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(54) Titre : COMPOSITIONS POLYCARBONATE IGNIFUGEES A RESILIENCE MODIFIEE
(54) Title: FLAME-PROOF IMPACT RESISTANT-MODIFIED POLYCARBONATE COMPOSITIONS

(57) Abrégé/Abstract:

The invention relates to polycarbonate compositions containing A) 38 to 99.3 parts by weight of aromatic polycarbonate and/or aromatic polyester carbonate, B) 0.5 to 12 parts by weight of rubber-modified graft polymer, C) 0.1 to 25 parts by weight of a salt of a phosphinic acid, and D) 0.1 to 25 parts by weight of talc, the parts by weight of each of components A, B, C, and D being relative to the total parts by weight of components A+B+C+D. Said polycarbonate compositions are characterized by an optimal combination of great thermostability, good resistance to flames, excellent mechanical properties, good resistance to chemicals, and good hydrolytic resistance. The invention also relates to the use of said polycarbonate compositions for producing molded articles as well as said molded articles.

Abstract

The present invention relates to polycarbonate compositions comprising

A) 38 to 99.3 parts by wt. (in each case based on the sum of the parts by weight of components A+B+C+D) of aromatic polycarbonate and/or aromatic polyester carbonate,

B) 0.5 to 12 parts by wt. (in each case based on the sum of the parts by weight of components A+B+C+D) of rubber-modified graft polymer,

C) 0.1 to 25 parts by wt. (in each case based on the sum of the parts by weight of components A+B+C+D) of a salt of a phosphinic acid, and

D) 0.1 to 25 parts by wt. (in each case based on the sum of the parts by weight of components A+B+C+D) of talc,

which are distinguished by an optimum combination of high heat distortion point, good flameproofing, excellent mechanical properties and a good resistance to chemicals and hydrolysis, the use of the polycarbonate compositions for the production of shaped articles and the shaped articles themselves.

Flame-proof impact resistant-modified polycarbonate compositions

The present invention relates to impact-modified polycarbonate compositions which comprise a salt of a phosphinic acid and talc, the use of the polycarbonate compositions for the production of shaped articles and the shaped articles themselves.

WO-A 2005/044906 discloses thermoplastic moulding compositions comprising at least one metal salt of hypophosphoric acid and at least one aromatic polycarbonate resin and a mixture thereof with a styrene-containing graft copolymer resin having a rubber content of 5-15 %. The contents of the styrene-containing graft copolymer are 10-40 wt.%. The moulding compositions obtained are distinguished by good flame resistance, high heat stability under processing conditions and good weather resistance. Because of the low rubber content, other properties, in particular mechanical properties, are at a low level.

WO-A 1999/57192 describes thermoplastic moulding compositions comprising 5-96 wt.% of a polyester or polycarbonate, 1-30 wt.% of a phosphinic acid salt and/or of a diphosphinic acid salt and/or polymers thereof, 1-30 wt.% of at least one organic phosphorus-containing flameproofing agent, and possible further additives.

DE-A 102004049342 discloses thermoplastic moulding compositions comprising 10-98 wt.% of thermoplastic polymer, 0.01-50 wt.% of highly branched polycarbonate or highly branched polyester or mixtures thereof, 1-40 wt.% of halogen-free flameproofing agent chosen from the group of P-containing or N-containing compounds or of P-N condensates or mixtures thereof, and possible further additives.

JP-A 2001-335699 describes flameproofed resin compositions comprising two or more thermoplastic resins chosen from styrene resin, aromatic polyester resin, polyamide resin, polycarbonate resin and polyphenylene ether resin and one or more (in)organic phosphinic acid salts, and possible further additives.

JP-A 2001-261973 (Daicel Chemical Industries Ltd.) describes compositions of thermoplastic resins and (in)organic phosphinic acid salts. A combination of PBT, calcium phosphinate and PTFE is given as an example.

JP-A 2002-161211 discloses compositions of thermoplastic resins and flameproofing agents, such as salts of phosphinic and phosphoric acid and derivatives thereof. A combination of PBT, ABS, polyoxyphenylene, calcium phosphinate, an organophosphate and glass fibres is given as an example.

Flameproofing agents which are conventional according to the prior art for polycarbonate/ABS blends are organic aromatic phosphates. These compounds can be in a low molecular weight form, in the form of a mixture of various oligomers or in the form of a mixture of oligomers with low molecular weight compounds (e.g. WO-A 99/16828 and WO-A 00/31173). The good activity as flameproofing agents is counteracted adversely by the highly plasticizing action of these compounds on the polymeric constituents, so that the heat distortion point of these moulding compositions is not satisfactory for many uses.

The object of the present invention is to provide impact-modified polycarbonate moulding compositions having an optimum combination of high heat distortion point, good flameproofing, excellent mechanical properties and a good resistance to chemicals and hydrolysis.

It has now been found, surprisingly, that moulding compositions or compositions comprising A) polycarbonate, B) rubber-modified graft polymer, C) a salt of a phosphinic acid and D) talc have the desired profile of properties.

It has thus been found, surprisingly, that compositions comprising

A) 38 to 99.3 parts by wt., preferably 61 to 97 parts by wt., particularly preferably 71 to 84 parts by wt. (in each case based on the sum of the parts by weight of components A+B+C+D) of aromatic polycarbonate and/or aromatic polyester carbonate,

B) 0.5 to 12 parts by wt., preferably 1 to 9 parts by wt., particularly preferably 2 to 5 parts by wt. (in each case based on the sum of the parts by weight of components A+B+C+D) of rubber-modified graft polymer,

C) 0.1 to 25 parts by wt., preferably 1 to 15 parts by wt., particularly preferably 7 to 12 parts by wt. (in each case based on the sum of the parts by weight of components A+B+C+D) of a salt of a phosphinic acid,

D) 0.1 to 25 parts by wt., preferably 1 to 15 parts by wt., particularly preferably 7 to 12 parts by wt. (in each case based on the sum of the parts by weight of components A+B+C+D) of talc,

E) 0 to 20 parts by wt. (based on the sum of the parts by weight of components A+B+C+D = 100) of rubber-free vinyl (co)polymer and/or polyalkylene terephthalate, preferably the composition is free from rubber-free vinyl (co)polymer and/or polyalkylene terephthalate,

F) 0 to 50 parts by wt., preferably 0.5 to 25 parts by wt. (in each case based on the sum of the parts by weight of components A+B+C+D = 100) of additives,

wherein all the parts by weight stated in the present application are standardized such that the sum of the parts by weight of components A+B+C+D in the composition is 100, achieve the abovementioned technical object.

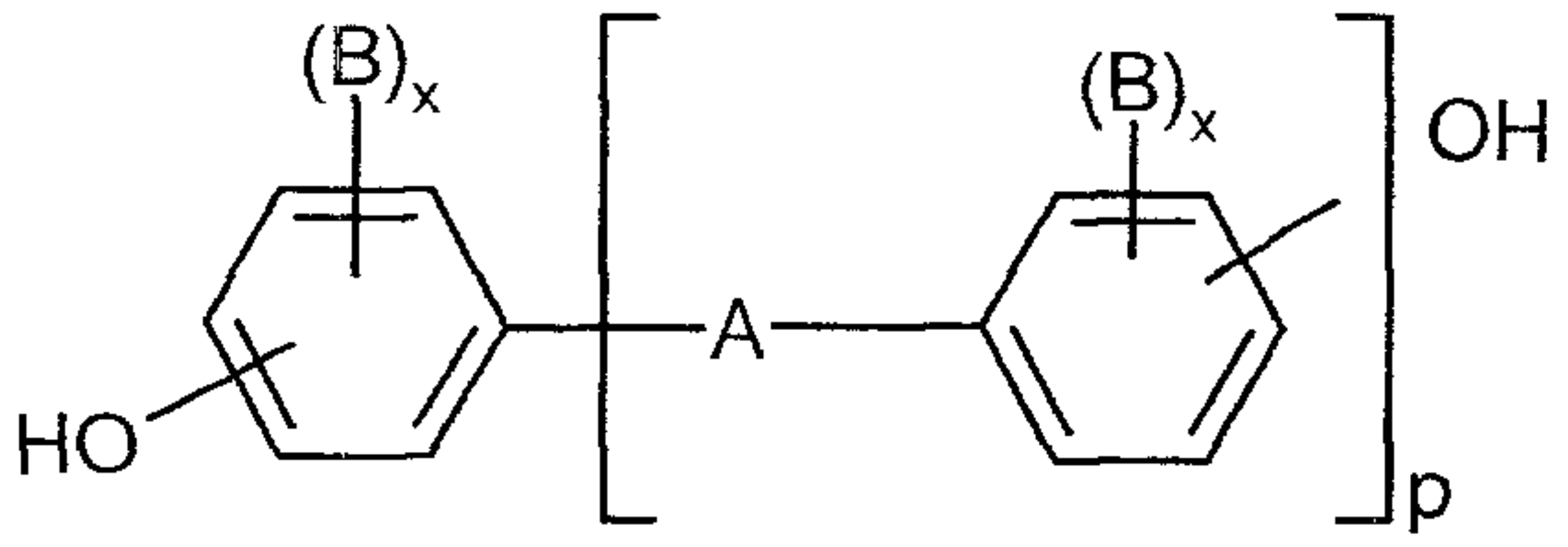
Too high a content of component B has the disadvantage that the burning properties and the heat distortion point (Vicat B) are impaired.

