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AND METHOD OF MAKING SAME

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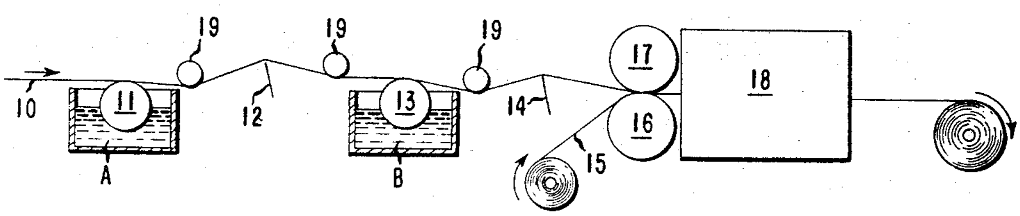

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NON-CRACKING TUFTED CARPET WITH NON-WOVEN SECONDARY BACKING AND METHOD OF MAKING SAME

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This invention relates to tufted carpets and in particular to a process for the production of improved carpets having a nonwoven secondary backing.

Tufted carpets are composite structures in which the yarn forming the loops or pile in the surface of the carpet is needled through a base fabric (primary carpet backing) such as woven jute, burlap, or a nonwoven fabric such as is described in British Patent 989,591. The base segments of the yarn loops are bonded firmly to the underside of the primary carpet backing by means of a suitable adhesive. The adhesive is preferably applied as an aqueous dispersion of an elastomeric material, such as a latex of natural or synthetic rubber. In order to improve the appearance, dimensional stability, bulk and body of the tufted carpet, and also to provide a tough covering which further protects the primary carpet backing and the base segments of the yarn loops, a secondary backing is customarily adhered to the composite structure by means of the same latex adhesive used to bond the yarn loops to the primary backing. The secondary backing may be either a woven fabric composed of a material such as jute or twisted paper strands or a nonwoven fabric. Nonwoven fabrics, for example, those composed of bonded polypropylene fibers, possess several advantages as secondary backings, particularly in regard to their low cost and improved dimensional stability at varying relative humidities.

A disadvantage of nonwoven secondary backings, however, is the occurrence of cracking or buckling of the backing when the carpet is bent. This cracking occurs mainly along lines parallel to and between the tuft rows when the carpet is bent along a similar bending axis. Due to the structure of the carpet, cracking does not occur as readily along lines perpendicular to the tuft rows.

It has been found that the cracking can be eliminated by using a higher level, for example, twice as much, of a standard latex-adhesive formulation but this entails an economic penalty. In addition, these thick coatings are difficult to dry on present commercial equipment at economically attractive speeds. It has also been found that cracking behavior can be improved by the use of latex-adhesive formulations containing a higher ratio of filler to rubber, for example, 4:1 rather than 2–3:1 of the standard latex formulations. Filler refers to the pigments of both the hiding and extender types. Carpets produced with adhesives having the higher-filler formulations, however, are deficient to resistance to fuzzing and pilling of the pile yarn as well as tuft-pullout strength.

This invention provides an economically attractive method for obtaining noncracking tufted carpets with nonwoven secondary backings while maintaining a good balance of physical properties. The method of this invention comprises coating the underside of a tufted primary carpet backing with a latex formulation having a filler-to-rubber ratio of from 0 to 1:1 on a weight basis, applying a second coating of a latex formulation having a filler-to-rubber ratio of at least 2:1, bringing a nonwoven fabric into contact with the second coating and drying the resulting structure.

The first coating should have a viscosity of 10,000 cps. or less, and is applied at a pickup rate of about 5 to 10 oz./yd.^{2} (170 to 340 g./m.^{2}). This coating provides fuzz-

and pill-resistance to the pile yarn and improved tuft-pullout strength. If desired, an unmodified elastomeric latex, that is, one containing no filler, can be used as the first coat.

The second coating should have a viscosity of at least about 10,000 cps. or more, and is applied at a pickup rate of about 12 to 25 oz./yd.^{2} (410 to 850 g./m.^{2}). This coating fills the spaces between the tuft rows, and bonds the secondary backing to the tufted primary backing. Presence of the second coating improves cracking behavior. In order to obtain adequate adhesion between the tufted primary backing and the secondary backing, the filler-to-rubber ratio of the second coating should not exceed about 6:1.

