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(54) Titre : COMPOSITIONS THERMOPLASTIQUES A BASE D'UNE POLYOLEFINE ET D'UN POLYMERE DE COMPOSE AROMATIQUE VINYLIQUE

(54) Title: THERMOPLASTIC COMPOSITIONS BASED ON A POLYOLEFINE AND A VINYL AROMATIC POLYMER

(57) Abrégé/Abstract:
Thermoplastic compositions endowed with a optimal combination of physical, mechanical and thermal properties, comprising: - a vinyl aromatic polymer containing as an elastomeric component, from 0.5 to 5% by weight of a vinyl aromatic monomer-conjugated diene linear block polymer and from 5 to 15% by weight of a diene rubber; a polyolefine; and an olefinic elastomer containing a vinylaromatic monomer grafted thereon.

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"THERMOPLASTIC COMPOSITIONS BASED ON A POLYOLEFINE AND A VINYL AROMATIC POLYMER"

Abstract

Thermoplastic compositions endowed with a optimal combination of physical, mechanical and thermal properties, comprising:

- a vinyl aromatic polymer containing as an elastomeric component, from 0.5 to 5% by weight of a vinyl aromatic monomer-conjugated diene linear block polymer and from 5 to 15% by weight of a diene rubber;
- a polyolefine; and
- an olefinic elastomer containing a vinylaromatic monomer grafted thereon.

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The present invention relates to thermoplastic compositions based on a polyolefine and a vinyl aromatic polymer.

More perticularly, the present invention relates to thermoplastic compositions based on a polyolefine and a vinyl aromatic polymer endowed with an optimal combination of properties, including thermoformability, moldability, thermal resistance, modulus, resilience, resistance to naturally-occurring organic substances which tend to accelerate the degradation of some polymers, etc.

Such particular combination of properties makes the compositions of the present invention particularly suitable for the production of shaped articles by any forming technique known for the thermoplastic resins, such as thermoforming, injection molding, forging, rotational molding and the like.

As is known, vinyl aromatic polymers are thermoplastic resins suitable for being transformed, under heating, into shaped articles by injection or extrusion molding. Said vinyl aromatic polymers have a fair tena-

city, but they are not suitable for use in applications where a high tenacity associated with good chemical re= sistance is required.

A way to improve this lack of properties is to provide blends with other polymers having the lacking properties to obtain a material exhibiting the desired combination of properties. However, this appro= ach was successful only in a few cases; generally, in fact, the blending results in the combination of the worst characteristics of each component, the overall result being a material of such poor properties as not to be of any practical or commercial value.

The reasons for this drawback are the fact that not all polymers are compatible with each other and, therefore, do not perfectly adhere. As a result, inter= faces are formed among the components of the blend which represent weakness and breaking points.

More particularly, mixtures based on polystyrene, or generally on a vinyl aromatic polymer or copolymer, either as such or made impact resistant by grafting it with a rubber, and on a polyolefine, give rise to blends en= dowed with heterogeneous structure and mechanical wea= kness, due to the incompatibility between these two ty= pes of polymers.

Many attempts to solve the incompatibility problem have been made by using defined amounts of the two resins and making use of a so-called compatibilizing agent.

Thus, for example, U. S. Patents 4, 386, 187 and 4, 386, 188 describe the use of a styrene-buta= diene-styrene block copolymer as compatibilizing agent between the polyolefines and a vinyl aromatic polymer.

Published European Patent Application 60, 524 and Japanese Patent Publication (Kokai) 49-28637/1974 describe the use of styrene-butadiene block copolymers to compatibilize blends of a polyolefine with a high impact polystyrene or styrenic resins.

Published European Patent Application 291, 352 discloses polymeric compositions comprising a polyole= fine and a vinyl aromatic polymer containing, as elasto= meric component, small quantities of a vinyl aromatic monomer-conjugated diene linear block polymer, wherein, as a compatibilizing agent, a vinyl aromatic monomer-conjugated diene star-block polymer is used.

In English Patent 1, 363, 466 and in U. S. Patent 4, 020, 025, hydrogenated styrene-butadiene di-block copolymers are proposed as compatibilizing agent for polyolefine/styrenic polymer blends.

