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(54) **EASY-TO-DISASSEMBLE AND REUSABLE SOUNDPROOF SELF-ADHESIVE FLOORBOARD, AND PREPARATION AND USE METHOD THEREFOR**

(57) The present invention provides an easy-to-disassemble and reinstallable soundproof self-adhesive floorboard, comprising, sequentially from top to bottom: a floor layer, a first adhesive layer, a soundproof layer, a second adhesive layer, and a release layer. The adhesion strength between the first adhesive layer and the soundproof layer is greater than the adhesion strength between the second adhesive layer and the ground; the tear strength of the soundproof layer is greater than the adhesion strength between the second adhesive layer and the ground; the soundproof layer is prepared from a porous foaming material having no plasticizer, the pores of the soundproof layer are not communicated with each other; and the upper surface and the lower surface of the soundproof layer each have a continuous non-porous skin-layer structure.

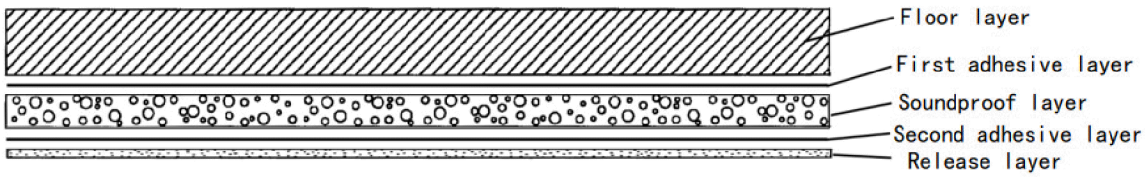


Fig.1

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Description

Technical field

[0001] The present invention relates to an easy-to-disassemble and reinstallable soundproof self-adhesive floorboard, and preparation and use methods thereof.

Background of the invention

[0002] Traditional plastic soundproof floorboards are installed as follows: first, a water-based pressure sensitive adhesive is coated on a ground; after the moisture evaporates, the floorboard is paved on the ground coated with the adhesive; and after waiting for 24 to 72 hours, the adhesive dries, thereby fixing the floorboard. If the floorboard paving is not deal, the installed floorboard needs to be pried up and reinstalled. However, when replacing the floorboard, a part of the pressure sensitive adhesive will remain at the bottom of the floorboard, and the other part of the pressure sensitive adhesive will remain on the ground, making it necessary to clean the bottom of the floorboard and clean or repair the ground at the same time, which greatly affects the reinstallability of the floorboard. In extreme cases, when the soundproof floorboard is pried up, the soundproof pad in the lower portion of the floorboard will also fall off, which will render the pried-up floorboard unable to be reused, resulting in great economic losses. Therefore, it has become increasingly urgent to develop an easy-to-disassemble and reinstallable soundproof self-adhesive floorboard.

[0003] In addition, Chinese patent application CN 102454278A and its European family patent application EP 2,447,054 disclose a self-bonding floor tile, which includes a main body and a self-bonding layer connected with the main body. The self-bonding layer includes an absorbate, a first adhesive and a second adhesive, wherein the first adhesive connects the main body and the self-bonding layer, at least a portion of the absorbate extends into the first adhesive, and at least a portion of the second adhesive penetrates into the absorbate for connecting the self-bonding layer with a member to be paved. The absorbate is an object with porous or wick structure (see paragraphs [0008] and [0010] of the description of CN 102454278A). Although such an interconnected and through structure has satisfactory bonding performance in the short term, there are risks to its durability. Over time, plasticizers in the main body or the first adhesive will migrate out and penetrate into the absorbate and the second adhesive, thereby affecting the cohesion of the second adhesive and causing degradation and aging. When the floorboard is pried up and reinstalled, due to aging, the second adhesive will break and remain on both the floorboard and the ground, affecting the reinstallability.

[0004] However, there is no report related to easy-to-disassemble and reinstallable soundproof self-adhesive floorboards in the prior art.

[0005] In view of this, there is an urgent need in the art to find an easy-to-disassemble and reinstallable soundproof self-adhesive floorboard.

Summary of the invention

[0006] The present invention provides an easy-to-disassemble and reinstallable soundproof self-adhesive floorboard, comprising, sequentially from top to bottom: a floor layer, a first adhesive layer, a soundproof layer, a second adhesive layer, and a release layer, wherein the adhesion strength between the first adhesive layer and the soundproof layer is greater than the adhesion strength between the second adhesive layer and the ground, the tear strength of the soundproof layer is greater than the adhesion strength between the second adhesive layer and the ground, the soundproof layer is prepared from a porous foaming material having no plasticizer, the pores of the soundproof layer are not communicated with each other, and the upper surface and the lower surface of the soundproof layer each have a continuous non-porous skin-layer structure.

[0007] The present invention also provides a method for preparing the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to the present invention, the method comprising:

preparing a soundproof layer;
bonding the soundproof layer and a floor layer by a first adhesive layer;
applying a second adhesive layer to the side of the soundproof layer opposite to the first adhesive layer; and
attaching a release layer to the second adhesive layer;
or
the method comprising:

preparing a soundproof layer;
bonding the soundproof layer and a floor layer by a first adhesive layer;
applying a second adhesive layer to a release layer; and

adhering a release layer with the second adhesive layer to the side of the soundproof layer opposite to the first adhesive layer, wherein the second adhesive layer is located between the release layer and the soundproof layer.

