Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).
The present invention relates to a coated mineral wool product such as an acoustically transparent ceiling panel or a facade insulation board in accordance with the preamble of claim 1, a process for producing a mineral wool product in accordance with claim 8, and a coating mass for producing an acoustically transparent mineral wool product in accordance with claim 13.

Particularly in acoustics and architectural acoustics, sound absorbing wall and ceiling constructions are employed essentially for two tasks. On the one hand, this is the reduction of the sound level in a room in order to counteract noise in workplaces and living spaces, on the other hand the improvement of acoustical conditions by correcting the reverberation period. A sound absorber effective for both applications must possess a sufficiently high flow resistance for the obtention of high friction losses, and at the same time a porous structure to better allow penetration by sound waves. For sound absorption, for example sound absorbing panels of mineral wool were used in the prior art. Sound deadening (sound absorption) is basically understood to be the conversion of sound energy into heat. For the purposes of sound absorption, mineral wool being a porous and open-cell material is particularly well suited. Energy conversion fundamentally takes place as a result of friction processes inside the absorber material.

Open mineral wool products such as, e.g., mineral wool boards are not suited for acoustic insulation in interiors if only for esthetic reasons. For sound absorption in the visible range, the prior art consequently i.e. employed insulation boards of mineral wool provided on at least one side with a lining, or lamination, of resin-bonded glass fiber mat having a weight per surface unit between 20 and 150 g/m². The glass fiber mats were provided with various decorative printings for esthetic reasons.

In addition to acoustic and esthetic properties, the sound absorbing or acoustically transparent materials are moreover generally expected to be not flammable within the meaning of German Industrial Standard DIN 4102 Part 1, building materials rating A.

In order to attain building materials rating A, a low binder content is aspired in the fiber mats used as a lining for insulation boards in the prior art, such that these are comparatively brittle and only attain a poor impact penetration strength. As a result, this had to be compensated for in the prior art by an enhanced bulk density of the mineral wool body, resulting in high costs for energy and starting materials.

In terms of sound insulation, however, the weight per surface unit and the sound absorption are diametrically opposed to each other:

High weight per surface unit values result in better impact penetration strengths, whereas lower weight per surface unit values result in better sound absorption characteristics.

For the production of the above mentioned insulation boards laminated with fiber mats, the glass fiber mats were applied onto the uncured mineral wool mat by means of a suitable adhesive and cured in a tunnel furnace. Following the curing process, mechanical molding into the corresponding size formats by means of machining units and finally packaging was carried out. Owing to this post-processing, however, a considerable amount of fiber material was discharged, which in turn results in soiling of the surface and associated cleaning work.

In particular, there resulted a certain reject rate of panels due to soiling and deformations of the fiber mat surface inside the tunnel furnace.

Although the sound absorbing mineral wool insulation boards thus produced already presented good sound absorption properties, their handling on the construction site was frequently connected with damage and therefore replacement of the mineral wool products because of the low impact penetration strengths of the glass fiber mats.

Starting out from this prior art, it was therefore the object of the present object to furnish coated mineral wool products having higher impact penetration strength at low cost, which are suited, for example, both for acoustically transparent ceiling panels and facade insulation boards which are subject to higher mechanical strain than ceiling panels.

This object is attained by the characterising features of claim 1.

In terms of process technology, this object is attained by the characterising features of claim 8.

When, in accordance with the invention, a mineral wool product laminated with a fiber mat is coated on at least one side with a layer based on a siliceous material and containing at least one organic plastic, it was surprisingly found that the surface of the mineral wool product assumes a membrane-type character, i.e., it yields to pressure and springily resumes its former shape upon release of pressure, whereby the impact penetration strength is increased considerably.

Owing to the combination of the features "membrane-type character" and "enhanced impact penetration strength", the surface of the mineral wool product according to the invention becomes markedly more resistant against any possible, inadvertent destruction occurring on the construction site.

In addition it is another advantage of the mineral wool products according to the invention that the layer may receive an admixture of paint pigments according to need, whence they fit in with the respective circumstances of
The mineral wool products according to the invention present high degrees of sound absorption in comparison with conventional coated mineral wool products.