Component A

Aromatic polycarbonates and/or aromatic polyester carbonates according to component A which are suitable according to the invention are known from the literature or can be prepared by processes known from the literature (for the preparation of aromatic polycarbonates see, for example, Schnell, "Chemistry and Physics of Polycarbonates", Interscience Publishers, 1964 and DE-AS 1 495 626, DE-A 2 232 877, DE-A 2 703 376, DE-A 2 714 544, DE-A 3 000 610 and DE-A 3 832 396; for the preparation of aromatic polyester carbonates e.g. DE-A 3 077 934).

Aromatic polycarbonates are prepared e.g. by reaction of diphenols with carbonic acid halides, preferably phosgene, and/or with aromatic dicarboxylic acid dihalides, preferably benzenedicarboxylic acid dihalides, by the interfacial process, optionally using chain terminators, for example monophenols, and optionally using branching agents which are trifunctional or more than trifunctional, for example triphenols or tetraphenols. A preparation via a melt polymerization process by reaction of diphenols with, for example, diphenyl carbonate is likewise possible.

Diphenols for the preparation of the aromatic polycarbonates and/or aromatic polyester carbonates are preferably those of the formula (I)

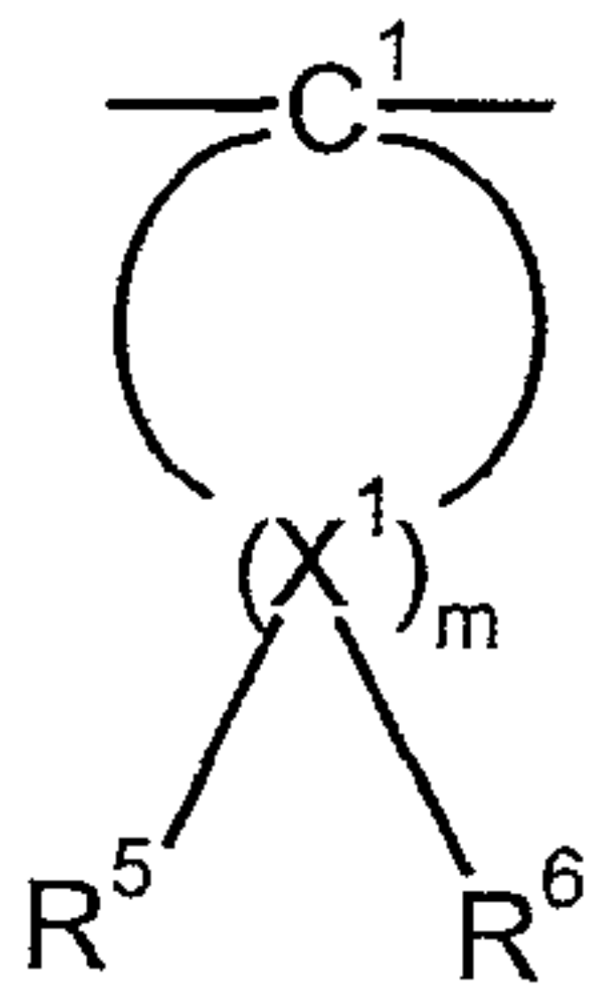


(I)

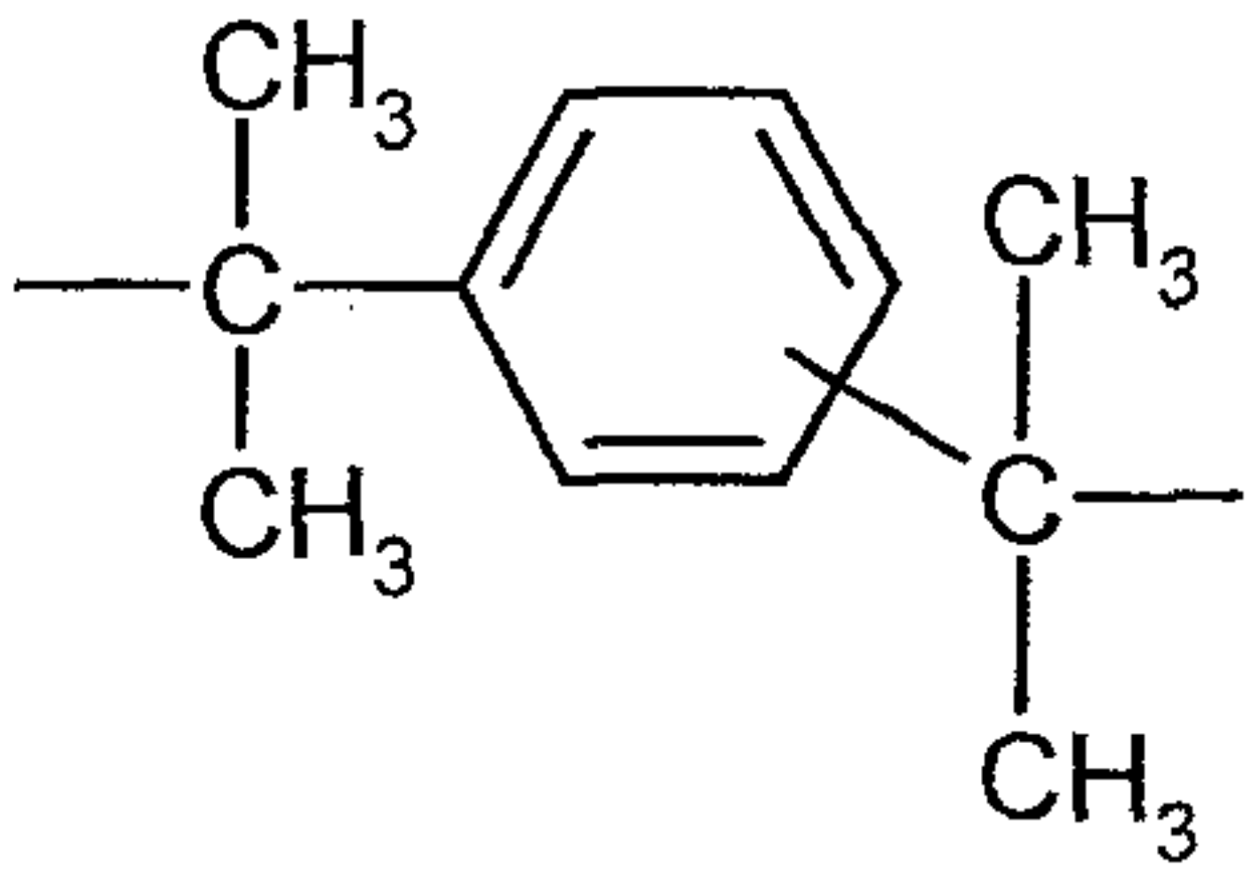
wherein

A is a single bond, C_1 to C_5-alkylene, C_2 to C_5-alkylidene, C_5 to C_6-cycloalkylidene, -O-, -SO-, -CO-, -S-, $-SO_2-$, C_6 to C_{12}-arylene, on to which further aromatic rings optionally containing hetero atoms can be fused,

or a radical of the formula (II) or (III)



(II)



(III)

B is in each case C_1 to C_{12}-alkyl, preferably methyl, or halogen, preferably chlorine and/or bromine,

x is in each case independently of one another 0, 1 or 2,

p is 1 or 0, and

R^5 and R^6 can be chosen individually for each X^1 and independently of one another denote hydrogen or C_1 to C_6-alkyl, preferably hydrogen, methyl or ethyl,

X^1 denotes carbon and

m denotes an integer from 4 to 7, preferably 4 or 5, with the proviso that on at least one atom X^1 R^5 and R^6 are simultaneously alkyl.

