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(54) IMPROVEMENTS IN REINFORCED POLYCARBONATE COMPOSITIONS

(71) We, GENERAL ELECTRIC COMPANY, a corporation organized and existing under the laws of the State of New York, United States of America, of 1 River Road, Schenectady 12305, State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to thermoplastic compositions comprising halobisphenolethylene polycarbonates containing glass fiber reinforcing agents. These compositions exhibit improved notched Izod impact properties as well as excellent flame retardancy characteristics.

The prior art has made limited observations regarding the properties of chlorobisphenolethylene polycarbonates such as the infra-red spectroscopic data by Z. Wielgosz, Z. Boranowska and K. Janicka, reported in *Plaste und Kautschuk* 19 (12) 902 (1972). Among the chlorobisphenolethylene polycarbonates described by Z. Wielgosz et al. are homopolymers of (1) 1,1 - dichloro - 2,2 - bis(4 - hydroxyphenyl)ethylene, copolymers of 1,1 - dichloro - 2,2 - bis(4 - hydroxyphenyl)ethylene and (2) bis(4 - hydroxyphenyl)propane - 2,2 and blends of homopolymers of (1) and (2).

Other observations include attempts to stabilize chlorobisphenolethylene polycarbonates as reported by Z. Gobiczewski, Z. Wielgosz, and K. Janicka in *Plaste und Kautschuk* 16 (2) 99 (1969) which describe the ineffectiveness of commercially available hindered phenols, e.g. Parmonox, i.e. 2,6 - di - *t* - butyl - 4 - methylphenol, Topanol\* CA, i.e. 2,2,3 - tris(2 - methyl - 4 - hydroxy - 5 - *t* - butylphenyl)butane and Jonox 330, i.e. 1,3,5-tris(3,5 - di - *t* - butyl - 4 - hydroxybenzyl)benzene as stabilizers for chlorobisphenolethylene polycarbonates at elevated temperatures, e.g. from 160 to 260°C. Still other observations include the determination of the resistance to hydrolysis of chlorobisphenolethylene polycarbonates as reported by the Z. Boranowska and Z. Wielgosz, *Polimery* 15 (1), 12—14 (1970).

Other prior art publications which relate to the preparation of chlorobisphenolethylene polycarbonates which illustrate the state of the art are the following: The Synthesis of Chlorobisphenolethylene Polycarbonates by the methods described by S. Porejko et al., Polish patent 48,893, issued December 12, 1964, entitled *Process for Synthesizing Self-extinguishing Thermoplastics*, Z. Dobkowski, B. Krajewki, and Z. Wielgosz, *Polimery* 15 (8), 428 (1970), and Z. Wielgosz et al., *Polimery* 17, 76 (1972).

We are unaware of any other published prior art which is believed to be significant regarding the properties of halobisphenolethylene polycarbonates or their methods of preparation.

Unexpectedly, we have found that certain halobisphenolethylene polycarbonate compositions containing glass reinforcing agents exhibit substantially improved impact properties. The improvement in the mechanical properties of halobisphenolethylene polycarbonate compositions by means of fibreglass reinforcement is a significant contribution to the availability of flame retardant or flame resistant thermoplastic materials since it is believed that the fiber glass

\* Registered Trade Mark.

reinforced halobisphenolethylene polycarbonate have the highest impact properties and the highest resistance to surface flammability of any fiber glass reinforced polycarbonate composition tested to date in accordance with ASTM E162-67 (reapproved) 1973 Test Procedures entitled Standard Method of Test for Surface Flammability of Materials Using a Radiant Heat Energy Source.

This invention embodies a thermoplastic composition comprising halobisphenolethylene polycarbonates and glass fiber reinforcing agents which exhibits improved notched Izod impact strength as well as excellent flame retardancy.

