(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
8 November 2001 (08.11.2001)

PCT

(10) International Publication Number
WO 01/83632 A2

(51) International Patent Classification[7]: C09J 7/00

(21) International Application Number: PCT/EP01/04921

(22) International Filing Date: 2 May 2001 (02.05.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0010392.9 2 May 2000 (02.05.2000) GB

(71) Applicant *(for all designated States except US)*: **MILLIKEN EUROPE N.V.** [BE/BE]; Ham 24, B-9000 Gent (BE).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **VANGHELUWE, Lieven** [BE/BE]; Blauwesteen 101, B-9600 Ronse (BE). **DE MEYER, Willy** [BE/BE]; J.B. d'Hanedreef 8, B-9031 Drongen (BE). **AVIO, Bruno** [FR/FR]; 47, avenue de Verdun, F-59700 Marcq en Baroeul (FR).

(74) Agent: **BEYER, Andreas**; Wuesthoff & Wuesthoff, Schweigerstrasse 2, 81541 München (DE).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

WO 01/83632 A2

(54) Title: BY HAND TEARABLE COMPOSITE MATERIAL

(57) Abstract: The present invention relates to a by hand tearable composite material, in particular for use as a substrate for an adhesive tape such as, for example, a pressure-sensitive adhesive tape. According to one main embodiment, the composite material comprises a reinforcement layer in the form of a weft inserted knitted fabric, and at least one extruded layer of thermoplastic material on one surface of the reinforcement layer. According to another main embodiment, the composite material comprises a reinforcement layer in the form of a laid fabric consisting of a warp and a weft, and at least one extruded layer of thermoplastic material on one surface of the reinforcement layer. Production costs are thus significantly lowered without sacrificing other properties of the composite material.

By Hand Tearable Composite Material

The present invention relates to a by hand tearable composite material, in particular for use as a substrate for an adhesive tape such as, for example, a pressure-sensitive adhesive tape.

US patent no. 4 304 813 and European patent no. 0 466 342, the entire contents of which documents are incorporated herein by reference, disclose pressure-sensitive adhesive tapes having a substrate comprising a plastic film as a base or backing layer, and a fabric layer adjacent the film. A coating of pressure-sensitive adhesive is applied over an outer surface of the fabric layer and passes through the fabric to the film. The adhesive bonds the film and fabric layers together as a laminate.

By employing a fabric having a relatively open construction as described in the above-referenced documents, it is possible to produce a tape which is light-weight and has good distribution of the adhesive. The tapes disclosed in the above documents are also able to be readily torn by hand. Those tapes, however, have the disadvantage of relatively poor dimensional stability and are therefore easily distorted. Furthermore they are relatively expensive to manufacture.

It is accordingly an aim of the invention to provide a composite material which is in particular suited for the production of an improved and less costly adhesive tape which may exhibit the advantages of the prior art tapes described above without the same degree of susceptibility to distortion.

To this end, the present invention provides in its broadest form a by hand tearable composite material which is in particular suited as a substrate for an adhesive tape and which comprises a reinforcement layer in the form of a weft inserted

knitted fabric, and at least one extruded layer of thermoplastic material on one surface of the reinforcement layer. According to an alternative main embodiment of the invention the composite material comprises a reinforcement layer in the form of a laid fabric consisting of a warp and a weft, and at least one extruded layer of thermoplastic material on one surface of the reinforcement layer. In this latter embodiment of the invention the reinforcement layer contains at least one non-interconnected direction of ends. Warp and/or weft ends may be directly laid into the "soft" material of the extruded layer during or immediately after the extrusion process.

By extruding the at least one layer of thermoplastic material to the reinforcement layer, the latter is at least partially thermally bonded to the thermoplastic material without use of an adhesive. The heat bonding is effected between the opposed facing surfaces of the thermoplastic material and reinforcement layers. That is, the thermal bonding occurs at the interface between the layers. The nature of the reinforcement layer permits good tearability by hand.

As is readily apparent from the above description of the two main embodiments of the invention, no film material is used in manufacturing the composite material. Instead, the thermoplastic material is extruded onto the reinforcement layer. Extruding the thermoplastic material onto the reinforcement layer permits to use plastic pellets as starting material instead of having to use a plastic film which is much more costly than pellets. Production costs of the composite material are thus significantly lowered. Further savings may be obtained by way of the present invention if an adhesive is to be applied to the composite material. With known fabric-film constructions, a substantial part of the adhesive applied to the fabric side of the composite material just fills the voids in the fabric without actually contributing to the desired adhesive properties of the final product. According to the present invention, however, due to the thermoplastic material

being extruded onto the fabric the thermoplastic material, while still being "soft", at least partly fills the voids in the fabric thus on the one hand achieving good bonding between the fabric reinforcement layer and the layer of thermoplastic material and on the other hand creating a smoother, flatter surface on the other side of the fabric layer, i.e. the side of the fabric which is not coated with thermoplastic material. Therefore less adhesive needs to be applied to obtain the desired adhesive properties.

