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54 **All-polyamide carpet construction.**

57 The present invention is directed to a carpet construction in which the primary components -- tufts, backing(s) and adhesive -- are all formed from a polyamide. Carpet samples such as used carpet or carpet scraps having this construction are easily recyclable into a polyamide blend which can function as a substitute for virgin polyamides in a variety of applications.

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BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is directed to a carpet construction. More specifically, the present invention is directed to a carpet construction wherein each primary component (backing[s], tufts and adhesive) is formed of a polyamide. Use of all polyamide materials results in a carpet construction which is more easily recyclable into a polyamide blend.

2. Description of the Prior Art

For many years, disposal of waste materials has been conducted in ways detrimental to the environment. It has been burned in massive incinerators thereby polluting the air. It has been dumped in the ocean thereby contaminating the water supply. It has been buried in landfills where it collects without decomposing for years.

In recent times, individuals and corporations alike have expended significant effort on identifying environmentally responsible methods for disposing of waste products from synthetic materials such as man-made polymeric materials. One important direction taken along this line is the development of programs for collecting the synthetic waste materials for recycling and re-use in other products or applications.

The flooring industry, including commercial and residential carpet and tile manufacturers, has actively participated in investigating the applicability of recycling for their products; however, some of these products present particularly difficult challenges to recycling efforts since they are typically manufactured from components formed from different synthetic materials which have different physical and chemical characteristics. For example, conventional nylon carpeting typically includes a plurality of tufts formed from nylon fibers, at least one backing formed from a polyolefin such as polypropylene and a calcium carbonate-filled adhesive material of styrene-butadiene rubber (SBR) originally applied as a latex.

The success of attempts to recycle such multi-component products has been severely limited. For example, U.S. Patent Nos. 4,158,646 and 5,145,617 disclose methods for reprocessing fiber-containing waste materials wherein the process results in a fiber-containing final product. These types of processes are restricted in utility to the limited application where composite (fiber/matrix) materials are useful.

Other processes focus on separating out the individual components. Specifically, efforts in reclaiming or recycling carpet materials, such as

those disclosed in U.S. Patent Nos. 4,028,159, and 5,169,870, involve separating the individual materials through various processing steps and recovering the material for re-use. These methods, while effective in reclaiming individual synthetic materials, are extremely expensive to the extent of often being cost prohibitive. Further, the additional energy required to effect the necessary processing steps at least partially reduces the environmental advantage of recycling or reclaiming.

A need therefore exists for a carpet construction which is economically and readily recyclable without the disadvantages described above.

15 **BRIEF SUMMARY OF THE INVENTION**

The present invention satisfies this need for a economically recyclable carpet construction and achieves the advantages set forth below by providing a carpet construction wherein each of the primary components -- tufts, backing(s) and adhesive -- is formed of a polyamide. Because all of the components share the same chemical polymeric basis (i.e., polyamide), carpet samples, such as used carpet or carpet scraps, are readily recyclable into a polyamide blend by conventional blending and processing procedures. The resulting blend is an effective substitute for virgin polyamide.

30 **BRIEF DESCRIPTION OF THE DRAWINGS**

FIG 1 is a side elevational view of a sample of the carpet construction of the present invention.

35 **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

As shown in FIG 1, carpet of the present invention includes three primary components: (1) at least one backing material 10; (2) a plurality of tufts 15; and (3) an adhesive 20. Preferably, the carpet includes a primary backing 25 and a secondary backing 30. A plurality of tufts 15 which make up the carpet pile 50 extend outwardly from the primary backing 25 and are formed from pile yarn 55 which is stitched into the primary backing 25. Adhesive 20 is applied between the primary backing 25 and the secondary backing 30 to bond the secondary backing 30 to the primary backing 20 and also to bond the pile yarn 55 to the primary backing 20.

Each of these components is formed from a polyamide. The term polyamide, as utilized herein, is defined to be any long-chain polymer in which the linking functional groups are amide (-CO-NH-) linkages.

