

[54] **CARPET BACKSIZED WITH HOT MELT ADHESIVE AND METHOD**

[75] Inventors: **David D. Taft**, Minneapolis; **Terry H. Shepler**, St. Paul, both of Minn.

[73] Assignee: **Ashland Oil, Inc.**, Ashland, Ky.

[ \* ] Notice: The portion of the term of this patent subsequent to Sept. 11, 1990, has been disclaimed.

[22] Filed: **May 15, 1973**

[21] Appl. No.: **360,616**

**Related U.S. Application Data**

[60] Division of Ser. No. 149,843, June 3, 1971, Pat. No. 3,758,431, which is a continuation-in-part of Ser. No. 121,150, March 4, 1971, abandoned.

[52] **U.S. Cl.**..... **428/95**; 260/28.5 AV; 260/887; 428/516; 427/398

[51] **Int. Cl.**..... **D03d 27/00**; D04h 11/00

[58] **Field of Search**..... 161/67, 62-66, 161/234, 247, 245, 231; 156/72, 334; 117/161 UZ, 161 UH, 76 T, 90, 138.8 A; 260/28.5 AV, 887

[56]

**References Cited**

**UNITED STATES PATENTS**

3,390,035	6/1968	Sands.....	156/72
3,676,280	7/1972	Sands.....	161/67
3,745,054	7/1973	Smedberg.....	156/72
3,770,558	11/1973	Stahl.....	156/72
3,779,799	12/1973	Kennedy.....	161/67

*Primary Examiner*—Marion E. McCamish

[57]

**ABSTRACT**

Hot melt compositions containing copolymer of ethylene and vinyl acetate and/or alkyl acrylate wherein the alkyl group contains 1-18 carbon atoms; ester of rosin and polyhydric alcohol; and ester of polyhydric alcohol and dimer and/or trimer of fatty acid are particularly useful as carpet backing adhesives.

**6 Claims, No Drawings**

## CARPET BACKSIZED WITH HOT MELT ADHESIVE AND METHOD

### RELATED CASES

This application is a division of copending application Ser. No. 149,843, filed June 3, 1971, now U.S. Pat. No. 3,758,431, which is a continuation-in-part of copending application Ser. No. 121,150, filed Mar. 4, 1971, now abandoned.

### BACKGROUND OF THE INVENTION

The present invention is concerned with hot melt compositions which are especially useful as adhesives for the backsizing of tufted carpets. More particularly the present invention is concerned with hot melt compositions which are substantially free of wax.

Tufted carpets are composite structures in which the yarn forming the pile, i.e., the surface of the carpet, is needled through a base fabric whereby the base of each tuft extends through the base fabric and is visible on the bottom surface. Tufted carpets are generally of two types, the first being the type commonly known as a "nap" carpet where the yarn loops are formed by needling or punching a continuous yarn just through the base fabric, thus forming the base of the carpet, while the tops of the loops are generally  $\frac{1}{4}$  inch to  $\frac{3}{4}$  inches long, thus forming the wearing surface of the carpet. The second type of tufted carpet, commonly known as a "shag" carpet, has the same base as the nap carpet but the tops of the loops have been split or the tips of the loops have been cut off. The surface of the shag carpet is thus formed by the open ends of the numerous U-shaped pieces of yarn - the base of the U being embedded in the base fabric.

The loops of yarn are needled through and embedded in the base fabric (the combination of which is the raw tufted carpet) thus forming the tufted base, which must be secured to the base fabric to prevent the loops from being pulled out of the base fabric. The tufted bases are generally secured by applying an adhesive to the back of the raw tufted carpet to bond the tufted yarns to the base fabric. A secondary backing material is usually also applied to the back of the raw tufted carpet and bonded thereto with the same adhesive that bonds the yarn to the base fabric. The application of the secondary backing material further secures the loops of yarn since the loops of yarn are then bonded by the adhesive to the backing material as well as the base fabric.

The yarn used in forming the pile of a tufted carpet can be made of any type of fiber known in the art to be useful for tufted carpets, e.g., nylon, acrylics, wool, cotton, rayon and the like.

The base fabric or primary backing may be of any type known in the art and may be woven, for example, woven jute, woven slit polypropylene film, burlap, and the like, or may be non-woven fabric, e.g., needle punched, non-woven polypropylene web. Likewise, the secondary backing material may be of any type known in the art, e.g., woven jute, woven slit polypropylene film, burlap, foam material such as polyurethane foams or blown vinyl film and non-woven fabrics such as needle punched, non-woven polypropylene web, and blends of polyesters and polypropylene.

In preparing such tufted carpets, the adhesives are usually applied to the primary backing which holds the tufted matrix in the form of a latex. A secondary backing is then usually applied to the carpet. The carpet is

then heated to cure the latex to ensure a bond between the latex and the tufted carpet, and the latex and the primary and secondary backings. This curing or drying of the latex is quite time consuming, expensive, and often leads to rejects because of insufficient curing during the process. In addition, overheating of the carpet may occur during the curing which in turn may affect the shade of the carpet.

In addition to the use of latex as an adhesive carpet backing, recently there has been some activity in the use of hot melt adhesives as carpet backings or sizing adhesives. For example, such hot melt adhesives have been based upon compositions containing copolymers of ethylene and vinyl acetate admixed with a wax such as paraffin wax or microcrystalline wax. For example, U.S. Pat. 3,390,035 discloses a hot melt adhesive consisting essentially of from 90 to 10% by weight of an ethylene/vinyl acetate copolymer and from 90 to 10% by weight of a wax. Such hot melt adhesives however exhibit incompatibility and sometimes separation upon cooling of the hot melt. In addition, such compositions have not demonstrated the degree of flexibility and adhesive strength desired by the carpet industry.

