

THERMALLY CONDUCTIVE COMPOSITE ELEMENT BASED ON
EXPANDED GRAPHITE

The present invention relates to a thermally conductive composite element based on expanded graphite, a method for the production thereof and also the use thereof.

Thermally conductive composite elements of this kind are used as thermally conductive elements in surface heating and surface cooling, such as in underfloor, wall and ceiling heating, for example, in order to distribute the coolness emitted by the surface cooling or the heat emitted by the surface heating in the surface uniformly and emit it into the space surrounding said surface, in order thereby to achieve a pleasant indoor temperature. Composite elements of this kind usually comprise a thermally conductive plate in which a pipe body through which a heat transfer medium can flow, such as a pipe coil or pipe meander, for example, is embedded. Alternatively to this, thermally conductive plates of this kind may also be used without pipe bodies embedded therein, such as in the case of concrete core activation, for example, in which thermally conductive plates are arranged beneath a concrete floor, in which the pipe body through which the heat transfer medium can flow is arranged.

In order to achieve good heat distribution in the surface, thermally conductive plates of this kind frequently contain expanded graphite. Expanded graphite is produced by the expansion of natural graphite, in that an intercalation compound such as sulphuric acid, for example, is initially incorporated in graphite, before the graphite treated in this manner is expanded by heating by a factor of 200 to 500. Graphite is known to comprise individual layers of graphene in which carbon atoms are covalently connected to one another,

whereas the individual layers are only weakly connected to one another. Due to this structure, graphite exhibits anisotropic properties and, in particular, an anisotropic heat conductivity, wherein the heat conductivity in the plane of graphite layers is greater than in the direction perpendicular thereto. Following expansion, the graphite is compressed again, but to a lower density than the starting density, so that the layers of graphene in the graphite are preferably arranged perpendicularly to the direction of influence of the pressure and the individual graphite aggregates formed during expansion are hooked to one another, in order thereby to produce self-supporting, planar plates without the addition of binding agents. Plates of this kind exhibit a high degree of anisotropy in relation to heat conductivity and high heat conductivity in the plane or surface of the plate. In addition, expanded graphite exhibits a certain heat storage capacity on account of its high heat conductivity and high porosity. Due to their high heat conductivity in the plane and their heat storage capacity, heat conductivity plates of this kind arranged above a pipe body through which a heat transfer medium flows, such as a pipe meander or pipe spiral, and made of expanded graphite achieve a uniform heat distribution even over large surfaces and emit the heat supplied to them by the pipe body uniformly into the space surrounding them.

However, expanded graphite is comparatively soft, which is why existing thermally conductive plates made of expanded graphite exhibit low strength and low stiffness. Although these plates are self-supporting in principle, they are not therefore suitable for use in the construction sector without additional reinforcement.

In order to increase the stiffness of thermally conductive plates made of expanded graphite, it has already been proposed that one or a plurality of organic filling materials should be added to the expanded graphite. A thermally conductive plate is known from DE 10 2009 055 442 A1, for example, which contains a consolidated mixture of graphite particles and plastic particles, wherein the graphite particles are preferably made of expanded graphite. In order to achieve sufficient stiffness, the mixture preferably contains 20 to 50 % by wt. plastic particles such as polyvinyl chloride particles, for example. Due to the high proportion of organic filling material particles, these thermally conductive plates exhibit a high fire load, however, which makes these unsatisfactory for safety reasons.

A problem addressed by the present invention is therefore that of providing a plate-shaped, thermally conductive building element which exhibits outstanding heat-conductivity, particularly in the plane, high strength and also high stiffness, so that this can be used as a thermally conductive element in surface cooling and surface heating, such as in underfloor, wall and ceiling heating, for example.

According to the invention, this problem is solved by the provision of a thermally conductive composite element which comprises at least one mould containing expanded graphite and also at least one textile fabric arranged on at least one side of the mould, wherein the at least one textile fabric is connected to the mould by means of an inorganic adhesive.

