Provided is a laminate of masticated rubber. A layer of fabric, capable of withstanding vulcanization temperatures, such as a non woven layer of polyester or polyester and nylon is bonded by means of vulcanization to at least one outer surface of the rubber laminate. Advantageously, this increases the stiffness of the rubber laminate. Further advantageously and unexpectedly, the fabric reinforced rubber laminate in accordance with the invention shows significant improvement in heat aging properties, such as heat resistance, tensile strength, hardness and tear strength.
FABRIC REINFORCED RUBBER PRODUCT

FIELD OF THE INVENTION

[0001] The present invention relates to rubber products, and more particularly to rubber products reinforced with fabric.

BACKGROUND OF THE INVENTION

[0002] Fiber reinforced rubber products, such as masticated rubber formulations, designed to withstand tensile forces or elevated temperatures are well known. Mastication of rubber involves the mixing of rubber with additional ingredients. An example of a typical masticated rubber (hereinafter referred to as “Masticated Rubber”) which is available from the applicant, NRI Technology Inc. and its affiliates, comprises a thermoset rubber blend based on tire belt, tread and sidewall compounds in both cured and uncured form that also contains fiber strands originating from original tire manufacturing, homogeneously dispersed throughout the blend. Additional fabric strands from other sources can also be incorporated to further increase stiffness and tensile strength. Fiber, blended into the Masticated Rubber mixtures increases stiffness adds strength, increases the modulus and overall hardness of the final product and reduces elongation or stretching of the rubber product. The fibers utilized are typically a mixture of short and long fibers comprised of polyester or nylon or other synthetic polymers.

[0003] Masticated Rubber is known to be an ideal material for under the hood and chassis application in the automotive industries and as such is referenced in various automobile company specifications. Masticated Rubber is also ideal for other applications which require product stiffness and heat resistance. Rubber sheets formed from urethane bonded rubber crumb, rubber dispersed in a polyolefin matrix, and various other thermoplastic sheets may also be engineered for such automotive or like applications. Those parts containing thermoplastic components are susceptible to deformation when exposed to a higher temperature than the softening point temperature of that thermoplastic component. Regardless of the chosen material, parts made for automotive applications and the like must be able to withstand impact of water and road debris, dynamic air flow forces, tensile stresses caused by jounce of the vehicle, cold and hot temperatures. As such a significant amount of tensile strength, hardness and heat resistance is required.

[0004] Alternate vulcanizable rubber compounds based on formulations using prime or virgin ingredients or other recycled rubber ingredients derived in part from other sources of rubber compound such as road vehicle tires, roofing membrane, hose, gaskets and the like may too be suitable for applications requiring tensile strength, hardness and heat resistance.

[0005] There has arisen an increasing need for stiffer rubber products and for rubber products with improved heat aging properties (i.e. heat resistance, tensile strength, hardnes, tear strength) over the rubber products presently known in the prior art. Although known rubber formulations, such as Masticated Rubbers, rubbers derived from urethane bonded rubber crumb and rubber crumb/EVA blends are well suited to withstand certain environmental conditions, an improved fabric reinforced rubber product exhibiting increased stiffness and improved heat aging properties is desirable.

SUMMARY OF THE INVENTION

[0006] It is an object of the present invention to overcome, inter alia, the shortcomings of the prior art described above by providing an improved fabric reinforced rubber product.

[0007] In accordance with an aspect of the invention there is provided a rubber laminate comprising a rubber layer having an outer surface and a fabric layer bonded to said outer surface. Preferably, the fabric layer is bonded to the rubber layer by vulcanization, the rubber layer is comprised of cured Masticated Rubber and the fabric layer is comprised of spun bonded non woven polyester and nylon or polyester.

[0008] In accordance with a further aspect of the invention there is provided a method of producing a rubber laminate comprising the steps of:

[0009] (a) providing a rubber layer having an outer surface,

[0010] (b) providing a fabric layer,

[0011] (c) bonding said fabric layer to said rubber layer outer surface. Preferably the fabric layer is bonded to the rubber layer by means of vulcanization.

