



(86) Date de dépôt PCT/PCT Filing Date: 1999/08/26
(87) Date publication PCT/PCT Publication Date: 2000/03/09
(45) Date de délivrance/Issue Date: 2008/01/08
(85) Entrée phase nationale/National Entry: 2001/02/26
(86) N° demande PCT/PCT Application No.: EP 1999/006271
(87) N° publication PCT/PCT Publication No.: 2000/012287
(30) Priorités/Priorities: 1998/08/27 (GB9818560.6);
1999/07/08 (DE199 31 722.4)

(51) Cl.Int./Int.Cl. *B29C 49/24* (2006.01)
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(54) Titre : ETIQUETTE CONSTITUEE D'UN FILM DE POLYOLEFINE

(54) Title: IN-MOULDED LABEL FILM FOR BLOW-MOULDING, METHOD FOR PRODUCING SAME AND ITS USE

(57) **Abrégé/Abstract:**

The invention relates to the use of an opaque multilayered polypropylene film as in-mold label in blow-molding. The label is built up from a base layer and at least two top layers, where the base layer comprises vacuole-initiating fillers and pigments. The film has an overall thickness of at least 85 μm , and the base layer contains a combination of tertiary aliphatic amine and fatty acid amide, and both top layers contain an antiblocking agent. The density of the film is in the range from 0.65 to 0.85 g/cm^3 , and the film has been corona- or flame-treated on both surfaces.

30054-5

Abstract

The invention relates to the use of an opaque multilayered polypropylene film as in-mold label in blow-molding. The label is built up from a base layer and at least two top layers, where the base layer comprises vacuole-initiating fillers and pigments. The film has an overall thickness of at least 85 μm , and the base layer contains a combination of tertiary aliphatic amine and fatty acid amide, and both top layers contain an antiblocking agent. The density of the film is in the range from 0.65 to 0.85 g/cm^3 , and the film has been corona- or flame-treated on both surfaces.

In-mould label film for blow-moulding, method for producing same and its use

5 The present invention relates to the use of an opaque film as in-mold label for blow molding.

Films made from thermoplastics have recently increasingly been used for labeling containers. The prior art discloses various labeling processes. The films which are suitable for use of this type must have a selected property profile, with different
10 labeling processes requiring different film properties. This means that very frequently only a single good property does not enable the film to be used for the proposed purpose. Rather, only a multiplicity of properties, which must be achieved simultaneously in a film, ensure that the film can be used for the proposed purpose.

15 A known process is in-mold labeling during blow molding of plastic containers. In this process, a tube of a suitable polymer is extruded continuously or batchwise. The tube is laid in a multipart mold cavity, pinched off at the lower end and cut off at the upper end. A nozzle is inserted in a tight-fitting manner into the upper opening which remains, and air is blown in through this nozzle during the actual blowing operation,
20 blowing up the extruded tube and bringing it into close contact with the wall of the mold. The mold is then opened, projecting tube residues of the demolded blow molding are removed at the top and bottom, and the process started afresh.

Labeling by blow molding during production of containers is known in the prior art
25 and is referred to as in-mold labeling. In this process, a label is laid in the opened blow mold, usually by a robot, in such a way that the printed outside of the label is in contact with the mold wall, and the unprinted inside is facing the blow molding to be shaped. During introduction of the tubular melt and shaping of the blow molding by the air pressure, the still-plastic surface of the polymer composition comes into
30 intimate contact with the label and bonds thereto to give a labeled container.

30054-5

2

It must be ensured during this labeling process that the label lies against the mold wall in a flat and fold-free manner. This is achieved either by means of vacuum applied to fine aeration perforations in such a way that the perforations are
5 substantially sealed by the label, or by means of electrostatic forces between the electrostatically charged label and the earthed mold.

In the case of simple label shapes, the label is introduced in roll form and cut to size directly at the blow-molding machine (cut in place). In the case of more complex
10 outlines, the label is cut to size in advance and away from the blow-molding machine, stacked, segregated from the stack at the blow-molding machine (cut & stack process) and introduced individually into the blow mold.

The present invention provides an inexpensive label film which is
15 suitable for in-mold labeling in blow-molding processes. On use for in-mold labeling, the film should give rise to a visually perfect, well-adhering label, and the film must be processable without problems in the process.