This solution is based on the surprising finding that by adhering a textile fabric to at least one side of a mould based on expanded graphite, the stiffness of the

mould made of expanded graphite can be substantially increased, without a stiffening material, such as an organic filling material, for example, having to be added to the expanded graphite. This is based on the fact that due to the low elasticity with simultaneously high tensile strength of the fibres contained in the textile fabric, the bend resistance of the mould can be substantially improved, because during the action of bending forces on the composite element, the fibres in the textile fabric are stressed and due to their low elasticity and high tensile strength, they absorb the bending forces without expanding significantly. Because the stiffness of the mould is thereby significantly increased through the provision of the textile fabric on at least one side of the mould based on expanded graphite, in the case of the thermally conductive composite element according to the invention, the addition of organic filling materials which exhibit a high fire load, as shown, to the expanded graphite can be dispensed with. Since in addition to the adhesion of the textile fabric to the expanded graphite mould, an inorganic adhesive is used which exhibits no fire load, a thermally conductive composite element is obtained, which exhibits no fire load or possibly only a very low fire load. In addition, the composite element according to the invention is characterized on account of the expanded graphite contained in the mould by outstanding heat conductivity, particularly in the plane, and on account of the comparatively low density of expanded graphite by a comparatively low weight. Due to its low fire load, its outstanding heat conductivity, particularly in the plane, its high strength, its low weight and also its great stiffness, the composite element according to the invention is outstandingly suitable for use as, among other things, a thermally conductive element in surface cooling and surface

heating, such as in underfloor, wall and ceiling heating, for example.

Textile fabrics within the meaning of the present invention are all fabrics which contain fibres.

As described, the thermally conductive composite element according to the invention is particularly suitable for use in surface cooling or in surface heating, such as in underfloor, wall or ceiling heating, in particular. To this end, the composite element according to the invention comprises a pipe body through which a heat transfer medium, in other words a heating medium or a cooling medium, flows according to a preferred embodiment of the present invention, which pipe body is preferably embedded in the at least one mould containing expanded graphite. The pipe body in this case may be partially or completely embedded in the at least one mould containing expanded graphite, wherein it is preferable, however, for the pipe body to be embedded completely and at least substantially centrally in the at least one mould containing expanded graphite. If the composite element contains a plurality of moulds containing expanded graphite, such as two such moulds, for example, the pipe body may also be embedded between the two moulds, which can be achieved due to the high compressibility of expanded graphite, for example, in that the pipe body is arranged between the two moulds containing expanded graphite and the structure produced in this manner is then pressed, in order to compress the expanded graphite contained in the moulds and thereby simultaneously embed the pipe body in the expanded graphite.

The pipe body may be each pipe body customarily used in surface cooling and surface heating, such as a pipe

body configured in a meandering or spiral shape, for example. Irrespective of the concrete embodiment of the pipe body, the mould or one of the moulds surrounding the pipe body contains two holes, one of which acts as the inlet for one end of the pipe body and the other as the outlet for the other end of the pipe body.

In order to achieve good thermal conductivity between the pipe body and the expanded graphite of the at least one mould, it is proposed as a development of the basic ideal underlying the invention that the pipe body should be made of plastic, ceramic, graphite or metal, such as preferably copper, in particular.

As described above, the pipe body is purely optional, since the composite element according to the invention can also be used without pipe bodies embedded therein for air-conditioning, such as for concrete core activation, for example, in that the composite element is arranged beneath a concrete floor, for example, in which the pipe body through which the cooling or heat transfer medium can flow, is arranged.

According to the invention, the at least one mould is connected to the textile fabric via an inorganic adhesive, because inorganic adhesives have the advantage of exhibiting a high adhesive force but no fire load or else only a low fire load. All known filling materials can be used as inorganic filling materials, such as inorganic adhesives, for example, which are chosen from the group made up of silicates, colloidal silicic acid, phosphates, oxides, sulphates, borates and any mixtures of two or more of the aforementioned kinds of adhesive.