Preferred diphenols are hydroquinone, resorcinol, dihydroxydiphenols, bis-(hydroxyphenyl)-C_1-C_5-alkanes, bis-(hydroxyphenyl)-C_5-C_6-cycloalkanes, bis-(hydroxyphenyl) ethers, bis-(hydroxyphenyl) sulfoxides, bis-(hydroxyphenyl) ketones, bis-(hydroxyphenyl) sulfones and α,α-bis-(hydroxyphenyl)-diisopropyl-benzenes and derivatives thereof brominated on the nucleus and/or chlorinated on the nucleus.

Particularly preferred diphenols are 4,4'-dihydroxydiphenyl, bisphenol-A, 2,4-bis(4-hydroxyphenyl)-2-methylbutane, 1,1-bis-(4-hydroxyphenyl)-cyclohexane, 1,1-bis-(4-hydroxyphenyl)-3,3,5-trimethylcyclohexane, 4,4'-dihydroxydiphenyl sulfide, 4,4'-dihydroxydiphenyl sulfone and di- and tetrabrominated or chlorinated derivatives thereof, such as, for example, 2,2-bis(3-chloro-4-hydroxyphenyl)-propane, 2,2-bis-(3,5-dichloro-4-hydroxyphenyl)-propane or 2,2-bis-(3,5-dibromo-4-hydroxyphenyl)-propane. 2,2-Bis-(4-hydroxyphenyl)-propane (bisphenol A) is particularly preferred.

The diphenols can be employed individually or as any desired mixtures. The diphenols are known from the literature or obtainable by processes known from the literature.

Chain terminators which are suitable for the preparation of the thermoplastic aromatic polycarbonates are, for example, phenol, p-chlorophenol, p-tert-butylphenol or 2,4,6-tribromophenol, but also long-chain alkylphenols, such as 4-[2-(2,4,4-trimethylpentyl)]-phenol, 4-(1,3-tetramethylbutyl)-phenol according to DE-A 2 842 005 or monoalkylphenols or dialkylphenols having a total of 8 to 20 carbon atoms in the alkyl substituents, such as 3,5-di-tert-butylphenol, p-iso-octylphenol, p-tert-octylphenol, p-dodecylphenol and 2-(3,5-dimethylheptyl)-phenol and 4-(3,5-dimethylheptyl)-phenol. The amount of chain terminators to be employed is in general between 0.5 mol% and 10 mol%, based on the sum of the moles of the particular diphenols employed.

The thermoplastic aromatic polycarbonates have average weight-average molecular weights (M_w, measured e.g. by GPC, ultracentrifuge or scattered light measurement) of from 10,000 to 200,000 g/mol, preferably 15,000 to 80,000 g/mol, particularly preferably 24,000 to 32,000 g/mol.

The thermoplastic aromatic polycarbonates can be branched in a known manner, and in particular preferably by incorporation of from 0.05 to 2.0 mol%, based on the sum of the diphenols employed, of compounds which are trifunctional or more than trifunctional, for example those having three and more phenolic groups.

Both homopolycarbonates and copolycarbonates are suitable. 1 to 25 wt.%, preferably 2.5 to 25 wt.%, based on the total amount of diphenols to be employed, of polydiorganosiloxanes having hydroxyaryloxy end groups can also be employed for the preparation of the copolycarbonates according to the invention according to component A. These are known (US 3 419 634) and can be prepared by processes known from the literature. The preparation of copolycarbonates containing polydiorganosiloxane is described in DE-A 3 334 782.

Preferred polycarbonates are, in addition to bisphenol A homopolycarbonates, copolycarbonates of bisphenol A with up to 15 mol%, based on the sum of the moles of diphenols, of other diphenols mentioned as preferred or particularly preferred, in particular 2,2-bis(3,5-dibromo-4-hydroxyphenyl)-propane.

Aromatic dicarboxylic acid dihalides for the preparation of aromatic polyester carbonates are preferably the diacid dichlorides of isophthalic acid, terephthalic acid, diphenyl ether 4,4'-dicarboxylic acid and of naphthalene-2,6-dicarboxylic acid.

Mixtures of the diacid dichlorides of isophthalic acid and of terephthalic acid in a ratio of between 1:20 and 20:1 are particularly preferred.

A carbonic acid halide, preferably phosgene, is additionally co-used as a bifunctional acid derivative in the preparation of polyester carbonates.

Possible chain terminators for the preparation of the aromatic polyester carbonates are, in addition to the monophenols already mentioned, also chlorocarbonic acid esters thereof and the acid chlorides of aromatic monocarboxylic acids, which can optionally be substituted by C_1 to C_{22}-alkyl groups or by halogen atoms, and aliphatic C_2 to C_{22}-monocarboxylic acid chlorides.

The amount of chain terminators is in each case 0.1 to 10 mol%, based on the moles of diphenol in the case of the phenolic chain terminators and on the moles of dicarboxylic acid dichloride in the case of monocarboxylic acid chloride chain terminators.

The aromatic polyesters carbonates can also contain incorporated aromatic hydroxycarboxylic acids.

The aromatic polyester carbonates can be either linear or branched in a known manner (in this context see DE-A 2 940 024 and DE-A 3 007 934).

Branching agents which can be used are, for example, carboxylic acid chlorides which are trifunctional or more than trifunctional, such as trimesic acid trichloride, cyanuric acid trichloride, 3,3',4,4'-benzophenone-tetracarboxylic acid tetrachloride, 1,4,5,8-naphthalenetetracarboxylic acid tetrachloride or pyromellitic acid tetrachloride, in amounts of from 0.01 to 1.0 mol-% (based on the dicarboxylic acid dichlorides employed), or phenols which are trifunctional or more than trifunctional, such as phloroglucinol, 4,6-dimethyl-2,4,6-tri-(4-hydroxyphenyl)-hept-2-ene, 4,6-dimethyl-2,4-6-tri-(4-hydroxyphenyl)-heptane, 1,3,5-tri-(4-hydroxyphenyl)-benzene, 1,1,1-tri-(4-hydroxyphenyl)-ethane, tri-(4-hydroxyphenyl)-phenylmethane, 2,2-bis[4,4-bis(4-hydroxy-phenyl)-cyclohexyl]-propane, 2,4-bis(4-hydroxyphenyl-isopropyl)-phenol, tetra-(4-hydroxyphenyl)-methane, 2,6-bis(2-hydroxy-5-methyl-benzyl)-4-methyl-phenol, 2-(4-hydroxyphenyl)-2-(2,4-dihydroxyphenyl)-propane, tetra-(4-[4-hydroxyphenyl-isopropyl]-phenoxy)-methane or 1,4-bis[4,4'-dihydroxytriphenyl)-methyl]-benzene, in amounts of from 0.01 to 1.0 mol%, based on the diphenols employed. Phenolic branching agents can be initially introduced with the diphenols, and acid chloride branching agents can be introduced together with the acid dichlorides.

The content of carbonate structural units in the thermoplastic aromatic polyester carbonates can vary as desired. The content of carbonate groups is preferably up to 100 mol%, in particular up to 80 mol%, particularly preferably up to 50 mol%, based on the sum of ester groups and carbonate groups. Both the ester and the carbonate content of the aromatic polyester carbonates can be present in the polycondensate in the form of blocks or randomly distributed.

The relative solution viscosity (η_{rel}) of the aromatic polycarbonates and polyester carbonates is in the range of 1.18 to 1.4, preferably 1.20 to 1.32 (measured on solutions of 0.5 g of polycarbonate or polyester carbonate in 100 ml of methylene chloride solution at 25 °C).

The thermoplastic aromatic polycarbonates and polyester carbonates can be employed by themselves or in any desired mixture.

Component B

Component B includes one or more graft polymers of

B.1 5 to 95, preferably 30 to 90 wt.% of at least one vinyl monomer on

B.2 95 to 5, preferably 70 to 10 wt.% of at least one graft base chosen from the group consisting of diene rubbers, EP(D)M rubbers (i.e. those based on ethylene/propylene and optionally diene) and acrylate, polyurethane, silicone, silicone/acrylate, chloroprene and ethylene/vinyl acetate rubbers.

The graft base B.2 in general has an average particle size (d_{50} value) of from 0.05 to 10 µm, preferably 0.1 to 5 µm, particularly preferably 0.2 to 1 µm.