This is achieved by the use of an opaque, multilayered polypropylene film as
20 in-mold label in blow molding. The film has a base layer and at least two top layers, where the base layer contains vacuole-initiating fillers, the film has an overall thickness of at least 85 μm , and the base layer contains a combination of tertiary aliphatic amine and fatty acid amide. Both top layers contain antiblocking agents, the density of the film is in the range from 0.65 to 0.85 g/cm^3 , and the film has been
25 corona- or flame-treated on both surfaces.

It has been found that the special additive formulation of the opaque film in combination with the film thickness, and the selected density and surface treatment on both sides, ensures that it can be used for the purpose according to the invention.

For the purposes of the present invention, the term "opaque film" means a non-transparent film whose transparency to light (ASTM-D 1003-77) is at most 70%, preferably at most 50%.

5

The opaque base layer of the multilayered film essentially comprises a polyolefin, preferably a propylene polymer, and opacifying fillers and the stated additives in effective amounts in each case. In general, the base layer comprises at least 50% by weight, preferably from 60 to 99% by weight, in particular from 70 to 98% by weight,
10 of the polyolefin, in each case based on the weight of the layer.

Preferred polyolefins are propylene polymers. These propylene polymers comprise from 90 to 100% by weight, preferably from 95 to 100% by weight, in particular from 98 to 100% by weight, of propylene units, have a melting point of 120°C or above,
15 preferably from 150 to 170°C, and generally have a melt flow index of from 0.5 to 8 g/10 min, preferably from 2 to 5 g/10 min, at 230°C and a force of 21.6 N (DIN 53735). Isotactic propylene homopolymer having an atactic content of 15% by weight or less, copolymers of ethylene and propylene having an ethylene content of 5% by weight or less, copolymers of propylene with C₄-C₈-olefins having an olefin content of
20 5% by weight or less, terpolymers of propylene, ethylene and butylene having an ethylene content of 10% by weight or less and having a butylene content of 15% by weight or less are preferred propylene polymers for the base layer, with isotactic propylene homopolymer being particularly preferred. The stated percentages by weight are based on the respective polymer.

25

Also suitable is a mixture of said propylene homopolymers and/or copolymers and/or terpolymers with other polyolefins, in particular made from monomers having 2 to 6 carbon atoms, where the mixture comprises at least 50% by weight, in particular at least 75% by weight, of propylene polymer. Suitable other polyolefins in the polymer
30 mixture are polyethylenes, in particular HDPE, LDPE, VLDPE and LLDPE, where the proportion of these polyolefins is in each case not in excess of 15% by weight, based on the polymer mixture.

The opaque base layer of the film comprises fillers in an amount of at most 40% by weight, preferably from 1 to 30% by weight, in particular from 2 to 20% by weight, based on the weight of the opaque layer. For the purposes of the present invention,
5 the fillers are pigments and/or vacuole-initiating particles.

For the purposes of the present invention, pigments are incompatible particles and essentially do not result in vacuole formation when the film is stretched. The coloring action of the pigments is caused by the particles themselves. The term "pigments" is
10 generally associated with a mean particle diameter in the range from 0.01 to a maximum of 1 μm and covers both so-called "white pigments", which color the films white, and "colored pigments", which give the film a colored or black color. In general, the mean particle diameter of the pigments is in the range from 0.01 to 1 μm , preferably from 0.01 to 0.7 μm , in particular from 0.01 to 0.4 μm .

15 Conventional pigments are materials such as, for example, aluminum oxide, aluminum sulfate, barium sulfate, calcium carbonate, magnesium carbonate, silicates, such as aluminum silicate (kaolin clay) and magnesium silicate (talc), silicon dioxide and titanium dioxide, of which white pigments, such as calcium
20 carbonate, silicon dioxide, titanium dioxide and barium sulfate, are preferably employed.

The titanium dioxide particles generally comprise at least 95% by weight of rutile and are preferably employed with a coating of inorganic oxides and/or of organic
25 compounds containing polar and nonpolar groups. TiO_2 coatings of this type are known in the prior art.

