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(54) Title: PACKAGING POLYESTER FILM WITH EASY OPENING PROPERTY

(57) Abstract: The present invention relates to a packaging polyester film prepared by biaxially drawing a polyester sheet having a glass transition temperature (T_g) of 60 °C or higher, followed by heat-treating, the packaging film having a refractive index of 1.64 or less, a strength of 6 kgf/mm² or more and an energy at break of 90 kgf·mm or less in the longitudinal direction, and a birefringence of 0.03 or more. A package made of the inventive polyester film having no notch can be easily opened.



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PACKAGING POLYESTER FILM WITH EASY OPENING PROPERTY

FIELD OF THE INVENTION

5 The present invention is directed to a packaging polyester film having an easy opening property.

BACKGROUND OF THE INVENTION

10 Packaging films having easy opening properties have been used for packaging beverages, foods or various daily products. Conventional packaging films such as cellophane films and biaxially oriented polypropylene films are associated with various environmental and hygienic problems, and accordingly, there have been attempts to use polyester films having good mechanical and
15 chemical properties, which suffer from no environmental or food hygienic problems. However, a conventional biaxially drawn polyester film still needs a notching process to confer an easy opening property thereto.

SUMMARY OF THE INVENTION

20 Accordingly, it is an object of the present invention to provide a polyester film having improved easy opening property, printability and processibility in addition to good mechanical and chemical properties, environmental acceptability and food sanitary safety.

25 In accordance with the present invention, there is provided a packaging polyester film prepared by biaxially drawing a polyester sheet having a glass transition temperature (T_g) of 60 °C or higher, followed by heat-treating, the packaging film having a refractive index of 1.64 or less, a strength of 6 kgf/mm² or more and an energy at break of 90 kgf·mm or less in the longitudinal direction, and
30 a birefringence of 0.03 or more.

DETAILED DESCRIPTION OF THE INVENTION

The packaging polyester film according to the present invention is
5 characterized by having a refractive index of 1.64 or less, a strength of 6 kgf/mm² or more together with an energy at break of 90 kgf·mm or less in the longitudinal direction, and a birefringence of 0.03 or more.

The polyester resin suitable for use in preparing the packaging polyester film of the present invention may be made from a polyester prepared by
10 polycondensing an acid component comprising an aromatic dicarboxylic acid with a glycol component comprising an alkylene glycol, melting and extruding as an amorphous sheet.

In a preferred embodiment, the aromatic dicarboxylic acid is dimethyl terephthalate or terephthalic acid. It is also preferable that the acid component
15 further comprises other aromatic dicarboxylic acid such as isophthalic acid, naphthalene dicarboxylic acid, dimethyl isophthalate, dimethyl-2,6-naphthalene dicarboxylate, etc.

In a preferred embodiment, the alkylene glycol is ethylene glycol. It is also preferable that the alkylene glycol further comprises other alkylene glycol
20 component such as dimethylene glycol, trimethylene glycol, tetramethylene glycol, 1,4-cyclohexane dimethanol or 2,2-dimethyl(-1,3-propane) diol.

Tg of the polyester resin used in the present invention should be 60°C or higher. If Tg of the polyester resin is less than 60°C, mechanical and thermal properties of the polyester become unsatisfactory.

25 The polyester resin sheet used in the present invention may be prepared from a blend of polyester resins obtained by polymerizing the aforementioned aromatic dicarboxylic acid and glycol components.

According to the present invention, the polyester resin sheet is preferably biaxially drawn in the longitudinal direction at a draw ratio of 1.2 to 2.5 and in the
30 transverse direction at a draw ratio of 3.0 to 5.0 during the film making process to

provide a film having satisfactory mechanical strengths in both directions.

Drawing conditions such as drawing ratio or drawing temperature influence the refractive index of the resulting polyester film. The refractive index represents the degree of orientation of the molecular structure, which, in turn, determines the mechanical properties such as strength or elongation of the polyester film.

The inventive polyester film has a refractive index in the longitudinal direction of 1.64 or less and an energy at break in the longitudinal direction of 90 kgf·mm or less and can be easily cut in the longitudinal direction.

Also, the inventive polyester film has a birefringence of 0.03 or more. The birefringence of a polyester film is the value obtained by subtracting the refractive index in the longitudinal direction from that in the transverse direction, and it preferably is 0.03 or more to obtain sufficient strength in the transverse direction.

The inventive polyester film has a strength in the longitudinal direction of 6 kgf/mm² or more, preferably 7 to 15 kgf/mm² to prevent breakage of the film during the film making or packaging step.