Monomers B.1 are preferably mixtures of

B.1.1 50 to 99 parts by wt. of vinylaromatics and/or vinylaromatics substituted on the nucleus (such as styrene, α-methylstyrene, p-methylstyrene and p-chlorostyrene) and/or (meth)acrylic acid (C_1-C_8)-alkyl esters (such as methyl methacrylate and ethyl methacrylate) and

B.1.2 1 to 50 parts by wt. of vinyl cyanides (unsaturated nitriles, such as acrylonitrile and methacrylonitrile) and/or (meth)acrylic acid C_1-C_8-alkyl esters, such as methyl methacrylate, n-butyl acrylate and t-butyl acrylate, and/or derivatives (such as anhydrides and imides) of unsaturated carboxylic acids, for example maleic anhydride and N-phenyl-maleimide.

Preferred monomers B.1.1 are chosen from at least one of the monomers styrene, α-methylstyrene and methyl methacrylate, and preferred monomers B.1.2 are chosen from at least one of the monomers acrylonitrile, maleic anhydride and methyl methacrylate. Particularly preferred monomers are B.1.1 styrene and B.1.2 acrylonitrile.

Preferred graft bases B.2 are silicone/acrylate rubbers, diene rubbers (for example based on butadiene and isoprene) or mixtures of diene rubbers. Diene rubbers in the context according to the invention are also to be understood as meaning copolymers of diene rubbers or mixtures thereof with further copolymerizable monomers (e.g. according to B.1.1 and B.1.2). The graft bases B.2 in general have a glass transition temperature of < 10 °C, preferably < 0 °C, particularly preferably < -10 °C.

Particularly preferred polymers B are, for example, ABS polymers (emulsion, bulk and suspension ABS) such as are described e.g. in DE-OS 2 035 390 (= US 3 644 574) or in DE-OS 2 248 242 (= GB 1 409 275) and in Ullmanns, Enzyklopädie der Technischen Chemie, vol. 19 (1980), p. 280 et seq. The gel content of the graft base B.2 is at least 20 wt.%, in the case of graft bases B.2 prepared in emulsion polymerization preferably at least 40 wt.% (measured in toluene).

Preferably, the graft polymer of components B.1 and B.2 has a core-shell structure, wherein component B.1 forms the shell (also called casing) and component B.2 forms the core (see e.g. Ullmann's Encyclopedia of Industrial Chemistry, VCH-Verlag, vol. A21, 1992, page 635 and page 656).

The graft polymers B are prepared by free-radical polymerization, e.g. by emulsion, suspension, solution or bulk polymerization, preferably by emulsion or bulk polymerization.

Particularly suitable graft rubbers are also ABS polymers which are prepared in the emulsion polymerization process by redox initiation with an initiator system of organic hydroperoxide and ascorbic acid in accordance with US 4 937 285.

Since as is known the grafting monomers are not necessarily grafted completely on to the graft base during the grafting reaction, according to the invention graft polymers B are also understood as meaning those products which are produced by (co)polymerization of the grafting monomers in the presence of the graft base and are also obtained during the working up.

Suitable acrylate rubbers according to B.2 of the polymers B are preferably polymers of acrylic acid alkyl esters, optionally with up to 40 wt.%, based on B.2, of other polymerizable ethylenically unsaturated monomers. The preferred polymerizable acrylic acid esters include C_1 to C_8-alkyl esters, for example methyl, ethyl, butyl, n-octyl and 2-ethylhexyl esters, haloalkyl esters, preferably halo-C_1-C_8-alkyl esters, such as chloroethyl acrylate, and mixtures of these monomers.

For crosslinking, monomers having more than one polymerizable double bond can be copolymerized. Preferred examples of crosslinking monomers are esters of unsaturated monocarboxylic acids having 3 to 8 C atoms and unsaturated monohydric alcohols having 3 to 12 C atoms, or of saturated polyols having 2 to 4 OH groups and 2 to 20 C atoms, such as ethylene glycol dimethacrylate and alkyl methacrylate; polyunsaturated heterocyclic compounds, such as trivinyl and triallyl cyanurate; polyfunctional vinyl compounds, such as di- and trivinylbenzenes; but also triallyl phosphate and diallyl phthalate. Preferred crosslinking monomers are allyl methacrylate, ethylene glycol dimethacrylate, diallyl phthalate and heterocyclic compounds which contain at least three ethylenically unsaturated groups. Particularly preferred crosslinking monomers are the cyclic monomers triallyl cyanurate, triallyl isocyanurate, triacryloylhexahydro-s-triazine and triallylbenzenes. The amount of the crosslinking monomers is preferably 0.02 to 5, in particular 0.05 to 2 wt.%, based on the graft base B.2. In the case of cyclic crosslinking monomers having at least three ethylenically unsaturated groups, it is advantageous to limit the amount to less than 1 wt.% of the graft base B.2.

Preferred "other" polymerizable ethylenically unsaturated monomers which can optionally serve for preparation of the graft base B.2 in addition to the acrylic acid esters are e.g. acrylonitrile, styrene, α-methylstyrene, acrylamides, vinyl C_1-C_6-alkyl ethers, methyl methacrylate and butadiene. Preferred acrylate rubbers as graft base B.2 are emulsion polymers which have a gel content of at least 60 wt.%.

Suitable silicone rubbers according to B.2 can be prepared by emulsion polymerization, as described, for example, in US 2891920 and US 3294725. Further suitable graft bases according to B.2 are silicone rubbers having grafting-active sites, such as are described in DE-OS 3 704 657, DE-OS 3 704 655, DE-OS 3 631 540 and DE-OS 3 631 539.

According to the invention, silicone/acrylate rubbers are also suitable as graft bases B.2. These silicone/acrylate rubbers are composite rubbers having grafting-active sites containing a silicone rubber content of 10 - 90 wt.% and a polyalkyl (meth)acrylate rubber content of 90 to 10 wt.%, the two rubber components mentioned penetrating each other in the composite rubber, so that they cannot be separated substantially from one another. If the content of the silicone rubber component in the composite rubber is too high, the finished resin compositions have adverse surface properties and cannot be coloured so readily. On the other hand, if the content of the polyalkyl (meth)acrylate rubber component in the composite rubber is too high, the impact strength of the finished resin composition is adversely influenced. Silicone/acrylate rubbers are known and are described, for example, in US 5,807,914, EP 430134 and US 4888388. A graft polymer prepared in emulsion polymerization with B.1 methyl methacrylate and B.2 silicone/acrylate composite rubber is preferably employed.

In a preferred embodiment, the graft polymer according to component B) is a graft polymer which is prepared in the bulk, solution or bulk-suspension polymerization process and has a rubber content (corresponds to the content of component B.2 in the graft polymer) of from 16 to 25 wt.%, preferably from 17 to 19 wt.%, and a grafted shell which contains, in each case based on the monomers of the grafted shell, 22 to 27 wt.% of at least one of the monomers according to B.1.2 and 73 to 78 wt.% of at least one of the monomers according to B.1.1. The graft polymer very preferably contains a butadiene/styrene block copolymer rubber as the graft base B.2 (core) and a shell of styrene (B.1.1) and acrylonitrile (B.1.2). The graft polymer has a gel content (measured in acetone) of from 20 to 30 wt.%, preferably from 22 to 26 wt.%. If the graft polymer according to the invention contains a rubber content of less than 16 wt.%, this has the disadvantage that the mechanical properties, in particular the notched impact strength, and the resistance to chemicals are at a level which is inadequate for many uses.

