Title: EXTERNAL THERMAL INSULATION COMPOSITE FACADE SYSTEM (ETICS)

Abstract: The present invention relates to an external thermal insulation composite system (ETICS) for reduction of algae and mould formation on a facade surface, further relates to methods for thermally insulating a facade of a building as well as the use of a wood wool board to reduce the presence of mold and/or algae at a building facade.
EXTERNAL THERMAL INSULATION COMPOSITE FACADE SYSTEM (ETICS)

Description

The present invention relates to an external thermal insulation composite system (ETICS) notably for reduction of algae and mould formation on a facade surface, and to methods for thermally insulating a facade of a building.

Insulation materials are typically used in thermal and acoustic insulation in buildings; known insulation materials include those disclosed in documents EP2277692A2, NL1 010514C2 and EP2277692A3.

Recently, thermal insulation of exterior walls in the construction of new buildings as well as in the renovation of buildings has become more and more important due to improved demands in energy saving and in view of a desired reduction of climate-damaging greenhouse gases. Accordingly, at present, insulating materials used on exterior walls of buildings have a typical thickness in the range of 12 to 16 cm. In so-called "passive houses" and "zero-energy houses", insulation materials having a thickness of more than 20 cm are currently employed.

However, this development has led to a variety of disadvantages. As a consequence of the improved insulation properties of the insulating materials, the thermal flow from inside the building no longer affects the surface temperature of the exterior walls to the same extent as before. Accordingly, the facades do not receive as much thermal energy from inside the building, and thus drying time of moisture on the facades of the buildings greatly increases. In addition, due to the relatively low specific thermal capacity of any plaster layer on the exterior surface of the facades, the temperature of the facade frequently falls below the dew point at night, thus leading to further generation of condensation water (moisture) on the surface thereof. As a direct consequence of the wet surfaces, algae and mould formation is greatly enhanced on such facades.

To counter the above problem of algae and mould formation, several solutions have
been proposed:

(1) Applying biocidal layers on facades to avoid algae and mould formation. However, such layers merely slow down algae formation and have to be renewed regularly, since the biocides are easily washed off by rain. Moreover, with respect to environmental considerations, the employment of biocides should be avoided, particularly for ground water protection.

(2) Applying hydrophobic layers on facades to promote draining of rain water. However, such hydrophobic layers are not effective against condensation of water due to lower temperatures at night, so that algae and mould formation still occurs.

(3) Painting facades with dark colours so that solar radiation leads to a higher and faster temperature increase of the surface of the facade to promote faster drying. However, due to the relatively small specific thermal capacity of the plaster on the exterior wall, dark colours barely affect the problem of condensation at night and/or at low temperatures. Moreover, use of thicker plaster layers did not solve the above-mentioned problem.

(4) Applying layers showing a lotus effect on facades to promote self-cleaning of facade surfaces by rainfall. However, such layers are generally only employed with reasonable success on the weather side of buildings.

(5) Applying hydrophilic layers on facades so that the surface moisture is soaked through the plaster and is no longer available for algae and mould growth. However, when facing large amounts of moisture, this principle does not prevent algae and mould formation and leads to the presence of moisture within the facade structure.

Accordingly, each of the aforementioned proposed solutions is linked to one or more disadvantages regarding environmental concerns, applicability etc.

Thus, the technical problem underlying the present invention is to overcome the above-mentioned problems by providing an external thermal insulation composite system (ETICS) which is capable of reducing algae and mould formation on a facade surface in an ecologically acceptable manner, and by providing methods for thermally
insulating a facade of a building.

The solution to the above technical problem is achieved by providing the embodiments characterized in the claims.

In particular, there is provided an external thermal insulation composite system (ETICS), notably for reduction of algae and/or mould formation on a facade surface, the external thermal insulation composite system comprising an insulant layer and at least one wood wool board, wherein the at least one wood wool board has a thickness of at least 15 mm.

The terms "algae" and "mould" used according to the present invention are not specifically restricted. They include any unicellular or multicellular plants or fungi capable of growing on facades of buildings, thereby often spoiling the optical appearance of the facades.

The term "facade" used according to the present invention is not specifically restricted, and includes, for example, the outer face of a building, e.g. a house, commercial building, office etc. However, according to the present invention, any surface of a building which is in contact with weather conditions, notably which is directly exposed to external weather conditions, is included in the term "facade".