In the published European Patent Application 60525 and U. S. Patent 4, 188, 432, a hydrogenated styrene-butadiene-styrene block copolymer, i.e. a styrene-ethylene-butylene-styrene copolymer, is blended with styrenic and olefinic polymers.

In general, however, these approaches have not been industrial successful since the resulting blends, even if they are homogeneous, do not exhibit a satisfac= tory property combination or have other undesirable pro= perties.

Laid-open European Patent Application 195, 829 describes the use of a alpha-olefin copolymer grafted vinyl aromatic polymer, as a compatibilizing agent in the polyolefines-vinyl aromatic polymer blends.

The polymeric compositions disclosed in this European Patent Application comprise: at least 20% by weight (preferably between 20 and 90%) of a polyolefine; at least 5% by weight (preferably between 5 and 75%) of a vinyl aromatic polymer and from 2 to 15% by weight of the alpha-olefine copolymer grafted with a vinyl aromatic polymer.

Also the compositions so obtained, however, do not exhibit a satisfactory property combination for all the uses they are intended for. In particular, an accep= table value of resilience (IZOD) may be obtained by

using an excess of polyolefine; this increase, however, occurs to the prejudice of the modulus. By increasing, on the contrary, the amount of the vinyl aromatic polymer, the modulus of the composition increases but to the prejudice of the resilience thereof which assumes values of poor use interest.

Tests carried out by the Applicant have set forth that polyolefine/vinyl aromatic polymers thermoplastic compositions endowed with an optimal property combination, and, therefore, suitable for being used in all the sectors wherein high physic-mechanical characteristics are required, may be obtained by using a particular type of high-impact vinyl aromatic polymer and, as a compatibilizing agent, an olefinic elastomer containing a vinyl aromatic polymer grafted thereon having a well determined molar ratio between the elastomer and the vinyl aromatic polymer in the grafted phase.

The subject matter of the present invention is, therefore, a thermoplastic composition endowed with an optimal combination of physical-mechanical properties, comprising:

-- from 40 to 80% by weight of a vinyl aromatic polymer (A) containing, as an elastomer component, from 0.5 to 5% by weight of a vinyl aromatic monomer-conjugated diene linear block polymer and from 5 to

15% of a diene rubber;

-- from 5 to 50% by weight of à polyolefine (B); and

-- from 10 to 50% by weight of an olefinic elastomer (C) containing a vinyl aromatic polymer grafted thereon, wherein the ratio by moles between the vinyl aromatic polymer and the olefinic elastomer in the grafted phase is greater than 0.8;

the sum of the three components (A), (B) and (C) being equal to 100.

Preferably, the thermoplastic/polymeric composition of the present invention comprises the above reported components (A), (B) and (C) in the following proportions, with respect to the sum of the three components:

-- from 50 to 70% by weight of a vinyl aromatic polymer (A);

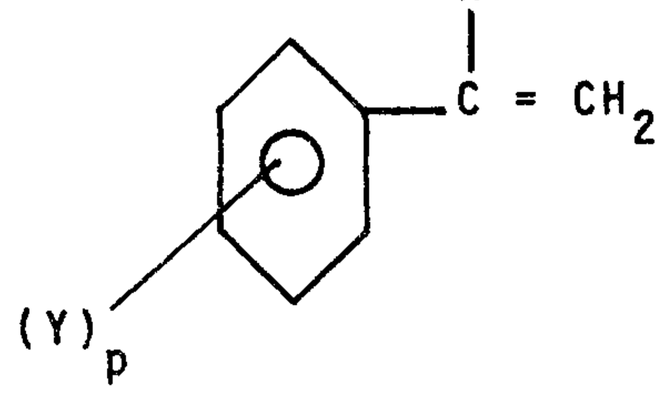
-- from 10 to 30% by weight of a polyolefine (B); and

-- from 10 to 40% by weight of an olefinic elastomer containing a vinyl aromatic polymer grafted thereon (C);

the sum of components (A), (B) and (C) being equal to 100.

