

HEAT TRANSPORT MATERIAL WITH GOOD SOUND ABSORPTION PROPERTIES

TECHNICAL FIELD

[0001] The invention relates to a heat transport material having good sound absorption properties at the same time, and its application.

BACKGROUND

[0002] Even in temperate climate zones, it is usually desirable particularly for modern buildings to air-condition the rooms of the building by dissipating heat from the building or supplying heat to it. Heat dissipation is important particularly for rooms frequented by people and/or rooms equipped with numerous electronic devices, since they have a significant heat output in the three-digit watt range. The same applies, for example, to production halls, where machines and installations emit considerable amount of heat which has to be removed from the building.

[0003] There are in principle different possibilities for heat dissipation, wherein large-area air-conditioning elements based on the heat-radiating principle have proven to be particularly suitable. Heat transfer devices or air conditioning elements known from the prior art are used for air conditioning of rooms, in particular for room cooling. In principle, such air-conditioning elements are also suitable for room heating when the heat transfer direction is reversed.

[0004] Ceiling or wall elements having frames are already known from the prior art, the frames being fastened onto the ceiling or the wall and having a base plate and a heating or cooling register arranged in the frame. For example, a wall or ceiling lining with a heating or cooling register in the form of pipelines fastened onto heat-conducting profiles is known from DE 20 2007 010 215 U1. The heat conducting profiles abut against the rear side of a lining surface formed by lining plates. The lining plates are fastened to mounting rails with U-shaped cross-section. The mounting rails and the lining plates fastened thereto thus form a frame which can be fastened to a ceiling or wall and has a base formed by the lining plates. The heat-conducting profiles are arranged inside this frame and abut against the lining plates. The heat-conducting profiles and the pipelines fastened thereto form the heating or cooling register. In order to provide a good heat-conducting contact between the pipelines

and the lining surface, hold-down clamps that cause at least two adjacent heat-conducting profiles to abut against the lining plate under spring tension are arranged transversely with respect to the elongate heat-conducting profiles.

[0005] The heat-conducting profiles have an approximately semi-circular attachment piece in which the pipelines are arranged. According to the application purpose, the pipelines are flown through as heating or cooling pipe by a heating or cooling medium, for example hot or cold water. The heat-conducting profiles are usually made of metal, for example aluminum. The lining plates can be, for example, plasterboards or perforated metal cassettes made of steel or aluminum.

[0006] In order to enable a more efficient heat transfer between the heating or cooling register and the room to be heated or cooled, DE 10 2009 055 440 A1 proposes a ceiling or wall element for fastening to a ceiling or a wall, the ceiling or wall element having a frame that can be fastened to the ceiling (or the wall) and has a base in which a heating or cooling register is arranged, wherein the a non-woven and a graphite foil are arranged between the base of the frame and the heating or cooling register.

[0007] The perforated graphite foil should ensure a good thermal contact between the heating or cooling register and the base plate of the ceiling or wall element, and the non-woven should improve the sound absorption of the ceiling or wall element. As for the non-woven, a carbon fiber non-woven is presented as preferable as it has a high thermal conductivity. The non-woven and the perforated graphite foil arranged thereon are preferably a composite which can be produced by calendaring.

[0008] A disadvantage of the described heat transport material is that the heat transport must be accomplished in the vertical direction via the carbon fiber non-woven, since the graphite foil permits only a flat heat conduction. However, carbon fiber non-wovens are undesirable in building applications for reasons of health and unattractive with regard to price. In addition, the use of a foil is disadvantageous in that it must be perforated in order to become sound-permeable and acoustically effective. As a result, foils tear rapidly and are brittle.

[0009] It is also an object of EP 2 468 974 A2 to improve the heat transfer for heating and cooling elements. For this purpose, this publication proposes a structure for a heating and cooling element, particularly for an air-conditioning ceiling, comprising a perforated heat-conducting support plate on whose back side pipes of a heating or cooling register run, the pipes being in heat-conducting contact with the support plate, wherein the back side of

the support plate and the heating or cooling pipes are covered by a cover strip having a textile or grid-like structure and consisting of a heat-conducting material or being coated with a heat-conducting material.

