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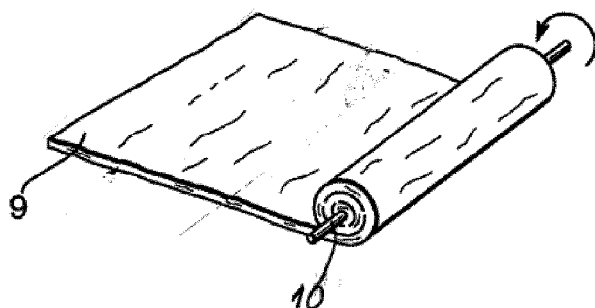


Figure 1

(57) Abstract: The present invention describes a mineral wool product comprising mineral fibers bound by a binder resulting from the curing of a binder composition comprising a hydrophobic agent comprising: at least one silicone compound, such as silicone resin, such as a reactive silicone resin, such as a reactive silicone resin chosen from the group of polyalkylethoxysiloxane, polymethylethoxysiloxane, polyphenylethoxysiloxane, polyphenylsiloxane, polyphenylmethylsiloxane; to inhibit corrosion when insulating metallic structures.

Use of a mineral wool product

Field of the Invention

The present invention relates to the use of a mineral wool product comprising mineral fibers bound by a binder resulting from the curing of a binder composition comprising a hydrophobic agent comprising at least one silicone compound to inhibit corrosion when insulating metallic structures. The present invention is also directed to a binder composition for mineral fibers comprising such a hydrophobic agent, a mineral wool product comprising mineral fibers bound by a binder resulting from the curing of such a binder composition and a method for producing a mineral wool product which comprises the steps of contacting mineral fibers with such a binder composition.

Background of the Invention

Corrosion is the deterioration of a metal as result of a chemical reaction between it and the surrounding environment. Corrosion involves the conversion of the metal to a more chemically stable form, such as oxide, hydroxide or sulfide.

Corrosion of steel occurs in the presence of water and oxygen. Corrosion of steel parts is a major economic problem which often times makes up a major part of the maintenance and renewal costs of steel structures.

A very specific problem is the problem of corrosion under insulation (CUI) which affects steel parts which are thermally isolated by an insulating material. Steel structures are often insulated in order to avoid heat loss. Such a thermal insulation might be desirable for steel structures which are much warmer or colder than their surrounding environment. CUI occurs in particular under insulation for steel structures which undergo cyclic temperature changes like e.g. pipelines in the oil and gas industry.

Since corrosion of steel occurs in the presence of water and oxygen, the presence of water in contact with the steel structure is a major factor contributing to corrosion. Since thermal insulation materials surrounding the steel structures in order to avoid heat loss tend to keep water in contact with the steel structure for a longer time than the contact would last without the surrounding insulating material, such insulating materials can contribute to increased corrosion. Steels are in general susceptible to CUI in the temperature range of 0 °C to 175 °C. The most frequently occurring types of CUI are general and pitting corrosion of carbon steel which may occur if wet insulation comes in contact with carbon steel, and external stress corrosion cracking (ESCT) of austenitic stainless steel, which is a specific type of corrosion mainly caused by the action of water-soluble chloride from rain water or if the insulation is not meeting the appropriate requirements. Since the corroded surface is mostly hidden by the insulation system and will not be observed until the insulation is removed for inspection or in the event of metal failure leading to incidents, it is very important to control CUIs as much as possible.

In order to avoid CUI, the insulated steel structures are often covered by an additional cladding which is to prevent the entering of water. However, experience shows that water often enters via fault or damages in the cladding system or via humid air in structures which undergo cyclic temperature changes. Water may also come into contact with the steel structure internally from non-tight fittings or externally from events like flooding.

In order to avoid CUI, steel structures like pipelines in the oil and gas industries are often protected against corrosion by coating the steel parts with a protective

layer, e.g. with other metals like zinc or aluminum. However, such coating layers are never a completely protecting layer and these protective measures can be extremely cost-intensive and might be economically unacceptable for extensive pipeline systems.

There have been previous attempts to use mineral wool products as insulation of metallic structures and still protect them from CUI. The most common way to reduce CUI is by use of a mineral wool product prepared from a mineral wool binder to which a mineral oil has been added. By adding mineral oil, the water repellent requirements according to EN13472 can be met. However, for these mineral wool products, the inhibition of CUI is still not satisfactory, because the water absorption is still too high. In addition, these mineral wool products used as insulation materials suffer from the disadvantage that when exposed to higher temperatures, the water absorbance quickly raises to unacceptable levels. This is in particular a problem for the use of such insulation materials for insulating pipelines in the oil and gas industry since in these pipelines operating temperatures often exceed 150°C. Under these conditions, the water repellent properties of these insulation materials are quickly lost.

The problems associated with CUI can be so serious, that some companies choose to avoid thermal insulation of pipelines even though this leads to a highly energy-inefficient operation.

Summary of the Invention

Accordingly, it was an object of the present invention to provide an insulation of a metallic structure that allows effective thermal insulation of such a structure and at the same time minimizes maintenance costs and optimizes durability of the structure.

In particular, it was an object of the present invention to provide an insulation of a metallic structure that allows effective thermal insulation of such a structure and at the same time minimizes corrosion of the metallic structure

It was a further object of the present invention to provide a binder composition for mineral fibers which allows the production of a mineral wool product for such purposes.

It was a further object of the present invention to provide a mineral wool product prepared with such a binder composition.

It was a further object of the present invention to provide a method of making such a mineral wool product.

In accordance with a first aspect of the present invention, there is provided the use of a mineral wool product comprising mineral fibers bound by a binder resulting from the curing of a binder composition comprising a hydrophobic agent comprising at least one silicone compound, such as silicone resin, such as a reactive silicone resin, such as a reactive silicone resin chosen from the group of polyalkylethoxysiloxane, polymethylethoxysiloxane, polyphenylethoxysiloxane, polyphenylsiloxane, polyphenylmethysiloxane to inhibit corrosion when insulating metallic structures.

In accordance with a second aspect of the present invention, there is provided a binder composition for mineral fibers comprising a phenol-formaldehyde-based resin, and/or a carbohydrate-containing component, and a hydrophobic agent comprising (i) at least one silicone compound, such as silicone resin, such as a reactive silicone resin, such as a reactive silicone resin chosen from the group of polyalkylethoxysiloxane, polymethylethoxysiloxane, polyphenylethoxysiloxane, polyphenylsiloxane, polyphenylmethysiloxane, (ii) at least one hardener, such as silane, such as alkyltriethoxysilane, such as octyltriethoxysilane, (iii) at least one emulsifier.

