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(54) Composite synthetic fibre material for footwear insoles and production process therefor

(57) A method for the manufacture of a composite synthetic fibre material in the form of sheets or strip intended for the use in the footwear field, especially for the production of footwear insoles. The method comprises the steps of: homogenization of the fibres; carding of the fibres to obtain a fibre structure arranged in several layers; multi-phase needle punching of the layered fibre structure to obtain a felt; characterized in that said felt is subjected to a controlled surface heat treatment suitable for causing the fluff present thereon to melt, and to form partially molten clots without affecting the whole mass of said felt. The felt treated in this manner is then subjected to a finishing treatment in a bath containing an aqueous suspension of a synthetic rubber, the resulting product being subjected to drying in an hot air furnace.

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Description

[0001] The present invention relates to a composite synthetic fibre material in the form of a sheet or a strip intended for use in the footwear field and, more particularly, for the production of insoles for footwear. The invention also relates to a method for the production of this composite synthetic fibre material.

[0002] As is well known, the insole of a piece of footwear performs both the function of supporting the sole that is applied to its lower face and the function of supporting the foot by means of its upper contact surface. This important component of a shoe must therefore have characteristics such as to facilitate the assembly of the shoe and, at the same time, to assure good comfort for the foot.

[0003] If it is to facilitate the assembly of the shoe, the insole has to be characterized by sufficient rigidity and by resistance to abrasion, tearing and gluing. Currently, the materials most widely used for the manufacture of insoles for glued or assembled shoes are leather, regenerated leather and impregnated vegetable fibres, which are used to produce the so-called cellulose insole.

[0004] Impregnated vegetable fibres are the most widely used materials in the footwear industry for insole production on account of its low cost. This material is constituted by a structure of cellulose fibres and latex and is produced by mixing the cellulose fibers with latex to form a paste that is subsequently dried and transformed into sheets so as to make it sufficiently stiff.

[0005] The process followed for the production of this cellulose material is derived from the paper industry and is characterized by the following steps:

- formation of a paste consisting of cellulose fibres and latex;
- application of the paste onto a belt in such a manner as to form a layer of homogeneous width and thickness;
- extraction of the aqueous part by means of suction;
- drying the layer by passing it over heated cylinders;
- cutting into sheets of the material as it comes out of the plant.

[0006] The material obtained in this way has a relatively high density and is sufficiently stiff for being used in the production of insoles for footwear; on the other hand, since latex becomes coagulated in the course of the production process, the material does not permit transpiration to take place and does not therefore assure sufficient comfort for the foot. Furthermore, the type of cellulose material currently most widely used for the production of insoles gives rise to some problems during the actual wearing of the shoe, because it tends to flake under the effect of the sweat produced by the foot and the bending to which the shoe becomes subjected during use. Given its structure, which is similar to cardboard, it also tends to lose consistency and to become macerated when it comes into contact with water or is placed for a long time in a humid environment, which is very liable to happen during the footwear use. Consequently, according to the current state of the art, there does not exist a material for glued or assembled shoes that is capable of assuring the mechanical characteristics of the cellulose insole combined with a sufficient transpiration capacity and resistance to abrasion and sweating.

[0007] An effective alternative to the cellulose material described above could be represented by the nonwoven fabrics, which, as is well known, are formed from a web of fibres by means of needle punching and subsequent finishing treatment with chemical products. These materials, already utilized for other applications in the footwear sector, are interesting also from an economic point of view as they can be produced by a low-cost process.

[0008] Up to now, however, the use of nonwoven fabrics as material for the production of insoles for assembled shoes has been discarded on account of the surface fluff that characterizes these materials. In fact, though the fluff undoubtedly facilitates adhesion of the glue between the sole and the insole, it also brings about a greater consumption of glue and transmits a sensation of heat that is not always valued in a positive manner by the market, especially for applications in shoes intended to be worn in spring or summer. The surface fluff also tends to oppose the sliding of the foot within the shoe, thus generating disagreeable difficulties in moving the foot inside the shoe. Furthermore, just like the cellulose material, a nonwoven fabric does not of itself have the rigidity needed for being applied to shoes and, consequently, will always have to undergo some finishing treatment in the course of which a hardening resin has to be applied to it.

[0009] It is therefore the object of the present invention to make possible the use of a nonwoven synthetic fibre fabric for the production of footwear insoles.

[0010] A particular object of the present invention is to make available a composite synthetic fibre material in the form of sheets or strip that can advantageously be used in the footwear industry for the manufacture of footwear insoles.

[0011] Another object of the present invention is to provide a process for the production of a composite synthetic fibre material in the form of sheets or strips that can be used in the footwear industry for the production of footwear insoles.

