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(54) **PACK OF INSULATING PANELS**

(57) The invention relates to a pack (1) comprising an arrangement of insulating panels (2,2'), wherein all insulating panels are disposed in parallel, and wherein each insulating panel comprises a first layer (3) and a second layer (4). Particularly, the arrangement of the pack of the invention provides a low cost packaging for safely shipping and storing insulating panels. The invention also provides a pallet comprising at least one pack of the invention, the use of the pack or of the pallet of the invention for protecting insulating panels during transportation and handling, and a method for preparing the pack of the invention.

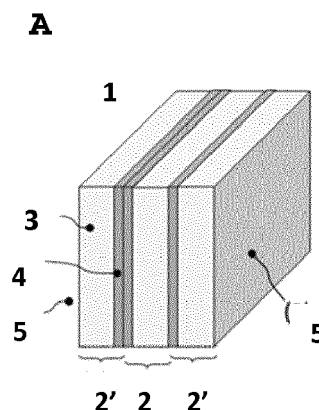


Fig. 1

Description**Field of the invention**

5 **[0001]** The present invention relates to a pack comprising an arrangement of insulating panels according to the preamble of claim 1, a method to manufacture such pack, a pallet comprising such pack and the use of such pack.

Background

10 **[0002]** The façades of buildings are recurrently thermally and acoustically insulated by applying insulating elements externally to the structural elements. For this purpose, the use of generically called "External Thermal Insulation Composite Systems" (abbreviated as ETICS) is nowadays well established. The ETICS commonly comprise a layer of insulation elements (e.g. panels) arranged externally on the surface of a structural element (e.g. the façade), fastening devices, a rendering coating (e.g. mesh reinforced mortar) applied to the external surface of the insulation elements, and optionally a finishing layer (e.g. dyed mortar), acting as an aesthetic and/or protective layer for the outer surface of the system. The insulation elements in these insulation systems are usually formed by panels made of fibrous insulating materials (glass wool, stone wool, or wood wool). These insulation elements are required to have high mechanical robustness and resistance against compression and tearing forces, particularly in the direction of the thickness of the insulation elements.

20 **[0003]** Particularly, ETICS comprising insulation elements with layers of different rigidity have been described as advantageous. In these systems, a softer, more flexible layer is arranged closer to the structural element (internal layer), while a harder, more rigid layer is located further away from the structural element (external layer). In these configurations, the harder layer serves as a resilient base withstanding mechanical stresses applied to the insulation element, while the softer layer reduces the weight of the insulation element, contributes to an improved thermal insulation capacity, and being more flexible, is capable of better adapting itself to contours and irregularities which might be present in the surface of the structural element.

[0004] Insulating panels are normally delivered to construction sites with a suitable protecting packaging in order to preserve their properties. In this sense, the most common packaging is film wrapping.

30 **[0005]** The selection of an appropriate packaging selection is even more critical when mineral wool insulating panels contain two differentiated layers of different consistency, one being rigid and the other deformable, since blows and hits have different effect on both layers. The risk of damages in said insulating panels further increases when they are packed under compression, for instance in film wrapping.

35 **[0006]** WO 2018/007231 discloses a stack of dual density fibrous mineral insulating boards, wherein each insulation board is wrapped individually in a packaging foil. The disclosed mineral insulating boards comprise an upper part having a density within the range of 100-250 kg/m³ and a lower part having a second density within the range of 50-140 kg/m³, wherein the first density is always higher than the second density. The insulating boards are stacked on a transport unit, such as on a pallet, and the stack is wrapped in packaging foil. However, when such stack of fibrous insulating panels is wrapped with film under compression, the film tends to round up the edges and corners of the insulation boards.

40 **[0007]** EP 2635502 B1 also discloses a packing and/or transport unit comprising several fibrous insulation elements arranged in at least one stack and at least one support arranged under the stack. The packing unit is enveloped in a foil which protects the stack. The stack contains at least two different types of fibrous insulation elements arranged alternatively: lamellas, and insulation boards having a higher compression strength. Further, one of the insulation boards with a higher compression strength is arranged on top of the lamellas, serving as a pressure resistant plate to stabilize the packing- and/or transport unit.

45 **[0008]** Similarly, WO 2015/040024 discloses a packing comprising first insulation elements, and second insulation elements having a higher compression strength than the first insulation elements, wherein one of the second insulation elements having a higher compression strength is arranged as a covering on top of the uppermost layer of the first insulation elements.

50 **[0009]** However, in the packaging disclosed in both latter patent documents, blows and hits during handling can cause permanent damage at the external rigid layer, especially at the corners, making the panels useless for ETICS. Moreover, the additional incorporation of reinforcing/protection elements in the panels, such as rigid cardboard corners, may increase the cost of packaging and generate unwanted residues after the transportation. On top, said reinforcing/protection elements, being rigid, can hamper and limit the compression itself.

55 **[0010]** Therefore, there is a need for a packaging solution to guarantee the protection of insulating panels, particularly of dual density fibrous insulating panels during packaging, transportation and handling, which additionally minimizes packaging materials, transportation cost and environmental footprint.

Summary of the invention

[0011] This problem is solved by a pack with the features of claim 1, a method for preparing a pack with the features of claim 11, and the use of the pack according to claim 15. Preferred embodiments follow from the dependent claims.

The inventors of the present invention have found a safe pack for protecting insulating panels, particularly for protecting dual density fibrous insulating panels. The pack according to the present invention removes the need of additional reinforcing elements to protect the insulating panels during packaging, transportation and handling, thus reducing the material and transportation costs, as well as the environmental impact.

[0012] Thus, in a first aspect the present invention provides a pack comprising an arrangement of insulating panels, all insulating panels being disposed in parallel, wherein the arrangement comprises two outermost insulating panels, wherein each insulating panel comprises a first fibrous layer and a second layer, wherein the thickness ratio of the first fibrous layer with respect to the second layer is at least 1, wherein the compressive strength at 10% deformation of the first layer of each insulating panel is at least 1.5 times lower than the compressive strength at 10% deformation of the second layer, characterized in that the two outermost insulating panels of the arrangement are disposed so that the first fibrous layers of said two outermost panels are directed outwards forming the external faces of the arrangement.

