

Description

The molding technique and mould making process for a flame retardant bending beam with a 3D nylon air duct

Technology field

This invention relates to a molding technique and mould making process which specifically relates to a flame retardant bending beam with a 3D nylon air duct.

Background technology

Compared with traditional metal, carbon fiber composite has much excellent performance, like light weight, higher strength, stable measurement, excellent chemical stability, therefore it can be used in more and more fields, and the production process also tends to be mature. According to the different application and structure of the product, there are also many different carbon fiber composites molding technique. Compared with traditional metal high-speed rail bending beam, composite material flame retardant bending beam made with 3D nylon air molding technique exempts itself from making openings, bending, welding or other complex processes. The product shape after molding process is guaranteed with unified standard (mould guarantee) which hardly can be realized on metal products after hand work of opening, bending or welding.

The invention mainly solves the problems of complicated

manufacturing structure, unique shape, reduced weight, and enhanced mechanical properties.

Invention content

In view of above problems, the goal of this invention is to provide a molding technique and mould making process which specifically relates to a flame retardant bending beam with a 3D nylon air duct.

The invention adopts the following technical solution to solve the above technical problems: a molding technique for a flame retardant bending beam with a 3D nylon air duct, which includes the following steps:

Step 1: To make a 3D nylon air duct; cutting the 300–500mm width nylon air duct into a prototype of mould with the size and shape of inner cavity; and then using sealing machine to seal up periphery of prototype air duct while leaving the air outlet open;

Step 2: The selection of carbon fiber flame retardant prepreg material; Flame retardant carbon fiber prepreg is is one kind of material that flame retardant epoxy resin to prepreg with carbon fiber precursor;

Step 3: Lamination and premolding of prepreg; after correct size cutting, carbon fiber preregs are pasted both into mould cavity and on the slider block according to lamination design sequence. During operation, preregs need to be pressed tightly with the plastic scraper;

Then place 3D nylon air duct into the hollow space in the middle of bending beam, and then pump safety air pressure to 3D nylon air duct to check if air duct ventilates normally: pressure is 0.1 MPa

Step four: Curing and molding of the composite material:

After closing the product moulds that referred in Step three, the whole unit is put in the hot pressing machine to thermoform under regulated standard temperature and pressure parameters setted for bending beam molding. Specific parameters are as following:

Curing time: 3600S, pressure is 1.2mpa

Curing temperature: $145\pm 5^{\circ}\text{C}$

External pressure of the machine: 4 MPa

3D nylon air duct pressing program: 0-50 S, pressure slowly be increased to 0.2Mpa; 50-300S, pressure slowly be increased to 0.6Mpa;300-600s, pressure slowly be increased to 1.0Mpa;600-3600s, pressure slowly be increased to 1.2Mpa.

In a specific example of this invention, the thickness of 3D nylon air duct is different according to the shape and size of products: 20um, 40um, 60um.

In a specific example of this invention, during lamination, all layers need to be pressed tightly with a plastic scraper whose material can be: PET, PTFE, PVC, and mixtures of rubber with one or more.

The mould making in the process of using a 3D nylon air duct to make a flame retardant bending beam: The mould consists of upper part, lower part, 2 pieces of slide blocks and air nozzle device that locates on the lower part mould. The 3D nylon air duct nozzle is placed at the mouth of the air nozzle device. The lower part mould works as a reference for product placement, and 2 pieces of slide blocks will be placed on both

sides of the lower mould, and then upper mould be placed and fixed above the lower mould as well as slide blocks in order to undergo the molding process.

In a specific example of this invention, upper mould includes upper mould main body with the arc space; cutting board is installed on arc space' s left and left sides, and dam board on its upper and lower sides. One of the two dam boards is built with steps, and the other dam board is built with groove that matches with lower mould. The flame retardant bending beam to be produced is within the cutting board and the dam board. The whole upper mould is integrally formed.

In a specific example of this invention, the length range of the arc groove is 380-440mm, and the width range of the arc groove is 2-4mm.

In a specific example of this invention, the lower mould, which is a reference position to place the product, consists of the lower mould base, steps on both upper and lower and also convex part in middle of the two steps. The air nozzle opening is cut on one of the steps. There is convex strip on lower mould which matches to the groove on the slide block. The whole lower mould is integrally formed. Edge border is built at the joints between the step of air nozzle opening and lower mould base.