### BRIEF DESCRIPTION OF INVENTION

The hot melt composition of the present invention consists essentially of:

A. about 10 to 50% by weight of copolymer of ethylene and vinyl acetate and/or alkyl acrylate wherein the alkyl group contains 1-18 carbon atoms, containing from 40 to 85% by weight of ethylene and from 15 to 60% by weight of vinyl acetate or the  $C_1-C_{18}$  alkyl acrylate;

B. about 25 to 65% by weight of ester of rosin and polyhydric alcohol having an acid value between about 5 and 40, and a melting point between about 75 and 140°C; and

C. about 10 to 50% by weight of ester of polyhydric alcohol and dimer and/or trimer of fatty acid and having an acid value of 6 to 40.

The above quantities of copolymer and esters are based upon the combined weight of the copolymer and ester present in the composition and not necessarily upon the total composition which may contain other ingredients.

### DESCRIPTION OF PREFERRED EMBODIMENTS

The hot melt composition contains from about 10 to 50% by weight, and preferably from about 15-35% by weight of copolymer of ethylene and an unsaturated ester which is vinyl acetate or alkyl acrylate wherein the alkyl group contains 1-18 carbon atoms. The most preferred quantity of the copolymer of ethylene and unsaturated ester is about 20-30% by weight.

The copolymers to be employed in the present invention contain from 40 to 85% by weight of ethylene and from 15 to 60% by weight of vinyl acetate or  $C_1-C_{18}$  alkyl acrylate. Preferably the copolymer contains about 65 to 82% by weight of ethylene and about 35 to 18% by weight of vinyl acetate or  $C_1-C_{18}$  alkyl acrylate. Generally the copolymer has a melt index of 5-350. Some examples of suitable alkyl acrylates include methyl acrylate, ethyl acrylate, propyl acrylate, butyl acrylate, hexyl acrylate, 2-ethylhexyl acrylate, dodecyl acrylate, lauryl acrylate and stearyl acrylate. Preferably the alkyl group of the acrylate contains 1-8 carbon atoms.

The most preferred alkyl acrylates are ethyl acrylate and butyl acrylate. Copolymers of ethylene and vinyl acetate and/or C<sub>1</sub>-C<sub>18</sub> alkyl acrylate are commercially available and their methods of preparation are adequately described in the literature including numerous U.S. patents. For example, the procedures described in U.S. Pat. No. 2,200,429 are useful for preparing the copolymers of ethylene used in the present invention. The ethylene copolymers can also contain about 0.001 to 15% by weight of a comonomer such as acrylic acid, methacrylic acid, itaconic acid, acrylamide, beta dimethyl aminoethyl methacrylate, beta hydroxyethyl acrylate, diallyl maleate, diallyl phthalate, diallyl ether, ethylene glycol dimethacrylate, hydroxypropyl acrylate, or hydroxypropyl methacrylate.

Some commercially available copolymers of ethylene suitable for the purposes of the present invention are Ultrathene 636X, which is a copolymer of 72% ethylene and 28% vinyl acetate with a melt index of 24, Ultrathene 638 which is a copolymer of 69% ethylene and 31% vinyl acetate with a melt index of 24; Ultrathene 639 which is a copolymer of 70% ethylene and 30% vinyl acetate with a melt index of 120; Ultrathene 664 which is a copolymer of 50% ethylene and 50% vinyl acetate with a melt index of 50; Ultrathene 662 which is a copolymer of 45% ethylene and 55% vinyl acetate with a melt index of 100; Ultrathene 633 which is a copolymer of 81% ethylene and 19% vinyl acetate with a melt index of 20; CoMer EVA 501 which is a copolymer of 72% ethylene and 28% vinyl acetate with a melt index of 350; CoMer EVA 505 which is a copolymer of 72% ethylene and 28% vinyl acetate with a melt index of 20; CoMer EVA 605 which is a copolymer of 67% ethylene and 33% vinyl acetate with a melt index of 20; Elvax 150 which is a copolymer of 67% ethylene and 33% vinyl acetate with a melt index of 25; Elvax 240 which is a copolymer of 72% ethylene and 28% vinyl acetate with a melt index of 22-28; Elvax 250 which is a copolymer of 72% ethylene and 28% vinyl acetate with a melt index of 12-18; Elvax 350 which is a copolymer of 75% ethylene and 25% vinyl acetate with a melt index of 16-22; Elvax 40 which is a copolymer of 60% ethylene and 40% vinyl acetate with a melt index of 45 to 70; CoMer DPDA-9169 which is a copolymer of 82% ethylene and 18% ethyl acrylate with a melt index of 20; and the Zetafax resins which are copolymers of ethylene and butyl acrylate. The Ultrathene polymers are available from USI, the CoMer polymers from Union Carbide, the Elvax polymers from Dupont and the Zetafax polymers from Dow Chemical.

The composition also contains from about 25 to 65% by weight and preferably about 35-55% by weight and most preferably about 40-50% by weight of ester of rosin and polyhydric alcohol. The ester has an acid value between about 5 and 40 and most preferably between about 10 and 20, and a melting point range between about 75° and 140°C, and preferably between about 90° and 115°C.

The most preferred melting point is between about 90° and 100°C. The polyhydric alcohol used in forming this ester generally contains from 2 to 6 alcohol groups and is a saturated aliphatic compound.

