

【DESCRIPTION】

【Invention Title】

INTEGRATED COMPOSITE-MATERIAL VEHICLE BODY FOR A
TRANSPORTATION VEHICLE, AND A PRODUCTION METHOD THEREFOR

5 【Technical Field】

The present invention relates to an integrated
composite-material vehicle body with a good surface state
manufactured by a simultaneous curing method using a
composite material, and to a production method therefor.

10

【Background Art】

In general, a vehicle body for transport vehicles, such
as buses or trains, is formed in such a way that the side
shell, the front shell, the rear shell and the ceiling shell
15 are mechanically joined or welded to a frame. The mechanical
joining and welding techniques are labor-intensive and takes
much production time. Joined parts through the mechanical
joining need repair and may cause noise and be exposed to
insulation since joining tools are loosened as time goes by.
20 Moreover, welded parts may be weaken and easily break as time
goes by.

As another technique, there is a method to bond a shell
of each part to the frame, but it has various merits and
demerits in comparison with the mechanical joining method and
25 the welding method. Such a method has several problems in
that it takes much time to bond, in that there is a need to
review reliability of bonding strength in the shell of each
part, and in that the lightweight efficiency is weak.

As a technology according to a prior art, an integrated
30 composite-material vehicle body includes an outer skin
material, a frame, a core material, and an outer skin

material. In case where the vehicle body is manufactured by a simultaneous curing method, since the outer skin material and the inner skin material are respectively made using flexible prepregs at the beginning of molding, in the course
5 of vacuum autoclave molding, if a honeycomb core is used as the core material, the outer skin material and the inner skin material are sucked into a honeycomb space, and it causes a bad surface.

In order to solve the above problems of the prior arts,
10 the vehicle bodies according to the prior arts are manufactured through the steps of laminating and curing the outer skin material, inserting the frame and the core material using an adhesive sheet, and laminating and curing the inner skin material.

Accordingly, molded products using the composite
15 material have a problem in that it is difficult in commercialization and expensive despite their excellent characteristics due to their expensive manufacturing costs. Furthermore, the molded product using the composite material
20 has another problem in that the surface of the product is bad and even the next painting process requires significant costs since there is no technology of the simultaneous curing method.

25 **【Disclosure】**

【Technical Problem】

Accordingly, the present invention has been made in an effort to solve the above-mentioned problems occurring in the prior arts, and it is an object of the present invention to
30 provide an integrated composite-material vehicle body, which is reduced in a manufacturing period of time and

manufacturing costs, and has a good surface state by being manufactured by a simultaneous curing method.

【Technical Solution】

5 To accomplish the above object, according to the present invention, there is provided an integrated composite-material vehicle body with a good surface state by being manufactured through the steps of using an outer skin material that a sheet metal plate is adhered to or inserted into a composite
10 material, laminating a core material and an inner skin material, and curing them simultaneously.

That is, in an aspect of the present invention, there is an integrated composite-material vehicle body for transport vehicles, which is obtained by integral forming in the shape
15 of the vehicle body, using a sandwich panel comprising: a core material; an inner skin material which is made using a prepreg of reinforcing fibres impregnated with a synthetic resin and semi-cured, and which is adhered to one side of the core material; an outer skin material which is made using a
20 prepreg of reinforcing fibres impregnated with synthetic resin and semi-cured, and which is adhered to the other side of the core material; and a sheet metal material which is inserted between the core material and the outer skin material.

25 In this instance, the sheet metal material includes a plurality of holes formed therein.

As another aspect of the present invention, provided is an integrated composite-material vehicle body for a transportation vehicle, which is obtained by integral forming
30 in the shape of the vehicle body, using a sandwich panel comprising: a core material; an inner skin material which is made using a prepreg of reinforcing fibres impregnated with a

synthetic resin and semi-cured, and which is adhered to one side of the core material; an outer skin material which is made using a plurality of prepregs of reinforcing fibres impregnated with synthetic resin and semi-cured, and which is
5 adhered to the other side of the core material; and a sheet metal material which is inserted between the plural prepregs constituting the outer skin material.