The inorganic adhesive is preferably provided between the mould and the textile fabric in a quantity of 10 to

1,000 g/m², particularly preferably of 100 to 500 g/m² and quite particularly preferably of 200 to 300 g/m², such as roughly 250 g/m², for example.

Particularly good results are obtained when the inorganic adhesive is a geopolymer and/or water glass. The geopolymers are usually silicate-based adhesives and the water glass a melt of solidified, amorphous and water-soluble sodium, lithium and potassium silicates, so that the term geopolymer includes water glass. Water glass in this case is particularly preferable for the composite element of the present invention because it is not only characterized by a high wettability on almost all surfaces but, in particular, also a high strength, high heat resistance and quick hardening. Apart from this, water glass is comparatively cheap.

As set out above, the adhesion of the at least one textile fabric to at least one side of the at least one mould based on expanded graphite increases the stiffness of the mould considerably. This effect is achieved particularly well when the at least one textile fabric is chosen from the group which comprises non-woven fabrics, non-crimp fabrics, woven fabrics, knitted fabrics, knotted fabrics, felts, paper, cardboard and any mixtures of two or more of the aforementioned kinds of fabrics. As described above, a textile fabric according to the present invention is understood to mean any fabric which contains fibres, so including paper and cardboard, which contain cellulose fibres. Good results are particularly obtained with woven fabrics and non-woven fabrics, which is why these are particularly preferred as the textile fabric according to the present invention.

In principle, the textile fabric provided in the composite element according to the invention may

contain fibres from all materials known to the person skilled in the art. Good results are particularly obtained using textile fabrics based on fibres which are chosen from the group comprising glass fibres, carbon fibres, hemp fibres, mineral fibres, cement-coated mineral fibre structures, cellulose fibres and any mixtures of two or more of the aforementioned kinds of fibres. In this case, glass fibres, carbon fibres and mineral fibres are particularly preferable due to their outstanding tensile strength, while glass fibres are quite particularly preferred due to their comparatively low price.

According to a further particularly preferred embodiment of the present invention, the at least one textile fabric contained in the composite element according to the invention is a fibreglass fabric or a non-woven fibreglass fabric.

The at least one textile fabric contained in the composite element according to the invention is preferably made from fibres exhibiting a length of 0.1 to 100 mm, preferably of 1 to 50 mm and particularly preferably of 5 to 20 mm.

According to a further preferred embodiment of the invention, the at least one textile fabric is made from fibres with a diameter of 1 to 100 μm , preferably of 5 to 50 μm and particularly preferably of 10 to 15 μm .

In order to achieve a sufficient increase in the stiffness of the at least one mould based on expanded graphite provided in the composite element according to the invention, it is proposed in a development of the basic idea underlying the invention that the at least one textile fabric exhibits a thickness of 0.1 to 1.0

mm, preferably of 0.2 to 0.8 mm and particularly preferably of 0.4 to 0.6 mm.

In order to be capable of being used as the thermally conductive element, the at least one mould containing expanded graphite, which determines the form of the composite element according to the invention, is configured at least substantially in plate form, wherein the at least one textile fabric is arranged on the upper and/or lower side of the plate-shaped mould, in other words on one of the or both largest faces of the mould.

According to the invention, the at least one mould of the composite element according to the invention contains expanded graphite, because this exhibits good heat-conductivity, in particular in the surface or plane, and also a certain heat-storage capacity. Expanded graphite within the scope of the present invention is understood to mean graphite which is expanded in comparison with untreated natural graphite. As described above, expanded graphite of this kind is produced by integrating an intercalation compound, such as sulphuric acid, for example, in graphite to begin with before the graphite treated in this manner is expanded by heating by a factor of 200 to 500, for example, and then compressed again to a smaller density than the starting density, for example, so that a self-supporting, planar mould is thereby produced with the addition of binding agents. Consequently, the expanded graphite, strictly speaking, is compressed, expanded graphite. However since the density of the compressed, expanded graphite is smaller than that of natural graphite, this graphite is generally referred to as expanded graphite.

