627180

COMMONWEALTH of AUSTRALIA
Patents Act 1952

APPLICATION FOR A STANDARD PATENT

I/We

Shell Oil Company

of

900 Louisiana Street, Houston, Texas, 77002, United States of America

hereby apply for the grant of a Standard Patent for an invention entitled:

A composition comprising polymers of but-1-ene and propylene

which is described in the accompanying complete specification.

Details of basic application(s):-

Number	Convention Country	Date
198548	United States of America	24 May 1988

The address for service is care of DAVIES & COLLISON, Patent Attorneys, of 1 Little Collins Street, Melbourne, in the State of Victoria, Commonwealth of Australia.

DATED this TWENTY THIRD day of MAY 1989

To: THE COMMISSIONER OF PATENTS

.....
a member of the firm of
DAVIES & COLLISON for
and on behalf of the
applicant(s)

Davies & Collison, Melbourne

M 009284 230589

T-4508

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952–1973

DECLARATION IN SUPPORT OF CONVENTION OR NON-CONVENTION APPLICATION FOR A PATENT OR PATENT OF ADDITION

In support of the Application made for a patent for an invention entitled: A COMPOSITION COMPRISING POLYMERS OF BUT-1-ENE AND PROPYLENE

Insert title of invention

I RAND N. SHULMAN, Assistant General Counsel

Insert full name(s) and address(es) of declarant(s) being the applicant(s) or person(s) authorized to sign on behalf of an applicant company.

of: SHELL OIL COMPANY, a Corporation organised and existing under the laws of the State of Delaware, United States of America of:900, Louisiana, Houston, Texas 77001, United States of America.

do solemnly and sincerely declare as follows :-

Cross out whichever of paragraphs 1(a) or 1(b) does not apply

1(a) relates to application made by individual(s)
1(b) relates to application made by company; insert name of applicant company.

1(a) I am / we are the applicant for the patent / patent of addition

or 1(b) I am authorized by SHELL OIL COMPANY,

the applicant for the patent / patent of addition to make this declaration on its behalf

Cross out whichever of paragraphs 2(a) or 2(b) does not apply

2(a) relates to application made by inventor(s)
2(b) relates to application made by company(s) or person(s) who are not inventor(s). Insert full name(s) and address(es) of inventors.

2(a) I am / we are the actual inventor of the invention

or 2(b) CHARLES CHIU HSIUNG HWO, a citizen of the United States of America of: 2710 Sugarwood, Sugarland, Texas, United States of America.

the actual inventor / are the actual inventors of the invention and the facts upon which the applicant is / are entitled to make the application are as follows :-

State manner in which applicant(s) derive title from inventor(s)

"The Applicant would, if a patent were granted upon an application made by the Inventor, be entitled to have the patent assigned to it"

Cross out paragraphs 3 and 4 for non-convention applications. For convention applications, insert basic country(s) followed by date(s) and basic applicant(s).

3. The basic application as defined by Section 141 of the Act was made

in U.S.A. No. 198,548 on the 24th May, 1988

by CHARLES CHIU HSIUNG HWO

in ..... on the .....

by .....

in ..... on the .....

by .....

4. The basic application referred to in paragraph 3 of this Declaration was / were the first application made in a Convention country in respect of the invention the subject of the application.

Insert place and date of signature.

Declared at Houston this 3rd day of May 1989

Signature of declarant(s) (no attestation required)

Note: Initial all alterations.

DAVIES & COLLISON, MELBOURNE and CANBERRA.

(12) PATENT ABRIDGMENT (11) Document No. AU-B-35116/89
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A COMPOSITION COMPRISING POLYMERS OF BUT-1-ENE AND PROPYLENE

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(56) Prior Art Documents
AU 603422 11485/88 C08L 23/10
AU 597158 13036/88 C08L 23/10
US 3356765

(57) Claim

1. A composition comprising 10% or less by weight of a low molecular weight, isotactic but-1-ene polymer having a melt index of from 50 to 1000, and at least 90% by weight of a propylene polymer.

