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NON-WOVEN POLYPROPYLENE FABRICS

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3 Claims. (Cl. 161—150)

This invention relates to non-woven products, in particular to non-woven paper-like fabrics composed of stereoregular polyolefine fibres.

It is known to produce felts and non-woven fabrics from artificial, in particular synthetic organic, fibres by processes involving preparation of a mat or batt of intermingled fibres and consolidation of this mat or batt in presence of a binding agent which may be a different fibre, a particulate solid or a solution or dispersion of the binder. It is also known to produce felt-like sheets from mixtures of oriented and unoriented polyester fibres, the latter acting as the binder fibres, as for example is described in British patent specifications 808,287 and 844,760. Such felt-like sheets, however, are not entirely satisfactory because heat treatment, which is usually part of the consolidation process, causes embrittlement of the unoriented polymer fibres leading to a reduced life of the product in use.

I have now found that non-woven paper-like fabrics can be produced without the use of dissimilar binding agents and without the disadvantages attendant upon embrittlement during the manufacturing process.

According to my invention I provide non-woven paper-like fabrics consisting wholly of stereoregular polyolefine fibres comprising at least 10% by weight of undrawn stereoregular polyolefine fibres and up to 90% by weight of drawn stereoregular polyolefine fibres, said undrawn and drawn fibres having the same molecular structure.

The products of this invention are thin coherent sheets which may be transparent, translucent or opaque depending upon the processing conditions, i.e., the proportion of undrawn to drawn fibres used and the presence or absence of pacifiers therein. Paper-like fabrics are also sheet materials but these have a smooth, fibrous appearance.

By undrawn stereoregular polyolefine fibres I mean polyolefine fibres produced by melt or solution spinning of the polymer, not subjected to an additional cold drawing process and having a birefringence of less than 20×10^{-3} and an extension at break of more than 100%.

By drawn stereoregular polyolefine fibres I mean polyolefine fibres which have been oriented substantially fully and which have a birefringence above 25×10^{-3} , an extension at break of less than 70% and a free shrinkage at 140°C. of at least 10%.

Any stereoregular olefine polymer which can be melt or solution spun into fibres, preferably having a denier per filament of less than 10, may be used to produce the non-woven products of this invention. For example linear polyethylene, isotactic or syndiotactic polymers of such olefines as propylene, isobutylene or 4-methyl-pentene-1 and crystalline copolymers of olefines having a stereoregular structure, may be used to produce fibres suitable for use in the invention.

The non-woven paper-like fabrics of this invention are prepared by blending the undrawn and drawn fibres, for example by carding the cut fibres or by other mechanical means if uncut fibres are used, an appropriate mixture, which may contain polyolefine fibres of different chemical composition in the undrawn or drawn forms, of the drawn

and undrawn fibres and hot compressing a mat or batt of the fibres either between the heated platens of a press or continuously by passage one or more times between the heated rollers of a calender. In either case for the production of satisfactory products the pressures should exceed 0.2 ton per square inch or 0.1 ton per inch width for the press and calender respectively. The surface temperature of the platens of the press or the heated bowl or bowls of the calender is dependent upon the polymer or polymers comprising the mat or batt but is suitably about $10\text{--}60^\circ \text{C.}$ below the melting point of the lowest melting component.

I have found, surprisingly that the presence or absence or crimps in the polyolefine fibres used to produce the non-woven products of this invention is unimportant in that satisfactory products of high strength have been produced from fibres having little or no crimp. The products of this invention will have pleasing aesthetic properties and good physical properties, in particular high tear and tensile strengths, find many outlets as for example as packaging materials, wall coverings, carpet backings, reinforcement for plastic articles, electrical insulation or apparel.

The following examples illustrate the invention but do not limit the scope thereof.

EXAMPLE 1

Isotactic polypropylene is melt spun through a 72-hole spinneret held at a temperature of 285°C. and the extruded filaments, wound up at 4,000 feet per minute, have the following properties:

Denier	5.7
Birefringence	19.3×10^{-3}
Tenacity, grams/denier	2.0
Extension at break, percent	330

The filaments are cut to a length of 2 to 4 inches and a batt measuring approximately 4 feet long by 18 inches wide and 0.08 inch thick is prepared by carding.

A coherent, translucent sheet is produced by passing the prepared batt twice through the nip of a calender, one bowl of which is heated to a surface temperature of 135°C. and the other indirectly by contact with the first (upper) roll. The pressure between the two rolls is 0.75 ton per inch width and the rolls are 20 inches wide. The properties of the sheet are;

Thickness (d), cm.	0.020
Weight (w), g. per sq. metre	133
Elmendorf tear strength ¹ kg. per cm. thickness	
(a) across the length of the sheet (T_{S1})	125
(b) across the width of the sheet (T_{S2})	101
Tensile strength ² kg. per sq. cm. cross section	
(a) along the length (T_1)	245
(b) along the width (T_2)	77

¹ A.S.T.M. Standard method D 1424-59.