Further, it is preferable that the specific gravity of the polyester film is 1.372 or more to provide a proper strength and elongation in the longitudinal direction.

The polyester film according to the present invention is further heat-treated at a temperature which is higher than T_g of the polyester sheet by 55°C or more to obtain a good cutting property in the longitudinal direction and sufficient stiffness in the transverse direction.

Meanwhile, the inventive polyester film has a thickness of 8 to 25 μ m and a longitudinal elongation of 100 % or less, preferably 80 % or less. If the longitudinal elongation is more than 100 % in such a thickness range, the film cannot be easily cut.

The polyester film according to the present invention may further comprise other components such as a polycondensation catalyst, dispersant, electrostatic

generator, antistatic agent, sun-bloking agent, antiblocking agent and inorganic lubricant. Also, the inventive polyester film may be corona-treated by a conventional method to improve the printability thereof.

Thus, the inventive polyester films for packaging has good easy opening
5 property which can be easily cut without notching, in addition to good printability and processibility.

The present invention is further described and illustrated in Examples, which are, however, not intended to limit the scope of the present invention.

10

The polyester films manufactured in examples were examined for the following properties.

15

(1) Specific Gravity: Density gradient tube method (ASTM D1505, JIS K7112)

(2) Refractive Index and Birefringence:

Refractive indexes in the longitudinal and transverse directions of film were measured with Abbe Refractor

20

$$\text{Birefringence} = \text{R.I. (TD)} - \text{R.I. (LD)}$$

wherein R.I. (TD) is the refractive index in the transverse direction and R.I. (LD) is the refractive index in the longitudinal direction

25

(3) Glass transition temperature :

Differential Scanning Calorimeter (Perkin-Elmer DSC-7)

Temperature rising 20 °C/min

30

(4) Film Strength, Elongation and Energy at break (ASTM D882):

Strength and Elongation at break were measured using 50mm x 15mm specimen at a rate of 200mm/min and at room temperature (23 ± 2 °C).

An Energy at break is a value integrating the area of load-displacement curve in a tensile test.

5

(7) Film thickness difference:

The film thickness was measured at 50 points which were arranged at 5 cm intervals in both the longitudinal and transverse directions.

10 Thickness difference (%) = $(T_{\max} - T_{\min}) / T_{\text{ave}} \times 100$

wherein $T_{\max}$ is maximum thickness of film; $T_{\min}$ is minimum thickness of film; and T_{ave} is average thickness of film.

15 **Example 1**

100 parts by mole of dimethyl terephthalate and 180 parts by mole of ethylene glycol were placed in an autoclave equipped with a distillation column, heated to 150°C, and manganese acetate (an interesterification catalyst) was
20 added thereto in an amount of 0.05 % by weight based on the weight of dimethyl terephthalate. While removing methanol formed, the temperature was raised to 220°C over a period of 120 min. After the interesterification was complete, trimethylphosphate (a stabilizer) was added in an amount of 0.045 % by weight based on the weight of dimethyl terephthalate, and silicon dioxide
25 having an average particle diameter of 2 micron (an antiblocking agent), in an amount of 0.2 % by weight based on the amount of dimethyl terephthalate. After 10 minutes, antimonytrioxide (polymerization catalyst) was added in an amount of 0.03 % by weight based on the weight of dimethyl terephthalate, and the resulting mixture was transferred to a second reactor equipped with a

vacuum unit, and reacted at 280°C for about 140 minutes, to obtain a polyethylene terephthalate (Tg 78°C) having an intrinsic viscosity of 0.65 dl/g.

5 The polyester thus obtained was melted at 280°C, extruded through a conventional T-die and cooled by a casting roller maintained at 30°C, to obtain an amorphous sheet of 92 μm thickness. The amorphous sheet was drawn 1.5 times in the longitudinal direction at 95°C and drawn 4.1 times in the transverse direction at 110°C, and then conducted heat-treatment at 170°C, followed by relaxation to a degree of 2 %, to obtain a biaxially drawn polyester film of 15
10 μm thickness.

The drawing conditions for the polyester sheet obtained above are shown in Table 1, and the properties of the resulting biaxially drawn films are shown in Table 2.

15

Examples 2 to 6 and Comparative Examples 1 to 6

The procedure of Example 1 was repeated except that various drawing conditions shown in Table 1 were used. The resulted properties of the biaxially drawn
20 polyester films are shown in Table 2.