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COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

COMPLETE SPECIFICATION

NAME & ADDRESS
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COMPLETE SPECIFICATION FOR THE INVENTION ENTITLED:

A composition comprising polymers of but-1-ene and propylene

The following statement is a full description of this invention, including the best method of performing it known to me/us:-

The present invention relates to compositions comprising a high melt flow isotactic but-1-ene polymer and a propylene polymer. Such compositions are suitable for molding into shaped articles or for films, sheets or fibers. The films and sheets are either shrinkable or non-shrinkable and can be biaxially or monoaxially oriented. Furthermore, the compositions can be processed into tape.

Films of thermoplastic polymer compositions have found many commercial uses, particularly in packaging. One use of such films is in the production of shrink films and films for wrapping foods. Blown films are also popular in the commercial arena. Methods for producing blown film from commercial film grade polybutylene resins are described, for example, in Technical Bulletin SC:397-79 of Shell Chemical Company, "Processing Shell Polybutylene Film Grade Resins," published May 1979.

US-A-3,808,304 discloses heat sealable blends of but-1-ene homopolymers and polypropylene. It does not discuss using high melt index but-1-ene polymers prepared by peroxide cracking. In addition, it discloses that preferred blends comprise 20 to 80% by weight of polypropylene.

US-A-4,075,290 discloses heat sealable blends of 80 to 99% by weight of polybutylene and 1 to 20% by weight of polypropylene. The disclosure is limited to specified ranges

of each polymer component.

US-A-4,345,004 claims a heat sealable blend prepared from copolymers of but-1-ene and ethylene from about 2 to 9% by weight of polypropylene and from about 0.02% to 1.5% by weight of high density polyethylene.

The present invention provides a composition comprising 10% or less by weight of a low molecular weight, isotactic but-1-ene polymer, having a melt index from 50 to 1000, and at least 90% by weight of a propylene polymer.

The composition suitably further comprises from 0.1 to 1% by weight of an additive. The additive is typically at least one mold release agent, U. V. stabilizer, thermal stabilizer, filler, slip agent, antiblock agent, nucleating agent, pigment, antioxidant or flame retardant.

The but-1-ene polymer used in the compositions of the invention preferably has a melt index of from 150 to 225. Examples of suitable but-1-ene polymers include but-1-ene homopolymers and copolymers of but-1-ene and from 1 to 30 mole % of a C_2 - C_8 α-olefin.

The propylene polymer is suitably a propylene homopolymer, or a copolymer of propylene and from 1 to 30 mole % of a C_2 - C_8 α-olefin other than propylene. A preferred composition of the invention comprises 95% by weight of the propylene polymer and 5% by weight of the but-1-ene polymer.

The present invention further provides molded articles, sheets and films formed from the composition defined above in

accordance with the invention. The molded articles are suitably molded by any conventional method, such as thermal molding or injection molding. Alternatively the articles may be blow molded using conventional blow molding techniques.

In addition the present invention provides fibers prepared from the composition as defined above in accordance with the invention. The fibers may be formed by any conventional method, such as the spin draw method.

The sheets formed from the compositions of the present invention have improved processing properties and good optical properties. These sheets can be biaxially oriented to give films having good optical properties. The number of scraps which result from making films with a biaxially stretched system is reduced in the present invention.

The blown articles formed from the compositions of the invention have high gloss and clarity compared with those formed from more conventional low melt index but-1-ene polymer blends. In addition, the fibers which are formed from the compositions of the invention exhibit improved stretchability over conventional fibers and are also capable of being spun. It is believed that the high melt index but-1-ene polymers act as a lubricant or plasticizer for the predominantly propylene polymer fibers.

The isotactic but-1-ene polymer referred to herein is a but-1-ene polymer comprising at least 95%, typically at least 97%, and preferably 98%, by weight of isotactic portions.

Isotactic but-1-ene polymers having a low molecular weight, for example 300,000 or less as determined by solution viscosity in "Decalin" (decahydronophthalene), are particularly useful. Suitable but-1-ene polymers generally have a density of 914 to 919 kgm^{-3}, for example from 916 to 919 kgm^{-3} and especially from 917 to 919 kgm^{-3}. They have melt indices in the range of from 50 to 1000, for example from 150 to 225 and particularly from 175 to 225 determined by ASTM D-1238 Condition E, at 190°C.

As stated above, the but-1-ene polymers (PB) used in the invention are either but-1-ene homopolymers or copolymers. If but-1-ene copolymers are used, the non-butene comonomer content typically is from 1 to 30 mole % of either ethylene, propylene, or a C_5 - C_8 α-olefin.