The insulant layer according to the present invention is not specifically restricted, and any insulant layer previously known in the art may be employed in the present invention. According to one embodiment of the present invention, the insulant layer comprises at least one member selected from the group consisting of mineral wool and rigid foam.

The term "mineral wool" according to the present invention includes any fiber wool which is made from natural or synthetic minerals or metal oxides. According to a preferred embodiment, the mineral wool comprises slag wool fibers, rock wool fibers, glass wool fibers, ceramic fibers or combinations thereof. According to the present invention, the average fiber diameter of said mineral wool is not specifically restricted.
The average fiber diameter of said mineral wool may be, for example, in the range of 3 to 8 µm, 3.5 to 7.5 µm, 4 to 7 µm or 4.5 to 7 µm.

The term "rigid foam" used herein is not specifically restricted. According to a preferred embodiment, the rigid foam comprises a polyvinyl chloride rigid foam, an expanded polystyrene (EPS) rigid foam, an extruded polystyrene (XPS) rigid foam, a polyisocyanurate (PIR) rigid foam, a polyurethane (PUR) rigid foam, a phenolic rigid foam, or combinations thereof.

The thickness of the insulant layer according to the present invention is not particularly limited. According to a preferred embodiment, the thickness of the insulant layer is at least 10 cm in order to secure proper insulation. Further examples include thicknesses of at least 12 cm, at least 15 cm, at least 16 cm and at least 18 cm. Preferably, the insulant layer has a thickness of not more than 50 cm.

The wood wool board used in the present invention is not particularly limited, as long as the wood wool board has a thickness of at least 15 mm, in order to achieve a desired thermal energy-storing effect. The ETICS system according to the present invention comprises at least one wood wool board having the above thickness. If the ETICS system according to the present invention comprises more than one wood wool board, only the one wood wool board which faces outside the building when the ETICS system is applied on the facade of a building is required to have the above-mentioned thickness of 15 mm. An additional wood wool board on the other surface of the insulant layer facing inside the building may also have a thickness of less than 15 mm.

The thickness of the wood wool board of the present invention is at least 15 mm to achieve the above-described advantageous thermal energy-storing effect. Examples of thickness of the wood wool board of the present invention include ranges of 15 to 100 mm, 15 to 80 mm, 15 to 60 mm, 15 to 50 mm, 15 to 40 mm, 15 to 35 mm and 15 to 30 mm. Other examples of thickness ranges of the wood wool board of the present invention include ranges of 20 to 50 mm, 25 to 50 mm, 30 to 50 mm and 35 to 50 mm. According to a preferred embodiment, the thickness of the wood wool board of the present invention is in the range of 25 to 35 mm, since in such a board an appropriate
amount of thermal energy is stored to reduce algae and mould formation, while at the same time the wood wool board can still be easily handled and readily used at the construction site.

Typical wood wool boards usable in the present invention, which have for example been commercialized under the trade names Heraklith® and Tektalan®, usually consist of wood wool shavings bonded together with a binding agent, notably an inorganic binding agent, for example a magnesite binding agent. The term wood wool shavings as used herein includes wood wool and/or wood shavings and/or wood fibers. The proportion of binding agent with respect to the entire wood wool board is usually between 10 and 70 % by weight, preferably 15 to 65 % by weight, more preferably 20 to 60 % by weight, more preferably 25 to 55 % by weight, more preferably 30 to 55 % by weight, and most preferably 35 to 50 % by weight.

When such a wood wool board having a thickness of at least 15 mm is used in the external thermal insulation composite systems according to the present invention between the insulant layer and the plaster, the wood wool board of the present invention stores thermal energy during daytime (e.g. solar radiation). Accordingly, the stored thermal energy reduces cooling of the plaster during the night and/or at low temperatures. Thereby, the formation of condensation moisture caused by ambient temperatures below the dew point is remarkably reduced. At the same time drying of the facade after rainfall is also improved, i.e. the drying time of the facade is shortened. As a consequence of these advantageous effects, the formation of algae and mould is significantly reduced or avoided. The above-described thermal energy-storing effect can further be improved when the plaster is painted in dark colours for better absorption of radiation energy.