The polyamides of the present invention are also defined to be "melt processable" i.e. having a

degradation temperature sufficiently above the melting point temperature such that the polyamide does not substantially degrade at the melt point temperature.

The term polyamide is further defined to include copolymers, terpolymers and the like as well as homopolymers and also includes blends of two or more polyamides.

As set forth above, the tufts 15, which extend outwardly from a backing 10 to form the carpet pile 50, are formed by stitching the pile yarn 55 into a backing 10. In the carpet construction of the present invention, this backing is formed of a first polyamide. The specific polyamide selected for use as the primary backing is dependent upon the desired characteristics for the primary backing, such as dimensional stability and may be the same as or different from that selected for the tufts. A preferred polyamide for use as the backing material is nylon 66, its copolymers or terpolymers as these provide a desirable combination of limited dimensional stability with useful flexibility; however, other polyamides, including those suitable for tuft application, are suitable for use in the backing.

The backing may be produced in any form conventionally utilized for carpet backings, which are suitable for receiving the pile yarn as it is stitched thereto and which supports the resulting tufts. For example, the backing may be in the form of a woven fabric formed from polyamide fibers or a knitted fabric formed from polyamide fibers. Alternatively, the backing may be in the form of a nonwoven web or fabric formed from polyamide fibers. As the backing will be subjected to increased temperatures during the carpet manufacturing process, it is preferred that the backing, regardless of its form, be stable and resistant to shrinkage or growth at these increased temperatures. Methods for producing these and other forms of carpet backings are well within the scope of the ordinary artisan's skill.

The pile yarn used in forming the carpet of the present invention, and therefore the tufts which make up the carpet pile, is formed from fibers comprising a second polyamide. Polyamides conventionally used for fibers and useful in the present invention for fibers in tuft and pile yarn applications include nylon 6 and nylon 6,6, as well as copolymers and terpolymers thereof; however, other polyamides, including those useful in backing applications discussed herein, are within the scope of the present invention.

The polyamide fibers which make up the pile yarn and tufts formed therefrom may also include various additives or modifiers which alter the physical and/or chemical characteristics of the carpet. For example, the polymer from which the fibers are made may have blended therewith an antimicrobial

compound such as zinc oxide; an organic or inorganic pigment; a delusterant such as titanium dioxide; or a polymeric modifier such as polyethylene glycol.

The tufts which make up the carpet pile may also include various chemical agents on their surfaces which enhance their performance. Such treating agents include conventional fluorochemicals for reducing wettability of the tufts and increasing soil resistance and sulfonated condensation products or stainblockers which impart acid dye stain resistance to the tufts. The tufts may also be dyed with known dyes useful for dyeing polyamide fibers.

The tufts may be formed by any conventional process, using staple or BCF (bulked continuous filament) yarn. If a staple product is desired, the staple fibers are then typically spun into a yarn, plied, heatset, and then tufted. BCF yarns are typically plied, heatset and then tufted. The tufts may also be made from yarns which are not plied or heat set.

An adhesive 20 is utilized to bond or lock the pile yarn 55 into the backing 10. In the carpet construction of the present invention, this adhesive is formed from a third polyamide. A preferred polyamide adhesive is a meltable polyamide adhesive, most preferably having a melting point of between about 115°C and about 180°C. Such adhesives are commercially available and are exemplified by an adhesive available from EMS-American Grilon, Inc. under the trade name GRIL-TEX®. The preferred meltable polyamide may be applied in various forms, including, for example, film, hot melt, solution or latex. The adhesive may also contain conventional additives or fillers such as calcium carbonate and the like.