[0012] Yet another object of the present invention is to provide a production process of the aforementioned type that will make it possible to obtain sheets of said material characterized by the absence of surface fluff on at least one face and by adequate rigidity to permit its being used for the production of footwear insoles, though without thereby negatively affecting its transpiration properties.

[0013] The essential feature of the method for produc-

ing a composite fibre material used to manufacture footwear insoles in accordance with the present invention consists in that the fibre web, mechanically cohered by needle punching, is subjected to a controlled surface heat treatment on at least one of its sides capable of causing the fluffy part present thereon to melt and to form semi-molten clots thereon without affecting the whole mass of the web, and thereafter is subjected to a finishing treatment in a bath containing an aqueous suspension of a synthetic rubber, and possibly is dried in a hot air furnace. Simultaneous control of the heat flow and the speed at which the web is moved makes it possible to eliminate the fluff without creating molten zones that could limit the transpiration properties and to avoid excessive web heating, which would otherwise tend to shrink and to form folds and defects.

[0014] The nonwoven fabric web may be made either from common synthetic fibres or from recycled fibres, for example, the polyester fibres obtained from the plastic bottles disposal.

[0015] The composite material obtained with the process according to the invention can represent not only an alternative to the cellulose material currently employed for the production of soles in footwear, but, thanks to its structure, also exhibits significantly improved properties, such as better transpiration, greater elasticity and resistance to bending stress, a high capacity for absorbing and desorbing humidity (sweat), dimensional stability when dry and, above all, when wet, absence of flaking, and quick diffusion, by capillarity, of the humidity generated at isolated points over the entire mass of the insole.

[0016] The insole made with the material according to the invention, therefore, has a smooth and slippery surface that makes the use of a lining unnecessary and gives a feeling of freshness to the touch.

[0017] Further characteristics and advantages of the method and the product in accordance with the invention will be apparent with the following description of a particular embodiment thereof, which is given by way of example and is not to be considered limitative in any way, the description making reference to the attached figure that illustrates said method in a schematic manner.

[0018] Referring to said figure, the process according to the invention is based on the use of synthetic fibres, such as polyester, polyamide and acrylic fibres either by themselves or in mixtures, received in bales 2a that are subjected to a preparatory treatment, indicated by the reference number 1, consisting of their being processed in a machine known as "bale opener" 2 and serves to homogenize the lot as regards colour and type of fibre (denier, length, volume, composition). This step also envisages the addition of any antistatic additives necessary for the subsequent processing steps. A first and very rough opening of the fibre masses, made compact due to a long storage within the bales, is carried out in a carding machine 3, where the fibres are parallelized until they form a web of homogeneous weight and thickness. The carded webs obtained in this way are then superposed in a layering machine 4 to produce a fibrous or felt mattress of the desired weight as a function of the final weight.

[0019] This semi-finished product is then sent to the needle punching station, indicated by the reference number 5, comprising a series of needle punching machines 6 that, by the action of a plurality of needles in fast alternating motion in the direction at right angles to the direction in which the fibrous mattress is being fed, capture the fibres and drag them through the fibrous mass, which thus becomes bound and compacted. At the outlet of the needle punching station the semi-finished product appears as a felt that is rolled up and sent to a smoothing station, indicated by 7, for the removal of the surface fluff.

[0020] At this station the semi-finished product is unrolled by a first reel 8 and transported over guide rollers 9 and a working roller 10 to a linear burner 11, which serves to melt the fluff present on the surface of the product and thus to eliminate it. Immediately downstream of the burner 11 the semi-finished product is subjected to a rolling action by means of pressure roller 12, which rotates in the direction opposite to roller 10, in order to crush the partially molten clots that would otherwise render the surface bristly. With a view to making sure that the rolling action is performed while the clots are still partially molten, it is important that the roller 12 should be placed at a minimum distance from the burner 11. Rather than other types of heat treatment (hot air furnaces, irradiation with infrared rays, calendaring with heated rollers), exposure to a direct flame is deemed to be preferable according to the invention, because the other heat treatments cause the heating of the whole of the textile and thus deform it.

[0021] The semi-finished product thus obtained is then sent to a finishing unit 15, where it is processed to reach the desired mechanical strength. In this unit there is provided a processing bath 16 constituted by a synthetic rubber (SBR, acrylic or vinylic rubber) in aqueous suspension in a mixture containing also mineral fillers and various additives, applied by means of a foulard impregnation and/or scraper spreading and/or plating. After being treated in this way, the product is passed through an hot air furnace 17 to remove the entrained water and to make it stiff and coherent. At the outlet side of the furnace the material is rolled into coils or cut into sheets, indicated by F, and then stacked.

