I/We, the Applicant(s)/Nominated Person(s) specified below, request I/We be granted a patent for the invention disclosed in the accompanying standard complete specification.

Applicant(s)/Nominated Person(s):
Himont Incorporated, incorporated in Delaware, of 2801 Centerville Road, Wilmington, Delaware, 19850-5439, UNITED STATES OF AMERICA

Invention Title:
Blends of a Graft Copolymer of Propylene Polymer Material With A Graft Copolymer of Olefinic Rubber Material

Inventor(s):
Anthony J. DeNicola, Jr.

Address for service in Australia:
Spruson & Ferguson, Patent Attorneys
Level 33 St Martins Tower
31 Market Street
Sydney New South Wales Australia (Code SF)

Details of Basic Application(s):

Appl'n No(s): 593,142
Country: US
Application Date: 5 October 1990

DATED this FOURTH day of OCTOBER 1991

Himont Incorporated

By: [Signature]

Registered Patent Attorney

IRN: 192309
INSTR CODE: 55475
COMMONWEALTH OF AUSTRALIA
THE PATENTS ACT 1952
DECLARATION IN SUPPORT OF A
CONVENTION APPLICATION FOR A PATENT

In support of the Convention Application made for a patent for an invention entitled:

**Title of Invention**

BLENDS OF A GRAFT COPOLYMER OF PROPYLENE POLYMER MATERIAL WITH A GRAFT COPOLYMER OF OLEFINIC RUBBER MATERIAL

Signed Homer Paul Appleby on behalf of HIMONT Incorporated

of 2801 Centerville Road
P. O. Box 15439
Wilmington, DE 19850-5439
United States of America

do solemnly and sincerely declare as follows:

1. **Full name(s) and address(es) of Declarant(s)**

   Homer Paul Appleby on behalf of HIMONT Incorporated

   of 2801 Centerville Road
   P. O. Box 15439
   Wilmington, DE 19850-5439
   United States of America

2. **Full name(s) of Applicant(s)**

   Anthony J. DeNicola, Jr.

   of 16 Grayfox Ridge
   Newark, DE 19713
   United States of America

3. **Full name(s) and address(es) of inventor(s)**

   Anthony J. DeNicola, Jr.

4. **Set out how applicant(s) derive(s) from actual inventor(s)**

   The Applicant is the assignee of the invention from the inventor

5. **Basic Country(ies)**

   in United States of America

6. **Priority Date(s)**

   on October 5, 1990

7. **Basic Applicant(s)**

   Anthony J. DeNicola, Jr.

8. **Basic application(s)**

   The basic application(s) as defined by Section 141 of the Act were made

9. **I am/We are the actual inventor(s) of the invention referred to in the basic application(s)**

10. **I am/We are authorised by**

    HIMONT Incorporated

    the applicant(s) for the patent to make this declaration on its/their behalf.

11. **The basic application(s) referred to in paragraph 2 of this Declaration was/were the first application(s) made in a Convention country in respect of the invention(s) the subject of the application.**

12. **Declared at Delaware**

    this 7th day of September 1991

    HIMONT Incorporated

13. **To: The Commissioner of Patents**

    Homer Paul Appleby, VP, Law & General
    General Counsel
(19) AUSTRALIAN PATENT OFFICE

(54) Title
BLENDS OF A GRAFT COPOLYMER OF PROPYLENE POLYMER MATERIAL WITH A GRAFT COPOLYMER OF OLEFINIC RUBBER MATERIAL

International Patent Classification(s)
C08L 051/06  C08L 023/08  C08L 023/16

(21) Application No.: 85625/91  (22) Application Date: 04.10.91

(30) Priority Data

(31) Number  (32) Date  (33) Country
593142  05.10.90  US  UNITED STATES OF AMERICA

(43) Publication Date: 09.04.92

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(57) Claim

1. A thermoplastic blend comprising, by weight, (A) 40 to 90% of a graft copolymer of a propylene polymer material having a polymerized monomer content of 5 to 70% and (B) 10 to 60% of a graft copolymer of an olefin rubber material having a polymerized monomer content of 5 to 50%, wherein the grafting monomer(s) are selected from the group consisting of (i) an aromatic vinyl compound, (ii) an acrylic compound, (iii) mixtures of (i) and (ii), and (iv) other copolymerizable monomers selected from the group consisting of C_{1-10} linear or branched alkyl acrylates, acrylic acid, methacrylic acid, glycidyl methacrylate, glycidyl acrylate, acrylonitrile and methacrylonitrile with at least one (i) or at least one (ii) or mixtures of at least one (i) and at least one (ii) wherein said other copolymerizable monomer being present in an amount of up to 50%.
Name and Address of Applicant: Himont Incorporated  
2801 Centerville Road  
Wilmington Delaware 19850-5439  
UNITED STATES OF AMERICA

Actual Inventor(s): Anthony J. DeNicola, Jr.

