

**Composition containing thermoplastic polymers**

The present invention relates to compositions containing thermoplastic polymers and benzotriazoles and triazines as UV absorbers and products produced therefrom. The products according to the invention are preferably multilayer sheets in which one or both of the outer layers consist of the compositions according to the invention.

Sheets containing thermoplastic polymers are known.

Polycarbonate sheets are known for example from EP-A 0 110 221 and are provided for a plurality of application purposes. They are produced, for example, by extrusion of compositions containing polycarbonate and optionally coextrusion with compositions containing polycarbonate which contain an increased proportion of UV absorbers.

EP-A 0 320 632 and EP-A 0 247 480 describe coextruded sheets of compositions containing polycarbonate which contain a difficultly volatile UV absorber based on substituted benzotriazoles.

In EP-A 0 500 496 and EP-A 0 825 226, UV absorbers based on substituted triazines are described which are suitable for protecting polycarbonate against UV radiation.

A problem which occurs during extrusion of such sheets is the depositing of volatile components from the compositions containing polycarbonate or general thermoplastic polymers on the calibrator (in multi-wall sheets) or on the rollers (in solid sheets) which can lead to surface interferences. Volatile components are, for example, UV absorbers and other low molecular components of the compositions containing thermoplastic polymers.

The disadvantage of these sheets according to the prior art is that the surface of the sheets is disadvantageously influenced during prolonged duration of extrusion owing

to the above-mentioned evaporations from the melt of the compositions containing polycarbonate or general thermoplastic polymers, particularly during coextrusion.

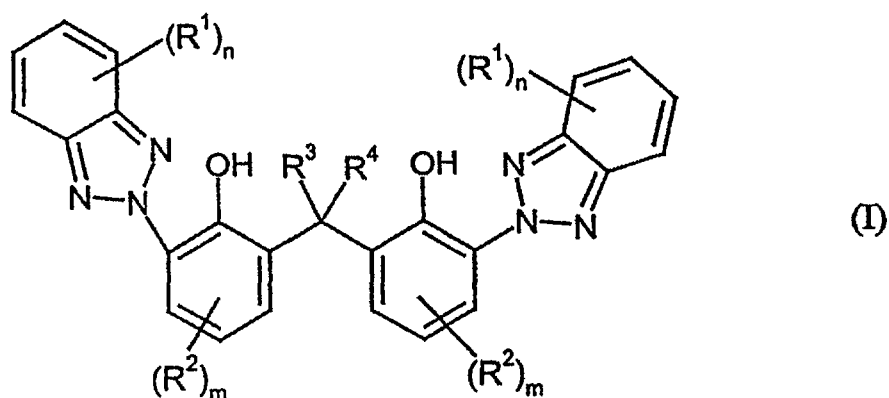
5 The increased evaporations of the UV absorber from the melt of the compositions containing polycarbonate or general thermoplastic polymers leads to coating deposition on the calibrator or the rollers and finally to the formation of interferences of the sheet surface (for example white spots, undulation etc.). In addition, the rubbed-off polycarbonate parts or the rubbed-off thermoplastic polymers on the calibrator generally leads to pulverulent depositions on the coextruded polycarbonate sheets or
10 sheets of thermoplastic polymers.

The object of the present invention is therefore to optimise compositions containing thermoplastic polymers to the effect that the good quality of the surface of the extruded sheets can be retained with constant protection against UV radiation during
15 extrusion of the compositions to form sheets, even with prolonged continuous mode of operation.