[0010] For example, a non-woven consisting of graphite or being coated with graphite can be used as the cover strip. This non-woven has no special acoustic properties. In order to improve the acoustics, it is therefore proposed to laminate an acoustic non-woven onto the back side of the cover strip.

[0011] The EP 2 191 058 B1 describes a layer for application in a metal ceiling, having a weight per unit area of up to 45 g/m² and comprising a fiber mixture that is present in a proportion of up to 30 g/m² and a flame retardant that is present in a proportion of up to 10 g/m². The layer shows good acoustic properties as it has a high and defined porosity. As a result of its high porosity, however, the layer is only conditionally suitable for applications where heat conduction is of great importance.

SUMMARY

[0012] The primary object of the invention is to provide a material that combines outstanding heat-conducting properties with very good acoustic properties in a simple structure and can thus be used for heat transport and sound absorption, for example, in the above-mentioned heat transfer device.

[0013] The object is accomplished by a heat transport material with a flow resistance of 60 Pa*s/m to 400 Pa*s/m, preferably 100 Pa*s/m to 300 Pa*s/m, further preferably 120 Pa*s/m to 250 Pa*s/m, having a textile fabric and a thermally conductive coating that contains graphite, wherein the graphite contained is present in a proportion of 5% to 50% by weight with regard to the total weight of the heat transport material.

[0014] It has been surprisingly found that with the heat-transport material according to the invention, very good heat-conducting properties can be combined with very good acoustic properties. The heat transport material can have a very simple and thin structure.

[0015] In a preferred embodiment, the proportion of graphite with respect to the thermally conductive coating is higher than 50% by weight, for example 50% to 100% by weight, more preferably 60% to 100% by weight, more preferably 70% to 100% by weight, and more preferably 80% to 100% by weight. This is advantageous in that the heat-conducting properties of the textile fabric can be significantly improved as a result.

Accordingly, good thermal conductivity can thus be realized even with a low application quantity. Low application quantity is in turn advantageous in that in this way, the porosity and the air permeability of the textile fabric are affected to a lesser degree.

[0016] In contrast, thermally conductive coatings of textile fabrics known from the prior art often have a smaller proportion of graphite, since the graphite layer usually contains more than 50% of binding agent by weight.

[0017] As compared to foils, it is advantageous to use a thermally conductive coating in that it can at least partially penetrate the textile material. Penetration into the material is advantageous in that the heat transport towards the surface normal is improved. Accordingly, the thermally conductive coating in a preferred embodiment has at least partially penetrated the textile fabric.

[0018] An advantage of the thermally conductive coating over perforated metal sheets is that the glueability can be improved due to the faster and more uniform distribution of heat in the textile fabric realized by it.

[0019] In a preferred embodiment of the invention, the high proportion of graphite in the thermally conductive coating is realized by the fact that the textile fabric has fibers made from a hydrophilic fiber material. It is assumed, without adopting a mechanism, that the hydrophilic fiber material has a high affinity and thus a particularly good adhesion to the graphite. This makes it possible to keep the proportion of binding agent in the thermally conductive coating and/or between the thermally conductive coating and the textile fabric at a very low level.

[0020] Nevertheless, the thermally conductive coating can contain binding agent. Examples for binding agents are polymer binding agents from the group of acrylates, vinyl acrylate, vinyl acetate, ethylene-vinyl acetate (EVA), acrylonitrile butadiene (NBR), styrene-butadiene (SBR), acrylonitrile butadiene styrene (ABS), vinyl chloride, ethylene-vinyl chloride, polyvinyl alcohol, polyurethane, starch derivatives, cellulose derivatives as well as mixtures and/or copolymers thereof. The proportion of polymer binding agent, particularly the above-mentioned polymer binding agents in the thermally conductive coating and/or between thermally conductive coating and textile fabric is lower than 50% by weight, for example 1% to 50% by weight, preferably lower than 40% by weight, for example 1% to 40% by weight, more preferably lower than 30% by weight, for example 1% to 30% by weight, particularly lower than 20% by weight, for example 1% to 20% in a preferred embodiment of the invention. It is advantageous to use a small

proportion of polymer binding agent or not to use it at all in that the fire behavior of the material in case of fire and the acoustic properties are improved.

