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(54) Title: HIGH MOISTURE BARRIER POLYPROPYLENE-BASED FILM (57) Abstract A polymeric film having improved moisture barrier characteristics and enhanced mechanical properties. The film has a base layer which includes a blend of a high crystallinity polypropylene having an isotactic stereoregularity greater than 93 %, a conventional isotactic polypropylene having an isotactic stereoregularity of from 90 % to 93 %, and up to 9 % by weight of a resin modifier.		

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HIGH MOISTURE BARRIER POLYPROPYLENE-BASED FILM

The present invention relates to a polypropylene-based multilayer film which exhibits improved moisture barrier
5 properties and enhanced mechanical properties.

Polymeric films are used in many commercial applications. One particularly important application is the packaging of food products. Films employed in the food packaging industry are chosen and/or designed to provide characteristics
10 necessary for proper food containment. Such characteristics include water vapor barrier properties, oxygen and gas barrier properties and flavor and aroma barrier properties.

Polypropylene is a polymer commonly employed in the manufacture of films used in the food packaging industry. In
15 the case of multilayer films, polypropylene is typically used in the base or core layer. Often the polypropylene layer is modified to obtain desired characteristics which are not inherent in unmodified polypropylene. For example, resin modifiers and/or additives may be blended with the
20 polypropylene.

Attempts to vary the characteristics of polypropylene are often directed towards improving the moisture barrier of the resultant film. To this end, it is known that blending polypropylene with a resin modifier will provide such
25 improvements. Typically, from 10% to 20% resin modifier must be added to the film to achieve the desired reduction in water vapor transmission.

However, the addition of the resin modifier, within the aforementioned ranges, is not without its disadvantage.
30 Particularly, at the loading ranges typically employed in the art, the polypropylene suffers a significant decrease in dimensional stability. This in turn hinders the machinability and processability of the resultant films, resulting in increased manufacturing costs and/or films of inferior
35 quality.

The mechanical properties of a polymeric film are another important characteristic, particularly with respect to such

applications as wrappings for tobacco products. Films having enhanced mechanical properties facilitate handling and packaging because such films are more readily accommodated by typical industrial machinery. Attempts have been made to enhance the mechanical properties of polypropylene-based films (as measured by the stiffness and moduli of the film) through increased orientation and/or by the addition of additives. However, increased orientation often increases the likelihood of film splitting during manufacturing, while the addition of additives typically provides limited enhancement of mechanical properties but can negatively impact other film characteristics such as dimensional stability and clarity.

Commonly-owned copending U.S. Patent Application Serial Nos. 08/490,081 filed June 13, 1995 and 08/542,209 filed October 12, 1995 disclose polymeric film structures having a base layer of high crystallinity polypropylene and up to 8% by weight of a resin modifier. Skin layers may be adhered to opposing surfaces of the base layer. The disclosed film structures exhibit improved moisture barrier properties and enhanced mechanical properties, while maintaining dimensional stability, machinability, processability and clarity. However, the use of high crystallinity polypropylene in the disclosed film structures increases the difficulty of manufacturing the structures, particularly with respect to such manufacturing steps as stretching and slitting of the films. The use of high crystallinity polypropylene also increases the cost of the film structures.

Thus, there is still a need in the art for a resin modified polypropylene-based film which may be readily manufactured at reduced cost, while exhibiting improved moisture barrier properties, enhanced mechanical properties, dimensional stability, machinability, processability and clarity.

The present invention, which addresses the needs of the prior art, relates to a polymeric film having improved moisture barrier characteristics and enhanced mechanical properties. The film has a base layer which includes a blend

of a first polypropylene polymer having an isotactic stereoregularity greater than 93%, a second polypropylene polymer having an isotactic stereoregularity of from 90% to 93%, and a resin modifier at a loading level up to 9% by weight of the base layer.

