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(54) **IMPACT-RESISTANT
POLYOXYMETHYLENE MOULDING
COMPOUNDS WITH A LOW EMISSION,
THE USE THEREOF AND MOULDED
BODIES PRODUCED THEREFROM**

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(57) **ABSTRACT**

The present invention relates to a polyoxymethylene molding composition comprising:

- (A) from 0.01 to 1.0% by weight of a cyclic stabilizer which contains at least one nitrogen atom in the ring
- (B) from 0.001 to 0.5% by weight of a salt of a carboxylic acid
- (C) from 5 to 50% by weight of an impact modifier
- (D) from 0.0 to 2.0% by weight of a sterically hindered phenol compound
- (E) from 0.0 to 1.0% by weight of at least one stabilizer from the group of the benzotriazole derivatives or benzophenone derivatives or aromatic benzoate derivatives
- (F) from 0.0 to 0.8% by weight of a sterically hindered amine as light stabilizer (HALS)
- (G) a polyoxymethylene polymer to 100% by weight.

The molding compositions of the invention have substantially reduced formaldehyde emission, while the level of mechanical properties, particularly strength and impact strength, is retained.

**IMPACT-RESISTANT POLYOXYMETHYLENE
MOULDING COMPOUNDS WITH A LOW
EMISSION, THE USE THEREOF AND MOULDED
BODIES PRODUCED THEREFROM**

[0001] The present invention relates to impact-modified polyoxymethylene molding compositions which are suitable for producing molding or extrudates. The products produced therewith are particularly stable during processing and have low formaldehyde emission and little odor.

[0002] This application relates to the German Patent Applications DE 10126787.8 and DE 10047488.8, which are expressly incorporated herein by way of reference. They are therefore part of the disclosure of this Patent Application.

[0003] Since their introduction to the market about 40 years ago, polyoxymethylenes have become established as extremely useful technical materials in many applications. Polyoxymethylene is particularly widely used as an engineering material in automotive construction, in the electrical industry, and in medical technology. In these applications, polyoxymethylene molding compositions are subject to a requirement for a certain level of mechanical properties, such as stiffness, hardness, and toughness, this level being an essential requirement for the use of these materials for technical components like gear wheels and levers, among many other examples. The published values for yield stress are from 60 to 70 N/mm². The values found for the tensile modulus of elasticity of unmodified copolymers are from 2400 to 3100 N/mm². The values found for tensile strain at break are from 10 to 30%.

[0004] However, the impact strength of polyoxymethylenes is too low for many potential applications. Another desirable property in these applications is the capability of the products to retain their good impact strength properties even at relatively low ambient temperatures.

[0005] It is known that polyoxymethylenes can be toughened by adding impact modifiers. Impact modifiers used comprise organic additives, such as crosslinked or non-crosslinked elastomers, or graft copolymers made from an elastomeric, single-phase core and from a hard outer graft layer. Impact-modified polyoxymethylene molding compositions are known from the patent literature, e.g. polyoxymethylene modified with polyurethanes (DE 1 193 240), polyoxymethylene modified with a 2-phase mixture made from polybutadiene and styrene-acrylonitrile (ABS) (DE 1 931 392), polyoxymethylene modified with a graft copolymer prepared from acrylatebutadiene (DE 1 964 156), a polyoxymethylene provided with modified polysiloxanes and, respectively, silicone rubbers (DE 2 659 357), and finally polyoxymethylene modified with a graft copolymer composed of an elastomeric, single-phase core based on polydiene and of a hard, single- or multiphase outer graft layer, e.g. made from poly(alkyl)acrylates, poly(alkyl)acrylonitriles or polystyrene (EP 0156285 B1).

[0006] However, these foreign materials can cause degradation of the materials during processing, followed by release of formaldehyde, severely restricting the usefulness of the material for the production of moldings. Impact-modified polyoxymethylene molding compositions therefore often have high formaldehyde emission. Contaminants such as residual monomers or solvents present in the impact modifiers are released during the processing of impact-

modified polyoxymethylene molding compositions and during the use of the moldings produced therefrom. The emission of formaldehyde and contaminants from the impact modifiers causes an unpleasant odor, restricting the use of these materials in many application sectors.

[0007] A particular requirement during the processing of impact-modified polyoxymethylene molding compositions is that the degradation of the material is suppressed, to avoid any impairment of the properties of the product or of the material. Stabilizers are added for this purpose. EP 0156285 mentions the following stabilizers for the polyacetal phase: polyamides, amides of polybasic carboxylic acids, amidines, hydrazines, ureas, poly(N-vinyl lactams), and the alkaline earth metal salts of aliphatic mono- to tribasic carboxylic acids having from 2 to 20 carbon atoms and preferably containing hydroxy groups. Mention is also made of oxidation stabilizers and light stabilizers. However, even the addition of stabilizers has not hitherto removed the shortcoming of high emission. Known stabilizers and stabilizer systems which reduce formaldehyde emission moreover cause impairment of mechanical property profile.

[0008] None of the formulations described hitherto for impact-modified polyoxymethylene molding compositions gives sufficiently low formaldehyde emission together with retention of mechanical property profile.

[0009] The object of the present invention is to provide polyoxymethylene molding compositions in which the formaldehyde emission found hitherto has been reduced while mechanical property profile is retained. The moldings produced from these molding compositions are to have little odor.

[0010] The object is achieved by means of a polyoxymethylene molding composition comprising:

[0011] (A) from 0.01 to 1.0% by weight of a cyclic stabilizer which contains at least one nitrogen atom in the ring

[0012] (B) from 0.001 to 0.5% by weight of a salt of a carboxylic acid

[0013] (C) from 5 to 50% by weight of an impact modifier

[0014] (D) from 0.0 to 2.0% by weight of a sterically hindered phenol compound

[0015] (E) from 0.0 to 1.0% by weight of at least one stabilizer from the group of the benzotriazole derivatives or benzophenone derivatives or aromatic benzoate derivatives

[0016] (F) from 0.0 to 0.8% by weight of a sterically hindered amine as light stabilizer (HALS)

[0017] (G) a polyoxymethylene polymer to 100% by weight.

[0018] Surprisingly, it has been found that the polyoxymethylene molding compositions of the invention have substantially reduced formaldehyde emission when compared with the prior art. The reduction in emission is brought about by the interaction between the cyclic stabilizer having at least one ring nitrogen atom and the carboxylic salt. Unlike with other stabilizer systems which can be used to reduce

emission from polyoxymethylene molding compositions, the level of mechanical properties, particularly strength and impact strength, is retained.