[0021] In a preferred embodiment of the invention, the proportion of graphite with respect to the total weight of the heat transport material is 10% to 50% by weight, more preferably 10% to 35% by weight, further preferably 10% to 20% by weight.

[0022] In a further preferred embodiment of the invention, the thermally conductive coating is present in the form of a pattern on the textile fabric. This means that some areas of the surface of the textile fabric are covered with the thermally conductive coating and other areas are not. The thermally conductive coating has also at least partially penetrated the textile fabric. It is advantageous to form a pattern in that the covered areas provide the heat transport material with a high thermal conductivity, while the uncovered areas are acoustically particularly active, since their porosity is not reduced by the provided thermally conductive coating. The pattern can be a geometric or irregular pattern. The surface coverage degree of the thermally conductive coating with respect to the surface of the heat transport material is advantageously 1% to 95%, preferably 10% to 60%, particularly preferably 30% to 50%. In a preferred embodiment, the pattern has at least partially continuous lines, preferably with a line width > 0.5 mm, preferably of 2.0 to 10.0 mm, particularly preferably of 4.0 to 7.0 mm. A good thermal conductivity in the surface of the heat transport material can be achieved as a result of the continuity.

[0023] In a further preferred embodiment, the pattern has at least partially discrete points, sticks and/or non-continuous surfaces, preferably having a size of < 100 mm², particularly preferably of 1.0 to 50 mm² and in particular of 2.0 to 10 mm². Practical tests have shown that this leads to rapid heat transport through the thickness of the material, namely perpendicular to the plane of the textile fabric.

[0024] The heat transport material according to the invention is also distinguished by outstanding acoustic properties. The heat transport material has a flow resistance of 60 Pa*s/m to 400 Pa*s/m, more preferably 100 Pa*s/m to 300 Pa*s/m, further preferably 120 Pa*s/m to 250 Pa*s/m. The flow resistance is measured in accordance with DIN EN 29053-A: 1993-05. By lowering the proportion of polymer binding agent or totally avoiding using it, the negative influence of the thermally conductive coating on the acoustic properties of the material can be reduced. In this way, a complete sealing of the surface can be avoided, so that sufficient porosity is maintained for the acoustic efficiency. The flow resistance can be adjusted in a way known to the person skilled in the art, for

example, through suitable selection of the fiber materials in accordance with the selected parameters during the production and coating of the textile fabric. It has been found that a particularly good sound absorption is realized with the flow resistances selected according to the invention. The sound absorption degree $\alpha(0)$ of the heat transport material according to the invention, measured in a impedance tube at 1600 Hz, is preferably higher than 0.55, for example 0.55 to 1.0, more preferably higher than 0.60, for example 0.6 to 1.0, and particularly higher than 0.65, for example 0.65 to 1.0. The sound absorption degree is determined in accordance with DIN EN ISO 10534-1: 2001-10 with the parameter specified in Example 2.

[0025] In accordance with the invention, the textile fabric preferably comprises fibers selected from the group consisting of glass fibers, polyolefins, polyester, in particular polyethylene terephthalate, polybutylene terephthalate; polyamide, in particular polyamide 6.6 (nylon®), polyamide 6.0 (Perlon®), aramid, wool, cotton, silk, hemp, bamboo, kenaf, sisal, cellulose, soy, flake, glass, basalt, carbon, viscous and mixtures thereof. According to the invention, the fiber material particularly preferably comprises glass fibers, cellulose and/or mixtures thereof, particularly glass fibers and cellulose.

[0026] The textile fabric can also contain conductive fibers, for example metal fibers, ceramic fibers, carbon fibers, etc. to further improve the thermal conductivity.

[0027] Cellulose fibers are particularly preferred according to the invention. Cellulose fibers refer to fibers which have cellulose, viscous and/or fine fibrous or fibrillated cellulosic components, so-called fiber pulp or pulp. Particularly preferably, the fibers consist essentially of the above-mentioned components, which means that its proportion is more than 80% by weight.