In preferred embodiments of the present invention, the composite material comprises at least one extruded layer of preferably thermoplastic material on the other surface of the reinforcement layer. Dimensional stability of the composite material is thus enhanced while tearability is not significantly imparted.

In one embodiment of the present invention the at least one extruded layer of thermoplastic material on the one surface of the reinforcement layer consists of thermoplastic rubber. According to a modification of this embodiment, also the at least one extruded layer of thermoplastic material on the other surface of the reinforcement layer consists of thermoplastic rubber. According to another modification of this embodiment, the at least one extruded layer on the other surface of the reinforcement layer consists of thermoset rubber.

In embodiments of the present invention, where the thermoplastic material is thermoplastic rubber, the thermoplastic rubber advantageously contains a polyolefine, preferably polypropylene or polyethylene.

As has been pointed out above, bonding between the reinforcement layer and the extruded layer on the one surface or on both surfaces of the reinforcement layer is effected by way of the extrusion process, i.e. while the extruded material is still in a "soft" state. In a preferred form of the

invention the reinforcement layer is thermally bonded to the thermoplastic layer at a plurality of discrete locations over the interface between the fabric and the thermoplastic material. Desirably, the bond locations between the reinforcement layer and the at least one extruded layer on one or both surfaces of the reinforcement layer are relatively evenly distributed, preferably substantially evenly distributed over the extruded material-reinforcement layer interface area. This assures good dimensional stability as well as good tearability of the composite material of the present invention all over the composite material. Alternatively, the thermal bonding may be effected over substantially the entire area of contact between the reinforcement layer and the thermoplastic layer. While it is possible for the extruded material to cover only part of the surface area of the reinforcement layer, it is preferred that the extruded material covers substantially the entire surface area of the reinforcement layer.

In order to obtain good tearability characteristics of the composite material in normal use, the pitch between weft ends is preferably at least 2 mm, i.e. the spacing between adjacent weft ends is at least 2 mm measured axis to axis.

To obtain good dimensional stability and load bearing characteristics, the pitch between warp ends of the composite material of the present invention is preferably less than 2.5 mm, more preferably less than 1.4 mm, i.e. there should be at least seven warp ends per cm.

If the composite material of the present invention is intended to be used in the making of adhesive tapes, an adhesive is provided at an outer surface of said composite material. The independent bonding of the layer of extruded material and the reinforcement layer in the composite material may be achieved by physical bonding, chemical bonding or a combination of both physical and chemical bonding. Desirably, however, the adhesive provided at the outer surface of the composite material may

further enhance the bonding between the composite material layers.

In one form of the invention the adhesive properties are obtained from a coating of adhesive applied to an outer surface of the composite material. The outer surface of the composite material may be a surface of the reinforcement layer. On the other hand, however, the composite material may include a layer of extruded material on each side of the reinforcement layer. For example, the composite material may include a further layer of extruded material adjacent to and in opposed face-to-face relation with the other side of the reinforcement layer; i.e. such that the reinforcement layer is sandwiched between two thermoplastic layers. The adhesive is then applied to an outer surface of one of the thermoplastic layers.

The layer(s) of extruded material and the reinforcement layer are typically in the form of substantially planar strips, each strip having two main (upper and lower) surfaces. The extruded material and reinforcement layer strips typically have the same length and width dimensions (the thickness of the layers will typically differ, but may also be equal) and are superposed adjacent one another such that they are essentially coextensive.

In a preferred form of the invention the reinforcement layer is manufactured from yarn that includes at least some thermoplastic synthetic. Accordingly, the reinforcement layer may be manufactured purely from a thermoplastic synthetic yarn or, alternatively, may be manufactured from a combination or blend of different yarns which include a thermoplastic synthetic. The yarn in the reinforcement layer may also include a finish or component that promotes adhesion to the layer of extruded material; an example being a co-extruded yarn with one fibre type having low melt properties. For example, the yarn of the reinforcement layer preferably includes at least a proportion of PVC, polyurethane, polyester, polyethylene,

polypropylene and/or polyamide. Upon heating, the thermoplastic part of the yarn softens and fuses to the layer of extruded material. The yarn may also, however, include non-thermoplastic fibres or filaments such as rayon, viscose, or natural fibres such as cotton, flax, wool and/or silk.