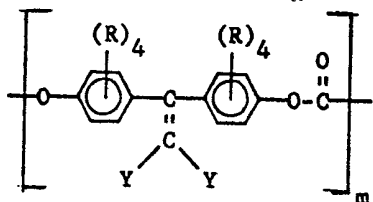
According to the present invention, there is provided a halo bisphenolethylene polycarbonate composition comprising a reinforcing amount of glass fibers and

(i) homopolymer containing halo bis(phenyl) ethylene carbonate units;

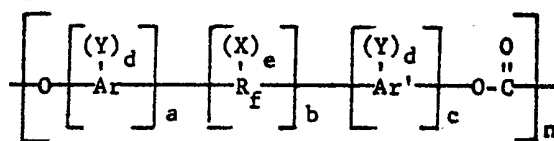
(ii) a copolymer containing at least 5 parts by weight halo bis(phenyl) ethylene carbonate units and a maximum of 95 parts by weight of arylene carbonate units in 100 parts of copolymer; or

(iii) a blend containing at least 5 parts by weight of the homopolymer of (i) and a maximum of 95 parts by weight of a polycarbonate of arylene carbonate units in 100 parts of the blend;

the halobis(phenyl)ethylene carbonate units being of formula I

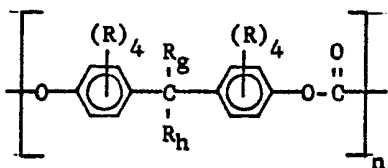


where independently each R is hydrogen, chlorine, bromine or a C<sub>1-30</sub> monovalent hydrocarbon or hydrocarboxy group, each Y is hydrogen chlorine or bromine subject to the proviso that at least one Y is chlorine or bromine, and m is an integer of at least 2, and the arylene carbonate units being of formula II



wherein R<sub>f</sub> is an alkylene, alkylidene, cycloalkylene, cycloalkylidene or arylene linkage or a mixture thereof, or an ether, carbonyl, amine, sulfur or phosphorus containing linkage, Ar and Ar' are arylene radicals, Y is an organic, an inorganic or an organo-metallic radical, X is alkyl, aryl, cycloalkyl or a mixture thereof, halogen, an ether group of the formula-OE, wherein E is alkyl, aryl or cycloalkyl d represents a whole number of at least 1, e represents 0 or a whole of 1 or more, a, b and c represent 0 or whole numbers, a or c but not both may be 0, and wherein n is an integer of at least 2. Preferred monovalent hydrocarbon groups in formula I are C<sub>1-4</sub> alkyl or phenyl. More preferred polycarbonates contain units of formula I wherein each R is hydrogen and each Y is chlorine. Polycarbonates containing only recurring moieties of formula I are halobisphenolethylene homopolycarbonates.

Preferred copolycarbonates included within the scope of this invention are polycarbonates containing both the halobis(phenyl)ethylene carbonate units of formula I as well as arylene carbonate units of the formula:



wherein independently each R is hydrogen, chloride, bromine or a C<sub>1-30</sub> monovalent hydrocarbon or hydrocarboxy group, independently R<sub>g</sub> and R<sub>h</sub> are hydrogen or a C<sub>1-30</sub> monovalent hydrocarbon group and n is an integer of at least 2. Presently preferred monovalent hydrocarbon groups are C<sub>1-4</sub> alkyl or phenyl. More preferred copolycarbonates contain bisphenyl carbonate units of formula III wherein each R is hydrogen and R<sub>g</sub> and R<sub>h</sub> are methyl.

Halobisphenoethylene polycarbonates can be prepared by methods known to those skilled in the art such as those described by S. Porejko et al., Polish patent 48,893, issued December 12, 1964, entitled *Process for Synthesizing Self-Extinguishing Thermoplastics* and Z. Wielgosz et al., *Polimery* 17, 76 (1972). In general, the S. Porejko et al. and Z. Wielgosz et al. methods describe reactions of a chlorobisphenoethylene, i.e. 1,1 - dichloro - 2,2 - bis(4 - hydroxyphenyl)ethylene and bisphenol-A, i.e. bis(4 - hydroxyphenyl) - propane - 2,2 mixture with a carbonate precursor, e.g. phosgene and an acid acceptor, e.g. caustic soda and a catalyst, e.g. triethylamine, wherein the reactions are carried out under conventional phosgenating reaction conditions, i.e. reaction conditions generally associated with the phosgenation of bisphenol-A as described in the Encyclopedia of Polymer Science and Technology 10, entitled *Polycarbonates*, pages 710—764, Interscience Publishers (1969).

