

POLYPROPYLENE FILM AND MULTILAYER FILM THEREOF

5

TECHNICAL FIELD

The present invention relates to a polypropylene film and a laminated film thereof, which are free of irregularities on the film (such as "orange peel") due to heat sterilization such as retort sterilization process, and which can be preferably used as a food packaging material such as a film for packaging retort pouch food.

BACKGROUND ART

Conventionally, polypropylene films have been used as various food packaging materials and various medical packaging materials taking advantage of their characteristics such as low cost, heat resistance, chemical resistance, ease of heat sealing, and the like. In a packaging material for retort pouch food, which undergoes heat sterilization such as boil sterilization or retort sterilization after filling with the contents, aluminum foil, polyvinylidene chloride, or a saponified product of ethylene-vinyl acetate copolymer resin is used as a gas barrier resin, which is combined with a polyamide resin layer, a polyester resin layer, or the like, and a polypropylene is used as the heat seal layer. As the polypropylene used for this purpose, a film is used which is

obtained by: blending a propylene block copolymer or an ethylene-propylene random copolymer with an elastomer component such as polybutene and a thermoplastic elastomer such as an ethylene-propylene elastomer obtained using, for example, a vanadium polymerization catalyst; and then molding the blend.

However, there has been the problem that in the case where the film is subjected to heat sterilization such as retort sterilization, an irregular surface which is called "orange peel" is formed on the film surface after the heat sterilization, and the irregular surface affects the entire retort pouch if it is produced by laminating another substrate on such a film by a lamination process such as dry lamination, and seriously degrades the appearance of the product.

Various solutions to the above problem have been proposed such as a process in which polybutene is mixed in (Japanese Examined Patent Application, Second Publication (Kokoku), No. Hei 2-32142), a process in which an ethylene- α -olefin copolymer which is copolymerized using a specific catalyst is used (such as Japanese Unexamined Patent Application, First Publication (Kokai), No. Hei 7-266520 and Japanese Unexamined Patent Application, First Publication (Kokai), No. Hei 7-256841), a process in which a specific multistage polymerization is carried out (Japanese Unexamined Patent Application, First Publication (Kokai), No. Hei 3-

44087), a specific laminate (Japanese Unexamined Patent Application, First Publication (Kokai), No. Hei 3-56570), and the like.

However, none of the above processes sufficiently
5 prevents the occurrence of orange peel.

DISCLOSURE OF INVENTION

The present invention was achieved in view of of the above circumstances, and the object of the present invention
10 is to provide a polypropylene film which can be suitably used as a food packaging material, which does not develop irregular patterns, such as orange peel, on the film surface due to a retort sterilization process.

As a result of diligent research, the present inventors
15 have found that the above object can be achieved by a film comprising a specific propylene- α -olefin block copolymer and a specific ethylenic copolymer as main components, and have completed the present invention on the basis of this finding.

That is to say, the present invention provides a
20 polypropylene film which comprises as main components:

- (1) a propylene- α -olefin block copolymer (I) in an amount of 85 to 98% by weight which has
 - (a) a polypropylene block in an amount of 95 to 70% by weight and
 - 25 (b) an elastomer block of a copolymer of propylene and an α -olefin of C_2 to C_{12} (except for C_3), in an

amount of 5 to 30% by weight and

- (2) an ethylenic copolymer elastomer in an amount of 15 to 2% by weight which is a copolymer of ethylene in an amount of 90 to 70% by weight and an α -olefin of C_3 to C_{12} in an amount of 10 to 30% by weight.