The reinforcement layer itself is manufactured using either knitting or laying. When knitting is used, the fabric is manufactured with a "warp knitted-weft insertion" construction. Desirably, the fabric has a relatively open construction to facilitate distribution of the adhesive, in the case that the adhesive is applied to the surface of the reinforcement layer facing away from the layer of extruded material. The fabric may optionally be manufactured such that it includes tape yarns in the weft and/or warp.

In a preferred form of the invention the thermoplastic layer is manufactured from a thermoplastic polymer. Accordingly, upon heating, the thermoplastic layer softens and fuses to the yarns of the reinforcement layer. In a very preferred form of the invention, both the yarn of the reinforcement layer and the thermoplastic layer include a thermoplastic polymer (most preferably, the same polymer) such that heating causes a softening of both the fabric yarns and the thermoplastic layer enabling a fusion welding between the layers.

After a thermoplastic layer and a reinforcement layer are thermally bonded to one another to form a composite material, a coating of adhesive may be applied to the outer surface of the reinforcement layer, i.e. that surface which faces away from the thermoplastic layer. In one form of this invention the adhesive is pressed into and through the fabric, for example by calendering as in US 4 304 813 and EP 0 466 342, to create a further bond or adhesion between the reinforcement layer and the thermoplastic layer. The adhesive is preferably a rubber gum pressure-sensitive adhesive as typically known in the art.

Accordingly, the present invention is able to provide a pressure-sensitive adhesive tape in which the reinforcement layer is bonded to the thermoplastic layer both by thermal bonding as well as by adhesive bonding, thus rendering the yarns of the reinforcement layer substantially more dimensionally stable within the tape and significantly reducing the tape's susceptibility to distortion. There is therefore less tendency for the reinforcement layer yarns in the tape to shift (particularly with more open fabrics) as a result of the superior bonding between the reinforcement layer and the thermoplastic layer.

According to another broad aspect the present invention provides a method of manufacturing an adhesive composite material, comprising the steps of:
- extruding a layer of thermoplastic material to at least a portion of a surface area of a reinforcement layer of weft inserted knitted fabric or a laid fabric consisting of a warp and a weft, and
- applying an adhesive to an outer surface of the composite material.

The thermoplastic coating may be applied to just one or to both surfaces of the reinforcement layer, and preferably covers the entire surface area. Furthermore, the thermoplastic material is preferably a thermoplastic polymer, and the fabric also preferably includes at least a proportion of thermoplastic fibres, filaments or yarn, as also describe above.

In the event that the composite material only includes one thermoplastic layer and one reinforcement layer, then the adhesive is preferably applied to an outer surface of the reinforcement layer, namely the surface facing away from the thermoplastic layer. However, the composite material may include a further layer of extruded material bonded to the other side of the reinforcement layer, in which case the

adhesive is applied over an outer surface of one of the thermoplastic, or in general, extruded layers.

In a preferred form of the invention the layer of extruded material and the reinforcement layer are in the form of substantially coextensive sheets, which may be thermally bonded together by extrusion as described above or in a calender. That is, the sheets may be heated and brought into intimate bonding contact between a pair of calender rollers. Accordingly, the method further includes the step of cutting or slitting said sheet layers into elongate strips after the thermal bonding step. The step of applying the coating of adhesive may be performed either before or after the step of cutting the sheet layers into strips.

For assistance in arriving at an understanding of the invention, specific examples thereof are hereafter described way of illustration only. These examples may be read with reference to the preceding description but are in no way intended to limit the generality of that description.

In one example of the invention a sheet of polyethylene film (thickness in the range of 20 to 40 μm) is superposed with a sheet of fabric. The sheet of fabric is a "warp knitted-weft inserted" fabric manufactured from yarns comprising a blend of polyester and polyethylene. For example, the weft yarns may be a blend of polyester and polyethylene. The reinforcement layer therefore includes at least a proportion of the same thermoplastic material (i.e. polyethylene) as the thermoplastic layer.

The fabric and film sheets are brought into contact with one another between a pair of calender rollers, after and/or during heating of the sheets by radiant heating elements to such a temperature that the thermoplastic polyethylene component of the fabric and the film softens sufficiently to achieve heat bonding in the form of a fusion weld between the film and the

fabric. The thermal bonding takes place over substantially the entire interface contact area between the fabric and film sheets.