[0008] In addition, the present invention provides a method for using the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to the present invention, the method comprising:

removing the release layer from the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard, and bonding the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard from which the release layer has been removed to a ground by the second adhesive layer.

[0009] Surprisingly, the inventor found that, the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to the present invention ensures that the breakage occurs at the second adhesive layer during floorboard replacement by the adhesion strength between the first adhesive layer and the soundproof layer being greater than the adhesion strength between the second adhesive layer and the ground, thereby maintaining the integrity of the floorboard when reinstallation; it ensures that when the floorboard is pried up the second adhesive layer totally remain on the soundproof layer without residue on the ground by the tear strength of the soundproof layer being greater than the adhesion strength between the second adhesive layer and the ground, thereby enabling the pried-up floorboard to be used for a second time; it may prevent the plasticizer (including polyvinyl chloride) in the floor layer from penetrating the first adhesive layer and the soundproof layer to affect the cohesion of the second adhesive layer (especially the hot-melt pressure sensitive adhesive) and prevents the migration of small molecular additives in the system by the soundproof layer being prepared from a porous foaming material having no plasticizer, the pores of the soundproof layer being not communicated with each other, and the upper surface and the lower surface of the soundproof layer each having a continuous non-porous skin-layer structure, thereby further improving the stability of the second adhesive layer (especially the pressure sensitive adhesive) and the reinstallability of the floorboard.

Brief description of the drawings

[0010] Fig.1 depicts a schematic diagram of a layer structure of one embodiment of the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to the present invention.

Detailed description of the invention

[0011] Unless otherwise defined, all technical and scientific terms used herein have the same meanings as commonly understood by one of ordinary skill in the art to which this invention belongs. In case of conflict, the definitions in this specification shall prevail.

[0012] When numerical values or numerical ranges, preferred ranges, or a series of lower limit preferred values and upper limit preferred values are given, it should be understood that all ranges formed by any pair of values consisting of any smaller range limit or preferred value and any larger range limit or preferred value are specifically disclosed, regardless of whether such specific ranges are explicitly disclosed one by one. Unless otherwise specified, when describing a numerical range in the present invention, the range are intended to include the endpoints of the range and all integers and fractions within the range.

[0013] The "a" and "an" are used to describe elements and components of the present invention. This is done merely for convenience and to present a general context of the invention. Unless explicitly indicated otherwise, such expressions should be understood to include one or at least one.

[0014] Unless explicitly indicated to the contrary, all the methods for measuring parameters not specified in the descriptive part of this specification shall be those specifically described in the working examples.

[0015] The present invention provides an easy-to-disassemble and reinstallable soundproof self-adhesive floorboard, comprising, sequentially from top to bottom: a floor layer, a first adhesive layer, a soundproof layer, a second adhesive layer, and a release layer, wherein the adhesion strength between the first adhesive layer and the soundproof layer is greater than the adhesion strength between the second adhesive layer and the ground, the tear strength of the soundproof layer is greater than the adhesion strength between the second adhesive layer and the ground, the soundproof layer is prepared from a porous foaming material having no plasticizer, the pores of the soundproof layer are not communicated with each other, and the upper surface and the lower surface of the soundproof layer each have a continuous non-porous skin-layer structure.

[0016] All the tear strengths of the soundproof layer herein are obtained by referring to the peel force measurement method of EN 1372-2015 as follows: cutting the floorboard with the soundproof layer into floorboard sample pieces having a length of 20 cm and a width of 5 cm; coating a strong adhesive (gr19, available from UZIN UTZ, Germany) on an asbestos-free cement board (having a length of 15 cm, a width of 5 cm, and a thickness of 1 cm) with a standard a4 scraper;

horizontally attaching the above-mentioned floorboard sample piece to the above-mentioned cement board coated with the strong adhesive, such that one end of the sample piece protrudes by 5 cm, to facilitate clamping of one end of the floorboard by the fixture of a tensile testing machine; waiting for 48 hours to cure the strong adhesive; and finally measuring the minimum tensile force data obtained when the soundproof layer breaks and splits into two due to the bonding force between the strong adhesive and the cement board, which is the tear strength of the soundproof layer.

[0017] All the adhesion strengths and bonding forces between the second adhesive layer and the ground herein are used interchangeably, both of which are obtained by referring to the peel force measurement method of EN 1372-2015 as follows: using an asbestos-free cement board (having a length of 15 cm, a width of 5 cm, and a thickness of 1 cm) to simulate the ground; adhering the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard to the cement board; and finally measuring the tensile force between the wall floorboard and the cement board with a tensile testing machine (model: Haida International B614) at a tensile speed of 2 mm/s to obtain the bonding force between the second adhesive layer and the ground.

[0018] Each layer of the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to the present invention will be described below respectively.

Floor layer

[0019] The floor layer in the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to the present invention may be any floorboard known in the art, as long as it can achieve the purposes of the present invention. Preferably, the floor layer comprises polyvinyl chloride, polypropylene, polyethylene, polyurethane, polyester, and combinations thereof. More preferably, the main material of the floor layer is selected from the group consisting of polyvinyl chloride, polypropylene, polyethylene, polyurethane, polyester, and combinations thereof. Further preferably, the floor layer is a polyvinyl chloride or polypropylene floorboard.