Suitable but-1-ene polymers can be prepared, for example, by the Ziegler-Natta low-pressure polymerization of but-1-ene. An example of such a process, disclosed in DE-A-1570353, comprises polymerizing but-1-ene with catalysts of $TiCl_3$ or $TiCl_3/AlCl_3$ and $Al(C_2H_5)_2Cl$ at temperatures of 10 to 50°C, generally, 20 to 40°C. High melt indices are then obtained by further processing the polymer by peroxide cracking.

An example of a but-1-ene polymer which is particularly suitable for the present invention is "PB0800", a developmental polymer produced by Shell Chemical Company, of Houston, Texas. This novel polymer is a homopolymer having a melt index of 200.

As stated above, the propylene polymers used in accordance

with the invention are either propylene homopolymers or copolymers. If propylene copolymers are used, they are suitably either random or block copolymers. The comonomer content is typically from 1 to 30 mole % of ethylene, butene or a C_5 - C_8 α-olefin. The propylene polymer typically has a melt index of 60 or less, preferably from 1 to 15 as measured by ASTM D-1238, Condition L at 230°C. An example of a propylene polymer which is particularly suitable is "PP5C08" available from Shell Chemical Company, of Houston Texas. This polymer has a melt index of 2.8.

When the end use contemplated for the composition of the invention is a shrink film, random copolymers of propylene having a C_2 content of 3.5% by weight are particularly suitable. The high melt index PB used in the composition of the invention improves the stretching, processability and optical properties of these random copolymers and appears to result in a film having certain properties similar to those of vinyl.

When one or more additives as described above are added to the composition of the invention, the amount is from 0.1 to 1% by weight based on the total weight of the composition. The additive is suitably added to one or more of the principal components prior to their blending; alternatively, the additive is added during or after the blending of the principal components.

The components of the composition of the invention are

blended by one of several methods. Examples include tumble blending, masterbatch, and melt compounding techniques. The particular method used to blend the components is only significant as regards the ultimate commercialization of the product. For example, it is in some cases desirable to use the least amount of energy to merge the components into an effective blend.

After blending, the compositions of the present invention can be formed into sheets, fibers or molded articles using conventional manufacturing equipment. Sheets are typically formed using conventional casting equipment, wherein the composition is cast, passed through a die and then placed into a solid phase pressure forming device which produces the sheets. Films can be prepared from the sheets by stretching or orienting the sheets or, alternatively, by using tubular film blown processing equipment. Such processing techniques are well known in the art. Articles can be formed directly from the composition of the invention or from the sheets using blow molding equipment.

The sheets and articles formed from the compositions of the invention can have a variety of shapes and varying cross-sectional thickness. For example, the gauge of a sheet is typically from 508 to 7620 m (20-300 mils). Examples of parts and articles that can be made from the composition include liquid containers, spouts for inflatable bags, car parts and other types of articles.

US-A-4,354,004 discloses suitable methods for converting compositions of the present invention into blow molded articles, such as bottles. The compositions can be processed on equipment designed for the manufacture of polypropylene articles, substantially in the same manner as other commercially molded polymer articles.

When compositions of the present invention are processed into fibers, conventional techniques are used such as spin draw technique or the melt spinning technique. Monofilament or multifilament fibers may be produced. If multifilament fibers are prepared, 16 to 64 hole spinnerettes and Godet rollers to stretch the drawn filaments are typically used.

The present invention also includes laminates comprising a composition as defined above in accordance with the invention disposed on a substrate. The substrate is suitably nylon, polyester or polycarbon. An additional tie layer adhesive is optionally present between the substrate and the composition.

The following Examples further illustrate the invention. In the Tables following the Examples, Table I will show that improvement in particular stretch properties, and in some cases optical properties, has been achieved with the compositions of the invention as compared with a control composition of 100% polypropylene. Tables II and III will show that there is no significant difference in the water vapor transmission rate (WVTR) using the compositions of the invention compared with

the control. Similarly, the tensile data will show that there is no significant reduction of the tensile properties for the composition of the invention comprising 5% by weight of but-1-ene polymer. As regards the processability of the compositions of the invention, less stretching force was required and the compositions were biaxially oriented more easily than with the control.