In one preferred embodiment, the base layer includes from 60% to 94% and preferably from 70% to 88% by weight of the first polypropylene, from 3% to 37% and preferably from 4% to 26% by weight of the second polypropylene, and from 3% to 9% and preferably from 4% to 8% by weight of resin modifier. The resin modifier is preferably a hydrogenated hydrocarbon.

In another preferred embodiment, at least one skin layer is adhered to the base layer, preferably with a coating layer thereon. The skin layer is preferably formed from an ethylene-propylene random copolymer or an ethylene-propylene-butene-1 terpolymer. In one particularly preferred embodiment, the skin layer includes an amount of an antiblocking agent effective to reduce blocking of the film when wound and an amount of a silicone oil effective to maintain a low coefficient of friction on the exposed surface thereof.

As a result, the present invention provides a polypropylene-based film structure exhibiting improved moisture barrier properties and enhanced mechanical properties. These improved properties are obtained without a loss of dimensional stability and without a negative impact on other film characteristics such as clarity. Thus, the film structure exhibits a high degree of machinability and processability, providing higher quality films and/or reduced manufacturing costs. Finally, the film structure may be readily manufactured.

As disclosed in commonly-owned copending U.S. Patent Application Serial Nos. 08/490,081 filed June 13, 1995 and 08/542,209 filed October 12, 1995, polymeric film structures formed from HCPP exhibit unexpectedly large decreases in water vapor transmission with small additions of resin modifier. The moisture barrier increases as the loading level of resin

modifier is increased, up to a maximum of 8% resin modifier. That is, loading levels of greater than 8% do not provide further substantial increases in moisture barrier. Moreover, the HCPP-based film structures also provide enhanced

5 mechanical properties without suffering from losses in dimensional stability and clarity, as is common in prior art film structures which may require upwards of 20% resin modifier to achieve maximum moisture barrier. However, the use of HCPP in the film structure increases the difficulty of
10 manufacturing the film structures, particularly with respect to such manufacturing steps as stretching and slitting.

It has been discovered herein that the HCPP-based film structures disclosed in commonly-owned copending U.S. Patent Application Serial Nos. 08/490,081 and 08/542,209 can be
15 further improved by blending therein an amount of conventional isotactic polypropylene. More particularly, the present invention is prepared by blending high crystallinity polypropylene (HCPP) and conventional isotactic polypropylene (PP) with a resin modifier to form a base layer precursor.
20 The HCPP has an isotactic stereoregularity of greater than 93%, preferably from 94% to 98%, while the PP has an isotactic stereoregularity of from 90% to 93%. The blended base layer provides a significant increase in manufacturing efficiency, while maintaining the enhanced properties achieved in the
25 disclosed structures of the commonly-owned co-pending applications. Moreover, the blended base layer provides a significant reduction in cost, both in terms of materials and manufacturing costs.

The blend of HCPP and PP preferably includes an amount of
30 HCPP effective to provide the base layer with a moisture barrier versus resin modifier loading level curve having a substantially zero slope at loading levels of resin modifier greater than 9%. That is, a plot of water vapor transmission rate (WVTR) against % resin modifier shows an unexpectedly
35 large initial decrease in water vapor transmission up to loading levels of 9%. At loading levels of greater than 9% resin modifier, the slope of the plot becomes substantially

zero, whereby increasing the loading level does not provide further substantial increases in moisture barrier. With respect to the slope of the plot, the term substantially zero slope is defined herein as meaning that less than

5 approximately 10% and, more preferably, less than approximately 5%, additional moisture barrier is achieved as the loading level of resin modifier is increased above 9%.

The base layer preferably includes from 60% to 94% by weight of HCPP and, more preferably, from 70% to 88% by weight
10 of HCPP. The remaining percentage of the base layer is formed of PP, preferably in an amount effective to plasticize the base layer and thus increase the processability of the resultant extruded film structure and, more preferably, in an amount at least as great as the amount of resin modifier
15 present in the base layer.