[0013] The arrangement of the pack of the invention provides a low cost packaging for safely shipping and storing insulating panels. Unlike the packs of dual density insulating boards known in the art, in the pack of the invention the external faces are formed by the fibrous layers having the lowest compressive strength. In this sense, said external faces having a fibrous structure and being softer or less rigid are able to absorb the shocks and vibrations, thus protecting the pack from damages, and particularly protecting the hardest or most rigid layers (layers with a higher compressive strength) of the insulating panels that, once installed, have to withstand mechanical stresses.

[0014] Additionally, this solution, apart from preventing the need of further reinforcing/protection elements, allows delivering the insulating panels with greater compression, minimizing packaging materials, transportation cost and environmental footprint per m³ of insulating panel.

[0015] In a second aspect, the invention provides a method for preparing the pack of the invention comprising an arrangement of insulating panels, said method comprises:

a) providing insulating panels comprising a first fibrous layer and a second layer, wherein the thickness ratio of the first fibrous layer with respect to the second layer is at least 1, and wherein the compressive strength at 10% deformation of the first fibrous layer of each insulating panel is at least 1.5 times lower than the compressive strength at 10% deformation of the second layer, and

b) arranging the insulating panels of step a) in parallel one with respect to the others so that the first fibrous layers of the outermost insulating panels are outwardly oriented to form the external faces of the arrangement.

[0016] In a third aspect, the invention provides a pallet comprising at least one pack of insulating panels according to the invention.

[0017] A further aspect refers to the use of the pack of the invention or of the pallet of the invention for protecting insulating panels during transportation and handling.

[0018] In an advantageous embodiment, each insulating panel of the inventive pack has a total thickness of 60 - 220 mm, preferably of 80 - 200 mm, more preferably 100 - 190 mm, more preferably, 110 - 180 mm, even more preferably 120 - 170 mm, and most preferably 130-160 mm. The thickness of each insulating panel of the pack of the invention coincides with one dimension of the edge surface.

[0019] In a preferred embodiment, the thickness of the first fibrous layer of the insulating panels forming the pack of the invention, is from 10 to 200 mm, preferably from 30 to 150 mm and more preferably from 40 to 100 mm, depending on the application of the insulating panel.

[0020] In another preferred embodiment, the thickness of the second layer of the insulating panels forming the pack of the invention, is at least 10 mm, more preferably at least 20 mm, more preferably at least 25 mm and even more preferably at least 30 mm or 40 mm.

[0021] In another preferred embodiment, the thickness of the first fibrous layer is about 100 mm, and the thickness of the second layer is about 30 mm or 40 mm.

[0022] In the insulating panels of the inventive pack, the thickness ratio of the first fibrous layer with respect to the second layer is at least 1. In a particular advantageous embodiment the ratio of the first fibrous layer with respect to the second layer is between 1 and 23, preferably between 2 and 19, more preferably between 2.2 and 15 and most preferably between 2.5 and 3.5.

[0023] In another particular embodiment the length of each insulating panel is between 60 and 240 cm, preferably between 80 cm and 200 cm, more preferably between 100 cm and 180 cm, and most preferably between 110 cm and 160 cm.

[0024] In another advantageous embodiment the width of each insulating panel is between 30 and 130 cm, preferably

between 40 and 110 cm, more preferably between 50 and 100 cm, and most preferably between 60 and 80 cm.

[0025] In a preferred embodiment the length of each insulating panel is between 60 and 160 cm and the width is from 50 to 130 cm.

[0026] Moreover, each insulating panel of the inventive pack comprises a first layer and a second layer, wherein the first layer is fibrous. In the context of the present invention, the term "fibrous" in the expression "fibrous layers" refers to layers comprising glass wool, stone wool, and/or wood wool. Thus, in a particular embodiment the first fibrous layer of each panel of the pack of the invention comprises glass wool, stone wool, wood wool and/or mixtures thereof. Preferably, the first fibrous layer of each panel of the pack of the invention is a glass wool layer.

[0027] In an advantageous embodiment the second layer of each insulating panel of the pack of the invention is a fibrous layer, preferably a fibrous layer comprising glass wool, stone wool, wood wool, and/or mixtures thereof. In a particular embodiment, both the first and the second layer of each insulating panel are fibrous layers. Thus, in said embodiment the insulating panel is a fibrous insulating panel. In a preferred embodiment, the first and the second layer of each insulating panel of the pack of the invention are mineral wool layers, preferably glass wool layers.

[0028] In another advantageous embodiment, the second layer of each insulating panel of the pack of the invention is a foamed plastic layer, preferably an extruded polystyrene (XPS) foam layer. In a more preferred embodiment the pack of the invention comprises insulating panels, wherein each panel comprises a first glass wool layer and a second extruded polystyrene (XPS) foam layer.

[0029] The insulating panels of the inventive pack are commonly used to insulate a structural element, such as a wall in a building, so that the first fibrous layer of each insulating panel having a lower compressive strength than the second layer, is arranged more proximal to the structural element, while the second layer having a higher compressive strength is arranged more distal from the structural element.

[0030] In an advantageous embodiment, the first fibrous layer (3) of each insulating panel of the pack of the invention has a density of 100 kg/m³ or lower, preferably 95 kg/m³ or lower, more preferably 55 kg/m³ or lower, even more preferably between 45 kg/m³ and 60 kg/m³, and most preferably about 55 kg/m³.

[0031] In a preferred embodiment, the density of the second layer of each insulating panel is 280 kg/m³ or lower, preferably 200 kg/m³ or lower, more preferably 150 kg/m³ or lower, even more preferably between 70 kg/m³ and 120 kg/m³, and most preferably about 80 kg/m³.