Tables II and III will show further results on the same biaxially oriented film. An improvement in the optical properties of the high flow but-1-ene polymer on propylene polymer film will be evident from the data. The stretching temperature of the compositions of the invention comprising PB modified PP films were lower than that of the control. A tubular film line was also used to assess the stretching ability in terms of bubble stability. An improvement for the high melt flow PB was observed.

EXAMPLE 1

Formulation I was prepared from 95 % by weight "PPC508"(PP), available from Shell Chemical Co. of Houston, Texas (a propylene homopolymer having a melt index of 2.8) and 5 % by weight "DP0800", (PB), a but-1-ene homopolymer also known as "WBS608" having a melt index of 200, and a developmental polymer of Shell Chemical Co. of Houston, Texas. The "PPC508" amd "PB0800" were dry-tumbled for about 1 hour in a drum at room temperature. The dry-tumbled blend was placed in a 31.75 mm single stage single screw Brabender

extruder, with the screw having a mixing head disposed thereon. The compounding was run at a temperature from 215.5 to 232.2°C (420° to 450°F) and the mixture was given a residence time of about 5 minutes in the extruder. The mixture was extruded into a strand, cooled and chopped into pellets using conventional techniques. Sheets were then prepared by the casting process using a sheet processing line which consisted of a Killion extruder. Sheets were prepared of 508 m (20 mils) in thickness.

The sheets were tested on a biaxial stretcher. The stretcher was either an Iwamoto Film Stretcher available at the University of Akron or was a T.M. Long Stretcher available at the University of Tennessee. Sheet samples were drawn using a 4.4 stretch ratio. The stretching conditions on the sheet were as follows: Draw Temperature - 150°C, Draw Speed - 30 mm/sec or 54 mm/sec, Pre-heat time - 3 minutes, and grip force 860 to 1035 k Pa - (125-150 psi). Table I, which follows, provides the results of the stretching for Formulation I on the TM Long Stretcher as Samples 9-16, 29-32, 42, 50, 51, 53, 59, 62, 65, 70-72 and 84. In Tables II and III which follow, additional data is provided on tests performed on Formulation I using the Iwamoto film stretcher and the TM Long Stretcher respectively.

EXAMPLE 2

Formulation II was prepared from 90 % by weight "PPC508" (PP) and 10 % by weight "PB0800" (PB). Formulation II was

prepared in a manner identical to Formulation I as described in Example 1. Sheets of Formulation II were prepared in a manner identical to the Sheets of Formulation I, also as described in Example 1. Testing of formulation II was carried out on a biaxial stretcher under the same conditions described in Example 1. Table 1 which follows provides the results of the stretching of Formulation II on the TM Long Stretcher as stretched samples 17-24, 33-36, 38, 39, 41, 43-47, 54, 58, 60, 64, 73-76, 79, 80 and 83. In Tables II and III which follow, additional data is provided on tests performed on Formulation II using the Iwamoto and the TM Long Stretcher, respectively.

COMPARATIVE EXAMPLE

A composition was prepared as a control, comprising 100 % to "PPC508" polypropylene (PP). Samples of this control were tested as described in Example 1 for Formulation I. Table I which follows provides the results of the stretching of the control, as samples 1-8, 25-28, 37, 40, 48-49, 52, 55-57, 61, 63, 66-69, 77-78 and 81-82.

In Tables II and III which follow, additional data is provided on the properties of the control composition.