The process according to the invention furnishes products having a faultless, clean surface, namely owing to the fact that the coating mass is applied only after the so-called tunnel furnace, i.e., when the mineral wool body is already present in the cured state. Moreover it is essential that the coating mass is applied on the glass fiber mat in the form of a foam, for thereby it is possible to massage, as it were, the coating mass into the fiber mat and the adjacent body surface. This may, for example, be effected by means of an elastic roller, whereby an intimate connection between the surfaces of the fiber mat and of the underlying mineral wool is achieved through capillary effect. Fundamentally the coating may, however, also be carried out by immersion, spraying, flooding or doctor blade. The surface will, however, still be sealed in the wet state. The compound will obtain the actual open-pore, acoustically transparent surface only through the subsequent drying of the body surface coated with foam mass in a drying furnace, e.g., under intense infrared heating. Owing to this drying, the macroscopic air bubbles burst prior to curing of the coating mass and thus release the pores of the mat. As a result of the adhesion forces, both the mat fiber and the mineral fiber are enveloped by the coating mass which thus cures on the fiber.

The compound of glass fiber mat with mineral wool thus allows for optimum spatial distribution of forces in the event of impact stress, which is furthermore assisted by an elastifying constituent in the mass.

In accordance with the invention, a coating mass having the following composition is used:

<table>
<thead>
<tr>
<th>Content</th>
<th>Weight Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silica sol</td>
<td>20-40% (wt.)</td>
</tr>
<tr>
<td>Plastic dispersion</td>
<td>10-25% (wt.)</td>
</tr>
<tr>
<td>Aluminum hydroxide</td>
<td>1-5% (wt.)</td>
</tr>
<tr>
<td>Foaming agent</td>
<td>0.5-2% (wt.)</td>
</tr>
<tr>
<td>Foam stabiliser</td>
<td>0.05-1 % (wt.)</td>
</tr>
<tr>
<td>Balance</td>
<td>water, and optionally flameproofing agent and/or further additions</td>
</tr>
</tbody>
</table>

Although a similar coating mass is known from the prior art in accordance with EP 0 728 124 B1, the latter comprises plastic dispersion contents of a maximum 10% (wt.) on the one hand, whereas the instant plastic dispersion is contained at 10% (wt.) at the least, and on the other hand that coating is used merely for the purposes of mechanical stabilisation of the respective mineral wool products.

In particular, the prior art of EP 0 728 124 B1 stresses the importance of bitumen being prevented from penetrating through the coating material into the roof insulation boards thereof, or where used as so-called plaster base panels, their acquiring an affinity for the plaster mass.

The coating mass of EP 0 728 124 B1 is deeply impressed into the mineral wool surface, bringing about cobweb-type bridges of coating material between the fibers.

Other than in the prior art of EP 0 728 124 B1, in the present invention the inventive coating mass is applied on a fiber mat-laminated mineral wool product, generally a mineral wool board, resulting in the surprising properties of the mineral wool product according to the invention.

A preferred coating mass is represented in claim 2, wherein the content of organic substances is irrelevant under the aspect of flammability.

Using mineral wool products with a glass wool mat lamination in accordance with claim 3 has the advantage that herein it is possible to use a low-cost standard fiber mat which need not specifically be produced for the instant mineral wool product.

A mineral wool product in accordance with claim 4 has the advantage that - if the layer/coating is made to be electrically and/or magnetically effective, the mineral wool product may, e.g., be used as a radar absorber - or quite generally in the event of so-called electrosmog.

Preferred substances for a coating for the purpose of radar radiation absorption are represented in claim 5.

Advantageously, mineral wool products may be provided with a layer presenting, in accordance with claim 6, foam layer forming agents, particularly expanded graphite, pentaerythritol or the like which bring about thermally insulating properties in the case of a fire.

Preferred weight per surface unit values of the mat are represented in claim 7.

For the purposes of the present invention, the foamed coating mass is applied preferably in an application quantity of 100 g/m² to 500 g/m², preferably approx. 300 g/m² in accordance with claim 9.