In accordance with a third aspect of the present invention, there is provided a mineral wool product comprising mineral fibers bound by a binder resulting from the curing of a binder composition comprising a phenol-formaldehyde-based resin, and/or a carbohydrate-containing component, a hydrophobic agent comprising (i) at least one silicone compound, such as silicone resin, such as a reactive silicone resin, such as a reactive silicone resin chosen from the group of polyalkylethoxysiloxane, polymethylethoxysiloxane, polyphenyl-

ethoxysiloxane, polyphenylsiloxane, polyphenylmethysiloxane, (ii) at least one hardener, such as silane, such as alkyltriethoxysilane, such as octyltriethoxysilane, (iii) at least one emulsifier.

In accordance with a fourth aspect of the present invention, there is provided a method for producing a mineral wool product which comprises the steps of contacting mineral fibers with a binder composition comprising a phenol-formaldehyde-based resin, and/or a carbohydrate-containing component, and a hydrophobic agent comprising (i) at least one silicone compound, such as silicone resin, such as a reactive silicone resin, such as a reactive silicone resin chosen from the group of polyalkylethoxysiloxane, polymethylethoxysiloxane, polyphenylethoxysiloxane, polyphenylsiloxane, polyphenylmethysiloxane, (ii) at least one hardener, such as silane, such as alkyltriethoxysilane, such as octyltriethoxysilane, (iii) at least one emulsifier.

The present inventors have surprisingly found that a very specific hydrophobic agent can impart properties to a mineral wool binder which allow the use of a mineral wool product prepared from mineral fibers bound by such a binder as an insulation of a metallic structure and at the same time avoid problems with corrosion under insulation, associated with previously-known insulation products.

Description of the Preferred Embodiments

The present invention is directed to a use of a mineral wool product comprising mineral fibers bound by a binder resulting from the curing of a binder composition comprising a hydrophobic agent comprising at least one silicone compound, such as silicone resin, such as a reactive silicone resin, such as a reactive silicone resin chosen from the group of polyalkylethoxy-siloxane, polymethylethoxysiloxane, polyphenylethoxy-siloxane, polyphenyl-siloxane, polyphenylmethysiloxane to inhibit corrosion when insulating metallic structures.

Hydrophobic Agent

The present inventors have surprisingly found that by the use of the very specific hydrophobic agent described herein, corrosion problems in form of corrosion under insulation can be avoided. Without wanting to be bound to any specific

theory, the present inventors assume that the corrosion problems associated with the previously-known use of insulation elements for metal structures are connected to the so-called wicking-effect of such insulation products. This wicking effect of the insulation products causes moisture, once it has entered the system, to be retained for a prolonged period of time at the surface of the metal structure. Accordingly, such insulation materials prolong the time during which the surface of the metal structure is kept in contact with water which contributes to an increased rate of corrosion in particular at higher temperatures.

Without wanting to be bound to any specific theory the present inventors assume that the use of the very specific hydrophobic agent described herein allows a quicker dry out time which allows an inhibition of corrosion.

It has now surprisingly been found that by use of mineral wool products prepared from a binder containing the hydrophobic agent described herein, excellent insulation characteristics can be attained while at the same time the corrosion under insulation is effectively inhibited.

In one embodiment, the binder composition comprises a phenol-formaldehyde based resin, and/or a carbohydrate containing component.

In one embodiment, the hydrophobic agent comprises at least one hardener, such as silane, such as octyltriethoxysilane.

In one embodiment, the hydrophobic agent comprises at least one emulsifier.

In one embodiment, the mineral wool product is used as insulation of a metallic structure, said structure having an operating temperature between 0-650 °C, such as between 25-500 °C, such as between 70-300 °C, such as between 300-650 °C.

In one embodiment, the present invention is directed to the use of a mineral wool product comprising mineral fibers bound by a binder resulting from the curing of a binder composition comprising a hydrophobic agent comprising at least one silicone compound, such as silicone resin, such as a reactive silicone resin, such as a reactive silicone resin chosen from the group of polyalkylethoxysiloxane, polymethylethoxysiloxane, polyphenylethoxysiloxane, polyphenylsiloxane, polyphenylmethysiloxane; at least one hardener, such as silane, such as octyltriethoxysilane; at least one emulsifier; and wherein the use is as insulation of a metallic structure, said structure having an operating temperature between 0-650 °C, such as between 25-500 °C, such as between 70-300 °C, such as between 300-650 °C.

In one embodiment, the hydrophobic agent comprises (i) in an amount of 20 to 90 percent by weight, in particular 30 to 60 percent by weight, based on the weight of the hydrophobic agent.

In one embodiment, the hydrophobic agent comprises (i) in form of polymethylethoxysiloxane.

In one embodiment, the hydrophobic agent comprises (ii) in an amount of 0.5 to 10 percent by weight, in particular 1 to 5 percent by weight, based on the total weight of the hydrophobic agent.

In one embodiment, the hydrophobic agent comprises (ii) in form of octyltriethoxysilane.

In an alternative embodiment, the silicone compound component (i) also serves as the hardener component (ii) of the hydrophobic agent. Accordingly, in this alternative embodiment, the hydrophobic agent comprises at least one silicone compound, such as silicone resin, such as a reactive silicone resin, such as a reactive silicone resin chosen from the group of polyalkylethoxysiloxane, polymethylethoxysiloxane, polyphenylethoxysiloxane, polyphenylsiloxane, polyphenylmethysiloxane, and at least one emulsifier.

Accordingly, in one embodiment, the hardener is another compound than the silicone compound. In an alternative embodiment, the hardener is comprised in the silicone compound as a curable system. In this alternative embodiment, the hardener may be the feature that is effected by an intra-molecular hardening of the silicone compound.

In one embodiment, the hydrophobic agent comprises (i) in an amount of 30 to 60 percent by weight, (ii) in an amount of 1 to 5 percent by weight, based on the total weight of the hydrophobic agent, the remainder being (iii) and optionally other components and trace amounts of ethanol.

In one embodiment, the hydrophobic agent comprises polymethylethoxysiloxane in an amount of 30 to 60 percent by weight, octyltriethoxysilane in an amount of 1 to 5 percent by weight, based on the total weight of the hydrophobic agent, the remainder being (iii) and optionally other components and trace amounts of ethanol.

In one embodiment, the binder composition mineral wool product comprises the hydrophobic agent in an amount of 0.05 to 2 percent by weight, such as 0.10 to 1 percent by weight, such as 0.15 to 0.8 percent by weight, based on the weight of the aqueous binder composition mineral wool product.