Illustrative of some halobisphenoethylene compounds that can be employed in the preparation of homo- and copolycarbonates in accordance with the phosgenating reaction conditions described by S. Porejko et al., and Z. Wielgosz et al., as well as those described in the Encyclopedia of Polymer Science follow:

- 1,1 - dibromo - 2,2 - bis(4 - hydroxyphenyl)ethylene;
- 1,1 - dichloro - 2,2 - bis(5 - methyl - 4 - hydroxyphenyl)ethylene;
- 1,1 - dibromo - 2,2 - bis(3,6 - di - n - butyl - 4 - hydroxyphenyl)ethylene;
- 1,1 - dichloro - 2,2 - bis(2 - chloro - 5 - ethyl - 4 - hydroxyphenyl)ethylene;
- 1,1 - dibromo - 2,2 - bis(2,5 - dibromo - 4 - hydroxyphenyl)ethylene;
- 1 - bromo - 2,2 - bis(4 - hydroxyphenyl)ethylene;
- 1 - chloro - 2,2 - bis(3,5 - diisopropyl - 4 - hydroxyphenyl)ethylene;
- 1 - bromo - 2,2 - bis(2,6 - di - t - butyl - 4 - hydroxyphenyl)ethylene;
- 1 - chloro - 2,2 - bis(2,6 - dichloro - 4 - hydroxyphenyl)ethylene;
- 1 - bromo - 2,2 - bis(2,3 - dibromo - 4 - hydroxyphenyl)ethylene;
- 1,1 - dichloro - 2,2 - bis(3,5 - dichloro - 4 - hydroxyphenyl)ethylene;
- 1,1 - dichloro - 2,2 - bis(3,5 - dibromo - 4 - hydroxyphenyl)ethylene;
- 1,1 - dibromo - 2,2 - bis(5 - chloro - 4 - hydroxyphenyl)ethylene;
- 1 - chloro - 2,2 - bis(3,6 - dibromo - 4 - hydroxyphenyl)ethylene;
- 1 - bromo - 2,2 - bis(2 - chloro - 4 - hydroxyphenyl)ethylene;
- 1,1 - dichloro - 2,2 - bis(2,3,5 - trichloro - 4 - hydroxyphenyl)ethylene;
- 1,1 - dibromo - 2,2 - bis(2,3,5,6 - tetrabromo - 4 - hydroxyphenyl)ethylene;
- 1 - chloro - 2,2 - bis(3 - phenyl - 4 - hydroxyphenyl)ethylene;
- 1 - bromo - 2,2 - bis(3,5 - diphenyl - 4 - hydroxyphenyl)ethylene;
- 1,1 - dichloro - 2,2 - bis(2,6 - diphenyl - 4 - hydroxyphenyl)ethylene;
- 1,1 - dibromo - 2,2 - bis(3 - bromo - 5 - phenyl - 4 - hydroxyphenyl)ethylene;
- 1 - chloro - 2,2 - bis(3 - methoxy - 4 - hydroxyphenyl)ethylene;
- 1 - bromo - 2,2 - bis(3,5 - dimethoxy - 4 - hydroxyphenyl)ethylene;
- 1,1 - dichloro - 2,2 - bis(2 - ethoxy - 4 - hydroxyphenyl)ethylene;
- 1,1 - dibromo - 2,2 - bis(2,6 - diethoxy - 4 - hydroxyphenyl)ethylene;
- 1 - chloro - 2,2 - bis(5 - phenylether - 4 - hydroxyphenyl)ethylene;
- 1 - bromo - 2,2 - bis(3,5 - diphenylether - 4 - hydroxyphenyl)ethylene;
- 1,1 - dichloro - 2,2 - bis(3 - chloro - 5 - phenylether - 4 - hydroxyphenyl)ethylene; and
- 1,1 - dibromo - 2,2 - bis(3 - 2 - bromo - 5 - diphenylether - 4 - hydroxyphenyl)ethylene;