In the production of the foamed coating mass, preferably a foam weight per liter of 100 g/l to 400 g/l, preferably approx. 250 g/l in accordance with claim 10 is used.

The coating of the mineral wool product according to the invention is preferably dried in a drying kiln at a
temperature of approx. 260°C. Here it was found that at this temperature the macroscopic air bubbles within the layer burst prior to curing of the coating mass, resulting in the generation of an open-pore compound through which sound waves may penetrate into the inside of the mineral wool product to be absorbed there. At the same time, the coating acquires a membrane-type character so as to have mechanical strength.

Further advantages and features of the present invention may be taken from the description of an embodiment and by reference to the drawing, wherein:

Fig. 1: is a sectional view of a mineral wool product according to the invention; and

Fig. 2: is a graph showing impact penetration strength in accordance with the depth of impression.

The board-shaped mineral wool product, shown under 1 in the sectional view of Fig. 1, presents a coating 2 of a suitable glass fiber mat 3 intimately combined with the surface of a body 4 of mineral wool.

In the case of the example, the glass fiber mat is adhered to the body 4 in the course of curing inside the tunnel furnace, namely as a result of the organic binder which gives shape to the body. The glass mat 3 adhered to the mineral wool body 4 has a weight per surface unit of approx. 60 g/m².

For producing the mineral wool product 1 in the example of a ceiling insulation board, the recipe given below is used:

| 44.7% (wt.) | silica sol (40% solid content SiO₂) |
| 20% (wt.) | Bayceram® as a polyester-polyurethane based plastic dispersion |
| 15% (wt.) | aluminum hydroxide |
| 4% (wt.) | colorant |
| 2.1 % (wt.) | foaming agent |
| 0.3% (wt.) | foam stabiliser |
| balance: | water |

As a plastic dispersion, a polyester-polyurethane dispersion by Bayer AG, water content: 50% having the tradename "Bayceram®" is used in the present embodiment. It is, of course, possible to use any plastic dispersion which is water and light resistant on the one hand and brings about particularly good elasticity on the other hand. Thus it is, for example, also possible to use latex dispersions.

As a foaming agent, W53 by Zschimmer & Schwarz was used in the exemplary case, and as a foam stabiliser PS1, also by Zschimmer & Schwarz.

The coating mass is foamed to about 6 times the unfoamed volume with the aid of an agitator. The foam weight per liter is approx. 250 g/l. The foamed coating mass is applied on the surface of the fiber mat 3 by means of an elastic roller. Through massaging the foam into the mat surface which is achieved with the aid of the elastic roller, and the capillary effect of the underlyng mineral wool, an intimate permeation is achieved, with the surface still being sealed.

The coated raw product is in the exemplary case dried in a drying kiln at intense infrared heating at approx. 260°C. Through this drying process, the macroscopic air bubbles burst prior to curing of the coating mass and form open pores 5 in the coating 2, which at least partly communicated with pores 6 of the glass fiber mat 3 and thus with the mineral wool body 4.

As a result of this open-pore formation of the coating 2, sound waves may freely penetrate into the mineral wool body 4 to be absorbed therein. On the other side, for example when used as a ceiling panel, this open-pore formation is hardly visible to the observer who will receive the impression of a smooth, closed surface.

Ceiling insulation boards 1 produced in this way present a membrane-type behavior on the side having the coating applied due to the springy-elastic properties of the compound of coating 2, glass mat 3 and mineral wool body 4.

The ceiling panels 1 thus produced moreover present a high degree of sound absorption and present an appealing surface at markedly enhanced impact penetration strength in comparison with the conventional mineral wool products lined with fiber mats.

In Fig. 2, which shows the impact penetration strength plotted against the depth of impression, it can be seen that the impact penetration strength of the mineral wool products according to the invention is approximately tripled in comparison with glass fiber mats without a foam coating.