In one embodiment, the binder composition comprises a carbohydrate-containing binder component, wherein the binder component further comprises (a) a polycarboxylic acid component or any salt thereof and/or an inorganic acid or any salt thereof, and/or (b) a component selected from the group consisting of amine compounds, ammonia; and optionally, and/or (c) a reaction product of a polycarboxylic acid component or anhydride thereof and an alkanolamine component.

In one embodiment, the mineral wool product is a pipe section or a mat or wired mat.

Binder Composition

The present invention is also directed to a binder composition for mineral fibers comprising: a phenol-formaldehyde-based resin, and/or a carbohydrate-containing component; and a hydrophobic agent comprising: (i) at least one silicone compound, such as silicone resin, such as a reactive silicone resin, such as a reactive silicone resin chosen from the group of polyalkylethoxysiloxane, polymethylethoxysiloxane, polyphenylethoxysiloxane, polyphenylsiloxane, polyphenylmethysiloxane, (ii) at least one hardener, such as silane, such as alkyltriethoxysilane, such as octyltriethoxysilane, (iii) at least one emulsifier.

This binder composition, which comprises a specific hydrophobic agent, allows the production of mineral wool products which can be used as insulation of a metallic structure having very good insulation characteristics and at the same time allows the inhibition of corrosion under insulation.

In one embodiment, the hydrophobic agent comprises (i) in an amount of 20 to 90 percent by weight, in particular 30 to 60 percent by weight, based on the weight of the hydrophobic agent.

In one embodiment, the hydrophobic agent comprises (i) in form of polymethylethoxysiloxane.

In one embodiment, the hydrophobic agent comprises (ii) in an amount of 0.5 to 10 percent by weight, in particular 1 to 5 percent by weight, based on the total weight of the hydrophobic agent.

In one embodiment, the hydrophobic agent comprises (ii) in form of octyltriethoxysilane.

In an alternative embodiment, the silicone compound component (i) also serves as the hardener component (ii) of the hydrophobic agent. Accordingly, in this alternative embodiment, the hydrophobic agent comprises at least one silicone compound, such as silicone resin, such as a reactive silicone resin, such as a reactive silicone resin chosen from the group of polyalkylethoxysiloxane, polymethylethoxysiloxane, polyphenylethoxysiloxane, polyphenylsiloxane, polyphenylmethysiloxane, and at least one emulsifier.

Accordingly, in one embodiment, the hardener is another compound than the silicone compound. In an alternative embodiment, the hardener is comprised in the silicone compound as a curable system. In this alternative embodiment, the hardener may be the feature that is effected by an intra-molecular hardening of the silicone compound.

In one embodiment, the hydrophobic agent comprises (i) in an amount of 30 to 60 percent by weight, (ii) in an amount of 1 to 5 percent by weight, based on the total weight of the hydrophobic agent, the remainder being (iii) and optionally other components and trace amounts of ethanol.

In one embodiment, the hydrophobic agent comprises polymethylethoxysiloxane in an amount of 30 to 60 percent by weight, octyltriethoxysilane in an amount of 1 to 5 percent by weight, based on the total weight of the hydrophobic agent, the remainder being (iii) and optionally other components and trace amounts of ethanol.

Mineral Wool Product

The mineral fibres employed for the production of the mineral wool products may be any of man-made vitreous fibres (MMVF), glass fibres, ceramic fibres, basalt fibres, slag fibres, stone fibres and others. These fibres may be present as a wool product, e.g. like a stone wool product.

The present invention is directed to a mineral wool product comprising mineral fibers bound by a binder resulting from the curing of a binder composition comprising a phenol-formaldehyde-based resin, and/or a carbohydrate-containing component, a hydrophobic agent comprising: (i) at least one silicone compound, such as silicone resin, such as a reactive silicone resin, such as a reactive silicone resin chosen from the group of polyalkylethoxysiloxane, polymethylethoxysiloxane, polyphenylethoxysiloxane, polyphenylsiloxane, polyphenylmethylsiloxane, (ii) at least one hardener, such as silane, such as alkyltriethoxysilane, such as octyltriethoxysilane, (iii) at least one emulsifier.

In one embodiment, the hydrophobic agent comprises (i) in an amount of 20 to 90 percent by weight, in particular 30 to 60 percent by weight, based on the weight of the hydrophobic agent.

In one embodiment, the hydrophobic agent comprises (i) in form of polymethylethoxysiloxane.

In one embodiment, the hydrophobic agent comprises (ii) in an amount of 0.5 to 10 percent by weight, in particular 1 to 5 percent by weight, based on the total weight of the hydrophobic agent.

In one embodiment, the hydrophobic agent comprises (ii) in form of octyltriethoxysilane.

In an alternative embodiment, the silicone compound component (i) also serves as the hardener component (ii) of the hydrophobic agent. Accordingly, in this alternative embodiment, the hydrophobic agent comprises at least one silicone compound, such as silicone resin, such as a reactive silicone resin, such as a reactive silicone resin chosen from the group of polyalkylethoxysiloxane, polymethylethoxysiloxane, polyphenylethoxysiloxane, polyphenylsiloxane, polyphenylmethylsiloxane, and at least one emulsifier.

Accordingly, in one embodiment, the hardener is another compound than the silicone compound. In an alternative embodiment, the hardener is comprised in the silicone compound as a curable system. In this alternative embodiment, the hardener may be the feature that is effected by an intra-molecular hardening of the silicone compound.

In one embodiment, the hydrophobic agent comprises (i) in an amount of 30 to 60 percent by weight, (ii) in an amount of 1 to 5 percent by weight, based on the total weight of the hydrophobic agent, the remainder being (iii) and optionally other components and trace amounts of ethanol.

In one embodiment, the hydrophobic agent comprises polymethylethoxysiloxane in an amount of 30 to 60 percent by weight, octyltriethoxysilane in an amount of 1 to 5 percent by weight, based on the total weight of the hydrophobic agent, the

remainder being (iii) and optionally other components and trace amounts of ethanol.

In one embodiment, the mineral wool product comprises the hydrophobic agent in an amount of 0.05 to 2 percent by weight, such as 0.10 to 1 percent by weight, such as 0.15 to 0.8 percent by weight, based on the weight of the mineral wool product.

In one embodiment, the binder composition comprises a carbohydrate-containing binder component, wherein the binder composition further comprises (a) a polycarboxylic acid component or any salt thereof and/or an inorganic acid or any salt thereof, and/or (b) a component selected from the group consisting of amine compounds, ammonia; and optionally, and/or (c) a reaction product of a polycarboxylic acid component or anhydride thereof and an alkanolamine component.

In one embodiment the mineral wool product is in form of an insulation product for thermal insulation of metallic surfaces structures.