[0012] Surprisingly, it has been found that heat aging properties of the rubber are enhanced by the bonding of the fabric layer to the outer surface of the rubber laminate. A further advantage provided by the invention is that the bonding of fabric layer to the outer surface of the laminate of rubber increases the stiffness of the rubber laminate.

[0013] The rubber layer of the herein invention may be comprised of various rubber compositions, such as Masticated Rubber, natural rubber, recycled rubber, SBR blends, urethane bonded rubber crumb derivations and EVA/rubber blends and other rubber blends.

[0014] A further advantage provided by the invention is that the exposed surface of fabric provides better surface receptivity to adherence of coatings such as paints or adhesives which may need to be applied to a surface of the rubber.

[0015] Other advantages, features and characteristics of the present invention, as well as methods of operation and functions and economies of manufacture, will become more apparent upon consideration of the following detailed description and the appended claims.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

[0016] A preferred procedure for producing the rubber laminate of the invention will now be described. Provided is a rubber laminate. The rubber laminate preferably has a thickness of approximately 0.1 inches and preferably is in the range of 0.060 inches to 0.25 inches. The rubber laminate could be in the range of 0.04 inches to 0.5 inches thick. In fact, as desired, a rubber laminate having a thickness outside of these ranges could be utilized. The rubber laminate is preferably a formulation of Masticated Rubber. The preferred Masticated Rubber formulation is comprised of a thermoset rubber blend based on tire belt, tread and sidewall compounds in both cured and uncured form that also preferably includes fiber strands originating from original tire manufacturing, homogeneously dispersed throughout the
blend. Preferably the source of uncured rubber is tire manufacturers’ uncured rubber waste in either calendered rubber/fabric form subsequently baled or as slabs of essentially uncured compounded rubber. Preferably the source of the uncured rubber is recycled scrap tires and internally generated rubber waste originating from prior masticated rubber production. Preferably the source of the fabric strands is both recycled scrap tires and internally generated rubber waste originating from prior masticated rubber production. Additional fabric strands from other sources can also be incorporated and include chopped nylon strands to further increase stiffness and tensile strength. These ingredients along with known rubber processing and vulcanizing agents are blended together and masticated to a uniform blend which is then vulcanized in a known manner into a shape of flat sheet. The size and thickness of the sheet can be varied as desired. A layer of fabric, preferably a non woven polymer, such as polyester or a blend of polyester and nylon is provided, preferably having a thickness in the range of 0.006 inches to 0.013 inches. The fabric layer is mechanically bonded to the outer surface of the rubber laminate, preferably by vulcanization thereto in the following manner. During the vulcanization process, pressure forces the rubber to flow into the voids of the fabric and mechanically locks the rubber and fiber together. This bonding can be further enhanced during the vulcanization process with known chemical treatment of the fabric to promote a chemical bonding between the fabric and the rubber. As an alternate to vulcanization, the bonding of the fabric to the rubber outer surface may be effected with the application of a polyurethane adhesive to the fabric and then subsequent application to the outer surface of the rubber laminate.

[0017] Advantageously, this bonding of the fiber layer to the rubber layer increases the stiffness of the rubber laminate. Further advantageously and unexpectedly, the fabric reinforced rubber laminate in accordance with the invention shows significant improvement in heat aging properties. Fabric layers are preferably bonded to both sides of the rubber laminate, thereby further increasing laminate stiffness and further improving the heat aging properties as will be shown in the examples below. As desired, a plurality of layers of the fabric may be bonded preferably by vulcanization to the rubber laminate. Bonding of additional layers of fabric to the rubber will be expected to proportionally increase stiffness and further improve heat aging properties.