[0019] The molding composition of the invention comprises from 0.01 to 1.0% by weight, preferably from 0.03 to 0.3% by weight, of a cyclic stabilizer, component (A), which contains at least one nitrogen atom in the ring. Examples are pyrrolidine, piperidine, pyrrole, pyridine, purine, indole, carbazole, tryptophan, oxazole, imidazole, thiazole, picoline, lutidine, collidine, quinoline, pyridazine, pyrimidine, pyrazine, and their derivatives. Advantageous compounds are heterocyclic compounds having at least one nitrogen atom as heteroatom adjacent either to an amino-substituted carbon atom or to a carbonyl group, examples being pyridazine, pyrimidine, pyrazine, pyrrolidone, aminopyridine, and compounds derived therefrom. Advantageous compounds of this type are aminopyridine and compounds derived therefrom. In principle, any of the aminopyridines is suitable, e.g. melamine, 2,6-diaminopyridine, substituted and dimeric aminopyridines, and also pyrrolidone and compounds derived therefrom, and mixtures made from these compounds. Examples of suitable pyrrolidones are imidazolidinone and compounds derived therefrom, e.g. hydantoin, the derivatives of which are particularly advantageous, and of these compounds allantoin and its derivatives are particularly advantageous. Other particularly advantageous compounds are triamino-1,3,5-triazine (melamine) and its derivatives, e.g. melamine-formaldehyde condensates and methylolmelamine. Very particular preference is given to melamine, methylolmelamine, melamine-formaldehyde condensates and allantoin. The cyclic stabilizers which contain at least one nitrogen atom in the ring may be used individually or in combination.

[0020] The component (B) used comprises from 0.001 to 0.5% by weight of a metal salt of a carboxylic acid. Salts of fatty acids are advantageous, in particular salts of higher fatty acids having from 10 to 32 carbon atoms, preferably from 14 to 32 carbon atoms, and particular preference is given to salts of montanic acids and stearic acid. Preferred metals are those which occur in the form of mono- or divalent ions, e.g. alkali metals and alkaline earth metals, in particular alkaline earth metals. Particular preference is given to magnesium and calcium, an example being calcium stearate. Magnesium stearate is very particularly preferred as component (B).

[0021] The component (C) used comprises from 5 to 50% by weight, preferably from 5 to 40% by weight, particularly preferably from 7 to 30% by weight, of an impact modifier. Impact modifiers which may be used, individually or as a mixture, are polyurethanes, 2-phase mixtures made from polybutadiene and styrene-acrylonitrile (ABS), modified polysiloxanes and, respectively, silicone rubbers, or graft copolymers made from an elastomeric, single-phase core based on polydiene and from a hard outer graft layer (core-shell structure). In the latter case, component (C) is composed of particles most of which, preferably more than 70% of which, have a structure of core and outer layers. The core here is formed from an elastomeric polymer phase onto which has been grafted the hard outer layer, which may also be composed of two or more layers. The core is preferably single-phase, meaning that the core is composed mainly, preferably completely, of the elastomeric soft phase and comprises only small amounts of, preferably no, inclusions

made from hard polymer constituents of the outer layer. The graft copolymer is mostly composed of from 40 to 95% by weight, advantageously from 60 to 90% by weight, particularly advantageously from 70 to 80% by weight, of the elastomeric core. The proportion of the outer layers (shells) is from 5 to 60% by weight, advantageously from 10 to 40% by weight, particularly advantageously from 20 to 30% by weight. The core is generally composed of polydienes, e.g. polybutadiene or polyisoprene, and can contain up to 10% by weight, advantageously up to 5% by weight, of comonomer units. Styrene or acrylonitrile may advantageously be used as comonomer. The core polymer may also have been crosslinked and have a gel content, measured in toluene, generally greater than 70%, and preferably greater than 80%. An example of a crosslinker which may be used is divinylbenzene. The outer layer of the particles is composed of hard polymers which have been grafted onto the core as graft substrate. The outer layer here may have a single- or multishell structure, advantageously a dual-shell structure. If there is more than one outer layer, it is advantageous for the various layers to be composed of different polymers or copolymers. It is advantageous here for the first layer to have been crosslinked. However, where appropriate, the other layers may also have been crosslinked.

[0022] Examples of suitable monomers which give suitable polymers for the outer layer of the particles are unsaturated nitrites, acrylates, methacrylates, vinyl esters, styrene derivatives, advantageous monomers being acrylonitrile, methacrylonitrile acrylates and methacrylates having an alcohol component which has from 1 to 6, preferably from 1 to 4, carbon atoms, examples being methyl acrylate, ethyl acrylate, propyl acrylate, n-butyl acrylate, methyl methacrylate, ethyl methacrylate, propyl methacrylate, butyl methacrylate, and tert-butyl methacrylate. Vinyl compounds which may also be used with advantage are vinyl acetate, vinyl ethers, N-vinyl-N-methylacetamide, and vinylpyrrolidone, and examples of styrene derivatives which may be used with advantage are styrene, α -methylstyrene and vinyltoluene. Copolymers made from at least two of the above-mentioned monomer groups and monomers may also be used in the structure of the outer layer, in particular copolymers of the specified styrene derivatives with the other monomers. Particularly advantageous copolymers are those prepared from a mixture comprising from 20 to 80% by weight of acrylonitrile or methacrylonitrile with from 80 to 20% by weight of the other specified monomers, in particular acrylates, methacrylates and vinyl esters. Preference is also given to graft polymers which have a dual-shell outer layer structure, the first shell being composed of polystyrene and the second, outer, shell being composed of a poly-(meth)acrylate, which has particularly preferably been crosslinked to some extent. The crosslinking monomers used may in principle comprise any of the compounds suitable for this purpose, for example multifunctional olefins, such as divinylbenzene, ethylene glycol dimethacrylate, butylene glycol dimethacrylate, or else triallyl cyanurate.

[0023] According to the invention, the glass transition temperature of the component (C) described above is from -40 to -120°C ., preferably below -60°C ., in particular from -80 to -120°C . The preparation of the graft copolymers which can be used as component (C) and have a core-shell structure is known and can use single-stage polymerization in the case of a single-shell outer layer or multistage polymerization in the case of a multishell outer

layer, for example as described in the Patent Specification U.S. Pat. No. 39,875,704, which is incorporated herein by way of reference. The graft copolymerization is carried out using water-soluble initiators or using activated initiator systems of which one component at least is water-soluble, for example as described in C. B. Bucknall, "Toughened Plastics", p. 98, Applied Science Publishers Ltd. 1977 (London)). For the single- or multistage graft copolymerization the starting material is a polydiene, preferably in the form of an aqueous latex with defined average particle size, particularly preferably in the range from 0.1 to 5 μm , where the polydiene has particularly preferably been partially crosslinked.