Good results are particularly obtained when the at least one mould contains expanded graphite with a density of 0.02 to 0.5 g/cm³, preferably of 0.04 to 0.3 g/cm³ and particularly preferably of 0.05 to 0.2 g/cm³. If the density of the expanded graphite is too low, this exhibits no inherent strength, which means that the mould made from it is not dimensionally stable. On the other hand, if the density of the expanded graphite is too great, the mould resulting from it cannot be compressed.

As a development of the basic idea underlying the invention, it is proposed that the at least one mould contains expanded graphite with a surface weight of 100 to 4,000 g/cm², preferably of 350 to 3,500 g/cm² and particularly preferably of 500 to 2,000 g/cm².

According to a quite particularly preferred embodiment of the present invention, the at least one mould is made of expanded graphite, i.e. this contains no further constituents apart from expanded graphite, so in particular no constituents with a high fire load, such as organic filling materials, either.

The mould containing at least expanded graphite exhibits a thickness of 8 to 80 mm, preferably of 10 to 50 mm and particularly preferably of 12 to 25 mm.

Particularly if the composite element according to the invention comprises a pipe body, it is preferable for the composite element according to the invention to have two moulds each containing expanded graphite and particularly preferably two moulds consisting of expanded graphite, which are connected to one another via an inorganic adhesive. The high compressibility of expanded graphite means that by arranging a pipe body through which a heat transfer medium can flow between

the two moulds and pressing the assembly thereby created, an embedding of the pipe body in the expanded graphite surrounding the pipe body can easily be achieved, wherein the pipe body is preferably arranged centrally, i.e. at the interface between the two moulds. With this embodiment it is preferable for a textile fabric to be provided on the side of each of the two moulds lying opposite the pipe body, said fabric being connected to the mould in each case by means of an inorganic filling material.

According to a further preferred embodiment of the present invention, the composite element according to the invention exhibits edge protection. The provision of this kind of edge protection is not only preferred, in order to protect the edges of the composite element from mechanical damage, but in particular also to protect the composite element from moisture penetration. During its use, condensation may form on the composite element, particularly when there are rapid and large temperature changes, which condensation can get into the sides of the mould or moulds in the absence of any edge protection of this kind, where it can lead to an undesirable loss of strength in the expanded graphite.

On at least one of the edge sides of the composite element, an L-shaped component which is preferably made of metal or plastic, a U-shaped component which is preferably made of metal or plastic and/or a coating may be provided as the edge protection. These edge protection means may be connected to the mould or moulds in any manner and preferably mounted on or adhered to the composite element, wherein in the latter case a hydrophobic adhesive is particularly used as the adhesive, in order to protect the mould or moulds from the ingress of moisture via its/their edges. An

adhesive based on fluorine-containing acrylic may be used as the hydrophobic adhesive, for example. Although an organic adhesive of this kind exhibits a negligible fire load, it need only be used in a very small quantity as edge protection, so that the use thereof means that the total fire load of the composite element is barely changed.

Alternatively or in addition to this, it is also possible for the composite element to be inserted or adhered into a frame made of metal and/or non-woven fabric, in particular non-woven fibreglass or carbon fibre fabric. Particularly in the case of the aforementioned alternative, noise insulation is also achieved in addition to the edge protection.

In addition, a coating can be applied to one or a plurality of outer sides of the composite element and in particular to the at least one textile fabric, in order to adapt the composite element to customer requirements. The most common coating materials in this case are paints, varnishes, hydrophobic products, fire-protection agents and similar.

A further subject-matter of the present invention is a method of producing a thermally conductive composite element according to at least one of the preceding claims which comprises the following steps:

- i) provision of a first and a second plate-shaped premoulding, wherein the two premouldings each contain expanded graphite and are preferably made of expanded graphite,
- ii) arrangement of a pipe body through which a transfer medium can flow between the upper side of

the first premoulding and the lower side of the second premoulding,

iii) pressing of the assembly obtained in step ii),

wherein in step i) at least one textile fabric is applied to at least one of the sides of the premouldings lying opposite the pipe body in the subsequent composite element and/or following step iii) at least one textile fabric is applied to the upper side and/or lower side of the embodiment obtained in step iii).