BEST MODE FOR CARRYING OUT THE INVENTION

The propylene- α -olefin block copolymer (I) (which is hereinafter occasionally referred to as "block copolymer I") in the present invention is a block copolymer having (a) a polypropylene block in an amount of 95 to 70% by weight and (b) an elastomer block of a copolymer of propylene and an α -olefin of C_2 to C_{12} (except for C_3), in an amount of 5 to 30% by weight. The polypropylene block (a) is composed of homopolypropylene or a random copolymer component of propylene and an α -olefin other than propylene in which the amount of the α -olefin other than propylene is 5% by weight of less. The amount of α -olefin other than propylene is preferably 4.5% weight, and particularly preferably 4.0% by weight. An amount of the α -olefin other than propylene exceeding 5% by weight is not preferable, since the rigidity and the heat resistance are impaired, or components of low crystallinity increase, which causes mutual adhesion of films.

On the other hand, the copolymer elastomer block (b) consists of a copolymer which is composed of propylene and an

α -olefin of C_2 to C_{12} (except for C_3), and the copolymerized proportion of the α -olefin in the copolymer elastomer is 30 to 80% by weight. The copolymerized proportion is preferably 38 to 75% by weight, and particularly preferably 38 to 72% by weight. A copolymerized proportion of the α -olefin less than 30% by weight would degrade the impact resistance and the low temperature resistance. On the other hand, a copolymerized proportion exceeding 80% by weight would degrade the heat resistance and thus is not preferable.

Specific examples of the α -olefin for components (a) and (b) are ethylene, 1-butene, 3-methyl-1-butene, 3-methyl-1-pentene, 4-methyl-1-pentene, 4,4-dimethyl-1-pentene, vinylcyclopentane, and vinylcyclohexane. These may be used independently or as a mixture of at least two types.

The proportion of the copolymer elastomer block content in the block copolymer I of the present invention is 10 to 30% by weight, preferably 12 to 28% by weight, and particularly preferably 14 to 25% by weight. A copolymerized proportion of the copolymer elastomer less than 10% by weight would degrade the impact resistance and the low temperature resistance. On the other hand, a copolymerized proportion exceeding 30% by weight would degrade the rigidity and characteristics for retorting, causing mutual adhesion of films, for example, and thus is not preferable.

The block copolymer (I) in the present invention can be obtained by a known process in which a polymerization vessel

having at least two stages is used. Such a process is disclosed in many references, for example, T. Ogawa, T. Inaba: J. Appl. Polym. Sci., 18, 3345-3365 (1974) and A.J.Lononte: J. Polym. Sci., Part A, 2, 705-709 (1964).

5 The block copolymer I in the present invention having an intrinsic viscosity of xylene-soluble contents in the range of 3.5 to 5.0 dl/g is preferable, and a more preferable range is 3.6 to 4.7 dl/g, and a particularly preferable range is 3.7 to 4.5 dl/g. An intrinsic viscosity less than 3.5 dl/g
10 would degrade the heat resistance and hinder the effect of avoiding orange peel. On the other hand, an intrinsic viscosity exceeding 5.0 dl/g tends to cause fish eyes, which damage the appearance of the film.

 The "intrinsic viscosity of xylene-soluble contents" is
15 the intrinsic viscosity of the precipitate which is obtained by first dissolving a polymer in o-xylene at 135°C, and thereafter allowing the polymer to precipitate by reducing the temperature to 25°C. In order to measure the intrinsic viscosity, a process according to Elliott et al., J. App.
20 Poly. Sci., Vol. 14, pp 2947-2963 (1970) can be employed in which a decahydronaphthalene solution is measured at 135°C. More specifically, the polymer is dissolved in decahydronaphthalene to prepare solutions of various concentrations, and the viscosity of the solution at each
25 concentration is measured in a thermostatic chamber using an Ubbelohde capillary viscometer, an Ostwald-Fenske capillary

viscometer, or the like. Then, the intrinsic viscosity is obtained by extrapolation to infinity from these viscosity data according to the Huggins' viscosity equation.