[0024] For the preparation, the monomer or the monomer mixture is polymerized in the presence of the polydiene, whereupon the major portion of the monomers is grafted onto the polydiene particles. The amount of polydiene is generally 40 to 95% by weight, and the amount of the monomers or monomer mixture is generally from 5 to 60% by weight, based in each case on the total amount. The graft yield achieved varies from 60 to 95%, preferably from 80 to 90%. The graft polymerization is carried out in solution or emulsion, preferably in aqueous dispersion. For this purpose, the fine-particle polydiene latex forms an initial charge with addition of the usual polymerization auxiliaries, such as emulsifying agents or suspending agents, free-radical initiators, regulators, etc., and the monomer or the monomer mixture is added and polymerized at temperatures from 30 to 95° C., preferably from 50 to 80° C. For a single-stage reaction the initiator is water-soluble, and examples of initiators which may be used are water-soluble peroxides, percarbonates or perborates. In the case of a multicomponent initiator system (redox system) at least one component has to be water-soluble. Examples of emulsifiers which may be used, and are also termed dispersing agents, are aliphatic and aromatic sulfates, sulfonates, and salts of carboxylic acids, for example dresinates. The compounds suitable for this purpose are well known to the skilled worker.

[0025] For a multistage reaction the graft polymerization and the work-up generally take place as described in U.S. Pat. No. 3,985,704. To form a multishell outer layer, a monomer or a monomer mixture, such as styrene, is first grafted onto the core polymer, such as butadiene-styrene copolymer, and then another monomer or monomer mixture is used, where appropriate in the presence of a crosslinker.

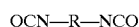
[0026] The average particle size of the particles is advantageously from 0.1 to 5 μm .

[0027] Other materials which can be used as graft copolymers for component (C) are those in which the core is composed mainly or completely of, preferably partially crosslinked, polyacrylates or polymethacrylates, the alcohol component of which contains from 1 to 15 carbon atoms, preferably from 1 to 8 carbon atoms. Olefinic monomers may be used as comonomers, advantageously butadiene, cyclooctadiene, vinyl ethers and haloalkyl acrylates. The gel content, measured in toluene, is preferably at least 50%, particularly preferably at least 70%. For the outer graft layer use may be made of the monomers and monomer mixtures described above. The particle sizes, too, are in the same range. Graft polymers based on polyacrylates and on polymethacrylates are described by way of example in DE 1964156, DE 2116653, EP 50265, EP 60601 and EP 64207,

incorporated herein by way of reference. The core of the graft polymer may also be composed entirely or partially of a silicone rubber and/or of non-crosslinked organopolysiloxanes. The other monomers and/or monomer mixtures described above may be grafted onto this core, which preferably contains functional groups having graft activity. These materials are described by way of example in DE 2659357, incorporated herein by way of reference. Component (C) preferably comprises a diluent, and in particular if the core of the graft polymer is composed of partially crosslinked polyacrylates or polymethacrylates. The diluent is a low-melting, advantageously polymeric substance which has good miscibility in the melt with the graft polymer used as impact modifier. It is particularly advantageous to use this diluent if the level of crosslinking of the graft polymers is sufficiently high to make them insoluble in the diluent, and a two-phase system forms, and the surface tension can lead to fine distribution of the graft polymers in the diluent. The graft polymer is preferably present mainly in the peripheral region of the two-phase system. As the amount of graft polymer increases it is also increasingly present in the core, and, with a further increase in the amount of the graft polymer, also outside the two-phase system within the matrix polymer, component (G). It is particularly advantageous to have uniform distribution of the two-phase system and of the graft polymer in component (G), in particular if the graft polymer is mainly present at the periphery of the two-phase system. The melting point of the diluent should be below 250° C., preferably from 180 to 210° C. The amount of the diluent is from 10 to 95%, advantageously from 30 to 70%, particularly preferably from 40 to 60%, based on the entirety of graft polymer and diluent. Materials which may be used with very particular advantage as diluents are polyurethanes and segmented copolyesters and ethylene-vinylacetate copolymers. Other suitable diluents are known to the skilled worker and are described by way of example in DE 2818240 and DE 2523991, incorporated herein by way of reference. The diluent may advantageously be mixed with the graft polymer prior to addition to component (G).

[0028] Other impact-modifying components, component (C), which may be used are polyurethanes, preferably thermoplastic polyurethanes. The polyurethanes which may be used according to the invention are known products described by way of example in DE 1193240 and DE 2051028, and in *Kunststoff-Taschenbuch*, [Plastics Handbook] (Saechtling, 27th edition, Hanser Verlag 1998) on pages 523-542, incorporated herein by way of reference. They are prepared in a known manner via polyaddition, from polyisocyanates, in particular diisocyanates, polyesters, polyethers, polyesteramides, polyacetals or other suitable hydroxy or amino compounds, such as hydroxylated polybutadiene, or mixtures of the abovementioned compounds. Where appropriate, use is also made of chain extenders, such as low-molecular-weight polyols, in particular diols, polyamines, in particular diamines, or water.

[0029] Examples of suitable diisocyanates are diisocyanates of the formula I



I

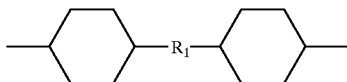
[0030] where R is a divalent, straight-chain or branched aliphatic radical having from 1 to 20, preferably from 2 to 12, carbon atoms, or a divalent cycloaliphatic radical having from 4 to 20, preferably from 6 to 15, carbon atoms, or a

divalent, substituted or unsubstituted aromatic radical having from 6 to 25, preferably from 6 to 15, carbon atoms.

[0031] An example of a divalent, aliphatic radical is the alkylidene radical $-(CH_2)_n-$, where $n=2$ to 12, e.g. ethylidene, propylidene, pentamethylene, or hexamethylene radical, or the like, or the 2-methylpentamethylene, 2,2,4-trimethylhexamethylene or 2,4,4-trimethylhexamethylene radical. Diisocyanates of this type which are particularly preferred are hexamethylene diisocyanate, and 2,2,4- and 2,4,4-trimethylhexamethylene diisocyanate.

[0032] If R in formula I above is a cycloaliphatic radical, this is preferably the unsubstituted or substituted cyclohexane radical. Examples of diisocyanates of this type are 1,2- or 1,4-di(isocyanatomethyl)cyclohexane or isophorone diisocyanate.

[0033] R in formula I above may also be a combination of divalent, open-chain aliphatic or cycloaliphatic radicals, for example



[0034] where R_1 is a saturated, straight-chain or branched aliphatic radical having from 1 to 8, preferably from 1 to 3, carbon atoms. The two rings here are preferably unsubstituted cyclohexane, while R_1 is preferably the methylene, ethylene, methylmethylene, or dimethylmethylene group.