[0020] Alternatively or additionally, preferably the floor layer has a structure of one, two or more layer(s).

[0021] Preferably, the floor layer in the present invention is the rigid PVC floorboard produced by the full-automatic calendering method as described in CN 110524998A or the lightweight and environment-friendly polypropylene composite floorboard as described in CN 108026730B, wherein the entire closures of the two patent documents are incorporated herein by reference.

First adhesive layer

[0022] The first adhesive layer in the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to the present invention may be prepared from any adhesive known in the art, as long as the adhesion strength between the first adhesive layer and the soundproof layer is greater than the adhesion strength between the second adhesive layer and the ground.

[0023] Preferably, the first adhesive layer is prepared from a reactive adhesive, and preferably a reactive structural adhesive. In a preferred embodiment of the present invention, the reactive adhesive is selected from the group consisting of one-part reactive polyurethane hot-melt adhesives, two-part reactive acrylate or polyurethane adhesives, and combinations thereof. By using the above preferred adhesive to prepare the first adhesive layer, the present invention can further reduce the risk of the soundproof layer falling off from the floor layer when replacing the floorboard.

Soundproof layer

[0024] In the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to the present invention, the tear strength of the soundproof layer is greater than the adhesion strength between the second adhesive layer and the ground, the soundproof layer is prepared from a porous foaming material having no plasticizer, the pores of the soundproof layer are not communicated with each other, and the upper surface and the lower surface of the soundproof layer each have a continuous non-porous skin-layer structure.

[0025] Preferably, the soundproof layer is prepared from a porous foaming material having no polyvinyl chloride. More preferably, the soundproof layer is prepared from a material selected from the group consisting of porous foaming materials based on polyethylene, porous foaming materials based on polypropylene, and combinations thereof. Further preferably, the soundproof layer is prepared from a radiation-crosslinked polyethylene and/or a radiation-crosslinked polypropylene.

[0026] In a preferred embodiment of the present invention, the porous foaming material has a foaming ratio of 5 to 30, preferably of 5 to 25, more preferably of 5 to 20, and further preferably of 5 to 15. All the foaming ratios herein are calculated according to the following calculation formula:

Foaming ratio = Volume after foaming/Original volume.

[0027] The foaming ratio described herein is preferably determined as follows: taking polyethylene (having a density of about 900 kg/m^3) as an example, the material to be tested is cut to have a thickness of 1 mm and a length and width of 10 cm each, and is weighed on an electronic balance. If the weight is 0.9 g ± 0.1 g, the foaming ratio of the material is 10.

[0028] In another preferred embodiment of the present invention, the porous foaming material has a thickness of 0.5 to 2.0 mm, preferably of 0.75 to 1.5 mm, and more preferably of 1 mm.

[0029] In a further preferred embodiment of the present invention, the soundproof layer is prepared from a porous foaming material based on polyethylene having a foaming ratio of 5 to 12.5, more preferably of 7.5 to 10, and/or a porous foaming material based on polypropylene having a foaming ratio of 8 to 15, more preferably of 10 to 15.

[0030] The parameters of examples of soundproof layers useful in the present invention will be listed below:

Main material of soundproof layer	Foaming ratio	Tear strength (N/cm)
Polyethylene	10	4.35
Polyethylene	7.5	5.9
Polyethylene	15	3.1
Polypropylene	10	5.4
Polypropylene	15	4.0
Polypropylene	20	3.05

[0031] Preferably, the tear strength of the soundproof layer is greater than 4 N/cm.

[0032] Alternatively or additionally, in a preferred embodiment of the present invention, the skin layer of the soundproof layer is treated by corona, plasma and/or flame, preferably by corona, before bonding with the first adhesive layer and the second adhesive layer, such that the surface tensions of the upper and lower surfaces of the soundproof layer before bonding with the first adhesive layer and the second adhesive layer are both equal to or greater than 38 dyn/cm.

[0033] All the surface tensions of the upper and lower surfaces of the soundproof layer before bonding with the first adhesive layer and the second adhesive layer herein are measured by the following method: drawing a line of approximately 5 to 10 cm in length on the soundproof layer to be tested using an American accu dyne pen. If the ink of the pen used for drawing decreases instantly, i.e., it wets the surface of the soundproof layer within 2 seconds, it indicates that the surface tension of the soundproof layer is lower than the dyne value of the dyne pen employed; and if the ink of the pen does not decrease, i.e., it shrinks into water droplets within 2 seconds, it indicates that the surface tension of the soundproof layer is equal to or greater than the dyne value of the dyne pen used. Each dyne pen has a fixed dyne value, such as a dyne pen with a dyne value of 36 and a dyne pen with a dyne value of 38.

[0034] In addition, the porous structure of the soundproof layer also has the function of absorbing and blocking sound transmission, thereby improving the soundproof effect of the floorboard itself.

Second adhesive layer

[0035] The second adhesive layer in the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to the present invention may be prepared from any adhesive known in the art, as long as the adhesion strength between the second adhesive layer and the ground is lower than the adhesion strength between the first adhesive layer and the soundproof layer, and is lower than the tear strength of the soundproof layer.