In this instance, the sheet metal material comprises a plurality of holes formed therein.

10 As a further aspect of the present invention, provided is a method of producing an integrated composite-material vehicle body for a transportation vehicle, comprising the steps of: producing a mold in the same form and size as the vehicle body in such a way that a front head part, a rear
15 head part, a ceiling, and side parts of the vehicle body can be produced integrally; laminating an outer skin material, which is made using a prepreg of reinforcing fibres impregnated with synthetic resin and semi-cured, in the inside surface of the mold; laminating a sheet metal material
20 or a porous sheet metal material on the inside surface of the outer skin material; laminating a core material on the inside surface of the sheet metal material; laminating an inner skin material, which is made using a prepreg of reinforcing fibres impregnated with synthetic resin and semi cured, on the
25 inside surface of the core material; and molding the above laminated materials in an autoclave.

As a still further aspect of the present invention, provided is a method of producing an integrated composite-material vehicle body for a transportation vehicle,
30 comprising the steps of: producing a mold in the same form and size as the vehicle body in such a way that a front head part, a rear head part, a ceiling, and side parts of the

vehicle body can be produced integrally; laminating a first outer skin material, which is made using a prepreg of reinforcing fibres impregnated with matrix materials and semi-cured, on the inside surface of the mold; laminating a
5 sheet metal material or a porous sheet metal material on the inside surface of the first outer skin material; laminating a second outer skin material, which is made using a prepreg of reinforcing fibres impregnated with synthetic resin and semi-cured, on the inside surface of the mold; laminating a core
10 material on the inside surface of the second outer skin material; laminating an inner skin material, which is made using a prepreg of reinforcing fibres impregnated with synthetic resin and semi cured, on the inside surface of the core material; and molding the above laminated materials in
15 an autoclave.

【Advantageous Effects】

As described above, the present invention can solve the problems of the complexity in process and the badness of the
20 surface state due to lack in technical skill of the simultaneous curing method.

Additionally, the present invention can enhance brittleness and fatigue characteristics of the composite material.

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【Description of Drawings】

FIG. 1 is a perspective view showing the overall appearance of a vehicle body cured simultaneously according to a preferred embodiment of the present invention.

30 FIG. 2 is a sectional view of the vehicle body cut along the line of A-A' of FIG. 1.

FIG. 3 is an enlarged sectional view of the area B of

FIG. 2.

FIG. 4 is an enlarged sectional view showing a structure of a vehicle body cured simultaneously according to another preferred embodiment of the present invention.

5 FIG. 5 is a perspective view showing a laminated structure of a composite material according to a further preferred embodiment of the present invention.

【Mode for Invention】

10 Reference will be now made in detail to the preferred embodiment of the present invention with reference to the attached drawings. While the invention has been described in connection with preferred embodiments, it is not intended to limit the scope of the invention to the particular
15 embodiments.

FIG. 1 is a perspective view showing the overall appearance of a vehicle body cured simultaneously according to a preferred embodiment of the present invention.

The integrated composite-material vehicle body according
20 to the present invention is a structure effective to enhance the rigidity and insulation strength and reduce noise since a front head part 1, a rear head part 2, a ceiling 3 and a side part 4 have an integrated structure without any joint through the simultaneous curing method.

25 FIG. 2 is a sectional view of the vehicle body, which is cut along the line of A-A' of FIG. 1.

In FIG. 2, the integrated composite-material vehicle
body 10 has a sandwich structure that honeycomb or foam is
used as a core material 11, and in detail, has a
30 configuration that an outer skin material 13, a sheet metal material 14, the core material 11, and an inner skin material 12 are laminated in order from the inside out.

FIG. 3 is an enlarged sectional view of the area B of FIG. 2.

As shown in FIG. 3, the outer skin material 13 and the inner skin material 12 are made using a prepreg of reinforcing fibres impregnated with synthetic resin and semi-cured, and laminated in a single layer or a multi-layer in consideration of required strength and thickness.