[0035] If R is an open-chain, divalent radical, it is preferably an unbranched alkylidene radical $-(CH_2)_n-$, where n =from 2 to 12. Examples of these are the ethylidene, propylidene, pentamethylene and hexamethylene radicals, and also the 2-methylpentamethylene, 2,2,4-trimethylhexamethylene or 2,4,4-trimethylhexamethylene radical. Diisocyanates of this type which are particularly preferred are hexamethylene diisocyanate and also 2,2,4- and 2,4,4-trimethylhexamethylene diisocyanate.

[0036] If R in formula I above is a divalent aromatic radical, it is preferably the toluene, diphenylmethane, phenylene or naphthalene radical. Examples of corresponding diisocyanates are toluene 2,4-diisocyanate, toluene 2,6-diisocyanate, diphenylmethane 4,4'-diisocyanate, 3,3'-dimethyldiphenylmethane 4,4'-diisocyanate, 3,3'-dimethyldiphenylene 4,4'-diisocyanate(3,3'-bitoluene-4,4'-diisocyanate), m-phenylene diisocyanate, p-phenylene diisocyanate, o-phenylene diisocyanate, chlorophenylene 2,4-(toluene diisocyanate), 3,3'-dichlorodiphenyl 4,4'-diisocyanate 4-chlorophenylene 1,3-diisocyanate, naphthalene 1,5-diisocyanate, and naphthalene 1,4-diisocyanate.

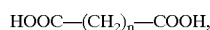
[0037] If R in formula I above is a cycloaliphatic radical, it is preferably the unsubstituted or substituted cyclohexane radical. Examples of diisocyanates of this type are 1,2- or 1,4-di(isocyanatomethyl)cyclohexane or isophorone diisocyanate.

[0038] The diisocyanates of formula I may also be used in oligomeric form, for example in dimeric or trimeric form. Instead of the polyisocyanates, use may also be made in a known manner of blocked polyisocyanates, these being

obtained from the isocyanates mentioned by reaction with phenol or caprolactam, for example.

[0039] Aliphatic polyhydroxy compounds which may be used are polyethers, such as polyethylene glycol ethers, polypropylene glycol ethers, and polybutylene glycol ethers, poly-1,4-butanediol ethers or mixed polyethers made from ethylene oxide and propylene oxide. Other compounds which may be used for this purpose are polyesteramides, polyacetals, and preferably aliphatic polyesters, all of these compounds having free OH end groups.

[0040] The aliphatic polyesters preferably used are mainly non-crosslinked polyesters with molecular weights of from 500 to 10000, preferably from 500 to 5000. The acid components derive from unbranched and/or branched aliphatic dicarboxylic acids, e.g. dicarboxylic acids of the formula



[0041] where n =from 0 to 20, preferably from 4 to 10, in particular adipic acid and sebacic acid. Use may also be made here of cycloaliphatic dicarboxylic acids, such as cyclohexanedicarboxylic acids, or of mixtures with the abovementioned aliphatic dicarboxylic acids.

[0042] The alcohol component used for these polyesters is in particular an unbranched or branched aliphatic primary diol, e.g. a diol of the formula



[0043] where m =from 2 to 12, preferably from 2 to 6. Mention may in particular be made here of 1,4-butanediol, 1,6-hexanediol and 2,2-dimethylpropanediol-1,3 and also diethylene glycol. Cycloaliphatic diols, such as bis-hydroxymethylcyclohexane, are also suitable here, as are mixtures with the aliphatic diols.

[0044] Each of the polyesters may be prepared from one dicarboxylic acid and one diol, or else, as mentioned, from a mixture of two or more dicarboxylic acids and/or two or more diols.

[0045] Chain extenders which may be used in preparing the polyurethanes are mainly low-molecular-weight polyols, in particular diols, or else polyamines, in particular diamines, or else water.

[0046] The polyurethanes used according to the invention are preferably thermoplastic and therefore preferably substantially non-crosslinked, i.e. capable of melting repeatedly without any significant signs of decomposition. Their reduced specific viscosities, measured at 30° C. in dimethylformamide, are generally from 0.5 to 3 dl/g, preferably from 1 to 2 dl/g. The values for the tensile strains at break are advantageously from 800 to 1500%, preferably from 1000 to 1500%, while the Shore hardness A is not more than 90, advantageously not more than 81, preferably from 50 to 85, particularly preferably from 60 to 80, in particular from 65 to 80, and the glass transition temperatures are mostly not above 0° C., advantageously not above -10° C., particularly advantageously not above -20° C.

[0047] The amount of sterically hindered phenol compound used, component (D), may be from 0.0 to 2.0% by weight, preferably from 0.1 to 1.0% by weight, particularly preferably from 0.2 to 1.0% by weight. Examples of these compounds are pentaerythrityl tetrakis-[3-(3,5-di-tert-butyl-

4-hydroxyphenyl)propionate] (Irganox 1010, Ciba Geigy), triethylene glycol bis[3-(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate] (Irganox 245, Ciba Geigy), 3,3'-bis[3-(3,5-di-tert-butyl-4-hydroxyphenyl)propiono] hydrazide (Irganox MD 1024, Ciba Geigy), hexamethylene glycol bis[3-(3,5-di-tert-butyl-4-hydroxyphenyl)propionate] (Irganox 259, Ciba Geigy), 3,5-di-tert-butyl-4-hydroxytoluene (Lowinox BHT, Great Lakes). Irganox 1010 and especially Irganox 245 are preferred.

[0048] The component (E) present may comprise at least one stabilizer from the group of the benzotriazole derivatives or benzophenone derivatives or aromatic benzoate derivatives, the amount being from 0.0 to 1.0% by weight, preferably from 0.0 to 0.8% by weight. Preference is given to 2-[2'-hydroxy-3',5'-bis(1,1-dimethylbenzyl)phenyl]benzotriazole, obtainable commercially as Tinuvin 234 (Ciba Geigy).

[0049] The component (F) present in the molding composition of the invention may comprise from 0.0 to 0.8% by weight, preferably from 0.0 to 0.5% by weight, very particularly preferably from 0.4% by weight, of a sterically hindered amine as light stabilizer (HALS). Preference is given to 2,2,6,6-tetramethyl-4-piperidyl compounds, e.g. bis(2,2,6,6-tetramethyl-4-piperidyl) sebacate (Tinuvin 770, Ciba Geigy), or to the polymer made from dimethyl succinate and 1-(2-hydroxyethyl)-4-hydroxy-2,2,6,6-tetramethyl-4-piperidine (Tinuvin 622, Ciba Geigy).