Preferably, the adhesive described above can also function as a binding means to adhere a secondary backing 30 to the backing 10. In this embodiment, the backing 10 is referred to as a primary backing 25. This secondary backing provides additional support for the final carpet construction as well as dimensional stability. In the preferred carpet construction of the present invention, the secondary backing 30 is formed from a fourth polyamide. The form of the secondary backing 30 may be any form which provides the functions described above; however, the woven fabric, knit fabric and non-woven web forms listed above as preferred forms of the backing 10 are also preferred forms for the secondary backing. The polyamide utilized in forming the secondary backing may be the same as or different from those utilized for the tufts or primary backing.

The carpet construction of the present invention, because of the physical and chemical similarity of the materials from which its primary components are formed, provides a carpet which is re-

cyclable in its entirety (i.e., without separation into its individual components). For example, the carpet of the present invention, or samples of the carpet such as used carpet or carpet scraps, is melt processable by conventional melt blending techniques into a polyamide blend including a polymeric component having a single, homogeneous phase. In such a melt blending step, the polyamides selected for the components of the carpet of the present invention can typically undergo amide interchange. Amide interchange is defined as the exchange of segments of two polymer molecules which occurs through exchange reactions at the amide group in the polymer main chain. For polyamides of different compositions, these reactions result in the formation of block copolymers and eventually result in the formation of random copolymers if the blend is maintained in the melt form for a sufficient length of time.

This recycled polyamide blend may be used in any application for which virgin polyamide polymers would be useful. For example, a used sample of the carpet of the present invention can be reduced to a workable size and passed through a twin-screw, counter-rotating extruder operating at a temperature and pressure sufficient to melt all of the polyamides utilized in the carpet construction without degrading the polymers. The resulting melt is a blend formed from the components of the carpet construction of the present invention. This blend has physical and chemical properties sufficiently similar to virgin polyamides to permit substitution for virgin polyamides with the recycled blend in many applications. The recycled material may also be blended with virgin polyamide to produce a blend useful in similar applications.

While melt blending is the preferable technique for recycling the materials which make up the carpet of the present invention, it may also be possible to process the carpet by solution blending techniques, wherein the carpet is dissolved in its entirety in a solvent capable of dissolving the polyamides from which the individual carpet components are formed. Examples of suitable solvents include formic acid, concentrated sulfuric acid, and the like. The process would include the above solvent treatment to form a polyamide solution and a subsequent processing step to recover the polyamide in a useful form.

Claims

1. A recyclable carpet construction comprising:
 - (a) a backing material formed from a first polyamide;
 - (b) a plurality of tufts extending outwardly from said backing material, said tufts formed from a pile yarn stitched into said

backing material; wherein said pile yarn is formed from fibers comprising a second polyamide; and

(c) a meltable adhesive binding said pile yarn to said backing wherein said adhesive is formed from a third polyamide.

2. A carpet construction in accordance with claim 1 wherein said tufts are formed from nylon 6,6 or a copolymer or terpolymer thereof.
3. A carpet construction in accordance with claim 1 wherein said tufts are formed from nylon 6 or a copolymer or terpolymer thereof.
4. A carpet construction in accordance with claim 1 wherein said primary backing is in the form of a woven fabric.
5. A carpet construction in accordance with claim 1 wherein said primary backing material is in the form of a nonwoven web.
6. A carpet construction in accordance with claim 1 wherein said adhesive is a meltable adhesive having a melting point temperature of from about 115°C to about 180 ° C.
7. A carpet construction in accordance with claim 1 wherein said backing material is a primary backing material and further comprising a secondary backing material adhered to said primary backing material with said adhesive, said secondary backing material being formed from a fourth polyamide.
8. A carpet construction in accordance with claim 7 wherein said secondary backing material is in the form of a woven fabric.
9. A carpet construction in accordance with claim 7 wherein said secondary backing is in the form of a nonwoven web.
10. A carpet construction in accordance with claim 7 wherein said pile yarn is formed from fibers comprising a second polyamide selected from the group consisting of nylon 6, nylon 6,6 and copolymers and terpolymers thereof; and wherein said primary backing material and said secondary backing material are selected from the group consisting of a woven web and a non-woven web.
11. A recyclable carpet construction comprising:
 - (a) a primary backing material formed from nylon 6,6; wherein said primary backing is in the form of a nonwoven web;