[0018] A preferred fabric is a layer of spun bonded, non woven polyester and nylon blend having a thickness of approximately 0.013 inches. A further preferred fabric is a non woven spun bonded layer of polyester having a thickness of approximately 0.007 inches. It should be understood that any fabric which is capable of withstanding vulcanization temperatures, (which could approach 400 degrees F) without melting could be utilized. For example, the fabric used in the laminate could be spun bonded polyester which is readily available in commercial form. The fabric could also be comprised of a thin metal screen, such as an aluminum insect excluding screen or it could be a fibreglass screen.

[0019] Although the above description provides ample information to those of ordinary skill in the art to make and use the fabric reinforced rubber laminate in accordance with the invention, for the avoidance of doubt, some detailed examples of test results are included herein which illustrate the effect of the bonding by vulcanization of the fabric on to the rubber laminate in accordance with the invention. It should be understood that although tests were conducted with specific fabrics and rubber compositions, bonded by vulcanization, the fabrics and rubber compositions and manner of bonding could be varied and comparable results would be expected.

[0020] In the below examples, two plies of the fabric are bonded by vulcanization to a laminate of Masticated Rubber, one ply attached to each side of the laminate. The version of Masticated Rubber used for the tests herein is Symar™ Masticated Rubber available from the applicant, NRI Technology Inc., Toronto, Canada. Symar™ Masticated Rubber is a blend of uncured friction cord (generally a natural rubber (NR)/styrene butadiene rubber (SBR) compound calendered onto tire belting) waste from tire manufacturers, uncured NR/SBR compound waste from rubber processors including tire manufacturers, ground up vulcanized tire rubber and fibers from recycled scrap tires, various ground rubber and fiber materials from internally generated waste and typical rubber processing and vulcanizing ingredients.

[0021] In essence, the test results show the layers of fabric improve the stiffness, tensile strength, tear strength, heat resistance, ozone resistance and oil resistance of the rubber laminate. The fabric used in the tests below is a 0.007 inch thick layer of non woven blend of polyester. Applicable American Society for Testing and Materials (ASTM) test reference standards were used to measure heat aging properties.

**EXAMPLE 1**

[0022] Measured at approximately 21 degrees Celsius, physical properties of a laminate of Masticated Rubber, are below compared to the properties of the same laminate to which is vulcanized is the layer of non woven polyester. As the chart below illustrates, the results show the bonding by vulcanization of the fabric to the Masticated Rubber increases tensile strength, tear strength and hardness and decreases elongation, and volume swell.

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Typical Result Masticated Rubber</th>
<th>Typical Result Reinforced Masticated Rubber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength, MPa</td>
<td>ASTM D412 Die C</td>
<td>5.4</td>
<td>12.1</td>
</tr>
<tr>
<td>Machines Direction</td>
<td></td>
<td>3.2</td>
<td>8.4</td>
</tr>
<tr>
<td>Transverse Direction</td>
<td>ASTM D412 Die C</td>
<td>22</td>
<td>23</td>
</tr>
<tr>
<td>Elongation, %</td>
<td>ASTMD624 Die B</td>
<td>9.1</td>
<td>79.8</td>
</tr>
<tr>
<td>Machine Direction</td>
<td></td>
<td>61</td>
<td>31</td>
</tr>
<tr>
<td>Tear Strength, K/Nm</td>
<td>ASTMD624 Die B</td>
<td>9.1</td>
<td>79.8</td>
</tr>
<tr>
<td>Hardness, Shore A</td>
<td>ASTM D2240</td>
<td>77</td>
<td>89</td>
</tr>
<tr>
<td>Volume Swell, %</td>
<td>ASTM D471 70 hrs</td>
<td>38</td>
<td>20</td>
</tr>
<tr>
<td>23°C.</td>
<td>ASTMD471 70 hrs</td>
<td>72</td>
<td>42</td>
</tr>
<tr>
<td>70°C.</td>
<td></td>
<td>94</td>
<td>55</td>
</tr>
</tbody>
</table>

**EXAMPLE 2**

[0023] Heat aging properties of a laminate of the Masticated Rubber compound are below compared to the heat aging properties of the same laminate to which is vulcanized a layer of spun bonded non woven fabric, namely polyester. Aging conditions were measured at 70 degrees Celsius after 1000 hours and at 100 degrees Celsius after 1000 hours.
As is illustrated above, the bonding by vulcanization of the layer of fabric to the Masticated Rubber significantly enhances heat aging properties of the rubber. This improved performance is shown at 70 degrees and 100 degrees Celsius.