In order to achieve a particularly good connection of the premouldings to one another and to the at least one textile fabric, it is proposed in a development of the basic idea underlying the invention that the method according to the invention should be realized in such a manner that it comprises the following steps in addition to those already described:

- a) application of an inorganic adhesive to the upper side and the lower side of the first premoulding,
- b) application of a textile fabric to the upper side or lower side of the first premoulding provided with adhesive and arrangement of a pipe body on the side of the first premoulding lying opposite the textile fabric,
- c) application of an inorganic adhesive to the upper side or the lower side of the second premoulding,
- d) application of a textile fabric to the upper side or lower side of the second premoulding provided with adhesive,

- e) arrangement of the second premoulding obtained in step d) with its side lying opposite the textile fabric downwards on the pipe body of the assembly obtained in step b) and
- f) pressing of the structure obtained in step e).

In the aforementioned embodiment, the inorganic adhesive is preferably applied to the corresponding sides of the premouldings in a full-surface manner. The premoulding in this context is understood to be a mould made of expanded graphite, wherein the expanded graphite has a smaller density than that of the expanded graphite in the final mould. The preform is changed into the final mould by pressing at step f).

A preform is preferably used in step b) and/or in step c) which exhibits two holes, one of which acts as the inlet for one end of the pipe body and the other as the outlet for the other end of the pipe body. These holes may be introduced into the preform in all manners known to the person skilled in the art, such as punching for example.

Good results are particularly obtained when two premouldings are used in step i), each of which is made of expanded graphite with a density of between 0.02 and 0.05 g/cm³.

According to a further preferred embodiment of the present invention, water glass is used in process steps a) and c) as an inorganic adhesive.

It is proposed as a development of the basic idea underlying the invention that non-woven fibreglass fabric should be used in each of the process steps b) and d) as the textile fabric.

In process step f), the structure is preferably pressed at a pressure of 0.02 to 5 MPa and preferably of 0.1 to 1 MPa.

A further subject-matter of the present invention is the use of the previously described thermally conductive composite element in surface cooling or in surface heating and preferably in underfloor, wall or ceiling heating. Moreover, the thermally conductive composite elements described can be used for the surface cooling and heating of machinery and equipment, such as photovoltaic cells, temperature chambers, housings for power electronics, battery cells, in particular battery packs containing lithium-ion battery cells, for cooling medical equipment such as CT scanners and MRI scanners, for air-conditioning in motor vehicles such as buses, heavy-goods vehicles and the like, for air-conditioning in ships and aircraft cabins, for temperature-control basins in swimming pools and the like.

The present invention is described below purely by way of example with the help of advantageous embodiments with reference to the following figure, wherein the

Figure shows a schematic cross section of a composite element according to an exemplary embodiment of the present invention.

The composite element 10 shown in the figure comprises two moulds 12, 12' which are each made of expanded graphite, i.e. which contain no further constituents apart from expanded graphite and in particular no organic filling materials. In this case, the two moulds 12, 12' are connected to one another by an inorganic adhesive 14, wherein the adhesive layer 14 in the figure is drawn in thicker in the interests of visual

clarity than it is in reality. Moreover, at the interface between the two moulds 12, 12' a meander-shaped pipe body 16 is provided and embedded in the two moulds 12, 12', wherein of the pipe body 16 in the figure a total of 6 windings 18, 18' are shown. The pipe body has an internally hollow configuration and can therefore have a heat transfer medium flowing through it. On the upper side of the upper mould 12 and on the lower side of the lower mould 12', a non-woven fibreglass fabric is provided as the textile fabric 20, 20' in each case, wherein the two textile fabrics 20, 20' are each connected to the moulds 12, 12' via an inorganic adhesive 14, 14'. In this case, the adhesive layers 14', 14'' in the figure are in turn drawn thicker in the interests of visual clarity than they are in reality.