Illustrative of some aryene dihydroxy compounds that can be employed in the preparation of halobisphenoethylene polycarbonates or blends of halobisphenoethylene polycarbonates with other polycarbonates which contain phenyl carbonate units of formulas II and III in accordance with the phosgenating reaction conditions described by Z. Wielgosz et al. and S. Porejko et al., as well as those described in the aforesaid Encyclopedia of Polymer Science publication follow:

- resorcinol;
- 4,4'-dihydroxy-diphenyl;
- 1,6-dihydroxy-naphthalene;
- 2,6-dihydroxy-naphthalene;
- 4,4'-dihydroxy-diphenyl methane;
- 4,4'-dihydroxy-1,1-ethane;
- 4,4'-dihydroxy-diphenyl-1,1-butane;
- 4,4'-dihydroxy-diphenyl-1,1-isobutane;
- 4,4'-dihydroxy-diphenyl-1,1-cyclopentane;

	4,4'-dihydroxy-diphenyl-1,1-cyclohexane;	
	4,4'-dihydroxy-diphenyl-phenyl methane;	
	4,4'-dihydroxy-diphenyl-2-chlorophenyl methane;	
5	4,4'-dihydroxy-diphenyl-2,4-dichlorophenyl methane;	
	4,4'-dihydroxy-diphenyl-p-isopropylphenyl methane;	5
	4,4'-dihydroxy-diphenylnaphthyl methane;	
	4,4'-dihydroxy-diphenyl-2,2-propane;	
	4,4'-dihydroxy-3-methyl-diphenyl-2,2-propane;	
10	4,4'-dihydroxy-3-cyclohexyl-diphenyl-2,2-propane;	
	4,4'-dihydroxy-3-methoxy-diphenyl-2,2-propane;	10
	4,4'-dihydroxy-3-isopropyl-diphenyl-2,2-propane;	
	4,4'-dihydroxy-3,3'-dimethyl-diphenyl-2,2-propane;	
	4,4'-dihydroxy-3,3'-dichloro-diphenyl-2,2-propane;	
15	4,4'-dihydroxy-diphenyl-2,2-butane;	
	4,4'-dihydroxy-diphenyl-2,2-pentane;	15
	4,4'-dihydroxy-diphenyl-2,2(4-methyl pentane);	
	4,4'-dihydroxy-diphenyl-2,2-n-hexane;	
	4,4'-dihydroxy-diphenyl-2,2-nonane;	
20	4,4'-dihydroxy-diphenyl-4,4-heptane;	
	4,4'-dihydroxy-diphenyl phenylmethyl methane;	20
	4,4'-dihydroxy-diphenyl-4-chlorophenylmethyl methane;	
	4,4'-dihydroxy-diphenyl-2,5-dichlorophenylmethyl methane;	
	4,4'-dihydroxy-diphenyl-3,4-dichlorophenylmethyl methane;	
25	4,4'-dihydroxy-diphenyl-4-fluorophenylmethyl methane;	
	4,4'-dihydroxy-diphenyl-2-naphthylmethyl methane;	25
	4,4'-dihydroxy-tetraphenyl methane;	
	4,4'-dihydroxy-diphenyl phenylcyano methane;	
	4,4'-dihydroxy-diphenyl-1,2-ethane;	
30	4,4'-dihydroxy-diphenyl-1,10-n-decane;	
	4,4'-dihydroxy-diphenyl-1,6(1,6-dioxo-n-hexane);	30
	4,4'-dihydroxy-diphenyl-1,10(1,10-dioxo-n-decane);	
	bis-p-hydroxy-phenylether-4,4'-diphenyl;	
	$\alpha,\alpha,\alpha',\alpha'$ - tetramethyl - $\alpha,\alpha'$ - (di - p - hydroxyphenyl)p - xylylene;	
35	$\alpha,\alpha,\alpha',\alpha'$ - tetramethyl - $\alpha,\alpha'$ - (di - p - hydroxyphenyl) - m - xylylene;	
	2,2'-dihydroxy-3,3',5,5'-tetramethyldiphenyl methane;	35
	4,4'-dihydroxy-3,3'-dimethyl-diphenyl methane;	
	4,4'-dihydroxy-2,2'-dimethyl-diphenyl methane;	
	4,4'-dihydroxy-3,3',5,5'-tetramethyl-diphenyl methane;	
40	4,4'-dihydroxy-3,3'-dichloro-diphenyl methane;	
	4,4'-dihydroxy-3,3'-dimethoxy-diphenyl methane;	40
	4,4'-dihydroxy-2,2',5,5'-tetramethyl-diphenyl methane;	
	4,4' - dihydroxy - 2,2',3,3',5,5',6,6' - octamethyl - diphenyl methane;	
	4,4' - dihydroxy - 2,2' - dimethyl - 5,5' - diisopropyl - diphenyl methane;	
45	4,4' - dihydroxy - 2,2' - dimethyl - 5,5' - dipropyl - diphenyl methane;	
	4,4' - dihydroxy - 2,2' - dimethyl - 5,5' - di - tert. - butyl - diphenyl methane;	45
	4,4'-dihydroxy-diphenyl-5,5-nonane;	
	4,4'-dihydroxy-diphenyl-6,6-undecane;	
50	4,4'-dihydroxy-diphenyl-3,3-butanone-2;	
	4,4'-dihydroxy-3,3'-dimethyl-diphenyl-3,3-butanone-2;	50
	4,4'-dihydroxy-diphenyl-4,4-hexanone-3;	
	4,4'-dihydroxy-diphenylmethyl-4-methoxy-phenyl methane;	
	4,4'-dihydroxy-diphenyl ether;	
55	4,4'-dihydroxy-diphenyl sulfide;	
	4,4'-dihydroxy-3,3'-dimethyldiphenyl sulfide;	55
	4,4'-dihydroxy-diphenyl sulfoxide;	
	4,4'-dihydroxy-diphenyl sulfone;	
	4,4'-dihydroxy-3,3'-dichlorodiphenyl sulfone;	
	4,4'-dihydroxy-3,3',5,5'-tetramethyl-diphenyl methane;	
60	4,4' - dihydroxy - 3,3',5,5' - tetrachloro - diphenyl - 1,1 - cyclohexane;	
	4,4' - dihydroxy - 3,3',5,5' - tetrachloro - diphenyl - 2,2 - propane;	60
	4,4' - dihydroxy - 3,3',5,5' - tetramethyl - 2,2',6,6' - tetrabromo - diphenyl - 2,2 - propane; and	
65	4,4' - dihydroxy - 3,3',5,5' - tetrabromo - diphenyl - 2,2 - propane.	
	Presently preferred halobisphenoethylene polycarbonates exhibit an intrinsic	65

