The present invention is related to a composite laminated structure for shoe stiffeners and preparing method thereof. The composite laminated structure comprises: a fiber fabric core layer, and a hot-melt-adhesive layer covering and interpenetrating the fiber fabric core layer, whereby the composite laminated structure has a tear resistance greater than 3.0 kg or a resilience greater than 2.0 kg. Preparing methods for said composite laminated structure are very simple processes, which are also provided herein. With the fiber fabric core layer, proper performances could be achieved with simple hot-melt-adhesives. High level of cheap fillers, such as recycled materials, inorganic fillers or the mixture thereof, could be added while still maintaining excellent tear resistance and resilience. Thus, the use of virgin materials and the overall cost could be greatly reduced for shoe stiffeners.
COMPOSITE LAMINATED STRUCTURE FOR SHOE STIFFENER AND PREPARING METHOD THEREOF

FIELD OF THE INVENTION

[0001] The present invention relates to a composite laminated structure for shoe stiffeners and the preparing methods thereof. More particularly, the present invention relates to a composite laminated structure using fabrics as its core.

BACKGROUND OF THE INVENTION

[0002] In shoe industry, stiffeners are usually used in the toe part or the heel part, known as toe puffs and counters, respectively. The use of stiffeners is aimed at providing support to shoe upper materials. Thus, materials for toe puffs and counters usually require proper tear resistance and resilience. Tear resistance is needed for keeping the desired durability of shoe uppers, while resilience is needed for recovering to the original shape upon deformation for any factors.

[0003] There are various stiffeners used in shoe industry, including: impregnated stiffeners, premolded stiffeners, powder coated stiffeners, extruded stiffeners, or the like. Here, impregnated stiffeners can be made stiff, but the ones with high stiffness grades usually do not have high resiliency and low-temperature operability or long-time operability. Impregnated stiffeners, premolded stiffeners and extruded stiffeners all require expensive processing steps. For example, extruded stiffeners are made via extrusion of resins such as ionomers or other thermoplastic polymers, followed by extrusion coating of binders onto polymer sheets, so that the desired resilience, tear resistance, and adhesion can be achieved. Such a process leads to increased processing steps and cost. Furthermore, it takes long time if not forever for these materials to be decomposed. Lots of waste are generated accordingly. To improve, there is a strong need for cheaper, better, and environmentally friendly stiffeners, which provide good tear resistance, resilience, and adhesion while using less virgin plastic materials.

SUMMARY OF THE INVENTION

[0004] In light of the deficiencies in prior art, a composite laminated structure for a shoe stiffener is provided herein, comprising:
[0005] a fabric core layer;
[0006] a hot-melt-adhesive layer, covering and interpenetrating the fabric core layer;
[0007] whereby the composite laminated structure has a tear resistance greater than 3.0 kg or a resilience greater than 2.0 kg.
[0008] A permanent interlocking structure will be formed among the fibers in the fabric core layer via interpenetration of the hot-melt-adhesive layer into the fabric core layer, and thus, the composite laminated structure will have excellent tear resistance and resilience.

[0009] In one embodiment, the composite laminated structure may have a tear resistance greater than 10.5 kg.
[0010] In another embodiment, the composite laminated structure may have a resilience greater than 5.0 kg.

[0011] In one embodiment, the fabric core layer may have a bending stiffness greater than 500 mg·cm. In one preferred embodiment, the fabric core layer may have a bending stiffness of about 500 to about 25000 mg·cm.

[0012] In another embodiment, the bending stiffness for the fabric core layer can be determined by using standard ISO 9073 and GB 18318 test methods but not limited hereto.

[0013] In a further embodiment, the fabric core layer may comprise a fabric having a fabric count of about 61 to 13 warp yarns per inch (wpi) and about 60 to 30 filling yarns per inch (fpi), and a weight of more than 80 g/m².

[0014] In a specific embodiment, the fabric core layer may comprise, but is not limited to, fine cloth for cap interlining, cloth (40 (wpi)×40 (fpi)) for cap interlining, Oxford, Lyca fabric, muslin, nonwoven, or the like.

[0015] In one embodiment, the hot-melt-adhesive layer may be a low application temperature hot-melt-adhesive layer having a softening temperature lower than 90° C. and a solidification time greater than one minute. In a specific embodiment, the low application temperature hot-melt-adhesive layer may comprise, but is not limited to, thermoplastic polyurethane (TPU), polycaprolactone (CAPA), or the like.