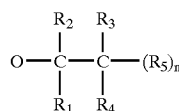
[0050] The base material used for the molding compositions of the invention, polyoxymethylene (G), may be homopolyoxymethylenes or copolyoxymethylenes. Polymers of this type are known to the skilled worker and are described in the literature. The homopolymers are generally obtained by polymerizing formaldehyde or trioxane, and the polymerization here may be initiated cationically or anionically. However, preference is given to copolyoxymethylenes which contain not only oxymethylene units but also oxyalkylene units, where the alkylene groups may contain from 2 to 8 carbon units, linear or branched. The polyoxymethylenes (POMs) described by way of example in DE-A 29 47 490 are generally unbranched linear polymers and generally contain at least 80%, preferably at least 90%, of oxymethylene units ($-\text{CH}_2\text{O}-$). The term polyoxymethylenes here encompasses homopolymers of formaldehyde or of its cyclic oligomers, such as trioxane or tetroxane, and also corresponding copolymers.

[0051] Homopolymers of formaldehyde or of trioxane are polymers of this type whose hydroxy end groups have been chemically stabilized in a known manner to resist degradation, e.g. by esterification or etherification. Copolymers are polymers made from formaldehyde or from its cyclic oligomers, in particular trioxane, and from cyclic ethers, cyclic acetals, and/or linear polyacetals.

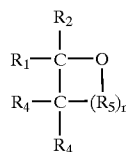
[0052] Homopolyoxymethylenes or copolyoxymethylenes are known per se to the skilled worker and are described in the literature. These polymers very generally have at least 50 mol % of $-\text{CH}_2\text{O}-$ repeat units in the main polymer chain. The homopolymers are generally prepared by polymerizing formaldehyde or trioxane, preferably in the presence of suitable catalysts. Examples of particularly suitable catalysts are boron trifluoride and trifluoromethanesulfonic acid.

[0053] For the purposes of the invention, preference is given to copolyoxymethylenes as component (G), in par-

ticular those which also contain, alongside the $-\text{CH}_2\text{O}-$ repeat units, up to 50 mol %, preferably from 0.1 to 20 mol %, and in particular from 0.5 to 10 mol %, of repeat units of the following formula



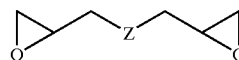
[0054] where R^1 to R^4 , independently of one another, are a hydrogen atom, a C_1 - C_4 -alkyl group, or a halo-substituted alkyl group having from 1 to 4 carbon atoms, and R^5 is $-\text{CH}_2-$, $-\text{CH}_2\text{O}-$, or a C_1 - C_4 -alkyl- or C_1 - C_4 -haloalkyl-substituted methylene group, or a corresponding oxymethylene group, and n is from 0 to 3. These groups may advantageously be introduced into the copolymers by the ring-opening of cyclic ethers. Preferred cyclic ethers are those of the formula



[0055] where R^1 to R^5 and n are as defined above. Cyclic ethers which may be mentioned as examples are ethylene oxide, propylene 1,2-oxide, butylene 1,2-oxide, butylene 1,3-oxide, 1,3-dioxane, 1,3-dioxolane and 1,3-dioxepan, and comonomers which may be mentioned as examples are linear oligo- or polyformals, such as polydioxolane or polydioxepan.

[0056] Particularly advantageous copolymers are those made from 99.5-95 mol % of trioxane and 0.5-5 mol % of one of the above of the above-mentioned comonomers.

[0057] Also suitable as component (G) are oxymethyleneterpolymers, for example those prepared by reacting trioxane with one of the abovementioned cyclic ethers and with a third monomer, preferably a bifunctional compound of the formula



[0058] where Z is a chemical bond, $-\text{O}-$, or $-\text{ORO}-$ ($\text{R}=\text{C}_1$ - C_8 -alkylene or C_3 - C_8 -cycloalkylene).

[0059] Preferred monomers of this type are ethylene diglycidide, diglycidyl ether, and diethers made from glycidyl compounds and formaldehyde, dioxane or trioxane in a molar ratio of 2:1, and also diethers made from 2 mol of glycidyl compound and 1 mol of an aliphatic diol having from 2 to 8 carbon atoms, for example the diglycidyl ether of ethylene glycol, 1,4-butanediol, 1,3-butanediol, 1,3-cyclobutanediol, 1,2-propanediol or 1,4-cyclohexanediol, to mention just a few examples.

[0060] Processes for preparing the above-described polyoxymethylene homo- and copolymers are known to the skilled worker and are described in the literature.

[0061] The preferred copolyoxymethylenes have melting points of 150° C. or above and molecular weights (weight average) M_w in the range from 2000 to 1000000, preferably from 7000 to 150000. Particular preference is given to end-group-stabilized polyoxymethylenes whose chain ends have carbon-carbon bonds. The melt index (MVR 190/2.16) of the polyoxymethylenes used is generally from 0.3 to 100 cm³/10 min (ISO 1133).

[0062] Particular preference is given to polyoxymethylenes substantially having oxymethylene units and oxyethylene units in the polymer chain. The proportion of the oxymethylene units, based on structural units in the polymer chain, is from 0.1 to 15 mol %, preferably 0.2 to 10 mol %. The melt index MFI, measured to ISO 1133 at 190° C. with an applied weight of 2.16 kg is from 0.5 to 76 g/10 min, preferably from 2 to 60 g/10 min, and particularly preferably from 5 to 35 g/10 min. The number-average molar mass is at least 5000 g/mol and at most 100000 g/mol, determined by GPC in dimethylacetamide at from 150 to 160° C. It is also possible to use a mixture of different copolyoxymethylenes of differing compositions instead of a single copolyoxymethylene. Well known preparation processes can be used to prepare the copolyoxymethylenes. An example of a possible process is the copolymerization of trioxane with dioxolane in the presence of generally conventional amounts of BF₃ and methylal. Preference is given to polyoxymethylenes whose preparation uses trifluoromethanesulfonic acid.

[0063] The molding composition of the invention may comprise other conventional additives, individually or as a mixture, at up to 40% by weight, examples being carbon blacks, e.g. conductivity blacks, acid scavengers, antioxidants, UV stabilizers, coupling agents, mold-release aids, substances to improve electrical conductivity, antistats, nucleating agents, such as polyoxymethylene terpolymers or talc, colorants, such as inorganic pigments, e.g. titanium dioxide, ultramarine blue, cobalt blue, or organic pigments and colours, such as phthalocyanines, anthrachinones, fillers, such as glass beads, wollastonite, chalk, loam, molybdenum sulfide, or graphite, inorganic or organic fibres, such as glass fibres, carbon fibres or aramide fibers, lubricants, such as soaps and esters, stearyl stearate, montanic esters, partially hydrolyzed montanic esters, stearic acids, polar and/or non-polar polyethylene waxes, poly- α -olefin oligomers, silicone oils, polyalkylene glycols and perfluoroalkyl ethers, polytetrafluoroethylene, ultrahigh-molecular-weight polyethylene, paraffins, solid and liquid, stearic acids, and thermoplastic or thermoset polymer additives, elastomers, and other polymers, such as EPDM (ethylene-propylene-diene rubber), EPM (ethylene-propylene rubbers), polyester elastomers, copolymers of ethylene with (meth)acrylates and with (meth)acrylamides, polymethyl methacrylate, polyethylene, polystyrene.