Address for Service: Spruson & Ferguson, Patent Attorneys  
Level 33 St Martins Tower, 31 Market Street  
Sydney, New South Wales, 2000, Australia

Invention Title: Blends of a Graft Copolymer of Propylene Polymer Material With A Graft Copolymer of Olefinic Rubber Material

The following statement is a full description of this invention, including the best method of performing it known to me/us:-
This invention relates to blends comprising a grafted copolymer of propylene polymer material and a graft copolymer of olefin rubber material, wherein the grafting monomers are (i) aromatic vinyl compounds, (ii) acrylic compounds, (iii) mixtures of (i) and (ii), or (iv) other copolymerizable monomers with at least one (i) or at least one (ii) or mixtures of at least one (i) and at least one (ii).

Typically, graft copolymers of olefin polymer materials have been impact modified with ethylene/propylene copolymer rubber, ethylene/propylene/diene monomer rubber, and ASA polymers. For example, U.S. Patent 3,314,904 describes forming a "gum plastic" by making a graft copolymer of styrene on polyethylene or polypropylene, and, in particular, a graft interpolymer of styrene, acrylonitrile, and polyethylene or polypropylene, and blending the graft copolymer with certain selected compatible rubbery materials. The grafted styrene or styrene/acrylonitrile content of the graft copolymer is 75-95%, preferably 85-95%, and more preferably 90-95%.

Hence the graft copolymer is predominantly bound styrene or bound styrene/acrylonitrile, and in the graft copolymers made from polypropylene, the polypropylene is only a minor component and present as a dispersed phase. Thus the properties of the bound styrene or styrene/acrylonitrile predominate. The graft copolymer is made by subjecting the polyolefin to high-energy ionizing radiation, and then contacting the irradiated polyolefin with styrene or with styrene and acrylonitrile.
U.S. Patent 4,537,933 discloses a blend of a polyolefin graft polymer, preferably a polyvinyl halide polyolefin graft polymer, and an ASA polymer. The ASA polymer is a copolymer of styrene and acrylonitrile (SAN) that is modified with an acrylate polymer, a chlorinated polyethylene or an olefin-diolefin modified polymer, such as an ethylene/propylene polyene modified polymer. The ASA polymer modified with the olefin-diolefin modified polymer has a styrene/acrylonitrile content of 60-95%. The properties of the SAN predominate since the rubber is only a minor component and present as a dispersed phase. Also, the matrix phase of the polymeric components must be miscible.

It has now been found that by functionalizing olefin rubber materials and blending said functionalized olefin rubber with a graft copolymer of a propylene polymer material, wherein the chains of the polymerizable (co)monomers used to functionalize the rubber and grafted on the propylene polymer are of a similar chemical structure, blends are obtained having improved weldline strength, impact strength and stiffness while retaining a balance of other properties. The blends are useful as stand-alone structural plastics for injection molding articles and extruded profiles.

According to the present invention, there is provided a blend which comprises (a) a graft copolymer of a propylene polymer material having a grafted monomer content of 5 to 70% and (b) a graft copolymer of an olefin rubber having a grafted monomer content of 5 to 50%, wherein the grafting monomers are selected from (i) an aromatic vinyl compound, (ii) an acrylic compound, (iii) mixtures of (i) and (ii), and (iv) other copolymerizable monomers selected from the group consisting of C_1-10 linear or branched alkyl acrylates, acrylic acid, methacrylic acid, glycidyl methacrylate, glycidyl acrylate, acrylonitrile and
methacrylonitrile with at least one (i) or at least one (ii) or mixtures of at least one (i) and at least one (ii).

Unless otherwise specified all percentages and parts are by weight in this specification.

The propylene polymer material backbone of component (a) can be (i) a homopolymer of propylene, (ii) a random copolymer of propylene and an olefin selected from ethylene and $C_4$-$C_{10}$ alpha-olefins, provided that, when the olefin is ethylene, the maximum polymerized ethylene content is about 10%, preferably about 4%, and when the olefin is a $C_4$-$C_{10}$ alpha-olefin, the maximum polymerized content thereof is about 20%, preferably about 16% or (iii) a random terpolymer of propylene with two alpha-olefins selected from the group consisting of ethylene and $C_4$-$C_8$ alpha-olefin, provided that the maximum polymerized $C_4$-$C_8$ alpha-olefin content is about 20%, preferably about 16%, and when ethylene is one of said alpha-olefins, the maximum polymerized ethylene content is about 5%, preferably about 4%. The $C_4$-$C_{10}$ alpha-olefins include linear or branched $C_4$-$C_{10}$ alpha-olefins such as 1-butene, 1-pentene, 4-methylpentene-1, 3-methyl-1-butene, 1-hexene, 3,4-dimethyl-1-butene, 1-heptene, 3-methyl-1-hexene and the like.