[0028] In a preferred embodiment of the invention, the textile fabric contains cellulose fibers in a proportion of at least 30% by weight, for example 30% to 100% by weight, and/or 30% to 95% by weight, preferably 50% to 100% by weight, and/or 50% to 90% by weight, more preferably 60% to 95% by weight, and in particular 65% to 85% by weight with respect to the total quantity of fiber material in the textile fabric.

[0029] In a further preferred embodiment of the invention, the textile fabric contains glass fibers, preferably in an amount of 5% to 80% by weight, more preferably 5% to 70% by weight, more preferably 10% to 60% by weight, in particular 20% to 40% by weight with regard to the total quantity of fiber material in the textile fabric. By adding glass fibers, the textile fabric can be provided with a particularly high structural stability and low

thermal shrinkage.

[0030] Particularly preferably, the textile fabric contains cellulose fibers, preferably in a proportion of 30% to 95% by weight, more preferably from 50 to 90% by weight, in particular 65% to 85% by weight, as well as glass fibers, preferably in a proportion of 5% to 70% by weight, more preferably 10% to 50% by weight, in particular 15% to 35% by weight with respect to the total quantity of fiber material in the textile fabric.

[0031] The textile fabric can be designed as non-woven, non-woven fabric or paper. Preferably, a non-woven fabric in accordance with DIN EN ISO 9092 is used according to the invention.

[0032] The non-woven fabric can be produced using a dry-laying carding process, a wet-laid non-woven process or a spunbonded non-woven process in a way known to the person skilled in the art. The non-woven is produced preferably using a wet-laid non-woven process or carding process. In this way, a particularly high uniformity can be achieved, which is decisive for the acoustic properties. Accordingly, the non-woven fabric is preferably a wet-laid non-woven fabric or a carded non-woven fabric. The non-woven is produced particularly preferably using a wet-laid non-woven process, particularly with an inclined wire part, as non-woven fabrics with particularly high uniformity can be obtained in this way.

[0033] The fiber mixture in the wet-laid non-woven process can also contain fine fibrous or fibrillated cellulosic components, so-called fiber pulp or pulp. These components enable a very effective coordination of the acoustic efficiency of the textile fabric. In a preferred embodiment of the invention, the non-woven fabric is thus a wet-laid non-woven fabric that contains fiber pulp, particularly cellulose pulp, and/or pulp, preferably in a proportion of at least 30% by weight, for example 30% to 100% by weight, and/or 30% to 95% by weight, preferably 50% to 100% by weight, and/or 50% to 90% by weight, more preferably 60% to 95% by weight, and in particular 65% to 85% by weight with respect to the total quantity of fiber material in the wet-laid non-woven fabric.

[0034] In this context, the wet-laid non-woven fabric can contain two or more different fiber pulp and/or pulp types that differ in their fineness. As a result, a particularly precise adjustment of the porosity and thus a textile fabric having a particularly effective acoustic flow resistance can be accomplished. It is also conceivable that the wet-laid non-woven fabric contains finely ground synthetic pulp made from, for example, viscose, polyolefin and/or aramid fibers.

[0035] The non-woven can be mechanically, chemically and/or thermally bonded to form the non-woven fabric in a known manner. The chemical bond with the aid of a polymeric binding agent is particularly preferred. Preferred fiber binding agents include polyacrylates,

[0036] polyvinyl acrylates, polystyrene acrylates, polyvinyl acetates, polyethylene vinyl acetates (EVA), acrylonitrile butadiene rubber (NBR), styrene butadiene rubber (SBR), acrylonitrile butadiene styrene rubber (ABS), polyvinyl chlorides, polyvinyl-ethylene-vinyl chlorides, polyvinyl alcohols, polyurethanes, starch derivatives, cellulose derivatives and copolymers and/or mixtures thereof.

[0037] Accordingly, the non-woven fabric is preferably a chemically bonded non-woven fabric. The textile fabric with a high strength and a good aging resistance can be obtained with the fiber binding agent. The fiber binding agent can be applied through impregnation, spraying or by means of common application methods.

