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(54) **FLOOR COVERING**

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(57) **ABSTRACT**

A floor covering is provided having a high slip resistance and including a base material which is substantially in sheet or tile form and is made of an elastomeric material and which has a slip-resistant surface containing granular particles. In order to provide ease of manufacture and processing of the floor covering, the granular particles are composed of a polymeric material having a hardness significantly greater than that of the elastomeric material.

FLOOR COVERING

[0001] This application claims priority to German Patent Application DE 102006034646.7-25, filed Jul. 24, 2006, and hereby incorporated by reference herein.

BACKGROUND

[0002] The present invention relates to a floor covering having a high slip resistance and including a base material which is substantially in sheet or tile form and is made of an elastomeric material and which has a slip-resistant surface containing granular particles.

[0003] A floor covering of this type is known from International Patent No. WO 03/100162. The floor covering described therein includes a support made of a plastic material, preferably a thermoplastic polymer or a thermoplastic elastomer. To provide enhanced slip resistance, the surface of the support is roughened by granular particles. Such granular particles preferably include hard particles of quartz, silicon carbide, aluminum oxide and/or emery.

[0004] The known floor covering has the disadvantage that it is difficult to cut because of the very hard particulate material (corundum problem). This results in problems during the preparation and compounding and/or during further processing of the floor covering.

SUMMARY OF THE INVENTION

[0005] In accordance with an embodiment of the present invention, a floor covering having a high slip resistance comprises: a base material which is substantially in sheet or tile form and is made of an elastomeric material and which has a slip-resistant surface containing granular particles. The granular particles are composed of a polymeric material having a hardness significantly greater than that of the elastomeric material.

DETAILED DESCRIPTION

[0006] An embodiment of the present invention provides a floor covering which provides high slip resistance and is also easy and inexpensive to manufacture and process.

[0007] The floor covering with high slip resistance in accordance with an embodiment of the present invention includes a base material which is substantially in sheet or tile form and is made of an elastomeric material. The surface of the floor covering is roughened by granular particles, and therefore provides slip resistance. The granular particles are made of a polymeric material having a hardness greater than that of the elastomeric material. Surprisingly, it turns out that these materials provide high slip resistance although they are markedly softer than mineral particles, such as corundum, and despite the fact that they tend to form edges that are more rounded than sharp. However, unlike floor coverings containing mineral particles, they have the advantage of being easy to manufacture and process. In particular, a floor covering in accordance with an embodiment of the present invention can be cut very easily.

[0008] It has been found that good results in terms of slip resistance are already achieved if the hardness of the polymeric material is 10 Shore D units greater than that of the elastomeric material.

[0009] Suitable polymeric materials may generally include thermoplastic and thermosetting plastics. Both materials can be mixed into the base material, for example, in the form of particles. Thermosetting plastics are not very well suited for sprinkle application because, just as the corundum particles known in the prior art, they may sink into the base material when it is liquefied during vulcanization.

[0010] Thermoplastic polymers that are suitable for mixing into the base material are generally those having a melting temperature that is higher than the high temperatures occurring during subsequent manufacturing steps. If it is ensured that during subsequent manufacturing steps, no shear forces may occur which could result in the mixing of the materials, then it is also possible to use thermoplastic polymers having lower melting temperatures. Melting of the particulate material, per se, is not critical as long as the drops of particulate material are maintained as such. As long as there are no shear forces, this is generally ensured by the large difference in viscosity between the materials alone.

[0011] The materials preferably used are semicrystalline thermoplastic polymers.

[0012] In the case of the sprinkled-on particles of semicrystalline thermoplastic material, it is even desired for the particulate material to melt during the vulcanization of the base material, so as to float on the surface thereof. Thus, the drops of particulate material remain intact at the surface during vulcanization, and do not sink into the liquefied base material. After cooling, the drops of particulate material recrystallize into granular particles.