Some suitable dihydric alcohols include among others the lower glycols such as ethylene glycol, 1,2-propanediol, 1,3-propanediol, diethylene glycol, triethylene glycol, tetraethylene glycol, hexamethylene gly-

col, 1,3-butanediol, 1,4-butanediol, and 2,3-butanediol. Some suitable alcohols which contain from 3 to 6 alcohol groups include glycerol, trimethylol propane, trimethylolethane, pentacrythritol, and hexitols, such as mannitol and sorbitol

Of course, mixtures of alcohols may be employed in preparing this ester. One such mixture is Sutro 250 which is available from Atlas Chemical Industries, Inc., and is a mixture of essentially straight-chain polyhydric alcohols of 3 to 6 carbon atoms. Sutro 250 and other Sutro polyhydric alcohols are described in Industrial Polyol Bulletin LG-93 Rev. 4M-11/66, Sutro Polyols, Atlas Chemical Industries, Inc., Chemicals Division, Wilmington, Del., 19899, which is incorporated herein by reference.

The preferred polyhydric alcohol is pentaerythritol. The rosin employed is generally a wood or tall oil rosin.

The ester may be prepared, for instance, by reacting 100 parts of the rosin and about 6 to 15 parts by weight of the alcohol such as pentaerythritol in the presence of a metallic catalyst at elevated temperature of 200°-250°C until the desired acid value is reached.

The hot melt composition also contains from about 10 to 50%, preferably about 20-45%, and more preferably about 25-35% by weight of ester of polyhydric alcohol and dimer and/or trimer of aliphatic ethylenically unsaturated monocarboxylic fatty acid having 16-22 carbon atoms. Correspondingly, the dimer contains 32-44 carbon atoms and the trimer contains 48-66 carbon atoms. The preferred dimers and trimers are the dimers and trimers of oleic acid and/or linoleic acid. The most preferred dimers and trimers are the dimers and trimers of tall oil fatty acids.

Also the dimer and/or trimer may be employed as a mixture with such other materials as monomeric aliphatic ethylenically unsaturated monocarboxylic fatty acids having 16-22 carbon atoms, polymeric forms of the monomeric aliphatic ethylenically unsaturated monocarboxylic fatty acids higher than trimer, rosin acids, and dimerized rosin. Preferably the dimer and/or trimer is employed as a mixture with rosin acids and dimerized rosin. When employing a mixture it should contain at least 20% by weight of the dimer and/or trimer and/or higher polymers of the acids. Such mixtures are commercially available. Of particular importance is Emtall 664 available from Emery Industries, Inc., Cincinnati, Ohio. This mixture according to Emery contains about 25-30% by weight of dimer and/or higher polymers of tall oil fatty acids and about 40-55% by weight of rosin acids. The rosin acids include both monomeric and polymeric forms of the acid. The remainder is fatty acids having an average chain length of about 18 carbon atoms or higher, and unsaponifiables. Another commercially available material is Fatty Acid 7002 available from Arizona Chemical. This mixture contains about 45% by weight of dimerized tall oil fatty acids, 25% by weight of trimerized and higher polymers of tall oil fatty acids, 6% of C<sub>20</sub> fatty acids, 13% of rosin acids, 2% of unsaponifiables, and 7% of C<sub>18</sub> fatty acids. In addition, conventionally supplied pure dimer or trimer acids or mixtures thereof may be employed in the preparation of this ester. The polyhydric alcohol used in forming this ester generally contains from 2 to 6 alcohol groups.

Some suitable dihydric alcohols include among others the lower glycols such as ethylene glycol, 1,2-propanediol, 1,3-propanediol, diethylene glycol, trieth-

ylene glycol, tetraethylene glycol, hexamethylene glycol, 1,3-butanediol, 1,4-butanediol, and 2,3-butanediol. Some suitable alcohols which contain from 3 to 6 alcohol groups include glycerol, trimethylolpropane, trimethylolethane, pentaerythritol, dipentaerythritol, and hexitols, such as mannitol and sorbitol. Of course, mixtures of alcohols of the above as well as Sutro 250 may be employed in preparing this ester.

The preferred polyhydric alcohols contain from 3-6 alcohol groups. The most preferred polyhydric alcohols are glycerine and pentaerythritol. This ester should have an acid value between about 8 and 40, and preferably between 10 and 25 and a viscosity of between about 1.0 to 40.0 stokes, preferably 2.0-20.0 stokes, as measured in mineral spirits at a 70% non-volatile concentration.

This ester can be prepared by reacting the dimer and/or trimer or mixture containing the dimer and/or trimer with the polyhydric alcohol under esterification conditions, e.g., 200°-250°C, until the desired acid value is obtained. For instance, the desired ester can be prepared by reacting about 100 parts by weight of the dimer and/or trimer and about 5 to 35 parts by weight of polyhydric alcohol, such as pentaerythritol, in the presence of a calcium acetate catalyst. The reaction mixture is heated to 400°F and held at that temperature for 1 hour. After this the temperature is raised to between about 480° and about 500°F and is held there until the reaction is complete as evidenced by a product having an acid value and viscosity within the desired ranges. The mixture is usually held at the 480° to 500°F temperature range for about 10-15 hours. If desired, the reaction time can be reduced by carrying the reaction out under a partial vacuum of about 15 to 20 inches of Hg. Similarly this dimer and/or trimer ester can be prepared together with the ester of rosin and polyhydric alcohol by adding the dimer and/or trimer, the rosin and polyhydric alcohol together and esterifying.

