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International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :

C08L 69/00, 67/02 // (C08L 69/00, 67:02, 51:08) (C08L 67/02, 69:00, 51:08)

A1

(11) International Publication Number: **WO 98/17725**

(43) International Publication Date: 30 April 1998 (30.04.98)

(21) International Application Number: PCT/US97/18724

(22) International Filing Date: 21 October 1997 (21.10.97)

(30) Priority Data:

60/028,767	21 October 1996 (21.10.96)	US
08/915,020	20 August 1997 (20.08.97)	US

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(81) Designated States: JP, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: 1,4-CYCLOHEXANEDIMETHANOL BASED POLYESTER BLENDS

(57) Abstract

A composition comprising an aromatic polycarbonate, a polyester comprising the residue of one or more dicarboxylic acids and the residue of 1,4-cyclohexanedimethanol, and a core-shell impact modifier comprising a polyorganosiloxane-co-alkyl (meth)acrylate core and a vinyl shell. The invention further provides an article comprising the composition. In a further embodiment, the invention provides a method for using the composition to form an article comprising melt mixing the composition at from about 225 °C to about 350 °C to form an article.

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1,4-CYCLOHEXANEDIMETHANOL BASED POLYESTER BLENDS

This is an ORIGINAL application based on the PROVISIONAL Serial No. 60/028,767 filed October 21, 1996.

Background of the Invention

Field of the Invention

The present invention relates to polyester blends, and more particularly to blends containing polyester or copolyesters, aromatic polycarbonates, and polyorganosiloxane based core-shell impact modifiers, wherein the polyester or copolyester is formed from 1,4-cyclohexanedimethanol.

Polyesters such as poly(ethylene terephthalate) ("PET") and PET copolyesters containing modifying dibasic acids and/or glycols are widely used in the form of molded articles, bottles, containers, food trays, fibers, sheeting and film. Other polymers are often blended with the polyesters to obtain materials with special properties such as improved impact strength, and/or improved physical properties at low and/or high temperatures. Certain polycarbonates, for example, can sometimes be blended with polyesters to improve the physical properties of the polyesters. Impact modifiers containing polyorganosiloxane rubbers can also sometimes be incorporated into such blends to improve the impact properties of the blends. It is unusual, however, to find polymers that are compatible and which can be blended to provide such enhanced physical properties.

Hongo et al., in U.S. Patent 4,888,388, describe polycarbonate resin compositions that contain a saturated polyester resin such as PET or poly(butylene terephthalate), and a polyorganosiloxane rubber-g-vinyl monomer copolymer. The polyester resin does not include residues of 1,4-cyclohexanedimethanol. Belfoure et al., in U.S. Patent 5,116,905, describe blends comprising an aromatic polycarbonate, a polyester resin that contains some 1,4-cyclohexanedimethanol, and a diene based, graft core-shell copolymer. The core-shell copolymer is not polyorganosiloxane based. Moreover, the polyester predominantly contains residues of ethylene glycol, not 1,4-cyclohexanedimethanol.

It has now been found that certain blends of aromatic polycarbonates, core-shell polyorganosiloxane based impact modifiers, and polyesters that comprise residues of 1,4-cyclohexanedimethanol, have very desirable impact strength, low temperature properties, chemical resistance, scratch resistance, and heat distortion properties at elevated temperatures. These results are surprising in view of the fact that identical blends containing polyesters without 1,4-cyclohexanedimethanol residues do not exhibit the good impact, scratch resistance, and high temperature properties.

Summary of the Invention

The invention provides a composition comprising an aromatic polycarbonate, a polyester comprising the residue of one or more dicarboxylic acids and the residue of 1,4-cyclohexanedimethanol, and a core-shell impact modifier comprising a polyorganosiloxane-co-alkyl (meth)acrylate core and a vinyl shell. The invention further provides an article comprising the composition. In a further embodiment the invention provides a method for using the composition to form an article comprising melt mixing the composition at from about 255° C to about 350° C to form an article. In yet a further embodiment the invention provides an article formed by this method of using the composition.

Additional aspects and advantages of the invention will be set forth in part in the description that follows, and in part will be obvious from the description, or may be learned by practice of the invention. The advantages of the invention will be realized and attained by means of the elements and combinations particularly pointed out in the appended claims. It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

DESCRIPTION OF THE INVENTION

The present invention may be understood more readily by reference to the following detailed description of the invention and to the examples included herein. Before the present compounds, compositions and methods are disclosed and described, however, it is to be understood that this invention is not limited to specific methods, or to particular compositions or processing regimens, as such may, of course, vary. It is also to be understood that the terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting.