Table 1

Example No.	Sheet		Drawing conditions				Heat Treatment
			Longitudinal Direction(LD)		Transverse Direction(TD)		
	Thickness (μm)	Tg (°C)	Temp. (°C)	Ratio	Temp. (°C)	Ratio	Temp. (°C)
1	92	78	95	1.5	110	4.1	170
2	92	78	90	1.5	105	4.1	155
3	92	78	95	1.5	115	4.1	175
4	79	78	95	1.5	110	3.5	170
5	105	78	95	1.7	110	4.1	170
6	117	78	95	1.9	110	4.1	170
Com. Ex. 1	92	78	95	1.5	110	4.1	120
Com. Ex. 2	68	78	-	1.0	110	4.5	170
Com. Ex. 3	68	78	95	1.1	110	4.1	170
Com. Ex. 4	60	78	95	4.0	-	1.0	170
Com. Ex. 5	162	78	85	3.0	127	3.6	170
Com. Ex. 6	180	78	90	4.0	125	3.0	170

Table 2

Example No.	The properties of Biaxially drawn film										
	Thickness		Refractive Index			Energy at break	Strength (kgf/mm ²)		Elongation (%)		Specific gravity
	Thickness (μ m)	Difference (%)	LD	TD	Bire-fringence	LD (kgf. mm)	LD	TD	LD	TD	
1	15	2	1.607	1.671	0.064	35	10	28	50	100	1.390
2	15	3	1.605	1.669	0.064	48	10	26	70	130	1.382
3	15	2	1.606	1.673	0.067	31	11	30	45	110	1.395
4	15	3	1.608	1.667	0.059	39	10	25	55	120	1.385
5	15	2	1.616	1.670	0.054	54	13	27	65	110	1.392
6	15	2	1.622	1.669	0.047	60	14	27	70	110	1.393
Com. Ex.1	15	9	1.606	1.662	0.056	105	4	18	320	185	1.361
Com. Ex.2	15	12	1.581	1.677	0.096	1.2	2	32	7	105	1.390
Com. Ex.3	15	10	1.595	1.672	0.077	2.1	3	30	10	110	1.394
Com. Ex.4	15	15	1.671	1.580	-0.091	177	31	4	95	8	1.390
Com. Ex.5	15	2	1.655	1.671	0.016	166	22	29	130	105	1.395
Com. Ex.6	15	2	1.670	1.644	-0.026	170	27	25	110	125	1.395

As shown in Table 2, the film of Examples 1 through 6 show improved properties suitable for easy opening package, while the films of Comparative Examples 1 through 6 were evaluated to be poor.

While the invention has been described with respect to the above specific embodiments, it should be recognized that various modifications and changes may be made to the invention by those skilled in the art which also fall within the scope of the invention as defined by the appended claims.

WHAT IS CLAIMED IS:

1. A packaging polyester film prepared by biaxially drawing a polyester sheet having a glass transition temperature (T_g) of 60 °C or higher, followed by
5 heat-treating, the packaging film having a refractive index of 1.64 or less, a strength of 6 kgf/mm² or more and an energy at break of 90 kgf·mm or less in the longitudinal direction, and a birefringence of 0.03 or more.
2. The packaging polyester film of claim 1, wherein the biaxially drawing
10 process is conducted in the longitudinal direction at a draw ratio of 1.2 ~ 2.5 and in the transverse direction at a draw ratio of 3.0 ~ 5.0
3. The packaging polyester film of claim 1, wherein the heat-treating process
15 is conducted at a temperature which is higher than T_g of the polyester sheet by 55°C or more.
4. The packaging polyester film of claim 1, wherein the strength in the longitudinal direction is 7 to 15 kgf/mm².
- 20 5. The packaging polyester film of claim 1, which has a specific gravity of 1.372 or more.
6. The packaging polyester film of claim 1, which has a thickness of 8 to 25
25 μm and a longitudinal elongation of 100 % or less.
7. The packaging polyester film of claim 6, wherein the longitudinal elongation is 80 % or less.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2004/001830

A. CLASSIFICATION OF SUBJECT MATTER**IPC7 C08J 5/18, B29C 55/02**

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)

IPC7 C08J, B29C, C08G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean patents and applications for inventions

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2000-63537 A (Teijin Ltd.) 29 February 2000 See the whole document	1-7
A	JP 06-65409 A (Unitika Ltd.) 08 March 1994 See the whole document	1-7
A	KR 2003-48185 A (SKC Co., Ltd) 19 June 2003 See the whole document	1-7
A	US 5747174 A (Toray Industries, Inc.) 05 May 1998 See the whole document	1-7
A	JP 02-127022 A (Mitsui Toatsu Chem. Inc.) 15 May 1990 See the whole document	1-7
A	JP 10-249935 A (Toray Industries, Inc.) 22 September 1998 See the whole document -----	1-7

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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Information on patent family members

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