[0016] In one embodiment, the composite laminated structure may further comprise at least one adhesive layer to enhance its adhesion, such that the composite laminated structure can be connected to an upper or a lining and better laminated to more inert materials, e.g. greasy leathers.

[0017] In one embodiment, the composite laminated structure may further comprise a filler. And the percentage of the filler in the hot-melt-adhesive layer may be up to 90%. In another embodiment, the percentage of the filler in the hot-melt-adhesive layer may be up to 80%.

[0018] In a specific embodiment, the filler may comprise, but is not limited to, an inorganic filler material, such as inorganic mineral powders (e.g. calcium carbonate powders, silica powders, or the like); an organic polymer material, such as recycled plastic materials; or a combination thereof. One skilled in the art can optionally select the filler material as needed.

[0019] In a specific embodiment, the recycled plastic material may comprise, but is not limited to, polycarbonate (PC), thermoplastic polyurethane (TPU), polyethylene terephthalate (PET), phenol-formaldehyde resin, urea-formaldehyde resin, melamine-formaldehyde resin, epoxy resin, unsaturated polyester resin, polyurethane, a mixture thereof, or the like.

[0020] A method for preparing the composite laminated structure is also provided herein, including steps of:

[0021] providing a first hot-melt-adhesive material in a molten state;

[0022] providing a fabric, wherein the fabric is placed onto the first hot-melt-adhesive material in the molten state;

[0023] providing a second hot-melt-adhesive material in a molten state, wherein the second hot-melt-adhesive material in the molten state is placed onto the fabric; and

[0024] co-extruding and laminating the first hot-melt-adhesive material in the molten state, the fabric and the second hot-melt-adhesive material in the molten state to form the composite laminated structure.

[0025] The present invention further provides a method for preparing the composite laminated structure, including steps of:

[0026] providing a first hot-melt-adhesive material in a preheated mold;

[0027] providing a fabric, wherein the fabric is placed onto the first hot-melt-adhesive material,
providing a second hot-melt-adhesive material, wherein the second hot-melt-adhesive material is placed onto the fabric;

forming the first hot melt adhesive material and the second hot melt adhesive material to be in a molten state in the mold, and pressing the first hot melt adhesive material in the molten state, the second hot melt adhesive material in the molten state and the fabric together to form the composite laminated structure.

In one embodiment, the first hot-melt-adhesive material and the second hot-melt-adhesive material may be the same. Optionally, in another embodiment, the first hot-melt-adhesive material and the second hot-melt-adhesive material may be different.

In one embodiment, the method for preparing the composite laminated structure may further comprise a step of coating an adhesive layer onto a surface of the composite laminated structure.

The present invention provides another method for preparing the composite laminated structure, including steps of:

providing a hot-melt-adhesive material in a molten state;
providing a fabric, wherein the fabric is placed onto the hot-melt-adhesive material in the molten state; and
extruding and laminating the hot melt adhesive material in the molten state and the fabric to form the composite laminated structure.

The present invention provides still another method for preparing the composite laminated structure, including steps of:

providing a hot-melt-adhesive material in a pre-heated mold;
providing a fabric, wherein the fabric is placed onto the hot-melt-adhesive material;
forming the hot melt adhesive material to be in the molten state in the mold, and pressing the hot melt adhesive material in the molten state and the fabric together to form the composite laminated structure.

In one embodiment, the method for preparing the composite laminated structure may further comprise a step of coating an adhesive layer onto a surface of the composite laminated structure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a cross-sectional view of a composite laminated structure of a shoe stiffener according to Example 1 of the present invention.

FIG. 2 illustrates a cross-sectional view of a composite laminated structure of a shoe stiffener according to Example 2 of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the present invention will be described below in more detail with reference to the accompanying drawings. The present invention may, however, be embodied in different forms and should not be construed as limited to the embodiments set forth herein. Other objectives, advantages, and novel features of the invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

EXAMPLE 1

FIG. 1 shows a cross-sectional view of a composite laminated structure of a shoe stiffener according to Example 1 of the present invention. The composite laminated structure 1 comprised, in order: a first hot-melt-adhesive layer 11, a fabric core layer 12, and a second hot-melt-adhesive layer 13, wherein the first hot-melt-adhesive layer 11 and the second hot-melt-adhesive layer 13 covered and interpenetrated the fabric core layer 12. In this example, the first hot-melt-adhesive layer 11 and second hot-melt-adhesive layer 13 used the same materials. In other examples, the composite laminated structure 1 may comprise only a single hot-melt-adhesive layer (i.e. the first hot-melt-adhesive layer 11 or the second hot-melt-adhesive layer 13) and a fabric core layer 12.