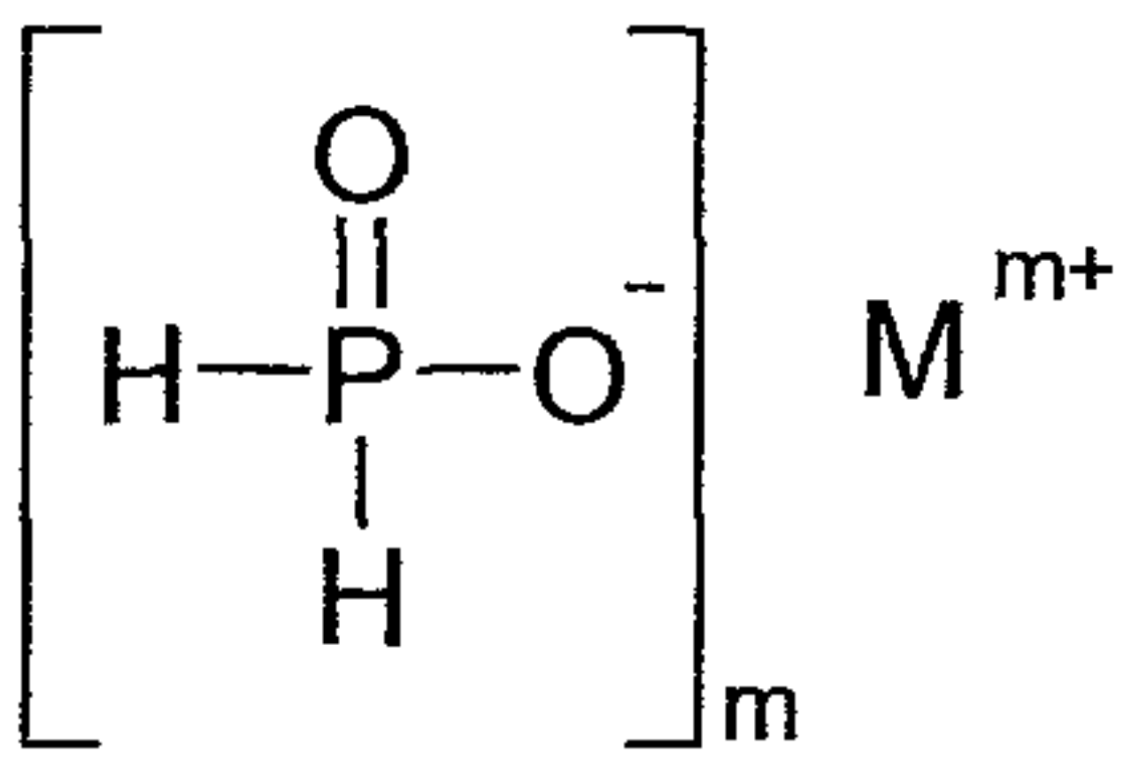
The gel content of the graft base B.2 is determined at 25 °C in a suitable solvent (M. Hoffmann, H. Krömer, R. Kuhn, Polymeranalytik I und II, Georg Thieme-Verlag, Stuttgart 1977).

The average particle size d_{50} is the diameter above and below which in each case 50 wt.% of the particles lie. It can be determined by means of ultracentrifuge measurement (W. Scholtan, H. Lange, Kolloid, Z. und Z. Polymere 250 (1972), 782-1796).

Component C

The salt of a phosphinic acid (component C) in the context according to the invention is to be understood as meaning the salt of a phosphinic acid with any desired metal cation. Mixtures of salts which differ in their metal cation can also be employed. The metal cations are the cations of metals of main group 1 (alkali metals, preferably Li^+, Na^+, K^+), of main group 2 (alkaline earth metals; preferably Mg^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, particularly preferably Ca^{2+}) or of main group 3 (elements of the boron group; preferably Al^{3+}) and/or of subgroup 2, 7 or 8 (preferably Zn^{2+}, Mn^{2+}, Fe^{2+}, Fe^{3+}) of the periodic table.

A salt or a mixture of salts of a phosphinic acid of the formula (IV) is preferably employed



$$\left[H-\overset{\overset{\displaystyle O}{\|}}{\underset{\underset{\displaystyle H}{|}}{P}}-O^{-} \right]_m M^{m+}$$

(IV)

wherein M^{m+} is a metal cation of main group 1 (alkali metals; $m = 1$), main group 2 (alkaline earth metals; $m = 2$) or of main group 3 ($m = 3$) or of subgroup 2, 7 or 8 (wherein m denotes an integer from 1 to 6, preferably 1 to 3 and particularly preferably 2 or 3) of the periodic table.

Particularly preferably, in formula (IV)
for $m = 1$ the metal cations $M^+ = Li^+, Na^+, K^+$,
for $m = 2$ the metal cations $M^{2+} = Mg^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}$ and
for $m = 3$ the metal cations $M^{3+} = Al^{3+}$,
Ca^{2+} ($m = 2$) and Al^{3+} ($m = 3$) are very preferred.

In a preferred embodiment, the average particle size d_{50} of the phosphinic acid salt (component C) is less than 80 µm, preferably less than 60 µm, and d_{50} is particularly preferably between 10 µm and 55 µm. The average particle size d_{50} is the diameter above and below which in each case 50 wt.% of the particles lie. Mixtures of salts which differ in their average particle size d_{50} can also be employed.

These requirements of the particle size d_{50} of the phosphinic acid salt are in each case associated with the technical effect that the flameproofing efficiency of the phosphinic acid salt is increased.

The phosphinic acid salt can be employed either by itself or in combination with other phosphorus-containing flameproofing agents. The compositions according to the invention are preferably free from phosphorus-containing flameproofing agents chosen from the group of mono- and oligomeric phosphoric and phosphonic acid esters, phosphonate-amines and phosphazenes. These other phosphorus-containing flameproofing agents, such as, for example, the mono- and oligomeric phosphoric and phosphonic acid esters, have the disadvantage compared with the phosphinic acid salts that they lower the heat distortion point of the moulding compositions.

Component D

Talc is understood as meaning a naturally occurring or synthetically prepared talc.

Pure talc has the chemical composition 3 MgO · 4 SiO_2 · H_2O and therefore has an MgO content of 31.9 wt.%, an SiO_2 content of 63.4 wt.% and a content of chemically bonded water of 4.8 wt.%. It is a silicate having a laminar structure.

Naturally occurring talc materials in general do not have the abovementioned composition for pure talc, since they are contaminated by replacement of some of the magnesium by other elements, by replacement of some of the silicon by e.g. aluminium and/or by intergrowths with other minerals, such as e.g. dolomite, magnesite and chlorite.

Specific talc varieties are preferably employed. The specific talc varieties of the preferred embodiment of the invention are distinguished by a particularly high purity, characterized by an MgO content of from 28 to 35 wt.%, preferably 30 to 33 wt.%, particularly preferably 30.5 to 32 wt.% and an SiO_2 content of from 55 to 65 wt.%, preferably 58 to 64 wt.%, particularly preferably 60 to 62.5 wt.%. Preferred talc types are furthermore distinguished by an Al_2O_3 content of less than 5 wt.%, particularly preferably less than 1 wt.%, in particular less than 0.7 wt.%. A commercially available talc type which corresponds to this definition is e.g. Luzenac® A3 from Luzenac Naintsch Mineralwerke GmbH (Graz, Austria). Talc types which do not meet this purity requirement of the preferred embodiment of the invention are e.g. Luzenac SE-Standard, Luzenac SE-Super, Luzenac SE-Micro and Luzenac ST 10, 15, 20, 30 and 60, all of which are marketed by Luzenac Naintsch Mineralwerke GmbH.

The use of the talc according to the invention in the form of finely ground types having an average particle size d_{50} of from 0.1 to 20 µm, preferably 0.2 to 10 µm, particularly preferably 1.1 to 5 µm, very particularly preferably 1.15 to 2.5 µm is advantageous in particular. The average particle size d_{50} is the diameter above and below which in each case 50 wt.% of the particles lie. Mixtures of talc types which differ in their average particle size d_{50} can also be employed. These requirements of the average particle size d_{50} of the talc are in each case associated with the technical effect that the mechanical properties of the resulting moulding compositions are improved.

The talc can be treated on the surface, e.g. silanized, in order to ensure a better compatibility with the polymer. In view of the processing and preparation of the moulding compositions, the use of compacted talc is also advantageous.

Component E

Component E includes one or more thermoplastic vinyl (co)polymers E.1 and/or polyalkylene terephthalates E.2.

Suitable vinyl (co)polymers E.1 are polymers of at least one monomer from the group of vinylaromatics, vinyl cyanides (unsaturated nitriles), (meth)acrylic acid (C_1-C_8)-alkyl esters, unsaturated carboxylic acids and derivatives (such as anhydrides and imides) of unsaturated carboxylic acids. (Co)polymers which are suitable in particular are those of

E.1.1 50 to 99, preferably 60 to 80 parts by wt. of vinylaromatics and/or vinylaromatics substituted on the nucleus, such as styrene, α-methylstyrene, p-methylstyrene and p-chlorostyrene, and/or (meth)acrylic acid (C_1-C_8)-alkyl esters, such as methyl methacrylate and ethyl methacrylate, and

E.1.2 1 to 50, preferably 20 to 40 parts by wt. of vinyl cyanides (unsaturated nitriles), such as acrylonitrile and methacrylonitrile, and/or (meth)acrylic acid (C_1-C_8)-alkyl esters, such as methyl methacrylate, n-butyl acrylate and t-butyl acrylate, and/or unsaturated carboxylic acids, such as maleic acid, and/or derivatives, such as anhydrides and imides, of unsaturated carboxylic acids, for example maleic anhydride and N-phenylmaleimide.