The various quantities set forth above for the ethylene copolymer, the rosin ester and the dimer and/or trimer ester are based upon the combined weight of these components and not necessarily upon the total composition which may include other ingredients.

The melting point of the ingredients in this invention is a softening point which is determined by a modified mercury drop method.

The hot melt composition of the present invention contains up to about 70% by weight of a solid filler material based upon the total composition. Preferably the composition contains between about 40 and 60% by weight of the solid filler material based upon the total composition. Some suitable solid fillers are calcium carbonate, clay, and talc. Calcium carbonate is the preferred filler. One feature of the present invention is the ability to incorporate such large quantities of solid filler material into the composition without detracting from the coating properties of the composition to such an extent as to render the composition unsuitable for its intended purpose. Flame retardant fillers may also be employed to improve the flame retardant properties of the carpet. Such fillers are sold under the trade designation of Phosgard obtainable from Monsanto and Firmaster obtainable from Michigan Chemical.

The composition of the present invention may also contain up to about 2% by weight and preferably from about 0.1 to 1% by weight of an antioxidant based upon

the total composition. Some suitable antioxidants include 2,2'-methylene bis (4-methyl-6-tert.butylphenol), 2,4,6-tri-tert.butylphenol, 2,6-di-tert.butyl-4-methylphenol, 4,4'-thio-bis (-6-tert.butyl-m-cresol), butylated hydroxy anisole, and butylated hydroxy toluene. The preferred antioxidant is 2,2'-methylene bis (4-methyl-6-tert.butylphenol).

The hot melt compositions of the present invention provide excellent adhesion between the pile loops and the primary backing and between the secondary backing and the carpet. This excellent adhesion can be observed from the force in pounds required to pull one of the pile loops loose from the primary backing and from the amount of force in pounds required to separate the secondary backing from the carpet.

In addition the compositions exhibit surprisingly high flexibility, elongation and tensile properties. Also the hot melts of the present invention are surprisingly soft as compared to ethylene/vinyl acetate copolymer compositions containing wax, thus facilitating the coating procedure. Moreover the compositions of the present invention are less likely to support combustion than are various wax containing hot melt compositions. Therefore, they are much safer to use.

Unlike the wax containing hot melt compositions, the present compositions are quite compatible and are not opaque at elevated temperatures. This high compatibility between the components of the present invention greatly diminishes the problem of possible separation of the components of the composition after they have been applied to the substrate and are allowed to age. In addition, the excellent properties of the present compositions are readily reproducible from batch to batch. In the wax containing hot melt compositions however it is quite difficult to reproduce a uniform product in that small changes in the melting point of the wax drastically vary the coating characteristics of the composition.

Surprisingly, the compositions of the present invention demonstrate their excellent adhesion properties when applied to polyolefin substrates such as polyethylene and polypropylene. Polyolefin fibers and/or secondary backings have not been commercially employed to the extent desired because of the difficulty in finding adhesive compositions suitable for adhering polyhydric substrates to other substrates or to each other. The present compositions however surprisingly are excellent adhesives for these polyolefin substrates.

The hot melt compositions of the present invention can be prepared by any of the conventional means by which two or more ingredients are brought into intimate contact with each other. For example, the ester of the polyhydric alcohol and rosin; the ester of the polyhydric alcohol and the dimer and/or trimer; and the antioxidant, if used, are added to a mixing vessel which is blanketed in a nitrogen atmosphere. The mixture is then heated to about 350°F. The copolymer of ethylene and vinyl acetate and/or C<sub>1</sub>-C<sub>18</sub> alkyl acrylate is then slowly added with stirring to the heated mixture. The stirring is continued at this temperature until a clear melt forms. The filler, if used, can then be added to the mixture slowly with stirring until thoroughly dispersed therein. The molten mixture can then be pumped directly to a carpet coating apparatus or can be cooled for storage and used at some later time.

The composition of the present invention can be applied to the particular substrate by any of the well

known methods of applying coatings of molten adhesives. For example, the hot melt coating can be applied by extrusion, a heated doctor blade, or by passing the bottom surface of the tufted material in contact with the top surface of a rotating roller partially submerged in a tank of the molten adhesive. It is convenient to employ a doctor blade in order to control the thickness of the adhesive on the roller.

The carpets prepared according to the present invention are useful wherever carpets are used, for example, on floors and on stairways in homes, restaurants, hotels, office buildings, and in passenger sections of ships, trains, airplanes, and automobiles.

The composition is applied to the carpet in amounts ranging from about 6 to about 40 ounces per square yard of carpet and preferably from about 12–28 ounces per square yard and at a temperature of about 160°F and 375°F. It is, of course, understood that the temperature must be maintained so that melting or decomposition of the textile backings and fibers do not occur, and must be substantially above the melting point of the coating composition. From about 15 to 80 feet of carpet per minute can be coated with the composition of the present invention.

In order to better understand the present invention, the following examples are given in which all quantities are by weight unless the contrary is set forth:

#### EXAMPLE A

##### Preparation of Ester of Rosin and Pentaerythritol

910 parts of tall oil rosin, 90 parts of pentaerythritol, and 0.5 parts of oxalic acid are charged to a reactor and heated to 250°C. The reactor is fitted for esterification. The reaction is continued until an acid value of 35 is reached. Vacuum is then applied until the acid value is less than 20. The material is cooled to 200°C and filtered into a cooling pan. The ester has an acid value of 7.5, a viscosity of 1.2 stokes in toluene at 70% non-volatiles, and a Gardner color of 12+.