Preferred propylene polymer material backbones are polypropylene and ethylene/propylene random copolymer.

The olefin rubber backbone of component (b) can be (i) an ethylene/propylene copolymer rubber (EPR) having an ethylene content of from 30 to 70%, (ii) an ethylene/butene-1 copolymer rubber (EBR) having an ethylene content of from 30 to 70%, (iii) a propylene/butene-1 copolymer rubber (PBR) having a butene-1 content of from 30 to 70%, (iv) an ethylene/propylene/non-conjugated diene monomer rubber (EPDM) having an ethylene content of 30 to 70% and diene content of from 1 to 10%, (v) an ethylene/propylene/butene terpolymer rubber (EPBR) having a propylene content.
of from 1 to 10% and butene content of from 30 to 70% or a propylene content of from 30 to 70% and butene content of from 1 to 10%, (vi) a homopolymer of propylene impact modified with from 10 to 80% of an ethylene/propylene copolymer rubber, an ethylene/butene copolymer rubber, an ethylene/propylene/non-conjugated diene monomer rubber and/or an ethylene/propylene/butene terpolymer rubber, (vii) a random copolymer of propylene and an olefin selected from ethylene and \( \text{C}_4-\text{C}_{10} \) alpha-olefins impact modified with from 10 to 80% of (i), (ii), (iii), (iv) and/or (v). In (vi) and (vii) the ethylene content is from 30 to 70%; the diene content, if present, is from 2 to 8%; and when the EPB terpolymer is used, the propylene content is from 1 to 10% when the butene content is from 30 to 70%, or the propylene content is from 30 to 70% when the butene content is from 1 to 10%. Examples of the non-conjugated dienes include 1,4-hexadiene, ethylidene-norbornene and dicyclopentadiene. The \( \text{C}_4-\text{C}_{10} \) alpha-olefins include linear or branched C\(_4\)-C\(_{10}\) alpha-olefins, such as 1-butene, 1-pentene, 4-methylpentene-1, 3-methyl-1-butene and 1-hexene. Preferred are ethylene/propylene/non-conjugated diene monomer rubber and ethylene/propylene rubber impact modified polypropylene.

The monomer(s) to be grafted onto the propylene polymer material backbone of component (a) and the olefin rubber backbone of component (b) can be (i) aromatic vinyl compounds selected from styrene, an alkyl or alkoxy ring-substituted styrene where the alkyl or alkoxy is a \( \text{C}_1-\text{C}_4 \) linear or branched alkyl or alkoxy, mixtures thereof wherein the alkyl or alkoxy ring-substituted styrene is present in an amount of from 5 to 95%, or mixtures of styrene or an alkyl or alkoxy ring-substituted styrene with 5 to 40% of alpha-methyl-styrene or alpha-methyl-styrene derivatives; (ii) acrylic compounds selected from methyl
methacrylate, ethyl methacrylate, benzyl methacrylate, phenyl methacrylate or $C_{1-4}$ alkoxy substituted phenyl methacrylate; (iii) mixtures of (i) and (ii); or (iv) other copolymerizable monomers selected from linear or branched alkyl acrylates having from 1 to 10 carbon atoms, acrylic acid, methacrylic acid, glycidyl methacrylate, glycidyl acrylate, acrylonitrile or methacrylonitrile with at least one (i) or at least one (ii) or mixtures of at least one (i) and at least one (ii) wherein said other copolymerizable monomer is present in an amount of up to 50%, preferably 1 to 30%.

Preferred grafting monomers are styrene, methyl methacrylate, styrene/acrylonitrile, styrene/methyl methacrylate, methyl methacrylate/acrylonitrile, methyl methacrylate/methacrylonitrile, styrene/methyl methacrylate/methacrylonitrile and styrene/methyl methacrylate/acrylonitrile.

Suitable particulate forms of the grafted propylene polymer material include powder, flake, granulate, spherical, cubic and the like. Spherical particulate forms prepared from a propylene polymer material having a pore volume fraction of at least about 0.07 are preferred.

Most preferred for preparing the grafted propylene polymer material is a propylene polymer material having (1) a weight average diameter of about 0.4 to 7 mm, (2) a surface area of at least 0.1 $m^2/g$, and (3) a pore volume fraction of at least about 0.07 wherein more than 40% of the pores in the particle have a diameter larger than 1 micron. Such propylene polymer materials are commercially available from HIMONT Italia S.r.l.