[0013] This property can be described by the position that the maximum of an exothermic melting peak of the thermoplastic polymeric material has in a thermogram measured by a differential scanning calorimetry (DSC) method. As for the elastomers usually used for floor coverings and the methods used for manufacturing the floor coverings, it turns out that the thermoplastic, preferably semicrystalline, polymers which are particularly suitable are especially those which exhibit a maximum of an exothermic melting peak in a temperature range of 100° C. to 250° C. in a thermogram obtained by differential scanning calorimetry (DSC) analysis according to DIN 53765. If the melting point is within the specified temperature range, then, during the vulcanization of the base material, the thermoplastic polymer melts into a drop which, in the case of the sprinkled-on particles, does not sink into the base material, but floats on the surface. After the vulcanization process, the drop recrystallizes on the surface into a granular particle. The slip-resistant properties are retained.

[0014] The selection of a suitable thermoplastic polymer for a given elastomeric base material and a given processing scheme in a particular case is within the ability of those skilled in the art without requiring inventive activity.

[0015] The thermoplastic polymers may generally include, for example, pure homopolymers or copolymers, or homo- or copolymers which have been modified by grafting. Preferably, they include thermoplastic polymers selected from the group consisting of polyolefins, modified polyolefins, semicrystalline polyamides and/or polyesters. The polymers used may also be grafted with conventional grafting agents, such as maleic anhydride and/or acrylic acid in order to improve the embedding of the particles into the matrix.

[0016] A floor covering according to the present invention can be manufactured in different ways. As has been explained hereinbefore, the granular particles can, for example, be simply sprinkled on the not-yet-vulcanized raw elastomer sheet and subsequently subjected, together with the raw sheet, to a heat treatment for vulcanization, during which process the particles are preferably also melted.

[0017] It is also possible to embed the granular particles into the elastomeric base material, as also described hereinbefore. In the latter embodiment, additional granular particles may be sprinkled on the surface, after which the method is continued as described above.

[0018] In another embodiment, the raw sheet of elastomeric base material containing the admixed granular particles is split and subsequently subjected to a vulcanization process, possibly after additional particles have been sprinkled thereon. In this processing scheme, it may be advantageous if the admixed particles, of which, after the splitting of the base sheet, a certain portion is also located at the surface of the split sheet, are also selected to be of a thermoplastic, preferably semicrystalline, polymer that melts at a temperature in the range of the vulcanization temperature of the elastomeric base material, in order that these particles are also prevented from sinking into the base material during vulcanization.

[0019] In comparison with simply sprinkling-on the granular particles, mixing them in has the advantage that a floor covering manufactured in this way has a higher abrasion resistance and, therefore, a longer service life. In addition, this makes it possible to manufacture a floor covering by splitting a base sheet.

[0020] In the case where the granular particles are mixed into the base material, it should be observed that these mixing processes are usually performed at temperatures between 100° C. und 130° C. Therefore, the melting temperature of the thermoplastic polymer used for the granular particles, which temperature is defined by the position of the maximum of the exothermic melting peak of the material, as has been described hereinabove, should preferably be >130° C. Subsequent process steps can also be performed at temperatures higher than the melting temperature of the thermoplastic polymer, provided that at such temperatures, there are no shear forces acting on the materials, which could cause the particulate material to mix with the base material.

[0021] Depending on the way in which the floor covering in accordance with an embodiment of the present invention is manufactured, there are different requirements in terms of the used particle sizes and quantities of particulate material. It has been found that in the case where the granular particles are sprinkled on, the best slip-resistant properties are achieved when the average size of the particles, as measured by sieve analysis according to DIN 66165, is between 100 μm and 800 μm, preferably about 300 μm. For particle sizes <100 μm, the slip-resistant properties deteriorate excessively, while for particle sizes >800 μm, the mechanical and fire properties deteriorate excessively for floor-covering thicknesses of 2 to 5 mm, which are commonly used for elastic floor coverings.

[0022] The quantity of sprinkled-on granular particles, as expressed by the total volume, should be between 30 cm^3/m^2 and 360 cm^3/m^2, preferably between 100 cm^3/m^2 and 250 cm^3/m^2. For quantities below 30 cm^3/m^2, the slip-resistant properties decrease excessively, while for quantities larger than 360 cm^3/m^2, there is the risk that the mechanical and fire properties will also deteriorate excessively.

[0023] In the case where the granular particles are mixed in, the average size of the particles, as measured by sieve analysis according to DIN 66165, should be between 100 μm and 2000 μm, preferably about 500 μm. For particle sizes below 100 μm, again, the slip-resistant properties decrease excessively, while for particle sizes greater than 2000 μm, the mechanical and fire properties deteriorate, as in the cases described above.