For the purposes of the present invention, "vacuole-initiating fillers" are solid particles which are incompatible with the polymer matrix and result in the formation of
30 vacuole-like cavities when the films are stretched, with the size, nature and number of the vacuoles being dependent on the size of the solid particles and the stretching conditions, such as stretching ratio and stretching temperature. The vacuoles reduce

the density and give the films a characteristic pearl-like opaque appearance caused by light scattering at the "vacuole/polymer matrix" interfaces. The light scattering at the solid particles themselves generally makes relatively little contribution toward the opacity of the film. In general, the vacuole-initiating fillers have a minimum size of 1 μm in order to result in an effective, i.e. opacifying amount of vacuoles. In general, the mean particle diameter of the particles is from 1 to 6 μm , preferably from 1.5 to 5 μm . The chemical character of the particles plays a secondary role.

- 10 Conventional vacuole-initiating fillers are inorganic and/or organic, polypropylene-incompatible materials, such as aluminum oxide, aluminum sulfate, barium sulfate, calcium carbonate, magnesium carbonate, silicates, such as aluminum silicate (kaolin clay) and magnesium silicate (talc), and silicon dioxide, of which calcium carbonate and silicon dioxide are preferred. Suitable organic fillers are the
- 15 conventional polymers which are incompatible with the polymer of the base layer, in particular those such as HDPE, copolymers of cyclic olefins, such as norbornene or tetracyclododecene, with ethylene or propene (COC), as described in EP-A-0 623 463, polyesters, polystyrenes, polyamides and halogenated organic polymers, preference being given to polyesters, such as, for example, polybutylene
- 20 terephthalate, and cycloolefin copolymers. For the purposes of the present invention, "incompatible materials or incompatible polymers" means that the material or polymer is in the film in the form of a separate particle or separate phase.

The base layer preferably comprises pigments in an amount of from 0.5 to 10% by weight, preferably from 1 to 8% by weight, in particular from 1 to 5% by weight.

Vacuole-initiating fillers are preferably present in an amount of from 0.5 to 25% by weight, preferably from 1 to 15% by weight, in particular from 1 to 10% by weight. The data are based on the weight of the base layer.

- 30 The vacuole-initiating fillers reduce the density of the film. It has been found that the density of the film must be kept within narrow limits in order to ensure that the film is highly suitable for use as an in-mold label in blow molding. The density of the film

must be in the range from 0.65 to 0.85 g/cm³. Films having a density of less than 0.65 g/cm³ exhibit optical defects on use as in-mold labels in blow molding, usually in the form of the so-called orange-peel effect, where the label film is deformed on the surface with formation of millimeter-sized bubbles, which result in a visually unacceptable appearance. If the density is greater than 0.85 g/cm³, the adhesion to the container is poor. The poor adhesion at a film density of greater than 0.85 g/cm³ could be connected with the fact that the label film, with only slightly reduced density, is too inflexible at the surface and does not come into sufficiently intimate contact with the blow molding being formed. It is therefore essential to the invention that the density is in the range from 0.65 to 0.85 g/cm³, preferably from 0.7 to 0.8 g/cm³.

The overall thickness of the film is furthermore essential to the invention and is at least 85 µm, preferably from 87 to 120 µm, in particular from 90 to 100 µm. It has been found that films having an overall thickness of less than 85 µm cannot be employed as in-mold label in the blow-molding process since on use of films which are thinner than 85 µm, relatively large bubbles form between the label and blow molding which frequently appear to be bulging or blown up. This is presumably caused by air being included between the blow molding being formed and the label and being compressed under the increasing blowing pressure on a narrowing area. After demolding of the still-warm blow molding, the included air expands still further, with arching of the label.

Besides the opaque base layer, the film according to the invention comprises top layers on both sides. For the purposes of the present invention, top layers are outer layers whose outer surface forms the film surface.

The top layer of the multilayered film generally comprises at least 70% by weight, preferably from 75 to < 100% by weight, in particular from 90 to 98% by weight, of a propylene polymer and antiblocking agents and, if desired, further conventional additives, such as stabilizers and/or lubricants, for example fatty acid amides, in effective amounts in each case. Preference is given to embodiments of the top

layers which additionally comprise fatty acid amides. The above data in % by weight are based on the weight of the top layer.