In this example, the first hot-melt-adhesive layer 11 and the second hot-melt-adhesive layer 13 were low application temperature hot-melt-adhesive layers of TPU, having a softening temperature lower than 90° C. and a solidification time greater than one minute. The first hot-melt-adhesive layer 11 and the second hot-melt-adhesive layer 13 may optionally comprise a filler of up to 90% or 80%, such as an inorganic filler material, an organic polymer material or the like. One skilled in the art may optionally select the filler material as needed. In this example, the organic polymer material used was a recycled plastic material, comprising, but not limited to, polycarbonate (PC), thermoplastic polyurethane (TPU), polyethylene terephthalate (PET), phenol-formaldehyde resin, urea-formaldehyde resin, melamine-formaldehyde resin, epoxy resin, unsaturated polyester resin, polyurethane or a mixture thereof.

FIG. 1 illustrates a cross-sectional view of a composite laminated structure of a shoe stiffener according to Example 1 of the present invention. The composite laminated structure 1 comprised, in order: a first hot-melt-adhesive layer 11, a fabric core layer 12, and a second hot-melt-adhesive layer 13, wherein the first hot-melt-adhesive layer 11 and the second hot-melt-adhesive layer 13 covered and interpenetrated the fabric core layer 12. In this example, the first hot-melt-adhesive layer 11 and second hot-melt-adhesive layer 13 used the same materials. In other examples, the composite laminated structure 1 may comprise only a single hot-melt-adhesive layer (i.e. the first hot-melt-adhesive layer 11 or the second hot-melt-adhesive layer 13) and a fabric core layer 12.

The above-mentioned fabric core layer 12 may be made of fine cloth for cap interlining, cloth (40 wpi x 40 (fpi)) for cap interlining, Oxford, Lyca fabric, muslin, non-woven, or the like, and its characteristics will be detailed with the tests described below.

In addition, the composite laminated structure 1 as in Example 1 may optionally comprise two adhesive layers 14, which are provided onto the surfaces of the first hot-melt-adhesive layer 11 and the second hot-melt-adhesive layer 13 respectively, to enhance its adhesion, such that the composite laminated structure 1 can be connected to an upper or a lining and better laminated to more inert materials, e.g. greasy leathers.

EXAMPLE 2

FIG. 2 shows a cross-sectional view of a composite laminated structure of a shoe stiffener according to Example 2 of the present invention. The composite laminated structure 1 comprised, in order: a first hot-melt-adhesive layer 11a, a fabric core layer 12a, and a second hot-melt-adhesive layer 13a, and a third hot-melt-adhesive layer 14a.
13a, wherein the first hot-melt-adhesive layer 11a and the second hot-melt-adhesive layer 13a covered and interpenetrated the fabric core layer 12a. In this example, the first hot-melt-adhesive layer 11a and second hot-melt-adhesive layer 13a used the same material. Also, the composite laminated structure 1a formed a tapered-off fringe 11a in the first hot-melt-adhesive layer 11a. In addition, the composite laminated structure 11a may optionally comprise two adhesive layers 14a, which are provided onto the surfaces of the first hot-melt-adhesive layer 11a and the second hot-melt-adhesive layer 13a respectively, to enhance its adhesion, such that the composite laminated structure 1a can be connected to an upper or a lining and better laminated to more inert materials, e.g. greasy leathers.

[0050] The above-mentioned composite laminated structure 1a may be prepared via a molding process, but is not limited to this method. In this example where a molding process was adopted, the mold had a upper die and a corresponding lower die (not shown), and part of the hot-melt-adhesive material was flattened in the mold cavity of the lower die of the preheated mold. The fabric was then placed onto the hot-melt-adhesive material in the mold. Next, the remainder of the hot-melt-adhesive material was placed onto the fabric and flattened in the mold. Then, the upper die was placed on top; heated and pressed. After the pressing was done by a hand press, the upper die was removed. Then, the molded products were taken out after they were cooled and solidified. By using the molding process, different mold shapes can be designed depending on user’s needs. The product may be molded into the final shape without additional cutting, and thus the waste from cutting the product into a specific shape can be reduced and the manufacturing cost may be saved.