[0036] Preferably, the second adhesive layer is prepared from a pressure sensitive adhesive. More preferably, the second adhesive layer comprises an elastomer-based pressure sensitive adhesive or a resin-based pressure sensitive adhesive.

[0037] In a preferred embodiment of the present invention, the pressure sensitive adhesive in the second adhesive layer is a water-based, solvent-based or solvent-free pressure sensitive adhesive.

[0038] In another preferred embodiment of the present invention, the elastomer-based pressure sensitive adhesive is selected from the group consisting of natural rubber-based pressure sensitive adhesives, synthetic rubber-based pressure sensitive adhesives, synthetic thermoplastic elastomer-based pressure sensitive adhesives, and combinations thereof. Preferably, the synthetic rubber-based pressure sensitive adhesive is prepared from styrene-butadiene rubber, polyisoprene rubber, polyisobutylene rubber, butyl rubber, chloroprene rubber and/or nitrile rubber as the main compo-

nents, as well as tackifying resins, softeners, anti-aging agents and the like as additives. More preferably, the synthetic rubber-based pressure sensitive adhesive comprises a styrene-butadiene rubber, a polyisobutylene rubber, a butyl rubber, a chloroprene rubber, and/or combinations thereof. Preferably, the synthetic thermoplastic elastomer-based pressure sensitive adhesive comprises a styrene-butadiene-styrene block copolymer, a styrene-isoprene-styrene block copolymer, and/or combinations thereof as the main raw materials of the hot-melt pressure sensitive adhesive. Hot-melt pressure sensitive adhesives do not use a solvent, and thus, they do not pollute the environment and have high production efficiency.

[0039] In yet another preferred embodiment of the present invention, the resin-based pressure sensitive adhesive is selected from the group consisting of polyacrylates, polyurethanes, polyvinyl ethers, vinyl acetate copolymers, polyesters, pressure sensitive adhesives composed of a mixture of a silicone resin and a silicone rubber, and combinations thereof. Preferably, the resin-based pressure sensitive adhesive is a polyacrylate, especially an acrylate copolymer obtained by copolymerizing various acrylate monomers. Compared with rubber-based pressure sensitive adhesives, polyacrylate pressure sensitive adhesives have the following advantages: they are colorless and transparent in appearance and have excellent weather resistance; good pressure sensitive adhesives can be obtained without using additives such as tackifying resins, softeners and anti-aging agents, and thus, their formulations are simple; and pressure sensitive adhesives meeting various performance requirements can be prepared by copolymerization and crosslinking. In addition, the pressure sensitive adhesive composed of a mixture of a silicone resin and a silicone rubber has excellent high-temperature resistance and aging resistance.

[0040] Further preferably, the second adhesive layer in the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to the present invention is prepared from a styrene-isoprene-styrene block copolymer elastomer-based pressure sensitive adhesive and/or a resin-based polyacrylate pressure sensitive adhesive. When the second adhesive layer of the present invention is prepared from one or both of the two pressure sensitive adhesives, the target effects desired by the present invention are better achieved.

[0041] Preferably, the bonding force between the second adhesive layer and the ground is 1.2 to 4 N/m.

Release layer

[0042] The release layer in the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to the present invention may be any release layer known in the art, as long as it can achieve the purposes of the present invention. Preferably, the release layer is selected from the group consisting of polypropylene or polyester films coated with a release agent, release papers, and combinations thereof. Preferably, the polyester film is a polyethylene terephthalate film.

[0043] The layer structure of the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to the present invention will be illustrated below with reference to the accompanying drawings.

[0044] Figure 1 shows one embodiment of the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to the present invention, which comprises, sequentially from top to bottom: a floor layer, a first adhesive layer, a soundproof layer, a second adhesive layer and a release layer.

[0045] The present invention also provides a method for preparing the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to the present invention, the method comprising:

preparing a soundproof layer;
bonding the soundproof layer and a floor layer by a first adhesive layer;
applying a second adhesive layer to the side of the soundproof layer opposite to the first adhesive layer; and
attaching a release layer to the second adhesive layer;
or
the method comprising:

preparing a soundproof layer;
bonding the soundproof layer and a floor layer by a first adhesive layer;
applying a second adhesive layer to a release layer; and
adhering a release layer with the second adhesive layer to the side of the soundproof layer opposite to the first adhesive layer, wherein the second adhesive layer is located between the release layer and the soundproof layer.

[0046] Preferably, by treating the soundproof layer by corona, plasma and/or flame, preferably by corona, both the surface tensions of the two surfaces of the soundproof layer are equal to or greater than 38 dyn/cm.

[0047] In addition, the present invention provides a method for using the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to the present invention, the method comprising:

removing the release layer from the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard, and bonding the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard from which the release layer has been removed to a ground by the second adhesive layer, preferably to a cement ground.