[0022] The processing bath has the following weight percent composition:

Styrene/butadiene latex	10-80%
Calcium carbonate	5-70%
Water	0-20%
Acrylic thickener	0-2.5%

[0023] A particularly preferred composition of the processing bath according to the invention is as follows:

Styrene/butadiene latex	30%
Calcium carbonate	58%
Water	11%
Acrylic thickener	1%

[0024] The thickener is added to obtain the viscosity necessary to maintain the mineral filler in suspension and apply the correct quantity of bath to the textile product.

[0025] Mineral fillers that should preferably be present in the processing bath are calcium carbonate, kaolin and similar materials. They have the purpose of:

- increasing the density of the product and therefore contributing to its thickness;
- preventing its thickness from becoming reduced during the thermoforming operation, i.e. when the product is shaped as desired by compression, to which the material is subjected during the subsequent construction of the insole;
- limiting the incidence of the raw material costs.

[0026] Other fillers or additives that could be present in the processing bath are: dispersing agents, generally, sodium hexametaphosphate, used for dispersing the mineral filler to avoid its coagulation and therefore instability of the impregnation bath with consequent irregular weight, rigidity and appearance of the finished product.

[0027] The transpiration characteristics of the raw textile are maintained also in the finished product, because during the process of improving its cohesion the impregnation bath provides it with a kind of gluing between the fibres at the points in which they already adhere to each other due to the effects of the needle punching process. The spaces between the fibres in the raw needle-punched state are maintained, because, during the drying step, the bath tends to adhere to the fibres at their points of contact, leaving free the zones in which the fibres are distant from each other.

[0028] The operating conditions in which the heat treatment for melting the surface fluff of the product is carried out are particularly important. Obviously, the contact time with the flame must be sufficient to cause the melting of the fluff present on the surface, but it must also avoid heating the bulk of the product, which, as already explained, would cause shrinkage and formation of folds. In this connection it is particularly important to control the feed rate of the product along the working roller 10, this feed rate being in any case related to the flame power of the linear burner 11.

[0029] When a water-cooled, aluminum-alloy burner with a variable-speed electronic mixer is used and methane and/or liquefied petroleum gas are used as fuel, the optimal feed rate that permits correct melting of the surface fibres, avoiding the formation of a completely molten surface, is comprised between 30 and 80 m/min.

[0030] The composite material that can be obtained by means of the process in accordance with the invention has the following technical specification:

Fibre weight	150/1000 g/m2
Weight of applied compound	500/1800 g/m2
Final weight	600/4000 g/m2
Thickness	0.5/5 mm

[0031] The following are some basic reasons why polyester fibre is the preferred fibre for the purposes of the present invention:

- being a synthetic fibre, it melts but does not carbonize when it is subjected to the heat of a flame;
- it is heat-resistant and is therefore suitable for being processed in the hot air furnaces used in shoe production;
- it resists the solvents present in the glues used in the shoe production;
- it has a considerable resistance to bending stress.

[0032] Variations and/or modifications may be brought to the composite synthetic fibre material for footwear insoles and the production process therefor according to the present invention without departing from the scope of the invention as set forth in the following claims.

Claims

1. A method for the manufacture of a composite synthetic fibre material in the form of sheets or strip intended for the use in the footwear field, especially for the production of footwear insoles, comprising the following steps:

   - homogenization of the fibres;
   - carding of the fibres to obtain a fibre structure arranged in several layers;
   - multi-phase needle punching of the layered fibre structure to obtain a felt;

   characterized in that said felt is subjected to a controlled surface heat treatment suitable for causing the fluff present thereon to melt, and to form partially molten clots without affecting the whole mass of said felt, and **in that** the felt treated in this manner is then subjected to a finishing treatment in a bath containing an aqueous suspension of a synthetic rubber, the resulting product being subjected to drying in an hot air furnace.

2. A method according to claim 1, wherein said heat treatment is carried out by exposing the surface of the felt, to the flame of a linear burner, the felt being moved forward at a controlled rate though said burner.

3. A method according to claim 1 or claim 2, wherein immediately after said heat treatment the felt is subjected to rolling so as to crush the partially molten clots formed on its surface.

4. A method according to any one of the preceding claims, wherein the rate at which the felt is moved forward at the heat treatment station is comprised between 20 and 80 m/min.

5. A method according to any one of the preceding claims, wherein said processing bath has the following composition by weight:

Styrene/butadiene rubber	10-80%
Calcium carbonate	5-70%
Water	0-20%
Acrylic thickener	0-2.5%

6. A method according to claim 5, wherein said processing bath has the following composition by weight:

Styrene/butadiene rubber	30%
Calcium carbonate	58%
Water	11%
Acrylic thickener	1%

7. A method according to any one of the preceding claims, wherein the synthetic fibre is a polyester fibre.

8. A composite synthetic fibre material in the form of sheets or strip for the production of footwear insoles, **characterized in that** it is produced by a method in accordance with any one of the preceding claims.