[0024] The proportion of admixed particles is preferably between 10 vol. percent and 40 vol. percent, preferably between 14 vol. percent and 25 vol. percent, of the base material. For a proportion of less than 10 vol. percent, the slip-resistant properties decrease excessively, while for a proportion greater than 40 vol. percent, the mechanical and fire properties deteriorate.

[0025] Suitable base materials include any elastomers which are suitable for use as a floor covering. Preferably, the base material includes the elastomers SBR (polystyrene-butadiene rubber), NBR (nitrile-butadiene rubber), EPM (ethylene-propylene rubber), EPDM (ethylene-propylene diene rubber), EVA (ethylene-vinyl acetate), CSM (chlorosulfonated polyethylene rubber), VSi (silicon rubber), and/or AEM (ethylene-acrylic rubber); said elastomers being either sulfur-crosslinked, peroxide-crosslinked, or addition-crosslinked. It is also possible to use mixtures of the aforementioned elastomers.

[0026] In a floor covering according to various embodiments of the present invention, mineral fillers, such as clay, chalk, silicic acids, and/or siliceous chalk, may be included in the base material in a generally known manner. These fillers are intended to adjust the physical properties, such as the hardness and abrasion, of the rubber compound. Moreover, the fillers are also used to improve the fire properties. Usually, they are added in quantities of 10 to 70 weight percent and particles sizes <100 μm.

[0027] A floor covering in accordance with an embodiment of the present invention can be used, for example, both as sheet and tile material.

[0028] The present invention will now be further illustrated by the following examples:

EXAMPLE 1

[0029] A polypropylene powder having an average particle size of 300 μm was sprinkled in a quantity of 275 cm^3 per cm^2 on a sheet of base material of a sulfur-crosslinkable SBR mixture. The maximum of the melting peak of the polypropylene powder, which was determined by DSC analysis according to DIN 53765, was at 163° C. Subsequently, the powder-sprinkled sheet was subjected for a period of 5 minutes to a vulcanization process at 180° C. in a continuous vulcanization system containing a belt press. The result was an elastomeric floor covering which, in a slip test performed using a British pendulum tester (BPT) and using water as the lubricant, achieved a slip resistance value of 40 scale divisions.

EXAMPLE 2

[0030] A sulfur-crosslinkable SBR mixture was mixed with 40 vol. percent of the aforementioned powder at a dump temperature of 120° C. This material was calandered into a raw sheet, which was then split in the middle. The resulting raw sheet was subjected for a period of 7 minutes to a vulcanization process at 180° C. in a non-continuous vulcanization system. In a test carried out as described above, using water as the lubricant, the resulting elastomeric floor covering achieved a slip resistance value of 36 scale divisions.

EXAMPLE 3

[0031] In another embodiment, the polypropylene powder-containing mixture described in Example 2 was calendered into a sheet. This sheet was additionally sprinkled with 275 cm^3/cm^2 of the same polypropylene powder. Then, the sheet was subjected for a period of 5 minutes to a vulcanization process at 180° C. in a continuous vulcanization system containing a belt press. The result was an elastomeric floor covering which, in a slip test performed as described above and using water as the lubricant, achieved a slip resistance value of 40 scale divisions.

Comparative Example 1

[0032] A sheet of base material of a sulfur-crosslinkable SBR mixture analogous to Example 1, but without any powder sprinkled thereon, was subjected for a period of 5 minutes to a vulcanization process at 180° C. in a continuous vulcanization system containing a belt press. In a test carried out as described above, using water as the lubricant, the resulting floor covering achieved a slip resistance value of only 12 scale divisions.

Comparative Example 2

[0033] In another comparative test, a sheet of base material of a sulfur-crosslinkable SBR mixture analogous to Example 1 was sprinkled with corundum particles in a quantity of 800 g/m^2 and subjected for a period of 5 minutes to a vulcanization process at 180° C. in a continuous vulcanization system containing a belt press. After vulcanization, a large part of the corundum particles had sunk into the base material and were surrounded by it. In a test carried out as described above, using water as the lubricant, the resulting floor covering achieved a slip resistance value of only 14 scale divisions

[0034] The above examples show that a floor covering made according to various embodiments of the present invention has a markedly increased slip resistance value as compared to both a floor covering without a slip-resistant surface and a floor covering having corundum particles sprinkled thereon.