In one embodiment the mineral wool product is in form of a pipe section or a mat or wired mat.

Pipe sections are pre-formed (formed in the factory) insulation materials used for the insulation around pipes.

A typical embodiment of such a pipe section is a mandrel wound pipe section.

A mandrel wound pipe section is a pre-formed, full-round cylindrical pipe insulation product which is produced by wrapping an uncured mineral wool blanket around a mandrel in spiral manner for forming and subsequent curing. The cylindrical pipe sections are split and hinged for easy snap-on assembly. Mandrel wound pipe sections can be both faced and un-faced with aluminum foil.

Figure 1 shows how such a mandrel wound pipe section is typically produced. In this method the pipe section is wound from a thin web 9 of mineral wool, preferably stone wool. The web 9 is wound around a perforated mandrel 10 as it

is known when producing wound pipe sections. After winding hot air is conventionally blown from inside the mandrel and through the wound pipe section for curing of the thermoset binder.

An alternative embodiment of a pre-formed pipe section is shown in figure 2.

Figure 2 illustrates a block (1) bonded mineral wool and a cutting string (4) by means of which pipe sections (5) having a tongue/groove-joint (6) and a T-shaped hinge slit (7) are cut out of the block in the transverse direction of the block and parallel to the main surface planes of the block. After cutting out each pipe section 5 is removed from the block.

A further embodiment of a pipe insulation is shown in figure 3 which shows a mat of mineral wool provided with transversally extending V-grooves. Due to the V-grooves the mat can be wrapped around a pipe on site as indicated in the version shown at the front in figure 3.

An alternative embodiment is a mineral wool product in form of a wired mat. Figure 4 is an illustration of such a wired mat.

Figure 4 illustrates in perspective view such a wired mat according to the invention where an insulation layer 1 in terms of a mineral fibre web is provided with a chicken wire 10 which is fastened to the insulating layer 1 by means of an iron thread 14 stitched through the insulating layer. A fixation means 5 in terms of a galvanised iron wire may be in zigzag configuration and placed under the chicken wire 10. In an alternative embodiment, no such fixation means are included.

In a further alternative embodiment, mats are used without any wiring. In this alternative embodiment, the mineral wool product is in form of a mineral wool mat – sometimes also called a slab.

Figure 5 shows how a wired mat according to figure 4 is mounted on a pipe as insulation material.

Figure 5 illustrates an embodiment of the insulating product according to the invention mounted on a pipe 16, where the product comprising insulating layer 1 is adapted to fit the circumference of pipe 16 and fixation means 5a and 5b extending around the mounted product secures the product on the pipe 16 by knots 15a and 15b. The fixation means 5c has not yet been extended to protrude beyond the adjoining end surfaces of the product to enable the fixation thereby.

In one embodiment the mineral wool product has a water absorption according to ASTM C1763-16 of less than 4.0 vol.%, such as less than 2.0 vol.%, such as less than 1.5 vol.%.

In one embodiment the mineral wool product has a water absorption according to EN13472 of less than 1.0 kg/m², such as less than 0.8 kg/m², such as less than 0.5 kg/m², such as less than 0.3 kg/m².

In one embodiment the mineral wool product has water absorption according to EN13472 of less than 1.0 kg/m², such as less than 0.8 kg/m², such as less than 0.5 kg/m², such as less than 0.3 kg/m², following storage of the mineral wool product at 250°C for 24 hours.

In this embodiment, in which the water absorption according to EN13472 is measured following storage of the mineral wool product at 250°C for 24 hours, the following protocol for exposing the product to 250°C for 24 hours is followed:

- Pre-heat a laboratory furnace to 250 °C which is placed under a fume hood.
- Place the samples in the furnace for a period of 24 hours.
- The ventilation of the furnace shall be off, except from the last 30 minutes of the heating when the ventilation shall be on in order to remove fumes from the furnace in a safe way.
- Remove the samples from the furnace and let them cool down to ambient temperature.
- After that proceed with the requested test program for water absorption.

In one embodiment, the mineral wool product according to the present invention has a density of 20 to 150 kg/m³, such as 40 to 130 kg/m³, such as 60-120 kg/m³.

A Method for Producing a Mineral Wool Product

The present invention is also directed to a method for producing a mineral wool product which comprises the steps of contacting mineral fibers with a binder composition comprising a phenol-formaldehyde-based resin, and/or a carbohydrate-containing component, and a hydrophobic agent comprising (i) at least one silicone compound, such as silicone resin, such as a reactive silicone resin, such as a reactive silicone resin chosen from the group of polyalkylethoxysiloxane, polymethylethoxysiloxane, polyphenylethoxysiloxane, polyphenylsiloxane, polyphenylmethysiloxane, (ii) at least one hardener, such as silane, such as alkyltriethoxysilane, such as octyltriethoxysilane, (iii) at least one emulsifier.

In one embodiment, the hydrophobic agent comprises (i) in an amount of 20 to 90 percent by weight, in particular 30 to 60 percent by weight, based on the weight of the hydrophobic agent.

In one embodiment, the hydrophobic agent comprises (i) in form of polymethylethoxysiloxane.

In one embodiment, the hydrophobic agent comprises (ii) in an amount of 0.5 to 10 percent by weight, in particular 1 to 5 percent by weight, based on the total weight of the hydrophobic agent.

In one embodiment, the hydrophobic agent comprises (ii) in form of octyltriethoxysilane.

In an alternative embodiment, the silicone compound component (i) also serves as the hardener component (ii) of the hydrophobic agent. Accordingly, in this alternative embodiment, the hydrophobic agent comprises at least one silicone

compound, such as silicone resin, such as a reactive silicone resin, such as a reactive silicone resin chosen from the group of polyalkylethoxysiloxane, polymethylethoxysiloxane, polyphenylethoxysiloxane, polyphenylsiloxane, polyphenylmethysiloxane, and at least one emulsifier.

Accordingly, in one embodiment, the hardener is another compound than the silicone compound. In an alternative embodiment, the hardener is comprised in the silicone compound as a curable system. In this alternative embodiment, the hardener may be the feature that is effected by an intra-molecular hardening of the silicone compound.

In one embodiment, the hydrophobic agent comprises (i) in an amount of 30 to 60 percent by weight, (ii) in an amount of 1 to 5 percent by weight, based on the total weight of the hydrophobic agent, the remainder being (iii) and optionally other components and trace amounts of ethanol.

In one embodiment, the hydrophobic agent comprises polymethylethoxysiloxane in an amount of 30 to 60 percent by weight, octyltriethoxysilane in an amount of 1 to 5 percent by weight, based on the total weight of the hydrophobic agent, the remainder being (iii) and optionally other components and trace amounts of ethanol.