The vinyl aromatic polymer (A), used in the thermoplastic compositions of the present invention, may be

prepared by carrying out the polymerization of a vinyl aromatic monomer having the general formula:



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wherein R represents hydrogen or an alkyl radical having from 1 to 4 carbon atoms; p is zero or an integer from 1 to 5, and Y represents a halogen atom or an alkyl radical having from 1 to 4 carbon atoms, in the presence of a diene rubber and of a vinyl aromatic monomer-conjugated diene linear block polymer, in the above reported amount, optionally in the presence of conventional radicalic polymerization catalysts.

Examples of vinyl aromatic monomers having the above general formula are: styrene; methyl-styrene; mono-, di-, tri-, tetra- and penta-chlorostyrene and the corresponding alpha-methyl - styrenes; styrenes alkylated in the nucleus and the corresponding alpha-methyl-styrenes such as ortho- and para-methyl-styrenes, ortho- and para-

ethyl-styrenes; ortho- and para-methyl-alpha-methyl-styrenes, and the like. These monomers may be used either alone or in admixture with each other or with other copolymerizable co-monomers such as, for instance, maleic anhydride, acrylonitrile, methacrylonitrile, C_1-C_4 alkyl esters of acrylic or methacrylic acid.

The used diene rubber is preferably comprised from 7 to 12% by weight and may be polybutadiene, low viscosity high or medium cis-polybutadiene, polyisoprene, copolymers of butadiene and/or isoprene with styrene or with other monomers.

The vinyl aromatic monomer-conjugated diene linear block polymer is preferably comprised between 2 and 5% by weight. It is per se well known in the art and available on the market. These linear block polymers contain from 20 to 75% by weight of recurring units of a vinyl aromatic monomer and, correspondingly, from 80 to 25% by weight of recurring units of a conjugated diene.

These block polymers can be constituted only by pure blocks or can optionally include random or tapered polymeric segments (B/S) or can be constituted by random and/or tapered copolymers.

The above linear block polymers are described by Allen Noshay & James E. McGrath "Block Copolymers" 1977 pages 83-92, 186-192.

Further information on the properties, structure and characteristics of these linear block copolymers is reported by Holden et al "Thermoplastic Elastomers" published by N.R. Legge et al. 1987.

Linear block polymers of this type are available on the market for example as "SOLPRENE® 1205", "SOLPRENE® 308" and "SOLPRENE® 314" produced and sold by Phillips Petroleum.

The preparation of the vinyl aromatic polymer (A) can be carried out according to any known suspension, bulk-suspension or continuous bulk polymerization process.

A preferred method of preparation consists in carrying out a pre-polymerization of the vinyl aromatic monomer in the presence of conventional free radical catalysts, of the dienic rubber and of the above block polymer, in a first reactor up to the attainment of a conversion lower than 50% by weight of the fed monomers. Then, the polymerization is completed in one or more subsequent reactors. The thus-obtained polymer is then devolatilized and granulated.

The polyolefines (B) suitable for use in the blends according to the present invention are well known in the art. These polyolefines include, for example,

polymers of ethylene, propylene and butene, the copo=lymers of two or more of these monomers as well as the copolymers of one or more of these monomers with one or more different monomers polymerized therewith. Such different copolymerizable monomers include, for example, olefin monomers having from 5 to 25 carbon atoms, ethylenically unsaturated carboxylic acids (both mono- and di- functional) as well as derivati=ves of these acids, such as esters and anhydrides. Exemplary monomers which can be copolymerized include acrylic acid, methacrylic acid, vinyl acetate and ma=leic anhydride and the like. The preferred olefin co=polymers contain at least 50% by weight of ethylene, propylene and/or butene and more preferably at least 75% by weight.

The particularly preferred polyolefine is po=lyethylene including either the linear low density polyethylene (LLDPE) or the medium density or the high density polyethylene. Other poly=olefines such as polypropylene and polybutene as well as the ethylene-propylene copolymers and the ethylene-vinyl acetate (EVA) copolymers, also may be used.

In component (C) of the composition of the pre=sent invention, the olefinic elastomer, which constitu=tes the substrate on which the vinylaromatic polymer is

grafted, is a rubber like copolymer, having a Mooney viscosity ranging from 10 to 150 ML-4 at 100°C, of at least two different alpha-mono-olefines having a stra= ight chain such as ethylene, propylene, butene-1, oc= tene-1 and the like, with at least another copolymeri= zable monomer, generally a polyene and typically a non-conjugated diene. Preferably one of the alpha-mono-olefines is ethylene together with another alpha-mono-olefine having a longer chain.