The ethylenic copolymer elastomer in the present invention (hereinafter referred to as "ethylenic elastomer") is a copolymer of ethylene in an amount of 90 to 70% by weight and an α -olefin of C_3 to C_{12} in an amount of 10 to 30% by weight. The copolymerized proportion of the α -olefin is preferably 30 to 80% by weight, and particularly preferably 13 to 25% by weight. A copolymerized proportion of the α -olefin less than 10% by weight would hinder the effect of avoiding orange peel. On the other hand, a copolymerized proportion of the α -olefin exceeding 30% by weight would degrade the heat resistance and the heat seal strength, and thus is not preferable. Specific examples of the α -olefin are propylene, 1-butene, 3-methyl-1-butene, 3-methyl-1-pentene, 4-methyl-1-pentene, 4,4-dimethyl-1-pentene, vinylcyclopentane, and vinylcyclohexane. These may be used independently or as a mixture of at least two types. Among these, propylene and 1-butene are preferable.

The ethylenic elastomer generally has a density of 0.85 to 0.90 g/cm³, preferably 0.86 to 0.89 g/cm³, and particularly preferably 0.87 to 0.89 g/cm³. A density lower than 0.85 g/cm³ or higher than 0.90 g/cm³ would hinder the effect of avoiding orange peel.

The melt flow rate (MFR) of the ethylenic elastomer

measured at a temperature of 230°C under a load of 2.16 kg is normally 0.1 to 10 g/10 minutes, preferably 0.2 to 8 g/10 minutes, and particularly preferably 0.3 to 5 g/10 minutes. An MFR less than 0.1 g/10 minutes would
5 degrade the appearance of the film. On the hand, an MFR exceeding 10 g/10 minutes would hinder the effect of avoiding orange peel, and thus is not preferable.

Examples of commercially available products which can be preferably used as the ethylenic elastomer in the present
10 invention are "TAFMER" (trade name) manufactured by Mitsui Petrochemical Industries, Ltd., and "JSR EBM" (trade name) manufactured by Japan Synthetic Rubber Co., Ltd.

The polypropylene film of the present invention can be obtained by a known film formation technique such as T-die
15 forming technique, using a composition comprising the above block copolymer (I) in an amount of 85 to 98% by weight and the above ethylenic elastomer in an amount of 15 to 2% by weight as main components. The ethylenic elastomer content is preferably 12 to 3% by weight, and particularly preferably
20 10 to 4% by weight. An ethylenic elastomer content exceeding 15% by weight would degrade the rigidity, the heat resistance, and the heat seal strength. On the other hand, an ethylenic elastomer content less than 2% by weight would hinder the effect of avoiding orange peel and degrade the impact
25 resistance, and thus is not preferable.

A polypropylene laminated film according to the present

invention is a laminated film comprising at least two layers (A) and (B), layer (A) consisting of the above polypropylene film, and layer (B) consisting of a propylene resin film which comprises as main components:

- 5 (1) a propylene- α -olefin block copolymer (II) in an amount of 70 to 95% by weight which has
 - (a) a polypropylene block in an amount of 95 to 70% by weight and
 - (b) an elastomer block of a copolymer of propylene and
10 an α -olefin of C_2 to C_{12} (except for C_3), in an amount of 5 to 30% by weight,
- (2) an ethylenic copolymer elastomer in an amount of 3 to 15% by weight which is a copolymer of ethylene in an amount of 90 to 70% by weight and an α -olefin of C_3 to
15 C_{12} in an amount of 10 to 30% by weight, and
- (3) a straight chain polyethylene resin in an amount of 2 to 15% by weight.

The polypropylene block (a) and the copolymer elastomer block (b) which constitute layer (B) have the same components
20 as those the polypropylene block and the copolymer elastomer block in the above block copolymer I have. However, it is essential for the block copolymer (II) to have an intrinsic viscosity of xylene-soluble contents of 1.5 to 3.5 dl/g. The intrinsic viscosity is preferably 1.7 to 3.3 dl/g, and
25 particularly preferably 1.8 to 3.2 dl/g. An intrinsic viscosity less than 1.5 dl/g would degrade the impact

resistance, the anti-blocking property, and the low temperature resistance. On the other hand, an intrinsic viscosity exceeding 3.5 dl/g would degrade the compatibility with the straight chain polyethylene, which is described below, and hinder the effect of avoiding orange peel, and thus is not preferable.