In one embodiment, the mineral wool product comprises the hydrophobic agent in an amount of 0.05 to 2 percent by weight, such as 0.10 to 1 percent by weight, such as 0.15 to 0.8 percent by weight, based on the weight of the mineral wool product.

In one embodiment, the binder composition comprises a carbohydrate-containing binder component, wherein the binder composition further comprises (a) a polycarboxylic acid component or any salt thereof and/or an inorganic acid or any salt thereof, and/or (b) a component selected from the group consisting of amine compounds, ammonia, and optionally, and/or (c) a reaction product of a polycarboxylic acid component or anhydride thereof and an alkanolamine component.

In one embodiment the method is a method for producing a mineral wool product in form of an insulation product for thermal insulation of metallic surfaces structures.

In one embodiment the method is a method for producing a mineral wool product in form of a pipe section or a mat or wired mat.

The present invention is further illustrated by the following examples:

Examples

Different insulation products were tested with regard to water absorption properties according to the standard ASTM C1763-16 test method.

The results of tests are stated in Table 1.

Sample	Density kg/m ³	Volume cm ³	Mass, initial g	Mass, after immersion (2 hr) g	Mass, recondition (after 48 hr) g	Water Abs. (WA) vol. %	Recovery WA, 2 hr vol. %	Recovery WA, 48 hr vol. %
Roxul SL960, mat	92	4532	415.69	658.47	415.82	5.4	4.9	0.003
E-glass, pipe section	234	2755	646.09	3166.03	2599.29	22.9	22.6	17.73
Roxul, pipe section with Silicone resin BS45	73	2162	158.14	183.88	158.93	1.2	0.5	0.037
Mineral wool, pipe section	145	2427	350.88	832.86	438.04	5.0	4.8	0.898
Roxul PS980, pipe section	183	1776	325.90	806.37	556.76	6.8	6.6	3.249
Mineral wool, mat	80	7582	606.86	2040.20	1269.98	18.9	18.2	8.746

Pipe sections were tested with regard to water absorption properties according to the standard EN13472. The pipe sections were manufactured as a mandrel wound

pipe section and are from the ProRox product series and the tested specimen had a thickness of 50 mm.

The tests were done on both untreated products and products that were aged (250°C/24h).

SILRES BS 45 silicon resin from Wacker had been added to the products in amount of 0.41 wt.%.

The results from a triple-determination are stated in Table 2.

Sample	Water Absorption level according to the EN13472 standard, Initial kg/m ²	Water Absorption level according to the EN13472 standard, Aged (24h, 250°C) kg/m ²
ProRox 960	0.09	0.08

Table 2.

Claims

1. Use of a mineral wool product comprising mineral fibers bound by a binder resulting from the curing of a binder composition comprising a hydrophobic agent comprising:
 - at least one silicone compound, such as silicone resin, such as a reactive silicone resin, such as a reactive silicone resin chosen from the group of polyalkylethoxysiloxane, polymethylethoxysiloxane, polyphenylethoxysiloxane, polyphenylsiloxane, polyphenylmethoxysiloxane;to inhibit corrosion when insulating metallic structures.
2. Use according to claim 1, wherein the binder composition comprises a phenol-formaldehyde-based resin, and/or a carbohydrate containing component.
3. Use according to claim 1 or 2, wherein the hydrophobic agent comprises at least one hardener, such as silane, such as alkyltriethoxysilane, such as alkyltriethoxysilane, such as octyltriethoxysilane.
4. Use according to any one of the claims 1 to 3, wherein the hydrophobic agent comprises at least one emulsifier.
5. Use according to any one of the preceding claims, wherein the mineral wool product is used as insulation of a metallic structure, said structure having an operating temperature between 0-650 °C, such as between 25-500 °C, such as between 70-300 °C, such as between 300-650 °C.
6. Use according to any one of the preceding claims, wherein the hydrophobic agent comprises (i) in an amount of 20 to 90 percent by weight, in

particular 30 to 60 percent by weight, based on the weight of the hydrophobic agent.

7. Use according to any one of the preceding claims, wherein the hydrophobic agent comprises (ii) in an amount of 0.5 to 10 percent by weight, in particular 1 to 5 percent by weight, based on the total weight of the hydrophobic agent.
8. Use according to any one of the preceding claims, wherein the hydrophobic agent comprises (i) in an amount of 30 to 60 percent by weight, (ii) in an amount of 1 to 5 percent by weight, based on the total weight of the hydrophobic agent, the remainder being (iii) and optionally other components and trace amounts of ethanol.
9. Use according to any one of the preceding claims, wherein the hydrophobic agent comprises polymethylethoxysiloxane in an amount of 30 to 60 percent by weight, octyltriethoxysilane in an amount of 1 to 5 percent by weight, based on the total weight of the hydrophobic agent, the remainder being (iii) and optionally other components and trace amounts of ethanol.
10. Use according to any one of the preceding claims, wherein the mineral wool product comprises the hydrophobic agent in an amount of 0.05 to 2 percent by weight, such as 0.10 to 1 percent by weight, such as 0.15 to 0.8 percent by weight, based on the weight of the mineral wool product.
11. Use according to any one of the preceding claims, wherein the binder composition comprises a carbohydrate-containing binder component, wherein the binder composition further comprises:
 - (a) a polycarboxylic acid component or any salt thereof and/or an inorganic acid or any salt thereof, and/or
 - (b) a component selected from the group consisting of amine compounds, ammonia; and optionally, and/or
 - (c) a reaction product of a polycarboxylic acid component or anhydride thereof and an alkanolamine component.

12. Use according to any one of the preceding claims, wherein the mineral wool product is a pipe section or a mat or wired mat.
13. A binder composition for mineral fibers comprising:
 - a phenol-formaldehyde-based resin, and/or a carbohydrate-containing component; and
 - a hydrophobic agent comprising:
 - (i) at least one silicone compound, such as silicone resin, such as a reactive silicone resin, such as a reactive silicone resin chosen from the group of polyalkylethoxysiloxane, polymethylethoxysiloxane, polyphenylethoxysiloxane, polyphenylsiloxane, polyphenylmethysiloxane;
 - (ii) at least one hardener, such as silane, such as alkyltriethoxysilane, such as octyltriethoxysilane;
 - (iii) at least one emulsifier.
14. A binder composition according to claim 13, wherein the hydrophobic agent comprises (i) in an amount of 20 to 90 percent by weight, in particular 30 to 60 percent by weight, based on the weight of the hydrophobic agent.
15. A binder composition according to claim 13 or 14, wherein the hydrophobic agent comprises (ii) in an amount of 0.5 to 10 percent by weight, in particular 1 to 5 percent by weight, based on the total weight of the hydrophobic agent.
16. A binder composition according to any one of claims 13 to 15, wherein the hydrophobic agent comprises (i) in an amount of 30 to 60 percent by weight, (ii) in an amount of 1 to 5 percent by weight, based on the total weight of the hydrophobic agent, the remainder being (iii) and optionally other components and trace amounts of ethanol.