The weight ratio of ethylene to the other alpha-mono-olefine in the rubber like copolymer is usually in the range of from 20/80 to 80/20. Particularly prefer= red copolymers are the ethylene/propylene/non-conjuga= ted diene terpolymers in which the non-conjugated diene can be cyclic or acyclic such as: 5-methylene-2-norbor= nene; 5-ethylidene-2-norbornene; 5-isopropylene-2-nor= bornene; pentadiene-1,4; hexadiene-1,4; hexadiene-1,5; heptadiene-1,5; dodecatriene-1,7,9; methyl-heptadiene-1,5; norbornadiene-2,5; cyclo-octadiene-1,5; dicyclopen= tadiene; tetrahydroindene; 5-methyl-tetrahydroindene, etc. The diene content ranges from about 2 to 20% by weight and preferably from 8 to 18% by weight of diene monome= ric units in the rubber-like terpolymer. Particularly interesting results are obtained by using a rubber-like terpolymer having a Mooney viscosity (ML-4), determined

at 100°C, ranging from 30 to 90 and a iodine number higher than 5 and preferably ranging from 10 to 40. The graft or superstrate portion of component (C) is a vinyl aromatic polymer as is defined above.

The grafting reaction of the vinyl aromatic polymer on the elastomeric substrate may be carried out by any of the grafting techniques generally known in the art. Thus, the olefinic elastomeric component can be contacted with the vinyl aromatic monomer or monomers in a polymerization system of well-known bulk, bulk-solution, suspension, bulk-suspension types or the like.

In general, the grafting reaction can be free radical, namely thermally, chemically or radiation ini= tiated, anionic or Friedel-Crafts.

The grafting techniques of vinyl monomers on an olefinic substrate are well known and described, for example, in U. S. Patents 3, 489, 822; 3, 489, 821; 3, 642, 950; 3, 819, 765; 3, 538, 190; 3, 538, 191; 3, 538, 192; 3, 671, 608; 3, 683, 050; 3,876,727; 4, 340, 669.

It is understood that in the grafting polymeri= zation not all the vinyl aromatic monomer is grafted on the rubber like substrate; a portion of the monomer forms a free polymer which is present in physical

admixture with the grafted polymer. Preferably the molecular weight of the grafted vinyl aromatic polymer is about equal to that of the non-grafted polymer.

In order to achieve the objects of the present invention, it is necessary that, as said before, the vinyl aromatic polymer/olefinic elastomer molar ratio in the grafted phase be higher than 0.8 and preferably comprised between 1 and 2.

This ratio can be regulated by carrying out the grafting polymerization of the vinyl aromatic monomer on the olefinic elastomer in the presence of variable amounts of initiator, solvent and/or chain transfer, as described in Italian Patent 1, 007, 901, "La Chimica e l'Industria" Vol. 47, n. 4, 1965 and Vol. 59, n. 7, 9 and 10, 1977.

The molecular weight of the vinyl-aromatic polymer grafted on the olefinic support can influence the properties of the compositions; excellent results are obtained with vinylaromatic polymers having a molecular weight higher than 50,000 and up to 500,000 and, preferably, a molecular weight about equal to that the vinyl aromatic polymer of component (A).

In addition to components A, B and C, the compositions of the present invention can contain reinforcing additives such as for example glass fibres, carbon

fibres, organic and inorganic high-modulus fibres, metal fibres, inorganic fillers, etc., as well as antiflame agents, dyestuffs, pigments, stabilizers, lubricants, etc., which are well-known to those skilled in the art.

The reinforcing additives can be used in amounts generally not exceeding 50% by weight and preferably not higher than 30% by weight calculated on the total compo= sition.

Particularly preferred reinforcing additives are the glass fibres which can be untreated or, better, trea= ted with silanes or titanates, as is well-known to the technicians and to the manufacturers of said fibres.