TEST EXAMPLE 1
Characteristics Tests of the Fabric Core Layer

[0051] The samples of the fabric core layer 12, 12a were fine cloth for cap interlining, cloth for cap interlining 40 (wpi)x40 (fpi), Oxford, a Lyca fabric, muslin, and non-woven. These samples were cut to strips of 2 cm x 20 cm, held onto a clamp of a fully automatic fabric stiffness tester (Model YG022D, Wenzhou Jigao Testing Instrument Co. Ltd) and moved forward in the rate of the tester. The tests were conducted using standard ISO 9073 and GB 18318 test methods. The ratio of bending angle was calculated by the tester when each sample passed through a bending angle. Also, the bending stiffness (mg·cm) was calculated. These data were shown in the following Table 1.

<table>
<thead>
<tr>
<th></th>
<th>Weight (g/m²)</th>
<th>fabric count (wpi x fpi)</th>
<th>Bending stiffness (mg·cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine cloth for cap interlining</td>
<td>100 g/m²</td>
<td>61 x 60</td>
<td>2346</td>
</tr>
<tr>
<td>Oxford</td>
<td>180 g/m²</td>
<td>32 x 30</td>
<td>6544</td>
</tr>
<tr>
<td>Lyca fabric</td>
<td>220 g/m²</td>
<td>13 x 45</td>
<td>8855</td>
</tr>
<tr>
<td>Muslin</td>
<td>190 g/m²</td>
<td>non-specified</td>
<td>2000</td>
</tr>
<tr>
<td>Non-woven</td>
<td>80 g/m²</td>
<td>45 x 46</td>
<td>1000</td>
</tr>
<tr>
<td>Non-woven</td>
<td>120 g/m²</td>
<td>non-specified</td>
<td>4891</td>
</tr>
</tbody>
</table>

TEST EXAMPLE 2
Characteristics Tests of the Composite Laminated Structure for a Shoe Stiffener Without Recycled Plastics

[0052] 1. Process of Manufacturing the Composite Laminated Structure for a Shoe Stiffener Without Recycled Plastics

[0053] A mold having an upper die and a lower die was placed on an electric hot plate and heated to 100°C. Part of the TPU hot-melt-adhesive powder was positioned in the mold cavity of the lower die, and then scraped flatly back and forth with a scraper. After the TPU powder was scraped evenly, samples of the fabric core layer were cut into smaller pieces (i.e. a fringe 11a of each sample was tapered-off) and positioned as desired in the mold cavity. The remainder of the TPU powder was added evenly onto the fabric core layer in the mold cavity and scraped flatly again. A release paper was put in after the TPU powder became flat, followed by covering the upper die on top. At the time, the TPU powder was in a molten state and was then flattened by a hand press. After the pressing was done, the upper die and the release paper were removed. Each product was taken out after sufficient cooling.

[0054] 2. Tests for Strength of Tear Resistance

[0055] The above-mentioned composite laminated structures were cut to strips of 2 cm (width) x 8 cm (length). Each of the strips was further cut at the middle to form a slit of 1.5 cm, and was then fixed between the upper retaining clamp and the lower retaining clamp of a universal tensile testing machine for testing (SATRA TM65, at a rate of 100 mm/min). The maximum tensile strength measured by the machine was recorded as the strength of tear resistance. The test results are shown in Table 2.

[0056] 3. Tests for Compression Resilience

[0057] A pneumatic cylinder having a diameter of 16 mm was stood upright and comprised a gas pressure regulator having a ball head of 10 mm at the front. For making samples of proper size and shape, an outer frame having a diameter of 60 mm and a fixture having an upper die and a lower die with a diameter of 47 mm and a height of 9.5 mm were prepared. Each sample of the composite laminated structure was first cut to a 70 mm-diameter circle, then softened in hot water and shaped to a hemisphere by the just mentioned hemispherical fixture. The hemispherical sample was placed under the pneumatic cylinder. The ball head at the front of the pneumatic cylinder was pointed at the central convex point of the hemispherical sample at a distance about 1 cm to start the tests.

[0058] The gas pressure regulator was first set to zero, then rotated for visual observation of the value on the gas pressure regulator. When the ball head of the pneumatic cylinder collapsed the hemispherical sample, the maximum value was recorded as the collapse pressure or resilience force. The rebound height was also measured, wherein the ratio of the rebound height to the initial height represented the shape retention. The measurement was repeated ten times to observe the change, wherein the ratio of the final to the initial pressure/resilience force represented the resiliency. The test results are shown in Table 2.
As shown in the above table, significantly better tear resistance and resilience force could be achieved depending on the fabric used. This was due to the formation of interlocking structures in the fabric core layers via the interpenetration of the hot-melt-adhesive through the fabric core layer. The production method for the composite laminated structures was simple, and thus the cost for shoe stiffeners could be lowered. Materials for the fabric core layer were cheap and readily available. With different fabric, one can achieve different tear resistance and resilience. Furthermore, in the preferred examples as provided herein, the cutting step was no longer needed since the stiffeners were prepared via molding. Wastes generated from cutting the stiffeners to a specific shape could be greatly reduced.