The mineral wool products according to the invention are thus on the one hand excellently suited for insertion in ceiling constructions of hung ceilings. On the other hand, however, owing to their high impact penetration strength, they are also well suited for use as facade insulation boards to allow for a reduction of the bulk densities thereof.
Claims

1. A mineral wool product, such as a ceiling or facade insulation board, having on at least one side a layer (2) based on a siliceous material and containing at least one organic plastic, characterised in that the layer (2) is foamed and that a fiber mat (3) is provided between said foamed coating (2) and the surface of said mineral wool product (1).

2. The mineral wool product according to claim 1, characterised in that it is obtainable by application of a foamed coating mass on a mineral wool product laminated with a fiber mat and subsequent drying, wherein the coating mass presents the following composition:

<table>
<thead>
<tr>
<th>Composition</th>
<th>Percentage (wt.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silica sol (40% solid content SiO₂)</td>
<td>20-40%</td>
</tr>
<tr>
<td>Plastic dispersion</td>
<td>10-25%</td>
</tr>
<tr>
<td>Aluminum hydroxide</td>
<td>1-5%</td>
</tr>
<tr>
<td>Foaming agent</td>
<td>0.5-2%</td>
</tr>
<tr>
<td>Foam stabiliser</td>
<td>0.05-1%</td>
</tr>
<tr>
<td>Water and flameproofing agent</td>
<td>optionally</td>
</tr>
<tr>
<td>Balance</td>
<td></td>
</tr>
</tbody>
</table>

3. The mineral wool product according to claim 1 or 2, characterised in that said fiber mat (3) is a glass wool mat.

4. The mineral wool product according to any one of claims 1 to 3, characterised in that said layer (2) is electrically and/or magnetically effective.

5. The mineral wool product according to claim 4, characterised in that said layer (2) further contains:

- Electrically conductive and/or magnetically attenuating substances, such as carbon, in particular powdered carbon, carbon fibers, graphite, in particular expanded graphite, mu-metal, chromium dioxide, metal whisker, and carbonyl iron.

6. The mineral wool product according to any one of claims 1 to 5, characterised in that said layer (2) additionally presents foam layer forming agents, in particular expanded graphite, pentaerythritol.

7. The mineral wool product according to any one of claims 1 to 6, characterised in that the weight per surface unit of said fiber mat (3) is 20 to 150 g/m², in particular 40 to 80 g/m², preferably approx. 60 g/m².

8. A process for producing a mineral wool product (1) according to any one of claims 1 to 7, characterised in that a foamed coating (2) on the basis of a siliceous binder and containing at least one organic plastic is applied on a fiber mat lamination (3) of a mineral wool product, and the foam bubbles are made to burst through drying.

9. The process according to claim 8, characterised in that an application quantity of 100 g/m² to 500 g/m², preferably approx. 300 g/m² of foamed coating mass is used.

10. The process according to claim 8 or 9, characterised in that a foam weight per liter of 100 g/l to 400 g/l, preferably approx. 250 g/l is used.

11. The process according to any one of claims 8 to 10, characterised in that said layer (2) is dried in a tunnel furnace, preferably at temperature of approx. 260°C.

12. The process according to any one of claims 8 to 11, characterised in that a coating mass having the following composition is used:

<table>
<thead>
<tr>
<th>Composition</th>
<th>Percentage (wt.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silica sol (40% solid content SiO₂)</td>
<td>20-40%</td>
</tr>
<tr>
<td>Plastic dispersion</td>
<td>10-25%</td>
</tr>
</tbody>
</table>
Patentansprüche

1. Mineralwollprodukt, so wie eine Decken- oder Fassadenisolationsplatte, die auf wenigstens einer Seite eine Schicht (2) aufweist, die auf einem silikatischen Material basiert und die wenigstens einen organischen Kunststoff enthält, dadurch gekennzeichnet, dass die Schicht (2) geschäumt ist und dass ein Faservlies (3) zwischen der geschäumten Beschichtung (2) und der Oberfläche des Mineralwollproduktes (1) angeordnet ist.