It must be noted that, as used in the specification and the appended claims, the singular forms "a," "an" and "the" include plural referents unless the context clearly dictates otherwise. Thus, for example, reference to "an aromatic compound" includes mixtures of aromatic compounds, reference to "a polyester" includes mixtures of two or more such polyesters, and the like.

References in the specification and concluding claims to parts by weight, of a particular element or component in a composition or article, denote the weight relationship between the element or component and any other elements or components in the composition or article for which a part by weight is expressed. Thus, in a compound containing 2 parts by weight of component X and 5 parts by weight component Y, X and Y are present at a weight ratio of 2:5, and are present in such ratio regardless of whether additional components are contained in the compound.

Ranges are often expressed herein as from about one particular value, and/or to about another particular value. When such a range is expressed, it is to be understood that a more preferred range is typically from the one particular value and/or to the other particular value. Similarly, when values are expressed as approximations, by use of the antecedent "about," it will be understood that the particular value is typically more preferred.

In this specification and in the claims which follow, reference will be made to a number of terms that shall be defined to have the following meanings unless stated to the contrary:

A residue of a chemical species, as used in the specification and concluding claims, refers to the moiety that is the reaction product of the chemical species in a particular reaction scheme or subsequent formulation or chemical product, regardless of whether the moiety is actually obtained from the chemical species. Thus, an ethylene glycol residue in a polyester refers to one or more $-OCH_2CH_2O-$ units in the polyester, regardless of whether ethylene glycol was used to prepare the polyester. Similarly, a sebacic acid residue in a polyester refers to one or more $-CO(CH_2)_8CO-$ moieties in the polyester, regardless of whether the residue is obtained by reacting sebacic acid or an ester, anhydride, or other reactive equivalent thereof to obtain the polyester.

"Optional" or "optionally" means that the subsequently described event or circumstance may or may not occur, and that the description includes instances where said event or circumstance occurs and instances where it does not. For example, the phrase "optionally substituted lower alkyl" means that the lower alkyl group may or may not be substituted and that the description includes both unsubstituted lower alkyl and lower alkyl where there is substitution.

By the term "effective amount" of a compound or property as provided herein is meant such amount as is capable of performing the function of the compound or property for which an effective amount is expressed. As will be pointed out below, the exact amount required will vary from process to process, depending on recognized variables such as the compounds employed and the processing conditions observed. Thus, it is not possible to specify an exact "effective amount." However, an appropriate effective amount may be determined by one of ordinary skill in the art using only routine experimentation.

The terms "polymer" and "resin" are used interchangeably herein, and each term is meant to include any of various substances made by chemical synthesis, especially those used in the making of plastics, any compound formed by polymerization, and any compound containing two or more of such polymers or resins.

The term "modified" is often used herein to describe polymers and means that a particular monomeric unit that would typically make up the pure polymer has been replaced by another monomeric unit that shares a common polymerization capacity with the replaced monomeric unit. Thus, for example, it is possible to substitute diol residues for ethylene glycol residues in poly(ethylene glycol), in which case the poly(ethylene glycol) will be "modified" with the diol. If the poly(ethylene glycol) is modified with a mole percentage of the diol, then such a mole percentage is based upon the total number of moles of ethylene glycol that would be present in the pure polymer but for the modification. Thus, in a poly(ethylene glycol) that has been modified by 50 mole

% with another diol, the other diol and ethylene glycol residues are present in equimolar amounts.

The term “polyester” includes copolyesters.

The term “polycarbonate” includes copolycarbonates.

The term “polyorganosiloxane” includes copolyorganosiloxanes.

The term “(meth)acrylate” includes both acrylates and methacrylates.

When referenced herein, the inherent viscosity of polyesters is measured in 60/40 phenol/tetrachloroethane.

In one embodiment the invention relates to compositions that comprise: polyesters in which 1,4-cyclohexanedimethanol residues are incorporated; an aromatic polycarbonate; and a core-shell impact modifier comprising a polyorganosiloxane-co-alkyl (meth)acrylate core and a vinyl shell. It has been surprisingly found that the 1,4-cyclohexanedimethanol lends to the compositions comprising the polyester very desirable impact strength, low temperature properties, chemical resistance, scratch resistance, and heat distortion properties at elevated temperatures.

Polyesters used in the compositions of the present invention typically comprise an effective amount of 1,4-cyclohexanedimethanol (“CHDM”) residues to obtain the properties desired. The 1,4-cyclohexanedimethanol residues may be in the cis- or trans- form or as cis-/trans- mixtures. The polyesters generally comprise residues of from about 1.5 to about 100 mol percent 1,4 cyclohexanedimethanol. Preferably, however, the polyesters comprise residues of from about 20 to about 90 mol percent 1,4 cyclohexanedimethanol, and even more preferably the polyesters comprise residues of from about 60 to about 90 mol percent 1,4 cyclohexanedimethanol. Such mole percentages are based upon the total moles of glycol residues present in the polyester.