[0048] The easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to the present invention ensures that the breakage occurs at the second adhesive layer during floorboard replacement by the adhesion strength between the first adhesive layer and the soundproof layer being greater than the adhesion strength between the second adhesive layer and the ground, thereby maintaining the integrity of the floorboard when reinstallation; it ensures that when the floorboard is pried up the second adhesive layer totally remain on the soundproof layer without residue on the ground by the tear strength of the soundproof layer being greater than the adhesion strength between the second adhesive layer and the ground, thereby enabling the pried-up floorboard to be used for a second time; it may prevent the plasticizer (including polyvinyl chloride) in the floor layer from penetrating the first adhesive layer and the soundproof layer to affect the cohesion of the second adhesive layer (especially the hot-melt pressure sensitive adhesive) and prevents the migration of small molecular additives in the system by the soundproof layer being prepared from a porous foaming material having no plasticizer, the pores of the soundproof layer being not communicated with each other, and the upper surface and the lower surface of the soundproof layer each having a continuous non-porous skin-layer structure, thereby further improving the stability of the second adhesive layer (especially the pressure sensitive adhesive) and the reinstallability of the floorboard.

Examples

[0049] The present invention will be illustrated by the following examples, but these examples are not intended to limit the invention in any way.

Example 1

[0050] The structure of the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard of Example 1 according to the present invention comprised, sequentially from top to bottom:

floor layer: a rigid polyvinyl chloride floorboard having a thickness of about 2 mm, prepared according to the specific method as described in Example 1 of CN110524998A;
first adhesive layer: a two-part solvent-free polyurethane adhesive 9001, purchased from Wuxi Wanli Adhesive Materials Co., Ltd., 40 g/m^2;
soundproof layer: a radiation-crosslinked polyethylene NMP-10010ka-174.6, having a foaming ratio of 10, a thickness of 1 mm, and a tear strength of 4.35 N/cm, purchased from Hubei Xiangyuan New Materials Co., Ltd., wherein the pores of the soundproof layer were not communicated with each other, and the upper surface and the lower surface of the soundproof layer each had a continuous non-porous skin-layer structure;
second adhesive layer: a styrene-isoprene-styrene block copolymer hot-melt pressure sensitive adhesive FS1001, purchased from Zhongshan Chengtai Chemical Technology Co., Ltd., 30 g/m^2; and
release layer: a 65 g release paper coated with silicone on one side (width: 1300 mm), purchased from Kunshan Caiyi paper plastic products Co., Ltd..

[0051] The easy-to-disassemble and reinstallable soundproof self-adhesive floorboard of Example 1 according to the present invention was prepared as follows:

1. treating the two surfaces of the radiation-crosslinked polyethylene soundproof layer by corona with a corona treater at a speed of 25 m/min, such that both the surface tensions of the two surfaces of the soundproof layer were changed from about 36 dyn/cm to be equal to or greater than 38 dyn/cm;
2. bonding the soundproof layer and the floor layer with the two-part solvent-free polyurethane adhesive, and waiting for 24 hours to cure the adhesive, to form a first adhesive layer;
3. heating the solvent-free styrene-isoprene-styrene block copolymer hot-melt pressure sensitive adhesive to about 140°C to form a fluid, and coating the adhesive on the side of the soundproof layer opposite to the first adhesive layer, to form a second adhesive layer; and
4. attaching the release paper to the second adhesive layer.

[0052] The soundproof layer and the floor layer in the sample of the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard of Example 1 were peeled apart, and it was found that the soundproof layer was torn, which indicates that herein the adhesion strength between the first adhesive layer and the soundproof layer was much greater than the tear strength of the soundproof layer.

Example 2

[0053] The structure of the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard of Example 2 according to the present invention comprised, sequentially from top to bottom:

floor layer: a polypropylene floorboard having a thickness of about 2.5 mm, prepared according to the specific method as described in the working example of CN108026730B;
first adhesive layer: a one-part reactive polyurethane hot-melt adhesive, purchased from Henkel, model: 9515, 30 g/m^2;
soundproof layer: a radiation-crosslinked polypropylene NMP-10010ka-174.6, having a foaming ratio of 10, a thickness of 1 mm, and a tear strength of 5.4 N/cm, purchased from Hubei Xiangyuan New Materials Co., Ltd., wherein the pores of the soundproof layer were not communicated with each other, and the upper surface and the lower surface of the soundproof layer each had a continuous non-porous skin-layer structure;
second adhesive layer: a solvent-based polyacrylate pressure sensitive adhesive F6A508, purchased from Ningbo Yongliu New Material Technology Co., Ltd., 30 g/m^2; and
release layer: a biaxially oriented polyester (BOPET) release film having a thickness of 50 μm (width: 1000 mm), purchased from Hangzhou Shengsheng Film Technology Co., Ltd..

[0054] The easy-to-disassemble and reinstallable soundproof self-adhesive floorboard of Example 2 according to the present invention was prepared as follows:

1. treating the two surfaces of the radiation-crosslinked polypropylene soundproof layer by corona with a corona treater at a speed of 25 m/min, such that both the surface tensions of the two surfaces of the soundproof layer were changed from about 30 dyn/cm to be equal to or greater than 38 dyn/cm;
2. heating the one-part reactive polyurethane hot-melt adhesive (which was a solvent-free moisture-curable adhesive) to about 140°C to melt it, coating it on the back surface of the floor layer, attaching and compacting the soundproof layer to the adhesive within the open time of the adhesive; waiting for 24 hours to react the moisture in air with the adhesive and cure the adhesive, so as to form a first adhesive layer;
3. coating the polyacrylate adhesive in liquid form on the biaxially oriented polyester (BOPET) release film;
4. attaching the release film coated with the polyacrylate adhesive to the soundproof layer, wherein the polyacrylate adhesive was located between the release film and the soundproof layer, and was located on the side of the soundproof layer opposite to the first adhesive layer.