- 5 The propylene polymer of the top layer is preferably a copolymer of propylene and ethylene or propylene and butylene or propylene and another olefin having from 5 to 10 carbon atoms. Also suitable for the purposes of the invention are terpolymers of ethylene and propylene and butylene or ethylene and propylene and another olefin having 5 to 10 carbon atoms. It is also possible to employ mixtures or blends of two
10 or more of said copolymers and terpolymers.

For the top layer, preference is given to ethylene-propylene copolymers and ethylene-propylene-butylene terpolymers, in particular random ethylene-propylene copolymers having an ethylene content of from 2 to 10% by weight, preferably from
15 5 to 8% by weight, or random ethylene-propylene-1-butylene terpolymers having an ethylene content of from 1 to 10% by weight, preferably from 2 to 6% by weight, and a 1-butylene content of from 3 to 20% by weight, preferably from 8 to 10% by weight, in each case based on the weight of the copolymer or terpolymer.

- 20 The copolymers and terpolymers described above generally have a melt flow index of from 1.5 to 30 g/10 min, preferably from 3 to 15 g/10 min. The melting point is in the range from 120 to 140°C. The blend of copolymers and terpolymers described above have a melt flow index of from 5 to 9 g/10 min and a melting point of from 120 to 150°C. All the melt flow indices given above are measured at 230°C and a force of
25 21.6 N (DIN 53735).

The film according to the invention has at least three layers and comprises, as essential coextruded layers, always the opaque base layer and at least one top layer on both sides. If desired, 4- and 5-layered embodiments are also possible, in which
30 the opaque layer forms the base layer of the film, and an interlayer has been applied to the surfaces of the base layer on one or both sides.

The thickness of the top layers is preferably in the range from 0.5 to 5 μm , in particular from 1.5 to 3 μm , preferably from 2 to 3 μm . Within the scope of the present invention, it has been found that comparatively thick top layers are advantageous for the film appearance, in particular for the quality of the print image on the printed outside of the label film. It has been found that, for opaque base layers having a layer thickness of up to 70 μm , the top layer thickness is comparatively unimportant. It has been found that a uniform appearance is particularly difficult to achieve with very thick opaque base layers of greater than 80 μm . This problem has been solved by providing the thick opaque base layer with particularly thick top layers of greater than 1.5 μm . Advantages have furthermore arisen with respect to the adhesion of the label to the blow molding if the layer thickness of the inner top layer, i.e. the side facing the blow molding, is greater than 1.0 μm , preferably greater than 1.5 μm . Finally, particularly good flat lying during processing of the film (printing, stacking and segregation) arose if the top layers are of identical or virtually identical thickness on both sides.

In accordance with the prior art, BOPP films are frequently corona- or flame-treated on one side in order to anchor printing inks, metal layers or adhesives to be applied. The opposite side usually remains untreated. It has been found that, on use in the cut & stack process, the in-mold label film according to the invention can be segregated particularly simply and reliably if the film is subjected to corona- or flame-pretreatment on both sides.

25

In accordance with the invention, the base layer contains a tertiary aliphatic amine in an amount of from 0.02 to 0.3% by weight, preferably from 0.05 to 0.2% by weight, and fatty acid amides in an amount of from 0.04 to 0.4% by weight, preferably from 0.07 to 0.25% by weight, and, if desired, glycerol monostearate in an amount of from 0.05 to 0.4% by weight, preferably from 0.10 to 0.25% by weight.

30

Tertiary aliphatic amines include compounds of the general formula R_3N , in which R is a fatty acid radical or a C_{12} - C_{18} -alkyl radical or a hydroxyl-substituted alkyl radical, where the radicals R may be identical or different. Hydroxyl-substituted alkyl radicals
5 are preferably hydroxyethyl, hydroxypropyl or hydroxybutyl radicals. Particular preference is given to N,N-bis(2-hydroxyethyl)alkylamines. In industry, use is frequently made of mixtures of differently substituted tertiary aliphatic amines, which may also contain hydroxyalkyl chains extended by oxyalkylidene groups. In addition, N,N-bis-hydroxyalkyl fatty acid esters may also be used.