TABLE 1

COMPOSITIONS ACCORDING TO EXAMPLES 1 AND 2 AND THE COMPARATIVE EXAMPLE TESTED ON A T.M. LONG BIAXIAL FILM STRETCHER

Sample No.	Composition (w%)	Draw Temp °C	Draw Speed (mm/sec)	Preheat Time (min)	Remark
1 to 8	100 PP	150	30	3	Good stretching
9 to 16	95 PP/5 PB	150	30	3	Good stretching
17 to 24	90 PP/10 PB	150	30	3	Good stretching
25 to 28	100 PP	150	30	3	Good stretching
29 to 32	95 PP/5 PB	150	30	3	Good stretching
33 to 36	90 PP/10 PB	150	30	3	Good stretching
37	100 PP	120	30	3	Would not stretch
38	90 PP/10 PB	120	30	3	Would not stretch
39	90 PP/10 PB	125	30	3	Slightly stretch
40	100 PP	125	30	3	Would not stretch
41	90 PP/10 PB	130	30	3	Slightly stretch
42	95 PP/5 PB	130	30	3	Slightly stretch
43	90 PP/10 PB	135	30	3	Stretch half way
44	90 PP/10 PB	135	30	3	Stretch half way
45	90 PP/10 PB	140	30	3	Stretch 3/4 fully
46	90 PP/10 PB	145	30	3	Good stretch
47	90 PP/10 PB	145	30	3	Good stretch
48	100 PP	145	30	3	Good stretch
49	100 PP	145	30	3	Good stretch
50	95 PP/5 PB	145	30	3	Good stretch
51	95 PP/5 PB	145	30	3	Good stretch
52	100 PP	145	54	3	Good stretch
53	95 PP/5 PB	145	54	3	Good stretch
54	90 PP/10 PB	145	54	2	Good stretch
55	100 PP	145	54	2	Good stretch
56	100 PP	145	54	1	Good stretch
57	100 PP	145	54	0.5	OK but orange peel
58	90 PP/10 PB	145	54	0.5	Good stretch
59	95 PP/5 PB	145	54	0.5	Slight orange peel
60	90 PP/10 PB	140	54	3	Good stretch
61	100 PP	140	54	3	Slightly stretch
62	95 PP/5 PB	140	54	3	Slightly stretch
63	100 PP	140	54	3	Slightly stretch
64	90 PP/10 PB	140	54	3	Good stretch
65	95 PP/5 PB	142.5	54	3	Good stretch
66	100 PP	142.5	54	3	Stretch half way
67	100 PP	145	54	3	Good stretch
68	100 PP	145	54	0.5	OK but orange peel
69	100 PP	145	54	0.5	OK but orange peel
70	95 PP/5 PB	145	54	0.5	Slight orange peel
71	95 PP/5 PB	145	54	0.5	Slight orange peel
72	95 PP/5 PB	145	54	0.5	Slight orange peel

TABLE 1 (cont'd)

73	90 PP/10 PB	145	54	0.5	Good stretch
74	90 PP/10 PB	145	54	0.5	Good stretch
75	90 PP/10 PB	145	54	0.5	Good stretch
76	90 PP/10 PB	145	54	0.5	Good stretch
77	100 PP	160	54	3	OK but film hazy
78	100 PP	160	54	3	OK but film hazy
79	90 PP/10 PB	160	54	3	Uneven stretch
80	90 PP/10 PB	160	54	3	Uneven stretch
81	100 PP	160	54	0.5	Uneven but clear
82	100 PP	160	54	0.5	Uneven but clear
83	90 PP/10 PB	160	54	0.5	Uneven but clear
84	95 PP/5 PB	160	54	0.5	Uneven but clear

**PP is Shell PP508 (2.8 MF homopolymer) and PB is DURAFLEX^{R} Polybutylene WBS608 (200 MI)
These films were stretched using a T. M. Long Stretcher

TABLE II

FILM PROPERTIES OF COMPOSITIONS ACCORDING TO EXAMPLES 1 AND 2 AND THE COMPARATIVE EXAMPLE

Property	100 w% PP5C08 Control	95 w% PP5C08 + 5 wt% PB0800 Formulation I	90 w% PP5C08 + 10 w% PB0800 Formulation II
Optics			
Haze, %	0.55	0.40	0.55
Gloss (@60°)	100	117	100
Clarity, %	69	75	76
Specimen Thickness m (mil)	11.43 (0.45)	15.75 (0.62)	11.43 (0.45)
WVTR @37.8°C (100°F) & 90% RH			
$kg/m^2/day$ ($g/100in^2/day$)	0.014 (0.902) @8.89/m (0.35mil)	0.0094 (0.605) @13.97/m (0.55mil)	0.0096 (0.620) @10.16/m(0.40mil)
(g. mil/100 in^2/day)	(0.315)	(0.328)	(0.248)
Mechanical			
Tensile, kPa (psi)	$1.69x10^5$ (24,540)	$1.71x10^5$ (24,841)	$1.42x10^5$ (20,545)
Elongation, %	34	42	70
Modulus, kPa (psi) (1% Secant)	$3.13x10^6$(453,458)	$3.01x10^6$ (435,855)	$1.79x10^6$ (260,183)
Stretching Force, Kg	10-18	8-15	8-12

Haze was determined by a haze meter ASTM D1003.
Gloss was determined by ASTM D2457.
Clarity was determined by ASTM, D 1003.
WVTR was determined by ASTM E96.
Tensile was determined by ASTM D882.
Elongation was determined by ASTM D882.
Modulus was determined by ASTM D882.
Stretching Force was determined by the dial reading of the Iwamoto Stretcher.