[0055] The soundproof layer and the floor layer in the sample of the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard of Example 2 were peeled apart, and it was found that the soundproof layer was torn, which indicates that herein the adhesion strength between the first adhesive layer and the soundproof layer was much greater than the tear strength of the soundproof layer.

Example 3

[0056] The structure of the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard of Example 3 according to the present invention comprised, sequentially from top to bottom:

floor layer: a rigid polyvinyl chloride floorboard having a thickness of about 2.5 mm, prepared according to the specific method as described in Example 1 of CN110524998A;
first adhesive layer: a one-part reactive polyurethane hot-melt adhesive, purchased from Henkel, model: 9515, 30 g/m^2;
soundproof layer: a radiation-crosslinked polyethylene NMP-75010ka-174.6, having a foaming ratio of 7.5, a thickness of 1 mm, and a tear strength of 5.9 N/cm, purchased from Hubei Xiangyuan New Materials Co., Ltd., wherein the pores of the soundproof layer were not communicated with each other, and the upper surface and the lower surface of the soundproof layer each had a continuous non-porous skin-layer structure;
second adhesive layer: a solvent-based polyacrylate pressure sensitive adhesive F6A508, purchased from Ningbo Yongliu New Material Technology Co., Ltd., 30 g/m^2; and
release layer: a biaxially oriented polyester (BOPET) release film having a thickness of 50 μm (width: 1300 mm), purchased from Hangzhou Shengsheng Film Technology Co., Ltd..

[0057] The easy-to-disassemble and reinstallable soundproof self-adhesive floorboard of Example 3 according to the present invention was prepared as follows:

1. treating the two surfaces of the radiation-crosslinked polyethylene soundproof layer by corona with a corona treater at a speed of 25 m/min, such that both the surface tensions of the two surfaces of the soundproof layer were changed from about 36 dyn/cm to be equal to or greater than 38 dyn/cm;
2. heating the one-part reactive polyurethane hot-melt adhesive (which was a solvent-free moisture-curable adhesive) to about 140°C to melt it, coating it on the back surface of the floor layer, attaching and compacting the soundproof layer to the adhesive within the open time of the adhesive; waiting for 24 hours to react the moisture in air with the adhesive and cure the adhesive, so as to form a first adhesive layer;
3. coating the polyacrylate adhesive in liquid form on the biaxially oriented polyester (BOPET) release film;
4. attaching the release film coated with the polyacrylate adhesive to the soundproof layer, wherein the polyacrylate adhesive was located between the release film and the soundproof layer, and was located on the side of the soundproof layer opposite to the first adhesive layer.

[0058] The soundproof layer and the floor layer in the sample of the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard of Example 3 were peeled apart, and it was found that the soundproof layer was torn, which indicates that herein the adhesion strength between the first adhesive layer and the soundproof layer was much greater than the tear strength of the soundproof layer.

Comparative Example 1

[0059] Example 1 was repeated, except that the second adhesive layer was replaced with a styrene-isoprene-styrene block copolymer pressure sensitive adhesive having a high bonding force (purchased from Guangzhou Deyuan Fine Chemical Co., Ltd., model: 712), whose bonding force with the ground was 8.3 N/cm. In other words, the tear strength of the soundproof layer herein (4.35 N/cm) was lower than the adhesion strength between the second adhesive layer and the ground (8.3 N/cm).

Comparative Example 2

[0060] Example 2 was repeated, except that the surface of the soundproof layer to be bonded with the first adhesive layer had not been treated by corona.

[0061] The soundproof layer and the floor layer in the sample of the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard of Comparative Example 2 were peeled apart; and it was found that the soundproof layer and the floor layer could be separated, and the adhesion strength between the first adhesive layer and the soundproof layer was 0.3 N/cm, which was much lower than the tear strength of the soundproof layer (5.4 N/cm).

[0062] Herein, the method for measuring the adhesion strength between the first adhesive layer and the soundproof layer was as follows: cutting a sample wherein the floor layer had been bonded to the soundproof layer having a length of 20 cm and a width of 5 cm, tearing it open for a length of 5 cm, clamping the two sides to the fixtures of a tensile testing machine (model: Haida International B614), and finally measuring the tensile force using the tensile testing machine at a speed of 2 mm/s.

Test method and judgment criteria

[0063] A high-temperature condition of 80° C for 24 hours was used to simulate the state of the floorboard after 2 to 3 years of service. According to the peel force test method of EN 1372-2015, the initial peel strength and the peel strength after aging at 80° C for 24 hours between the second adhesive layer of the floorboard and the ground were measured at room temperature (i.e., 25° C) as the initial bonding force and the bonding force after aging, respectively. Then, the change rate of peel strength was calculated with the initial bonding force and the bonding force after aging between the second adhesive layer and the ground. If the reduction of bonding force after aging does not exceed 30% and no adhesive residue remains when the floorboard is replaced, it is indicated that the system meets the requirements of the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to the present invention.