The ethylenic copolymer elastomer which is a component of layer (B) is the same type of resin as that of the above polypropylene film.

10 An example of the straight chain polyethylene resin is a copolymer of ethylene and an α -olefin of C_3 to C_{12} . Examples of the α -olefin are propylene, 1-butene, 1-octene, 3-methyl-1-butene, 3-methyl-1-pentene, 4-methyl-1-pentene, 4,4-dimethyl-1-pentene, vinylcyclopentane, and vinylcyclohexane.

15 These may be used independently or as a mixture of at least two types. Among these, 1-butene and 1-octene are preferable. The copolymerized proportion of the α -olefin is 10% by weight or less, preferably 9% by weight, and particularly preferably 8% by weight. The lower limit of the copolymerized

20 proportion of the α -olefin is 3% by weight. A copolymerized proportion exceeding 10% by weight would hinder the effect of avoiding orange peel, and thus is not preferable.

 The straight chain polyethylene normally has a density of 0.88 to 0.930 g/cm³, preferably 0.89 to 0.925 g/cm³, and particularly preferably 0.90 to 0.925 g/cm³. The melt flow rate (MFR) of the straight chain polyethylene measured at a

temperature of 190°C under a load of 2.16 kg is normally 1 to 30 g/10 minutes, preferably 5 to 25 g/10 minutes, and particularly preferably 7 to 23 g/10 minutes

Layer (B) in the present invention comprises the block copolymer (II) in an amount of 70 to 95% by weight, the ethylenic elastomer in an amount of 3 to 15% by weight, and the straight chain polyethylene resin in an amount of 2 to 15% by weight. The amount of the block copolymer (II) is preferably 75 to 93% by weight, and particularly preferably 77 to 91% by weight. An amount of the block copolymer (II) less than 70% by weight would degrade the rigidity and the heat resistance. On the other hand, an amount of the block copolymer (II) exceeding 95% by weight would degrade the impact resistance and be liable to cause orange peel, and thus is not preferable.

The amount of the ethylenic elastomer is preferably 4 to 13% by weight, and particularly preferably 5 to 10% by weight. An amount of the elastomer less than 32% by weight would hinder the effect of avoiding orange peel. On the other hand, an amount of the elastomer exceeding 15% by weight would degrade the heat seal strength, and thus is not preferable.

The amount of the straight chain polyethylene resin is preferably 3 to 10% by weight, and particularly preferably 4 to 10% by weight. An amount of the straight chain polyethylene resin less than 2% by weight would hinder the effect of avoiding orange peel. On the other hand, an amount of the

straight chain polyethylene resin exceeding 15% by weight would degrade the heat seal strength, and thus is not preferable.

In addition, the propylene block (a) for the block copolymers (I) and (II) having the following properties (i) and (ii) can be even more preferably used in view of the prevention of orange peel:

- (i) the isotactic pentad fraction (IP) according to ^{13}C nuclear magnetic resonance spectra is at least 98.5%
- 10 (ii) an isotactic average chain length (N) is at least 500.

The isotactic pentad fraction (hereinafter occasionally abbreviated as "IP") is the isotactic fraction with respect to pentad units in a polypropylene molecular chain, which is determined from nuclear magnetic resonance with isotopic carbon spectra (^{13}C -NMR) in accordance with the method in A. Zambelli; *Macromolecules*, Vol. 6, p. 625 (1973).

The isotactic average chain length (N) indicates an average length of isotactic portions with respect to methyl groups in a polypropylene molecule, which can be determined in accordance with the method reported in J. C. Randall et al. (Polymer Sequence Distribution, Academic Press, New York, 1977, Chapter 2).

These properties are described in detail in Japanese Unexamined Patent Application, First Publication (Kokai), No. 25 Hei 8-73547.