Polyesters are defined to include copolyesters, and the polyester used in the invention may suitably comprise the residue of one or more glycols other than 1,4-cyclohexanedimethanol. Particularly suitable modifying glycols typically have from 2 to about 16 carbon atoms. Preferred glycols with which to modify the polyesters include 1,3-propanediol, 1,2-propanediol, 1,4-butanediol, 1,6-hexanediol, 1,10-decanediol, diethylene glycol, neopentyl glycol, 2,2,4,4-tetramethyl-1,3-cyclobutanediol, and mixtures thereof. A more preferred glycol with which to modify the polyester is ethylene glycol.

The polyesters of the present invention may similarly comprise residues of one or more dicarboxylic acids or their lower alkyl esters, such as the methyl esters. The one or more dicarboxylic acids can be aliphatic or aromatic. In a preferred embodiment, however, the polyester comprises residues of one or more dicarboxylic acids that is aromatic. Particularly suitable aromatic dicarboxylic acids include terephthalic acid, isophthalic acid, naphthalenedicarboxylic acid, and mixtures thereof.

In another embodiment the compositions of the present invention comprise residues of modifying acids, and preferably up to 25 mol percent of residues of one or more modifying acids containing from 2 to about 40 carbon atoms. Particularly suitable modifying acids with which to modify the polyester include succinic acid, glutaric acid, suberic acid, sebacic acid, dimer acid, isophthalic acid, 1,4-cyclohexanedicarboxylic acid, terephthalic acid, naphthalenedicarboxylic acid, and mixtures thereof. A particularly suitable acid with which to modify PCT is naphthalenedicarboxylic acid comprising or, in another embodiment consisting essentially of, a 2,6-, 2,7-, 1,4-, or 1,5- isomer.

In one embodiment the compositions of the present invention comprise a poly(1,4-cyclohexylenedimethylene terephthalate) polyester ("PCT"). A particularly suitable PCT polyester is a copolyester that comprises at least 75 mol percent of terephthalic acid residues. In a more preferred embodiment the polyester is a PCT copolyester comprising at least 90 mol percent of terephthalic acid residues. Such mol percentages are based upon the total number of dicarboxylic acid residues present in the polyester.

In another embodiment the compositions of the present invention comprise a poly(1,4-cyclohexylenedimethylene naphthalenedicarboxylate) polyester ("PCN"). Particularly suitable PCN polyesters are copolyesters comprising at least 75 mol percent of naphthalenedicarboxylic acid residues. In a preferred embodiment the PCN polyesters comprise 2,6-, 2,7-, 1,4-, and/or 1,5-naphthalenedicarboxylic acid isomer residues, and even more preferably the naphthalene dicarboxylic residues of the PCN polyesters consist essentially of a 2,6-, 2,7-, 1,4-, or 1,5- isomer.

The polyesters included in the compositions of the present invention may further comprise one or more branching agents to improve the viscosity or workability of the polyester, typically up to 2 mol percent. Particularly suitable branching agents include trimellitic acid, trimellitic anhydride, pyromellitic dianhydride, trimethylolpropane, pentaerythritol, and mixtures thereof. Particularly suitable polyesters have an inherent viscosity of from about 0.4 to about 1.5.

Methods of preparing polyesters of this invention are well known to those of skill in the art.

Aromatic polycarbonate resins which are suitable for use in the present invention are well known in the art and are generally commercially available.

These polycarbonates may be prepared by a variety of conventional and well known processes which include transesterification, melt polymerization, interfacial polymerization, etc. The polycarbonates are generally prepared by reacting a dihydric phenol with a carbonate precursor, such as for example, phosgene. Other carbonate precursors include, for example, dibutyl carbonate, diphenyl carbonate, dimethyl carbonate, and mixtures thereof.

Preferred dihydric phenols for preparing the aromatic polycarbonates include, for example, resorcinol, hydroquinone, 2,2-bis(4-hydroxyphenyl) pentane, bis(2-hydroxyphenyl) methane, bis(4-hydroxyphenyl) methane, 2,4'-(dihydroxydiphenyl) methane, bis(4-hydroxy-5-nitrophenyl) methane, bis(4-hydroxy-5-nitrophenyl) methane, 1,1-bis(4-hydroxyphenyl) ethane, 3,3-bis(4-hydroxyphenyl) pentane, 2,2'-dihydroxyphenyl, 2,6-dihydroxynaphthalene, bis(4-hydroxydiphenyl)sulfone, bis(3,5-diethyl-4-hydroxyphenyl) sulfone, 2,4'-dihydroxydiphenyl sulfone, 5-chloro-2,4'-dihydroxydiphenyl sulfone, bis(4-hydroxyphenyl diphenyl sulfone, 2,2-bis(3,5-dimethyl-4-hydroxyphenyl) propane, 4,4'-dihydroxydiphenyl ether, 4,4'-dihydroxy-3,3'-dichlorodiphenyl ether, 4,4'-dihydroxy-2,5-dihydroxydiphenyl ether, and mixtures thereof. An especially preferred dihydric phenol is 4,4-isopropylidenediphenol.

