different aperture ratios in Example 3 was obtained, as shown in Table 1 below.

Table 1 Tensile strength of continuous alumina fiber blanket with different aperture ratios in Example 3

Aperture ratio	Tensile strength (MPa)
1:10	5.6
1:20 (Example 3)	5.78
1:30	5.7
1:40	5.0
1:50	4.1
1:60	4.1
1:70	2.8
1:80	0.1

From the results obtained in Table 1, it can be found that with the increase of the aperture ratio, the strength of the obtained continuous alumina fiber blanket has a significant decrease. This is because the fiber length increases. Although the entanglement between the fibers is more obvious under the action of negative pressure, the uniformity of the fiber length decreases, and defects are prone to appear in the continuous alumina fiber blanket. In the strength test, the defects are more likely to produce stress concentration and damage.

Example 4

This example is a process flow explored to obtain a thicker ($>100\text{mm}$) continuous alumina fiber blanket.

The alumina spinning solution prepared in the storage tank is passed through a safety valve to a metering pump, and the speed of the metering pump is preferably 0.5rpm .

The alumina spinning solution reaches the multi-row blowing mechanism through a metering pump, and the radius R of the spinneret hole is further preferably 0.8mm . The number of transverse and longitudinal spinneret holes is preferably arranged in $18*5$. The transverse spacing of the spinneret holes is preferably 10mm , and the longitudinal spacing T_y is preferably 10mm .

The side surface of the multi-row blowing mechanism is arranged with ventilation holes, as shown in FIG3, the radius r of the ventilation holes is preferably 5mm , the number of ventilation holes is preferably arranged in $36*3$, the aperture ratio is preferably $1:60$, and the spacing Y between the first layer of spinneret holes and the second layer of spinneret holes is 30mm .

The frequency of the negative pressure fan is preferably 2Hz. The speed of the negative pressure fan is preferably 200rpm, and while cooling the alumina precursor fibers, the fibers are blown off to form short fibers.

The alumina short fibers obtained by the multi-row blowing mechanism are adsorbed onto the negative pressure net by the negative pressure fan. The rotation speed of the negative pressure fan is preferably 120rpm, and the forward movement speed of the negative pressure net is preferably 2mm/min.

The thickness of the continuous alumina fiber blanket preform obtained by the above steps reaches 120mm. Further, sintering is started, the temperature is raised to 700°C at a lower rate, and the temperature is kept for 30min; then the blanket is heated from 700°C to 800, 900, 1000, 1100 and 1200°C in sequence at a higher heating rate, and the blanket is taken out after being kept for 30min, and cooled at room temperature to obtain an continuous alumina fiber blanket with a final thickness of 100mm.

The continuous alumina fiber blanket obtained by the above process is well formed and has a tensile strength of 7.32MPa.

Comparative Example 4

The aperture ratios in Example 4 were adjusted to 1:10, 1:30, 1:40, 1:50, 1:60, 1:70 and 1:80 respectively. The other operation steps were kept consistent with Example 4, and the tensile strength of the continuous alumina fiber blanket with different aperture ratios in Example 4 was obtained, as shown in Table 2 below.

Table 2 Tensile strength of continuous alumina fiber blanket with different aperture ratios in Example 4

Aperture ratio	Tensile strength (MPa)
1:10	2.56
1:20	4.10
1:30	5.34
1:40	6.66
1:50	6.54
1 : 60	7.21
1 : 70	7.32

(Example 4)	
1 : 80	7.10

It can be seen that with the increase of aperture ratio, the tensile strength of the continuous alumina fiber blanket is greatly improved. This is because as the fineness of the alumina precursor short fibers increases, the overall strength of the fibers increases. The larger aperture ratio makes it easier for the short fibers falling on the negative pressure net to entangle with each other, and the friction force between the fibers increases, thereby improving the overall strength of the continuous alumina fiber blanket.

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. A multi-row blowing device for assisting the formation of continuous alumina fiber blanket, characterized in that it comprises a material storage tank, a multi-row blowing mechanism and a hollow cylinder, wherein the material storage tank is connected to the multi-row blowing mechanism through a pipeline, a hollow cylinder is arranged below the multi-row blowing mechanism and is connected to the hollow cylinder, a negative pressure fan is connected below the hollow cylinder, a negative pressure net and a conveyor belt are further arranged between the hollow cylinder and the negative pressure fan, the negative pressure net is located above the conveyor belt, and the conveyor belt drives the negative pressure net to move; wherein the upper and lower surfaces of the multi-row blowing mechanism are provided respectively with a first layer of spinneret holes and a second layer of spinneret holes, and a plurality of the first layer of spinneret holes correspond one to one to a plurality of the second layer of spinneret holes.