The polypropylene film of the present invention can be

made into a formed article by a known T-die forming technique. Normally, the forming is carried out at a die temperature in the range of 220 to 280°C. The cooling temperature is normally at 40 to 90°C.

- 5 The thickness of the film is normally 20 to 180 μm . A thickness less than 20 μm would degrade the heat seal strength, and thus is not preferable. On the other hand, a thickness exceeding 180 μm would degrade the heat sealing property and the transparency, and thus is not preferable.
- 10 The thickness of the film is preferably 30 to 170 μm , and particularly preferably 40 to 160 μm .

 In the case of the multilayer film comprising layer (A) and layer (B) according to the present invention, the ratio of layer (A) to layer (B) in thickness is preferably in the

15 range of 9:1 to 1:9. This ratio is preferably 8:2 to 2:8, and particularly preferably 7:3 to 5:5. A film in the form of the multilayer film can be superior in the heat seal strength to a film of a single layer of layer (A).

 Accordingly, when the multilayer film is used in a retortable

20 package, being laminated together with a gas barrier layer such as an aluminum foil layer, a layer of a saponified product of ethylene-vinyl acetate copolymer, a polyamide resin layer, and a vinylidene chloride resin layer, or with a polyester resin layer, layer (B) may be used as the innermost

25 (heat seal) layer in order to provide a package which is superior in the heat seal strength.

"Heat sterilization" means, for the purpose of describing the present invention, a process of killing microorganisms which are the major cause of food rotting. The temperature range for heat sterilization is dependent on the subject microorganisms, but heat sterilization is normally carried out at a temperature range of 60°C to 135°C.

Heat sterilization in which heat of hot water and heated vapor at a temperature of 100°C or higher is utilized is called retort sterilization, which can be carried out at a high temperature for a short period of time without damaging the taste and the flavor of the contents. Details of heat sterilization are described, for example, in Isao SHIBAZAKI, "Shokuhin sakkin kogaku (Food sterilization engineering)", Korin Zensho, 24 (published on March 14, 1981) and in Ushio SHIMIZU and Norio YOKOYAMA, "Retoruto shokuhin no riron to jissai (Theory and practice for retort food)", Saiwai Shobo (published on January 15, 1981).

For the film of the present invention, other additives which have been conventionally used for thermoplastic resins (for example, antioxidants, weather resistant stabilizers, antistatic agents, lubricants, anti-blocking agents, anti-fog agents, dyes, pigments, oils, waxes, and fillers) and other thermoplastic resins can be added in an amount which does not impair the object of the present invention.

Examples of such additives are: as antioxidants, 2,5-di-butylhydroquinone, 2,6-di-t-butyl-p-cresol, 4,4'-

thiobis(6-t-butylphenol), 2,2'-methylenebis(4-methyl-6-t-butylphenol, octadecyl 3-(3'5'-di-t-butyl-1'-hydroxyphenyl)propionate, and 4,4'-thiobis(6-butylphenol); as ultraviolet absorbers, ethyl 2-cyano-3,3-diphenylacrylate, 2-
5 (2'-hydroxy-5-methylphenyl)benzotriazole, and 2-hydroxy-4-octoxybenzophenone; as plasticizers, dimethyl phthalate, diethyl phthalate, waxes, liquid paraffins, and phosphoric esters; as antistatic agent, pentaerythritol monostearate, sorbitan monopalmitate, sulfated oleic acids, polyethylene
10 oxides, and carbon waxes; as lubricants, ethylenebisstearamide, and butyl stearate; as colorants, carbon black, phthalocyanine, quinacridone, indoline, azo pigments, titanium oxide, red iron oxide, and the like; and as fillers, glass fibers, asbestos, mica, wollastonite, calcium silicate,
15 aluminum silicate, and calcium carbonate. In addition many other polymer compounds may be blended in for the present invention, to such a level that they do not hinder the actions and the effects of the present invention.