These formulations were stretched using an Iwamoto Stretcher.

TABLE III

FILM PROPERTIES OF COMPOSITIONS ACCORDING TO EXAMPLES 1 AND 2 AND THE COMPARATIVE EXAMPLE

Property	PP5C08 Control	PP5C08 + 5 wt% PB0800	PP5C08 + 10 wt% PB0800
Optics			
Haze, %	2.59	1.40	1.10
Gloss (@60°)	75.9	85.9	85.4
Clarity, %	5.3	24.5	17.0
Specimen Thickness m (mil)	20.32 (0.80)	18.79 (0.74)	20.83 (0.82)
WVTR, @37.8°C (@100°F) & 90% RH kg/m^2/day (g/100 in^2/day)	0.0066 (0.425) @16.51μm(0.65 mil)	0.0074 (0.475) 16.51μm(0.65 mil)	0.0083 (0.535) 16.51μm(0.65 mil)
(g. mil/100 in^2/day)	(0.276)	(0.309)	(0.348)
Mechanical			
Tensile, kPa (psi)	1.63x10^5 (23,695)	1.39x10^5 (20,253)	1.28x10^5 (18,599)
Elongation, %	84	82	88
Modulus, psi (1% Secant)	2.43x10^6 (351,911)	2.68x10^6 (388,472)	2.14x10^6 (309,716)
Stretching Temperature Window,	145-160°C(293-320°F)	142-160°C(289-319°F)	140-158°C(284-315°F)

Haze was determined by a haze meter ASTM D1003.
Gloss was determined by ASTM D2457.
Clarity was determined by ASTM, D 1003.
WVTR was determined by ASTM E96.
Tensile was determined by ASTM D882.
Elongation was determined by ASTM D882.
Modulus was determined by ASTM D882.
Stretching Force was determind by the dial reading of the T. M. Long Stretcher.

These samples were stretched on the T. M. Long Stretcher.

The claims defining the invention are as follows:

1. A composition comprising 10 % or less by weight of a low molecular weight, isotactic but-1-ene polymer having a melt index of from 50 to 1000, and at least 90 % by weight of a propylene polymer.

2. A composition according to claim 1 comprising from 0.1 to 1 % by weight of an additive.

3. A composition according to claim 2, wherein the said additive is at least one of a mold release agent, U.V. stabilizer, thermal stabilizer, filler, slip agent, antiblock agent, nucleating agent, pigment, antioxidant or flame retardant.

4. A composition according to any one of the preceding claims wherein the isotactic but-1-ene polymer has a melt index of from 150 to 225.

5. A composition according to any one of the preceding claims wherein the isotactic but-1-ene polymer comprises a but-1-ene homopolymer, or a copolymer of but-1-ene and from 1 to 30 mole % of a C_2 - C_8 α-olefin comonomer.

6. A composition according to any one of the preceding claims wherein the propylene polymer comprises a propylene homopolymer, or a copolymer of propylene and from 1 to 30 mole % of a C_2 or C_4 to C_8 α-olefin comonomer.

7. A composition according to any one of the preceding

claims comprising 95 % by weight of the said propylene polymer and 5% by weight of the said isotactic but-1-ene polymer.

8. A composition according to claim 1 and substantially as hereinbefore described in Example 1 or 2.

9. A molded article, a fiber, a film or sheet prepared from a composition as claimed in any one of claims 1 to 8.

10. A molded article according to claim 9 which is a blow-molded article.

11. A laminate comprising a composition as claimed in any one of claims 1 to 8 disposed on a substrate.

12. A molded article, a fiber, a film or sheet according to claim 9 and substantially as hereinbefore described.

Dated this 18th day of May, 1992

SHELL OIL COMPANY
By its Patent Attorneys
DAVIES COLLISON CAVE