**TEST EXAMPLE 3**

Characteristic Tests of the Composite Laminated Structure for a Shoe Stiffener With Recycled Plastics

Recycled plastics were ground into particles of about 30 to about 50 mesh in size. The hot-melt-adhesive (i.e., TPU powder) and the recycled plastic powder were weighed respectively according to the ratio shown in the following Table 3. The weighed powders were put into plastic bags, then shaken for well mixing. A mold having an upper die and a lower die was placed onto an electric hot plate and heated to 100° C. Part of the TPU powder and the recycled plastic powder was positioned in the mold cavity of the lower die and then flattened back and forth with a scraper. After the mixture powder was scraped evenly, samples of the fabric core layer were cut to smaller pieces (i.e., a fringe 111a of each sample was tapered-off) and positioned on top. The remainder of the mixture powder was added evenly onto the fabric core layer and scraped flat again. A release paper was put in after the mixture powder became flat, followed by covering the upper die on top. At the time, the mixture powder was in a molten state and was then flattened by a hand press. After the pressing was done, the upper die and the release paper were removed. Each product was then taken out after cooled down. Tests for strength of tear resistance and compression resilience were conducted respectively according to the above-mentioned method, which is not to be repeated here. The test results are shown in Table 3.

**TABLE 2**

Data for tear resistance and resilience of the composite laminated structure for a shoe stiffener without recycled plastics

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Tear resistance (KG)</th>
<th>Initial height (mm)</th>
<th>Final height (mm)</th>
<th>Initial shape retention (%)</th>
<th>Final shape retention (%)</th>
<th>The first collapse (kg)</th>
<th>The tenth collapse (kg)</th>
<th>Resiliency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>pure hot-melt-adhesive</td>
<td>10.5</td>
<td>9.4</td>
<td>9.4</td>
<td>&gt;98</td>
<td>&gt;98</td>
<td>5.75</td>
<td>5.5</td>
<td>96</td>
</tr>
<tr>
<td>2</td>
<td>pure hot-melt-adhesive + fine cloth for cap interlining</td>
<td>15</td>
<td>9.4</td>
<td>9.4</td>
<td>&gt;98</td>
<td>&gt;98</td>
<td>9</td>
<td>8.3</td>
<td>92</td>
</tr>
<tr>
<td>3</td>
<td>pure hot-melt-adhesive + cloth for cap interlining</td>
<td>15</td>
<td>9.4</td>
<td>9.4</td>
<td>&gt;98</td>
<td>&gt;98</td>
<td>9.5</td>
<td>8.75</td>
<td>92</td>
</tr>
<tr>
<td>4</td>
<td>pure hot-melt-adhesive + 40 x 40 (wpi x fpi)</td>
<td>8</td>
<td>9.4</td>
<td>9.4</td>
<td>&gt;98</td>
<td>&gt;98</td>
<td>9.5</td>
<td>8.75</td>
<td>92</td>
</tr>
<tr>
<td>5</td>
<td>pure hot-melt-adhesive + Oxford fabric</td>
<td>12.4</td>
<td>9.4</td>
<td>9.4</td>
<td>&gt;98</td>
<td>&gt;98</td>
<td>7.5</td>
<td>7</td>
<td>93</td>
</tr>
<tr>
<td>6</td>
<td>pure hot-melt-adhesive + Lyen fabric</td>
<td>7.5</td>
<td>9.4</td>
<td>9.4</td>
<td>&gt;98</td>
<td>&gt;98</td>
<td>6.5</td>
<td>6</td>
<td>92</td>
</tr>
<tr>
<td>7</td>
<td>pure hot-melt-adhesive + nonwoven(120 g)</td>
<td>10.7</td>
<td>Incomplete rebound</td>
<td>Incomplete rebound</td>
<td>Incomplete Resiliency (%)</td>
<td>Incomplete Resiliency (%)</td>
<td>Incomplete Resiliency (%)</td>
<td>Incomplete Resiliency (%)</td>
<td></td>
</tr>
</tbody>
</table>

**TABLE 3**

Data for tear resistance and resilience of the composite laminated structure for a shoe stiffener with recycled plastics