In the present invention, synthetic resin impregnated in the prepreg is one selected from epoxy resin, phenol resin, unsaturated polyester resin, vinyl ester resin, melamine resin, urea resin, and so on, and the reinforcing fibres are one-way or two-way fabrics woven with carbon fiber, glass fiber, Kevlar fiber, boron fiber, and so on.

In order to enhance lightweight efficiency, insulation, soundproof, and rigidity of the structure, the core material 11 applied to the integrated composite-material vehicle body of the sandwich structure is made of one of various kinds of foam, such as urethane foam, PE foam, and PVC foam, one of various kinds of honeycomb, such as aluminum honeycomb and Nomex honeycomb, aluminum foam, and so on.

According to the prior arts, when the multi-component molding is carried out, the outer skin material is sunken into holes of the core material, under the influence of holes of the foam or holes of the honeycomb structure, which constructs the core material, and it causes a non-uniform surface, and accordingly, it requires lots of time and labor costs in the next painting process.

In the present invention, the sheet metal material 14 is interposed between the outer skin material 13 and the core material 11 or between first and second outer skin materials 13a and 13b constructing the outer skin material 13 as shown in FIG. 4 in such a way as to exist near to the core material

11. The sheet metal material 14 with a firm surface prevents that the prepreg is sunken to the core material 11 having holes for the lightweight efficiency to thereby remove the unsmooth surface.

5 The sheet metal material 14 is 10 μ m to 10mm in thickness and is made of steel, stainless steel, aluminum, copper, galvanized iron sheet, or the like.

FIG. 4 is an enlarged sectional view showing a structure of a vehicle body cured simultaneously according to another
10 preferred embodiment of the present invention.

FIG. 4 illustrates an example that the sheet metal material 14 is interposed between the first and second outer skin materials 13a and 13b, and in this instance, it is preferable that the sheet metal material 14 is laminated near
15 to the core material 11 and the first outer skin material 13a of the outer skin material 13 is thicker than the second outer skin material 13b.

The outer skin material 13, which is made using the composite material, and the sheet metal material 14 are used
20 in a hybrid structure. The inner skin material 11 is located inside the integrated composite-material vehicle body, and it is advantageous not to use the sheet metal material 14 for the lightweight efficiency.

FIG. 5 is a perspective view showing a laminated
25 structure of the composite material according to a further preferred embodiment of the present invention.

In FIG. 5, a sheet metal material 14 having a plurality of holes 14a formed therein. The holes 14a of the sheet metal material 14 serve to remove bubbles by inducing a free
30 flow of resin generated due to rising of temperature during curing reaction.

A production method of the integrated composite-material

vehicle body according to the present invention uses an autoclave device, which keeps a constant temperature and a constant pressure or adjusts changes in temperature and pressure at regular intervals.

5 First, it is preferable to laminate the outer skin material including the sheet metal material in a mold of a vehicle body shape and apply pressure in a vacuum condition to compress it. After the compression is released and the core material and the inner skin material are laminated on
10 the inside surface of the outer skin material in order, they are wrapped with a bag and compressed again, and then, molded in an autoclave by the simultaneous curing method, whereby the integrated composite-material vehicle body with the uniform surface state can be produced.

15 In detail, according to the preferred embodiment, first, produce a mold in the same form and size as the vehicle body in such a way that the front head part, the rear head part, the ceiling, and the side part constituting the vehicle body can be manufactured integrally.

20 Next, laminate the outer skin material, which is made using the prepreg of reinforcing fibres impregnated with synthetic resin and semi cured, on the inside surface of the mold.

25 After that, laminate the sheet metal material or the sheet metal material having the plural holes on the inside surface of the outer skin material.

 Next, laminate the core material on the inside surface of the sheet metal material.

30 Next, laminate the inner skin material, which is made using the prepreg of reinforcing fibres impregnated with synthetic resin and semi cured, on the inside surface of the core material.

Finally, mold the above laminated materials in the autoclave.

As described above, the vehicle body according to the present invention is molded in such a way that the outer skin
5 material, the sheet metal material, the core material and the inner skin material are laminated to the inside of the mold in order.