Experimental results

[0064]

	Initial bonding force	Bonding force after aging	Adhesive residue status
Example 1	2.5 N/cm	2.05 N/cm	No residue
Example 2	3.5 N/cm	3 N/cm	No residue

(continued)

	Initial bonding force	Bonding force after aging	Adhesive residue status
Example 3	3.6 N/cm	3 N/cm	No residue
Comparative Example 1	The soundproof layer was torn and remained adhered to the ground		
Comparative Example 2	The soundproof layer was totally peeled from the first adhesive layer, and remained adhered to the ground		

[0065] In Examples 1, 2 and 3, after the floorboards were pried up, no residue of the second adhesive layer was left on the ground at all. This is considered to be caused by the fact that all the adhesion strengths between the first adhesive layer and the soundproof layer were higher than the adhesion strengths between the second adhesive layer and the ground, and all the tear strengths of the soundproof layer were higher than the adhesion strengths between the second adhesive layer and the ground. In addition, in Examples 1, 2 and 3, compared with the initial bonding force, the reductions of bonding force after aging did not exceed 30%, which is deemed to be attributed to the pores of the soundproof layer being not communicated with each other, and the upper surface and the lower surface of the soundproof layer each having a continuous non-porous skin-layer structure. The above results confirm that Examples 1, 2 and 3 all meet the requirements of the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard.

[0066] In contrast, in Comparative Example 1, the tear strength of the soundproof layer was lower than the adhesion strength between the second adhesive layer and the ground, and the soundproof layer was torn and remained adhered to the ground; and thus, it failed to meet the requirements of the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard. In Comparative Example 2, the adhesion strength between the first adhesive layer and the soundproof layer was very low, and was lower than the adhesion strength between the second adhesive layer and the ground; after the floorboard was pried up, the soundproof layer was totally peeled from the first adhesive layer and remained adhered to the ground; and thus, it failed to meet the requirements of the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard.

[0067] The present invention has been illustrated above by some embodiments and examples, but these embodiments and examples do not limit the present invention. Those skilled in the art will appreciate that modifications may be made to the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard within the spirit of the present invention based on the present disclosure.

Claims

1. An easy-to-disassemble and reinstallable soundproof self-adhesive floorboard, comprising, sequentially from top to bottom: a floor layer, a first adhesive layer, a soundproof layer, a second adhesive layer, and a release layer, wherein the adhesion strength between the first adhesive layer and the soundproof layer is greater than the adhesion strength between the second adhesive layer and the ground, the tear strength of the soundproof layer is greater than the adhesion strength between the second adhesive layer and the ground, the soundproof layer is prepared from a porous foaming material having no plasticizer, especially having no polyvinyl chloride, the pores of the soundproof layer are not communicated with each other, and the upper surface and the lower surface of the soundproof layer each have a continuous non-porous skin-layer structure.

2. The easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to claim 1, wherein the soundproof layer is prepared from a material selected from the group consisting of porous foaming materials based on polyethylene, porous foaming materials based on polypropylene, and combinations thereof; and preferably, the soundproof layer is prepared from a radiation-crosslinked polyethylene and/or a radiation-crosslinked polypropylene.

3. The easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to claim 1 or 2, wherein the porous foaming material has a foaming ratio of 5 to 30, and/or the porous foaming material has a thickness of 0.5 to 2.0 mm; and preferably, the soundproof layer is prepared from a porous foaming material based on polyethylene having a foaming ratio of 5 to 12.5, more preferably of 7.5 to 10, and/or a porous foaming material based on polypropylene having a foaming ratio of 8 to 15, more preferably of 10 to 15.

4. The easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to any one of claims 1 to 3, wherein the floor layer comprises polyvinyl chloride, polypropylene, polyethylene, polyurethane, polyester, and combinations thereof; and/or the floor layer has a structure of one, two or more layer(s).

5. The easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to any one of claims 1 to 4, wherein the first adhesive layer is prepared from a reactive adhesive; and preferably, the reactive adhesive is selected from the group consisting of one-part reactive polyurethane hot-melt adhesives, two-part reactive acrylate or polyurethane adhesives, and combinations thereof.

6. The easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to any one of claims 1 to 5, wherein the second adhesive layer is prepared from a pressure sensitive adhesive; and preferably, the second adhesive layer comprises an elastomer-based pressure sensitive adhesive or a resin-based pressure sensitive adhesive.

7. The easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to claim 6, wherein the pressure sensitive adhesive in the second adhesive layer is a water-based, solvent-based or solvent-free pressure sensitive adhesive.

8. The easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to claim 6, wherein the elastomer-based pressure sensitive adhesive is selected from the group consisting of natural rubber-based pressure sensitive adhesives, synthetic rubber-based pressure sensitive adhesives, synthetic thermoplastic elastomer-based pressure sensitive adhesives, and combinations thereof; and preferably, the synthetic rubber-based pressure sensitive adhesive comprises a styrene-butadiene rubber, a polyisobutylene rubber, a butyl rubber, a chloroprene rubber, and/or combinations thereof, and/or the synthetic thermoplastic elastomer-based pressure sensitive adhesive comprises a styrene-butadiene-styrene block copolymer, a styrene-isoprene-styrene block copolymer, and/or combinations thereof.