After the thermal bonding of the fabric and film sheets, a coating of adhesive, such as a rubber gum pressure-sensitive adhesive, is then applied to the outer surface (i.e. the non-film facing surface) of the fabric. This application of the adhesive coating is preferably done by passing the now bonded sheets through a pair of calender rollers as described in US patent 4 304 813. The bonded and coated sheet is then cut or slit into elongate strips which are individually wound onto reels or spools to form the final adhesive tape product. The layer of extruded material of the composite material used as tape substrate provides good release properties as the tape is peeled off the reel or spool during use.

As has previously been made clear, the invention allows for significant variation in the composition and construction of the reinforcement layer. The yarns making up the fabric may be a wide variety of combinations of synthetic, natural and artificial yarns. Furthermore, the yarns may be whole or partly mono- or multi-filament yarns, spun yarns (using rotor, ring, friction or any other known spinning technique), or in tape form including co-extended tape and filament yarns to which functional sizing is applied.

The composition blends of the yarns can essentially be in any percentages of yarn contribution provided that the reinforcement layer and the layer of extruded material of the tape of the invention are still capable of bonding in the required manner.

Claims

1. A by hand tearable composite material, in particular a substrate for an adhesive tape, comprising
- a reinforcement layer in the form of a weft inserted knitted fabric, and
- at least one extruded layer of thermoplastic material on one surface of the reinforcement layer.

2. A by hand tearable composite material, in particular a substrate for an adhesive tape, comprising
- a reinforcement layer in the form of a laid fabric consisting of a warp and a weft, and
- at least one extruded layer of thermoplastic material on one surface of the reinforcement layer.

3. A composite material according to claim 1 or 2, further comprising at least one extruded layer of material on the other surface of the reinforcement layer, in particular a layer of thermoplastic material.

4. A composite material according to one of claims 1 to 3, wherein the at least one extruded layer of thermoplastic material on one surface of the reinforcement layer is thermoplastic rubber.

5. A composite material according to claim 4, wherein the at least one extruded layer of thermoplastic material on the other surface of the reinforcement layer is thermoplastic rubber.

6. A composite material according to claim 4, wherein the at least one extruded layer of material on the other surface of the reinforcement layer is thermoset rubber.

7. A composite material according to claim 4 or 5, wherein the thermoplastic rubber contains a polyolefine.

8. A composite material according to claim 7, wherein the polyolefine is polypropylene.

9. A composite material according to claim 7, wherein the polyolefine is polyethylene.

10. A composite material according to one of the preceding claims, wherein the bond locations between the reinforcement layer and the at least one extruded layer of thermoplastic material on one and/or the other surface of the reinforcement layer are substantially evenly distributed over the interface between the reinforcement layer and the extruded material.

11. A composite material according to claim 10, wherein the extruded material covers substantially the entire surface area of the reinforcement layer.

12. A composite material according to one of the preceding claims, wherein the pitch between weft ends is at least 2 mm.

13. A composite material according to one of the preceding claims, wherein the pitch between warp ends is less than 2.5 mm, in particular less than 1.4 mm.

14. A composite material according to one of the preceding claims, wherein an adhesive is provided at one of its outer surfaces.

15. A composite material as claimed in any one of the preceding claims, wherein the reinforcement layer is manufactured from a yarn that includes at least some thermoplastic synthetic, preferably

selected from the group comprising polyester, polyethylene, polypropylene and polyamide.

16. A composite material as claimed in any one of the preceding claims,
wherein the adhesive is provided at a surface of said reinforcement layer and wherein the adhesive provides a further bond between the layer of fabric and the layer of extruded material.

17. A method of manufacturing an adhesive composite material comprising the steps of:
- extruding a layer of thermoplastic material to at least a portion of a surface area of a reinforcement layer of weft inserted knitted fabric or a laid fabric consisting of a warp and a weft, and
- applying an adhesive to an outer surface of the composite material.

18. A method as claimed in claim 17,
wherein the bonding between the layer of thermoplastic material and the reinforcement layer occurs as the extruded material cools down or sets.

19. A method as claimed in claim 17 or claim 18,
wherein the thermoplastic material is applied over at least one surface of the reinforcement layer.

20. A method as claimed in claim 19,
wherein the thermoplastic material is applied over substantially the entire surface area of the reinforcement layer.

21. A method as claimed in any one of claims 17 to 20,
wherein the step of forming the composite material includes extruding a further layer of thermoplastic material to the other surface of the reinforcement layer.

22. A method as claimed in any one of claims 17 to 21, wherein the layer(s) of thermoplastic material and the reinforcement layer are substantially coextensive and wherein the composite material is in the form of a sheet, the method further comprising the step of:

- cutting or slitting said sheet of composite material into elongate strips.