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Tear resistance (KG)</th>
<th>Initial height (mm)</th>
<th>Final height (mm)</th>
<th>Initial shape retention (%)</th>
<th>Final shape retention (%)</th>
<th>The first collapse (kg)</th>
<th>The tenth collapse (kg)</th>
<th>Resiliency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>85% RPC + 15% hot-melt-adhesive + fine cloth for cap interlining</td>
<td>4.2</td>
<td>9.4</td>
<td>9.2</td>
<td>&gt;98</td>
<td>&gt;98</td>
<td>2.25</td>
<td>1.75</td>
<td>77</td>
</tr>
<tr>
<td>2</td>
<td>85% RPC + 15% hot-melt-adhesive + cloth for cap interlining 40 x 40 (wpi x fpi)</td>
<td>5.6</td>
<td>9.4</td>
<td>9.2</td>
<td>&gt;98</td>
<td>&gt;98</td>
<td>2.25</td>
<td>1.75</td>
<td>77</td>
</tr>
<tr>
<td>3</td>
<td>85% RTPU + 15% hot-melt-adhesive + fine cloth for cap interlining</td>
<td>3.5</td>
<td>9.4</td>
<td>9.2</td>
<td>&gt;98</td>
<td>&gt;98</td>
<td>2.25</td>
<td>1.75</td>
<td>77</td>
</tr>
<tr>
<td>4</td>
<td>85% RTPU + 15% hot-melt-adhesive + cloth for cap interlining 40 x 40 (wpi x fpi)</td>
<td>5.2</td>
<td>9.4</td>
<td>9.2</td>
<td>&gt;98</td>
<td>&gt;98</td>
<td>2.25</td>
<td>1.75</td>
<td>77</td>
</tr>
</tbody>
</table>
TABLE 3-continued

Data for tear resistance and resilience of the composite laminated structure for a shoe stiffener with recycled plastics