2. Mineralwollprodukt gemäß Anspruch 1, dadurch gekennzeichnet, dass es durch die Anwendung einer geschäumten Beschichtungsmasse auf ein mit einem Faservlies laminiertem Mineralwollprodukt und durch anschließendes Trocknen erhältlich ist, wobei die Beschichtungsmasse die folgende Zusammensetzung aufweist:

| 20-40 Gew.-% | Kieselsol (40 Gew.-% Feststoffgehalt SiO₂) |
| 10-25 Gew.-% | Kunststoffdispersion |
| 1-5 Gew.-% | Aluminiumhydroxid |
| 0.5-2 Gew.-% | Schaumbildner |
| 0.05-1 Gew.-% | Schaumstabilisator |
| Rest: | Wasser, und |
| optional | Flammschutzmittel und/oder weitere Zusatzstoffe. |

3. Mineralwollprodukt gemäß Anspruch 1 oder 2, dadurch gekennzeichnet, dass das Faservlies (3) ein Glasfaservlies ist.

4. Mineralwollprodukt gemäß einem der Ansprüche 1-3, dadurch gekennzeichnet, dass die Schicht (2) elektrisch und/oder magnetisch wirksam ist.

5. Mineralwollprodukt gemäß Anspruch 4, dadurch gekennzeichnet, dass die Schicht (2) weiterhin umfasst: elektrisch leitfähige und/oder magnetisch dämpfende Substanzen, so wie Kohlenstoff, insbesondere pulverförmigen Kohlenstoff, Carbonfasern, Graphit, insbesondere expandierten Graphit, Mu-Metall, Chromdioxid, Metall-Splitter, Carbonyleisen.

6. Mineralwollprodukt gemäß einem der Ansprüche 1-5, dadurch gekennzeichnet, dass die Schicht (2) zusätzlich Schaumschicht-bildende Mittel, insbesondere expandiertes Graphit, Pentaerythritol, aufweist.

7. Mineralwollprodukt gemäß einem der Ansprüche 1-6, dadurch gekennzeichnet, dass die Gewicht-pro-Oberfläche Einheit des Faservlieses (3) 20-150 g/m², insbesondere 40-80 g/m², besonders bevorzugt 60 g/m² beträgt.

8. Verfahren zur Herstellung eines Mineralwollproduktes (1) gemäß einem der Ansprüche 1-7, dadurch gekennzeichnet, dass eine geschäumte Beschichtung (2) auf der Basis eines silikatischen Bindemittels und enthaltend wenigstens einen organischen Kunststoff auf eine Faservlieslaminierung (3) eines Mineralwollproduktes angewendet wird, wobei die Schaumblasen im Laufe des Trocknens zum Platzen gebracht werden.

9. Verfahren gemäß Anspruch 8, dadurch gekennzeichnet, dass eine Anwendungsmenge von 100-500 g/m², vorzugsweise etwa 300 g/m², geschäumter Beschichtungsmasse verwendet wird.
10. Verfahren gemäß Anspruch 8 oder 9, dadurch gekennzeichnet, dass ein Schaumgewicht pro Liter von 100-400 g/l, vorzugsweise etwa 250 g/l verwendet wird.

11. Verfahren gemäß einem der Ansprüche 8-10, dadurch gekennzeichnet, dass die Schicht (2) in einem Tunnelofen, vorzugsweise bei einer Temperatur von etwa 260 °C getrocknet wird.

12. Verfahren gemäß einem der Ansprüche 8-11, dadurch gekennzeichnet, dass eine Beschichtungsmasse mit der folgenden Zusammensetzung verwendet wird:

<table>
<thead>
<tr>
<th>Gew.-%</th>
<th>Zutat</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-40</td>
<td>Kieselsol (40 Gew.-% Feststoffgehalt SiO₂)</td>
</tr>
<tr>
<td>10-25</td>
<td>Kunststoffdispersion</td>
</tr>
<tr>
<td>1-5</td>
<td>Aluminiumhydroxid</td>
</tr>
<tr>
<td>0.5-2</td>
<td>Schaumbildner</td>
</tr>
<tr>
<td>0.05-1</td>
<td>Schaumstabilisator</td>
</tr>
<tr>
<td>Rest:</td>
<td>Wasser, und</td>
</tr>
<tr>
<td>optional:</td>
<td>Flammschutzmittel und/oder weitere Zusatzstoffe.</td>
</tr>
</tbody>
</table>

Revendications

1. Produit en laine minérale, tel qu’un panneau d’isolation de façade ou de plafond, ayant au moins sur un côté, une couche (2) basée sur un matériau siliceux et contenant au moins un plastique organique caractérisé en ce que la couche (2) forme une mousse et en ce qu’un tapis de fibres (3) est prévu entre le dit revêtement en mousse (2) et la surface dudit produit en laine minérale (1).