[0035] Moreover, a Taber abrasion test according to ISO 9352, which was carried out on the floor coverings manufactured in accordance with the Examples, showed that the floor coverings manufactured in accordance with Examples 2 and 3 and containing admixed granular particles of polypropylene had an abrasion resistance more than 20 percent higher than that of the base material without such admixture, which was used in Example 1.

What is claimed is:

1. A floor covering having a high slip resistance comprising:

a base material which is substantially in sheet or tile form and is made of an elastomeric material and which has a slip-resistant surface containing granular particles; and

wherein the granular particles are composed of a polymeric material having a hardness significantly greater than that of the elastomeric material.

2. The floor covering as recited in claim 1 wherein the polymeric material includes one or both of thermoplastic and thermosetting material which is sprinkled on the surface of the base material and/or mixed into the base material.

3. The floor covering as recited in claim 2 wherein the thermoplastic material is a semicrystalline thermoplastic material.

4. The floor covering as recited in claim 3 wherein the thermoplastic, semicrystalline material includes thermoplastic polymers having a melting point below or in the range of the vulcanization temperature of the elastomeric base material.

5. The floor covering as recited in claim 4 wherein the semicrystalline thermoplastic polymeric material includes thermoplastic polymers which exhibit an exothermic melting peak in a temperature range of 100° C. to 250° C. in a thermogram obtained by differential scanning calorimetry (DSC) analysis according to DIN 53765.

6. The floor covering as recited in claim 2, wherein the thermoplastic polymers are selected from the group consisting of polyolefins, modified polyolefins, semicrystalline polyamides, polyesters, and combinations thereof.

7. The floor covering as recited in claim 1, in which the particles are sprinkled on the surface, wherein the average size of the particles, as measured by sieve analysis according to DIN 66165, is between 100 μm and 800 μm.

8. The floor covering as recited in claim 7, in which the particles are sprinkled on the surface, wherein the average size of the particles, as measured by sieve analysis according to DIN 66165, is preferably about 300 μm.

9. The floor covering as recited in claim 1, in which the particles are sprinkled on the surface, wherein a quantity of sprinkled-on particles, as expressed by the total volume of sprinkled-on particles, is between 30 cm^3/m^2 and 360 cm^3/m^2.

10. The floor covering as recited in claim 9, in which the particles are sprinkled on the surface, wherein a quantity of sprinkled-on particles, as expressed by the total volume of sprinkled-on particles, is between 100 cm^3/m^2 and 250 cm^3/m^2.

11. The floor covering as recited in claim 1, in which the particles are mixed into the base material, wherein the average size of the particles, as measured by sieve analysis according to DIN 66165, is between 100 μm and 2000 μm.

12. The floor covering as recited in claim 11, in which the particles are mixed into the base material, wherein the average size of the particles, as measured by sieve analysis according to DIN 66165, is about 500 μm.

13. The floor covering as recited in claim 1, in which the particles are mixed into the base material, wherein the proportion of admixed particles is between 10 and 40 vol. percent of the base material.

14. The floor covering as recited in claim 13, in which the particles are mixed into the base material, wherein the proportion of admixed particles is between 14 and 25 vol. percent of the base material.

15. The floor covering as recited in claim 1, wherein the base material includes one or more of the following elastomers: SBR (polystyrene-butadiene rubber), NBR (nitrile-butadiene rubber), EPM (ethylene-propylene rubber), EPDM (ethylene-propylene diene rubber), EVA (ethylene-vinyl acetate), CSM (chlorosulfonated polyethylene rubber), VSi (silicon rubber), and AEM (ethylene-acrylic rubber);
 said elastomers being either sulfur-crosslinked, peroxide-crosslinked, or addition-crosslinked.

16. The floor covering as recited in claim 1 wherein mineral fillers are included in the base material.

17. The floor covering as recited in claim 16 wherein the filler is selected from the group consisting of clay, chalk, silicic acids and combinations thereof.

18. The floor covering as recited in claim 17 wherein the chalk is siliceous chalk.

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