Commercially suitable PPs include Fina 3371 (available from Fina Oil and Chemical Co. of Dallas, Texas), Exxon 4612 and Exxon 4052 (available from Exxon Chemical Co. of Houston, Texas) and Amoco 6361 (available from Amoco Chemical Co. of
20 Chicago, Illinois). Commercially suitable HCPPs include Amoco 9117 and Amoco 9119 (available from Amoco Chemical Co. of Chicago, Illinois), and Chisso HF5010 and Chisso XF2805 (available from Chisso Chemical Co., Ltd. of Tokyo, Japan). Suitable HCPPs are also available from Solvay in Europe.

25 The HCPP has a high isotactic stereoregularity, resulting in higher crystallinity than conventional isotactic polypropylene, i.e., greater than 93%. (Conventional isotactic polypropylene is defined herein as having an isotactic stereoregularity of from 90% to 93%). The HCPP thus exhibits
30 higher stiffness, surface hardness, lower deflection at higher temperatures and better creep properties than conventional isotactic polypropylene. Further information relating to HCPP, including methods for preparation thereof, is disclosed in U.S. Patent No. 5,063,264.

35 For purposes of the present invention, stereo-regularity can be determined by IR spectroscopy according to the procedure set out in "Integrated Infrared Band Intensity

Measurement of Stereoregularity in Polypropylene," J.L. Koenig and A. Van Roggen, Journal of Applied Polymer Science, Vol. 9, pp. 359-367 (1965) and in "Chemical Microstructure of Polymer Chains," Jack L. Koenig, Wiley-Interscience Publication, John Wiley and Sons, New York, Chichester, Brisbane, Toronto.

Stereoregularity can also be determined by decahydronaphthalene (decalin) solubility and nuclear magnetic resonance spectroscopy (NMR).

As mentioned, the HCPP and PP components are blended with a resin modifier to form the base layer precursor. The resin modifier is present in an amount of up to 9% by weight, preferably from 4% to 8% by weight, and more preferably 6% by weight. The blending may be accomplished by the direct feeding of HCPP, PP and resin modifier into the film extruder or by use of a masterbatch. One preferred method of blending the components utilizes a masterbatch formed of PP and resin modifier, e.g., 80% PP and 20% resin modifier. The masterbatch is then blended with HCPP, which reduces the concentrations of both the PP and resin modifier to the final desired levels.

The resin modifier is preferably a low molecular weight hydrogenated hydrocarbon which is compatible with the HCPP and PP polymers and which provides the desired enhancement of film properties. The preferred resin modifier has a number average molecular weight less than 5000, preferably less than 2000, and more preferably from 500 to 1000. The resin modifier can be natural or synthetic and preferably has a softening point of from 60°C to 180°C. Particularly suitable hydrocarbons which can be subsequently hydrogenated are the hydrocarbon resins. Preferred hydrocarbon resins include among others petroleum resins, terpene resins, styrene resins and cyclopentadiene resins.

Examples of commercially available hydrogenated hydrocarbon resins suitable for use in the present invention are those sold under the trademarks PICCOLYTE, REGALREZ and REGALITE by Hercules Corporation of Delaware and under the trademark ESCOREZ by Exxon Chemical Company of Houston, Texas.

One particularly preferred resin modifier is referred to herein as a saturated alicyclic resin. The saturated alicyclic resins are obtained by the hydrogenation of aromatic hydrocarbon resins. The aromatic resins are themselves
5 obtained by polymerizing reactive unsaturated hydrocarbons containing, as the principal component, aromatic hydrocarbons in which the reactive double bonds are generally in side-chains. More particularly, the alicyclic resins are obtained from the aromatic resins by hydrogenating the latter until
10 all, or almost all, of the unsaturation has disappeared, including the double bonds in the aromatic rings.