[0064] The polyoxymethylene molding compositions of the invention may be prepared using the conventional and known mixing methods, such as pelletizing, extrusion, kneading, etc. The molding compositions of the invention are preferably prepared by mixing polyoxymethylene with additives and stabilizers and then pelletizing the mixture.

[0065] The colored polyoxymethylene molding compositions of the invention have substantially reduced emission. The reduction in formaldehyde release can be observed even during preparation of the molding composition, e.g. during pelletizing, and also during processing. The polyoxymethylene molding composition of the invention therefore contributes to health and safety in the workplace. However, there is a particularly substantial reduction in the formaldehyde emission from moldings produced by injection molding or extrusion. The formaldehyde emission measured to VDA 275 on plaques of wall thickness 1 mm after 24 h of storage is advantageously less than 40 mg/kg, particularly advantageously less than 30 mg/kg, very particularly advantageously less than 20 mg/kg. The mechanical properties of the molding compositions of the invention comply with the conventional requirements placed upon commercially available polyoxymethylene products, and the conventional application sectors and processing techniques for polyoxymethylene are therefore applicable without restriction.

[0066] Particular application sectors for the molding compositions of the invention are internal fittings and claddings for means of transport, such as automobiles, aircraft, etc., other application sectors being household goods, toys, baby items, and also devices and components for electronics and electrical engineering. The molding compositions of the invention are particularly suitable for producing apparatus and instruments, or parts thereof, for medical applications. The molding compositions prepared according to the invention have the lowest formaldehyde emission of any currently commercially available products, have defect-free surfaces, and have high colorfastness when the moldings are exposed for a long time to light or heat.

[0067] The references mentioned in this Patent Application are expressly incorporated herein by way of reference. Those references are therefore part of the disclosure of this Patent Application.

EXAMPLES

[0068] In the examples below, the properties of the materials were determined by the following methods:

[0069] Melt index (MFI) to ISO 1133 at 190° C. with an applied weight of 2.16 kg;

[0070] Tensile modulus of elasticity to ISO 527

[0071] Yield stress to ISO 527

[0072] Tensile strain at break to ISO 527.

[0073] Formaldehyde emission: Plaques of wall thickness 1 mm were manufactured from the colored polyoxymethylene molding compositions. The formaldehyde emission from the plaques was determined to VDA 275 after a storage time of 24 h (VDA Guideline No. 275, Dokumentation Kraftfahrwesen e.V. July 1994).

[0074] Production of test specimens: The polyacetal pellets are molded by injection molding to give plaques of dimensions 80*50*1 mm. A Kraus Maffei KM 120/340 B injection molding machine is used with the following injection molding parameters: melt temperature 195° C., flow front velocity 200 mm/s, mold wall temperature 85° C., hold pressure 900 bar, hold pressure time 30 s, cooling time 10 s, back pressure from 0 to 10 bar. The test specimens are stored for 24 h in a cabinet under standard temperature and

humidity conditions at 23° C. and 50% relative humidity prior to testing. Testing: two test specimens are suspended on a stainless steel hook above 50 ml of deionized water in a 1 l glass bottle and stored for 3 h in a circulating-air drying cabinet at 60° C. The test specimens are removed from the test bottle. 5 ml of test solution are pipetted into a test tube, which is heat-conditioned at 95° C. for 10 minutes. 3 ml of acetylacetone and 3 ml of a 20% strength of ammonium acetate solution are then added to the test tube. The formaldehyde forms the diacetyldihydrolutidine complex with the reagents, and the absorption of the complex at 412 nm is determined photometrically. The formaldehyde concentration in the specimen solution is calculated from the absorption.

[0075] Brabender Test: The polyoxymethylene molding composition is sheared at 210° C. in a twin-screw Brabender kneader. The formaldehyde which escapes is discharged with an inert gas stream and absorbed in sodium sulfite solution. The sodium sulfite solution is titrated for quantitative determination of the formaldehyde released. The result obtained is the amount of formaldehyde released as a function of time. The degradation rate is determined from the gradient of the curve by linear extrapolation.

[0076] The results of testing of the material from the examples and comparative examples are given in tables 1 to 3. The comparative experiments are indicated by c, and the inventive examples are indicated by e.

[0077] The polyoxymethylene used in the examples and comparative examples comprises Hostaform C 9021. In the case of the experiments listed in table 1, the polymer contained 3.4% of dioxolane as comonomer, and trifluo-

romethanesulfonic acid was used as initiator. In the case of the experiments listed in table 2, the polymer contained 3.4% of dioxolane as comonomer and boron trifluoride was used as initiator. In the case of the experiments listed in table 3, the polymer comprised 5.6% of dioxolane as comonomer, and trifluoromethanesulfonic acid was used as initiator. Irganox 1010 from Ciba Spezialitätenchemie was used as antioxidant. Licowachs E or Licowachs C from Clariant were used as flow aids. Comparative experiments used Eurelon from Vantico and dicyandiamide (DCD), where appropriate in combination with magnesium stearate, to reduce emission. The impact-modifier component used comprised Paraloid EXL 2600 from Röhm & Haas.

[0078] The pellets from the examples and comparative examples were molded by injection molding to give the test specimens for determining tensile modulus of elasticity, yield stress, and tensile strain at break, and also to injection-mold the plaques for determining formaldehyde emission.

[0079] All of the inventive examples show lower formaldehyde emission from the moldings (VDA 275 test) and lower formaldehyde emission during processing (Brabender test). Table 3 gives the mechanical properties of some of the examples and comparative examples. The mechanical properties can be seen to remain comparably good.

[0080] Particularly low emission values can be obtained when using polyoxymethylenes for which the initiator used comprised trifluoromethanesulfonic acid. It can be seen from example 25 and comparative example 25 that even in the case of colored molding compositions it is possible to achieve a reduction in formaldehyde emission with comparable mechanical properties.