Suitable stabilizers to be used in the composi= tions of the present invention comprise many of the known thermal and oxidation stabilizers which are suitable and generally utilized for vinyl aromatic polymers and/or polyolefines. For example, phosphites, phosponites and hindered phenols can be added to the compositions of the present invention in amounts which can range from 0.05 to 5% by weight.

The method for producing the compositions of the present invention is not critical and any conventional method is utilizable.

Generally, mixing is carried out in the molten state with preliminary pre-mixing at room temperature.

The time and temperature are selected and determined as a function of the composition. The temperatures are generally in the range of from 180 to 300°C.

Any known mixing unit can be utilized. The method can be continuous or discontinuous. Specifically, single-screw and two-screw extruders, Banbury inner mix= ers, mixing rollers, Brabender plastographs and the like can be used.

The compositions of the present invention are easily processable by injection molding or by extrusion and exhibit a complex of properties which make them suita= ble to be utilized for the manufacture of shaped articles having a high impact strenght along with a good stiffness and chemical resistance. Thanks to these properties, the compositions of the present invention can be used in the sectors of food packaging and refrigerants.

In order to better understand the present invention and to reduce it to practice, a few illustrative examples are given hereinafter, which however are not limitative of the scope of the invention.

EXAMPLES 1 to 3

In a blender of rotating drum type the following components were blended, at room temperature:

-- an impact-resistant styrene polymer (A) con= taining dispersed in the polymeric matrix 7.75% by weight

of a polybutadiene rubber and 3% or a linear block polymer (SOLPRENE® 1205 produced and sold by Phil= lips Petroleum) containing 25% of styrene and 75% of butadiene and having a molecular weight of 75,000, in the amounts listed in Table I;

-- a linear low density polyethylene (LLDPE) (B) having a density of 0.926 g/cm^3 and an M.F.I. (Melt Flow Index) of 0.7 g/10 min. (at 190°C-2.16 Kg.), in the amounts listed in Table I; and

-- a polystyrene grafted EDPM elastomer (C), having the following composition: 50% by weight of EPDM (Mooney viscosity equal to 62-72 ML-4 at 100°C and a iodine number equal to 18), 42% by weight of grafted polystyrene and 8% by weight of free polysty= rene having a weight/molecular weight average (Mw) equal to 273,000, wherein the polystyrene/elastomer molar ratio in the grafted phase is 1.14, in the amounts listed in Table I.

The blends were homogenized into a Brabender plastograph equipped with a 50 ml cell heated at 200°C.

The Brabender mastication speed was 80 r.p.m. and the residence time of the blend in the plastograph was 3 minutes.

The resulting blends were ground, compression molded at 180°C and characterized.

The so obtained blends characteristics are indicated in the following Table I.

In Table I, the measured characteristics and the employed methods were as follows:

Mechanical properties

There were determined: the IZOD notch resiliency at 23°C, according to standard ASTM D 256, on 3.2 mm thick specimens; the ultimate tensile strength modulus according to and the elastic standard ASTM D 790.

Thermal properties

The VICAT softening temperature was determined at 1 kg and at 5 kg in oil, according to standard ISO 306.

TABLE I

		EX.1	EX. 2	EX. 3
COMPONENT A		75	66,7	58,3
COMPONENT B		15	13,3	11,7
COMPONENT C		10	20	30
MECHANICAL PROPERTIES	UNITS			
. IZOD	J/m	102	184	400
. Ultimate tensile strength	N/mm^2	32,5	32	30
. Elastic modulus	N/mm^2	1600	1550	1350
THERMAL PROPERTIES				
. VICAT at 1 kg	°C	102	101.5	101.
. VICAT at 5 kg	°C	89	88	83

The polystyrene/elastomer molar ratio in the grafted phase of component (C) is determined by first removing any materials other than polystyrene (both grafted and free) and EPDM rubber (both grafted and ungrafted. To do this, a 0.5 g of component (C) is dissolved in 5 ml of toluene and to the solution 3 ml of acetone are added. The polymers are precipitated by slowly adding 10 ml of 2-propanol. The mixture is centrifuged and the clear solvent is decanted from the precipitate and discarded.

Next, the free polystyrene is separated from the EPDM rubber and graft copolymer by selective pre= cipitation.