The saturated alicyclic resins used in the present invention have a softening point from 85°C to 140°C, and preferably from 100°C to 140°C, as measured by the ball and
15 ring method. Examples of commercially available saturated alicyclic resins suitable for use in the present invention are those sold under the trademark ARKON-P by Arakawa Forest Chemical Industries, Ltd. of Japan.

In one preferred embodiment, at least one skin layer of
20 an olefinic polymer is adhered to at least one side of the base layer. The skin layer is preferably coextruded with the base layer. In an additional preferred embodiment, skin layers are simultaneously co-extruded on both sides of the base layer.

25 In a still further preferred embodiment, a coating is applied to the outer surface of the skin layer(s). An acrylic coating, which provides improved printability, machinability and aroma barrier characteristics, may be applied to one of the skin layers. A heat seal coating such as ethylene methyl
30 acrylate (EMA) or ethylene acrylic acid (EAA) may be applied to the other skin layer. Other suitable coatings include polyvinylidene chloride (PVDC), polyvinyl alcohol (PVOH) and low temperature heat seal coatings, as disclosed in commonly-owned U.S. Patent No. 5,419,960.

35 Suitable olefinic polymers utilized for the skin layer(s) include i) ethylene homopolymers, ii) copolymers of ethylene and propylene, iii) copolymers of ethylene or propylene and

butylene or another alphaolefin having 5 to 10 carbon atoms, iv) terpolymers of ethylene, propylene and butylene or another alpha-olefin having 5 to 10 carbon atoms, and v) mixtures thereof.

5 Olefinic polymers which are particularly preferred for the skin layer(s) include ethylene-propylene copolymers with propylene as the main constituent and an ethylene content of 2 to 10% by weight (relative to the weight of the copolymer), propylene-butylene copolymers with propylene as the main
10 constituent and a butylene content of 0.5 to 25% by weight (relative to the weight of the copolymer), and ethylene-propylene-butene-1 terpolymers with propylene as the main constituent, 0.5 to 7% by weight of ethylene and 5 to 30% by weight of butene-1 (each time relative to the weight of the
15 terpolymer), and mixtures of these polymers. The co- and terpolymers are preferably random polymers.

In order to further improve certain properties of the resultant film, effective amounts of additives such as antiblocking agents, antistatic agents and/or slip agents may
20 be contained in the base layer and/or in the skin layer(s).

Preferred antiblocking agents include silica, talc, clay, sodium aluminum silicate, and conventional inorganic anti-blocks. Other suitable antiblocking agents include inorganic additives, such as silicon dioxide, calcium carbonate,
25 magnesium silicate, aluminum silicate, calcium phosphate, and the like, and/or incompatible organic polymers, such as polyamides, polyesters, polycarbonates and the like.

Preferred antistatic agents include alkali alkane sulfonates and essentially straight-chain, saturated aliphatic
30 tertiary amines possessing aliphatic radicals with 10 to 20 carbon atoms and being substituted by 2-hydroxyalkyl-(C₁ to C₄) groups. Preferred amines are N,N-bis-(2-hydroxyethyl)-alkylamines having 10 to 20, preferably 12 to 18, carbon atoms in their alkyl groups. The effective amount of antistatic
35 agent varies in the range from 0.05 to 3% by weight, relative to the weight of the layer.

Preferred slip agents include higher aliphatic acid amides, higher aliphatic acid esters, waxes, metallic soaps and silicone oils such as polydimethylsiloxane. The effective added amount of lubricant varies from 0.1% to 2% by weight.