The process for combining the components of the present
20 invention is not particularly limited, and any known process may be employed. An example of such a process is a process in which the components are mixed using a mixer such as a mixing roll, a Banbury mixer, a Henschel mixer, a tumbler, and a ribbon blender, and thereafter the mixture is
25 pelletized using an extruder or the like. Alternatively, in the blending process, the components may be blended by a dry

process, and directly fed into a forming machine to make a film.

The melt flow rate of the film according to the present invention (MFR; measured under a load of 2.16 kg at a temperature of 230°C according to JIS K7210) is not particularly limited and depends on the forming process. For example, a proper MFR of the film produced by the T-die forming technique is 0.5 to 30 g/10 minutes, preferably 0.8 to 25 g/10 minutes, and particularly preferably 1.0 to 20 g/10 minutes.

The polypropylene film according to the present invention can be used additionally with another material, such as a gas barrier layer made of an aluminum foil, a film on which a metal is vapor-deposited, a film on which a silicon oxide is vapor-deposited, a vinylidene chloride resin, a saponified product of an ethylene-vinyl acetate copolymer, or the like, and a polyamide resin layer and a polycarbonate resin layer, which is laminated using a known dry laminate forming machine.

20

Examples

In the following, the present invention will be described in further detail, making reference to examples.

Methods of measuring various properties employed in order to evaluate the present invention are as follows.

25

MFR was measured in accordance with JIS K7210, Table 1,

Condition 14. The equipment used was a melt indexer manufactured by Takara Thermistor Instruments Co., Ltd.

The intrinsic viscosity was determined by measuring the intrinsic viscosity $[\eta]$ of xylene-soluble contents in
5 decahydronaphthalene solvent at a temperature of 135°C using an Ubbelohde capillary viscometer.

The ethylene content was measured in accordance with the ^{13}C -NMR method reported in C. J. Carman et al.,
Macromolecules, 10, 537 (1977).

10 Isotactic pentad fraction (IP):

An mmmmm fraction is an isotactic fraction of methyl groups in polypropylene molecular chain with respect to pentad units. The measurement was carried out using "JNM-GSX400" (^{13}C nuclear magnetic resonance: 100 MHz)

15 manufactured by JEOL Ltd. Each signal was attributed to A. Zambelli et al., Macromolecules, 13, 267 (1980). The conditions for the measurement are shown below:

Measuring mode: proton decoupling method

Pulse width: 8.0 μs

Pulse repetition time: 3.0 s

Cumulative number of

repetitions: 20000 times

Solvent: a mixture of 1,2,4-

trichlorobenzene and benzene.

deuteride (75/25% by volume)

Internal circulation: hexamethyldisiloxane

Sample concentration: 300 mg/3.0 ml solvent

Measuring temperature: 120°C

Isotactic average chain length (N):

The isotactic average chain length (N) was determined in accordance with the method reported in J. C. Randall, Polymer
5 Sequence Distribution, Academic Press, New York 1977, chapter
2.

The film impact strength was evaluated by measuring the film impact strength at -5°C and the heat seal strength in accordance with ASTM D781 using a film impact tester
10 manufactured by Toyo Seiki Seisaku-Sho, Ltd.

Transparency was evaluated by measuring haze using a hazemeter "HGM-2DP" manufactured by Suga Test Instruments Co., Ltd., in accordance with JIS K7105.

The occurrence of orange peel was evaluated as belonging
15 to one of the following five grades by visually inspecting irregularities (orange peel) which developed on the surface layer of the pouch after retort process:

- 1 ... Occurrence of orange peel was not observed.
- 2 ... Some orange peel as indistinct irregularities was
20 observed, but the pouch was usable.
- 3 ... Considerable orange peel as indistinct irregularities was observed, but the pouch was

usable.

4 ... Orange peel as distinct irregularities was
observed on the entire surface of the pouch, and
the pouch was unusable.

5 5 ... Orange peel as serious irregularities was
observed on the entire surface of the pouch, and
the pouch was unusable.