17. A binder composition according to any one of claims 13 to 16, wherein the hydrophobic agent comprises polymethylethoxysiloxane in an amount of 30 to 60 percent by weight, octyltriethoxysilane in an amount of 1 to 5 percent by weight, based on the total weight of the hydrophobic agent, the remainder being (iii) and optionally other components and trace amounts of ethanol.
18. A binder composition according to claims 13 to 17, wherein the binder composition comprises a carbohydrate-containing binder component, wherein the binder composition further comprises:
 - (a) a polycarboxylic acid component or any salt thereof and/or an inorganic acid or any salt thereof, and/or
 - (b) a component selected from the group consisting of amine compounds, ammonia; and optionally, and/or
 - (c) a reaction product of a polycarboxylic acid component or anhydride thereof and an alkanolamine component.
19. A mineral wool product comprising mineral fibers bound by a binder resulting from the curing of a binder composition comprising a phenol-formaldehyde-based resin, and/or a carbohydrate-containing component;
a hydrophobic agent comprising:
 - (i) at least one silicone compound, such as silicone resin, such as a reactive silicone resin, such as a reactive silicone resin chosen from the group of polyalkylethoxysiloxane, polymethylethoxysiloxane, polyphenylethoxysiloxane, polyphenylsiloxane, polyphenylmethoxysiloxane;
 - (ii) at least one hardener, such as silane, such as alkyltriethoxysilane, such as octyltriethoxysilane;
 - (iii) at least one emulsifier.
20. A mineral wool product according to claim 19, wherein the hydrophobic agent comprises (i) in an amount of 20 to 90 percent by weight, in

particular 30 to 60 percent by weight, based on the weight of the hydrophobic agent.

21. A mineral wool product according to claim 19 or 20, wherein the hydrophobic agent comprises (ii) in an amount of 0.5 to 10 percent by weight, in particular 1 to 5 percent by weight, based on the total weight of the hydrophobic agent.
22. A mineral wool product according to any one of the claims 19 to 21, wherein the hydrophobic agent comprises (i) in an amount of 30 to 60 percent by weight, (ii) in an amount of 1 to 5 percent by weight, based on the total weight of the hydrophobic agent, the remainder being (iii) and optionally other components and trace amounts of ethanol.
23. A mineral wool product according to any one of the claims 19 to 22, wherein the hydrophobic agent comprises polymethylethoxysiloxane in an amount of 30 to 60 percent by weight, octyltriethoxysilane in an amount of 1 to 5 percent by weight, based on the total weight of the hydrophobic agent, the remainder being (iii) and optionally other components and trace amounts of ethanol.
24. A mineral wool product according to any one of the claims 19 to 23, wherein the mineral wool product comprises the hydrophobic agent in an amount of 0.05 to 2 percent by weight, such as 0.10 to 1 percent by weight, such as 0.15 to 0.8 percent by weight, based on the weight of the mineral wool product.
25. A mineral wool product according to any one of the claims 19 to 24, wherein the binder composition comprises a carbohydrate-containing binder component, wherein the binder composition further comprises:
 - (a) a polycarboxylic acid component or any salt thereof and/or an inorganic acid or any salt thereof, and/or
 - (b) a component selected from the group consisting of amine compounds, ammonia; and optionally, and/or

- (c) a reaction product of a polycarboxylic acid component or anhydride thereof and an alkanolamine component.
26. A mineral wool product according to any one of the claims 19 to 25, in form of an insulation product for thermal insulation of metallic structures.
27. A mineral wool product according to any one of the claims 19 to 26, in form of a pipe section or a mat or wired mat.
28. A mineral wool product according to any one of the claims 19 to 27, having a water absorption according to ASTM C1763-16 of less than 4.0 vol.%, such as less than 2.0 vol.%, such as less than 1.5 vol.%.
29. A mineral wool product according to any one of the claims 19 to 28, having a water absorption according to EN13472 of less than 0.5 kg/m², such as less than 0.3 kg/m².
30. A mineral wool product according to any one of the claims 19 to 29, having a water absorption according to EN13472 of less than 1.0 kg/m², such as less than 0.8 kg/m², such as less than 0.5 kg/m², such as less than 0.3 kg/m², following storage of the mineral wool product at 250°C for 24 hours.
31. A method for producing a mineral wool product which comprises the steps of contacting mineral fibers with a binder composition comprising a phenol-formaldehyde-based resin, and/or a carbohydrate-containing component; and a hydrophobic agent comprising:
- (i) at least one silicone compound, such as silicone resin, such as a reactive silicone resin, such as a reactive silicone resin chosen from the group of polyalkylethoxysiloxane, polymethylethoxysiloxane, polyphenylethoxysiloxane, polyphenylsiloxane, polyphenylmethysiloxane;

- (ii) at least one hardener, such as silane, such as alkyltriethoxysilane, such as octyltriethoxysilane;
 - (iii) at least one emulsifier.
- 32. A method for producing a mineral wool product according to claim 31, wherein the hydrophobic agent comprises (i) in an amount of 20 to 90 percent by weight, in particular 30 to 60 percent by weight, based on the weight of the hydrophobic agent.
- 33. A method for producing a mineral wool product according to claim 31 or 32, wherein the hydrophobic agent comprises (ii) in an amount of 0.5 to 10 percent by weight, in particular 1 to 5 percent by weight, based on the total weight of the hydrophobic agent.
- 34. A method for producing a mineral wool product according to any one of the claims 31 to 33, wherein the hydrophobic agent comprises (i) in an amount of 30 to 60 percent by weight, (ii) in an amount of 1 to 5 percent by weight, based on the total weight of the hydrophobic agent, the remainder being (iii) and optionally other components and trace amounts of ethanol.
- 35. A method for producing a mineral wool product according to any one of the claims 31 to 34, wherein the hydrophobic agent comprises polymethyl-ethoxysiloxane in an amount of 30 to 60 percent by weight, octyltriethoxysilane in an amount of 1 to 5 percent by weight, based on the total weight of the hydrophobic agent, the remainder being (iii) and optionally other components and trace amounts of ethanol.
- 36. A method for producing a mineral wool product according to any one of the claims 31 to 35, wherein the mineral wool product comprises the hydrophobic agent in an amount of 0.05 to 2 percent by weight, such as 0.10 to 1 percent by weight, such as 0.15 to 0.8 percent by weight, based on the weight of the mineral wool product.