viscosity of at least 0.3 and more preferably 0.5 deciliters per gram (dl./g.) as measured in either methylene chloride or chloroform or similar solvent systems at 25°C. The upper intrinsic viscosity number is not critical, however, it will generally be 1.5 dl./g. Especially useful halobisphenolethylene polycarbonates generally have an intrinsic viscosity within the range of from 0.38 to 0.7 dl./g. Preferably, the halobisphenolethylene polycarbonates contain a sufficient number of repeating units of formulas I, or I and II, or III, set out hereinbefore, to give a number average molecular weight of homo- or copolycarbonates—including blends thereof with other polycarbonates—of at least 5,000, and more preferably a number average molecular weight of from 10,000 to 50,000. Polycarbonates of such molecular weight characteristics can be processed between 450°F. and 650°F., or even higher, and are preferably processed between 550°F. and 650°F.

Blends of halobisphenolethylene polycarbonates and any other polycarbonate containing arylencarbonate units of formula II or III, as described hereinbefore, are included within the scope of this invention, and can be prepared by any means known to those skilled in the art. Preferred blends are prepared by heating admixtures of a halobisphenolethylene polycarbonates and any other polycarbonate to a temperature above their softening point(s). Preferably, the mixing or blending is carried out—when carried out in the absence of a solvent—at the aforesaid elevated temperature, i.e. above their softening point(s), while subjecting the admixture to mechanical working. Accordingly, blends can be mixed with such equipment as extruders including mono- and multiple-screw types, internal Banbury mixers, roll mills, or any other mechanical equipment which will subject the admixture to shear stresses at elevated temperatures.