The grafted propylene polymer material and olefin rubber material of the present invention are prepared by the free radical-initiated graft polymerization of at least one monomer as set forth above, at free radical sites on propylene polymer material and olefin rubber material. The
free radical sites may be produced by irradiation or by a free radical generating chemical material, e.g., by reaction with a suitable organic peroxide.

According to the method where the free radical sites are produced by irradiation, the propylene polymer material, preferably in particulate form, is irradiated at a temperature in the range of about 10°C to 85°C with high-energy ionizing radiation to produce free radical sites in the propylene polymer material. The irradiated propylene polymer material, while being maintained in a substantially non-oxidizing atmosphere, e.g., under inert gas, is then treated at a temperature up to about 100°C for a period of at least about 3 minutes, with about from 5 to 80% of the particular grafting monomer or monomers used, based on the total weight of propylene polymer material and grafting monomer(s). After the propylene polymer material has been exposed to the monomer for the selected period of time, simultaneously or successively in optional order, the resultant grafted propylene polymer material, while still maintained in a substantially non-oxidizing environment, is treated to deactivate substantially all of the residual free radicals therein, and any unreacted grafting monomer is removed from said material.

The free radical deactivation of the resulting graft copolymer is conducted preferably by heating, although it can be accomplished by the use of an additive, e.g., methyl-mercaptan, that functions as a free radical trap. Typically the deactivation temperature will be at least 110°C, preferably at least 120°C. Heating at the deactivation temperature for at least 20 minutes is generally sufficient.

Any unreacted grafting monomer is removed from the graft copolymer, either before or after the radical deactivation, or at the same time as deactivation. If the
removal is effected before or during deactivation, a substantially non-oxidizing environment is maintained.

In the method where the free radical sites are produced by an organic chemical compound, the organic chemical compound, preferably an organic peroxide, is a free radical polymerization initiator which has a decomposition half-life of about 1 to 240 minutes at the temperature employed during the treatment. Suitable organic peroxides include acyl peroxides, such as benzoyl and dibenzoyl peroxides; dialkyl and aralkyl peroxides, such as di-tert-butyl peroxide, dicumyl peroxide, cumyl butyl peroxide, 1,1-di-tert-butylperoxy-3,5,5-trimethyl-cyclohexane, 2,5-dimethyl-2,5-di-tert-butylperoxyhexane, and bis(alpha-tert-butyl peroxyisopropylbenzene); peroxy esters, such as tert-butylperoxypivalate, tert-butyl perbenzoate, 2,5-dimethylhexyl-2,5-di(perbenzoate), tert-butyl-di(perphthalate), tert-butylperoxy-2-ethyl hexanoate; and 1,1-dimethyl-3-hydroxybutylperoxy-2-ethyl hexanoate; and peroxy carbonates, such as di(2-ethylhexyl) peroxy dicarbonate, di(n-propyl)peroxy dicarbonate, and di(4-tert-butylcyclohexyl)peroxy dicarbonate. The peroxides can be used neat or in a diluent medium, having an active concentration of from 0.1 to 6.0 pph, preferably from 0.2 to 3.0 pph.

According to this method, the propylene polymer material, preferably in particulate form, at a temperature of from about 60°C to 125°C is treated with from 0.1 to 6.0 pph of a free radical polymerization initiator described above. The polymer material is treated with about 5 to 240 pph of a grafting monomer at a rate of addition that does not exceed 4.5 pph per minute at all addition levels of 5 to 240 pph of the monomer, over a period of time which coincides with, or follows, the period of treatment with the initiator. In other words, the monomer and initiator may be added to the heated propylene polymer material at
the same time or the monomer may be added 1) after the addition of the initiator has been completed, 2) after addition of the initiator has started but has not yet been completed, or 3) after a delay time or hold time subsequent to the completion of the initiator addition.

After the propylene polymer material has been grafted, the resultant grafted propylene polymer material, while still maintained in a substantially non-oxidizing environment, is treated, preferably by heating at a temperature of at least 120°C for at least 20 minutes, to decompose any unreacted initiator and deactivate residual free radicals therein. Any unreacted grafting monomer is removed from said material, either before or after the radical deactivation, or at the same time as deactivation.

The grafted copolymer of propylene polymer material, component (a) is present in the amount of from 40 to 90%, preferably from 45 to 80%, most preferably 50 to 70%, based on the total composition. The grafted propylene polymer material has from 5 to 70% of the monomer grafted or graft polymerized thereto, and preferably from 25 to 55%.