According to one embodiment, the wood wool board has a specific thermal capacity of at least 1400 J/kg-K, preferably at least 1700 J/kg-K, more preferably at least 2100 J/kg-K. Such specific thermal capacities may be used to provide advantageous levels of storage of thermal energy to reduce algae and mould formation, notably in combination with convenient thicknesses of wood wool boards.
Preferably, the wood wool board of the present invention has a density in the range of 100 to 900 kg/m³, more preferably 200 to 800 kg/m³, more preferably 250 to 700 kg/m³, more preferably 300 to 600 kg/m³ and most preferably 350 to 500 kg/m³.

According to one embodiment of the present invention, the thermal insulation composite system (ETICS) is a multilayer slab comprising a rigid foam layer and at least one wood wool board arranged on at least one of the main surfaces of the rigid foam layer. According to another embodiment of the present invention, the thermal insulation composite system (ETICS) is a multilayer slab comprising a mineral wool layer and at least one wood wool board arranged on at least one of the main surfaces of a mineral wool layer. If the ETICS of the present invention comprises two wood wool boards on both main surfaces of an insulant layer (e.g. rigid foam layer or mineral wool layer), it is advantageously possible to thermally insulate a building (prevent unwanted heat loss or gain), while at the same time storing thermal energy on the exterior wall, thereby reducing algae and mould formation.

The type of connection of the wood wool board and the insulant layer forming the ETICS according to the present invention is not particularly limited. According to a preferred embodiment, the wood wool board is adhered to a pre-assembled insulant layer by using an adhesive. Typical adhesives include various mineral glues, such as mineral mortars and cements. Moreover, for improved fixation, anchors, such as screw anchors, may be used, notably in addition to an adhesive.

Another aspect of the present invention relates to a method for thermally insulating a facade of a building, the method comprising the steps of applying an insulant layer on a building surface; and applying a wood wool board having a thickness of at least 15 mm on the insulant layer. In this context, the term "building surface" is not specifically limited and includes surfaces, for example facades and exterior walls of a building, which are to be thermally and/or acoustically insulated and on top of which the ETICS of the present invention may be applied. According to the present invention, the building surface may already comprise one or more functional layers applied thereon, for example moisture barriers, sound insulation materials and the like.
The insulant layer and the wood wool board of the methods according the present invention are the same as described above. For example, the thickness of the wood wool board is at least 15 mm, preferably at least 25 mm, at least 35 mm or at least 50 mm.

The mode of applying the insulant layer on the facade of a building, and the mode of applying the wood wool board on the insulant layer are not particularly limited. According to a preferred embodiment, the wood wool board is adhered to the insulant layer by using an adhesive, for example a mineral glue, including mineral mortars and cements. Moreover, for improved fixation, anchors, such as screw anchors, may be used in addition to an adhesive.

A further aspect of the present invention relates to another method for thermally insulating a facade of a building, the method comprising the steps of applying the external thermal insulation composite system (ETICS) according to the present invention on a building surface, arranged in the order building surface/insulant layer/wood wool board, or in the order building surface/wood wool board/insulant layer/wood wool board.

The mode for applying the ETICS on the building surface is not particularly limited. For example, various glues including mineral glues and/or various fixation systems including anchors, e.g. screw anchors, etc., can be used as such or in combination.

The methods as defined above may further comprise a step of plastering the exterior surface of the wood wool board. Preferably, the plaster is subsequently painted in dark colours to further improve the thermal energy-storing effect of the present invention, which results in a further reduction of algae and mould formation.

Another aspect of the present invention relates to the use of a wood wool board having a thickness of at least 15 mm as the outermost layer of an external thermal insulation composite system (ETICS).

The wood wool board and the ETICS are the same as defined above. The term
“outermost layer” used according to the present invention means the respective surface of an external thermal insulation composite system which faces outside the building, and on which plaster is optionally applied.

The external thermal insulation composite system (ETICS) of the present invention is advantageously effective in the reduction of algae and mould formation on a facade surface. Due to the specific thickness of the wood wool board comprised in the ETICS of the present invention and its specific high thermal capacity, the ETICS of the present invention efficiently stores thermal energy during daytime, and thus advantageously reduces cooling of the plaster of a building etc. during the night/at low temperatures. Accordingly, moisture generation caused by low ambient temperatures falling below the dew point is advantageously reduced. Also the drying time of the facade after rainfall is shortened which leads to a desirable reduction of algae and mould formation.