The term "glass fibers", as used herein and in the appended claims includes, among others, (1) continuous fibers formed by the rapid attenuation of streams of molten glass to strands formed when such glass fiber filaments are gathered together in forming; and (2) discontinuous fibers formed by high pressure stream or air directed angularly downwardly onto multiple streams of molten glass issuing from the bottom side of a glass melting bushing.

Halobisphenolethylene polycarbonate compositions of this invention contain reinforcing amounts of a glass fiber, such as, e.g. grounds, short glass fibers and rovings, especially staple glass fiber, and preferably glass fibers having average fiber lengths of from 100—600  $\mu$ m, and more preferably from 200—400  $\mu$ m provided that the glass fibers possess a fiber finish which is compatible with the polycarbonate resins employed in this invention. Where electrical properties of the halobisphenolethylene polycarbonates are important, a preferred reinforcing glass filler also defined herein as fibrous glass filaments are comprised of lime-aluminum borosilicate glass that is relatively soda-free (commonly known as "E" glass) which glass filaments can be made by any standard process, e.g., by steam or air blowing, flame blowing and mechanical pulling.

Any amount of halobisphenolethylene homo- or copolycarbonate or blends of halobisphenolethylene polycarbonate with any other polycarbonate containing "arylene carbonate" units of formulas II or III can be employed in combination with a reinforcing amount of a glass fiber. The halobisphenolethylene polycarbonate compositions comprise polycarbonate compositions containing on a weight ratio basis—in either homo- or copolymer or blends thereof—halobisphenylethylene carbonate units of formula I to arylene carbonate units of formulas II or III within the range of from 5:95 to 95:5, preferably from 20:80 to 80:20. The above mentioned ranges describe fiberglass reinforced polycarbonate compositions of this invention having optimum mechanical properties, especially notched Izod impact, oxygen index, tensile yield, and flexural strength properties.

Any amount—on a weight basis—of glass fiber, e.g. 1 to 10, 10 to 50, 50 to 100 parts or even greater amounts of glass fiber per 100 parts of halobisphenolethylene polycarbonate can be employed. Presently preferred compositions contain from 5 to 50, and more preferably from 7.5 to 30 parts of glass fiber per 100 parts of halobisphenolethylene polycarbonate.

The glass fiber materials can be added to the polycarbonates in any way, e.g. the fibers can be added to polycarbonate solutions or melts, or can be mixed with polycarbonate powder or mixtures thereof and homogenized by subsequent melt extrusion in a manner analogous with the procedures described elsewhere with regard to the preparation of blends of halobisphenolethylene polycarbonates. In the same sequence of the manufacturing process, it is possible to add to the polycarbonate compositions other reinforcing and/or nonreinforcing fillers, flame

retardant additives, or other additives such as pigments, mold release agents, stabilizers, antioxidants, drip retarding agents and surfactant agents.

The following examples illustrate—but do not limit—the best mode of practicing the invention. Unless otherwise indicated in the examples, the following general procedures are employed in the preparation and testing of the comparisons of this invention. Deviations from the general procedure are noted in the specific examples.

#### General Procedure

A series of blends of chlorobisphenolethylene polycarbonates and bisphenol-A polycarbonates were prepared from noncommercially available material and commercially available materials, respectively. The chlorobisphenol polycarbonate (abbreviated in the example as bisphenol-E polycarbonate) were prepared by the reaction of an aqueous alkaline solution of 1,1 - dichloro - 2,2 - bis(4 - hydroxyphenyl)ethylene with phosgene carried out in the presence of triethylamine and methylene chloride at a temperature range of from 20° to 40°C. to form high molecular weight chlorobisphenolethylene polycarbonates having an intrinsic viscosity as measured in methylene chloride at a temperature of 25.3°C. within the range of from 0.41 to 0.54.

The bisphenol-A polycarbonate, a commercial produce of General Electric Company, was prepared by the reaction of an aqueous alkaline solution of bis(4-hydroxyphenyl)propane-2,2 with phosgene carried out in the presence of triethylamine and methylene chloride in accordance with standard commercial reaction conditions to provide a high molecular weight bisphenol-A polycarbonate having an intrinsic viscosity of within the range of from 0.46 to 0.52 dl./g. as measured in dioxane at 25°C.