As block copolymer (I), BPP1 and BPP2 shown in Table 1
which are produced by multistage polymerization are used. As
10 block copolymer (II), BPP3 and BPP4 shown in Table 1 are used.
For comparison, BPP5 and BPP6 shown in Table 1 are used. The
physical properties of these copolymers are shown in Table 1.

As the ethylenic elastomer, ethylene-butene copolymer
(manufactured by Mitsui Petrochemical Industries, Ltd., under
15 the trade name "TAFMER A1085") was used.

As the straight chain polyethylene resin, an ethylene-
butene-1 copolymer having a density of 0.920 g/cm³ and an MFR
(measured at a temperature of 190°C under a load of 2.16 kgf
in accordance with JIS K7210) of 15 g/10 minutes was used.

20

Examples 1 to 9, Comparative Examples 1 to 3

[Kneading Process]

The components shown in Table 2 for each of layer (A)
and layer (B) in the amounts shown in Table 2 were mixed in a
25 tumbler, and thereafter the mixtures were pelletized at a
temperature of 190°C to 210°C using a co-directional double-

screw kneader ("KTX37") manufactured by Kobe Steel Co., Ltd.

[T-die Forming]

Each pellet obtained was formed by a multilayer T-die forming machine manufactured by Yoshii Tekko, K.K., having a diameter of 40 mm $\varnothing$ and a die width of 250 mm, at a die temperature of 250°C, and cooled at a temperature of 70°C to produce a film having a thickness of 70 μ m. In Examples 4 to 9, a multilayer laminate film consisting of layer (A) and layer (B) was formed. The impact resistance and the transparency of each film were measured, and the results are shown in Table 3.

[Heat Seal]

A polyester film having a thickness of 12 μ m and each of the above-described films were laminated together by a dry lamination method (in Examples 4 to 9, the polyester film was laminated on the layer (B) side), and the laminate was subjected to a heat sealing process at a temperature of 160°C under a pressure of 2 kg/cm² for 1 second using a heat sealer manufactured by Tester Sangyo Co., Ltd. The heat seal strength of the laminate obtained was measured, and the results are shown in Table 3.

[Retort Process]

A polyester film having a thickness of 12 μ m, an

aluminum foil having a thickness of 9 μm , and each BPP film shown in Table 2 were laminated together by a dry lamination method (in Examples 4 to 9, the polyester film and the aluminum foil were laminated on the layer (B) side), a pouch of 15 cm $\times$ 18 cm was prepared, and a commercial retort pouch food "Chinjaorousu" (trade name; shredded and stir-fried beef and bell pepper; manufactured by Ajinomoto Co., Inc.) was sealed in the pouch by heat sealing the BPP layers together. Then, a retort process was carried out at 121°C for 30 minutes using "RCS-40T" manufactured by Hisaka Works, Ltd.

After the retort process, orange peel was evaluated by visual inspection. The results are shown in Table 3.

Table 1

Type of block copolymer		Type of propylene block	Copolymer block		MFR (g/10 min)	Intrinsic viscosity (dl/g)	Pentad fraction IP (%)	Average chain length N
			Ethylene Content (wt%)	Copolymerized proportion (wt%)				
Block copolymer (I)	BPP1	Homo PP	9.6	19.2	2.8	3.8	99.5	705
	BPP2	Homo PP	9.3	19.8	3.2	4.2	99.4	658
Block copolymer (II)	BPP3	Homo PP	15.8	26.5	2.9	2.0	99.3	526
	BPP4	Homo PP	9.8	19.7	2.5	2.8	99.4	688
BPP5		Homo PP	9.8	19.5	2.4	3.9	97.8	204
BPP6		Homo PP	9.6	19.8	2.3	2.9	98.1	231