The vinyl (co)polymers E.1 are resinous, thermoplastic and rubber-free. The copolymer of E.1.1 styrene and E.1.2 acrylonitrile is particularly preferred.

The (co)polymers according to E.1 are known and can be prepared by free-radical polymerization, in particular by emulsion, suspension, solution or bulk polymerization. The (co)polymers preferably have average molecular weights Mw (weight-average, determined by light scattering or sedimentation) of between 15,000 and 200,000.

The polyalkylene terephthalates of component E.2 are reaction products of aromatic dicarboxylic acids or their reactive derivatives, such as dimethyl esters or anhydrides, and aliphatic, cycloaliphatic or araliphatic diols, and mixtures of these reaction products.

Preferred polyalkylene terephthalates contain at least 80 wt.%, preferably at least 90 wt.%, based on the dicarboxylic acid component, of terephthalic acid radicals and at least 80 wt.%, preferably at least 90 mol%, based on the diol component, of radicals of ethylene glycol and/or butane-1,4-diol.

The preferred polyalkylene terephthalates can contain, in addition to terephthalic acid radicals, up to 20 mol%, preferably up to 10 mol% of radicals of other aromatic or cycloaliphatic dicarboxylic acids having 8 to 14 C atoms or aliphatic dicarboxylic acids having 4 to 12 C atoms, such as e.g. radicals of phthalic acid, isophthalic acid, naphthalene-2,6-dicarboxylic acid, 4,4'-diphenyldicarboxylic acid, succinic acid, adipic acid, sebacic acid, azelaic acid and cyclohexanediacetic acid.

The preferred polyalkylene terephthalates can contain, in addition to radicals of ethylene glycol or butane-1,4-diol, up to 20 mol%, preferably up to 10 mol% of other aliphatic diols having 3 to 12 C atoms or cycloaliphatic diols having 6 to 21 C atoms, e.g. radicals of propane-1,3-diol, 2-ethylpropane-1,3-diol, neopentyl glycol, pentane-1,5-diol, hexane-1,6-diol, cyclohexane-1,4-dimethanol, 3-ethylpentane-2,4-diol, 2-methylpentane-2,4-diol, 2,2,4-trimethylpentane-1,3-diol, 2-ethylhexane-1,3-diol, 2,2-diethylpropane-1,3-diol, hexane-2,5-diol, 1,4-di-(β-hydroxyethoxy)-benzene, 2,2-bis-(4-hydroxycyclohexyl)-propane, 2,4-dihydroxy-1,1,3,3-tetramethyl-cyclobutane, 2,2-bis-(4-β-hydroxyethoxy-phenyl)-propane and 2,2-bis-(4-hydroxypropoxyphenyl)-propane (DE-A 2 407 674, 2 407 776 and 2 715 932).

The polyalkylene terephthalates can be branched by incorporation of relatively small amounts of 3- or 4-hydric alcohols or 3- or 4-basic carboxylic acids, e.g. in accordance with DE-A 1 900 270 and US 3 692 744. Examples of preferred branching agents are trimesic acid, trimellitic acid, trimethylolethane and -propane and pentaerythritol.

Polyalkylene terephthalates which have been prepared solely from terephthalic acid and reactive derivatives thereof (e.g. dialkyl esters thereof) and ethylene glycol and/or butane-1,4-diol and mixtures of these polyalkylene terephthalates are particularly preferred.

Mixtures of polyalkylene terephthalates contain 1 to 50 wt.%, preferably 1 to 30 wt.% of polyethylene terephthalate and 50 to 99 wt.%, preferably 70 to 99 wt.% of polybutylene terephthalate.

The polyalkylene terephthalates preferably used in general have a limiting viscosity of from 0.4 to 1.5 dl/g, preferably 0.5 to 1.2 dl/g, measured in phenol/o-dichlorobenzene (1:1 parts by weight) at 25 °C in an Ubbelohde viscometer.

The polyalkylene terephthalates can be prepared by known methods (see e.g. Kunststoff-Handbuch, volume VIII, p. 695 et seq., Carl-Hanser-Verlag, Munich 1973).

Component F

The composition can comprise further commercially available additives according to component F), such as flameproofing synergists, antidripping agents (for example compounds of the substance classes of fluorinated polyolefins, of silicones and aramid fibres), lubricants and mould release agents (for example pentaerythritol tetrastearate), nucleating agents, stabilizers, antistatics (for example conductive carbon blacks, carbon fibres, carbon nanotubes and organic antistatics, such as polyalkylene ethers, alkylsulfonates or polyamide-containing polymers), acids, fillers and reinforcing substances (for example glass fibres or carbon fibres, mica, kaolin, talc, $CaCO_3$ and glass flakes) and dyestuffs and pigments.

Preparation of the moulding compositions and shaped articles

The thermoplastic moulding compositions according to the invention are prepared by mixing the particular constituents in a known manner and subjecting the mixture to melt compounding and melt extrusion at temperatures of from 260 °C to 300 °C in conventional units, such as internal kneaders, extruders and twin-screw extruders.

The mixing of the individual constituents can be carried out in a known manner either successively or simultaneously, and in particular either at about 20 °C (room temperature) or at a higher temperature.

The invention likewise provides processes for the preparation of the moulding compositions and the use of the moulding compositions for the production of shaped articles and the mouldings themselves.

The moulding compositions according to the invention can be used for the production of all types of shaped articles. These can be produced by injection moulding, extrusion and blow moulding processes. A further form of processing is the production of shaped articles by thermoforming from previously produced sheets or films.

Examples of such shaped articles are films, profiles, housing components of all types, e.g. for domestic appliances, such as televisions, juice presses, coffee machines and mixers; for office machines, such as monitors, flatscreens, notebooks, printers and copiers; sheets, tubes, electrical installation conduits, windows, doors and further profiles for the building sector (interior finishing and exterior uses) and electrical and electronic components, such as switches, plugs and sockets, and vehicle body or interior components for utility vehicles, in particular for the automobile sector.

The moulding compositions according to the invention can also be used in particular, for example, for the production of the following shaped articles or mouldings: interior finishing components for rail vehicles, ships, aircraft, buses and other motor vehicles, housing of electrical equipment containing small transformers, housing for equipment for processing and transmission of information, housing and lining of medical equipment, massage equipment and housing therefor, toy vehicles for children, planar wall elements, housing for safety equipment and for televisions, thermally insulated transportation containers, mouldings for sanitary and bath fittings, cover grids for ventilator openings and housing for garden equipment.

The following examples serve to explain the invention further.

Examples

Component A-1

Linear polycarbonate based on bisphenol A having a weight-average molecular weight M_w of 27,500 g/mol (determined by GPC).

Component A-2

Linear polycarbonate based on bisphenol A having a weight-average molecular weight M_w of approx. 17,000 to 19,000 g/mol (determined by GPC).

Component A-3

Branched polycarbonate based on bisphenol A having a relative solution viscosity of eta rel = 1.34, measured in CH_2Cl_2 as the solvent at 25 °C and a concentration of 0.5 g/100 ml, which has been branched by employing 0.3 mol% of isatin-biscresol, based on the sum of the mol% from bisphenol A and isatin-biscresol.

Component B-1

ABS polymer having a core-shell structure prepared by bulk polymerization of 82 wt.%, based on the ABS polymer, of a mixture of 24 wt.% of acrylonitrile and 76 wt.% of styrene in the presence of 18 wt.%, based on the ABS polymer, of a polybutadiene/styrene block copolymer rubber having a styrene content of 26 wt.%. The gel content of the ABS polymer is 24 wt.% (measured in acetone).