The present invention is described below with the help of an example explaining the invention but not limiting it.

EXAMPLE

Two plate-shaped premouldings made of expanded graphite were provided, each of which exhibits a surface area of $625 \times 625 \text{ mm}^2$, a thickness of 15 mm and a surface weight of $1,000 \text{ g/m}^2$.

On the upper and lower sides of a first of the two premouldings, water glass with an application quantity of 60 g per side was applied as an adhesive, wherein a product manufactured by Merck was used as the water glass. After this, a non-woven fibreglass fabric with a surface weight of 60 g/m^2 and a thickness of 0.6 mm made of glass fibres with a diameter of $13 \text{ }\mu\text{m}$ was applied to one of the two sides of the premoulding

coated with adhesive, pressed on and the adhesive allowed to dry.

In addition, the aforementioned product with an application quantity of 100 g was applied to one of the upper and lower sides of the second premoulding as the adhesive and then two holes were punched in this premoulding, which holes act as the inlet and outlet for the pipe body being fitted. After this, a non-woven fibreglass fabric with a surface weight of 60 g/m² and with a thickness of 0.6 mm made of glass fibres with a diameter of 13 µm was applied to the side of the premoulding coated with adhesive, pressed on and the adhesive allowed to dry.

A meander-shaped copper pipe body was then arranged on the side of the first premoulding lying opposite the non-woven fibreglass fabric and the premoulding was then arranged with its side opposite the non-woven fibreglass fabric downwards. This structure was then pressed in a press mould with spacers inserted in it to the desired height. The retention time in this case was 5 to 10 seconds.

The composite element produced in this way was stiff and had no fire load. Both the individual components of the composite element, in other words adhesive, graphite and non-woven fabric, and also the entire composite element were not combustible or inflammable. In particular, samples of the composite element produced with a diameter of 45 mm and a height of 40 mm to 60 mm did not burn when they were heat-treated at 800 °C in a box-type furnace. The composite element showed no sag when supported on a wooden frame with a web width of 2 cm. When the composite element was loaded with 10 kg on a surface of 70.9 cm² in the centre of the plate, the measurable sag was only 2 mm.

COMPARATIVE EXAMPLE

A composite element such as that described in example 1 was produced, except that rather than the water glass adhesive, an organic adhesive was used and the premouldings created from a mixture of expanded graphite and 20 % by weight polyvinyl chloride particles as an organic filling material.

Samples of the composite element produced in this manner with the dimensions referred to in example 1 burned for 26 seconds with an open flame when they were heat-treated at 800 °C in a box-type furnace.

LIST OF REFERENCE NUMBERS

10	Composite element
12, 12'	Mould made of expanded graphite
14, 14', 14''	Adhesive/adhesive layer
16	Meander-shaped pipe body
18, 18'	Windings of the pipe body
20, 20'	Textile fabric

PATENT CLAIMS

1. A thermally conductive composite element (10) for use in surface cooling or in surface heating, in particular, comprising at least one mould (12, 12') containing expanded graphite and at least one textile fabric (20, 20') arranged on at least one side of the mould (12, 12'), wherein the at least one textile fabric (20, 20') is connected to the mould (12, 12') by means of an inorganic adhesive (14', 14'').
2. The thermally conductive composite element (10) according to claim 1,

characterized in that

a pipe body (16) through which a heat transfer medium can flow is embedded in the at least one mould (12, 12') containing expanded graphite.
3. The thermally conductive composite element (10) according to claim 2,

characterized in that

the pipe body (16) is configured in a meandering or spiral shape.
4. The thermally conductive composite element (10) according to at least one of the preceding claims,

characterized in that

the at least one mould (12, 12') containing expanded graphite is configured at least substantially in plate form and the at least one

textile fabric (20, 20') is arranged on the upper and/or lower side of the plate-shaped mould (12, 12').