37. A method for producing a mineral wool product according to any one of the claims 31 to 36, wherein the binder composition comprises a carbohydrate-containing binder component, wherein the binder composition further comprises:
- (a) a polycarboxylic acid component or any salt thereof and/or an inorganic acid or any salt thereof, and/or
 - (b) a component selected from the group consisting of amine compounds, ammonia; and optionally, and/or
 - (c) a reaction product of a polycarboxylic acid component or anhydride thereof and an alkanolamine component.
38. A method for producing a mineral wool product according to any one of the claims 31 or 37, in form of an insulation product for thermal insulation of metallic structures.
39. A method for producing a mineral wool product according to any of the claims 31 to 38, in form of a pipe section or a mat or wired mat.

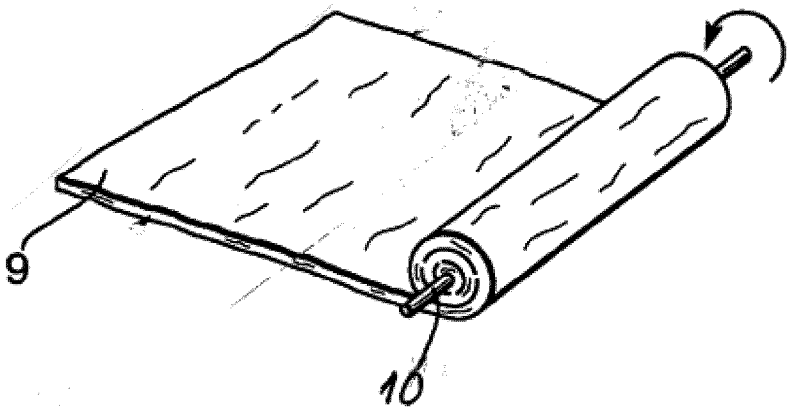


Figure 1

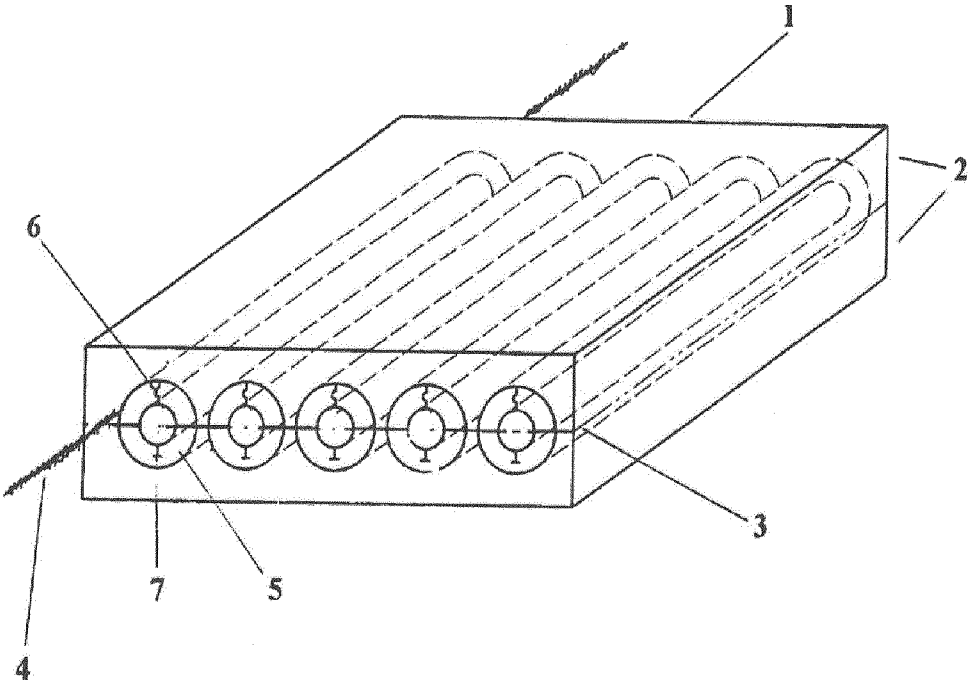


Figure 2

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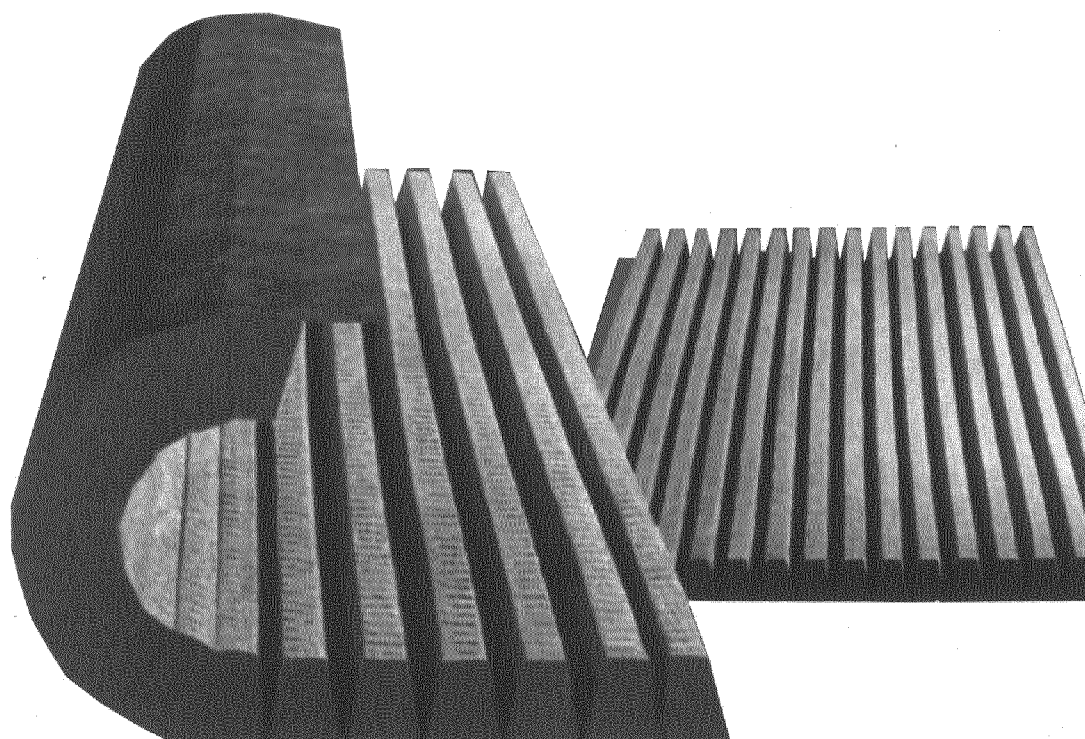