The resulting bisphenol-E polycarbonate and bisphenol-A polycarbonate were powder blended into a series of compositions, extruded and chopped into pellets. The pelleted materials were injection or compression molded and tested accordingly:

Notched Izod Impact (1/8" specimens, ft.-lbs. per inch of notch) ASTM D256 method A;  
Oxygen Index ASTM D2863;  
Tensile Yield Stress (psi) ASTM D1822; L specimen, .05"/min.;  
Flexural Strength (psi) ASTM D790.

#### EXAMPLES 1—7

A series of bisphenol-E polycarbonate and bisphenol-A polycarbonate blends which contained various proportions of bisphenol-E/bisphenol-A components were prepared containing 10 parts by weight of glass fiber per 100 parts of polycarbonate. For control purposes, individual bisphenol-E polycarbonate and bisphenol-A polycarbonate compositions containing 10 parts by weight of glass fiber per 100 parts of polycarbonates were also evaluated. The control (Example I) and blends were tested in accord with the tests described in the General Procedure. The results of the tests are tabulated in Table I set out hereafter and further illustrated by Figures 1, 2, 3 and 4.

TABLE I  
Composition and Mechanical Properties of Fiberglass  
Reinforced Blends of Bisphenol-E and  
Bisphenol-A Polycarbonates

Example No.	1	2	3	4	5	6	7	5
<b>I. Polycarbonate Composition</b>								
(a) bisphenol-E, phr(1)	0	10	25	50	75	90	100	
(b) bisphenol-A, phr	100	90	75	50	25	10	0	
(c) glass fiber, phr	10	10	10	10	10	10	10	
<b>II. Physical Properties</b>								
(a) notched Izod impact (2)	2.0	3.18	8.0	5.73	2.7(3)	3.9	2.6	10
(b) oxygen index	33.5	32.3	53.0	54.5	54.2	53.9	54.8	
(c) tensile yield stress	9430	9250	9185	9335	9466	10170	10270	
(d) flexural strength	16146	15930	15660	16109	16190	16770	17320	
(1) phr=parts per hundred of polycarbonate resin								15
(2) average of five or more test specimens								
(3) experimental data error								

Referring now to Figures 1, 2, 3 and 4 which graphically illustrate the data set out in Table I hereinbefore, it is shown that (1) the notched Izod impact properties of bisphenol-E/bisphenol-A polycarbonate blends are unexpectedly improved based on the impact properties associated with glass fiber reinforced polycarbonates containing only bisphenol-E or bisphenol-A polycarbonates, (2) the oxygen index values of bisphenol-E/bisphenol-A polycarbonate blends are exceptionally high, (3) the tensile yield stress data and the flexural strength data substantiate the conclusion that the impact data observed and reported in Figure 1 is accurate and that the impact properties of bisphenol-E/bisphenol-A polycarbonate blends are optimum depending upon the proportions of halobisphenylethylene carbonate and arylene carbonate moieties.

Although the above illustrative examples and associated figures describe the notched Izod impact, oxygen index, tensile yield and flexural strength data of glass fiber reinforced polycarbonates blended from homopolymers of bisphenol-E and bisphenol-A polycarbonates, analogous results are obtained when copolymers of halobisphenolethylene polycarbonates are prepared having comparable weight percentages of halobis(phenyl)ethylene carbonate units and arylene carbonate units.

The fiber glass reinforced halobisphenolethylene polycarbonates can be molded or formed into films, sheets, fibers, laminates or other molded articles by conventional molding techniques.

#### WHAT WE CLAIM IS:—

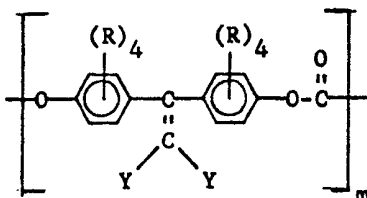
1. A halo bisphenolethylene polycarbonate composition comprising a reinforcing amount of glass fibres and

(i) homopolymer containing halo bis(phenyl) ethylene carbonate units;

(ii) a copolymer containing at least 5 parts by weight halo bis(phenyl) ethylene carbonate units and a maximum of 95 parts by weight of arylene carbonate units in 100 parts of copolymer; or