5. The thermally conductive composite element (10) according to at least one of the aforementioned claims,

characterized in that

the at least one mould (12, 12') contains expanded graphite with a density of 0.02 to 0.5 g/cm³, preferably of 0.04 to 0.3 g/cm³ and particularly preferably of 0.05 to 0.2 g/cm³.

6. The thermally conductive composite element (10) according to at least one of the preceding claims,

characterized in that

the at least one mould (12, 12') contains expanded graphite with a surface weight of 100 to 4,000 g/cm², preferably of 350 to 3,500 g/cm² and particularly preferably of 500 to 2,000 g/cm².

7. The thermally conductive composite element (10) according to at least one of the preceding claims,

characterized in that

it exhibits two moulds (12, 12') each consisting of expanded graphite which are connected to one another via an inorganic adhesive (14).

8. The thermally conductive composite element (10) according to claim 7,

characterized in that

a pipe body (16) through which a heat transfer medium can flow is embedded between the two moulds (12, 12').

9. The thermally conductive composite element (10) according to at least one of the preceding claims,

characterized in that

it exhibits edge protection.

10. The thermally conductive composite element (10) according to claim 9,

characterized in that

an L-shaped component which is preferably made of metal or plastic, a U-shaped component which is preferably made of metal or plastic or a coating is provided as the edge protection on at least one of the edge sides of the composite element (10).

11. The thermally conductive composite element (10) according to at least one of the preceding claims,

characterized in that

it is inserted or adhered into a frame made of metal and/or non-woven fabric.

12. A method for the production of a thermally conductive composite element (10) according to at least one of the preceding claims, which comprises the following steps:

- i) provision of a first and a second plate-shaped premoulding (12, 12'), wherein the two premouldings (12, 12') each contain expanded graphite,
- ii) arrangement of a pipe body (16) through which a transfer medium can flow between the upper side of the first premoulding (12') and the lower side of the second premoulding (12) and
- iii) pressing of the assembly obtained in step ii),

wherein in step i) at least one textile fabric (20, 20') is applied to at least one of the sides of the premouldings (12, 12') lying opposite the pipe body (16) in the subsequent composite element (10) and/or following step iii) at least one textile fabric (20, 20') is applied to the upper side and/or lower side of the embodiment obtained in step iii).

13. The method according to claim 12,

characterized in that it comprises the following steps in addition:

- a) application of an inorganic adhesive (14, 14'') to the upper side and the lower side of the first premoulding (12'),
- b) application of a textile fabric (20') to the upper side or lower side of the first premoulding provided with adhesive (14, 14'') and arrangement of a pipe body (16) on the side of the first premoulding (12') lying opposite the textile fabric (20'),

- c) application of an inorganic adhesive (14') to the upper side or the lower side of the second premoulding (12),
 - d) application of a textile fabric (20) to the upper side or lower side of the second premoulding (12) provided with adhesive (14'),
 - e) arrangement of the second premoulding (12) obtained in step d) with its side lying opposite the textile fabric (20) downwards on the pipe body (16) of the assembly obtained in step b) and
 - f) pressing of the structure obtained in step e).
14. The method according to at least one of the claims 12 or 13,
- characterized in that
- the structure in step f) is pressed at a pressure of 0.02 to 5 MPa and preferably of 0.1 to 1 MPa.
15. Use of a thermally conductive composite element (10) according to at least one of the claims 1 to 11 in surface cooling or in surface heating and preferably in underfloor, wall or ceiling heating, for the surface cooling and heating of machinery and equipment, such as photovoltaic cells, temperature chambers, housings for power electronics, battery cells, in particular battery packs containing lithium-ion battery cells, for cooling medical equipment such as CT scanners and MRI scanners, for air-conditioning in motor

vehicles such as buses, heavy-goods vehicles and the like, for air-conditioning in ships and aircraft cabins or for temperature-control basins in swimming pools.