In a specific example of this invention, the structures of the two slide blocks are completely symmetrical. The slider block comprises a convex surface and another convex part; slide block has screw holes on its side which enable it to be locked tightly on the lower mould with screws.

In a specific example of this invention, the nylon air duct is made into 3D shape that matches the interior space of bending beam. During the process of carbon fiber composites pressing molding, 3D nylon air duct is used as an inner tank and put inside the mould cavity that laminated with carbon fiber composites, and the high-speed rail bending beam with carbon fiber composite is integrally formed when air pressure is bumped inside the product through the air nozzle.

The positive progresses of this invention lie in: the molding technique and mould making process of a flame retardant bending beam with 3D nylon air duct have the following advantages: the invention is to make a kind of high strength high-speed rail flame retardant bending beam by using 3D nylon air duct molding technique. During thermal molding, 3D nylon air duct is used to assist carbon fiber prepreg with press molding process. The process involves a 3D nylon air duct production, mainly used in assisting composites products with complicated shape structure. Compared with traditional metal molded bending beam, the high strength flame retardant bending beam made with 3D nylon air duct technique can achieve the same flame retardant effect with advantages of simple operation, flexible in product shape, higher strength, lighter weight and corrosion resistance.

Description of Figures

In this invention, Figure 1 is the overall structural diagram of mould making process to produce flame retardant bending beam with 3D nylon air

duct.

Figure 2-1 is the three dimensional diagram of the whole upper mould structure in this invention.

Figure 2-2 is the main view of the whole upper mould structure in this invention.

Figure 2-3 is the left view of the whole upper mould structure in this invention.

Figure 2-4 is the bottom view of the whole upper mould structure in this invention.

Figure 3-1 is the three dimensional diagram of the whole lower mould structure in this invention

Figure 3-2 is the main view of the whole lower mould structure in this invention.

Figure 3-3 is the left view of the whole lower mould structure in this invention.

Figure 3-4 is the bottom view of the whole lower mould structure in this invention.

Figure 4-1 is the three dimensional diagram of the whole slider block structure in this invention.

Figure 4-2 is the main view of the whole slider block structure in this invention.

Figure 4-3 is the left view of the whole slider block structure in this invention.

Figure 4-4 is the bottom view of the whole slider block structure

in this invention.

Figure 5 is the structural diagram of the flame retardant bending beam made with moulds in this invention.

Specific implementation

A preferred example is given together with following figures to describe technical solution of this invention in detail.

It is a kind of molding technique to produce a flame retardant bending beam with a 3D nylon air duct, it includes the following steps:

Step 1: To make a 3D nylon air duct; cutting the 300–500mm width nylon air duct into a prototype of mould with the size and shape of inner cavity; and then using sealing machine to seal up periphery of prototype air duct while leaving the air outlet open;

Step 2: The selection of carbon fiber flame retardant prepreg material; The flame retardant carbon fiber prepreg is one kind of material that the flame retardant epoxy resin prepreg with carbon fiber precursor;

Step 3: Lamination and premolding of prepreg; after correct size cutting, carbon fiber prepregs are pasted both into cavity and on the slider block according to lamination design sequence. During operation, prepregs need to be pressed tightly with a plastic scraper;

Then place 3D nylon air duct into the hollow space in middle of bending beam, and then pump safety air pressure to 3D nylon air duct to check if air duct ventilates normally: pressure is 0.1 MPa

Step four: Curing and molding of the composite material:

After lamination inspection being approved, product moulds will be closed(make sure no lamination comes out of mould), the whole mould unit is putted in the hot pressing machine to thermoform under regulated standard temperature and pressure parameters setted for bending beam molding. After reaching the curing time, pull the mould out from the hot pressing machine, and put it on cooling table for mould cooling. After the mould get cold, product can be taken out from mould. Then we have the high strength flame retardant bending beam 5 in Figure 5. Specific parameters are as following:

Curing: 3600S, kept pressure of 1.2mpa

Curing temperature: $145\pm 5^{\circ}\text{C}$

External pressure of the machine: 4 MPa

3D nylon air duct pressing program: 0-50 S, pressure slowly increased to 0.2Mpa; 50-300S, pressure slowly increased to 0.6Mpa; 300-600s, pressure slowly increased to 1.0Mpa;600-3600s, pressure slowly increased to 1.2Mpa.