10

The carboxylic acid amides include amides of a water-soluble carboxylic acid having 8 to 24 carbon atoms, or mixtures of these amides. Particular preference is given to erucamide, oleamide, stearamide and the like.

15 Suitable glycerol monostearates may, if desired, be substance mixtures which, besides the stearyl radical, may also contain further fatty acid radicals and differ with respect to the substitution pattern on the glycerol radical. Particularly advantageous mixtures are those having a high proportion of alpha-glycerol monostearate.

20 As part of the present invention, it has been found that films having a thickness of greater than 85 μm and a density of from 0.65 to 0.85 g/cm^3 and the additive formulation described can be processed without bubbles and without increased shrinkage and do not have an orange-peel effect. It is therefore preferred for the film to have shrinkage values of $< 4\%$ in both directions. The shrinkage is preferably from
25 0.5 to 3%, in particular 1-2%, in both directions. The shrinkage values are determined by the OPMA shrinkage test, in which the film is kept in an oven at a temperature of 130° for 10 minutes.

In order to set/improve certain properties of the polypropylene film according to the
30 invention for the production and processing of the film and for use, both the base layer and the top layers may comprise further additives in an effective amount in

each case, preferably stabilizers and/or neutralizers which are compatible with the polymers of the base layer and of the top layer(s).

- 5 Neutralizers are preferably calcium stearate and/or calcium carbonate having a mean particle size of at most 0.7 μm , an absolute particle size of less than 10 μm and a specific surface area of at least 40 m^2/g . Other neutralizers, such as DHT 4A, have also proven successful.
- 10 Stabilizers which can be employed are the conventional stabilizing compounds for ethylene, propylene and other olefin polymers. Their added amount is between 0.05 and 2% by weight. Particularly suitable are phenolic stabilizers, also in combination with phosphitic co-stabilizers, alkali metal / alkaline earth metal stearates and/or alkali metal/alkaline earth metal carbonates. Phenolic stabilizers are employed in an
- 15 amount of from 0.1 to 0.6% by weight, in particular from 0.15 to 0.3% by weight; in combination with phosphitic co-stabilizers, like the latter themselves, they are employed in an amount of from 0.04 to 0.2%, in particular from 0.05 to 0.15%. Preference is given to stabilizers and co-stabilizers which have a molar mass of greater than 500 g/mol. Pentaerythrityl tetrakis[3-(3,5-di-tertiary-butyl-4-hydroxy-
- 20 phenyl)propionate] and 1,3,5-trimethyl-2,4,6-tris(3,5-di-tertiarybutyl-4-hydroxy-benzyl)benzene, if desired in combination with (*Ultranox 626 or Irgafos 168), are particularly advantageous.

In accordance with the invention, antiblocking agents and preferably also fatty acid

25 amides are added to the top layers. The effective amount of antiblocking agent is in the range from 0.05 to 2% by weight, preferably from 0.15 to 0.6% by weight. Fatty acid amides may be present in the top layer in an amount of from 0.05 to 0.3% by weight. In addition, the top layers may also comprise siloxanes in an amount of from 0.05 to 1.0% by weight, preferably from 0.1 to 0.5% by weight, siloxane only being

30 added to the layer which is subsequently not intended for printing.

Suitable antiblocking agents are inorganic additives, such as silicon dioxide, calcium carbonate, magnesium silicate, aluminum silicate, calcium phosphate and the like, and/or incompatible organic polymers, such as polyamides, polyesters, poly-
5 carbonates, and/or crosslinked organic polymers, such as polymethacrylates and polysiloxanes and the like, preference being given to benzoguanamine-formaldehyde polymers, silicon dioxide and calcium carbonate. The mean particle size is between 1 and 6 μm , in particular between 2 and 5 μm , particles having a spherical shape, as described in EP-A-0 236 945 and DE-A-38 01 535, being particularly suitable.

10

The invention furthermore relates to a process for the production of the multilayered film according to the invention by the coextrusion process, which is known per se.

15

This process is carried out by coextruding the melts corresponding to the individual layers of the film through a flat-film die, taking off the resultant film over one or more rolls for solidification, subsequently, if desired, biaxially stretching (orienting) the film, heat-setting the optionally biaxially stretched film, and corona- or flame-treating the film on one side, preferably on both surface layers.