TABLE 1

Op. No.	Stabilization										Paraloid EXL 2600 [%]	VDA 275 test [mg/kg]	Brabender test [Degr. ppm/h]
	Irganox 1010 [%]	Ca citrate [%]	Lico- wachs C [%]	Lico- wachs E [%]	Mela- mine [%]	Mg stearate [%]	Eure- Ion [%]	DCD [%]	T 1020 [%]				
c1	0.8	0.1	0.2	—	0.07	—	—	—	0.5	13	943.39	—	
c2	0.8	0.1	—	0.2	0.07	—	—	—	0.5	13	791.79	1653	
c3	0.8	0.1	0.2	—	—	—	0.05	0.03	0.5	13	661.96	895	
c4	0.8	0.1	—	0.2	—	—	0.05	0.03	0.5	13	717.40	1024	
c5	0.8	0.1	0.2	—	0.07	—	—	—	0.5	25	506.33	579	
c6	0.8	0.1	—	0.2	0.07	—	—	—	0.5	25	489.52	565	
c7	0.8	0.1	0.2	—	—	—	0.05	0.03	0.5	25	455.16	378	
c8	0.8	0.1	—	0.2	—	—	0.05	0.03	0.5	25	425.08	343	
e1	0.8	0.1	0.2	—	0.07	0.1	—	—	0.5	13	22.12	—	
e2	0.8	0.1	—	0.2	0.07	0.1	—	—	0.5	13	21.21	111	
c9	0.8	0.1	0.2	—	—	0.1	0.05	0.03	0.5	13	42.56	180	
c10	0.8	0.1	—	0.2	—	0.1	0.05	0.03	0.5	13	47.08	164	
e3	0.8	0.1	0.2	—	0.07	0.1	—	—	0.5	25	24.73	85	
e4	0.8	0.1	—	0.2	0.07	0.1	—	—	0.5	25	36.31	158	
c11	0.8	0.1	0.2	—	—	0.1	0.05	0.03	0.5	25	44.48	145	
c12	0.8	0.1	—	0.2	—	0.1	0.05	0.03	0.5	25	43.43	—	
c13	0.8	0.1	0.2	—	0.07	—	—	—	0.5	13	427.06	1083	
c14	0.8	0.1	0.2	—	0.07	—	—	—	0.5	13	449.77	1538	

[0081]

TABLE 2

Op. No.	Irganox 1010 [%]	Ca citrate [%]	Lico-wachs C [%]	Mela-mine [%]	Mg stearate [%]	Eure-Ion [%]	DCD [%]	T 1020 [%]	Paraloid EXL 2600 [%]	VDA 275 test [mg/kg]	Brabender test [Degr. ppm/h]
c15	0.8	0.1	0.2	—	—	0.05	0.03	0.5	—	40.24	—
c16	0.8	0.1	0.2	—	—	0.05	0.03	0.5	13	303.67	276
c17	0.8	0.1	0.2	0.07	0	—	—	0.5	13	871.02	466
e5	0.8	0.1	0.2	0.07	0.01	—	—	0.5	13	276.95	285
e6	0.8	0.1	0.2	0.07	0.03	—	—	0.5	13	114.97	210
e7	0.8	0.1	0.2	0.07	0.05	—	—	0.5	13	71.90	169
e8	0.8	0.1	0.2	0.07	0.07	—	—	0.5	13	68.39	191
e9	0.8	0.1	0.2	0.07	0.07	—	—	0.5	13	62.82	171
c18	0.8	0.1	0.2	—	—	0.05	0.03	0.5	25	253.54	309
c19	0.8	0.1	0.2	0.07	0	—	—	0.5	25	338.12	507
e10	0.8	0.1	0.2	0.07	0.01	—	—	0.5	25	266.67	362
e11	0.8	0.1	0.2	0.07	0.03	—	—	0.5	25	173.27	359
e12	0.8	0.1	0.2	0.07	0.05	—	—	0.5	25	102.81	311
e13	0.8	0.1	0.2	0.07	0.07	—	—	0.5	25	99.55	336
e14	0.8	0.1	0.2	0.07	0.10	—	—	0.5	25	80.86	293

[0082]

TABLE 3

Op. No.	Irganox 1010 [%]	Ca citrate [%]	Lico-wachs C [%]	Mela-mine [%]	Mg stearate [%]	Eure-Ion [%]	DCD [%]	T 1020 [%]	Paraloid EXL 2600 [%]	VDA 275 test [mg/kg]	Bra-bender test [Degr. ppm/h]	Notched impact strength Charpy ISO 179/1eA	Heat-con- ditioned 24 h/ [KJ/m ²]	Tensile Test		
														Et [MPa]	σB [MPa]	εB [%]
c20	0.8	0.1	0.2	—	—	0.05	0.03	0.5	—	48.92	—	—	—	—	—	—
c21	0.8	0.1	0.2	—	—	0.05	0.03	0.5	13	407.43	1182	15.25	10.42	2121	42.66	59.12
c22	0.8	0.1	0.2	0.07	0	—	—	0.5	13	377.96	1586	14.01	9.58	2136	41.59	70.24
e15	0.8	0.1	0.2	0.07	0.05	—	—	0.5	13	32.38	155	—	—	—	—	—
e16	0.8	0.1	0.2	0.07	0.10	—	—	0.5	13	29.80	157	15.61	10.16	2136	41.66	68.04
e17	0.8	0.1	0.2	0.07	0.15	—	—	0.5	13	34.58	181	—	—	—	—	—
e18	0.8	0.1	0.2	0.07	0.20	—	—	0.5	13	29.95	188	—	—	—	—	—
e19	0.8	0.1	0.2	0.07	0.30	—	—	0.5	13	26.83	209	15.36	10.84	2134	41.97	60.01
c23	0.8	0.1	0.2	—	—	0.05	0.03	0.5	25	387.01	441	—	—	—	—	—
c24	0.8	0.1	0.2	0.07	0	—	—	0.5	25	375.74	791	—	—	—	—	—
e20	0.8	0.1	0.2	0.07	0.05	—	—	0.5	25	26.13	173	—	—	—	—	—
e21	0.8	0.1	0.2	0.07	0.10	—	—	0.5	25	37.14	244	—	—	—	—	—
e22	0.8	0.1	0.2	0.07	0.15	—	—	0.5	25	—	197	—	—	—	—	—
e23	0.8	0.1	0.2	0.07	0.20	—	—	0.5	25	36.34	215	—	—	—	—	—
e24	0.8	0.1	0.2	0.07	0.30	—	—	0.5	25	32.65	320	—	—	—	—	—

Example 25

[0083] Preparation of Base Polymer (copolyoxymethylene)

[0084] 94.4% by weight of trioxane, 5.6% by weight of dioxolane and 350 ppm of methylal form an initial charge in a batch reactor at a temperature of 80° C. and a pressure of about 1 bar. 30 ppm of BF₃ are added. The amounts given are based on the entire monomer mixture. The crude polymer formed was suspended in a water/triethylamine mixture and then hydrolyzed at 170° C. in a water/methanol (10/90) mixture. On cooling to room temperature the polymer precipitated in the form of a fine powder and was filtered off with suction, washed with water, and dried. The product had a melt index (MFI) of 9 g/10 min. The following components were combined and intimately mixed in a Henschel mixer: 190 g of acetylene black, 330 g of Kronos 2220, 240 g of Sicotan Yellow K 2112, 20 g of Renol Brown EKX 851,

300 g of Irganox 245, 200 g of Lichowachs E, 70 g of melamine, 50 g of magnesium stearate, 400 g of Tinuvin 234, 400 g of Tinuvin 770, 13 kg of Paraloid EXL 2600 (producer Rohm & Haas), and polyoxymethylene base polymer to 100 kg. A twin-screw extruder is used to pelletize the mixture. Mechanical Properties: Tensile modulus of elasticity 2100 N/mm², yield stress 44.6 N/mm², tensile strain at break 61%; formaldehyde emission to VDA 275: 16 mg/kg.