**EXAMPLE 3**

A simple test method was employed in order to quantify stiffness of the rubber laminate. A portion of the rubber laminate was placed on an elevated piece with a portion of the laminate extending over the edge of the piece. Droop of the portion of the laminate extending off the piece was measured. The stiffer the product, the smaller the droop. Negative droop measurement indicates that the product exhibits curling, due to differential shrinkage between the materials, i.e. fabric versus Masticated Rubber. In these examples, a non woven polyester was utilized.

**EXAMPLE 4**

Stiffness tests comparing “control” Masticated Rubber laminate to the same laminate with a second ply of fabric vulcanized on the opposite surface of the rubber laminate reduce the possibility of curling and dramatically increases stiffness, as shown in the chart below.

<table>
<thead>
<tr>
<th>Droop “d” (min)</th>
<th>Thickness</th>
<th>Control</th>
<th>Regular Masticated</th>
<th>2-Ply 0.007*</th>
<th>2-Ply 0.013*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.080*</td>
<td>With Grain</td>
<td>25</td>
<td>8</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Across Grain</td>
<td>33</td>
<td>110</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.100*</td>
<td>With Grain</td>
<td>11</td>
<td>6</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Across Grain</td>
<td>35</td>
<td>10</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>0.125*</td>
<td>With Grain</td>
<td>11</td>
<td>4</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Across Grain</td>
<td>15</td>
<td>6</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

The bonding preferably by vulcanization of the fabric layer onto the rubber laminate, expectedly improves stiffness and surprisingly increases the ability of the rubber to withstand elevated temperatures. The thickness of the fabric layer may be varied beyond the preferred range indicated above, as desired for varying effect on stiffness and heat aging properties. A plurality of layers of the fabric may be bonded preferably by vulcanization on the surfaces of the rubber to increase stiffness. In fact, preferably layers are added to both surfaces of the rubber laminate.

Although Masticated Rubber may be preferred as the rubber used for many of the applications wherein improved heat aging properties and increased stiffness are desired, such as automotive applications, the vulcanization of a laminate of fabric such as non woven polyester or spun bonded nylon and polyester to other rubbers achieve similar improvements in stiffness and heat aging properties. For example, layers of fabric vulcanized to an outer surface, and preferably both outer surfaces of a rubber laminate improve the stiffness and heat aging characteristics of various rubber.
compositions, such as natural rubber, SBR blends, urethane bonded rubber crumb derivations, EVA/rubber blends and other rubber blends. Again, it should be understood that any fabric which is capable of withstanding Vulcanization temperatures could be utilized.

[0031] It should be further understood that the term “rubber” as used herein is to be interpreted broadly, as it would be understood by those skilled in the art, to mean natural rubber and all natural or synthetic polymers having mechanical properties similar to the properties characteristic of natural rubber, namely deformability, rapid recovery from deformation, and mechanical strength. Examples of such materials include natural rubber, styrene-butadiene rubber, polybutadiene, polyisoprene, polyisobutylene, isoprene-butadiene copolymers, neoprene, nitrile rubber, butyl rubber, polystyrene elastomers, acrylic elastomers, silicone rubbers, polyester rubbers, disocyanate-linked condensation elastomers, EPDM (ethylene-propylene diene rubbers), EPT (ethylene-propylene terpolymer rubbers), crosslinked ethylenevinylacetate polymers, crosslinked polyethylene, and mixtures thereof. The vulcanization of the fabric, preferably non woven spun bonded polyester/nylon to any of these such rubbers or mixtures thereof improves stiffness and heat aging performance in a like manner to that described above. Any rubber capable of withstanding vulcanization could be utilized.