Processes for preparing the polycarbonates of the present invention are described in, for example, U.S. Pat. Nos. 4,018,750, 4,123,436 and 3,153,008. However, other known processes for producing polycarbonates are suitable. Particularly preferred polycarbonates are aromatic polycarbonates, which are prepared, for example, by reacting Bisphenol A with phosgene. A homopolymer of Bisphenol A with phosgene is sold by General Electric, Bayer Chemicals, and Dow Chemicals, under the trade names LEXAN, MAKROLON, and CALIBRE, respectively.

Preferred polycarbonates have an inherent viscosity between about 0.35-

0.55 dl/gram. Preferred polycarbonates also have a molecular weight of from about 10,000 to about 150,000.

Preferred impact modifiers are available generally from Mitsubishi Rayon Company, Ltd., of Tokyo, Japan, under the name METABLEN, and include S-2001, XS-002, RK-120, RK-200, KS4015, and SX-2. Each of these impact modifiers contains a polyorganosiloxane co-alkyl (meth)acrylate core and a vinyl shell. Core-shell impact modifiers can be prepared by processes generally known in the art, including the processes disclosed in U.S. Patents 3,808,180, 4,096,202, 4,404,161, and 4,888,388, the disclosure from each is hereby incorporated by this reference. As stated in U.S. Patent 4,888,388, the vinyl shell can be graft polymerized onto the core material in a single step or in multiple steps by radical polymerization, followed by pouring the polymer into hot water in which a metal salt is dissolved, followed by salting out and coagulation.

A preferred impact modifier is METABLEN S-2001 which is obtained typically as a white granular powder of about 280 μm particle size and 1.17-1.20 specific gravity. These powders have a bulk density of about 0.45 g/cc.

The polyorganosiloxane which makes up the impact modifier may be prepared by emulsion polymerization using an organosiloxane and a cross-linking agent as known in the art, and as described by Hongo, et al., in U.S. Patent 4,888,388, the disclosure from which is hereby incorporated by reference. The organosiloxane may be chosen from various types of cyclic siloxanes having a ring structure of at least 3 members. Cyclosiloxanes having ring structures with from 3 to 6 members are especially preferred. For example, hexamethylcyclotrisiloxane, octamethylcyclotetrasiloxane, decamethylcyclopentasiloxane, dodecamethylcyclohexasiloxane, trimethyltriphenylcyclotrisiloxane, tetramethyltetraphenylcyclotetrasiloxane and octaphenylcyclotetrasiloxane are preferred. These siloxanes may be used alone or in combination as a mixture of 2 or more different types. The organosiloxane comprises at least 50% by weight, and preferably at least 70% by weight, of the polyorganosiloxane-co-alkyl (meth)acrylate.

The alkyl (meth)acrylate used to form the polyorganosiloxane-co-alkyl (meth)acrylate can be an acryl acrylate such as methyl acrylate, ethyl acrylate, n-propyl acrylate, n-butyl acrylate, or 2-ethylhexyl acrylate, or an alkyl methacrylate such as hexyl methacrylate, 2-ethylhexyl methacrylate or n-lauryl methacrylate. It is particularly preferred to use n-butylacrylate. Methods of preparing these polyorganosiloxane-co-alkyl (meth)acrylates are described by Hongo, et al., in U.S. Patent 4,888,388 (previously incorporated by reference).

The vinyl shell of the impact modifiers is graft polymerized onto the polyorganosiloxane-co-alkyl (meth)acrylate by graft polymerization according to processes known in the art, including the method described by Hongo, et al., in U.S. Patent 4,888,388. The vinyl monomer to be graft polymerized onto the polyorganosiloxane-co-alkyl acrylate may be various vinyl monomers including: alkenyl aromatic compounds such as styrene, alpha-methylstyrene and vinyl toluene; methacrylic acid esters such as methyl methacrylate or 2-ethylhexyl methacrylate; acrylic acid esters such as methyl acrylate, ethyl acrylate and butyl acrylate; and vinyl cyanide compounds such as acrylonitrile and methacrylonitrile. These vinyl monomers may be used alone or in combination as a mixture of 2 or more different kinds. A particularly suitable vinyl shell comprises methyl methacrylate or methyl methacrylate-co-vinyl.