Figure 3

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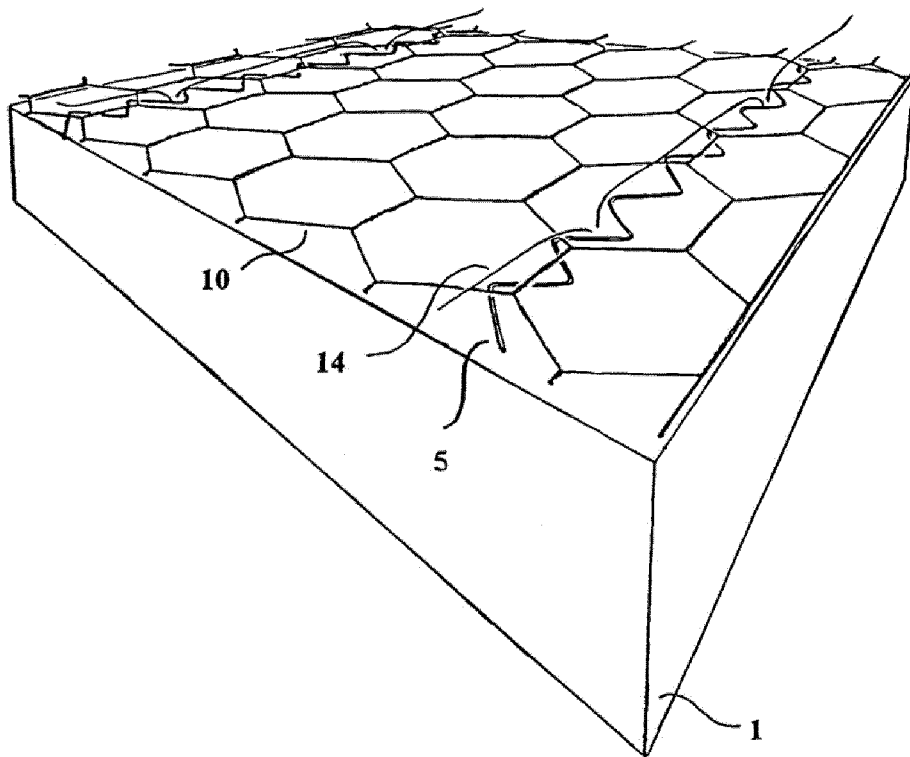


Figure 4

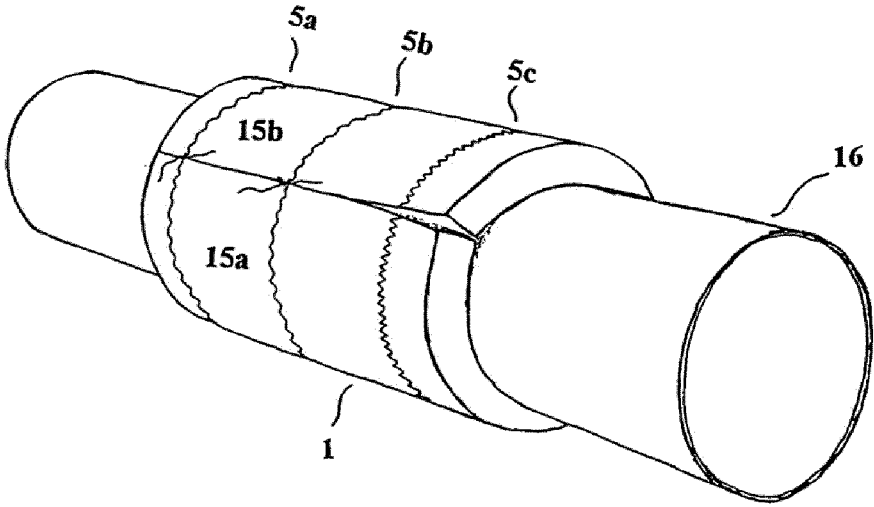


Figure 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/073268

A. CLASSIFICATION OF SUBJECT MATTER

INV. D04H1/4209 C09D183/04 D04H1/4218 D04H1/64 D04H3/002
D04H3/004 F16L59/14

ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D04H C09D F16L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 104 402 211 A (HUZHOU WUXING DOJO URBAN CONSTRUCTION DEV CO LTD) 11 March 2015 (2015-03-11) paragraph [0002] paragraph [0010]; claim 1 -----	13,19, 26,27, 31,38,39
X	US 2012/070645 A1 (JAFFRENNOU BORIS [FR] ET AL) 22 March 2012 (2012-03-22) paragraphs [0067], [0069] - [0070] paragraph [0078] - paragraph [0087]; example 1; table 1 paragraph [0077] paragraph [0059] - paragraph [0064] ----- -/-	13-16, 18-39

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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Date of the actual completion of the international search

10 September 2018

Date of mailing of the international search report

19/09/2018

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/073268

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2008/127936 A2 (KNAUF INSULATION GMBH [US]; SWIFT BRIAN LEE [US]) 23 October 2008 (2008-10-23) page 20, line 9 - page 21, line 2; figure 3 page 33 - page 34; example 6 page 36, line 13; example 7 page 37, line 29 - line 32 page 40 - page 41; tables 3-4 page 17, line 21 - line 26 -----	1-39

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2018/073268

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 104402211	A	11-03-2015	NONE

US 2012070645	A1	22-03-2012	AR 079590 A1 08-02-2012
			AU 2010255574 A1 02-02-2012
			BR PI1011135 A2 06-02-2018
			CA 2763970 A1 09-12-2010
			CN 102459112 A 16-05-2012
			EP 2438129 A1 11-04-2012
			FR 2946352 A1 10-12-2010
			JP 5875977 B2 02-03-2016
			JP 2012528948 A 15-11-2012
			KR 20120034075 A 09-04-2012
			RU 2011154198 A 20-07-2013
			UA 106497 C2 10-09-2014
			US 2012070645 A1 22-03-2012
			WO 2010139899 A1 09-12-2010

WO 2008127936	A2	23-10-2008	CA 2683706 A1 23-10-2008
			EP 2137223 A2 30-12-2009
			US 2011190425 A1 04-08-2011
			US 2014088225 A1 27-03-2014
			US 2016185950 A1 30-06-2016
			US 2017190902 A1 06-07-2017
			WO 2008127936 A2 23-10-2008