20

Biaxial stretching (orientation) is preferred and can be carried out simultaneously or consecutively, with consecutive biaxial stretching, in which stretching is firstly carried out longitudinally (in the machine direction) and then transversely (perpendicular to the machine direction), being particularly favorable.

25

As is conventional in the coextrusion process, the polymer or polymer mixture of the individual layers is firstly compressed and liquefied in an extruder, it being possible for any additives added already to be present in the polymer. The melts are then forced simultaneously through a flat-film die (slot die), and the extruded multilayered film is taken off on one or more take-off rolls, during which it cools and solidifies.

30

The film obtained in this way is preferably then stretched longitudinally and transversely to the extrusion direction, which results in alignment of the molecule

chains. The stretching is preferably carried out in a ratio of from 4:1 to 7:1 in the longitudinal direction and in a ratio of from 6:1 to 11:1 in the transverse direction. The longitudinal stretching is advantageously carried out with the aid of two rolls running
5 at different speeds corresponding to the desired stretching ratio, and the transverse stretching is advantageously carried out with the aid of an appropriate tenter frame.

The biaxial stretching of the film is followed by heat-setting (heat treatment) thereof, in which the film is held at a temperature from 110 to 150°C for from about 0.5 to 10
10 seconds. The film is subsequently wound up in a conventional manner by means of a wind-up unit.

It has proven particularly favorable to keep the take-off roll or rolls, by means of which the extruded film is cooled and solidified, at a temperature from 10 to 90°C,
15 preferably from 20 to 60°C.

In addition, the longitudinal stretching is advantageously carried out at a temperature below 140°C, preferably in the range from 110 to 125°C, and the transverse stretching is advantageously carried out at a temperature above 140°C, preferably
20 from 145 to 160°C.

After the biaxial stretching, one, preferably both, surface(s) of the film is (are), as mentioned above, preferably usually corona- or flame-treated by one of the known methods.

25 For the corona treatment, the film is passed between two conductor elements serving as electrodes, with such a high voltage, usually an alternating voltage (about 10000 V and 10000 Hz), being applied between the electrodes that spray or corona discharges can occur. Due to the spray or corona discharge, the air above the film
30 surface is ionized and reacts with the molecules of the film surface, causing formation of polar inclusions in the essentially non-polar polymer matrix. The treatment intensities are in the usual range, preferably from 38 to 45 mN/m.

The opaque multilayered film is highly suitable in accordance with the invention for the in-mold labeling process. The ready-labeled blow molding exhibits an optically sparkling appearance without optical defects due to the orange-peel effect or
5 bubbles. When used in accordance with the invention, the film can be processed and handled extremely well. In particular, the film can, after cutting to size and stacking, be segregated very well and without errors at high speed. None of the measures for optimizing this use impair the other important properties, such as gloss and good printability. In addition, the cut-to-size label has a very low curl tendency, which
10 enables the label stack to be handled very well.

The film can be used particularly advantageously in accordance with the invention for the labeling of blow moldings or containers made from polyethylene.

15

The invention is now explained by the examples below.

Example 1

A three-layer film having an ABA layer structure, i.e. a top layer A had been applied
20 to both sides of the base layer B, was extruded as the sum by the coextrusion method from a flat-film die at an extrusion temperature of 260°C. Both top layers A were corona-treated.

The essentially components of the base layer B were the following:

25 92.70% by weight of a propylene homopolymer (PP) having an n-heptane-soluble content of 4.5% by weight (based on 100% PP) and a melting point of 165°C; the melt flow index of the propylene homopolymer is 3.2 g / 10 min at 230°C and a load of 21.6 N (DIN 53 735);

6.0% by weight of TiO₂ via masterbatch ®P 8555 LM, supplier Schulman GmbH,
30 Hüttenstraße 211, D-54578 Kerpen;

0.10% by weight of N,N-bis(2-hydroxyethyl)(C₁₀-C₂₀)alkylamine (®Armostat 300)

0.25% by weight of erucamide

30054-5

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5% by weight of calcium carbonate having a mean particle size of 3 μm

- 5 The top layers A consisted of
 50% by weight of a random ethylene-propylene copolymer from Solvay (Eltex™
 PKS 409), having an ethylene content of 4.5% by weight, and
 0.1% by weight of antiblocking agent (@Syloblock 45) as well as
 0.1% by weight of erucamide.