The latex formulations which are used as the first and second coatings in this invention are similar to the standard latex formulations now used as backing adhesives except that they differ in the filler-to-rubber ratios. Any of the known elastomers are suitable for use in the adhesive formulations including natural rubber, synthetic polyisoprene, unmodified and carboxyl-modified butadiene/styrene copolymers, butadiene/acrylonitrile copolymers, chloroprene and polyisobutylene. A typical, standard latex formulation is shown below (components):

	Parts (dry basis)
Butadiene/styrene copolymer latex	100
Sulfur curing system:	
Sulfur	2
Zinc oxide	5
Zinc diethyldithiocarbamate	2
Mercaptobenzothiazole	1
Casein (dispersing agent)	2
Potassium oleate (dispersing agent)	2
Antioxidane (e.g. polybutylated Bisphenol A)	1
Whiting (extender pigment)	290
Titanium dioxide	10
Water (to a solids content of 65%).	

Carboxyl-modified butadiene/styrene copolymers are self-curing and thus can be formulated without the sulfur curing system. A typical formulation of this type is shown below (components):

	Parts (dry basis)
Carboxyl - modified butadiene/styrent copolymer latex	100
Tetrasodium pyrophosphate (dispersing agent)	0.25
Whiting (extender pigment)	200
Thickener (e.g. sodium polyacrylate)	0.8
Water (to a solids content of 68%).	

Other suitable extender pigments include clay, talc, asbestos mica, sand and glass microbeads. The viscosity of the formulation can be adjusted by use of known thickeners such as sodium carboxymethylcellulose, polyvinyl alcohol, sodium polyacrylate and the natural water-soluble gums.

The coatings can be applied by the standard methods known in the art including spraying, roller coating, knife coating and the like. The figure is a schematic diagram of a suitable procedure for carrying out the coating process of this invention. In the figure, tufted primary carpet backing **10** is coated on the underside with latex formulation A by applicator roll **11**, the excess coating is removed by doctor blade **12**, then a coating of latex formulation B is applied by applicator roll **13**, the coating is smoothed with doctor blade **14**, and the secondary carpet backing **15** is then brought into contact with the wet second coating. The structure is passed between low-pressure rolls **16** and **17** to press the secondary backing firmly against the second coating. The composite structure is then dried at about 130°–170° C. in oven **18**. If desired, the carpet may be supported in a tenter during the drying operation. Idler rolls **19** are used to provide the required tension and guidance for the tufted primary carpet backing during the coating steps.

The process of this invention can be used with advantage with all known types of nonwoven fabrics which, except for their cracking behavior, are suitable as secondary carpet backings. A particularly preferred material for this application is a nonwoven fabric of self-bonded, continuous filaments of polypropylene. In the preparation of such a fabric, an unbonded nonwoven web of polypropylene filaments, such as can be produced by the process described in British Patent 932,482, can be pressed between heated embossing rolls at 140 to 190° C. to effect simultaneous bonding and formation of a decorative pattern on the surface of the sheet. Other bonded nonwoven fabrics of continuous filaments or staple fibers of such organic polymers as the polyamides, polyesters, polyacrylonitrile, etc. are also suitable. Although nonwoven fabrics of the synthetic, organic polymers are preferred because of their improved dimensional stability at varying relative humidities, nonwoven fabrics of natural and regenerated fibers can also be used. The nonwoven fabric used in the process of this invention must be bonded. Excessive fuzzing of the exposed surface of the secondary carpet backing is observed with unbonded webs since the second coating in this invention does not completely impregnate and bond the fibers in the secondary backing but instead merely serves to bond the secondary backing to the tufted primary backing. The bonding of the nonwoven fabric to be used as a secondary carpet backing can be effected by methods well-known in the art and accordingly they are not further described herein.

The invention will be further understood by reference to the following control experiments and examples.

Experiment A

To the underside of a nonwoven primary carpet backing tufted with about 20 oz./yd.^{2} (680 g./m.^{2}) of bulked continuous filament nylon carpet yarn (denier, 3700) is applied a 24 oz./yd.^{2} (810 g./m.^{2}) coating of a standard latex formulation having a filler-to-rubber ratio (weight basis) of 2:1, a solids content of 65% and a viscosity of 8000 cps. The elastomeric material is a carboxyl-modified butadiene/styrene copolymer. A secondary backing in the form of a self-bonded and embossed nonwoven fabric composed of continuous polypropylene filaments is then brought into contact with the latex coating as soon after application of the coating as possible. The laminate formed is passed between two low-pressure rolls and then dried with the pile yarn down at 130° C. for 30 minutes.