[0038] The fiber binding agent may additionally contain conventional additives such as a flame retardant, for example, metal hydroxides such as aluminum hydroxide, diammonium phosphate or other nitrogen- or phosphor-based fire retardant, such as ammonium polyphosphates or nitrogen-containing phosphoric acid salts. This can be introduced via the fiber binding agent into the impregnation mixture for fiber binding.

[0039] The proportion of fiber binding agent including the additives in the heat transport material is preferably 10% to 70% by weight, more preferably 20% to 50% by weight, and in particular 30% to 40% by weight with respect to the total weight of the heat transport material.

[0040] The textile fabric can additionally contain anti-corrosion agent: The condensation moisture in case of application in a cooling ceiling can lead to damage to the metal elements, e.g. aluminum profiles etc. The addition of an anti-corrosion agent can counteract this.

[0041] In addition, the textile fabric can be antimicrobially treated with a biocidal additive. Condensation moistures in the application can lead to bacterial and fungal growth in the textile fabric, which can be prevented with such treatment.

[0042] The weight per unit area of the heat transport material, measured in accordance with ISO 9073-1, is preferably 20 to 100 g/m², more preferably 40 to 70 g/m², and in particular 45 to 60 g/m². A material with low weight per unit area, namely low material

usage is recommended for a good fire behavior and good acoustic properties.

[0043] The thickness of the heat transport material, measured in accordance with ISO 9073-2, is preferably 0.1 to 0.5 mm, more preferably 0.15 to 0.4 g/m², and in particular 0.2 to 0.3 mm. A thin material that has good acoustic properties at the same time is advantageous in that the processing, namely lamination of the material in perforated metal ceilings is facilitated.

[0044] The air permeability of the heat transport material, measured in accordance with DIN EN ISO 9237 at an air pressure of 100 Pa, is preferably 100 to 3,000 l/m²/s, more preferably 200 to 1,000 l/m²/s, and in particular 300 to 700 l/m²/s. Particularly good acoustic properties are realized in case of such air permeability.

[0045] The tensile strength of the heat transport material in at least one direction, preferably in machine direction, measured in accordance with ISO 9073-3, is preferably 20 to 300 N/5cm, more preferably 30 to 150 N/5cm, and in particular 50 to 100 N/5cm.

[0046] In a preferred embodiment of the invention, the textile fabric is metallized. The metallization can be carried out, for example, through a vacuum deposition process, or electrochemical deposition (electroplating). Aluminum, copper, copper alloys, stainless steel, gold and/or silver have proven to be particularly suitable metals. It is particularly preferable to use stainless steel since it provides the textile fabric with a particularly high aging resistance. In addition, an anti-corrosion agent can be provided.

[0047] According to the invention, the heat transport material has a thermally conductive coating that contains graphite. According to the invention, “graphite” should refer to graphite-analogous compounds, such as, in particular, expanded graphite, graphene and hexagonal boron nitride in addition to graphite in the narrower sense. In a preferred embodiment, the graphite is selected from graphite in the form of a material having a plurality of crystal planes and graphene, namely a material with only a single crystal plane. The graphite exists preferably in particle form. The average size of the graphite particles can be preferably 0.5 to 10 micrometers, particularly preferably 1 to 3 micrometers. Practical tests have shown that this results in a good compromise on processability and thermal conductivity. Large graphite particles are advantageous for a good heat conduction, but are more difficult to process and remain preferably on the surface of the textile fabric. This results in a lower penetration depth of graphite into the heat transport material, which leads to a reduced conductivity perpendicular to the surface plane.

[0048] In an embodiment of the invention, the application weight of the thermally

conductive coating is 1 to 50 g/m², preferably 2 to 30 g/m², particularly preferably 5 to 15 g/m². Practical tests have shown that an obvious improvement of the thermal conductivity can be observed even with a low application weight of graphite. Good acoustic properties can be achieved at the same time, since the porosity of the material remain unchanged.

[0049] The thermally conductive coating is applied preferably by providing the textile fabric with an aqueous graphite dispersion and subsequent drying.

[0050] A binding agent, for example a polymer binding agent can be added to the graphite dispersion to improve the binding to the textile fabric, for examples Polyacrylates, polyvinyl acrylates, polyvinyl acetates, ethylene-vinyl acetate (EVA), acrylonitrile butadiene (NBR), styrene-butadiene (SBR), acrylonitrile butadiene styrene (ABS), vinyl chloride, ethylene-vinyl chloride, polyvinyl alcohols, polyurethane, starch derivatives, cellulose derivatives as well as mixtures and/or copolymers thereof.

