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(54) **Compound plate-shaped insulation material, method for producing the same as well as a wall, facade and roof construction**

Verbundplatte aus Dämmstoffmaterial, Verfahren zur deren Herstellung und Wand, Fassade und Dachkonstruktion

Panneau composé de matériaux d'isolation, procédé pour sa fabrication et construction d'une cloison, d'une façade et d'un toit

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(73) Proprietor: **OPSTALAN B.V.**
5061 KD Oisterwijk (NL)

(72) Inventor: **Van Bergen, Josephus Joannes Henricus**
5061 BC Oisterwijk (NL)

(74) Representative: **Dohmen, Johannes Maria Gerardus et al**
Algemeen Octrooi- en Merkenbureau
P.O. Box 645
5600 AP Eindhoven (NL)

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- **PATENT ABSTRACTS OF JAPAN vol. 014, no. 506 (M-1044), 6 November 1990 (1990-11-06) & JP 02 209229 A (M D KASEI KK), 20 August 1990 (1990-08-20)**

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Description

[0001] The present invention relates to a compound plate-shaped insulation material comprising a base layer and a layer of insulation material present thereon, which base layer may be provided with ribs in the longitudinal direction thereof, between which ribs the insulation material is present. The present invention furthermore relates to a method for producing a compound plate-shaped material, as well as to a wall, facade and roof construction provided with insulation material.

[0002] From Japanese patent publication JP 02 209 229 there is known an insulation panel comprising a hard-foam thermally insulating layer sandwiched between a rigid base part, e.g. a metal panel or gypsum board, and a back part, e.g. an aluminium foil. Polyisocyanurate is mentioned as the hard foam. A certain amount of ground graphite is contacted with a mixture of concentrated sulphuric acid and hydrogen peroxide, after which the whole is dried and processed as a coating.

[0003] From French patent application FR 2 764 679 there is known a rigid panel comprising a plate having a thickness of about 10 mm, on which a fabric layer of graphite and/or carbon is present, which is in turn provided with a layer of a polystyrene insulation material, on which polystyrene layer a thin layer having a thickness of 3 mm is present, which is finished with a top coat.

[0004] British patent application GB 2 357 111 relates to a fire door or partition wall, in which a rigid polyurethane foam is used as the insulation material, which foam comprises graphite in an amount of 10-75 wt.%.

[0005] From Dutch laid-open publication No. 8801468 in the name of the present inventor there is known a compound plate-shaped material suitable for use as a constructional insulation material in buildings, which insulation material is built up of, successively, a layer of a mineral material, a layer of polyurethane foam material and a coating. Such an insulation material is known to exhibit a fire resistance of more than 30 minutes, according to TN0 report B-88-005.

[0006] In recent years there has been an increasing demand for insulation materials that are noncombustible or at least exhibit a reduced combustibility in comparison with the known materials. Such materials are much in demand especially for insulating walls, facades and roofs. In addition to that, current legislation is aimed at achieving safe and durable construction methods, in which connection increasingly stringent requirements are being made especially as regards fire safety.

[0007] In the past, the inflammable polystyrene was frequently used, which was coated with a bituminous layer. To reduce the fire hazard, mineral wool such as rock wool or glass wool is currently being used instead of polystyrene. The use of such materials has certain drawback, such as the fact that they are not very suitable for being walked on, their low resistance against wind loads and their undesirably high specific weight. Moreover, the insulating properties of such roof insulation materials are still capable of improvement.

[0008] It is an object of the present invention to provide a compound plate-shaped insulation material which exhibits a good dimensional stability, good insulation properties and which, in addition, is easy to use.

[0009] Another object of the present invention is to provide a compound plate-shaped material which, in addition to the aforesaid properties, exhibits a high fire resistance in combination with a favourable smoke behaviour.

[0010] Yet another object of the present invention is to provide a compound plate-shaped material designed to minimise the propagation of fire into the insulation material in case of a fire.

[0011] The invention is according to the present invention characterized in that the graphite having an average particle size of 0.2-2 mm is present mainly in an upper layer of the insulation material, which upper layer can be considered to be a layer remote from the base layer, wherein the base layer has a thickness of 0-70%, based on the total thickness of the layer of insulation material.

[0012] The incorporation of graphite in the insulation material has made it possible to achieve one or more of the above objects. The present inventors do not wish to be bound by any explanation, but they assume that the graphite that is present in the insulation material will expand in case of a fire, thus forming a so-called carbon shield, which has a positive effect on the fire and smoke behaviour of the plate-shaped insulation material having the present composition.