The polyorganosiloxane and alkyl (meth)acrylate are preferably present in the polyorganosiloxane-co-alkyl (meth)acrylate in a range of from about 10 to about 90% by weight (wherein the total amount of the 2 components is 100% by weight). It is particularly preferred that each of the components is within a range of from about 20 to about 80% by weight.

The proportions of the polyorganosiloxane based core and the vinyl based shell in the impact modifier are preferably such that the core is from 30 to 95% by weight, preferably from 40 to 90% by weight, and the shell is from 5 to 70% by weight, preferably from 10 to 60% by weight, based on the weight of the impact modifier.

The compositions of the present invention typically comprise from about 9 to about 90 parts by weight of the polycarbonate, from about 9 to about 90 parts by weight of the polyester, and from about 1 to about 20 parts by weight of the core-shell impact modifier. Preferably the compositions of the present invention comprise from about 25 to about 70 parts by weight of the polycarbonate, from about 25 to about 70 parts by weight of the polyester, and from about 5 to about 20 parts by weight of the core-shell impact modifier. Even more preferably the compositions of the present invention comprise from about 40 to about 50 parts by weight of the polycarbonate, from about 40 to about 50 parts by weight of the polyester, and from about 5 to about 15 parts by weight of the core-shell impact modifier.

The compositions of the present invention may further comprise one or more additives, typically from about 0.01 to about 10 parts by weight. Typical additives that are included in the compositions include, for example, colorants, glass fibers, fillers, antioxidants, stabilizers, mold release agents, carbon black, and mixtures thereof.

In another embodiment the invention provides articles comprising the various compositions of the present invention. Particularly suitable articles include, for example, extruded articles, injection molded articles, and compression molded articles. Especially suitable articles include fibers, bottles, containers, sheeting, and film.

In yet another embodiment the invention provides a method for using the various compositions of the present invention to form an article. In the process the composition is preferably melt mixed at from about 255° C to about 350° C to form an article. In a more preferred process the composition is melt mixed at from about 260° C to about 300° C. The process may preferably be employed with polycarbonate, polyester, and core-shell impact modifier in the form of pellets. The pellets can contain either mixtures of the ingredients, or each of the pellets can contain only one of the ingredients. The melt mixing is preferably carried out in extruders, Brabender Plastographs, and other suitable melt mixing equipment.

In still another embodiment the invention provides an article formed by the process of this invention. Such articles are preferably extruded articles, injection molded articles, and compression molded articles. More particularly, such articles preferably include fibers, bottles, containers, sheeting, and film.

The compositions of the present invention can be used during the manufacture of various products, and can also be incorporated into many final products. Thus, the compositions can be raw materials that are further processed before a final product is prepared, and the compositions can also be present as the final article.

The compounds and components of the invention may be readily synthesized and prepared using techniques generally known to synthetic organic or polymer chemists. Suitable experimental methods for making and deriving the polymers are described, for example, in the references cited in this document, the disclosures of which being hereby incorporated by this reference for their general teachings and for their synthesis teachings. Methods for making specific and preferred compositions of the present invention are described in detail in examples set forth below.

EXAMPLES

The following examples are put forth so as to provide those of ordinary skill in the art with a complete disclosure and description of how the compounds claimed herein are made and evaluated, and are intended to be purely exemplary of the invention and are not intended to limit the scope of what the inventors regard as their invention. Efforts have been made to ensure accuracy with respect to numbers (e.g., amounts, temperature, etc.) but some errors and deviations should be accounted for. Unless indicated otherwise, parts are parts by weight, temperature is in °C or is at room temperature, and pressure is at or near atmospheric.

Example 1-PCT Blend

A pellet blend containing 82.0 lbs. of a PCT homopolymer (30/70 cis/trans isomer ratio; I.V. 0.77), 9.0 lbs of METABLEN S-2001 core-shell silicone/acrylic impact modifier supplied by Mitsubishi Rayon Company Ltd., and 9.0 lbs of polycarbonate (Dow Calibre PC200-10) were prepared and dried overnight at 80°C. The dried pellet blend was melt mixed in a 40mm. Werner and Pfleiderer twin screw extruder at 265°C, then cooled in a water bath and pelletized. These pellets were dried and then injection molded in a Toyo Injection Molding Machine using a melt temperature of 270-290°C and a mold temperature of 25-50°C. The specimens had a good appearance, good chemical resistance, and scratch resistance. The specimens had a heat distortion temperature (HDT) of 72°C at 264 psi, a HDT of 88°C at 66 psi, a notched Izod impact strength of 4.8 ft.lb./in. at 23°C and an Izod value of 2.0 ft.lb./in at -40°C. Similarly good results were achieved when 95 wt % PCT homopolymer was used instead of 82 wt %.