#### EXAMPLE B

##### Preparation of Ester of Emtall 664 and Sutro 250

325 parts of Emtall 664 and 47 parts of Sutro 250 are charged to a reactor fitted for esterification and heated to 400°F. The reaction is continued for 3 hours until an acid value of 12.4 is reached. The material is cooled to room temperature for use in the hot melt compositions.

#### EXAMPLE C

##### Preparation of Ester of Pentaerythritol and Mixture Containing Dimerized Tall Oil Fatty Acids

936 parts of Emtall 664, 114 parts of pentaerythritol, and 0.17 parts of a calcium acetate catalyst are charged to a reactor which is blanketed in a nitrogen atmosphere. The reaction mixture is then heated to 200°C and held at that temperature for 1 hour. The temperature is then raised to between about 250°C and about 271°C and is held there for about 15 hours, at which time the reaction is complete. The ester has an acid value of 12–18, a viscosity of 2.5–4.0 stokes in mineral spirits at 70% non-volatiles, and a Gardner color of 9–12.

#### EXAMPLE D

##### Preparation of Ester of Pentaerythritol, Ethylene Glycol, and Mixture Containing Dimerized and Trimerized Tall Oil Fatty Acids

1500 parts of Fatty Acids 7002, 90 parts of pentaerythritol, and 47 parts of ethylene glycol are charged to a reaction vessel fitted for esterification. The reaction mixture is heated to 365°F where water begins to distill and then to 465°–485°F over a period of 4–5 hours. The reaction mixture is cooled slowly to room temperature. The ester has an acid value of 24 and a viscosity of 19.0 stokes in mineral spirits at 70% non-volatiles.

#### EXAMPLE E

##### Preparation of Ester of Glycerine and Mixture Containing Dimerized and Trimerized Tall Oil Fatty Acids

1500 parts of Fatty Acids 7002 and 132.8 parts glycerine are charged to a reaction vessel which is blanketed in a nitrogen atmosphere. The reaction mixture is then heated to 440°–460°F and held at that temperature for 3–4 hours. The reaction product has an acid value of 17.2, a viscosity of 9.0 stokes in mineral spirits at 70% non-volatiles, a color of 13+.

#### EXAMPLE 1

The raw tufted carpet is a shag carpet composed of a jute base fabric weighing about 10 ounces/yard<sup>2</sup> and tufted with about 14 ounces/yard<sup>2</sup> of bulked continuous filament nylon carpet yarn which is needled into the base fabric at 6 needles per inch across the width of the base fabric and about 6 stitches per running inch of base fabric. The tuft loops extend ¼ inch above the base fabric and the tufted bases extend 1/16 inch below the base fabric. The secondary backing material is woven polypropylene weighing about 3.5 ounces/yard<sup>2</sup>.

The raw tufted carpet is passed under and adjacent to an extruder where the bottom (non-pile) surface is coated with about 24 ounces/yard<sup>2</sup> of a molten coating composition at a temperature of 350°F and having the following formula:

	Parts
Copolymer of 67% ethylene and 33% vinyl acetate, having an inherent viscosity of 0.74 (0.25% in toluene at 86° F), a melt index of 20 (ASTM-D-1238-577), and a softening point of 220°F (ring and ball) (CoMer 605)	12.0
Ester from Example A	24.0
Ester from Example C	13.8
2,2'-methylene bis(-4-methyl-6-tert.butylphenol)	0.2
CaCO <sub>3</sub> (No. 1 White)	50.0

The molten composition which is kept at 350° F is forced through the extruder head onto the back of the raw tufted carpet as it passes by the extruder head. The carpet then passes underneath a heated doctor blade which evenly distributes any excess adhesive that may be present. The carpet then passes between two rollers at which point the secondary backing material from the upper roll is applied to the back side of the carpet. The carpet is then passed into a forced-air cooling section 10 feet in length to set the coating composition. The

primary backing of jute and the secondary backing material are firmly bonded to each other, and the base of each loop in the pile is firmly bonded to the primary backing. A pull of 26 pounds is required to pull one of the pile loops loose from the primary backing. The carpet has a T "peel" of about 25-27 pounds. In addition the carpet demonstrated excellent resistance to delamination when subjected to repeated bending and straightening.

In addition the percent elongation of a 40 mil film of the composition is greater than 600 percent as measured on an Instron Tensile Tester.

#### EXAMPLE 2

Example 1 is repeated except that the coating composition has the following formula:

	Parts	
Copolymer of 72% ethylene and 28% vinyl acetate, having an inherent viscosity of .54 (0.25% in toluene at 36° F), a melt index of 350 (ASTM-D-1238-577) and a softening point of 180°F (ring and ball) (CoMer EVA 501)	2.0	20
Copolymer of 67% ethylene and 33% vinyl acetate, having an inherent viscosity of .74 (0.25% in toluene at 86° F), a melt index of 20 (ASTM-D-1238-577) and a softening point of 220°F (ring and ball) (CoMer EVA 605)	1.0	25
Copolymer of 82% ethylene and 18% ethyl acrylate having an inherent viscosity of .81 (0.25% in toluene at 36° F), a melt index of 51 (ASTM-D-1238-577) and a softening point of 307°F (ring and ball) (CoMer DPD 9169)	9.0	30
Ester from Example A	24.0	35
Ester from Example C	13.8	
2,2'-methylene bis (-4-methyl-6-tert. butylphenol)	0.2	
CaCO <sub>3</sub> [No. 1 White]	50.5	

The primary backing of jute and the secondary backing of polypropylene are firmly bonded to each other, and the base of each loop in the pile is firmly bonded to the primary backing. A pull of 32 pounds is required to pull one of the pile loops loose from the primary backing. The carpet has a T "peel" of about 20-23 pounds. In addition the carpet demonstrates excellent resistance to delamination when subjected to repeated bending and straightening.