As another preferred embodiment, in the above-mentioned embodiment, the sheet metal material is located and laminated
10 between outer skin materials, and then, the core material and the inner skin material are laminated in order and molded.

While the invention has been described with reference to certain embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents
15 may be substituted without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from its scope. Therefore, it is intended that the invention not be limited to the
20 particular embodiment disclosed, but that the invention will include all embodiments falling within the scope of the appended claims.

【Industrial Applicability】

25 As described above, the present invention provides the integrated composite-material vehicle body with a good surface state manufactured by the simultaneous curing method using the composite material and the method for producing the same, and the vehicle body and the production method
30 according to the present invention can be widely used in manufacturing transport vehicles, such as trains, buses, and so on.

【CLAIMS】

【Claim 1】

An integrated composite-material vehicle body for a
5 transportation vehicle, wherein it is obtained by integral
forming in the shape of the vehicle body, using a sandwich
panel comprising: a core material (11); an inner skin
material (12) which is made using a prepreg of reinforcing
fibres impregnated with a synthetic resin and semi-cured, and
10 which is adhered to one side of the core material (11); an
outer skin material (13) which is made using a prepreg of
reinforcing fibres impregnated with synthetic resin and semi-
cured, and which is adhered to the other side of the core
material (11); and a sheet metal material (14) which is
15 inserted between the core material (11) and the outer skin
material (13).

【Claim 2】

The integrated composite-material vehicle body according
to claim 1, wherein the sheet metal material (14) comprises a
20 plurality of holes (14a) formed therein.

【Claim 3】

An integrated composite-material vehicle body for a
transportation vehicle, wherein it is obtained by integral
forming in the shape of the vehicle body, using a sandwich
25 panel comprising: a core material (11); an inner skin
material (12) which is made using a prepreg of reinforcing
fibres impregnated with a synthetic resin and semi-cured, and
which is adhered to one side of the core material (11); an
outer skin material (13) which is made using a plurality of
30 prepregs of reinforcing fibres impregnated with synthetic
resin and semi-cured, and which is adhered to the other side
of the core material (11); and a sheet metal material (14)

which is inserted between the plural prepregs constituting the outer skin material (13).

【Claim 4】

5 The integrated composite-material vehicle body according to claim 3, wherein the sheet metal material (14) comprises a plurality of holes (14a) formed therein.

【Claim 5】

10 A method of producing an integrated composite-material vehicle body for a transportation vehicle, comprising the steps of:

producing a mold in the same form and size as the vehicle body in such a way that a front head part, a rear head part, a ceiling, and side parts of the vehicle body can be produced integrally;

15 laminating an outer skin material, which is made using a prepreg of reinforcing fibres impregnated with synthetic resin and semi-cured, in the inside surface of the mold;

20 laminating a sheet metal material or a porous sheet metal material on the inside surface of the outer skin material;

laminating a core material on the inside surface of the sheet metal material;

25 laminating an inner skin material, which is made using a prepreg of reinforcing fibres impregnated with synthetic resin and semi cured, on the inside surface of the core material; and

molding the above laminated materials in an autoclave.

【Claim 6】

30 A method of producing an integrated composite-material vehicle body for a transportation vehicle, comprising the steps of:

producing a mold in the same form and size as the vehicle body in such a way that a front head part, a rear head part, a ceiling, and side parts of the vehicle body can be produced integrally;

- 5 laminating a first outer skin material, which is made using a prepreg of reinforcing fibres impregnated with matrix materials and semi-cured, on the inside surface of the mold;

- 10 laminating a sheet metal material or a porous sheet metal material on the inside surface of the first outer skin material;

laminating a second outer skin material, which is made using a prepreg of reinforcing fibres impregnated with synthetic resin and semi-cured, on the inside surface of the mold;

- 15 laminating a core material on the inside surface of the second outer skin material;

- 20 laminating an inner skin material, which is made using a prepreg of reinforcing fibres impregnated with synthetic resin and semi cured, on the inside surface of the core material; and

molding the above laminated materials in an autoclave.