The grafted copolymer of olefin rubber material, component (b) is present in the amount of from 10 to 60%, preferably from 20 to 55%, most preferably 30 to 50%, based on the total composition. The grafted olefin material has from 5 to 50% of the monomer grafted or graft polymerized thereto, and preferably from 10 to 45%.

Up to about 80 parts (total) of additives such as fillers, reinforcing agents, etc., per 100 parts of the graft copolymer and the rubber component can be included in the composition. In addition, the composition may contain about from 5 to 30 parts of a propylene polymer material per 100 parts of the graft copolymer and the rubber component, wherein suitable propylene polymer materials are as set forth herein for the propylene polymer material useful in preparing the graft copolymer.
The compositions of the present invention are prepared by mechanically blending the components in conventional mixing equipment, i.e., a single or twin screw extruder, Banbury mixer or any other conventional melt compounding equipment. The order in which the components of the composition are mixed is not critical.

The present invention will be illustrated in greater detail with reference to the examples of the invention set forth below.

**Examples 1-3, 5-7, 8-10 and 12-14**

The compositions of this invention are produced by a general procedure comprising tumble blending components (a) and (b) as set forth in Table I, until a homogeneous mixture is obtained (approximately 1 minute). The mixture was charged to a cold Banbury mill, milled until fluxed for about 3 to 5 minutes and then ground. The ground mixture was extruded at 520°F and 150 rpm in a vacuum vented, tapered, counter-rotating, intermeshing twin screw extruder manufactured by Haake. The compounded mixture was injection molded in a 42.5 gram, 25 ton Battenfeld injection molding machine with a barrel temperature of 232°C and mold temperature of 60°F. The molding cycle for the tensile and flex bars consisted of a 10 second injection time, 20 second cooling time, and 2 second mold open time, with a maximum injection speed (15 setting) and a screw speed setting of 2.

The compositions of Comparative Examples 4, 8, 11 and 15 were produced in the same manner as set forth above for the examples.

The physical properties set forth in the Tables were measured by the following methods:
<table>
<thead>
<tr>
<th>Property</th>
<th>ASTM Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength</td>
<td>D-638 (using a 5.08 cm/min crosshead without extensometer)</td>
</tr>
<tr>
<td>Break Elongation</td>
<td>D-638</td>
</tr>
<tr>
<td>Yield Elongation</td>
<td>D-638</td>
</tr>
<tr>
<td>Flexural Modulus</td>
<td>D-790 and D-618, Procedure A (1.27 cm/min crosshead speed and center section of a molded T-bar)</td>
</tr>
<tr>
<td>Flexural Strength</td>
<td>D-638, Procedure A (center section of a molded T-bar)</td>
</tr>
<tr>
<td>Notched Izod</td>
<td>D-256-87</td>
</tr>
<tr>
<td>Weldline Strength</td>
<td>D-638</td>
</tr>
</tbody>
</table>
Table I

<table>
<thead>
<tr>
<th>Composition</th>
<th>Examples</th>
<th>Comparative Example</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>PP-g-PS ¹</td>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td>Ethylene-propylene rubber impact modified polypropylene-g-PS ²</td>
<td>50</td>
<td>40</td>
</tr>
<tr>
<td>Hifax RA-063 ³</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sandostab P-EPQ</td>
<td>0.07</td>
<td>0.07</td>
</tr>
<tr>
<td>Irganox 1010 stabilizer</td>
<td>0.07</td>
<td>0.07</td>
</tr>
<tr>
<td>DSTDP ⁴</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>Tensile Strength, MPa</td>
<td>21.6</td>
<td>24.2</td>
</tr>
<tr>
<td>Weldline Strength, MPa</td>
<td>18.7</td>
<td>20.7</td>
</tr>
<tr>
<td>Retained Strength, %</td>
<td>87</td>
<td>85</td>
</tr>
<tr>
<td>Flex. Modulus, MPa</td>
<td>1123</td>
<td>1364</td>
</tr>
<tr>
<td>Flex. Strength, MPa</td>
<td>35.1</td>
<td>41.4</td>
</tr>
<tr>
<td>Yield Elongation, %</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>Break Elongation, %</td>
<td>163</td>
<td>102</td>
</tr>
<tr>
<td>Notched Izod, J/M</td>
<td>586</td>
<td>139</td>
</tr>
</tbody>
</table>

¹ Polypropylene grafted with styrene, 46% styrene content, 2.5 parts of (parts of t-butylperoxy-2-ethyl hexanoate/100 parts polypropylene) active peroxide, grafting temp. 116°C, styrene 84.4 pph, feed rate 0.77 pph/min for 110 min. deactivation at 130°C for 3 hours produced by the peroxide method set forth herein.