In addition the percent elongation of a 40 mil film of the coating composition is greater than 600 % as measured on an Instron Tensile Tester.

#### EXAMPLE 3

Example 1 is repeated except that the coating composition has the following formula:

	Parts	
Copolymer of 67% ethylene and 33% vinyl acetate, having an inherent viscosity of .78 (0.25% in toluene at 86° F), a melt index of 250 (ASTM-D-1238-577), and a softening point of 240°F (ring and ball) (Elvax 150)	12.0	60
Ester from Example A	22.0	
Ester from Example C	13.4	
2,2'-methylene bis (-4-methyl-6-tert. butylphenol)	0.4	65
CaCO <sub>3</sub> (No. 1 White)	52.2	

The primary backing of jute and the secondary backing of polypropylene are firmly bonded to each other, and the base of each loop in the pile is firmly bonded to the primary backing. A pull of 20-25 pounds is required to pull one of the pile loops loose from the primary backing. The carpet has a T "peel" of about 25 pounds. In addition the carpet demonstrated excellent resistance to delamination when subjected to repeated bending and straightening.

#### EXAMPLE 4

Example 1 is repeated except that the coating composition has the following formula:

	Parts
Copolymer of 72% ethylene and 28% vinyl acetate, having an inherent viscosity of .86 (0.25% in toluene at 86° F), a melt index of 24 (ASTM-D-1238-577), and a softening point of 242°F (ring and ball) (Ultrathene 636)	24.9
Ester from Example A	46.3
Ester from Example C	28.1
2,2'-methylene bis (-4-methyl-6-tert. butylphenol)	0.7
CaCO <sub>3</sub> (No. 1 White)	100.0

The primary and secondary backing of jute materials are firmly bonded to each other, and the base of each loop in the pile is firmly bonded to the primary backing. A pull of 20-25 pounds is required to pull one of the pile loops loose from the primary backing. The carpet as a T "peel" of about 20 pounds. In addition the carpet demonstrated excellent resistance to delamination when subjected to repeated bending and straightening.

#### EXAMPLE 5

Example 1 is repeated except that the coating composition has the following formula:

	Parts
Copolymer of 72% ethylene and 28% vinyl acetate, having an inherent viscosity of 0.86 (0.25% in toluene at 86° F), a melt index of 24 (ASTM-D-1238-577), and a softening point of 212°F (ring and ball) (Ultrathene 636X)	25.0
Ester from Example A	56.0
Ester from Example E	19.0
2,2'-methylene bis (-4-methyl-6-tert. butylphenol)	0.75
CaCO <sub>3</sub> (No. 1 White)	100.0

The primary backing of jute and the secondary backing of polypropylene are firmly bonded to each other, and the base of each loop in the pile is firmly bonded to the primary backing. A pull of 25 pounds is required to pull one of the pile loops loose from the primary backing. The carpet has a T "peel" of about 20 pounds. In addition the carpet demonstrated excellent resistance to delamination when subjected to repeated bending and straightening.

In addition the percent elongation of a 40 mil film of the coating composition is greater than 630 percent as measured on an Instron Tensile Tester.

## EXAMPLE 6

Example 1 is repeated except that the secondary backing material is jute weighing about 10 ounces/yard<sup>2</sup>.

The primary and secondary backing materials are firmly bonded to each other, and the base of each loop in the pile is firmly bonded to the primary backing. The carpet has a T peel of more than 50 pounds. In addition the carpet demonstrated excellent resistance to lamination when subjected to repeated bending and straightening.

## EXAMPLE 7

Example 2 is repeated except that the secondary backing material is jute weighing about 10 ounces/yard<sup>2</sup>.

The primary and secondary backing materials are firmly bonded to each other, and the base of each loop in the pile is firmly bonded to the primary backing. The carpet has a T peel of about 50 pounds. In addition the carpet demonstrated excellent resistance to delamination when subjected to repeated bending and straightening.

## EXAMPLE 8

Example 1 is repeated except that the secondary backing material is non-woven polyester/polypropylene weighing about 4.2 ounces/yard<sup>2</sup>.

The primary and secondary backing materials are firmly bonded to each other, and the base of each loop in the pile is firmly bonded to the primary backing. The carpet has a T peel of about 25-30 pounds. In addition the carpet demonstrated excellent resistance to delamination when subjected to repeated bending and straightening.

## EXAMPLE 9

Example 2 is repeated except that the secondary backing is non-woven polyester-polypropylene weighing about 4.2 ounces/yard<sup>2</sup>.

The primary and secondary backing materials are firmly bonded to each other, and the base of each loop in the pile is firmly bonded to the primary backing. The carpet has a T peel of about 18-20 pounds. In addition the carpet demonstrated excellent resistance to delamination when subjected to repeated bending and straightening.

## EXAMPLE 10

Example 3 is repeated except that the secondary backing material is jute weighing about 10 ounces/yard<sup>2</sup>.