[0051] Other additives, for example defoamers, wetting agents and tensides which facilitate the processing, bases and/or acids for adjusting the pH, fire retardants, anti-corrosion agents and/or biocides can be added to the graphite dispersion. A wetting agent selected from the group consisting of: glycerol, propylene glycol, sorbitol, trihydroxystearin, phospholipids, ethylene oxide/fatty alcohol ethers, ethoxylates of propylene oxide with propylene glycol, esters of sorbitol and/or glycerine, alkyl sulfonates, alkyl sulfosuccinates as well as docusates and mixtures thereof is preferably used.

[0052] Practical tests have shown that a particularly uniform and homogeneous wetting and particularly good penetration into the material take place in the case of a proportion of the wetting agent, with respect to the total amount of the graphite dispersion, in the range of 0.1% to 5% by weight, preferably 1% to 4% by weight, in particular 1.5% to 3.5% by weight.

[0053] The finishing can be carried out by all common finishing methods for fabrics, for example by impregnation, such as by means of foulard; by printing, for example flat or screen printing, rotary stencil printing; kiss-coating, squeegee, etc.; spraying. The finishing can be carried out on one side or on both sides.

[0054] Overlaying, for example printing, in particular in screening printing or rotary stencil printing is particularly preferred. In this way, the thermally conductive coating can be applied as pattern print onto the textile fabric. The heat transport material has a high thermal conductivity locally in the printed area, while the unprinted areas are acoustically particularly active, since their porosity is not impaired by finishing with the thermally

conductive coating. The surface coverage degree of the heat transport material by the thermally conductive coating in the form of a pattern is advantageously 1% to 100%, preferably 10% to 60%, particularly preferably 30% to 50%. In a preferred embodiment, the printing is carried out at least partially in the form of continuous lines, preferably with a line width > 0.5 mm, preferably 2.0 to 10.0 mm, particularly preferably 4.0 to 7.0 mm. This results in a rapid distribution of the heat in the plane of the textile fabric.

[0055] In a further preferred embodiment, the printing can be carried out at least partially in the form of discrete points, sticks and/or non-continuous surfaces, preferably having a size of < 100 mm², particularly preferably 1.0 to 50 mm² and in particular 2.0 to 10 mm². Practical tests have shown that this leads to rapid heat transport through the thickness of the material, namely perpendicular to the plane of the textile fabric.

[0056] The drying can be carried out using all common drying methods, for example contact drying with a roller dryer, circulating air or aeration drying with a belt dryer; IR or microwave drying, etc. It is preferable to use aeration drying in order to maintain the porosity of the material and thus the good acoustic properties. The material can additionally be after-treated using compression rollers in order to further improve the contact of the graphite particles with one another and thus the thermal conductivity of the material.

[0057] In a preferred embodiment of the invention, the heat transport material has an additional, preferably discontinuous adhesive compound coating. The adhesive compound coating consists preferably of a hot-melt adhesive. The discontinuity of the adhesive compound coating is advantageous in that the acoustic efficiency of the heat transport material is not significantly impaired by it. The adhesive compound coating can be applied, for example, by sprinkling a hot-melt adhesive powder onto the heat transport material and subsequent thermal fixing to the heat transport material. The hot-melt adhesive has preferably a melting point $< 125^{\circ}\text{C}$.

[0058] The weight per unit area of the adhesive compound coating is preferably 5 to 50 g/m², more preferably 10 to 40 g/m², and particularly preferably 12 to 25 g/m².

[0059] The adhesive compound coating preferably consists essentially of a thermoplastic polymer, for example a substantially amorphous polyester or copolyester, a polyamide or copolyamide, a polyurethane, a polyolefin, polyethylene-vinyl acetate and/or mixtures, copolymers or terpolymers thereof. In this context, "essentially" should refer to a proportion of at least 70% by weight, preferably more than 80% by weight with respect to

the total mass of the adhesive compound coating.