5 In one embodiment of the present invention, the film structure includes a pair of skin layers adhered to opposing sides of the core layer. Each of the skin layers includes an antiblocking agent (e.g., silica) in an amount effective to reduce blocking of the wound film and at least one of the skin
10 layers includes a silicone oil (e.g., a polydimethylsiloxane) in an amount effective to maintain a low coefficient of friction on the exposed surface(s) of the skin layer(s). The antiblocking agent is preferably present in an amount of from 0.1% to 0.3% by weight. The silicone oil is present in an
15 amount of from 0.5% to 2.0% by weight, and preferably from 0.8% to 1.2% by weight, and has a viscosity of from 350 to 1,000,000 centistokes, and preferably from 10,000 to 60,000 centistokes. If the silicone oil is added to both skin layers, an ABA structure is produced. In those embodiments in
20 which silicone oil is added to only one of the skin layers (resulting in an ABC structure), an amount of oil may still be transferred to the opposing skin layer upon winding of the film. In this particular ABC structure, the non-oil containing side may be flame or corona treated prior to
25 winding.

The multilayer films of the present invention may be prepared employing commercially available systems for coextruding resins. As mentioned, the blended PP, HCPP and resin modifier are preferably coextruded with at least one
30 second polymer which forms the skin layer. The polymers can be brought to the molten state and coextruded from a conventional extruder through a flat sheet die, the melt streams being combined in an adapter prior to being extruded from the die. After leaving the die orifice, the multilayer
35 film structure is quenched.

The film structure of the present invention is preferably biaxially oriented. In one preferred embodiment, the film

structure is stretched from 4.5 to 6 times in the machine direction (MD) and from 6 to 13 times in the transverse direction (TD). The overall orientation (MD x TD) preferably ranges from 25 to 80. After orientation, the edges of the
5 film can be trimmed and the film wound onto a core.

The film structures of the present invention also exhibit unexpectedly increased stiffness and moduli (MD and TD) over film structures having conventional isotactic polypropylene-based core layers. The increased stiffness and moduli provide
10 the film structure with enhanced mechanical properties which, in turn, facilitate subsequent handling and packaging. Moreover, the increases in MD and TD moduli are accomplished at relatively low orientation, thus reducing manufacturing costs and the associated likelihood of splitting.

15 The blended base layer of the present invention also increases line operability and line percentage uptime, such improvements being observed during manufacture of the film structures of the present invention. For example, the blended base layer reduces the force necessary to stretch the film and
20 in addition facilitates edge trimming of the extruded film, as compared to the films disclosed in commonly-owned copending U.S. Application Serial Nos. 08/490,081 filed June 13, 1995 and 08/542,209 filed October 12, 1995. These improvements provide further manufacturing cost reductions. It is to be
25 noted that these improved properties are obtained even while maintaining the improved moisture barrier properties demonstrated in the examples set forth below and without negatively impacting other film characteristics such as dimensional stability and clarity. Finally, the blended base
30 layer may provide additional savings in terms of reduction in material cost.

The film structures of the present invention are formed having a thickness ranging from 10 microns to 60 microns, preferably from 15 microns to 50 microns.

EXAMPLES

Water Vapor Transmission Rate (WVTR) in each of the following examples was measured at 37.8°C (100°F) and 90% Relative Humidity (ASTM F-372) and is expressed in

5 g/645.16 cm² (100 in²)/day/mil.

EXAMPLE 1

Sample 1 was produced to demonstrate the moisture barrier of a conventional isotactic polypropylene-based film structure. A core layer of an isotactic polypropylene (Fina 3371) having a thickness of 23.75 microns was coextruded with skin layers of an ethylene-propylene random copolymer (Fina 8573HB) each having a thickness of 0.6 microns to produce an ABA extrudate. The ABA extrudate was stretched 4.3 times in the machine direction and 9 times in the transverse direction.

15

Sample	Core Layer	Resin Modifier (%)	WVTR (Ambient)	WVTR (Aged)
1	Fina 3371	0	.311	.311

20

EXAMPLE 2

25 Samples 2a - 2c were produced to demonstrate the moisture barrier of conventional polypropylene-based film structures containing varying levels of resin modifier. Core layers of an isotactic polypropylene (Fina 3371) having a thickness of 18.8 microns and varying levels of a terpene polymer (PICCOLYTE C-115) added by melt blending were coextruded with skin layers of an ethylene-propylene random copolymer (Fina 8573) each having a thickness of 0.6 microns to produce an ABA structure. The ABA extrudate was stretched 4.3 times in the machine direction and 9 times in the transverse direction.