(b) a plurality of tufts extending outwardly from said primary backing material, said tufts formed from a pile yarn stitched into said primary backing material; wherein said pile yarn is formed from fibers comprising nylon 6,6 and wherein said tufts include on their surfaces a sulfonated condensation product and a fluorochemical; 5

(c) a meltable adhesive binding said pile yarn to said primary backing, said adhesive being formed from a polyamide having a melting point of from about 115 °C to about 180 °C; and 10

(d) a secondary backing adhered to said primary backing with said adhesive; wherein said secondary backing is formed from nylon 6,6 and is in the form of a nonwoven web. 15

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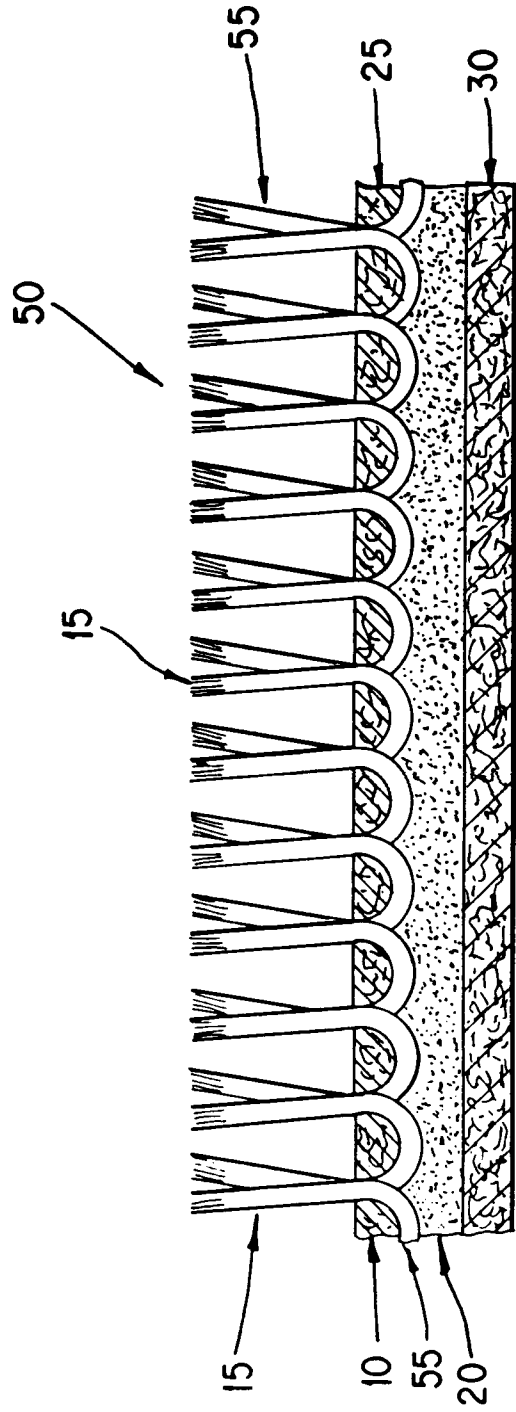


FIG.1



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EUROPEAN SEARCH REPORT

Application Number
EP 94 87 0080

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X	DE-C-41 11 455 (NORDDEUTSCHE FASERWERKE GMBH) * the whole document * ---	1-11	D05C17/02 D06N7/00
X	EP-A-0 529 575 (BASF CORPORATION) * the whole document * ---	1-11	
P,X	WO-A-93 12285 (TARKETT PEGULAN AG) * the whole document * ---	1-11	
A	DE-A-16 85 159 (WEBEREI SCHNEIDER KG) * claims 1,4 * -----	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.5)
			D05C A47G D06N
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 28 July 1994	Examiner D Hulster, E
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application I : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

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