Example 2-PET Blend (Comparative Blend)

The procedure of Example 1 was repeated using PET polyester (I.V. 0.76) instead of the PCT polyester. This blend was injection molded at a melt temperature of 280°C to provide test specimens. The specimens had a notched Izod impact strength of 2.7 ft.lb./in. at 23°C, and 1.4 ft.lb./in. at -40°C. The specimens also were readily scratched and had a heat distortion temperature of only 60°C at 264 psi., and 65°C at 66 psi.

Example 3-PCT Copolyester Blend

Using the procedure of Example 1, a melt blend was prepared from 77.3 lbs. of PCT copolyester modified with 19 mole percent ethylene glycol (I.V. 0.75), 9.0 lbs of METABLEN S-2001 impact modifier and 13.7 lbs of polycarbonate (Dow Calibre PC 300-10). Pellets of this blend were dried and injection molded into test specimens at 280°C (melt temperature). The specimens had good appearance and scratch resistance. The specimens exhibited a heat distortion temperature of 67°C at 264 psi and 78°C at 66 psi. Their notched Izod impact values were 20.0 ft.lb./in. at 23°C and 2.95 ft.lb./in. at -40°C.

Similarly good results would be achieved when 40 weight percent of 1/8 inch chopped glass fibers are included in the blend. Specimens from this blend would have a good appearance and excellent scratch resistance.

Example 4-PCT Copolyester Blend

Using the procedure in Example 1, a melt blend was prepared from 68.3 lbs of PCT copolyester modified with 38 mole percent ethylene glycol (I.V. 0.75), 9.0 lbs. of METABLEN S-2001 impact modifier and 22.7 lbs. of polycarbonate (Miles MK2608, a Makrolon polycarbonate from Bayer Chemicals). Specimens molded at a melt temperature of 285°C had a good appearance, good chemical resistance, and good scratch resistance. They had a heat distortion temperature of 75°C at 264 psi and 87°C at 66 psi. These specimens exhibited notched Izod impact strength values of 20.0 ft.lb./in. at 23°C and 5.9 ft.lb./in. at -40°C.

Similarly good results were achieved when the experiment was repeated using 5.0 lbs. of the impact modifier instead of 9.0 lbs.

Similarly good results were also achieved when the blend was prepared using 54.6 lbs. of the PCT copolyester, 9.0 lbs. of the impact modifier and 36.4 lbs. of the polycarbonate.

Example 5-PCT Copolyester Blend Containing Antioxidants and Mold Release Agents

Using the procedure of Example 1, a melt blend was prepared from 45.5 lbs. of PCT copolyester modified with 19 mole percent ethylene glycol (I.V. 0.75), 9.0 lbs. of METABLEN S-2001, and 45.5 lbs of polycarbonate (General Electric Co., Lexan 140), 0.1 lb. Irganox 1010, 0.2 lb. Weston 619, 0.2 lb. Ultranox 626 and 0.5 lb of Epolene E-10 polyethylene mold release agent. Specimens molded at 290°C had a good appearance and scratch resistance. The specimens had a heat distortion temperature of 87°C at 264 psi and 100°C at 66 psi. They exhibited notched Izod impact strength values of 15.5 ft.lb./in. at 23°C and 13.2 ft.lb./in. at -40°C.

Similarly good results were achieved when similar blends were prepared using 15.0 lbs. of the impact modifier instead of 9.0 lbs.

Example 6-PCT Copolyester Blend

Using the procedure of Example 1, a melt blend was prepared from 22.7 lbs of PCT copolyester modified with 69 mole percent ethylene glycol (I.V. 0.76), 9.0 lbs of METABLEN S-2001 impact modifier and 68.3 lbs of polycarbonate (Dow Calibre PC200-10). Specimens molded at 275°C had good appearance and scratch resistance. These specimens had a heat distortion temperature of 95°C at 264 psi and 117°C at 66 psi. They exhibited notched Izod impact strength values of 16.5 ft.lb./in. at 23°C and 10.3 ft.lb./in. at -40°C.

Similarly good results were achieved when a PCT copolyester modified with 88 mole percent ethylene glycol (I.V. 0.71) was used.