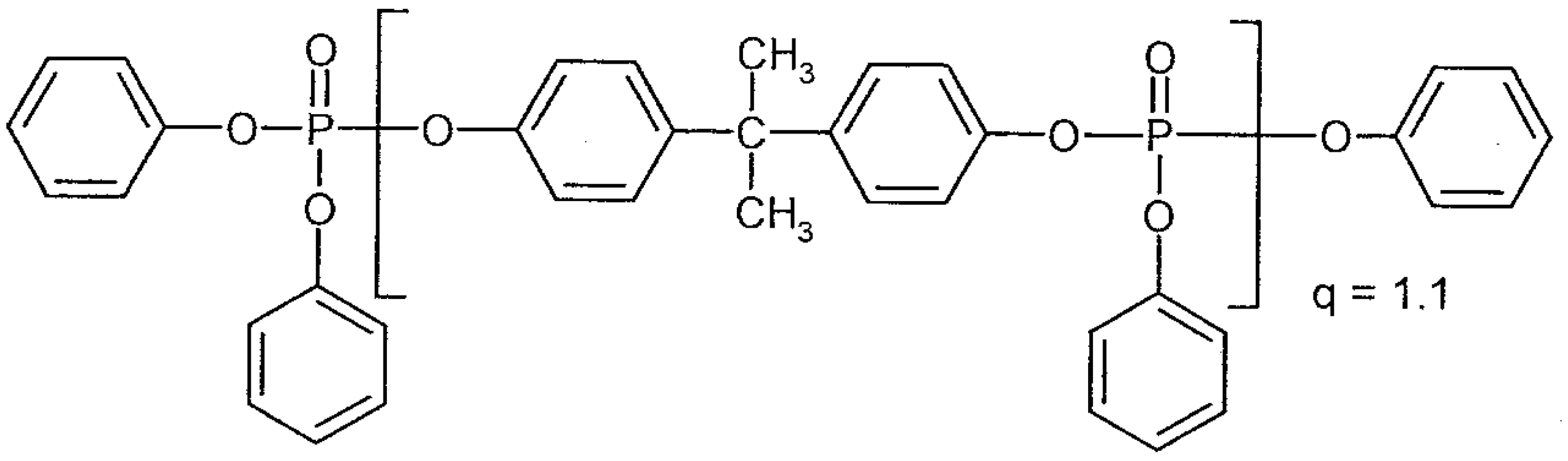
Component B-2

Impact modifier, methyl methacrylate-modified silicone/acrylate rubber, Metablen® SX 005 from Mitsubishi Rayon Co., Ltd., CAS 143106-82-5.

Component C

Component C-1 (comparison)

Oligophosphate based on bisphenol A



Component C-2

Calcium phosphinate, average particle size $d_{50} = 50\ \mu m$.

Component D-1

Talc, HTP Ultra® from Imi Fabi having an MgO content of 31.0 wt.%, an SiO_2 content of 61.5 wt.% and an Al_2O_3 content of 0.4 wt.%, average particle size $d_{50} = 0.5\ \mu m$.

Component D-2

Talc, Jetfine® 3CA from Luzenac/Rio Tinto having an MgO content of 32 wt.%, an SiO_2 content of 61 wt.% and an Al_2O_3 content of 0.3 wt.%, average particle size $d_{50} = 1.0\ \mu m$.

Component F

Component F-1:	polytetrafluoroethylene (PTFE)
Component F-2:	pentaerythritol tetrastearate
Component F-3:	Irganox B900 (manufacturer: Ciba Specialty Chemicals Inc., Basle, Switzerland)

Preparation and testing of the moulding compositions

The starting substances listed in Table 1 are compounded and granulated on a twin-screw extruder (ZSK-25) (Werner und Pfleiderer) at a speed of rotation of 225 rpm and a throughput of 20 kg/h at a machine temperature of 260 °C. The finished granules are processed on an injection moulding machine to give the corresponding test specimens (melt temperature 240 °C, mould temperature 80 °C, melt front speed 240 mm/s).

Characterization is carried out in accordance with DIN EN ISO 180/1A (Izod notched impact strength a_K), DIN EN ISO 527 (tensile E modulus and elongation at break), DIN ISO 306 (Vicat softening temperature, method B with a load of 50 N and a heating rate of 120 K/h), ISO 11443 (melt viscosity), DIN EN ISO 1133 (melt volume flow rate MVR) and UL 94 V (measured on bars of dimensions 127 x 12.7 x 1.5 mm) .

Hydrolysis test: The change in the MVR measured in accordance with ISO 1133 at 240 °C with a plunger load of 5 kg after storage (1 d = 1 day, 2 d = 2 days, 5 d = 5 days, 6 d = 6 days, 7 d = 7 days) of the granules at 95 °C and 100 % relative atmospheric humidity serves as a measure of the resistance to hydrolysis of the compositions prepared in this way. The MVR value before the corresponding storage is called "MVR value of the starting specimen" in Table 1.

Under the resistance to chemicals (ESC properties), the time until break at 2.4 % edge fibre elongation after storage of the test specimen in toluene/isopropanol (60/40 parts by vol.) at room temperature is stated.

Compositions 3 and 4 according to the invention have an improved Vicat heat distortion point, shorter after-burning time, better ESC properties, a higher E modulus and better tear strength as well as a higher resistance to hydrolysis compared with Comparison Examples 1 and 2. This technical effect is attributed to the difference that in the comparison examples an oligophosphate is employed as the flameproofing agent instead of the calcium phosphinate according to the invention.

The composition 6 according to the invention has a shorter after-burning time and better ESC properties compared with Comparison Example 5, with an unchanged, good Vicat heat distortion point. This technical effect is attributed to the difference that no talc is contained in Comparison Example 5.

The composition 8 according to the invention has an improved Vicat heat distortion point, shorter after-burning time, a higher E modulus and better tear strength compared with Comparison Example 7. This technical effect is attributed to the difference that in the comparison example an oligophosphate is employed as the flameproofing agent instead of the calcium phosphinate according to the invention.

Table 1: Compositions and their properties

Composition		**1 (comp.)**	**2 (comp.)**	**3**	**4**
A-1	pt. by wt.	79.9	74.8	79.9	74.8
B-1	pt. by wt.	5.0	5.0	5.0	5.0
C-1	pt. by wt.	5.0	10.1		
C-2	pt. by wt.			5.0	10.1
D-1	pt. by wt.	10.1	10.1	10.1	10.1
F-1	pt. by wt.	0.4	0.4	0.4	0.4
F-2	pt. by wt.	0.4	0.4	0.4	0.4
F-3	pt. by wt.	0.1	0.1	0.1	0.1
Properties:					
a_k (ISO 180/1A) 240 °C/RT	kJ/m^2	8	7	7	7
Vicat B 120 (ISO 306, DIN 53460)	°C	123	110	138	139
Burning properties (UL 94 V, 1.5 mm)					
UL 94 V 1.5 mm / 2 d [rating]		V0	V0	V0	V0
UL 94 V 1.5 mm / 2 d [total ABT]	s	24	16	12	7
ESC properties / [2.4 %]	rating	BR	BR	BR	BR
	min:sec	01:45	03:33	01:51	09:32
Tensile test in accordance with ISO 527					
Tensile E modulus	N/mm^2	3952	4136	4082	4442
Tear strength (SR)	N/mm^2	42	36	44	55
Hydrolysis test (MVR 240°C/5 kg)					
Starting specimen	cm^3/10 min	9.8	15.6	8.3	7.3
Storage 1 d / 95 °C	cm^3/10 min	10.1	16.1	7.6	7.5
Storage 2 d / 95 °C	cm^3/10 min	10.3	16.6	7.7	7.6
Storage 5 d / 95 °C	cm^3/10 min	11.0	18.2	8.2	7.6
Storage 6 d / 95 °C	cm^3/10 min	11.7	18.6	8.2	7.7
Storage 7 d / 95 °C	cm^3/10 min	11.8	19.0	8.4	7.7
Increase in the MVR on storage relative to starting specimen					
Storage 1 d / 95 °C	%	4	3	-9	3
Storage 2 d / 95 °C	%	5	6	-8	4
Storage 5 d / 95 °C	%	13	17	-1	4
Storage 6 d / 95 °C	%	19	19	-1	6
Storage 7 d / 95 °C	%	21	21	1	6

BR: break

ABT = after-burn time

Table 2: Compositions and their properties

Composition		**5 (comp.)**	**6**	**7 (comp.)**	**8**
A-1	pt. by wt.	73.2	70.1		
A-2	pt. by wt.	22.2	22.2		
A-3	pt. by wt.			75.1	75.1
B-2	pt. by wt.	2.3	2.3	4.7	4.7
C-1	pt. by wt.			10.1	
C-2	pt. by wt.	2.3	2.3		10.1
D-1	pt. by wt.		3.0		
D-2	pt. by wt.			10.1	10.1
F-1	pt. by wt.	0.4	0.4	0.4	0.4
F-2	pt. by wt.	0.4	0.4	0.2	0.2
F-3	pt. by wt.	0.1	0.1	0.1	0.1
Properties:					
a_k (ISO 180/1A) 260°C/RT	kJ/m^2	23	23	14	55
Vicat B 120 (ISO 306, DIN 53460)	°C	145	145	112	145
Burning properties (UL 94 V, 1.5 mm)	kJ/m^2				
UL 94 V 1.5 mm / 2 d [rating]	°C	V-1	V-0	V-0	V-0
UL 94 V 1.5 mm / 2 d [total ABT]	s	59	11	10	5
ESC properties / [2.4 %]	rating	BR	BR		
	min:sec	0:37	1:22		
Tensile test in accordance with ISO 527					
Tensile E modulus	N/mm^2			3740	3878
Tear strength (SR)	N/mm^2			44	48

BR: break

ABT = after-burn time

Claims

1. Compositions comprising

   A) 38 to 99.3 parts by wt. (in each case based on the sum of the parts by weight of components A+B+C+D) of aromatic polycarbonate and/or aromatic polyester carbonate,

   B) 0.5 to 12 parts by wt. (in each case based on the sum of the parts by weight of components A+B+C+D) of rubber-modified graft polymer,

   C) 0.1 to 25 parts by wt. (in each case based on the sum of the parts by weight of components A+B+C+D) of a salt of a phosphinic acid, and

   D) 0.1 to 25 parts by wt. (in each case based on the sum of the parts by weight of components A+B+C+D) of talc,

2. Composition according to claim 1, comprising 2 to 5 parts by wt. (in each case based on the sum of the parts by weight of components A+B+C+D) of rubber-modified graft polymer according to component B).