[0032] In another preferred embodiment, the density of the first fibrous layer is about 55 kg/m³, and the density of the second layer is about 80 kg/m³ in each insulating panel.

[0033] In this disclosure, the density of the insulating panel refers to the material as such in the uncompressed and unpacked state. In the case of fibrous insulating panels wherein both the first and the second layers are fibrous, the density of the panel refers to the density of the material including the fiber network and any binder, additive, etc. The skilled person knows how to determine the density of insulating panels. Reference is made to the standard method UNE EN 823:2013 for measuring the thickness of thermal insulating products, from which density can be calculated from the dimensions, and the weight of a fibrous material sample.

[0034] In a particular embodiment, each insulating panel comprises mineral wool, preferably glass wool or stone wool, even more preferably glass wool. Glass wool is a material formed by an intricate network of glass fibers having an average fiber diameter of 2 - 8 micrometers, and bonded in their cross-over points by a binder. The main component of the glass wool are the fibers, being the binder in a much lower amount, usually in a content of less than 30 wt.-% relative to weight of the fibers. In a particular embodiment, the amount of glass fibers is at least 85 wt.-%, preferably at least 90 wt.-%, related to the sum of the weights of the glass fibers and binder. The binder content of the glass wool is defined as the "Loss on Ignition" (LOI), measured according ISO 29771:2008. Preferably, the content of glass wool in the first and optionally second layers of each insulating panel of the pack of the invention is at least 90 wt.-%, more preferably at least 95 wt.-%, wherein the remaining percentage may be of other insulating materials, reinforcing layers or others.

[0035] The term glass wool according to this invention preferably does not cover fibrous materials typically used for facings, coverings, backings, support and/or filtration materials, but not intended as insulation materials, such as non-woven, woven, meshes, scrims, or continuous filament mat products, characterized by being manufactured of glass fibers, but which are usually prepared by weaving, cross-laying, wet-laying, dry-laying or spun-laying methods, and where the binder is applied to the preformed substrate, and not to the loose individual fibers as in the case of glass wool.

[0036] The skilled person in the thermal and acoustic insulation field readily identifies the characteristics making a mineral fiber composition and a glass fiber composition, and differentiates a glass from other minerals. In particular, glass wool is a mineral wool material where the fibers have a glass composition. As a simple practical distinguishing feature, the term "glass fibers" means that the mineral composition of the fibers is characterized by having a weight ratio of alkali metal oxides (i.e. K₂O, Na₂O) relative to earth alkaline metal oxides (i.e. MgO, CaO) higher than 1. In comparison, stone wool or slag wool fibers have a weight ratio of alkali metal oxides to earth alkaline metal oxides of less than 1.

[0037] Preferably, the composition of the glass wool of the first, and optionally second layer of the insulating panels of the pack of the invention contains between 62 and 67 wt.% silica (SiO₂), more preferably 64 wt.% silica; between 3.5 and 6.5 wt.% boron oxide (B₂O₃), preferably between 3.6 and 5 wt.% boron oxide; between 15 and 18 wt.% of alkali

metal oxides, preferably 17 wt.% of alkali metal oxides; and between 8 and 11 wt.% of earth alkaline metal oxides (i.e. MgO, CaO), preferably between 9 and 10 wt.% .

[0038] The composition of the glass wool of the first, and optionally of the second layer of the insulating panels contains a weight ratio of alkali metal oxides (i.e. K_2O , Na_2O) relative to earth alkaline metal oxides (i.e. MgO, CaO) higher than 1, preferably between 1.4 and 2.

[0039] Preferably, the glass composition of the fibers in the glass wool has less than 5 wt.% of the sum of Al_2O_3 and Fe_2O_3 , more preferably between 2.5 and 3 wt.%.

[0040] In a preferred embodiment, the glass wool comprised in the first, and optionally second layer of the insulating panels comprises from 0.01 to 5 wt.% of dust-suppressant agent with respect to the weight of the glass fibers. More preferably, the dust suppressant agent is an oil, even more preferably, a mineral oil.

[0041] The network of glass fibers in the glass wool of the first, and optionally of the second layer of the insulating panels, is preferably bonded by a thermoset binder. Suitable binders for glass wool are well known in the art. Examples of binders suitable for glass wool include phenol-formaldehyde resins, furan-based resins, sugar-based resins, starch-based resins, etc.

[0042] In a particular embodiment, the binder in the glass wool of the first, and optionally second layer of the insulating panels is based on a phenol-formaldehyde resole, preferably on a phenol-formaldehyde resole with a low content of free formaldehyde. Binders suitable for the insulating panels of the packs of the present invention are by way of example disclosed in EP 2657266 A1, EP 2657203 A1, EP 2865799 A1 and EP 3315470 A1.

[0043] In another particular embodiment, the binder in the glass wool of the first, and optionally second layer of the insulating panels of the pack of the invention, is free of formaldehyde. Exemplary binders include free-formaldehyde binders comprising saccharides (e.g. monosaccharides, oligosaccharides or polysaccharides), as such or chemically treated by hydrogenation, oxidation or functionalization. In this sense, binders suitable for the insulating panels of the packs of the present invention, are - by way of example - disclosed in EP 3315470 A1, EP 2865799 A1, EP 2657266 A1 and EP 2657203 A1), WO 2012118939 A1, WO 2008053332 A1, WO 2009080938 A2, WO 2007014236 A2, WO 2010/029266, WO2013014399 A1, WO 2015132518A1, and US 2009275699 A1.

[0044] In a particular embodiment the orientation of the fibers in the first, and optionally in the second layer of the insulating panels of the pack of the invention is laminar. By the expression "laminar glass wool", or "glass wool with a laminar orientation of the fibers", it is meant that the fibers forming the glass wool are predominantly oriented parallel to the major surfaces of the insulating panel or predominantly oriented in a plane perpendicular to the thickness of the insulating panel.

