

HDPE/POLYPROPYLENE FILM LAMINATES

- 5 This invention is concerned with film laminates of two different polymers having the utility of a packaging film.

All polymeric films posses both good and bad characteristics. An organic polymer film that may be an excellent barrier film for
10 excluding the transmission of oxygen and water vapor may be a poor film regarding flexibility, heat sealability, printability and appearance. Polypropylene film per se has poor heat seal characteristics and usually needs to be modified in order to improve its barrier characteristics. Polyethylene films on the other hand,
15 while excellent for structures such as grocery sacks or bread wrappers is not an excellent packaging film for products such as snack foods. Polyethylene does not have the clarity and high gloss characteristics required by food packagers.

- 20 It is an object of the present invention to present a laminated film structure that takes advantage of the best characteristics of both types of polymer films.

The present invention is concerned with a film combination laminate
25 of:

(A) a layer of biaxially oriented high density polyethylene (HDPE) film comprising at least 50 wt. % of HDPE having a density of 0.960 or greater; and

(B) a layer of biaxially oriented polypropylene film.

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As indicated above the laminate of the present invention comprises essentially a layer (A) and a layer (B) laminated together by any appropriate means which will effect a secure bond between the two layers. Layer (A) is preferably a biaxially oriented high density
35 polyethylene film having a density of 0.960 or greater. Films of this

type are disclosed in U.S. Patent No. 4,870,122 issued to P.C. Lu, the disclosure of which is incorporated herein in its entirety. The HDPE layer can be composed exclusively of a single HDPE resin, a mixture of HDPE resins, or of HDPE containing a minor proportion of up to about 10 wt. % microcrystalline wax. Films made with either a blend of HDPE resins or with microcrystalline wax reduce the splittingness of the film which manifests itself as a tendency of the film to break in the TD direction during packaging on vertical, form, fill and seal (VFFS) machinery.

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The blends of HDPE polymers can comprise two or more polymers all of which preferably have densities of 0.960 or greater. Blends of HDPE polymers advantageously comprise a major proportion of HDPE having a melt index of 0.6 to 1.2 and one or more polymers having a different melt index.

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Terblends have been found particularly desirable. Suitable terblends generally comprise 50 to 98 weight percent, preferably 84 to 96 weight percent of HDPE having a density of 0.960 or higher and a melt index of greater than 0.5 to about 2.0; 1 to 25 weight percent, preferably 3 to 8 weight percent of HDPE having a density of 0.960 or greater and a melt index of 0.1 to 0.5; and 1 to 25 weight percent, preferably 3 to 8 weight percent, of HDPE having a density of 0.960 or higher and a melt index of greater than 2 to about 8. Preferably, the second and third HDPE polymers, which are minor components, are present in about equal amounts.

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It is preferred that the HDPE films of this invention be biaxially oriented in an unbalanced manner. By this is meant that the HDPE is oriented to a degree of 1.25:1 to about 2:1 in the machine direction (MD) and to a degree of about 6:1 to about 12:1 in the transverse direction (TD). The HDPE can be coextruded with conventional heat-seal materials, e.g. Surlyn or EP copolymers.

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The layer (B) type film is a biaxially oriented polypropylene film. For example, an oriented polypropylene slip film is essentially composed of isotactic polypropylene which contains a minor portion of a coefficient of friction reducing additive present therein. Such an additive, e.g. erucamide, can be present in an amount from about 200 to 400 parts per million. The oriented polypropylene film can also be of the type which has a surface skin layer of a heat sealable material coextruded therewith. This skin can be on one or both sides of the polypropylene core layer. A suitable heat sealable layer can be an ethylene propylene random or block copolymer containing from about 2-6% of ethylene. Another type of polypropylene film which can be employed as the layer (B) herein is described in U.S. Patent 4,377,616 to Ashcraft et al. This type of film is an opaque biaxially oriented polymer film structure of lustrous satin appearance. It is essentially 3 layers, the center layer being a cavitated core layer of polypropylene carrying thin skin layers of non-cavitated polypropylene on the surface thereof.

The laminates of the present invention can be formed by extrusion lamination or adhesive lamination. In extrusion lamination an extruder delivers molten polymer to between the two moving substrates desired to be laminated. The substrates are brought together at the nip of a rubber roll and a chill roll and bonded by means of the molten polymer squeezed therebetween. A convenient bonding polymer would be a low density polyethylene having a density of anywhere from about 0.900 to about 0.929. Another effective laminating material is an ethylene-methacrylic acid copolymer salt ionomer available from DuPont.

In adhesive lamination, two layers are bonded together by means of a tie coat adhesive. The adhesive is dispersed in a vehicle and applied wet to one substrate and the vehicle (water or solvent) is driven off. The two layers are then pressure bonded together e.g. by passing them thru pressure rollers. Convenient adhesives can be any water based acrylic adhesive or a solvent based polyurethane adhesive.