10

The melting point of the copolymer was 134°C, and the melt flow index was
 7.0 g/10 min.

- 15 All layers contained 0.12% by weight of pentaerythrityl tetrakis[4-(3,5-di-tertiary-
 butyl-4-hydroxyphenyl)propionate] (@Irganox 1010) as stabilizer and 0.06% by
 weight of calcium stearate as neutralizer.

- 20 After coextrusion, the extruded three-layer film was, via the corresponding process
 steps, taken off and cooled via a first take-off roll and a further trio of rolls,
 subsequently stretched longitudinally, stretched transversely, set and corona-treated
 on both sides, with the following conditions, in detail, being selected:

- | | |
|---|------------------------------|
| Extrusion: | extrusion temperature 260 °C |
| Longitudinal stretching: | stretching roll T = 135 °C |
| 25 Longitudinal stretching by a factor of | 4.5 |
| Transverse stretching: | heating fields T = 180 °C |
| Stretching fields | T = 177 °C |
| Transverse stretching by a factor of | 8 |
| Setting: | temperature T = 155 °C |
| 30 Corona treatment: | voltage: 10,000 V |
| | frequency: 10,000 Hz |

The multilayered film produced in this way had a surface tension of from 40 to 41 mN/m on both sides directly after production. The film had a thickness of
5 approximately 90 μm , with the thickness of the top layers being about 1.8 μm . The film had a density of 0.72 g/cm³.

The film was printed, cut into label shape and stacked. The label stacks were provided in the usual manner at the blow-molding machine, and the stacks were
10 prepared for removal of the labels. The equipment and operations necessary for this purpose are known in the prior art and are described, for example, in company publications by Hoechst Trespaphan.

A blow-molding machine with automatic label feed was charged with HD-PE blow-
15 molding material and run under the usual processing conditions for HD-PE.

The results of the experiment are described in the table below.

20 Example 2

Example 1 was repeated, with the base layer containing, as lubricant and antistatic,
0.15% by weight of glycerol monostearate
0.05% by weight of N,N-bis(2-hydroxyethyl)(C₁₀-C₂₀)alkylamine (®Armostat 300)
0.05% by weight of erucamide.

25

Comparative Example 3

Example 1 was repeated, with the thickness of the film being 80 μm .

30 Comparative Example 4

Example 1 was repeated, with the thickness of the top layers being 0.7 μm .

Comparative Example 5

Example 1 was repeated, with the density of the film being 0.62 g/cm³.

5

Comparative Example 6

Example 1 was repeated, with the density of the film being 0.86 g/cm³.

Comparative Example 7

- 10 Example 1 was repeated, with only one outside of the film being corona-treated. The treated side was on the outside on laying in the blow mold.

Comparative Example 8

- 15 Example 1 was repeated, with the thickness of the top layer on the outside being 0.5 µm.

The raw materials and films were characterized using the following measurement methods:

20 Melt flow index

The melt flow index was measured in accordance with DIN 53 735 at a load of 21.6 N and at 230°C.

Melting point

- 25 DSC measurement, maxima of the melting curve, heating rate 20 K/min.

Density

The density is determined in accordance with DIN 53 479, Method A.

- 30 Assessment of the handling properties:

Curl tendency: a film sheet in DIN A4 format is laid with either the underside or the upper side on a flat substrate. After any static charge has dissipated, whether and to what extent the edges of the film lift up from the substrate is assessed and, where
5 appropriate, measured. The curl tendency is regarded as good if the edge height is less than 1 mm, moderate if it is up to 2 mm.

Segregation ability: the frequency with which a handling machine takes more than one film sheet from the stack during loading of a sheet offset printing machine or the
10 blow-molding machine is assessed. The destackability is regarded as good at an incorrect removal rate of less than 1:10,000, poor at greater than 1:5000.

Mold charging: the error rate on laying the label in the blow mold is assessed. Frequent errors are folding, turned-in edges and, in the case of electrostatic location,
15 incorrect positioning due to movement in the mold. The charging ability is regarded as good at an error rate of less than 1:10,000, and poor at greater than 1:5000.