The primary and secondary backing materials are firmly bonded to each other, and the base of each loop in the pile is firmly bonded to the primary backing. The carpet has a T peel of about 25-30 pounds. In addition the carpet demonstrated excellent resistance to delamination when subjected to repeated bending and straightening.

## EXAMPLE 11

Example 3 is repeated except that the secondary backing material is non-woven polyester/polypropylene weighing about 4.2 ounces/yard<sup>2</sup>.

The primary and secondary backing materials are firmly bonded to each other, and the base of each loop in the pile is firmly bonded to the primary backing. The carpet has a T peel of about 30 pounds. In addition the carpet demonstrated excellent resistance to delamination when subjected to repeated bending and straightening.

## EXAMPLE 12

Example 4 is repeated except that the secondary backing is non-woven polyester/polypropylene weighing about 4.2 ounces/yard<sup>2</sup>.

The primary and secondary backing materials are firmly bonded to each other, and the base of each loop in the pile is firmly bonded to the primary backing. The carpet has a T peel of about 45 pounds. In addition the carpet demonstrated excellent resistance to delamination when subjected to repeated bending and straightening.

## EXAMPLE 13

Example 4 is repeated except that the secondary backing material is jute weighing about 10 ounces/yard<sup>2</sup>.

The primary and secondary backing materials are firmly bonded to each other, and the base of each loop in the pile is firmly bonded to the primary backing. The carpet has a T peel of about 25-35 pounds. In addition the carpet demonstrated excellent resistance to delamination when subjected to repeated bending and straightening.

## EXAMPLE 14

Example 5 is repeated except that the secondary backing material is non-woven polyester/polypropylene weighing about 4.2 ounces/yard<sup>2</sup>.

The primary and secondary backing materials are firmly bonded to each other, and the base of each loop in the pile is firmly bonded to the primary backing. The carpet has a T peel of greater than 30 pounds. In addition the carpet demonstrated excellent resistance to delamination when subjected to repeated bending and straightening.

## EXAMPLE 15

Example 5 is repeated except that the secondary backing material is jute weighing about 10 ounces/yard<sup>2</sup>.

The primary and secondary backing materials are firmly bonded to each other, and the base of each loop in the pile is firmly bonded to the primary backing. The carpet has a T peel of more than 30 pounds. In addition the carpet demonstrated excellent resistance to delamination when subjected to repeated bending and straightening.

## COMPARISON EXAMPLE 16

Example 1 is repeated except that the coating composition has the following formula:

	Parts
Copolymer of 67% ethylene and 33% vinyl acetate having an inherent viscosity of .78 (0.25% in toluene at 86° F), a melt index of 25 (ASTM-D-1238-577) and a softening point of 240°F (ring and ball) (ELVAX 150)	14.0
Rosin WW (Available from Tenneco)	30.6
Polypale (Available from Picco)	8.2
2,2'-methylene bis (-4-methyl-6-tert.butylphenol)	0.2
CaCO <sub>3</sub> (No. 1 White)	30.0
Wax — Parafint RG Fisher-Tropsch wax having a melting point of 215° F	17.0

A pull of 18 pounds is required to pull one of the pile loops loose from the primary backing. The carpet has a T peel of about 1.5 pounds. The carpet demonstrated considerable delamination when subjected to repeated bending and straightening. The percent elongation of a 40 mil film of the coating composition is only 30.

#### COMPARISON EXAMPLE 17

Example 1 is repeated except that the coating composition has the following formula:

	Parts
Copolymer of 67% ethylene and 33% vinyl acetate having an inherent viscosity of .78 (0.25% in toluene at 86° F), a melt index of 25 (ASTM-D-1238-577) and a softening point of 240°F (ring and ball) (ELVAX 150)	14.0
Rosin WW (Available from Tenneco)	38.3
2,2'-methylene bis (-4-methyl-6-tert.butylphenol)	0.3
Barium sulfate	30.0
Wax — Parafint RG Fisher-Tropsch wax having a melting point of 215° F	17.4

A pull of 23 pounds is required to pull one of the pile loops loose from the primary backing. The carpet has a T peel of about 3.5 pounds. The carpet demonstrated considerable delamination when subjected to repeated bending and straightening. The percent elongation of a 40 mil film of the coating composition is only 200.

#### COMPARISON EXAMPLE 18

Example 1 is repeated except that the coating composition has the following formula:

	Parts
Copolymer of 72% ethylene and 28% vinyl acetate having an inherent viscosity of .85 (0.25% in toluene at 86° F), a melt index of 15 (ASTM-D-1238-577) and a softening point of 280°F (ring and ball) (ELVAX 250)	17.5
Rosin WW (Available from Tenneco)	40.8
2,2'-methylene bis (-4-methyl-6-tert.butylphenol)	0.2
CaCO <sub>3</sub> No. 1 White)	30.0
Wax — Parafint RG Fisher-Tropsch wax having a melting point of 215° F	11.5

A pull of 25 pounds is required to pull one of the pile loops loose from the primary backing. The carpet has

a T peel of about 3.5 pounds. The carpet demonstrated considerable delamination when subjected to repeated bending and straightening. The percent elongation of a 40 mil film of the coating composition is 365.