To do this, the precipitate from above is dis= solved in 5 ml of toluene. With agitation, 7 ml of a methyl ethyl ketone/-acetone solution (1:1 volume ratio) are slowly added, resulting in a very fine dispersion. Approximately, 15 ml of a methanol/methyl ethyl ketone/ acetone solution (1:2:2 volume ratio)are slowly added with agitation until coagulation of a white precipitate begins. The mixture is centrifuged and the clear super= natant liquid decanted from the precipitate. The super= natant liquid contains the free polystyrene which can be characterized by gel permeation chromatography. The pre= cipitate contains the free EPDM rubber as well as the

EPDM-polystyrene graft copolymer. The graft to rubber ratio of this sample can be determined by infrared spectroscopy. The percentage of the rubber which is grafted with polystyrene is then calculated via a sta= tistical method using the graft to rubber ratio, the molecular weight of the EPDM rubber and the molecular weight of the polystyrene, assuming the free polysty= rene and grafted polystyrene have the same molecular weight. This statistical method is described by L. H. Tung and R. M. Wiley in the Journal of Polymer Science. Polymer Physics Edition, Volume. 11, page 1413, 1973.

EXAMPLES 4 to 6

The operative modalities of example 1 were re= peated for preparing blends containing the same compo= nents of example 1 with the exception that the EPDM elastomer containing polystyrene grafted thereon (com= ponent C_1) had the following composition: 50% by weight of EPDM (Mooney viscosity 62-72 ML-4 at 100°C and a io= dine number of 18), 43% by weight of grafted polystyrene and 7% by weight of free polystyrene having a weight average molecular weight (Mw) of 360,000, wherein the polysty= rene/elastomer molar ratio in the grafted phase is 1.2.

The characteristics of the so obtained blends were the following:

TABLE II

		EX.4	EX.5	EX.6
COMPONENT A		75	66,7	58,3
COMPONENT B		15	13,3	11,7
COMPONENT C_1		10	20	30
MECHANICAL PROPERTIES	UNITS			
• IZOD	J/m	84	170	310
• Ultimate tensile strength	N/mm^2	34	31	32,5
• Elastic modulus	N/mm^2	1550	1500	1350
THERMAL PROPERTIES				
• VICAT at 1 kg	°C	103	102	101
• VICAT at 5 kg	°C	90	86	80

EXAMPLE 7

The operative modalities of example 1 were repeated for preparing a blend constituted by:

-- 66,7% by weight of the impact-resistant vinyl-aromatic polymer of example 1;

-- 13,3% by weight of polyethylene of example 1, and

-- 20% by weight of an EPDM elastomer containing polystyrene grafted thereon (component C_2) having the following composition: 50% by weight of EPDM (Mooney viscosity 62-72 ML-4 at 100°C and a iodine number of 18), 28% by

weight of grafted polystyrene and 22% of free poly= styrene having a weight average molecular weight (Mw) of 207,000, wherein the polystyrene/elastomer molecu= lar ratio in the grafted phase was 1.1.

The properties of the blend were:

Mechanical Properties

. IZOD	149	J/m
. Ultimate tensile strength	31.5	N/mm^2
. Elastic modulus	1500	N/mm^2

Thermal Properties

. VICAT at 1 Kg	102°C
. VICAT at 5 Kg	86°C

EXAMPLES 8 - 9 (comparison tests)

By operating according to the operative con= dititions of example 1, blends were prepared consti= tuted by:

-- 66,7% by weight of the impact resistant polymer (A) of the type reported in example 1;

-- 13,3% by weight of linear polyethylene (B) of the type reported in example 1;

-- 20% by weight of a EPDM elastomer contai= ning polystyrene grafted thereon selected: in example 8 from a grafted polymer having the following composition: 50% by weight of EPDM (Mooney viscosity 62-72 ML-4 at 100°C and a iodine number of 18), 47.4% by weight of graf= ted polystyrene and 2.6% of free polystyrene having

a weight average molecular weight (Mw) of 1,320,000 and wherein the polystyrene/elastomer molar ratio in the grafted phase is 0.35; and/a grafted polymer (C_4) having in example 9 from the following composition: 50% by weight of EPDM (Mooney viscosity 62-72 ML-4 at 100°C and a iodine number of 18), 41.8% by weight of grafted polystyrene and 8.2% by weight of free polystyrene having a weight average molecular weight (Mw) 1,746,000 and wherein the polystyrene/elastomer molar ratio in the grafted phase is 0.18.