Table 2

	Layer (A)				Layer (B)				
	BPP		Mixed amount of ethylenic elastomer (wt%)	Thickness (μ m)	BPP		Mixed amount of ethylenic elastomer (wt%)	Mixed amount of straight chain polyethylene resin (wt%)	Thickness (μ m)
	Type	Mixed amount (wt%)			Type	Mixed amount (wt%)			
Example 1	BPP1	94	6	70	—	—	—	—	—
Example 2	BPP2	94	6	70	—	—	—	—	—
Example 3	BPP1	85	15	70	—	—	—	—	—
Example 4	BPP1	94	6	20	BPP3	88	6	6	50
Example 5	BPP2	94	6	10	BPP4	88	6	6	60
Example 6	BPP1	94	6	35	BPP4	88	6	6	35
Example 7	BPP1	94	6	20	BPP4	85	10	5	50
Example 8	BPP2	94	6	15	BPP3	80	10	10	55
Example 9	BPP1	85	15	20	BPP4	88	6	6	50
Comparative Example 1	BPP5	94	6	70	—	—	—	—	—
Comparative Example 2	BPP5	94	6	20	BPP6	88	6	6	50
Comparative Example 3	BPP5	94	6	20	BPP6	85	10	5	50

Table 3

	Film impact strength (kg-cm/mm)	Transparency (Haze) (%)	Heat seal strength (kg/15 mm width)	Orange peel evaluation
Example 1	77	63.1	5.3	2
Example 2	85	65.3	5.6	2
Example 3	103	60.5	5.0	2
Example 4	79	48.1	4.4	1
Example 5	84	45	4.2	1
Example 6	95	53.2	5.1	1
Example 7	105	43.5	4.3	1
Example 8	91	47.2	4.5	1
Example 9	98	48.1	4.7	1
Comparative Example 1	61	63.9	4.2	5
Comparative Example 2	63	55.2	3.9	4
Comparative Example 3	69	51.5	3.6	3

INDUSTRIAL APPLICABILITY

The polypropylene film and the multilayer film thereof according to the present invention can be suitably used as a food packaging material such as a film for packaging retort
5 pouch food since they do not develop irregularities ("orange peel") on the film surface due to heat sterilization such as a retort sterilization process.



1. A polypropylene film comprising as main components:

(1) a propylene- α -olefin block copolymer (I) in an amount
5 of 85 to 98% by weight which has

(a) a polypropylene block in an amount of 95 to 70% by
weight and

(b) an elastomer block of a copolymer of propylene and
an α -olefin of C_2 to C_{12} (except for C_3), in an
10 amount of 5 to 30% by weight and

(2) an ethylenic copolymer elastomer in an amount of 15 to
2% by weight which is a copolymer of ethylene in an
amount of 90 to 70% by weight and an α -olefin of C_3 to
15 C_{12} in an amount of 10 to 30% by weight.

2. A propylene film according to claim 1, wherein
propylene- α -olefin copolymer (I) has an intrinsic viscosity
of xylene-soluble contents in the range of 3.5 to 5.0 dl/g.

20 3. A polypropylene multilayer film comprising at least two
layers (A) and (B), layer (A) consisting of the
polypropylene film as recited in claim 1 or 2, and layer (B)
consisting of a propylene resin film which comprises as main
components:

25 (1) a propylene- α -olefin block copolymer (II) in an amount

of 70 to 95% by weight which has

(a) a polypropylene block in an amount of 95 to 70% by weight and

(b) an elastomer block of a copolymer of propylene and an α -olefin of C_2 to C_{12} (except for C_3), in an amount of 5 to 30% by weight,

(2) an ethylenic copolymer elastomer in an amount of 3 to 15% by weight which is a copolymer of ethylene in an amount of 90 to 70% by weight and an α -olefin of C_3 to C_{12} in an amount of 10 to 30% by weight, and

(3) a straight chain polyethylene resin in an amount of 2 to 15% by weight.

4. A polypropylene multilayer film according to claim 3, wherein the total thickness of the film is 40 to 90 μm , and the ratio of layer (A) to layer (B) in thickness is in the range of 9:1 to 1:9.

5. A package for retorting comprising the polypropylene multilayer film as recited in claim 3 or 4, wherein layer (A) is used as the innermost layer of the package.