9. A composite synthetic fibre material in the form of sheets or strip for the production of footwear insoles, **characterized in that** it is constituted by a layer of nonwoven fabric having at least one fluff-free face and is impregnated by a synthetic resin to which there have been added mineral charges and other additives.

10. A composite material according to claim 8 or claim 9, wherein the synthetic fibre is a polyester fibre.

11. A composite material according to claim 8 or claim 10, wherein said synthetic resin is a styrene/butadiene latex.

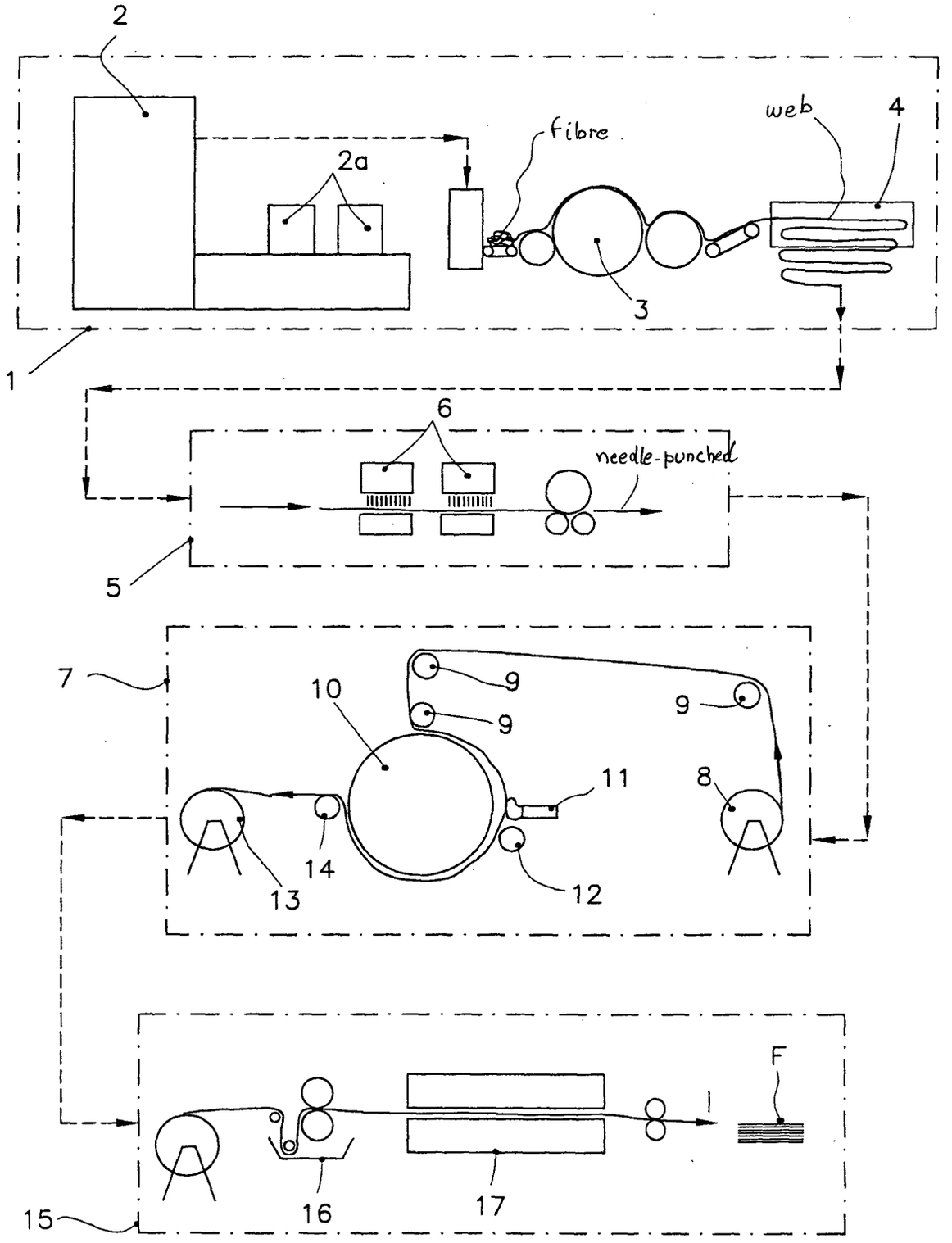
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Fig.1