#### COMPARISON EXAMPLE 19

Example 1 is repeated except that the coating composition has the following formula:

	Parts
Copolymer of 67% ethylene and 33% vinyl acetate having an inherent viscosity of .78 (0.25% in toluene at 86° F), a melt index of 22-28 (ASTM-D-1238-577) and a softening point of 240°F (ring and ball) (ELVAX 150)	10.0
Rosin WW (Available from Tenneco)	21.8
Polypale (Available from Picco)	5.9
2,2'-methylene bis (-4-methyl-6-tert.butylphenol)	0.2
CaCO <sub>3</sub> (No. 1 White)	50.0
Wax — Parafint RC Fisher-Tropsch wax having a melting point of 215° F	12.1

A pull of 25 pounds is required to pull one of the pile loops loose from the primary backing. The carpet has a T peel of about 2 pounds. The carpet demonstrated considerable delamination when subjected to repeated bending and straightening. The percent elongation of a 40 mil film of the coating composition is 40.

#### COMPARISON EXAMPLE 20

Example 16 is repeated except that the secondary backing is jute weighing about 10 ounces/yard<sup>2</sup>.

The carpet has a T peel of about 30 pounds. The carpet demonstrated considerable delamination when subjected to repeated bending and straightening.

#### COMPARISON EXAMPLE 21

Example 17 is repeated except that the secondary backing is jute weighing about 10 ounces/yard<sup>2</sup>.

The carpet has a T peel of about 8 pounds. In addition the carpet demonstrated considerable delamination when subjected to repeated bending and straightening.

#### COMPARISON EXAMPLE 22

Example 18 is repeated except that the secondary backing is jute weighing about 10 ounces/yard<sup>2</sup>.

The carpet has a T peel of about 35 pounds. In addition the carpet demonstrated considerable delamination when subjected to repeated bending and straightening.

#### COMPARISON EXAMPLE 23

Example 19 is repeated except that the secondary backing is jute weighing about 10 ounces/yard<sup>2</sup>.

The carpet has a T peel of about 23 pounds. In addition the carpet demonstrated considerable delamination when subjected to repeated bending and straightening.

#### COMPARISON EXAMPLE 24

Example 16 is repeated except that the secondary backing is non-woven polyester/polypropylene weighing about 4.2 ounces/yard<sup>2</sup>.

The carpet has a T peel of about 6.5 pounds. In addition the carpet demonstrated considerable delamina-

tion when subjected to repeated bending and straightening.

COMPARISON EXAMPLE 25

Example 17 is repeated except that the secondary backing is non-woven polyester-polypropylene weighing about 4.2 ounces/yard<sup>2</sup>.

The carpet has a T peel of about 7 pounds. In addition the carpet demonstrates considerable delamination when subjected to repeated bending and straightening.

COMPARISON EXAMPLE 26

Example 18 is repeated except that the secondary backing is non-woven polyester-polypropylene weighing about 4.2 ounces/yard<sup>2</sup>.

The carpet has a T peel of about 10 pounds. In addition the carpet demonstrated considerable delamination when subjected to repeated bending and straightening.

COMPARISON EXAMPLE 27

Example 19 is repeated except that the secondary backing is non-woven polyester-polypropylene weighing about 4.2 ounces/yard<sup>2</sup>.

The carpet has a T peel of about 4 pounds. In addition the carpet demonstrated considerable delamination when subjected to repeated bending and straightening.

The pull required to pull one of the pile loops loose from the primary backing is determined by attaching a sample of the carpet to a Chatillon tension tester. The pile is pulled at 12 inches/min. until it pulls out and the value in pounds is recorded from the tester. The above procedure is repeated five more times and the average of the six tests is used as the value.

The T-Peel is determined by attaching a sample of the carpet having about 4 inches of laminated surface in an Instron Tensile Tester and pulling at 12 inches/min. the sample apart at an angle of 180°.

A comparison of Examples 1-15 with 16-27 clearly establishes that the compositions of the present invention possess unexpectedly excellent adhesive properties, particularly when applied to a polyolefin containing substrate.

What is claimed is:

1. A process for backsizing a tufted carpet having a

primary textile backing and non-woven tufts of synthetic fibers protruding therefrom which comprises:

a. heating to about 160° F. to about 375° F. a hot melt coating composition consisting essentially of:

1. copolymer of ethylene and unsaturated ester monomer selected from the group consisting of vinyl acetate, alkyl acrylate wherein the alkyl group contains 1 - 18 carbon atoms, and mixtures thereof, containing from 40 - 85% by weight of ethylene and from 15 - 60% by weight of said unsaturated ester monomer;

2. ester of rosin and polyhydric alcohol wherein the ester has an acid value between about 5 and about 40, and melting point range between 75° and 140° C.; and

3. ester of polyhydric alcohol and dimer and/or trimer or mixture thereof, of ethylenically unsaturated monocarboxylic fatty acid having 16 - 22 carbon atoms, wherein said ester has an acid value of 6 to 40;

b. applying a uniform coating in an amount from about 6 to 40 ounces per square yard of said composition in a molten state to the back side of said carpet at a coating station while moving said carpet past said coating station at a speed of from about 15 to 80 feet per minute; and

c. thereafter solidifying said coating by cooling it below its melting point.

2. A tufted carpet comprising:

a. a primary textile backing;

b. tufts of textile fibers protruding from said primary textile backing and forming the surface of the carpet;

c. a secondary textile backing adjacent to the backside of said primary textile backing; and

d. the hot melt coating composition of claim 1 being interposed between said primary and secondary backings.

3. The carpet of claim 2 wherein at least one of the backings or fibers is a polyolefin.

4. The carpet of claim 3 wherein said polyolefin is polypropylene.

5. The carpet of claim 2 wherein said secondary backing is a polyolefin.

6. The carpet of claim 5 wherein said polyolefin is polypropylene.

\* \* \* \* \*

50

55

60

65