Upon bending the finished sample along an axis parallel to the tuft rows, creases in the secondary backing are very evident and are caused by collapse of the backing into the voids between the tuft rows. This phenomenon is termed "cracking." Another evidence of the cracking is the undesirable "grin-through" of the primary carpet backing when the bent carpet is viewed from the pile side.

Experiment B

Experiment A is repeated except that the amount of latex coating is increased to 35–40 oz./yd.^{2} (1180–1350 g./m.^{2}). After drying, the laminated structure does not exhibit the cracking observed in Experiment A. This demonstrates that cracking can be limited with high loading of a standard latex formulation.

Experiment C

A finished carpet sample is prepared as in Experiments A and B except that a modified latex formulation having a filler-to-rubber ratio of 4:1 is used. The increased ratio is obtained by adding clay to the standard latex formulation of Experiment A and diluting with water to maintain the solids level at 65%. The viscosity of the

modified formulation is over 12,000 cps. The latex formulation is applied at a level of 28 oz./yd.^{2} (95 g./m.^{2}). This slightly higher level compared to Experiment A is of no economic consequence because of the lower unit cost of the high-filler-content formulation. After the standard drying step, the sample does not crack. Compared to the products prepared in Experiments A and B, however, it is deficient in fuzz- and pill-resistance of the pile yarn and tuft-pullout strength.

EXAMPLE 1

A tufted primary carpet backing as in Experiment A is given an initial light coating (about 7 oz./yd.^{2}; 240 g./m.^{2}) of an unpigmented latex having a viscosity of 5000 cps. and containing 50% solids (carboxyl-modified butadiene/styrene copolymer). This first coating is immediately followed by a second coating of a high-filler-content (4:1 filler-to-rubber ratio), high-viscosity (13,000 cps.) latex formulation. The total weight of the two coatings is 28 oz./yd.^{2} (950 g./m.^{2}). A nonwoven carpet backing is then applied and the laminate dried as in the preceding experiments. The finished carpet sample is acceptable in all respects. It does not crack and it exhibits good fuzz- and pill-resistance and adequate tuft-pullout strength. The first latex coating penetrates the yarn bundles behind the primary backing and to some extent within said backing, and prevents fuzzing and pilling and provides tuft-pullout strength. The second latex coating fills the voids between the tuft rows and prevents cracking that occurs on collapse of the nonwoven secondary backing.

EXAMPLE 2

An initial coating of a latexing compound containing a carboxyl-modified butadiene/styrene copolymer and having a filler (whiting)-to-rubber ratio of 1:1, a solids content of 68%, and a viscosity of 10,000 cps. is applied to the back of a tufted primary carpet backing as in Experiment A. This is immediately followed by a second coating of a latexing compound having a filler-to-rubber ratio of 2.5:1, a solids content of 68%, and a viscosity of 10,000 cps. The first coating is applied at a level of 10 oz./yd.^{2} (340 g./m.^{2}) and the second coating, at 14 oz./yd.^{2} (470 g./m.^{2}). A nonwoven secondary backing is then applied and the composite structure dried as in Experiment A. The finished carpet sample is acceptable in all respects.

What is claimed is:

1. A method for preparing a tufted carpet having a nonwoven secondary backing and resistant to cracking comprising coating the underside of a tufted primary carpet backing with a latex formulation having a filler-to-rubber ratio of from 0 to 1:1 on a weight basis, applying a second coating of a latex formulation having a filler-to-rubber ratio of at least 2:1, bringing a bonded nonwoven fabric into contact with the second coating and drying the resulting structure.

2. The process of claim **1** wherein the first coating has a viscosity no greater than about 10,000 cps. and is applied at a pickup rate of about 5 to 10 oz./yd.^{2}, and the second coating has a viscosity of at least about 10,000 cps. and is applied at a pickup rate of about 12 to 25 oz./yd.^{2}.

3. A tufted carpet produced by the process of claim **1**.

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