[0013] The term "compound plate-shaped insulation material" is to be understood to mean: single-shell roof and facade elements to be described hereinafter and sandwiched roof and facade elements to be described hereinafter, in particular the insulation elements that are known from Dutch patents NL 1009801, NL 1015351 and NL 1009885.

[0014] The graphite used in the present compound plate-shaped insulation material is a granular graphite having an average particle size of 0.2-2 mm. If graphite particles having a particle size of less than 0.1 mm are used, a very large amount of graphite is needed to obtain a satisfactory fire and smoke behaviour, whilst a particle size of more than 3 mm will cause problems in forming the required carbon shield, which shield protects the insulation material against further combustion. In addition to this it can be mentioned that graphite particles having a particle size of 0.2-2 mm will form a slightly dense layer in the insulation material, so that such grains only need to exhibit a low degree of "swelling" in order to form a closed carbon shield, as a result of which the required fire resistance is reached sooner. The present inventors have found that when the temperature is further increased, the larger grains in the aforesaid range will build up a somewhat heavy carbon shield and cross-link in the already activated smaller grains.

[0015] To obtain a favourable fire and smoke behaviour, the graphite may be spread through the insulation material, wherein the graphite is present mainly in an

upper layer of the insulation material, which upper layer can be considered to be a layer remote from the base layer, having a thickness of 0-70%, in particular 0-40%, more in particular 0-10%, based on the total thickness of the layer of insulation material. The term "substantially" is understood to mean at least 50%, in particular at least 70%, more in particular at least 90% of the total amount of graphite.

[0016] Preferably, the graphite grains are incorporated in the compound plate-shaped insulation material at a location where the fire load is to be expected, viz. mainly on the side of the compound plate-shaped insulation material that is used on the inner side of the construction, viz. the building, the shed, the hall and the like. Thus it is possible to concentrate the graphite mainly in the upper layer, which, if designed to have a thickness of 0-10%, will provide a satisfactory result as regards improving the fire and smoke behaviour, with the graphite particles cross-linking in the insulation material. The carbon shield thus formed protects the underlying insulation material against fire, with a further increase of the temperature forcing the underlying graphite to cross-link and the carbon shield thus created forming a new barrier against fire penetrating and harmful smoke being formed.

[0017] Preferably, the graphite that is used in the present compound plate-shaped insulation material has been pre-treated with an acid, for example nitric acid. Washing with an acid has a positive influence on the required swelling effect of graphite, so that the carbon shield will be formed when the graphite particles are exposed to a temperature increase, for example caused by fire.

[0018] The insulation material that is used in the present invention can be selected from the group consisting of PU, PIR, EPS and mineral wool. Chipboard, plywood and OSB are suitable materials for the base layer, on which a number of longitudinal ribs may be mounted, for example by glueing, as is known from Dutch patent No. 1009801, or ribs may be provided first, whereupon a foam layer is applied to the base layer, as is known from Dutch patent No. 1015351.

[0019] The present invention also relates to a method for producing a compound plate-shaped insulation material comprising a base layer and a layer of insulation material present thereon, which method comprises the following steps:

i) providing a base layer material,
ii) applying a slurry of graphite and insulation material to the base layer material, and
iii) causing the slurry of step ii) to react into a foam.

[0020] Although the above method is aimed at obtaining a foam as the insulation material, it should be understood that also other insulation materials as mentioned above may be used, which insulation materials comprise graphite.

[0021] In a special embodiment, preferably the graphite as used in a slurry according to step ii) has been pretreated with an acid, and preferably the acid-treated graphite is washed and dried before being worked into a slurry according to step ii). Different amounts of graphite may be used in the slurry, with the graphite being spread over the entire thickness of the insulation material.

[0022] To effect an optimum fire and smoke behaviour, step iii) is preferably carried out in such a manner that the graphite is distributed over the insulation material. According to the present invention the graphite is present mainly in an upper layer of the insulation material, which upper layer can be considered to be a layer remote from the base layer, with step iii) being carried out in such a manner that the upper layer is provided in a thickness of 0-70%, in particular a 0-40%, more in particular 0-10%.

[0023] The aforesaid step ii), in which the graphite grains are incorporated in the insulation material by means of the so-called slurry system, takes place by making use of computer-controlled recipes, wherein the amount and the position of the graphite grains are determined for varying insulation material thicknesses.