[0032] A further advantage provided by the invention is that the exposed surface of fabric provides better surface receptivity to adherence of coatings such as paints or adhesives which may need to be applied to a surface of the rubber.

[0033] Particularly useful applications of the rubber laminate made in accordance with the invention are in various automotive applications, for example as radiator and condenser air baffles, upper and lower radiator closeouts, wheel house splash guards, engine shields, insert material for wheel openings, barriers for road debris, and in the engine compartment as an air flow management components.

[0034] Automotive parts requiring a certain amount of stiffness made in previously known manner with typical Masticated Rubber formulations such as the above references formulation are commonly individually molded with structural features such as ribs to provide stiffness without the need for additional thickness and mass. This individual molding requires special part-specific molds and thus additional manufacturing effort and costs. The fiber reinforced rubber product of the herein invention provides a stiff, suitably thin and correspondingly light, flat, common sheet material than can be easily die cut to a required shape thus avoiding the need for individually molded and profiled parts. A particular example of an advantageous commercial application of the fiber reinforced rubber product of this invention involves use of the laminate of the invention as an automotive air deflector. The air deflector can be made by die cutting a rubber laminate made in accordance with the invention. Such an air deflector has advantages over a compression molded air deflector. Although there may be increased material cost (i.e. the addition of the layers of fabric), this increased cost would be offset by lower manufacturing costs and higher capacity (therby eliminating the need for additional tooling) and lower waste.

[0035] The above description provides ample information for the person skilled in the art to practice the invention. Furthermore, it will be evident that modifications which are obvious to persons of ordinary skill in the art, may be made without departing from the spirit or scope of the invention, which is accordingly limited only by the claims appended hereto, purposely construed.

1. A rubber laminate comprising a rubber layer having an outer surface and a fabric layer bonded to said outer surface.
2. The rubber laminate as defined in claim 1 wherein the fabric layer is bonded to said outer surface by means of vulcanization.
3. The rubber laminate as defined in claim 1 wherein the fabric layer is bonded to said outer surface by means of adhesive.
4. The rubber laminate as defined in claim 2 wherein the fabric layer comprises spun bonded polymer capable of withstanding vulcanization temperatures.
5. The rubber laminate as defined in claim 2 wherein the fabric layer comprises polyester.
6. The rubber laminate as defined in claim 2 wherein the fabric layer comprises a polyester and nylon blend.
7. The rubber laminate as defined in claim 5 wherein the fabric layer has a thickness ranging between 0.006 inches to 0.015 inches.
8. The rubber laminate as recited in claim 2 wherein the rubber layer comprises cured Masticated Rubber.
9. The rubber laminate as recited in claim 5 wherein the rubber layer comprises cured Masticated Rubber.
10. The rubber laminate as recited in claim 1 wherein the rubber laminate has a thickness in the range of 0.04 inches to 0.5 inches.
11. The rubber laminate as recited in claim 1 wherein the rubber layer comprises an SBR blend.
12. The rubber laminate as recited in claim 1 wherein the rubber layer comprises rubber crumb adhered together with polyurethane.
13. The rubber laminate as recited in claim 2 wherein the rubber layer includes two outer surfaces, and said fabric layer is vulcanized to both said outer surfaces.
14. A method of manufacturing a reinforced rubber laminate comprising the steps of:
   (a) providing a rubber layer including an outer surface;
   (b) providing a fabric layer;
   (c) bonding said fabric layer to said rubber layer outer surface.
15. The method of claim 14 wherein said bonding is effected by means of vulcanization of said fabric layer to said outer surface.
16. The method of claim 15 wherein said rubber layer is recycled rubber.
17. The method of claim 15 wherein said rubber layer is cured Masticated Rubber.
18. The method or claim 16 wherein the fabric layer comprises unwoven spun bonded polyester.
19. The method of claim 16 wherein the fabric layer comprises unwoven spun bonded polyester and nylon.
20. The rubber laminate as recited in claim 2 wherein said rubber layer is recycled rubber.