[0045] The laminar orientation of the fibers in the insulating panel may result from the manufacturing line when no further process, such as lamella formation or crimping processes, is applied to orientate the fibers in the direction of the thickness of the panel. Thus, the laminar configuration of the fibers may result from the deposition of the fibers freshly formed by a series of fiberizers and attenuated by air streams from burners vertically onto a receiving permeable conveyor, under air suction from beyond the conveyor. Optionally, the laminar configuration of the fibers, this is, the predominant orientation parallel to the major surfaces, can be further improved by compressing the fibers in the thickness direction and/or by stretching the fibers before glass wool is heated for the binder to cure. The stretching can be achieved, for example, by running the conveyors at sequentially increased speeds downstream the manufacturing line, before the curing oven.

[0046] In a preferred embodiment the first and second layer of each insulating panel of the pack of the invention are glass wool layers, wherein the thickness of the first layer is about 100 mm and the thickness of the second layer is about 40 mm, wherein the compressive strength at 10% deformation of the first layer of each insulating panel is about 6 KPa and the compressive strength at 10% deformation of the second layer of each insulating panel is about 66 KPa.

[0047] The inventive arrangement of insulating panels of the pack advantageously protect said panels during storage and shipment, without requiring further reinforcing/protection elements. Additionally, this solution allows delivering the insulating panels with greater compression, which further minimizes packaging materials, transportation cost and environmental footprint per insulating area of insulating panel.

[0048] According to step a) of the inventive method, insulating panels are provided comprising a first fibrous layer and a second layer wherein the thickness ratio of the first fibrous layer with respect to the second layer is at least 1, preferably the ratio is comprised between 1 and 23, more preferably between 2 and 19, even more preferably between 2.2 and 15 and most preferably between 2.5 and 3.5.

[0049] Moreover, the compressive strength at 10% deformation of the first fibrous layer of each insulating panel provided in step a) of the method of the invention is at least 1.5 times lower than the compressive strength at 10% deformation of the second layer.

[0050] In a particular embodiment, two or more insulating panels are provided in step a).

[0051] In another particular embodiment, an odd number equal or higher than 3 of insulating panels are provided in step a). In a preferred embodiment, between 3 and 13 insulating panels, more preferably between 5 and 13, even more preferably between 7 and 9 insulating panels are provided in step a).

[0052] In a particular embodiment, the insulating panels provided in step a) are fibrous insulating panels wherein the first and the second layers are fibrous. In a preferred embodiment the insulating panels provided in step a) are fibrous insulating panels comprising glass wool, stone wool, wood wool and/or mixtures thereof. In a more preferred embodiment, the fibrous insulating panels are made of glass wool.

[0053] Processes for the production of glass wool panels are well known in the art, and usually comprise the steps of melting the mineral material to an adequate temperature, fiberizing the molten mixture into fine fibers, application (e.g. spraying) of a thermosetting binder to the individual fibers, collection of the fibers and formation of a primary fleece on a permeable conveyor, densifying the fleece, and curing the binder at elevated temperatures. The final glass wool is then cut to the desired size with transverse and hedge trimmers.

[0054] In a particular embodiment the second layer of each insulating panel provided in step a) of the method of the invention, is a foamed plastic layer, preferably an extruded polystyrene (XPS) foam layer. In a more preferred embodiment the insulating panels provided in step a) comprise a first glass wool layer and a second extruded polystyrene (XPS) foam layer.

[0055] In a particular embodiment, the first fibrous layer and the second layer of each insulating panel are manufactured separately from each other. Preferably the first fibrous layer and the second layer of each insulating panel of the pack of the invention are further either bonded to each other by an adhesive applied to their facing surfaces or bonded by stitching with thread, preferably, a glass thread. The adhesives used may be reactive (one or two component) polyurethane, polyolefin, hot melt or other adhesives, applied by any suitable method known in the art. Alternatively, the first fibrous layer and the second layer of each insulating panel may be joined by application of a layer of thermoplastic film or non-woven (e.g. non-woven polyamide) between them, which is molten before the layers are contacted and cooled down after the joining to achieve their bonding.

[0056] According to step b), the insulating panels of step a) are arranged in parallel one with respect to the others, so that the first fibrous layers of the two outermost insulating panels are outwardly oriented to form the external faces of the arrangement. Thus, the second layers of two outermost insulating panels are inwardly oriented facing the first or second layers of the adjacent panels disposed in parallel in the inventive pack, while the first fibrous layers of the outermost panels are oriented outwardly forming the external major surfaces of the arrangement.

[0057] In step b), the insulating panels are arranged in parallel one with respect to the other. That is, the insulating panels are stacked one next to the other, adjacent to each other, and extending in the same direction.

[0058] In a particular embodiment, the insulating panels are arranged so that the second layers of each insulating panel of the arrangement are adjacent to each other.

[0059] In another particular embodiment, the insulating panels are arranged so that the second layers of the insulating panels of the pack of the invention are all adjacent to each other except one. In another particular embodiment, the insulating panels are arranged so that the second layers of the insulating panels of the pack of the invention are all adjacent to each other except two or three.

[0060] In one particular embodiment, the method further comprises a step of compressing the arrangement of insulating panels in order to achieve a defined compression ratio. In the context of the present invention, the compression ratio is understood as the change in the height of the arrangement with respect to the height of the arrangement before compression. The height of the arrangement refers to the sum of the thickness of the insulating panels forming the arrangement of the pack of the invention. The compression ratio is calculated as from the difference between the heights of the arrangement before and after compression ($Height_{before} - Height_{after}$) divided by the height of the arrangement before compression ($Height_{before}$). The so obtained value is multiplied with 100% .

$$\frac{Height_{before} - Height_{after}}{Height_{before}} * 100\%$$

Thus, when the compression is applied, the height of the arrangement before the compression is greater than the height after compression. The compression ratio will increase, if starting from the same height before compression ($Height_{before}$), the height after compression ($Height_{after}$) is gradually decreased.