Example 7-PCT Copolyester Blend

Using the procedure of Example 1, a melt blend was prepared from 9.0 lbs. of PCT copolyester modified with 96.5 mole % ethylene glycol (I.V. 0.76), 9.0 lbs. of METABLEN S-2001 impact modifier, and 82.0 lbs of polycarbonate (Dow Calibre PC 300-10). Specimens molded at 290° had good appearance and scratch resistance. These specimens had a heat distortion temperature of 113°C at 264 psi and 129°C at 66 psi. They exhibited notched Izod impact strength values of 15 ft.lb./in. at 23°C and 11 ft.lb./in. at -40°C.

Similarly good results would also be achieved when a PCT copolyester modified with 98.5 mole percent ethylene glycol (I.V. 0.81), is used in the blends.

Similarly good results would also be achieved when a PCT copolyester modified with 5 mole percent isophthalic acid is used.

Similarly good results would also be achieved when 5 wt % PCT copolyester modified with 96.5 mole % ethylene glycol is used instead of 9 wt %.

It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope or spirit of the invention. Other embodiments of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. It is intended that the specification and examples be considered as exemplary only, with a true scope and spirit of the invention being indicated by the following claims.

What is claimed is:

1. A composition comprising:
   a. an aromatic polycarbonate;
   b. a polyester comprising the residue of one or more dicarboxylic acids and the residue of 1,4-cyclohexanedimethanol; and
   c. a core-shell impact modifier comprising a polyorganosiloxane-co-alkyl (meth)acrylate core and a vinyl shell.

2. The composition of claim 1 wherein the polyester comprises the residue of more than one glycol.

3. The composition of claim 1 wherein the polyester comprises residues of from about 1.5 to about 100 mol percent 1,4 cyclohexanedimethanol.

4. The composition of claim 1 wherein the polyester comprises residues of from about 20 to about 90 mol percent 1,4 cyclohexanedimethanol.

5. The composition of claim 1 wherein the polyester comprises residues of from about 60 to about 90 mol percent 1,4 cyclohexanedimethanol.

6. The composition of claim 1 wherein the polyester comprises residues of only one acid.

7. The composition of claim 1 wherein at least one of the one or more dicarboxylic acids is aromatic.

8. The composition of claim 1 wherein the one or more dicarboxylic acids comprise terephthalic acid, isophthalic acid, naphthalenedicarboxylic acid, or mixtures thereof.

9. The composition of claim 1 wherein the polyester is poly(1,4-cyclohexylenedimethylene terephthalate) comprising at least 75 mol percent of terephthalic acid residues.

10. The composition of claim 1 wherein the polyester is poly(1,4-cyclohexylenedimethylene terephthalate) comprising at least 90 mol percent of terephthalic acid residues.

11. The composition of claim 1 wherein the polyester is poly(1,4-cyclohexylenedimethylene naphthalenedicarboxylate) comprising at least 75 mol percent of naphthalenedicarboxylic acid residues.

12. The composition of claim 11 wherein the naphthalenedicarboxylic acid consists essentially of a 2,6-, 2,7-, 1.4-, or 1,5- isomer.

13. The composition of claim 1 wherein the polyester further comprises up to 25 mol percent of residues of one or more modifying acids containing from 2 to about 40 carbon atoms.

14. The composition of claim 13 wherein the one or more modifying acids comprise succinic acid, glutaric acid, suberic acid, sebacic acid, dimer acid, isophthalic acid, 1,4-cyclohexanedicarboxylic acid, terephthalic acid, naphthalenedicarboxylic acid, or mixtures thereof.

15. The composition of claim 13 wherein the one or more modifying acids is naphthalenedicarboxylic acid consisting essentially of a 2,6-, 2,7-, 1,4-, or 1,5- isomer.

16. The composition of claim 1 wherein the polyester further comprises up to 98.5 mol percent of residues of one or more modifying glycols containing from 2 to about 16 carbon atoms.

17. The composition of claim 16 wherein the one or more modifying glycols comprise ethylene glycol, 1,3-propanediol, 1,2-propanediol, 1,4-butanediol, 1,6-hexanediol, 1,10-decanediol, diethylene glycol, neopentyl glycol, 2,2,4,4-tetramethyl-1,3-cyclobutanediol, or mixtures thereof.

18. The composition of claim 16 wherein the one or more modifying glycols comprise ethylene glycol.

19. The composition of claim 1 comprising:
   a. from about 9 to about 90 parts by weight of the polycarbonate;
   b. from about 9 to about 90 parts by weight of the polyester; and
   c. from about 1 to about 20 parts by weight of the core-shell impact modifier.

20. The composition of claim 1 comprising:
   a. from about 25 to about 70 parts by weight of the polycarbonate;
   b. from about 25 to about 70 parts by weight of the polyester; and
   c. from about 5 to about 20 parts by weight of the core-shell impact modifier.