3. Composition according to claim 1 or 2, comprising 7 to 12 parts by wt. (in each case based on the sum of the parts by weight of components A+B+C+D) of a salt of a phosphinic acid.

4. Composition according to one of claims 1 to 3, comprising 7 to 12 parts by wt. (in each case based on the sum of the parts by weight of components A+B+C+D) of talc.

5. Composition according to one of claims 1 to 4, comprising 0 to 20 parts by wt. (based on the sum of the parts by weight of components A+B+C+D = 100) of rubber-free vinyl (co)polymer and/or polyalkylene terephthalate as component E).

6. Composition according to one of claims 1 to 4 which is free from rubber-free vinyl (co)polymer and/or polyalkylene terephthalate.

7. Composition according to one of claims 1 to 6, comprising 0 to 50 parts by wt. (in each case based on the sum of the parts by weight of components A+B+C+D = 100) of additives as component F).

8. Composition according to one of claims 1 to 7, comprising as component B) one or more graft polymers of

   B.1 5 to 95 wt.% of at least one vinyl monomer on

B.2 95 to 5 wt.% of at least one graft base chosen from the group consisting of diene rubbers, EP(D)M rubbers (i.e. those based on ethylene/propylene and optionally diene) and acrylate, polyurethane, silicone, silicone/acrylate, chloroprene and ethylene/vinyl acetate rubbers.

9. Composition according to claim 8, comprising as B.1 mixtures of

B.1.1 50 to 99 parts by wt. of vinylaromatics and/or vinylaromatics substituted on the nucleus and/or (meth)acrylic acid (C_1-C_8)-alkyl esters and

B.1.2 1 to 50 parts by wt. of vinyl cyanides and/or (meth)acrylic acid (C_1-C_8)-alkyl esters and/or derivatives of unsaturated carboxylic acids.

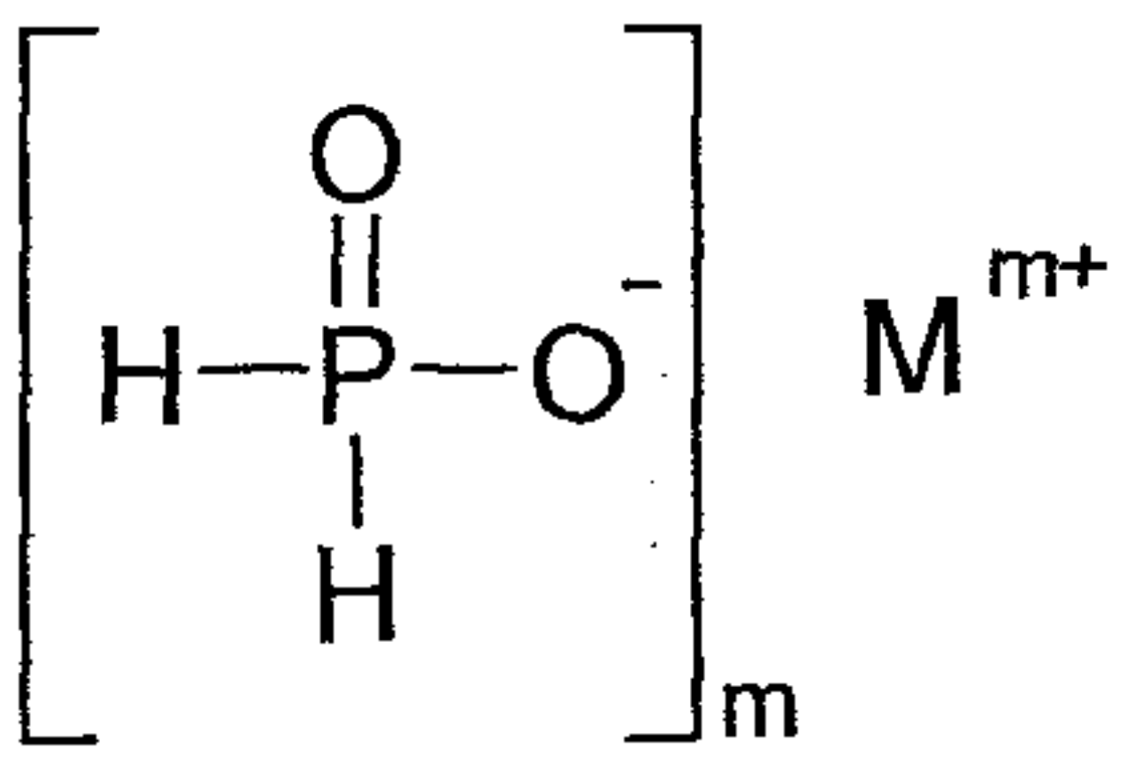
10. Composition according to claim 8 or 9, comprising a graft polymer according to component B) which is prepared in the bulk, solution or bulk-suspension polymerization process and has a rubber content (corresponds to the content of component B.2 in the graft polymer) of from 16 to 25 wt.%, and a grafted shell which contains, in each case based on the monomers of the grafted shell, 22 to 27 wt.% of at least one of the monomers according to B.1.2 and 73 to 78 wt.% of at least one of the monomers according to B.1.1.

11. Composition according to one of claims 8 to 10, wherein the graft polymer contains a butadiene/styrene block copolymer rubber as the graft base B.2 and a shell of styrene (B.1.1) and acrylonitrile (B.1.2).

12. Composition according to one of claims 1 to 9, comprising as component B) a graft polymer prepared in emulsion polymerization with B.1 methyl methacrylate and B.2 silicone/acrylate composite rubber.

13. Composition according to one of claims 1 to 12, comprising as component C) a salt or a mixture of salts of a phosphinic acid, wherein the metal cation is Li^+, Na^+, K^+, Mg^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Al^{3+}, Zn^{2+}, Mn^{2+}, Fe^{2+} and/or Fe^{3+}.

14. Composition according to claim 13, comprising as the salt or a mixture of salts a phosphinic acid of the formula (IV)



$$\left[H-\overset{\overset{O}{\|}}{\underset{\underset{H}{|}}{P}}-O^{-} \right]_m M^{m+}$$

(IV)

wherein

M^{m+} is a metal cation of main group 1 (alkali metals; m = 1), main group 2 (alkaline earth metals; m = 2) or of main group 3 (m = 3) or of subgroup 2, 7 or 8 (wherein m denotes an integer from 1 to 6) of the periodic table.

15. Composition according to claim 14, wherein $M^{m+} = Ca^{2+}$ and m = 2 or $M^{m+} = Al^{3+}$ and m = 3.

16. Composition according to one of claims 1 to 15, wherein the average particle size d_{50} of the phosphinic acid salt (component C) is less than 80 μm.

17. Composition according to one of claims 1 to 16, wherein the composition is free from phosphorus-containing flameproofing agents chosen from the group of mono- and oligomeric phosphoric and phosphonic acid esters, phosphonate-amines and phosphazenes.

18. Composition according to one of claims 1 to 17, wherein the commercially available additives according to component F) are flameproofing synergists, antidripping agents, lubricants and mould release agents, nucleating agents, stabilizers, antistatics, acids, fillers and reinforcing substances and dyestuffs and pigments.

19. Use of the compositions according to claim 1 to 18 for the production of shaped articles.

20. Shaped articles comprising a composition according to one of claims 1 to 18.

21. Shaped article according to claim 20, characterized in that the shaped article is a part of a motor vehicle, rail vehicle, aircraft or aquatic vehicle.