The material used for the product is a high strength, high modulus carbon fiber composite, and the flame retardant effect can be achieved as well. Compared with the bending beam in metal, carbon fiber composites is totally with a weight loss of40%.

The thickness of 3D nylon air duct is different according to the shape and size of products: 20um, 40um, 60um.

During lamination, all layers need to be pressed tightly with a plastic scraper whose material can be: PET, PTFE, PVC, or mixtures of

rubber with one or more.

Figure 1 is the overall structural diagram of mould making process to produce flame retardant bending beam with 3D nylon air duct. As shown in Figure 1, the mould consists of upper mould 1, lower mould 2, slider block 3, air nozzle device 4, air nozzle device opening 4 is located on a lower mould 2, the slider block 3 includes two parts; 3D nylon air duct nozzle is placed at the air nozzle device opening 4; lower mould 2 works as a product placement benchmark, two slider block 3 are placed on the left and right of the lower mould 2; then cover and fix the upper mould 1 on both the lower mould 2 and two slider block 3 to carry out the molding of the flame retardant bending beam.

Figure 2-1 is the three dimensional diagram of the whole upper mould structure in this invention, Figure 2-2 is the main view of the whole upper mould structure in this invention, Figure 2-3 is the left view of the whole upper mould structure in this invention, Figure 2-4 is the bottom view of the whole upper mould structure in this invention, As shown from figure 2-1 to 2-4, the structural characteristics of the upper mould is to guarantee the basic shape and appearance on upper surface of flame retardant bending beam; there are two shape following grooves on upper mould to work as reinforce strips. As shown in following Figure, upper mould includes main body 101 with the arc space 104; there is arc groove 102 on the upper mould main body 101; cutting board 103 is installed on arc space 104's left and left sides, and dam board 105 on its upper and lower sides. One of the two dam boards 105 is built with steps 106, and

the other dam board 105 is built with groove 107 that matches with lower mould 2. The flame retardant bending beam to be produced is within the range of cutting board 103 and the dam board 105. The whole upper mould 1 is integrally formed.

In the specific production process, the length range of the arc groove 102 is 380-440mm, and the width range of the arc groove 102 is 2-4mm.

Figure 3-1 is the three dimensional diagram of the whole low mould structure in this invention, Figure 3-2 is the main view of the whole low mould structure in this invention, Figure 3-3 is the left view of the whole low mould structure in this invention, Figure 3-4 is the bottom view of the whole low mould structure in this invention. As shown from figure 3-1 to 3-4, the structural characteristics of the lower mould 2 is to guarantee the basic shape and appearance on upper surface of flame retardant bending beam; the lower mould 2, which is a position reference to place the product, consists of the lower mould base 205, steps 201 and 202 on both upper and lower ends and convex part 203 in middle of the two steps. The air nozzle opening 4 is cut on one of the steps. There is convex strip 205 on lower mould 2 which matches to the groove 304 on the slide block 3. The whole lower mould 2 is integrally formed. Edge border 206 is built at the joints of the step 202 at the air nozzle opening 4 and lower mould base 205. (When closing upper and lower moulds, edge border 206 matches with upper mould groove 107)

Figure 4-1 is the three dimensional diagram of the whole slide block

structure in this invention, Figure 4-2 is the main view of the whole slide block structure in this invention, Figure 4-3 is the left view of the whole slide block structure in this invention, Figure 4-4 is the bottom view of the whole slide block structure in this invention. As shown from figure 4-1 to 4-4, the structural characteristics of the sliding block 3 is to guarantee the basic shape and appearance on two sides of the product (flame retardant bending beam). The structure of the two slide blocks 3 is completely symmetrical; the slider block 3 comprises a convex surface 301, convex part 302, and the screw hole 303 on the side; the sliding block 3 is locked on the lower mold 2 through the screw through the screw hole 303

All the above information is used to show and describe the basic principles, main features and advantages of this invention. The technician of this field should understand that the invention is not restricted to the examples above. Above examples and the specification are just used to describe the principle of the invention. Based on the principle and scope of this invention, various changes and improvement can be done, and these changes and improvements are included in the scope of the present invention. The scope of this invention which requires to be protected is defined in the Claim of Rights attached and its equivalent definition.