The characteristics of the thus-obtained blends were:

TABLE III

		Example 8	Example 9
COMPONENT A		66,7	66,7
COMPONENT B		13,3	13,3
COMPONENT C_3		20	-
COMPONENT C_4		-	20
MECHANICAL PROPERTIES	UNITS		
. IZOD	J/m	80	61
. Ultimate tensile strength	N/mm^2	32	33
. Elastic modulus	N/mm^2	1550	1600
THERMAL PROPERTIES			
. VICAT at 1 Kg	°C	101	102
. VICAT at 5 Kg	°C	86	87

EXAMPLES 10 - 11 (comparison tests)

By operating according to the operative modalities of example 1, the blends were prepared constituted by:

-- 58.3% by weight of a styrene polymer (A) selected from a crystal styrene homopolymer (A_1) and an impact-resistant styrene polymer (A_2) containing 7.75 of polybutadiene rubber;

-- 11.3% of polyethylene (B) of example 1;

-- 30% of the EPDM elastomer containing polystyrene grafted thereon (C) of example 1.

The properties of the so-obtained blends were:

TABLE IV

		Example 10	Example 11
COMPONENT A_1		58,3	-
COMPONENT A_2		-	58,3
COMPONENT B		11,3	11,3
COMPONENT C		30	30
MECHANICAL PROPERTIES	UNITS		
• IZOD	J/m	78	172
• Ultimate tensile strength	N/mm^2	35	26
• Elastic modulus	N/mm^2	1600	1250
THERMAL PROPERTIES			
• VICAT at 1 Kg	°C	100	99
• VICAT at 5 Kg	°C	82	78

CLAIMS

1. A thermoplastic composition based on a polyolefin and a vinylaromatic polymer, having an optimal combination of physical, mechanical and thermal properties, characterized in that it comprises:

- from 40 to 80% by weight of a vinyl aromatic polymer (A) containing, as an elastomer component, from 0.5 to 5% by weight of a vinyl aromatic monomer-conjugated diene linear block polymer and from 5 to 15% of a diene rubber;
- from 5 to 50% by weight of a polyolefin (B); and
- from 10 to 50% by weight of an olefinic elastomer (C) containing, grafted thereon, a vinylaromatic polymer, wherein the molar ratio between the vinylaromatic polymer and the olefinic elastomer in the grafted phase is higher than 0.8;

the sum of components (A), (B) and (C) being equal to 100.

2. The thermoplastic composition according to claim 1, which comprises:

- from 50 to 70% by weight of the vinyl aromatic polymer (A);
- from 10 to 30% by weight of the polyolefin (B); and
- from 10 to 40% by weight of the olefinic elastomer (C) containing, grafted thereon, the vinyl aromatic polymer,

the sum of components (A), (B) and (C) being equal to 100.

3. The thermoplastic composition according to claim 1 or 2, wherein the amount of the diene rubber in the vinyl aromatic polymer (A) is comprised between 7 and 12% by weight.

4. The thermoplastic composition according to any one of claims 1 to 3, wherein the amount of the vinyl aromatic monomer-conjugated diene linear block polymer, in the vinyl aromatic polymer (A), is comprised between 2 and 5% by weight.

5. The thermoplastic composition according to any one of claims 1 to 4, wherein the vinyl aromatic monomer-conjugated diene linear block polymer contains from 20 to 75% by weight of recurring units of a vinyl aromatic monomer and, correspondingly, from 80 to 25% by weight of recurring units of a conjugated diene.

6. The thermoplastic composition according to any one of claims 1 to 5, wherein the linear block polymer is constituted by pure polymeric blocks of vinyl aromatic monomer and conjugated diene monomer.

7. The thermoplastic composition according to any one of claims 1 to 5, wherein the linear block polymer contains random and/or tapered (B/S) polymeric segments of vinyl aromatic monomer and of conjugated diene.