² Instron tensile tester using a specimen $8 \times 0.5 \text{ cm.}$ and a breaking length of 5 cm.

The sheet is not embrittled by heating between glass plates at 150°C. for 30 minutes.

EXAMPLE 2

Isotactic polypropylene is melt spun through a 72-hole spinneret at 268°C. and the extruded filaments, wound up at 520 feet per minute, have the following properties;

Denier	5.6
Birefringence	1.8×10^{-3}
Tenacity	1.1
Extension	725

A batt of these fibres is prepared as in Example 1 from which a translucent sheet is prepared using one

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passage through a calender operated as in that example.

The product, a coherent translucent sheet through which print may be read easily has the following properties and is not embrittled by treatment for ½ hr. at 150° C.

<i>d</i> -----	0.025
<i>w</i> -----	170
<i>T</i> _{S1} -----	50
<i>T</i> _{S2} -----	39
<i>T</i> ₁ -----	163
<i>T</i> ₂ -----	103

EXAMPLE 3

Undrawn isotactic polypropylene fibres of 1.5–2.5 inches length prepared as in Example 2 are mixed in equal proportions by weight with drawn isotactic polypropylene fibres of 1.5 inches length having the following properties;

Denier -----	5
Birefringence -----	32.5×10 ⁻³
Tenacity -----	7.2
Extension -----	51
Free shrinkage at 140° C. -----	38.2

The batt prepared by carding of the mixture is hot-calendered as in Example 1. A coherent sheet through which print may be read easily is produced having the following properties.

<i>d</i> -----	0.015
<i>w</i> -----	99
<i>T</i> _{S1} -----	114
<i>T</i> _{S2} -----	134
<i>T</i> ₁ -----	218
<i>T</i> ₂ -----	150

EXAMPLE 4

A translucent coherent sheet is produced as in Example 1 from a 1:9 by weight mixture of the undrawn polypropylene fibres of Example 2 with the drawn fibres of Example 3. The film has the following properties;

<i>d</i> -----	0.010
<i>w</i> -----	138
<i>T</i> _{S1} -----	128
<i>T</i> _{S2} -----	166
<i>T</i> ₁ -----	104
<i>T</i> ₂ -----	65

EXAMPLE 5

A thin, paper-like fabric is produced from a batt prepared as in Example 1, but having a thickness of .04 inch, from a mixture of undrawn polypropylene fibres as used in Example 2 and drawn fibres as used in Example 3 containing 30% by weight of the undrawn fibres, by single-pass hot calendering (upper bowl surface tem-

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perature 135° C.) at a pressure of 0.1 ton per inch. The properties of the product are;

<i>d</i> -----	0.006
<i>w</i> -----	34
<i>T</i> _{S1} -----	36
<i>T</i> _{S2} -----	38
<i>T</i> ₁ -----	75
<i>T</i> ₂ -----	30

EXAMPLE 6

A transparent, coherent sheet is produced from a batt of polypropylene fibres as in Example 2 by pressing for one minute between the heated platens (150° C.) of an hydraulic press at a pressure of 0.4 tons per sq. inch. The properties of the film are;

<i>d</i> -----	0.036
<i>T</i> _{S1} -----	>89
<i>T</i> ₁ -----	160

What I claim is:

1. Non-woven fabrics consisting wholly of consolidated, blended stereoregular polypropylene fibres comprising at least 10% by weight of undrawn fibres having a birefringence of less than 20×10⁻³ and an extension at break of more than 100% and being selected from the group consisting of melt spun stereoregular polypropylene fibres and solution spun stereoregular polypropylene fibres and up to 90% by weight of drawn, substantially fully oriented stereoregular polypropylene fibres having a birefringence above 25×10⁻³, an extension at break of less than 70% and a free shrinkage at 140° C. of at least 10%, said undrawn and drawn fibres having the same molecular structure and at least a proportion of the fibres having been bonded together at the fibre cross-over points as a result of the softening of the fibres thereat.

2. Non-woven fabrics according to claim 1 wholly comprising fibres of undrawn stereoregular polypropylene.

3. Non-woven fabrics according to claim 1 wherein the fibres have a denier per filament of less than 10.

References Cited

UNITED STATES PATENTS

3,186,893	6/1965	Mercer	161
3,112,300	11/1963	Natta et al.	260—93.7
3,117,055	1/1964	Guandique et al.	161—170
3,193,442	7/1965	Schmulz et. al.	161—169
3,229,008	1/1966	Harrington et al.	264—122

FOREIGN PATENTS

808,287	2/1959	Great Britain.
844,760	8/1960	Great Britain.

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