Claims

1. A 3D nylon air duct molding method for making a flame retardant bending beam, the method comprising:

Step 1: making a 3D nylon air duct, including:

cutting a 300-500mm width nylon air duct into a prototype with size and shape of an inner cavity of a mould; and

using a sealing machine to seal up periphery of the prototype nylon air duct while leaving an air outlet open to obtain the 3D nylon air duct;

Step 2: preparing a carbon fiber flame retardant prepreg, wherein the carbon fiber flame retardant prepreg comprises a carbon fiber precursor pre-impregnated with a flame retardant epoxy resin;

Step 3: laminating and pre-molding the carbon fiber flame retardant prepreg, including:

cutting the carbon fiber flame retardant prepreg into correct size and pasting the carbon fiber flame retardant prepreg into the inner cavity of the mould in layers according to lamination design sequence, wherein during the pasting, the layers of the carbon fiber flame retardant prepreg are pressed tightly with a plastic scraper;

placing the 3D nylon air duct into a middle of the inner cavity of the mould, and then pumping safety air pressure into the 3D nylon air duct to check if the 3D nylon air duct ventilates normally, wherein the safety air pressure is 0.1 MPa;

Step 4: curing and molding the carbon fiber flame retardant prepreg, including:

closing the mould from Step 3,

putting the closed mould in a hot pressing machine to thermoform under regulated standard temperature and pressure parameters for bending beam molding, wherein the parameters are as following:

curing time: 3600S,

curing temperature: $145\pm 5^{\circ}\text{C}$,

external pressure of the hot pressing machine: 4 MPa,

3D nylon air duct pressing program:

0-50s, with a pressure within the 3D nylon air duct slowly increased to 0.2Mpa;

50-s, with the pressure within the 3D nylon air duct slowly increased to 0.6Mpa;

300-600s, with the pressure within the 3D nylon air duct slowly increased to 1.0Mpa; and

600-3600s, with the pressure within the 3D nylon air duct slowly increased to 1.2Mpa.

2. The method of Claim 1, wherein the thickness of the 3D nylon air duct is different according to shape and size of mould products, wherein the thickness is any one of $20\mu\text{m}$, $40\mu\text{m}$, or $60\mu\text{m}$.

3. The method of Claim 1, wherein a material of the plastic scraper can be PET, PTFE, PVC, and mixtures of rubber with one or more.

4. The method of Claim 1, wherein the mould consists of:

an upper mould,

a lower mould,

two slide blocks; and

an air nozzle device located on the lower mould,

wherein the air outlet of the 3D nylon air duct is placed at a mouth of the air nozzle device,

the lower mould works as a reference for product placement,

the two slide blocks are placed on both sides of the lower mould, and

the upper mould is placed and fixed above the lower mould and the two slide blocks during the molding process.

5. The method of Claim 4, wherein the upper mould includes:

an upper mould main body with an arc space;

an arc groove on the upper mould main body;

two cutting boards installed on a left and right of the arc space respectively; and

two dam boards installed on a upper and lower side of the arc space respectively; wherein

one of the two dam boards is built with steps, and the other dam board is built with an upper mould groove that matches with the lower mould;

the flame retardant bending beam to be produced is within a range defined by the cutting boards and the dam boards; and

the whole upper mould is integrally formed.

6. The method of Claim 5, wherein the length of the arc groove ranges between 380-440mm, and the width of the arc groove ranges between 2-4mm.

7. The method of Claim 4, wherein the lower mould, being the reference for product placement, comprises:

a lower mould base,

2 steps on an upper and lower end of the lower mould base respectively, the air nozzle device being on one of the 2 steps;

a convex part in middle of the 2 steps;

a convex strip which matches to a corresponding groove on one of the slide blocks; and

an edge border built at joints between the step with the air nozzle device and the lower mould base.

8. The method of Claim 4, wherein the two slide blocks are completely symmetrical, each slider block comprises a convex surface and a convex part, and a

plurality of screw holes on a side of the slider block which enables the slider block to be locked tightly to the lower mould with screws.