[0060] The adhesive compound coating may additionally be provided with thermally conductive additives, for example by compounding the thermoplastic polymer with thermally conductive fillers (e.g. soot, graphite, metal powders, metal oxides, boron nitride, ceramic compounds, etc.) in order to further increase the thermal conductivity of the heat transport material according to the invention.

[0061] By applying the adhesive compound coating in the form of a powder to the textile fabric, the powder can be processed as a mixture with other heat-conductive powders (e.g. metal powders, fine metal beads, metal oxide powders, ceramic powders, etc.) to further increase the thermal conductivity of the heat transport material. The adhesive compound coating can also contain a ceramic reactive adhesive comprising, for example, reactive silane groups.

[0062] The heat transport material according to the invention is outstandingly suitable for heat transport and simultaneous sound absorption in ceiling and/or wall elements, particularly comprising a frame that can be fastened onto the ceiling and/or the wall and has a base in which a heating and/or cooling element is arranged. The heat transport material according to the invention is preferably arranged between the base of the frame and the heating or cooling element.

[0063] The ceiling and/or wall elements can be used in suspended, perforated and/or slotted metal ceiling and/o wall systems (among other things, also in wood or gypsum plasterboard ceilings). It is also conceivable to use the heat transport material according to the invention in the construction of raised floors.

[0064] The invention is described in more details using several examples below.

[0065] Example 1: Production of the heat transport material according to the invention

[0066] To produce the heat transport material according to the invention, a textile fabric in the form of a wet-laid non-woven fabric is produced first. The weight per unit area of the wet-laid non-woven fabric is 48 g/m^2 in total. The textile fabric has a fiber mixture comprising pulp in a proportion of 70% by weight and glass fibers in a proportion of 30% by weight. The fiber mixture contributes with a total of 25 g/m^2 to the weight per unit area of the textile fabric. In addition, the textile fabric has a fiber binding agent comprising polyacrylate binding agent and fire retardant with a weight per unit area of 23 g/m^2 .

[0067] A commercially available graphite dispersion with an average particle diameter

of 2.5 micrometers and a solid content of 18% by weight is used to produce the thermally conductive coating. It is applied through rotary stencil printing and subsequent drying in aeration oven. A rectangular lozenge pattern is selected as stencil pattern. The average width of the printed lines on the wet-laid non-woven fabric is 5.0 mm, and the surface coverage by the thermally conductive coating is 52%. The proportion of graphite in the thermally conductive coating, measured in accordance with Example 4, is 80% by weight, which corresponds to a proportion of 14% by weight with respect to the total weight of heat transport material.

[0068] The obtained heat transport material has a total weight of 57 g/m², a thickness of 0.23 mm, a tensile strength of 65 N/5cm in machine direction, an air permeability of 550 l/m²/s at 100 Pa and a flow resistance of 190 Pa*s/m.

[0069] Example 2: Determination of the sound absorption degree of the heat transport material

[0070] The heat transport material is equipped with an adhesive compound coating for analysis in an impedance tube. The adhesive compound consists of epsilon-polycaprolactone which is powdered as ground powder with an average particle size of 150 micrometers onto the heat transport material and sintered in a furnace. The application amount in this case is 15 g/m².

[0071] The heat transport material equipped with the adhesive compound coating is then ironed onto perforated, painted steel sheet having a thickness of 0.5 mm, a hole area proportion of 15% and a perforation diameter of 2.3 mm. The sound absorption degree of the composite material is determined and specified $\alpha(0)$ at a frequency of 1,600 Hz.

[0072] A sound absorption of $\alpha(0) = 0.7$ at 1,600 Hz is determined.

[0073] Example 3: Determination of the thermal conductivity of the heat transport material

[0074] The thermal conductivity of the heat transport material is investigated in comparison to the textile fabric without a thermally conductive coating. The measurements are carried out on 6-fold stacked test specimens by means of a plate method according to DIN 52612 and on single-layer specimen in accordance with the hot-disk method according to ISO 22007-2.2:2008, part 2.