[0061] In one particular embodiment, the method further comprises a step of compressing the arrangement of insulating panels, preferably to a compression ratio of at least 5%, more preferably to a compression ratio of at least 25%, and most preferably to a compression ratio of 50%.

[0062] In another particular embodiment, the method of the inventions further comprises wrapping the arrangement of insulating panels under compression with a polymeric film. Preferably, the polymeric film is a PE (polyethylene) film, even more preferably the polymeric film is a polyethylene film. Other suitable polymeric film materials are also suitable and can be selected, and even custom designed, by those familiar with such materials without undue experimentation. In a preferred embodiment the film thickness is about 50 μm .

[0063] The invention also provides a method for assembling a pack of the invention on a pallet. In a particular embodiment, the method comprises driving one or more packs belonging to the invention to a palletizer through conveyor belts, and stack the packs on a pallet by using a palletizer.

[0064] Another aspect of the invention refers to a pallet comprising at least one pack of insulating panels of the invention. In a particular embodiment, the pallet comprises 6 packs or more inventive packs, preferably the pallet comprises 9 inventive packs, even more preferably the pallet comprises 12 inventive packs.

[0065] The pack of the invention, as well as the pallet comprising the pack of the invention, can be used to protect insulating panels during transportation and handling. Thus, one aspect of the invention refers to the use of the pack or of the pallet of the invention for protecting insulating panels during transportation and handling.

FIGURES

[0066] In the drawings,

Figures 1A-E represent a schematic view of several packs according to the invention, comprising an arrangement of insulating panels.

Figure 1F represents - as a reference - a schematic view of one pack not according to the invention.

Figure 2 represents a schematic view of an impact test to measure the impact resistance of packs of insulating panels.

DETAILED DESCRIPTION

[0067] Several examples of packs according to the invention are represented in figures 1A-E. The pack comprises an arrangement 1 of insulating panels 2, 2', all insulating panels 2 being disposed in parallel, wherein the arrangement 1 comprises two outermost insulating panels 2', wherein each insulating panel 2 comprises a first fibrous layer 3 and a second layer 4, wherein the thickness ratio of the first fibrous layer 3 with respect to the second layer 4 is at least 1, wherein the compressive strength at 10% deformation of the first fibrous layer 3 of each insulating panel 2 is at least 1.5 times lower than the compressive strength at 10% deformation of the second layer 4. The two outermost insulating panels 2' of the arrangement are disposed so that the first fibrous layers 3 of the two outermost panels are directed outwards forming the external faces 5 of the arrangement.

[0068] In the context of the present invention, the term "arrangement" refers to a stack of insulating panels, wherein the insulating panels are all arranged in parallel one with respect to the others; i.e. they are positioned one next to the other, so that their major surfaces are adjacent to each other and extend in the same direction. Five different inventive arrangements of insulating panels of the pack of the invention are represented in figures 1A-E.

Insulating panels

[0069] The inventive pack comprises an arrangement of insulating panels. Suitable insulating panels for the inventive pack include thermally and/or acoustically insulating panels. Each one of said insulating panels has two major surfaces and four smaller edge surfaces connecting the two major surfaces. Particularly, the edge surfaces of the insulating panels are more vulnerable to be damaged during handling and shipping.

[0070] The compressive strength values provided in this disclosure have been measured according to UNE EN 826:2013. The term "compressive strength" is understood in the context of the present invention as the capacity of a material or structure to withstand loads tending to reduce size. Compressive stress can be increased until compressive strength is reached, and then the insulating panels will react with fracture. Hence, the ultimate compressive strength of a material is the value of uniaxial compressive stress reached when the material fails completely. The compressive strength is usually obtained experimentally by means of a compressive test.

[0071] In the pack of the invention, the first fibrous layer 3 of each insulating panel 2 has a compressive strength at 10% deformation of at least 1.5 times lower than the compressive strength at 10% deformation of the second layer 4. In a particular embodiment, the compressive strength at 10% deformation of the first fibrous layer (3) of each insulating panel is at least 2 times, preferably at least 3 times, more preferably at least 5 times, the most preferably at least 11 times lower than the compressive strength at 10% deformation of the second layer (4).

[0072] Further, the compressive strength at 10% deformation of the second layer of each insulating panel of the pack of the invention, measured according UNE EN 826:2013, is at least 1.5 times, preferably at least 2 times, more preferably at least 3 times, even more preferably at least 5 times, the most preferably at least 11 times higher than the compressive strength at 10% deformation of the first fibrous layer. Also preferably, the compressive strength at 10% deformation of the second layer is 600 kPa or lower, preferably 490 kPa or lower, the most preferably 66 kPa or lower. The second

layer of each insulating panel of the pack of the invention is more rigid than the first layer; i.e., it bends less under the same load. In the context of the present invention, the term "rigidity" refers to the stiffness of the material or its resistance to bending deformation under load. In a preferred embodiment the compressive strength at 10% deformation of the first layer is 291 kPa or lower, preferably 100 kPa or lower, more preferably 13 kPa or lower, the most preferably about 6 kPa or lower.

[0073] In a particular embodiment, the compressive strength at 10% deformation of the first fibrous layer 3 of each insulating panel 2 of the pack of the invention is about 6 kPa, and the compressive strength at 10% deformation of the second layer 4 of each insulating panel 2 is about 66 kPa or higher.

[0074] Moreover, the pack of the invention may comprise an arrangement 1 of two or more insulating panels 2. Figures 1A-E show exemplary packs of the invention comprising respectively 3 (figure 1A), 4 (figure 1B-C) and 5 (figure 1D-E) insulating panels 2 forming the pack. In one embodiment, the pack of the invention comprises an odd number of insulating panels 2 equal or higher than 3, preferably 5 insulating panels 2. In a preferred embodiment, the pack according to the invention comprises up to 13 insulating panels 2, more preferably between 3 and 9, most preferably 5 or 7 insulating panels 2. The total number of insulating panels 2 in the pack of the invention includes two outermost panels 2' which major surfaces are the external faces 5 of the pack of the invention. In this way, when a pack contains three insulating panels 2, such as the pack represented in figure 1A, two of them are the outermost panels of the pack 2', and the remaining one is an internal panel in the pack.