² Ethylene/propylene rubber impact modified polypropylene grafted with styrene, 13% styrene content, 0.50 parts of (parts of t-butylperoxy-2-ethyl hexanoate/100 parts polypropylene) active peroxide, grafting temp. 160°C, styrene 15.0 pph, feed rate 0.75 pph/min for 20 min, deactivation at 100°C for 3 hours produced by the peroxide method set forth herein.

³ Ethylene/propylene rubber impact modified polypropylene, 40% ethylene content, commercially available from HIMONT Italia S.r.l.

⁴ Distearylthiodipropionate, commercially available.
The compositions set forth in Table II were prepared according to the general procedure used for the compositions in Table I, except that a methyl methacrylate grafted polypropylene was used instead of the styrene grafted polypropylene and methyl methacrylate grafted ethylene/propylene rubber modified polypropylene was used instead of the styrene grafted ethylene/propylene rubber modified polypropylene.
The compositions set forth in Table II were prepared according to the general procedure used for the compositions in Table I, except that a methyl methacrylate grafted polypropylene was used instead of the styrene grafted polypropylene and methyl methacrylate grafted ethylene/propylene rubber modified polypropylene was used instead of the styrene grafted ethylene/propylene rubber modified polypropylene.
<table>
<thead>
<tr>
<th>Composition</th>
<th>Table II</th>
<th>Comparative Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Examples</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>PP-g-PMMA 1</td>
<td>70</td>
<td>50</td>
</tr>
<tr>
<td>Ethylene-propylene rubber impact modified polypropylene-g-PMMA</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>Hifax RA-063</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sandostab P-EPQ</td>
<td>0.07</td>
<td>0.07</td>
</tr>
<tr>
<td>Irganox 1010 stabilizer</td>
<td>0.07</td>
<td>0.07</td>
</tr>
<tr>
<td>DSTDP</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>Tensile Strength, MPa</td>
<td>26.5</td>
<td>21.7</td>
</tr>
<tr>
<td>Weldline Strength, MPa</td>
<td>25.3</td>
<td>19.6</td>
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<tr>
<td>Retained Strength, %</td>
<td>95</td>
<td>90</td>
</tr>
<tr>
<td>Flex. Modulus, MPa</td>
<td>1605</td>
<td>1185</td>
</tr>
<tr>
<td>Flex. Strength, MPa</td>
<td>47.3</td>
<td>35.3</td>
</tr>
<tr>
<td>Yield Elongation, %</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>Break Elongation, %</td>
<td>83</td>
<td>113</td>
</tr>
<tr>
<td>Notched Izod, J/M</td>
<td>133</td>
<td>213</td>
</tr>
</tbody>
</table>

1 Polypropylene grafted with methyl methacrylate (MMA), 45% MMA content, 2.0 parts of (parts of t-butylperoxy-2-ethyl hexanoate/100 parts polypropylene) active peroxide, grafting temp. 120°C, MMA 80.9 pph, BA 2.0 pph, feed rate 0.82 pph/min for 105 min, deactivation at 140°C for 20 minutes produced by the peroxide method set forth herein.

2 Ethylene/propylene rubber impact modified polypropylene grafted with MMA, 23% MMA content, 0.50 parts of (parts of t-butylperoxy-2-ethyl hexanoate/100 parts polypropylene) active peroxide, grafting temp. 100°C, MMA 30.0 pph, BA 2.0 pph, feed rate 1.40 pph/min for 23 min, deactivation at 110°C for 60 minutes produced by the peroxide method set forth herein.
The compositions set forth in Table III were prepared according to the general procedure used for the compositions in Table I, except that a styrene/acrylonitrile grafted polypropylene and styrene/acrylonitrile grafted ethylene/propylene rubber modified polypropylene were used instead of the styrene grafted polypropylene and styrene grafted ethylene/propylene rubber modified polypropylene.
<table>
<thead>
<tr>
<th>Table III</th>
<th>Comparative Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Composition</strong></td>
<td><strong>Examples</strong> 8</td>
</tr>
<tr>
<td>PP-g-PSAN</td>
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<tr>
<td>Ethylene-propylene</td>
<td>1</td>
</tr>
<tr>
<td>rubber impact modified</td>
<td>polypropylene-g-PSAN</td>
</tr>
<tr>
<td>Hifax RA-063</td>
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</tr>
<tr>
<td>Sandostab P-EPQ</td>
<td>0.07</td>
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<td>Irganox 1010 stabilizer</td>
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<td>DSTDP</td>
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<tr>
<td>Tensile Strength, MPa</td>
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<td>Weldline Strength, MPa</td>
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<td>Flex. Strength, MPa</td>
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<td>Break Elongation, %</td>
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</tr>
<tr>
<td>Notched Izod, J/M</td>
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</tbody>
</table>

1 Polypropylene grafted with styrene/acrylonitrile (SAN) (3:1 wt ratio), 46% SAN content, 2.0 parts of (parts of t-butylperoxy-2-ethyl hexanoate/100 parts polypropylene) active peroxide, grafting temp. 120°C, SAN 84.2 pph, feed rate 1.02 pph/min for 85 min, deactivation at 140°C for 30 min. produced by the peroxide method set forth herein.