Method for thermal conductivity	Unit	Textile fabric	Heat transport material
Plate method	W/(K*m)	0.06	0.08
Hotdisk	W/(K*m)	0.06	0.09

[0075] Example 4: Qualitative and quantitative Determination of graphite

[0076] A qualitative identification of the graphite is carried out using X-ray angle scattering (XRD) according to DIN EN 13925-2 2003-07. For this purpose, X-ray diffractograms of the heat transport material are captured with CoK α -ray at 40 kV and 35 mA in the angle range of 5° to 60° (2 theta). A clear identification can be achieved via the sharp reflexes at 30.78° (3.37Å); 49.69° (2.13Å); 52.19° (2.04Å); 64.37° (1.68Å); 93.21° (1.23Å). A quantitative determination of the proportion of graphite in the heat transport material or the thermally conductive coating can be carried out using thermogravimetric analysis (TGA) according to DIN EN ISO 11358 2014-10. The sample is firstly heated to 1,000°C in an inert nitrogen atmosphere and cooled again to 300°C. The sample is then heated again to 1,000°C in oxygen. In this last combustion stage, combustion of the graphite and the soot (if present) takes place. In this process, soot burns in a temperature range of 380°C to 700°C and graphite burns at temperatures > 700°C. If the combustion of the soot is not completely separated from that of the graphite, the thermogravimetric curve which shows a reversal point at 700°C is derived to determine the temperature ranges to be evaluated.

CLAIMS

1. A heat transport material with a flow resistance of 60 Pa*s/m to 400 Pa*s/m, preferably 100 Pa*s/m to 300 Pa*s/m, further preferably 120 Pa*s/m to 250 Pa*s/m, having a textile fabric and a thermally conductive coating that contains graphite, wherein the graphite contained is present in a proportion of 5% to 50% by weight with regard to the total weight of the heat transport material.
2. The heat transport material according to claim 1, characterized in that the proportion of graphite with regard to the thermally conductive coating is higher than 50% by weight.
3. The heat transport material according to claim 1 or 2, characterized in that the proportion of polymer binding agent in the thermally conductive coating and/or between the thermally conductive coating and textile fabric is lower than 40% by weight.
4. The heat transport material according to any one or more of the preceding claims, characterized in that the textile fabric has fibers made from a hydrophilic fiber material.
5. The heat transport material according to any one or more of the preceding claims, characterized in that the thermally conductive coating exists in the form of a pattern on the textile fabric.
6. The heat transport material according to claim 5, characterized in that the pattern has at least partially continuous lines.
7. The heat transport material according to any one or more of the preceding claims, characterized in that the application weight of the thermally conductive coating is 1 to 50 g/m².
8. The heat transport material according to any one or more of the preceding claims, characterized in that the graphite exists in particle form with an average particle size of 0.5 to 10 μm .

9. The heat transport material according to any one or more of the preceding claims, characterized by a flow resistance of 60 Pa*s/m to 400 Pa*s/m and/or a sound absorption coefficient, measured in an impedance tube at 1,600 Hz, of higher than 0.55.
10. The heat transport material according to any one or more of the preceding claims, characterized in that the textile fabric contains cellulose fibers with a proportion of at least 30% by weight, with regard to the total quantity of fiber material in the textile fabric.
11. The heat transport material according to any one or more of the preceding claims, characterized in that the textile fabric contains glass fibers with a proportion of 5% to 80% by weight, with regard to the total quantity of fiber material in the textile fabric.
12. The heat transport material according to any one or more of the preceding claims, characterized in that the textile fabric is a wet-laid non-woven fabric or a carded non-woven fabric.
13. The heat transport material according to any one or more of the preceding claims, characterized by a weight per unit area of 20 to 100 g/m² and/or a thickness of 0.1 to 0.5 mm and/or an air permeability of 100 to 3,000 l/m²/s.
14. The heat transport material according to any one or more of the preceding claims, characterized in that it has a hot-melt adhesive in the form of a preferably discontinuous adhesive compound coating.
15. An application of a heat transport material according to any one or more of the preceding claims for heat transport and simultaneous sound absorption in ceiling and/or wall elements, preferably comprising a frame that can be fastened onto the ceiling and/or the wall and has a base in which a heating and/or cooling element is arranged.