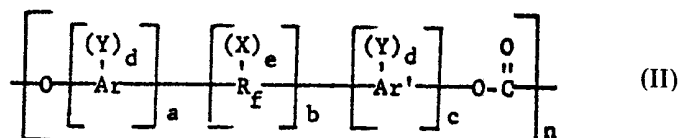
(iii) a blend containing at least 5 parts by weight of the homopolymer of (i) and a maximum of 95 parts by weight of a polycarbonate of arylene carbonate units in 100 parts of the blend;

the halobis(phenyl)ethylene carbonate units being of formula I



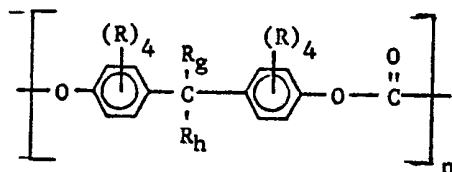
where independently each R is hydrogen, chlorine, bromine or a  $C_{1-30}$  monovalent hydrocarbon or hydrocarboxy group, each Y is hydrogen, chlorine or bromine

subject to the proviso that at least one Y is chlorine or bromine, and  $m$  is an integer of at least 2, and the arylene carbonate units being of formula II



wherein  $R$  is an alkylene, alkylidene, cycloalkylene, cycloalkylidene or arylene linkage or a mixture thereof, or an ether carbonyl, amine, sulfur or phosphorus containing linkage, Ar and Ar' are arylene radicals, Y is an organic, an inorganic or an organo-metallic radical, X is alkyl, aryl, cycloalkyl or a mixture thereof, halogen, an ether group of the formula-OE, wherein E is alkyl, aryl or cycloalkyl,  $d$  represents a whole number of at least 1,  $e$  represents 0 or a whole number of 1 or more,  $a$ ,  $b$  and  $c$  represent 0 or whole numbers,  $a$  or  $c$  but not both may be 0, and wherein  $n$  is an integer of at least 2.

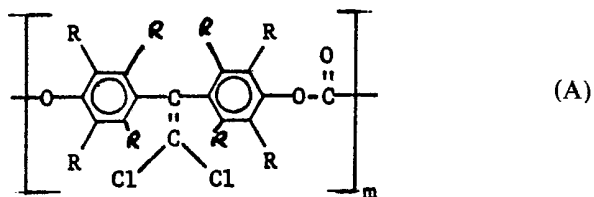
2. A composition as claimed in claim 1 wherein said arylene carbonate units have the formula:



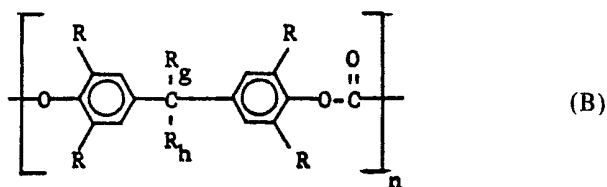
where  $R$  is as defined in Claim 1, and  $R_g$  and  $R_h$  are hydrogen or a  $C_{1-30}$  monovalent hydrocarbon group.

3. A composition as claimed in claim 2 wherein  $R$  is hydrogen, at least one Y is chlorine and the other Y is hydrogen, and  $R_g$  and  $R_h$  are methyl.

4. A composition as claimed in any one of the preceding claims wherein said halobis(phenyl)ethylene carbonate units are of the formula:



wherein  $R$  is hydrogen, chlorine, bromine,  $C_{1-4}$  alkyl or phenyl,  $m$  is an integer of at least 2, and said arylene carbonate units are of the formula:



wherein  $R$  is the same as above, and  $R_g$  and  $R_h$  are independently hydrogen,  $C_{1-4}$  alkyl or phenyl,  $n$  is an integer of at least 2.

5. A composition according to any one of the preceding claims, wherein the glass fiber is present in an amount of from 5—35 parts by weight based on the polycarbonate.

6. A composition according to any one of the preceding claims containing 20—80 parts by weight of said halobisphenylethylene carbonate units and 80—20 parts by weight of said arylene carbonate units.



7. A composition as claimed in claim 1 substantially as hereinbefore described in one of Examples 2 to 7.

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