2 Ethylene/propylene rubber impact modified polypropylene grafted with SAN (3:1 wt ratio), 23.2% SAN content, 1.0 parts of (parts of t-butylperoxy-2-ethyl hexanoate/100 parts polypropylene) active peroxide, grafting temp. 100°C, SAN 30.2 pph, feed rate 1.04 pph/min for 31 min, deactivation at 110°C for 45 min. produced by the peroxide method set forth herein.
The compositions set forth in Table IV were prepared according to the general procedure used for the compositions in Table I, except that Royaltuf 160 styrene grafted ethylene/propylene/non-conjugated diene monomer, was used instead the styrene grafted ethylene/propylene rubber modified polypropylene.
<table>
<thead>
<tr>
<th>Composition</th>
<th>Examples</th>
<th>Comparative Example</th>
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</thead>
<tbody>
<tr>
<td>PP-g-PS (^1)</td>
<td>80 70 60 100</td>
<td>12 13 14 15</td>
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<tr>
<td>Royaltuf 160 (^2)</td>
<td>20 30 40 -</td>
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<td>Sandostab P-EPQ</td>
<td>0.07 0.07 0.07 0.07</td>
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<td>Irganox 1010 stabilizer</td>
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<td>Flex. Modulus, MPa</td>
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<td>Break Elongation, %</td>
<td>49 96 126 4.2</td>
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<tr>
<td>Notched Izod, J/M</td>
<td>85 187 331 13</td>
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</tbody>
</table>

1 Polypropylene grafted with styrene, 45% styrene content, 1.57 parts of (parts of t-butylperoxy-2-ethylhexanoate/100 parts propylene) active peroxide, grafting temp. 100°C, styrene 84.4 pph, feed rate 2.41 pph/min., for 30 min. deactivation at 131°C produced by the peroxide method set forth herein.

2 40% styrene content, commercially available.

Other features, advantages and embodiments of the invention disclosed herein will be readily apparent to those exercising ordinary skill after reading the foregoing disclosures. In this regard, while specific embodiments of the invention have been described in considerable detail, variations and modifications of these embodiments can be effected without departing from the spirit and scope of the invention as described and claimed.
Claims

The claims defining the Invention are as follows:

1. A thermoplastic blend comprising, by weight, (A) 40 to 90% of a graft copolymer of a propylene polymer material having a polymerized monomer content of 5 to 70%, and (B) 10 to 60% of a graft copolymer of an olefin rubber material having a polymerized monomer content of 5 to 50%, wherein the grafting monomer(s) are selected from the group consisting of (i) an aromatic vinyl compound, (ii) an acrylic compound, (iii) mixtures of (i) and (ii), and (iv) other copolymerizable monomers selected from the group consisting of C\textsubscript{1-10} linear or branched alkyl acrylates, acrylic acid, methacrylic acid, glycidyl methacrylate, glycidyl acrylate, acrylonitrile and methacrylonitrile with at least one (i) or at least one (ii) or mixtures of at least one (i) and at least one (ii) wherein said other copolymerizable monomer being present in an amount of up to 50%.

2. The blend of claim 1, wherein said propylene polymer material is selected from the group consisting of a homopolymer of propylene, a random copolymer of propylene and an alpha-olefin selected from ethylene and C\textsubscript{4}-C\textsubscript{10} alpha-olefins, and a random terpolymer of propylene with two alpha-olefins selected from ethylene and C\textsubscript{4}-C\textsubscript{8} alpha-olefins.

3. The blend of claim 1, wherein said olefin rubber is selected from the group consisting of an ethylene/propylene copolymer rubber; an ethylene/butene copolymer rubber; a propylene-butene copolymer rubber; an ethylene/propylene/non-conjugated diene monomer rubber; an ethylene/propylene/butene terpolymer rubber; a homopolymer of propylene impact modified with ethylene/propylene copolymer rubber, an ethylene/butene copolymer rubber, an ethylene-
propylene/butene terpolymer rubber or ethylene/propylene/
non-conjugated diene monomer rubber; and a random copolymer
of propylene and an alpha-olefin selected from ethylene and
$C_4$-$C_{10}$ alpha-olefins impact modified with ethylene/
copolymer rubber, ethylene/propylene/non-
conjugated diene monomer rubber, an ethylene/butene
copolymer rubber or an ethylene/propylene/butene terpolymer
rubber.