[0075] Figure 1 shows exemplary embodiments of the pack of the invention wherein the external faces 5 of the pack are formed by the first fibrous layers 3 of the two outermost panels 2'. In the context of the present invention, the term "outermost panels" refers to the panels situated below the external faces of the pack (Figure 1). Thus, the pack of the invention comprises two outermost panels 2'. Moreover, the outermost insulating panels 2' are disposed so that the first fibrous layers 3 of said outermost panels 2', i.e. the layer having a lower compressive strength in the insulating panel, are directed outwards forming the external faces 5 of the arrangement of the pack of the invention. Thus, the first fibrous layers 3 of the outermost panels 2' being softer or less rigid than the second 4 ones, are able to absorb shocks and vibrations protecting the pack from damages better than the second layers 4 would do.

[0076] As figure 1 shows, there is no limitation in the orientation of the insulating panels located in between the two outermost panels 2' provided that the first fibrous layers 3 of the two outermost panels 2' form the external faces 5 of the pack. In a particular embodiment, all the second layers 4 of the insulating panels 2 of the pack of the invention are adjacent to each other. Figure 1C shows an exemplary pack of the invention wherein the second layers 4 of the insulating panels 2 of the pack of the invention are all adjacent to each other except one. Figures 1A and 1D show exemplary packs of the invention wherein the second layers 4 of each pack are all adjacent to each other except one.

[0077] In another particular embodiment, the insulating panels 2 are arranged so that the second layers 4 of the insulating panels 2 of the pack of the invention are all adjacent to each other except two or three. Exemplary packs of this arrangement 1 are represented in figures 1B and 1E.

[0078] According to the method of the invention, the compressive strength at 10% deformation of the first fibrous layer 3 of each insulating panel 2 is at least 1.5 times lower than the compressive strength of the second layer 4. In a particular embodiment, the compressive strength at 10% deformation of the first fibrous layer 3 of each provided insulating panel 2 is at least 2 times, preferably at least 3 times, more preferably at least 5 times, the most preferably at least 11 times lower than the compressive strength at 10% deformation of the second layer 4.

[0079] In a particular embodiment, the compressive strength at 10% deformation of the second layer of each provided insulating panel is 600 kPa or lower, preferably 490 kPa or lower, the most preferably 66 kPa or lower. In another particular embodiment, the compressive strength at 10% deformation of the first layer is 291 kPa or lower, preferably 100 kPa or lower, more preferably 13 kPa or lower, the most preferably about 6 kPa or lower.

[0080] In another particular embodiment, the insulating panels 2 are arranged so that the second layers 4 of the insulating panels 2 of the pack of the invention are all adjacent to each other except two or three. Exemplary packs of this arrangement are represented in figures 1B and 1E.

EXAMPLES

[0081] The behavior of six packs of double-density insulating panels have been tested. Particularly, the insulating panels are made of three different insulating materials: glass wool, stone wool and wood wool.

[0082] Table 1 below shows the description of the double-density insulating panels of the tested packs, including the density and the compressive strength modulus at 10% deformation of each one of the layers forming the insulating panel. The term "HC" in the table below refers to the higher compressive strength layer (i.e. the second layer) and "LC" refers to the lower compressive strength layer (i.e. the first fibrous layer).

Table 1

Panel	Layer (thickness)	Density (kg/m ³)	Compressive strength at 10% deformation (kPa)
Glass Wool 130mm thickness	LC (100 mm)	30	6
	HC (30 mm)	80	66
Stone Wool 140mm thickness	LC (110 mm)	95	291
	HC (30 mm)	150	491
Wood Wool 140mm thickness	LC (100 mm)	55	13
	HC (40 mm)	270	>500

[0083] A pack containing 3 panels of glass wool as described in the above table is prepared. The panels are disposed in parallel and wrapped with a PE film of about 50 μ m thickness. In the pack belonging to the invention the outer panels of glass wool were disposed with the first fibrous layer having a lower compressive strength (LC layer) directing outwards forming the external faces of the pack. In the same manner other two packs were prepared with the stone wool panels and with the wood wool panels described in the above table.

[0084] Another pack containing three panels of glass wool as described in the above table is prepared. In this pack not belonging to the invention, the outer panels of glass wool were disposed with the second layer having a higher compressive strength (HC layer) directing outwards forming the external faces of the pack. In the same way, other two packs were prepared with the stone wool panels and with the wood wool panels described in the above table.

[0085] Each pack of panels is laid on the floor with one of the major surface in horizontal as represented in Figure 2. A sharp-point 1.2 kg steel chisel is let to fall free, with the point directed down, over the package, from 1.2 m height. This means the distance between the tip of the chisel and the top surface of the pack is 1.2 m (Figure 2). Figure 2 shows an embodiment comprising an inventive packs with the first fibrous layer having a lower compressive strength (LC layer) directing outwards forming the external faces of the pack. The test setup comprising non-inventive packs with the second layer having a higher compressive strength (HC layer) directing outwards forming the external faces of the pack is not explicitly shown. The test set-up for non-inventive packs can be built in an analogous way, whereas the insulating panels are placed on top of each other, such that LC layer of the non-inventive pack takes the position of the HC layer (second layer in Fig. 2) of the inventive pack. Accordingly the LC layer of the non-inventive pack takes the position of the LC layer (first layer in Fig. 2) of the inventive pack. The approximate impact energy is 14 Joule. The impact is recorded. The operation is repeated twice on different package points. The package is open and the damages on the external face of panels are recorded. The results of both tests are provided in Table 2 below.