Comparative Example 25

[0085] The following components are combined and intimately mixed in a Henschel mixer: 190 g of acetylene black, 330 g of Kronos 2220, 240 g of Sicotan Yellow K 2112, 20 g of Renol Brown EKX 861, 600 g of Irganox 245, 200 g of Licowachs C, 50 g of Eurelon, 30 g of dicyandiamide, 400 g of Tinuvin 234, 400 g Tinuvin 770, 13 kg of Paraloid EXL 2600 (producer Rohm & Haas), and polyoxymethylene base

polymer to 100 kg. A twin-screw extruder is used to pelletize the mixture. The base polymer is identical with the base polymer used in Example 25. Mechanical properties: tensile modulus of elasticity 2050 N/mm², yield stress 42.9 N/mm², tensile strain at break 55%, formaldehyde emission to VDA 275:225 mg/kg.

1. A polyoxymethylene molding composition comprising

Component (A) from 0.01 to 1.0% by weight of a cyclic stabilizer which contains at least one nitrogen atom in the ring

Component (B) from 0.001 to 0.5% by weight of a salt of a carboxylic acid

Component (C) from 5 to 50% by weight of an impact modifier

Component (D) from 0.0 to 2.0% by weight of a sterically hindered phenol compound

Component (E) from 0.0 to 1.0% by weight of at least one stabilizer from the group of the benzotriazole derivatives or benzophenone derivatives or aromatic benzoate derivatives

Component (F) from 0.0 to 0.8% by weight of a sterically hindered amine as light stabilizer (HALS)

Component (G) a polyoxymethylene homo- or copolymer to 100% by weight.

2. A polyoxymethylene molding composition comprising

Component (A) from 0.03 to 0.3% by weight of a cyclic stabilizer which contains at least one nitrogen atom in the ring

Component (B) from 0.001 to 0.5% by weight of a salt of a carboxylic acid

Component (C) from 5 to 40% by weight of an impact modifier

Component (D) from 0.1 to 1.0% by weight of a sterically hindered phenol compound

Component (E) from 0.0 to 0.8% by weight of at least one stabilizer from the group of the benzotriazole derivatives or benzophenone derivatives or aromatic benzoate derivatives

Component (F) from 0.0 to 0.5% by weight of a sterically hindered amine as light stabilizer (HALS)

Component (G) a polyoxymethylene homo- or copolymer to 100% by weight.

3. A polyoxymethylene molding composition comprising

Component (A) from 0.01 to 1.0% by weight of a cyclic stabilizer which contains at least one nitrogen atom in the ring

Component (B) from 0.001 to 0.5% by weight of a salt of a carboxylic acid

Component (C) from 7 to 30% by weight of an impact modifier

Component (D) from 0.2 to 1.0% by weight of a sterically hindered phenol compound

Component (E) from 0.0 to 1.0% by weight of at least one stabilizer from the group of the benzotriazole derivatives or benzophenone derivatives or aromatic benzoate derivatives

Component (F) 0.4% by weight of a sterically hindered amine as light stabilizer (HALS)

Component (G) a polyoxymethylene homo- or copolymer to 100% by weight.

4. The polyoxymethylene molding composition as claimed in one or more of claims 1 to 3, where the component (A) used comprises aminopyridines, 2,6-diaminopyridine, substituted and dimeric aminopyridines, pyrrolidone, imidazolidinone, hydantoin, allantoin, triamino-1,3,5-triazine(melamine), melamine-formaldehyde condensates, methylolmelamine, individually or as a mixture.

5. The polyoxymethylene molding composition as claimed in one or more of claims 1 to 4, where the component (B) used comprises carboxylates of an alkali metal and/or of an alkali earth metal having from 10 to 32 carbon atoms.

6. The polyoxymethylene molding composition as claimed in one or more of claims 1 to 5, where the component (B) used comprises magnesium stearate.

7. The polyoxymethylene molding composition as claimed in one or more of claims 1 to 6, where the component (C) comprises a polyurethane, a 2-phase mixture made from polybutadiene and styrene-acrylonitrile (ABS), modified polysiloxanes or, respectively, silicone rubbers, or graft copolymers made from an elastomeric, single-phase core based on polydiene and from a hard outer graft layer, with fine distribution.

8. The polyoxymethylene molding composition as claimed in one or more of claims 1 to 7, where component (C) comprises graft copolymers made from an elastomeric, single-phase core based on polydiene and from a hard outer graft layer, and where the outer layer of the particles has a single- or dual-shell structure, and in the case of single-shell particles is composed of poly(meth)acrylate and poly(meth)acrylonitrile, and where in the case of dual-shell particles the inner shell is composed of crosslinked polystyrene and the outer shell is composed of crosslinked polymethacrylate.

9. The polyoxymethylene molding composition as claimed in one or more of claims 1 to 8, where component (D) comprises pentaerythrityl tetrakis[3-(3,5-di-tert-butyl-4-hydroxyphenyl)propionate] and/or triethylene glycol bis[3-(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate] and/or 3,3'-bis[3-(3,5-di-tert-butyl-4-hydroxyphenyl)propionate] hydrazide and/or hexamethylene glycol bis[3-(3,5-di-tert-butyl-4-hydroxyphenyl)propionate] and/or 3,5-di-tert-butyl-4-hydroxytoluene.

10. The polyoxymethylene molding composition as claimed in one or more of claims 1 to 9, where the component (E) used comprises 2-[2'-hydroxy-3',5'-bis(1,1-dimethylbenzyl)phenyl]benzotriazole.

11. The polyoxymethylene molding composition as claimed in one or more of claims 1 to 10, where component (F) comprises 2,2,6,6-tetramethyl-4-piperidyl compounds, bis-(2,2,6,6-tetramethyl-4-piperidyl) sebacate, and/or the polymer made from dimethyl succinate and 1-(2-hydroxyethyl)-4-hydroxy-2,2,6,6-tetramethyl-4-piperidine.

12. The polyoxymethylene molding composition as claimed in one or more of claims 1 to 11, where component (G), the polyoxymethylene, has been prepared using trifluoromethanesulfonic acid as initiator.

13. The use of the thermoplastic molding composition as claimed in one or more of claims 1 to 12 for producing moldings or films.

14. A molding produced from a thermoplastic molding composition as claimed in one or more of claims 1 to 12.

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