2. The multi-row blowing device for assisting the formation of continuous alumina fiber blanket according to claim 1, characterized in that the interior of the multi-row blowing mechanism is hollow, the first layer of spinneret holes and the second layer of spinneret holes are of the same size; and a plurality of ventilation holes is provided on the side of the multi-row blowing mechanism.

3. The multi-row blowing device for assisting the formation of continuous alumina fiber blanket according to claim 2, characterized in that the radius of the first layer spinneret holes and the second layer spinneret holes of the multi-row blowing mechanism are 0.3-0.6mm, and the spacing between the spinneret holes is 2-15 mm; the ratio of the radius of the spinneret holes to the spacing between the first layer spinneret holes and the second layer spinneret holes is 1:10-1:80.

4. The multi-row blowing device for assisting the formation of continuous alumina fiber blanket according to claim 3, characterized in that a safety valve and a metering pump are provided on the pipeline; mesh holes are provided on the conveyor belt and the negative pressure net, and the negative pressure fan is located inside the conveyor belt; the multi-row blowing mechanism is integrally formed of stainless steel, ceramic or silicon carbide.

5. A method for forming an auxiliary continuous alumina fiber blanket, characterized in that the method adopts the auxiliary continuous alumina fiber blanket forming multi-row blowing device according to claim 4, comprising the following steps:

(1) placing the prepared alumina spinning solution in a storage tank and conveying it through a safety valve and a metering pump;

(2) introducing the alumina spinning solution in step (1) into a multi-row blowing mechanism;

(3) in step (2), the upper and lower surfaces of the multiple-row blowing mechanism are arranged with spinneret holes according to actual needs, and the side surfaces of the multiple-row blowing mechanism are arranged with ventilation holes;

5 (4) the spinning solution passing through the multi-row blowing mechanism described in step (3) is drawn into filaments through the spinneret holes, is cooled through the ventilation holes, and is then blown off by the negative pressure fan to form alumina short fibers;

(5) the alumina short fibers obtained in step (4) are adsorbed into a net by a negative pressure net, and a conveyor belt drives the negative pressure net to move forward at a speed of 1-5mm/s to
10 form a precursor continuous alumina fiber blanket with a thickness of 1-100mm;

(6) the continuous alumina fiber blanket preform obtained in step (5) is subjected to heat treatment to form a final continuous alumina fiber blanket.

6. The method for forming an auxiliary continuous alumina fiber blanket according to claim 5, characterized in that the radius of the spinneret hole in step (3) is 0.25-1mm, and the spinneret hole
15 spacing is 2-15mm; the radius of the ventilation hole in step (3) is 1-20mm, and the ratio of the spinneret hole diameter to the distance between the first layer spinneret hole and the second layer spinneret hole is 1:10-1:80.

7. The method for forming an auxiliary continuous alumina fiber blanket according to claim 5, characterized in that the operating frequency of the negative pressure fan in step (3) is 0.5-2Hz, and
20 the rotation speed of the negative pressure fan is 200-300rpm.

8. The method for forming an auxiliary continuous alumina fiber blanket according to claim 5, characterized in that the rotation speed of the metering pump in step (1) is 0.1-0.2rpm.

9. The method for forming an auxiliary continuous alumina fiber blanket according to claim 5, characterized in that the heat treatment in step (6) is to heat the blanket to 700°C at a relatively low
25 rate and keep the temperature for 30 minutes; then, the blanket is heated from 700°C to 800, 900, 1000, 1100 and 1200°C in sequence at a relatively high heating rate, kept at the temperature for 30 minutes, taken out, and cooled at room temperature to obtain a continuous alumina fiber blanket with a final thickness of 5-150mm.

10. The method for forming auxiliary continuous alumina fiber blanket forming according to
30 claim 5, characterized in that the lateral spacing of the spinneret holes in step (3) is 2-15mm, and the longitudinal spacing is 2-15mm.