[0024] The present invention further relates to a wall, facade and/or roof construction comprising one or more compound plates of insulation material as described above. Single-shell roof and facade elements comprise a baseplate or base layer material consisting of chipboard, plywood, OSB or other plate materials, in which and/or on which a number of longitudinal ribs are mounted, for example by glueing, and on which an insulation material is present. Sandwiched roof and facade elements consist of two plate materials with an insulation material present therebetween, which may be provided with wooden ribs on both longitudinal sides thereof.

Claims

1. A compound plate-shaped insulation material comprising a base layer and a layer of foam as insulation material present thereon, which base layer is provided with ribs in the longitudinal direction thereof, between which ribs the insulation material is present, **characterized in that**
granular graphite is present in the insulation material, the graphite having an average particle size of 0.2-2 mm is present mainly in an upper layer of the insulation material, which upper layer can be considered to be a layer remote from the base layer, wherein the base layer has a thickness of 0-70%, based on the total thickness of the layer of insulation material.

2. A compound plate-shaped insulation material according to claim 1, **characterized in that** the base layer has a thickness of 0-40%, based on the total thickness of the layer of insulation material.

3. A compound plate-shaped insulation material according to claim 1, **characterized in that** the base

layer has a thickness of 0-10%, based on the total thickness of the layer of insulation material.

4. A compound plate-shaped insulation material according to any one or more of the preceding claims, **characterized in that** the graphite has been pre-treated with an acid

5. A method for producing a compound plate-shaped insulation material comprising a base layer and a layer of insulation material present thereon, **characterized in that** the method comprises the following steps:

i) providing a base layer material,
ii) applying a slurry of graphite and insulation material to the base layer material, and
iii) causing the slurry of step ii) to react into a foam,

wherein step iii) is carried out in such a manner that the graphite having an average particle size of 0.2-2 mm is present mainly in an upper layer of the insulation material, which upper layer can be considered to be a layer remote from the base layer, wherein the base layer has a thickness of 0-70%, based on the total thickness of the layer of insulation material.

6. A method according to claim 5, **characterized in that** the graphite as used in a slurry according to step ii) has been pre-treated with an acid.

7. A method according to claim 6, **characterized in that** the acid-treated graphite is washed and dried before being worked into a slurry according to step ii).

8. A roof construction comprising one or more compound plates of insulation materials as defined in any one or more of the claims 1-4.

9. A wall construction comprising one or more compound plates of insulation materials as defined in any one or more of the claims 1-4.

10. A facade construction comprising one or more compound plates of insulation materials as defined in any one or more of the claims 1-4.

Patentansprüche

1. Plattenförmiger Verbunddämmstoff mit einer Basisschicht und einer Schicht aus Schaumstoff als darauf vorhandener Dämmstoff, wobei die Basisschicht in ihrer Längsrichtung mit Rippen versehen ist, zwischen denen sich der Dämmstoff befindet, **dadurch gekennzeichnet, dass** in dem Dämmstoff körniger Graphit vorhanden ist, wobei der Graphit, der eine durchschnittliche Korngröße von 0,2 - 2 mm hat, hauptsächlich in einer oberen Schicht des Dämmstoffs vorhanden ist, wobei die obere Schicht als eine von der Basisschicht entfernt gelegene Schicht betrachtet werden kann, wobei die Basisschicht, bezogen auf die Gesamtstärke der Schicht aus Dämmstoff, eine Stärke von 0 - 70% aufweist.

2. Plattenförmiger Verbunddämmstoff nach Anspruch 1, **dadurch gekennzeichnet, dass** die Basisschicht, bezogen auf die Gesamtstärke der Schicht aus Dämmstoff, eine Stärke von 0 - 40% aufweist.

3. Plattenförmiger Verbunddämmstoff nach Anspruch 1, **dadurch gekennzeichnet, dass** die Basisschicht, bezogen auf die Gesamtstärke der Schicht aus Dämmstoff, eine Stärke von 0-10% aufweist.

4. Plattenförmiger Verbunddämmstoff nach mindestens einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der Graphit mit einer Säure vorbehandelt worden ist.

5. Verfahren zur Herstellung eines plattenförmigen Verbunddämmstoffs mit einer Basisschicht und einer darauf vorhandenen Schicht aus Dämmstoff, **dadurch gekennzeichnet, dass** das Verfahren die folgenden Schritte umfasst:

i) ein Basisschichtmaterial wird bereitgestellt,
ii) auf das Basisschichtmaterial wird eine Aufschlämmung aus Graphit und Dämmstoff aufgebracht, und
iii) die Aufschlämmung aus Schritt ii) wird in einen Schaumstoff umgesetzt,

wobei Schritt iii) so ausgeführt wird, dass der Graphit, der eine durchschnittliche Korngröße von 0,2 - 2 mm hat, hauptsächlich in einer oberen Schicht des Dämmstoffs vorhanden ist, wobei die obere Schicht als eine von der Basisschicht entfernt gelegene Schicht betrachtet werden kann, wobei die Basisschicht, bezogen auf die Gesamtstärke der Schicht aus Dämmstoff, eine Stärke von 0 - 70% aufweist.