Since typical wood wool boards, such as particularly Heraklith® and Tektalan® boards, usable in the ETICS of the present invention are also available as non-combustible building materials which meet the requirements of class A2 building materials, the ETICS of the present invention are advantageously not limited with regard to the height of the construction. Moreover, when the surface of the ETICS of the present invention, i.e. the surface of the wood wool board comprised in the ETICS, is plastered, the plaster shows an increased impact resistance which is based on the excellent adherence of the plaster to the wood wool board. In addition, such an ETICS further provides improved acoustic insulation.
Claims

1. An external thermal insulation composite system (ETICS) for reduction of algae and mould formation on a facade surface, the external thermal insulation composite system comprising an insulant layer and at least one wood wool board, wherein the at least one wood wool board has a thickness of at least 15 mm.

2. The external thermal insulation composite system according to claim 1, wherein the at least one wood wool board has a thickness in the range of 25 mm to 35 mm.

3. The external thermal insulation composite system according to claim 1 or 2, wherein the wood wool board has a specific thermal capacity of at least 1400 J/kg-K.

4. The external thermal insulation composite system according to any one of claims 1 to 3, wherein the wood wool board has a density in the range of 100 to 900 kg/m$^3$.

5. The external thermal insulation composite system according to any one of claims 1 to 4, wherein the insulant layer has a thickness of at least 10 cm.

6. The external thermal insulation composite system according to any one of claims 1 to 5, wherein the insulant layer comprises at least one member selected from the group consisting of mineral wool and rigid foam.

7. The external thermal insulation composite system according to claim 6, wherein the mineral wool comprises slag wool fibers, rock wool fibers, glass wool fibers, ceramic fibers or combinations thereof, and the rigid foam comprises a polyvinyl chloride rigid foam, an expanded polystyrene rigid foam, an extruded polystyrene rigid foam, a polyisocyanurate rigid foam, a polyurethane rigid foam, a phenolic rigid foam, or combinations thereof.
8. The external thermal insulation composite system according to any one of claims 1 to 5, wherein the ETICS is a multilayer slab comprising a rigid foam layer and at least one wood wool board arranged on at least one of the main surfaces of the rigid foam layer.

9. The external thermal insulation composite system according to any one of claims 1 to 7, wherein the wood wool board is adhered to a pre-assembled insulant layer by using an adhesive, and optionally by using anchors as a further fixation.

10. A method for thermally insulating a facade of a building, the method comprising the steps of applying an insulant layer on a building surface; and applying a wood wool board having a thickness of at least 15 mm on the insulant layer.

11. The method according to claim 10, wherein, in the step of applying the wood wool board on the insulant layer, the wood wool board is adhered to the insulant layer by using an adhesive, and optionally by using anchors as a further fixation.

12. A method for thermally insulating a facade of a building, the method comprising applying an external thermal insulation composite system as defined in any one of claims 1 to 9 on a building surface, arranged in the order building surface/insulant layer/wood wool board or in the order building surface/wood wool board/insulant layer/wood wool board.

13. The method according to any one of claims 10 to 12, further comprising a step of plastering the exterior surface of the wood wool board.

14. Use of a wood wool board having a thickness of at least 15 mm as the outermost layer of an external thermal insulation composite system (ETICS).

15. Use of a wood wool board in accordance with claim 14, in which the use
comprises the use of the wood wool board to reduce the presence of mold and/or algae at a building facade.
**INTERNATIONAL SEARCH REPORT**

**Inv. E04B1/76 E04C2/24**

According to International Patent Classification (IPC) and both national classification and IPC

**B. FIELDS SEARCHED**

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<td>E04B E04C B32B</td>
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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
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<td>EP 2 281 961 A1 (KNAUF INSULATION TECHNOLOGY GMBH [AT]) 9 February 2011 (2011-02-09)</td>
<td>1, 2, 4-15</td>
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<tr>
<td>A</td>
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<td>A</td>
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</tr>
<tr>
<td>A</td>
<td>CH 485 083 A (ISOTEX LEICHTBAUPLATTENWERK KA [DE]) 31 January 1970 (1970-01-31) the whole document</td>
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Further documents are listed in the continuation of Box C. See patent family annex.

- **A** document defining the general state of the art which is not considered to be of particular relevance
- **E** earlier application or patent or published on or after the international filing date
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**Date of the actual completion of the international search**

1 July 2013

**Date of mailing of the international search report**

15/07/2013

Name and mailing address of the ISA/Authorized officer

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<tr>
<td>EP 2281962 A2</td>
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<td>EP 2277692 A2</td>
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