Table 2

Example	Package description	Chisel impact	Damages on HC layer
A (inventive)	Glass wool pack. External layers: LC	Bounces back	None
AN (non-inventive)	Glass wool pack. External layers: HC	Pierces	2-3 cm deep holes
B (inventive)	Stone Wool External layers : LC	Pierces	None
BN (non-inventive)	Stone Wool External layers : HC	Pierces	2 - 3 cm deep holes
C (inventive)	Wood wool External layers : LC	Pierces	None
CN (non-inventive)	Wood wool External layers : HC	Damages	2-3 mm damage

[0086] With respect to the non-inventive packs (AN, AB, CN), the impact of the chisel on the HC layer directed outwardly causes severe damage on the HC layers. On the contrary, with respect to the inventive packs (A, B, C) the impact on the LC layer directed outwardly does not transmit any effect on the HC layers. The LC layer forming the external surface of the pack provides a surprising protective effect to the full package, absorbing the impact energy before it would damage the HC layer, which stays fully functional. Moreover, in the case of the inventive glass wool pack (A), the chisel even bounces back from the surface of the inventive pack evidencing the high protection reached.

Claims

1. A pack comprising an arrangement (1) of insulating panels (2), all insulating panels (2) being disposed in parallel, wherein the arrangement (1) comprises two outermost insulating panels (2'), wherein each insulating panel (2) comprises a first fibrous layer (3) and a second layer (4), wherein the thickness ratio of the first fibrous layer (3) with respect to the second layer (4) is at least 1, wherein the compressive strength at 10% deformation of the first fibrous layer (3) of each insulating panel (2) is at least 1.5 times lower than the compressive strength at 10% deformation of the second layer (4), **characterized in that** the two outermost insulating panels (2') of the arrangement are disposed so that the first fibrous layers (3) of said two outermost insulating panels are directed outwards forming the external faces (5) of the arrangement.
2. The pack according to claim 1, wherein the compressive strength at 10% deformation of the first fibrous layer (3) of each insulating panel is at least 11 times lower than the compressive strength at 10% deformation of the second layer (4).
3. The pack according to claim 1, wherein the compressive strength at 10% deformation of the first fibrous layer (3) of each insulating (2) panel is about 6 kPa, and the compressive strength at 10% deformation of the second layer (4) of each insulating panel (2) is about 66 kPa or higher.
4. The pack according to any previous claim, wherein the density of the first fibrous layer (3) of each insulating panel is 100 kg/m³ or lower, preferably 95 kg/m³ or lower, more preferably 55 kg/m³ or lower, even more preferably between 45 kg/m³ and 60 kg/m³, and most preferably about 55 kg/m³.
5. The pack according to claim 1 or 2, wherein the density of the second layer (4) of each insulating panel is 280 kg/m³ or lower, preferably 200 kg/m³ or lower, more preferably 150 kg/m³ or lower, even more preferably between 70 Kg/m³ and 120 Kg/m³, and most preferably about 80 kg/m³.
6. The pack according to any previous claim, wherein both the first (3) and the second layer (4) of each insulating panel (2) are fibrous layers.
7. The pack according to claim 6, wherein the first (3) and second (4) layer of each insulating panel of the pack of the invention are mineral wool layers, preferably glass wool layers.
8. The pack according to claim 7, wherein the first (3) and second (4) layer of each insulating panel of the pack of the invention are glass wool layers, wherein the thickness of the first layer is about 100 mm and the thickness of the second layer is about 40 mm, wherein the compressive strength at 10% deformation of the first layer (3) of each insulating panel (2) is about 6 kPa and the compressive strength at 10% deformation of the second layer (4) of each insulating panel (2) is about 66 kPa.
9. The pack according to any previous claim, comprising an odd number of insulating panels (2) equal or higher than 3, preferably 5 insulating panels.
10. The pack according to any one of claims 1 to 8 wherein all the second layers (4) of the insulating panels (2) are adjacent to each other.
11. Method of preparing a pack comprising an arrangement (1) of insulating panels (2) according to any of the previous claims comprising:
 - a) providing insulating panels (2) comprising a first fibrous layer and a second layer (3,4), wherein the thickness ratio of the first fibrous layer (3) with respect to the second layer (4) is at least 1, and wherein the compressive strength at 10% deformation of the first fibrous layer (3) of each insulating panel (2) is at least 1.5 times lower than the compressive strength at 10% deformation of the second layer (4), and
 - b) arranging the insulating panels (2) of step a) in parallel one with respect to the others (1) so that the first fibrous layers (3) of the outermost insulating panels (2') are outwardly oriented to form the external faces (5) of the arrangement (1).
12. Method according to claim 11, further comprising the step of compressing the arrangement (1) of insulating panels (2), preferably to a compression ratio of at least 5%, more preferably of at least 25%, and most preferably to a

compression ratio of 50%.

13. Method according to claims 12 further comprising wrapping the arrangement of insulating panels (2) under compression with a polymeric film.

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14. A pallet comprising at least one pack of insulating panels according to anyone of claims 1 to 10.

15. Use of the pack according to any of claims 1 to 10 or of the pallet according to claim 14 for protecting insulating panels during transportation and handling.