4. The blend of claim 1, wherein the grafting monomer
is styrene or styrene/alpha-methylstyrene.

5. The blend of claim 4, wherein (A) is a graft
copolymer of styrene on a polypropylene backbone or an
ethylene/propylene random copolymer backbone, or a graft
copolymer of styrene/alpha-methylstyrene on a polypropylene
backbone or an ethylene/propylene random copolymer backbone
and (B) is a graft copolymer of styrene on an ethylene/pro-
pylene copolymer rubber backbone, an ethylene/propylene/
non-conjugated diene monomer rubber backbone or an
ethylene/propylene rubber impact modified polypropylene
backbone, or a graft copolymer of styrene/alpha-methyl-
styrene on an ethylene/propylene copolymer rubber, an
ethylene/propylene rubber impact modified polypropylene
backbone or an ethylene/propylene/non-conjugated diene
monomer rubber backbone.

6. The blend of claim 5, wherein (A) is a graft
copolymer of styrene on a polypropylene backbone and (B) is
a graft copolymer of styrene on an ethylene/propylene
rubber impact modified polypropylene backbone.

7. The blend of claim 1, wherein the grafting monomer
is selected from the group consisting of methyl meth-
acrylate, ethyl methacrylate, benzyl methacrylate and
phenyl methacrylate.
8. The blend of claim 7, wherein (A) is a graft copolymer of methyl methacrylate on a polypropylene backbone or an ethylene/propylene random copolymer backbone and (B) is a graft copolymer of methyl methacrylate on an ethylene/propylene rubber backbone, an ethylene/propylene/non-conjugated diene monomer rubber backbone or an ethylene/propylene rubber impact modified polypropylene backbone.

9. The blend of claim 8, wherein (A) is a graft copolymer of methyl methacrylate on a polypropylene backbone and (B) is a graft copolymer of methyl methacrylate on an ethylene/propylene rubber impact modified polypropylene backbone.

10. The blend of claim 1, wherein the grafting monomer is selected from the group consisting of styrene/methyl acrylate, styrene/ethyl acrylate, styrene/methyl methacrylate and styrene/ethyl methacrylate.

11. The blend of claim 10, wherein (A) is a graft copolymer of styrene/methyl methacrylate on a polypropylene backbone or an ethylene/propylene random copolymer backbone and (B) is a graft copolymer of styrene/methyl methacrylate on an ethylene/propylene copolymer rubber backbone, an ethylene/propylene/non-conjugated diene monomer rubber backbone or an ethylene/propylene rubber impact modified polypropylene backbone.

12. The blend of claim 11, wherein (A) is a graft copolymer of styrene/methyl methacrylate on a polypropylene backbone and (B) is a graft copolymer of styrene/methyl methacrylate on an ethylene/propylene rubber impact modified polypropylene backbone.
13. The blend of claim 1, wherein the grafting monomer is selected from the group consisting of styrene/acrylonitrile, styrene/methacrylonitrile, methyl methacrylate/acrylonitrile, methyl methacrylate/methacrylonitrile, styrene/methyl methacrylate/methacrylonitrile, and styrene/methyl methacrylate/acrylonitrile.

14. The blend of claim 13, wherein (A) is a graft copolymer of styrene/acrylonitrile on a polypropylene backbone or an ethylene/propylene random copolymer and (B) is a graft copolymer of styrene/acrylonitrile on an ethylene/propylene copolymer rubber backbone, an ethylene/propylene/non-conjugated diene monomer rubber backbone or an ethylene/propylene rubber impact modified polypropylene backbone.

15. The blend of claim 14, wherein (A) is a graft copolymer of styrene/acrylonitrile on a polypropylene backbone and (B) is a graft copolymer of styrene/acrylonitrile on an ethylene/propylene rubber impact modified polypropylene backbone.

16. The blend of claim 1, wherein (A) is present in the amount of from 45 to 80% and (B) is present in the amount of from 20 to 55%.

17. The blend of claim 1 further comprising, per 100 parts of (A) and (B), up to 80 parts by weight of one or more additives selected from the group consisting of fillers, reinforcing agents and inorganic powders.

18. The blend of claim 1 further comprising from about 5 to 30 parts of a propylene polymer material per 100 parts of (A) and (B).

19. A thermoplastic blend substantially as hereinbefore described with reference to any one of the examples excluding the comparative examples.

DATED this THIRD day of OCTOBER 1991
Himont Incorporated
Patent Attorneys for the Applicant
SPRUSON & FERGUSON

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