8. The thermoplastic composition according to any one of claims 1 to 5, wherein the linear block polymer is constituted by random and/or tapered (B/S) copolymers of vinyl aromatic monomer and of conjugated diene.

9. The thermoplastic composition according to any one of claims 1 to 8, wherein the polyolefin is an ethylene, propylene or butene polymer.

10. The thermoplastic composition according to claim 9, wherein the polyolefine is a low density, medium density or high density polyethylene.

11. The thermoplastic composition according to any one of claims 1 to 10, wherein the olefinic elastomer is a rubber-like copolymer having a Mooney viscosity ranging from 10 to 150 ML-4 at 100°C, said copolymer consisting of at least two different straight chain alpha-mono-olefins with at least one other copolymerizable polyene monomer.

12. The thermoplastic composition according to claims 11, wherein the at least one other copolymerizable polyene monomer is a non-conjugated diene.

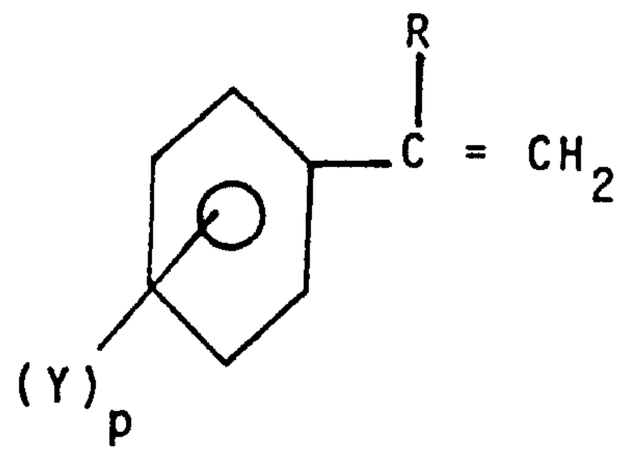
13. The thermoplastic composition according to claim 11 or 12, wherein said alpha-mono-olefin is ethylene and the other alpha-mono-olefin has a longer chain, and the weight ratio of ethylene to the other alpha-mono-olefin is comprised between 20/80 and 80/20.

14. The thermoplastic composition according to any one of claims 1 to 13, wherein the olefinic elastomer is an ethylene/propylene/non-conjugated diene terpolymer, having a diene content ranging from 2 t 20% by weight with respect to the terpolymer, said terpolymer having a Mooney

viscosity (ML-4), measured at 100°C ranging from 30 to 90 and a iodine number higher than 5.

15. The thermoplastic composition according to claim 14, wherein the diene terpolymer has a diene content ranging from 8 to 10% by weight and a iodine number ranging from 10 to 40.

16. The thermoplastic composition according to any one of claims 1 to 15, wherein the vinylaromatic polymer contains monomers having the following general formula:



(V)

wherein:

R represents hydrogen or an alkyl radical having from 1 to 4 carbon atoms;

y represents hydrogen, a halogen or an alkyl radical having form 1 to 4 carbon atoms, and

p is 0 or an integer ranging form 1 to 5.

17. The thermoplastic composition according to any one of claims 1 to 16, wherein the vinylaromatic polymer has a molecular weight comprised between 50,000 and 500,000.

18. The thermoplastic composition according to any one of claims 1 to 17, wherein the vinylaromatic

polymer/olefinic elastomer has a molar ratio in the grafted phase that is comprised between 1 and 2.

19. The thermoplastic composition according to any one of claims 1 to 18, which further comprises reinforcing additives, antiflame agents, dyestuffs, pigments, stabilizers and/or lubricants.

20. The thermoplastic composition according to claim 19, wherein the stabilizer is of the type used for the vinylaromatic polymers and/or for the polyolefins and is present in an amount comprised between 0.05 and 5% by weight, with respect to the total weight of the composition.

21. The thermoplastic composition according to claim 19, wherein the reinforcing additive is selected from glass fibres, carbon fibres, organic or inorganic high-modulus fibres and metal fibres and is present in an amount not higher than 50% by weight with respect to the total weight of the composition.

22. The thermoplastic composition according to claim 21, wherein the reinforcing additive is present in an amount not higher than 30% by weight with respect to the total weight of the composition.