The following Examples illustrate the invention.

EXAMPLES 1 AND 2

Layers (A)

Two biaxially oriented films (1a and 2a) having 1.1 mil final
5 thicknesses were prepared by coextruding a HDPE layer comprising 95%
of the film and a Surlyn 1652 (ethylene-methacrylic acid copolymer
salt ionomer-heat seal material from DuPont) layer comprising 5% of
the layer thickness. The HDPE of film 1a had a melt index of 1 and a
density of 0.960. The HDPE of film 2a was a blend of 90% of the 1a
10 film HDPE with 5% of a HDPE having a melt index of 0.45 and a density
of 0.960 and 5% of a HDPE having a melt index of 3.0 and a density of
0.960. Both layers were oriented 1.4 times MD and 10 times TD.

Layers (B)

A 1.25 mil white opaque polypropylene film (1b) was obtained having a
15 core layer of polybutylene terephthalate - cavitated polypropylene and
thin skin layers of the same polypropylene but without the PBT. The
core amounted to 40% of the film thickness and each skin layer 30%.
The film was oriented 8 times TD and 5 times MD. A 0.12 mil coating
of a commercially available adhesive Adcote-333 (a polyurethane
20 dispersed in a vehicle, available from Morton Thiokol, Inc.) was
applied to one surface and the vehicle evaporated.

A second polypropylene film (2b) of a thickness of 0.45 mil and
biaxially oriented 5 times TD and 8 times MD was obtained. This film
25 was coated with a 0.04 mil thickness of the same adhesive as applied
to film (1b).

Films (1a) and (1b) were laminated together by means of the Adcote-333
adhesive. The films were laminated by passing them through opposed
30 pressure rolls to form the finished laminate. In the laminate the
Surlyn layer is outermost. The films (2a) and (2b) were likewise
laminated together.

EXAMPLES 3 to 5

In these examples essentially the same HDPE film was employed and in
35 each case the films were coated on one side with Surlyn as in Examples
1 and 2.

The HDPE film of Example 3 was laminated to a 0.75 mil homopolymer polypropylene slip film containing a stearamide slip additive and a silica anti-block additive. This film had been oriented 8 times TD and 5 times MD. The HDPE film of Example 4 was laminated to a 0.7 mil polypropylene homopolymer which had a coextruded skin of a terpolymer of ethylene, propylene, butene -1 on both sides thereof. The skin layers constituted 4% each of the polypropylene film thickness. The HDPE of Example 5 was laminated to a 0.45 mil homopolypropylene film which had been oriented 8 times TD and 5 times MD. In these examples the high density polyethylene film was extrusion laminated to the polypropylene films employing a low density polyethylene having a density of 0.92 (Chevron 1017). For this lamination a continuous film of the molten low density polyethylene is extruded from a slot die and placed between the two layers (A) and (B). The sandwich is passed between a rubber roll and chill roll to effectively laminate the film together. The LDPE bond thickness is about 0.60 mil in each case. The physical properties of these films are listed below.

<u>Sample #</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Gauge, mil	2.47	1.59	2.44	2.38	2.15
WVIR, g/100in ² , 24hr, 100°F, 90%RH	0.17	0.20	0.15	0.16	0.18
Lamination bond strength, g/in	300	470	340	270	260
Crimp seal strength g/in, 20psi, 3/4 sec. at 220°F	390	400	370	380	400
Dead fold	good	good	good	good	good

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The above 5 laminated films were run on a Hayssen VFFS machine at 40 bags per minute. The packaging trial was run successfully with no web break. All the films showed a broad heat seal temperature of 70°F.

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CLAIMS

1. A film combination which comprises a laminate of: (A) a layer of
biaxially oriented high density polyethylene (HDPE) film comprising at
least 50 wt.% of HDPE having a density of 0.960 or greater; and (B) a
layer of a biaxially oriented polypropylene film.
2. A combination according to claim 1 wherein the HDPE comprises a
major proportion of a first HDPE having a density of at least 0.960
and a melt index from 0.6 to 1.2 and a minor proportion of a second
HDPE having a melt index different from the first HDPE.
3. A combination according to claim 1 or 2 wherein the HDPE
comprises from 50 to 98 wt.% of a first HDPE having a melt index from
greater than 0.5 to 2.0; from 1 to 25 wt.% of a second HDPE having a
melt index from 0.1 to 0.5; and from 1 to 25 wt.% of a third HDPE
having a melt index from greater than 2 to 8, all of the HDPE having a
density of at least 0.960.
4. A combination according to any preceding claim wherein the HDPE
film contains up to 10 wt.% of microcrystalline wax.
5. A combination according to any preceding claim wherein the
oriented polypropylene film has at least one skin layer of a heat
sealable polymer thereon.
6. A combination according to any preceding claim wherein layers (A)
and (B) are extrusion laminated together.
7. A combination according to any preceding claim wherein layers (A)
and (B) are adhesively laminated together.