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Tear resistance (kg)</th>
<th>Initial height (mm)</th>
<th>Final height (mm)</th>
<th>Initial shape retention (%)</th>
<th>Final shape retention (%)</th>
<th>The first collapse (kg)</th>
<th>The tenth collapse (kg)</th>
<th>Resiliency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>85% RPET + 15% hot-melt-adhesive + fine cloth for cap interlining</td>
<td>6.7</td>
<td>9.4</td>
<td>8.9</td>
<td>98</td>
<td>96</td>
<td>6</td>
<td>5.3</td>
<td>85</td>
</tr>
<tr>
<td>6</td>
<td>85% RPET + 15% hot-melt-adhesive + Oxford</td>
<td>6.7</td>
<td>9.4</td>
<td>8.9</td>
<td>98</td>
<td>96</td>
<td>6</td>
<td>5.3</td>
<td>85</td>
</tr>
<tr>
<td>7</td>
<td>85% RTPU + 15% hot-melt-adhesive (without the fabric core layer)</td>
<td>5.1</td>
<td>9.4</td>
<td>9.2</td>
<td>98</td>
<td>96</td>
<td>6</td>
<td>5.3</td>
<td>85</td>
</tr>
<tr>
<td>8</td>
<td>85% RPC + 15% hot-melt-adhesive (without the fabric core layer)</td>
<td>5.1</td>
<td>9.4</td>
<td>9.2</td>
<td>98</td>
<td>96</td>
<td>6</td>
<td>5.3</td>
<td>85</td>
</tr>
<tr>
<td>9</td>
<td>60% RPC + 40% hot-melt-adhesive + fine cloth for cap interlining</td>
<td>5.1</td>
<td>9.4</td>
<td>9.2</td>
<td>98</td>
<td>96</td>
<td>6</td>
<td>5.3</td>
<td>85</td>
</tr>
<tr>
<td>10</td>
<td>60% RPC + 40% hot-melt-adhesive + Oxford</td>
<td>5.1</td>
<td>9.4</td>
<td>9.2</td>
<td>98</td>
<td>96</td>
<td>6</td>
<td>5.3</td>
<td>85</td>
</tr>
<tr>
<td>11</td>
<td>60% RPC + 40% hot-melt-adhesive + cloth for cap interlining 40 x 40 (wp x fp)</td>
<td>4.4</td>
<td>9.4</td>
<td>9.2</td>
<td>98</td>
<td>96</td>
<td>6</td>
<td>5.3</td>
<td>85</td>
</tr>
<tr>
<td>12</td>
<td>60% RPET + 40% hot-melt-adhesive + fine cloth for cap interlining</td>
<td>4.4</td>
<td>9.4</td>
<td>9.2</td>
<td>98</td>
<td>96</td>
<td>6</td>
<td>5.3</td>
<td>85</td>
</tr>
<tr>
<td>13</td>
<td>60% RPET + 40% hot-melt-adhesive + cloth for cap interlining 40 x 40 (wp x fp)</td>
<td>4.4</td>
<td>9.4</td>
<td>9.2</td>
<td>98</td>
<td>96</td>
<td>6</td>
<td>5.3</td>
<td>85</td>
</tr>
<tr>
<td>14</td>
<td>60% RPET + 40% hot-melt-adhesive + Oxford</td>
<td>4.4</td>
<td>9.4</td>
<td>9.2</td>
<td>98</td>
<td>96</td>
<td>6</td>
<td>5.3</td>
<td>85</td>
</tr>
<tr>
<td>15</td>
<td>60% RTPU + 40% hot-melt-adhesive + fine cloth for cap interlining</td>
<td>4.4</td>
<td>9.4</td>
<td>9.2</td>
<td>98</td>
<td>96</td>
<td>6</td>
<td>5.3</td>
<td>85</td>
</tr>
<tr>
<td>16</td>
<td>60% RTPU + 40% hot-melt-adhesive + cloth for cap interlining 40 x 40 (wp x fp)</td>
<td>4.4</td>
<td>9.4</td>
<td>9.2</td>
<td>98</td>
<td>96</td>
<td>6</td>
<td>5.3</td>
<td>85</td>
</tr>
<tr>
<td>17</td>
<td>60% RTPU + 40% hot-melt-adhesive + Oxford</td>
<td>4.4</td>
<td>9.4</td>
<td>9.2</td>
<td>98</td>
<td>96</td>
<td>6</td>
<td>5.3</td>
<td>85</td>
</tr>
<tr>
<td>18</td>
<td>60% RTPU + 40% hot-melt-adhesive + nonwoven (120 g)</td>
<td>2.2</td>
<td>9.4</td>
<td>8.9</td>
<td>98</td>
<td>96</td>
<td>6</td>
<td>5.3</td>
<td>85</td>
</tr>
<tr>
<td>19</td>
<td>60% RPC + 40% hot-melt-adhesive + nonwoven (120 g)</td>
<td>2.2</td>
<td>9.4</td>
<td>8.9</td>
<td>98</td>
<td>96</td>
<td>6</td>
<td>5.3</td>
<td>85</td>
</tr>
<tr>
<td>20</td>
<td>86% RTPU + 14% hot-melt-adhesive + Oxford</td>
<td>2.2</td>
<td>9.4</td>
<td>8.9</td>
<td>98</td>
<td>96</td>
<td>6</td>
<td>5.3</td>
<td>85</td>
</tr>
</tbody>
</table>

*Note:
Plastics with the "R" initial referred to recycled plastic raw materials (e.g. from post-industrial or post-consumer waste), which were ground at a low temperature into plastic powders in this example. A #30 mesh sieve screen was used. The plastic powders had a particle size of about 30 to about 40 mesh.

As shown in the above table, the composite laminated structures with the fabric core layer had a significantly better tear resistance and resilience as compared to those without (see data for items 7 and 8 of Table 3). The composite laminated structures were environmentally friendly since the virgin material usage could be drastically reduced. The example provided a simple process without the need of complicated treatments, such as adding an impregnated nonwoven or compounding various ingredients, yet the desired tear resistance and resilience could be obtained. The cost for shoe stiffeners could be lowered. In addition, in the preferred examples as provided herein, the cutting step was no longer
needed since the stiffeners were prepared via molding. Wastes generated from cutting the stiffeners to specific shapes could be greatly reduced.

[0063] The above-disclosed subject matter is to be considered illustrative, and not restrictive, and the appended claims are intended to cover all such modifications, enhancements, and other embodiments, which fall within the true spirit and scope of the present invention. Thus, to the maximum extent allowed by law, the scope of the present invention is to be determined by the broadest permissible interpretation of the following claims and their equivalents, and shall not be restricted or limited by the foregoing detailed description.