9. The easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to claim 6, wherein the resin-based pressure sensitive adhesive is selected from the group consisting of polyacrylates, polyurethanes, polyvinyl ethers, vinyl acetate copolymers, polyesters, pressure sensitive adhesives composed of a mixture of a silicone resin and a silicone rubber, and combinations thereof.

10. The easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to any one of claims 1 to 9, wherein the release layer is selected from the group consisting of polypropylene or polyester films coated with a release agent, release papers, and combinations thereof.

11. A method for preparing the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to any one of claims 1 to 10, the method comprising:

    preparing a soundproof layer;
    bonding the soundproof layer and a floor layer by a first adhesive layer;
    applying a second adhesive layer to the side of the soundproof layer opposite to the first adhesive layer; and
    attaching a release layer to the second adhesive layer;
    or
    the method comprising:

        preparing a soundproof layer;
        bonding the soundproof layer and a floor layer by a first adhesive layer;
        applying a second adhesive layer to a release layer; and
        adhering a release layer with the second adhesive layer to the side of the soundproof layer opposite to the first adhesive layer, wherein the second adhesive layer is located between the release layer and the soundproof layer.

12. A method for using the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard according to any one of claims 1 to 10, the method comprising:

    removing the release layer from the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard, and
    bonding the easy-to-disassemble and reinstallable soundproof self-adhesive floorboard from which the release layer has been removed to a ground by the second adhesive layer, preferably to a cement ground.

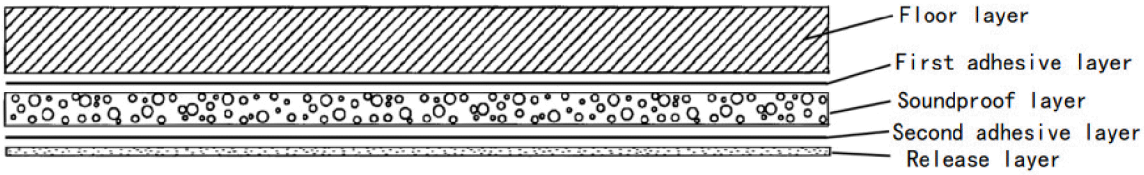

Floor layer
First adhesive layer
Soundproof layer
Second adhesive layer
Release layer

Fig.1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2023/134296

A. CLASSIFICATION OF SUBJECT MATTER

E04F15/20(2006.01)i; E04F15/10(2006.01)i; E04F15/02(2006.01)i

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)

IPC: E04F

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)

CNABS, CNTXT, CNKI, VEN, EPTXT, WOTXT, USTXT, VCN, WPABSC, ENTXTC, ISI Web of Knowledge, 万方, WANFANG, 超星读秀, DUXIU: 明和科技(唐山)股份有限公司, 张明奇, 地板, 静音, 粘结, 粘接, 黏结, 黏接, 胶黏, 胶粘, 胶, 强度, 力, 大于, 小于, 强, 弱, 离型, 层间, 中间, 中部, 残留, 残胶, 残余, 遗留, 无, 没有, 不含, 增塑剂, 析出, 剥离, 脱离, 脱落, 撕开, floor+, adhesiv+, bond+, glue, inter+, cull, remainder, silenc+, mute

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 216042400 U (JIANGSU LEJIA PLASTIC CO., LTD.) 15 March 2022 (2022-03-15) description, paragraphs 0022 and 0023, and figures 1 and 2	1-12
Y	JP 2009024409 A (DAIKEN TRADE & INDUSTRY CO., LTD.) 05 February 2009 (2009-02-05) description, paragraphs 0038 and 0058, and figures 1 and 2	1-12
Y	CN 106368413 A (MINGART (LUTAI) TECHNOLOGY CO., LTD.) 01 February 2017 (2017-02-01) claims 1 and 2, and description, paragraph 0062	1-12
A	JP 2009024413 A (DAIKEN TRADE & INDUSTRY CO., LTD.) 05 February 2009 (2009-02-05) description, paragraphs 0015-0044, and figures 1-10	1-12
A	CN 103436206 A (HUIDONG WEIKANG PLASTIC PRODUCTS CO., LTD. et al.) 11 December 2013 (2013-12-11) description, paragraphs 0004-0015	1-12

☑ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance
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"O" document referring to an oral disclosure, use, exhibition or other means
"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
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
09 July 2024	**18 July 2024**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **China No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2023/134296

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 201605766 U (SHANGHAI JINJIA BUILDING MATERIALS TECHNOLOGY CO., LTD.) 13 October 2010 (2010-10-13) description, paragraphs 0018-0023, and figure 1	1-12

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2023/134296

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 216042400 U	15 March 2022	None	
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CN 106368413 A	01 February 2017	CN 106368413 B	12 February 2019
JP 2009024413 A	05 February 2009	None	
CN 103436206 A	11 December 2013	CN 103436206 B	30 September 2015
CN 201605766 U	13 October 2010	None	

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REFERENCES CITED IN THE DESCRIPTION

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