35

Sample	Core Layer	Resin Modifier (%)	WVTR (Ambient)	WVTR (Aged)
2a	Fina 3371	0	---	0.325
2b	Fina 3371	10	---	0.27
2c	Fina 3371	20	---	0.25

EXAMPLE 3

Sample 3 was produced to demonstrate the moisture barrier of a HCPP-based film structure. Example 1 was repeated using a core layer of a high crystallinity polypropylene (Amoco 9117).

Sample	Core Layer	Resin Modifier (%)	WVTR (Ambient)	WVTR (Aged)
Amoco	9117	0	.246	.218

EXAMPLE 4

Samples 4a - 4j were produced to demonstrate the moisture barrier of HCPP-based film structures containing varying levels of resin modifier. A masterbatch of 80% HCPP (Amoco 9218) and 20% resin modifier (ARKON P-115) was blended with additional HCPP (Amoco 9218) and thereafter coextruded with skin layers of an ethylene-propylene random copolymer (Fina 8573HB) to produce an ABA extrudate. The ABA extrudate was stretched 4.3 times in the machine direction and 9 times in the transverse direction.

Sample	Film Thickness (microns)	HCPP (%)	Resin Modifier (%)	WVTR (Ambient)	WVTR (Aged)
5 4a	19.8	94	6	.230	.202
4b	19.8	94	6	.234	.205
4c	19.8	94	6	.235	.222
4d	19.8	94	6	.231	.217
10 4e	19.8	94	6	.229	.215
4f	19.8	94	6	.235	.215
4g	26.8	94	6	.219	.208
4h	26.8	94	6	.226	.212
4i	26.8	90	10	.216	.210
15 4j	26.8	90	10	.218	.209

EXAMPLE 5

Samples 5a - 5i were produced to demonstrate the moisture barrier of HCPP/PP-based film structures containing varying levels of resin modifier. A masterbatch of 85% PP and 15% resin modifier (ESCOREZ) was blended with HCPP (Amoco 9218) and thereafter coextruded with skin layers of an ethylene-propylene random copolymer (Fina 8573HB) to produce an ABA extrudate having a thickness of 27 microns. The ABA extrudate was stretched 4.3 times in the machine direction and 9 times in the transverse direction.

Sample	HCPP (%)	PP (%)	Resin Modifier (%)	WVTR (Ambient)	WVTR (Aged)
5a	60	34	6	.220	.203
35 5b	60	34	6	.215	.208
5c	60	34	6	.224	.213
5d	60	34	6	.221	.217
5e	60	34	6	.249	.220
5f	33	57	10	.216	.210
40 5g	33	57	10	.229	.206
5h	0	85	15	.233	.223
5i	0	85	15	.239	.219

EXAMPLE 6

Samples 6a - 6g set forth the average values of stiffness and moduli for the identified films of Examples 1, 4 and 5.

	Sample	Average of Samples	Stiffness		Moduli	
			MD	TD	MD	TD
			(g/4 in)		(ksi)	
5	6a	1	7.5	12.3	369.0	703.0
	6b	4a-4f	7.6	12.1	435.0	780.8
	6c	4g-4h	16.1	25.5	452.0	803.0
	6d	4i-4j	16.7	26.7	444.5	814.5
10	6e	5a-5e	15.4	24.6	421.1	796.8
	6f	5f-5g	15.9	24.0	420.5	769.5
	6g	5h-5i	15.2	22.0	415.0	692.0

EXAMPLE 7

15 Samples 7a - 7f were produced to demonstrate the dimensional stability of HCPP/PP-based film structures containing varying levels of resin modifier. A masterbatch of 80% PP and 20% resin modifier (ESCOREZ) was blended with HCPP
20 (Amoco 9218) and thereafter coextruded with skin layers of an ethylene-propylene random copolymer to produce an ABA extrudate having a thickness of 25 microns. The ABA extrudate was stretched 4.3 times in the machine direction.