21. The composition of claim 1 comprising:
   a. from about 40 to about 50 parts by weight of the polycarbonate;
   b. from about 40 to about 50 parts by weight of the polyester; and
   c. from about 5 to about 15 parts by weight of the core-shell impact modifier.

22. The composition of claim 1 wherein the polyester further comprises up to 2 mol percent of one or more branching agents of trimellitic acid, trimellitic anhydride, pyromellitic dianhydride, trimethylolpropane, pentaerythritol, or mixtures thereof.

23. The composition of claim 1 wherein the polyester has an inherent viscosity of from about 0.4 to about 1.5.

24. The composition of claim 1 wherein the polyorganosiloxane-co-alkyl (meth)acrylate is polyorganosiloxane-co-butyl (meth)acrylate.

25. The composition of claim 1 wherein the shell comprises methyl meth(meth)acrylate or methyl meth(meth)acrylate-co-vinyl.

26. The composition of claim 1 wherein the polycarbonate is aromatic.

27. The composition of claim 1 wherein the polycarbonate comprises the residue of one or more dihydric phenols and one or more carbonate precursors.

28. The composition of claim 27 wherein the one or more dihydric phenols comprise resorcinol, hydroquinone, 2,2-bis(4-hydroxyphenyl) pentane, bis(2-hydroxyphenyl) methane, bis(4-hydroxy-5-nitrophenyl) methane, 1,1-bis(4-hydroxyphenyl) ethane, 3,3-bis(4-hydroxyphenyl) pentane, 2,2'-dihydroxyphenyl, 2,6-dihydroxynaphthalene, bis(4-hydroxydiphenyl)sulfone, bis(3,5-diethyl-4-hydroxyphenyl) sulfone, 2,4'-dihydroxydiphenyl sulfone, 5-chloro-2,4'-dihydroxydiphenyl sulfone, bis(4-hydroxyphenyl diphenyl sulfone, 2,2-bis(3,5-dimethyl-4-hydroxyphenyl) propane, 4,4'-dihydroxydiphenyl ether, 4,4'-dihydroxy-3,3'-dichlorodiphenyl ether, 4,4'-dihydroxy-2,5-dihydroxydiphenyl ether, or mixtures thereof.

29. The composition of claim 1 wherein the polycarbonate comprises the residue of 4,4-isopropylidenediphenol.

30. The composition of claim 27 wherein the one or more carbonate

precursors comprises phosgene, dibutyl carbonate, diphenyl carbonate, dimethyl carbonate, or mixtures thereof.

31. The composition of claim 1 wherein the polycarbonate has a molecular weight from about 10,000 to about 150,000.

32. The composition of claim 1 further comprising from about 0.01 to about 10 parts by weight of one or more additives.

33. The composition of claim 32 wherein the one or more additives comprise one or more colorants, glass fibers, fillers, antioxidants, stabilizers, mold release agents, carbon black, or mixtures thereof.

34. An article comprising the composition of claim 1.

35. The article of claim 34 selected from the group consisting of extruded articles, injection molded articles, and compression molded articles.

36. The article of claim 34 comprising a fiber, bottle, container, sheeting, or film.

37. A method for using the composition of claim 1 to form an article comprising melt mixing the composition at from about 255° C to about 350° C to form an article.

38. The method of claim 37 comprising melt mixing the composition at from about 260° C to about 300° C.

39. The method of claim 37 wherein the polycarbonate, polyester, and core-shell impact modifier are in the form of pellets.

40. The method of claim 37 wherein the melt mixing is carried out by extrusion.

41. An article formed by the method of claim 37.

42. The article of claim 41 selected from the group consisting of extruded articles, injection molded articles, and compression molded articles.

43. The article of claim 41 comprising a fiber, bottle, container, sheeting, or film.

INTERNATIONAL SEARCH REPORT

Inte .ional Application No
PCT/US 97/18724

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 C08L69/00 C08L67/02 //(C08L69/00,67:02,51:08),(C08L67/02,
69:00,51:08)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 C08L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	PATENT ABSTRACTS OF JAPAN vol. 017, no. 162 (C-1042), 30 March 1993 & JP 04 325553 A (MITSUBISHI KASEI CORP), 13 November 1992, see abstract ---	1-43
Y	EP 0 273 151 A (GENERAL ELECTRIC COMPANY) 6 July 1988 see claims 1-11 -----	1-43

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
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"&" document member of the same patent family

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Date of the actual completion of the international search 5 February 1998	Date of mailing of the international search report 12/02/1998
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Decocker, L

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte. ..ional Application No
PCT/US 97/18724

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 273151 A	06-07-88	JP 63215759 A	08-09-88
		US 5424361 A	13-06-95