2. Produit en laine minérale selon la revendication 1, caractérisé en ce qu’il est peut être obtenu par une application d’une masse de revêtement en mousse sur un produit en laine minérale laminé avec un tapis de fibres et un séchage consécutif, dans lequel la masse de revêtement présente la composition suivante :

   20-40 % en poids de solution de silice (teneur en SiO₂ solide de 40 % en poids)  
   10-25 % en poids d’inclusion de plastique  
   1-5 % en poids d’hydroxyde d’aluminium  
   0,5-2 % en poids d’agent de mousage  
   0,05-1 % en poids d’agent de stabilisation de mousse

   complément : eau, et éventuellement, un agent ignifuge et/ou des ajouts supplémentaires.

3. Produit en laine minérale selon la revendication 1 ou 2, caractérisé en ce que ledit tapis de fibres (3) est un tapis de laine de verre.

4. Produit en laine minérale selon l’une quelconque des revendications 1 à 3, caractérisé en ce que ladite couche (2) est efficace électriquement ou magnétiquement.

5. Produit en laine minérale selon la revendication 4, caractérisé en ce que dans ladite couche (2) comprend de plus :

   des substances conductrices électriquement et/ou d’atténuation magnétique, telles que du carbone, en particulier du carbone en poudre, des fibres de carbone, du graphite, en particulier du graphite expansé, du métal mu, du dioxyde de chrome, de la barbe de métal, de l’acier carboneyle.

6. Produit en laine minérale selon l’une quelconque des revendications 1 à 5, caractérisé en ce que dans ladite couche (2) présente de manière supplémentaire des agents formant une couche de mousse, en particulier du graphite expansé, du pentaérythritol.

7. Produit en laine minérale selon l’une quelconque des revendications 1 à 6, caractérisé en ce que le poids par
unité de surface dudit tapis de fibres (3) est de 20 à 150 g/m², en particulier de 40 à 80 g/m², de préférence approximativement 60 g/m².

8. Procédé pour la production d'un produit en laine minérale (1) selon l'une quelconque des revendications 1 à 7, caractérisé en ce que un revêtement en mousse (2) à base d'un liant siliceux et contenant au moins un plastique organique est appliqué sur un de tapis de fibres laminé (3), et en ce que les bulles de mousse sont conçues pour éclater lors du séchage.

9. Procédé selon la revendication 8, caractérisé en ce qu'une quantité d'application de 100 g/m² à 500 g/m², de préférence d'approximativement 300 g/m² de masse de revêtement en mousse est utilisée.

10. Procédé selon la revendication 8 ou 9, caractérisé en ce qu'un poids de mousse par litre de 100 g/l à 400 g/l, de préférence approximativement 250 g/l est utilisé.

11. Procédé selon l'une quelconque des revendications 8 à 10, caractérisé en ce que ladite couche (2) est séchée dans un four à tunnel, de préférence à une température d'approximativement 260°C.

12. Procédé selon l'une quelconque des revendications 8 à 11, caractérisé en ce qu'une masse de revêtement ayant la composition suivante est utilisée :

20-40 % en poids de solution de silice (teneur en SiO₂ solide de 40 % en poids)
10-25 % en poids d'inclusion de plastique
1-5 % en poids d'hydroxyde d'aluminium
0,5-2 % en poids d'agent de moussage
0,05-1 % en poids d'agent de stabilisation de mousse

complément : eau, et
evénuellement, un agent ignifuge et/ou des ajouts supplémentaires.
Glass fiber mat 100 g/m² with/without foam coating

Impact penetration strength [kN/m²]

Depth of impression [mm]

Fig. 2