Adhesion: it is assessed (A) whether the edge of the label can be lifted from the container without using a tool, (B) whether a film detached from the substrate at the
20 edge can be peeled off without destruction, and (C) whether the label detaches from the substrate after flexural stressing at a flexural radius of less than 3 cm. It is regarded as poor if (A) the edge spontaneously detaches from more than 1 in 100 blow moldings, if (B) the label detached at the edge can be peeled off without destruction from more than 1 in 100 blow moldings or if (C) the label detaches from
25 the substrate after flexural stressing at a flexural radius of less than 3 cm.

Appearance of the labeled bottle: the number and size of raised bubbles is assessed, and in addition the bubbles are classified by type and size.

30 Orange-peel effect: the appearance of a labeled bottle is classified as good if less than 30 bubbles of the orange-peel type are evident on the label with an area of 100 cm² and as moderate if more than 200 bubbles are evident.

Large bubbles: the appearance of a labeled bottle is classified as good if not more than 3 bubbles of not greater than 3 mm in diameter and not greater than 0.5 mm in height are evident on a label area of 100 cm². The appearance is regarded as poor if
 5 more than 15 smaller bubbles of not greater than 3 mm in diameter and not greater than 0.5 mm in height or one bubble of greater than 10 mm in diameter or 2 mm in height are evident. The bottles that count are the worst ones.

10 The table below shows the properties of the in-mold-labeled, blow-molded bottles from the examples.

	Handling	Adhesion	Appearance
Example 1	good	good	good
Example 2	good	good	good
Comparative Example 3	good	good in the areas in contact	large bulging bubbles
Comparative Example 4	good	poor (detaches at the edge, flexural test poor)	poor gloss
Comparative Example 5	still good	good	poor (orange-peel effect)
Comparative Example 6	very good	poor (detaches at the edge, can be peeled off with substantially no destruction)	poor (waved appearance after spontaneous detachment from the blow molding)
Comparative Example 7	moderate (segregation flawed)	good	good
Comparative Example 8	poor (tendency to curl during printing)	good	good

30054-5

19

CLAIMS:

1. Use of an opaque, multilayered polypropylene film as an in-mold label in blow-molding which has a base layer and at least two top layers, wherein: the base layer
5 contains a vacuole-initiating filler, the film has an overall thickness of at least 85 μm , the base layer contains a combination of a tertiary aliphatic amine and a fatty acid amide, both top layers contain an antiblocking agent, the density of the film is in the range from 0.65 to 0.85 g/cm^3 ,
10 and the film has been corona- or flame-treated on both surfaces.
2. The use according to claim 1, wherein the base layer contains the aliphatic amine in an amount of from 0.02 to 0.3% by weight and the fatty acid amide in an amount of
15 from 0.04 to 0.4% by weight.
3. The use according to claim 1 or 2, wherein the thickness of the film is between 87 and 120 μm , and the thickness of the top layers is between 0.5 and 5 μm .
4. The use according to any one of claims 1 to 3,
20 wherein the thicknesses of the top layers differ by less than 30%.
5. The use according to any one of claims 1 to 4, wherein the base layer further contains glycerol monostearate.
- 25 6. The use according to claim 5, wherein the base layer contains the glycerol monostearate in an amount of from 0.05 to 0.4% by weight.
7. The use according to any one of claims 1 to 6, wherein both top layers contain the fatty acid amide.

30054-5

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8. The use according to claim 7, wherein both top layers contain the fatty acid amide in an amount of from 0.05 to 0.3% by weight.

9. The use according to any one of claims 1 to 8,
5 wherein the base layer is opaque and comprises the vacuole-initiating filler in an amount of from 1 to 15% by weight and further comprises a pigment in an amount of from 1 to 10% by weight.

10. The use according to any one of claims 1 to 9,
10 wherein the anti-blocking agent is present in an amount of from 0.05 to 2% by weight and has a mean particle diameter of from 1 to 6 μm .

11. The use according to any one of claims 1 to 10, wherein the film has a shrinkage of < 4% in both directions.

15 12. A container labeled in accordance with the use according to any one of claims 1 to 11.

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