	Sample	TD (x)	HCPP (%)	PP (%)	Resin Modifier (%)	MD Dim. Stability (-%@275°F)	TD Dim. Stability (-%@275°F)
25	7a	9	100	0	0	2.5	3.7
30	7b	9	50	40	10	3.3	3.3
	7c	9	0	80	20	4.7	6
	7d	12	100	0	0	1.9	4.2
	7e	12	50	40	10	5.9	7.9
	7f	12	0	80	20	7.3	6.9

35 It is thus readily apparent from the data set forth above that the present invention provides a film structure exhibiting improved WVTR (as compared to the prior art film of
40 Example 1), having improved stiffness and moduli (as compared to the prior art film described in Sample 6a), maintaining dimensional stability (as shown in Example 7) and providing ease of manufacturing, e.g., increased line operability and line percentage uptime (as observed during manufacture of the
45 present film structures).

CLAIMS:

1. A polymeric film having improved moisture barrier characteristics and enhanced mechanical properties,
5 comprising:
a base layer including a blend of a first polypropylene polymer having an isotactic stereoregularity of greater than 93%, a second polypropylene polymer having an isotactic stereoregularity of from 90% to 93%, and a resin modifier at a
10 loading level up to 9% by weight of the base layer.
2. The film of Claim 1, wherein said base layer includes an amount of said first polypropylene effective to provide said base layer with a moisture barrier vs. resin modifier loading level curve having a substantially zero slope
15 at loading levels of resin moisture greater than 9%.
3. The film of Claims 1 or 2, wherein the base layer includes from 60% to 94% by weight of the first polypropylene, from 3% to 37% by weight of the second polypropylene and from
20 3% to 9% by weight of the resin modifier.
4. The film of Claims 1, 2 or 3, wherein the first polypropylene has an isotactic stereoregularity of from 94% to 98%.
5. The film of Claims 1, 2, 3 or 4, wherein the resin
25 modifier is a hydrogenated hydrocarbon.
6. The film of Claim 5, wherein the mixture further comprises an additive selected from the group consisting of antiblocking agents, antistatic agents and slip agents.

7. The film of Claims 1, 2, 3, or 4, further comprising at least one skin layer adhered to at least one side of the base layer; said skin layer being selected from the group consisting of ethylene-propylene, random copolymers and
5 ethylene-propylene-butene-1 terpolymers.

8. The film of Claim 7, wherein the skin layer further comprises an additive selected from the group consisting of an antiblocking agent, antistatic agent, slip agent and silicone oil.

10 9. The film of Claim 8, wherein the skin layer includes from 1000 ppm to 3000 ppm by weight of the antiblocking agent and from 0.5% to 2.0% by weight of the silicone oil, said silicone oil exhibiting a viscosity of from 10,000 centistrokes to 60,000 centistrokes.

15 10. The film of Claim 7, further comprising a coating layer selected from the group consisting of acrylic, ethylene methyl acrylate, ethylene acrylic acid, polyvinylidene chloride and polyvinyl alcohol on the outer surface of the skin layer.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US97/05142

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :B32B 27/08

US CL :428/500, 515, 516, 518, 519, 520

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 428/500, 515, 516, 518, 519, 520

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
NONE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4,734,317 A (BOTHE et al.) 29 March 1988, see entire document	1-10
Y	US 5,482,780 A (WILKIE et al.) 09 January 1996, column 3 line 19- column 4 line 67.	1-10
A	US 5,500,282 A (HEFFELFINGER et al.) 19 March 1996, see entire document.	1-10

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Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231

Facsimile No. (703) 305-3230

Authorized officer

RALPH H. DEAN, JR.

Telephone No. (703) 308-2351