1. A composite laminated structure for a shoe stiffener, comprising:
   a fabric core layer;
   a hot-melt-adhesive layer, which covers and interpenetrates the fabric core layer;
   whereby the composite laminated structure has a tear resistance greater than 3.0 kg or a resilience greater than 2.0 kg.
2. The composite laminated structure of claim 1, wherein the composite laminated structure has a tear resistance greater than 10.5 kg.
3. The composite laminated structure of claim 1, wherein the composite laminated structure has a resilience greater than 5.0 kg.
4. The composite laminated structure of claim 1, wherein the fabric core layer has a bending stiffness greater than 500 mg cm.
5. The composite laminated structure of claim 1, wherein the fabric core layer has a bending stiffness of about 500 to about 25000 mg cm.
6. The composite laminated structure of claim 4, wherein the bending stiffness is determined by using standard ISO 9073 and GB 185118 test methods.
7. The composite laminated structure of claim 1, wherein the fabric core layer comprises: fine cloth for cap interlining, cloth (about 40 warp yarns per inch (wpi) and about 40 filling yarns per inch (fpi)) for cap interlining, Oxford, Lyca fabric, muslin or nonwoven.
8. The composite laminated structure of claim 1, wherein the fabric core layer comprises a fabric having a fabric count of 61 to 13 warp yarns per inch (wpi) and about 60 to 30 filling yarns per inch (fpi) and a weight more than 80 g/m².
9. The composite laminated structure of claim 1, wherein the hot-melt-adhesive layer is a low application temperature hot-melt-adhesive layer having a softening temperature lower than 90°C, and a solidification time greater than one minute.
10. The composite laminated structure of claim 1, wherein the hot-melt-adhesive layer comprises thermoplastic polyurethane (TPU) or polycaproactone (CAPA).
11. The composite laminated structure of claim 1, wherein the composite laminated structure further comprises at least an adhesive layer.
12. The composite laminated structure of claim 1, wherein the hot-melt-adhesive layer further comprises a filler and a percentage of the filler in the hot-melt-adhesive layer is up to 90%.
13. The composite laminated structure of claim 12, wherein the percentage of the filler in the hot-melt-adhesive layer is up to 80%.
14. The composite laminated structure of claim 12, wherein the filler comprises:
15. The composite laminated structure of claim 14, wherein the organic polymer material is a recycled plastic material.
16. The composite laminated structure of claim 15, wherein the organic polymer material is a recycled plastic material comprising: polycarbonate (PC), thermoplastic polyurethane (TPU), polyethylene terephthalate (PET), phenol-formaldehyde resin, urea-formaldehyde resin, melamine-formaldehyde resin, epoxy resin, unsaturated polyester resin, polyurethane, or a mixture thereof.
17. A method for preparing the composite laminated structure of claim 1, comprising:
   providing a first hot-melt-adhesive material in a molten state;
   providing a fabric, wherein the fabric is placed onto the first hot-melt-adhesive material in the molten state;
   providing a second hot-melt-adhesive material in a molten state, wherein the second hot-melt-adhesive material in the molten state is placed onto the fabric; and
   co-extruding and laminating the first hot-melt-adhesive material in the molten state, the fabric and the second hot-melt-adhesive material in the molten state to form the composite laminated structure.
18. The method of claim 17, wherein the method further comprises a step of coating an adhesive layer onto a surface of the composite laminated structure.
19. A method for preparing the composite laminated structure of claim 1, comprising:
   providing a first hot-melt-adhesive material in a preheated mold;
   providing a fabric, wherein the fabric is placed onto the first hot-melt-adhesive material;
   providing a second hot-melt-adhesive material, wherein the second hot-melt-adhesive material is placed onto the fabric; and
   forming the first hot melt adhesive material and the second hot melt adhesive material to be in a molten state in the mold, and pressing the first hot melt adhesive material in the molten state, the second hot melt adhesive material in the molten state and the fabric together to form the composite laminated structure.
20. The method of claim 19, wherein the method further comprises a step of coating an adhesive layer onto a surface of the composite laminated structure.
21. A method for preparing the composite laminated structure of claim 1, comprising:
   providing a hot-melt-adhesive material in a molten state;
   providing a fabric, wherein the fabric is placed onto the hot-melt-adhesive material in the molten state; and
   extruding and laminating the hot melt adhesive material in the molten state and the fabric to form the composite laminated structure.
22. The method of claim 21, wherein the method further comprises a step of coating an adhesive layer onto a surface of the composite laminated structure.
23. A method for preparing the composite laminated structure of claim 1, comprising:
   providing a hot-melt-adhesive material in a preheated mold;
   providing a fabric, wherein the fabric is placed onto the hot-melt-adhesive material; and
forming the hot melt adhesive material to be in the molten state in the mold, and pressing the hot melt adhesive material in the molten state and the fabric together to form the composite laminated structure.

24. The method of claim 23, wherein the method further comprises a step of coating an adhesive layer onto a surface of the composite laminated structure.