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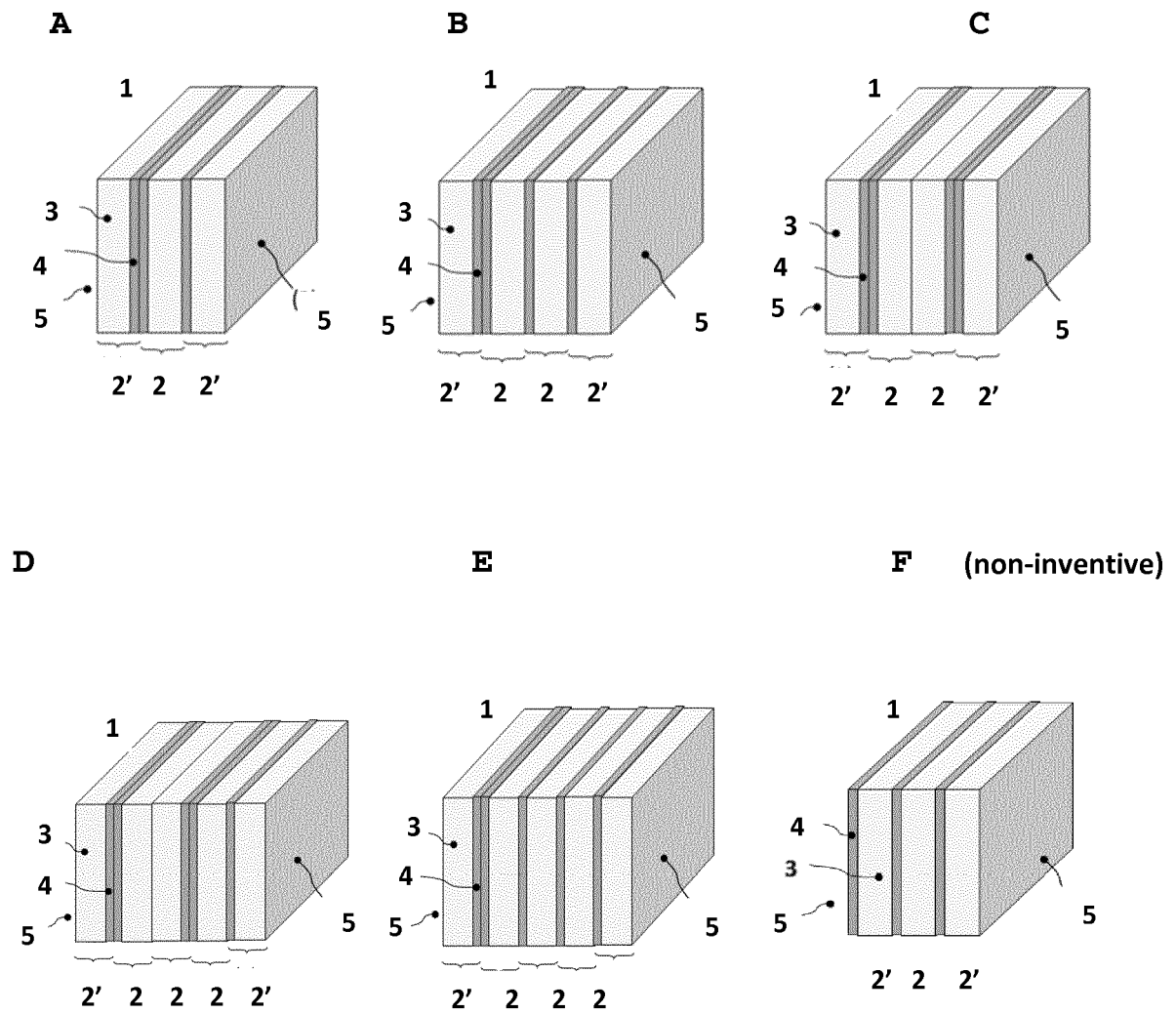


Fig. 1

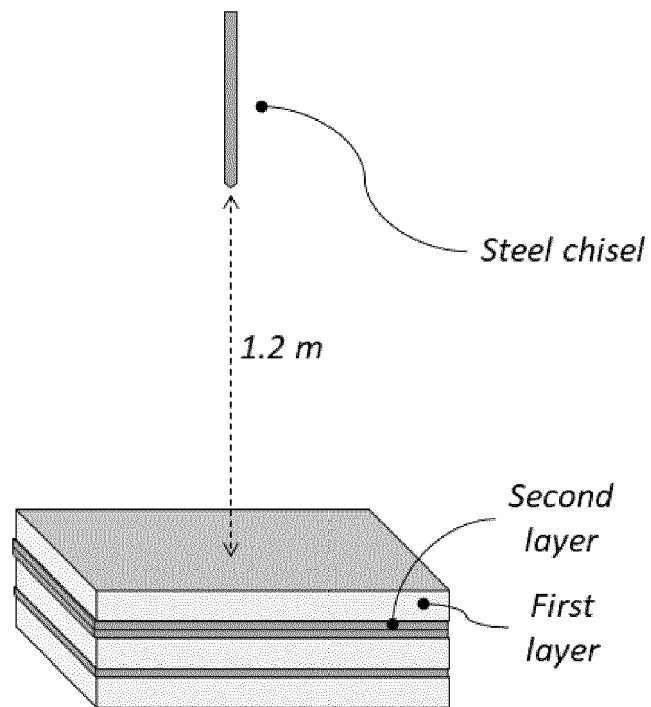


Fig. 2



EUROPEAN SEARCH REPORT

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 460 738 A1 (SAINT GOBAIN ECOPHON AB [SE]) 6 June 2012 (2012-06-06) * paragraphs [0025], [0046] - [0052], [0076] - [0077], [0085]; figures 1,8,11 * -----	1-15	INV. B65D85/07
			TECHNICAL FIELDS SEARCHED (IPC)
			B65D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 8 August 2019	Examiner Zanghi, Amedeo
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EPO FORM 1503 03.82 (P04C01)

08-08-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2460738 A1	06-06-2012	DK 2460738 T3	13-06-2016
		EA 201390746 A1	30-04-2014
		EP 2460738 A1	06-06-2012
		PL 2460738 T3	30-09-2016
		WO 2012072800 A2	07-06-2012

EPO FORM P0459

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2018007231 A [0006]
- EP 2635502 B1 [0007]
- WO 2015040024 A [0008]
- EP 2657266 A1 [0042] [0043]
- EP 2657203 A1 [0042] [0043]
- EP 2865799 A1 [0042] [0043]
- EP 3315470 A1 [0042] [0043]
- WO 2012118939 A1 [0043]
- WO 2008053332 A1 [0043]
- WO 2009080938 A2 [0043]
- WO 2007014236 A2 [0043]
- WO 2010029266 A [0043]
- WO 2013014399 A1 [0043]
- WO 2015132518 A1 [0043]
- US 2009275699 A1 [0043]