6. Verfahren nach Anspruch 5, **dadurch gekennzeichnet, dass** der in einer Aufschlämmung nach Schritt ii) verwendete Graphit mit einer Säure vorbehandelt worden ist.

7. Verfahren nach Anspruch 6, **dadurch gekennzeichnet, dass** der säurebehandelte Graphit gewaschen und getrocknet wird, bevor er in eine Aufschlämmung nach Schritt ii) eingearbeitet wird.

8. Dachkonstruktion mit mindestens einer Verbundplatte aus Dämmstoffen nach mindestens einem der

Ansprüche 1 - 4.

9. Wandkonstruktion mit mindestens einer Verbundplatte aus Dämmstoffen nach mindestens einem der Ansprüche 1 - 4.

10. Fassadenkonstruktion mit mindestens einer Verbundplatte aus Dämmstoffen nach mindestens einem der Ansprüche 1 - 4.

Revendications

1. Matériau d'isolation en forme de plaque composée comprenant une couche de base et une couche de mousse, en tant que matériau d'isolation, présente sur celle-ci, laquelle couche de base est pourvue de nervures dans sa direction longitudinale, le matériau d'isolation étant présent entre lesdites nervures, **caractérisé en ce que**
un graphite granulaire est présent dans le matériau d'isolation,
le graphite possédant une taille moyenne des particules de 0,2 à 2 mm est présent essentiellement dans une couche supérieure du matériau d'isolation, laquelle couche supérieure peut être considérée comme étant une couche éloignée de la couche de base, dans lequel la couche de base possède une épaisseur de 0 à 70 %, sur la base de l'épaisseur totale de la couche de matériau d'isolation.

2. Matériau d'isolation en forme de plaque composée selon la revendication 1, **caractérisé en ce que** la couche de base possède une épaisseur de 0 à 40 %, sur la base de l'épaisseur totale de la couche de matériau d'isolation.

3. Matériau d'isolation en forme de plaque composée selon la revendication 1, **caractérisé en ce que** la couche de base possède une épaisseur de 0 à 10 %, sur la base de l'épaisseur totale de la couche de matériau d'isolation.

4. Matériau d'isolation en forme de plaque composée selon l'une quelconque ou plusieurs des revendications précédentes, **caractérisé en ce que** le graphite a été traité préalablement avec un acide.

5. Procédé de fabrication d'un matériau d'isolation en forme de plaque composée comprenant une couche de base et une couche de matériau d'isolation présente sur celle-ci, **caractérisé en ce que** le procédé comprend les étapes suivantes consistant à :

i) fournir un matériau de couche de base,
ii) appliquer une pâte de graphite et un matériau d'isolation sur le matériau de couche de base, et
iii) entraîner la réaction de la pâte de l'étape ii) pour créer une mousse,

dans lequel l'étape iii) est réalisée d'une manière telle que le graphite possédant une taille moyenne des particules de 0,2 à 2 mm est présent essentiellement dans une couche supérieure du matériau d'isolation, laquelle couche supérieure peut être considérée comme étant une couche éloignée de la couche de base, dans lequel la couche de base possède une épaisseur de 0 à 70 %, sur la base de l'épaisseur totale de la couche de matériau d'isolation.

6. Procédé selon la revendication 5, **caractérisé en ce que** le graphite tel qu'il est utilisé sous la forme de pâte dans l'étape ii) a été traité préalablement avec un acide.

7. Procédé selon la revendication 6, **caractérisé en ce que** le graphite traité préalablement à l'acide est lavé et séché avant d'être travaillé pour obtenir une pâte selon l'étape ii).

8. Construction de toit comprenant une ou plusieurs plaques composées de matériaux d'isolation selon l'une quelconque ou plusieurs des revendications 1 à 4.

9. Construction de mur comprenant une ou plusieurs plaques composées de matériaux d'isolation selon l'une quelconque ou plusieurs des revendications 1 à 4.

10. Construction de façade comprenant une ou plusieurs plaques composées de matériaux d'isolation selon l'une quelconque ou plusieurs des revendications 1 à 4.

REFERENCES CITED IN THE DESCRIPTION

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