According to the invention, the object also consists in providing products which can be obtained from the compositions according to the invention.
20

It has surprisingly been found that compositions which, in addition to thermoplastic polymers, also contain two different UV absorbers in a specific weight ratio to one another achieve the object according to the invention. Products which can be obtained from these compositions also achieve the object according to the invention.
25

The object according to the invention is achieved by the use of mixtures containing one or more different compounds of Formula (I)



wherein

- 5 R^1 and R^2 are identical or different and represent H, halogen, C_1 - to C_{10} -alkyl, C_5 - to C_{10} -cycloalkyl, C_7 - to C_{13} -aralkyl, C_6 - to C_{14} -aryl, $-OR^5$ or $-(CO)-O-R^5$, where

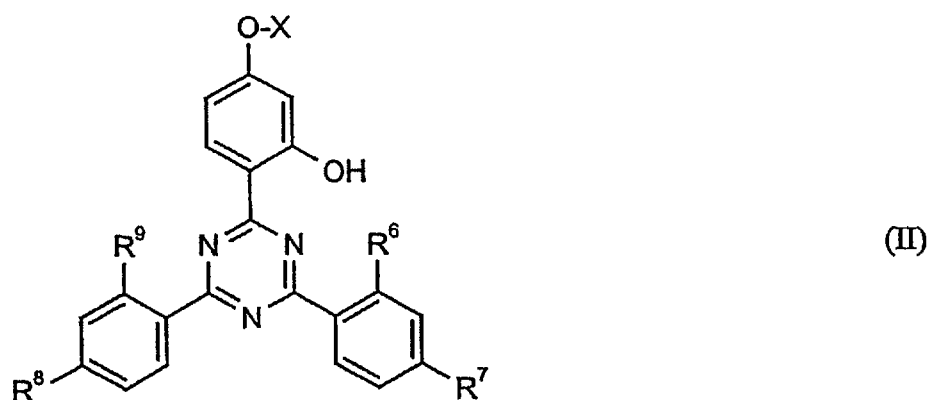
R^5 is H or C_1 - to C_4 -alkyl,

- 10 R^3 and R^4 are identical or different and represent H, C_1 - to C_4 -alkyl, C_5 - to C_6 -cycloalkyl, benzyl or C_6 - to C_{14} -aryl,

m is 1, 2 or 3 and

- 15 n is 1, 2, 3 or 4,

and one or more different compounds of Formula (II)



wherein

R^6 to R^9 are identical or different and are H or alkyl or CN or halogen and

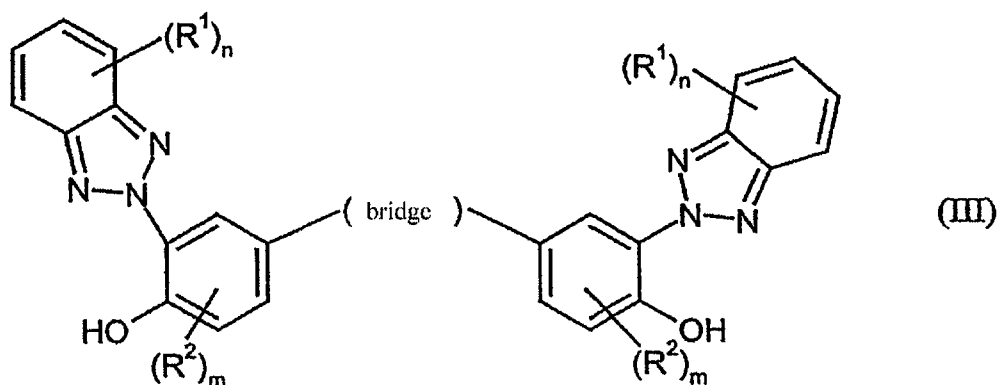
X equals alkyl,

wherein the content of the compounds according to Formula (I) and the content of the compounds according to Formula (II) in the mixture fulfils the following condition:

$$\frac{\text{Content of the compounds according to Formula (I) in wt.\%}}{\text{Content of the compounds according to Formula (II) in wt.\%}} = \frac{0.2}{1} \text{ to } \frac{4}{1},$$

in compositions containing thermoplastic polymers for improving the extrusion properties to the extent that when extruding the compositions to form sheets a good quality in the surface of the extruded sheets is obtained.

The object according to the invention is also achieved by the use of mixtures containing one or more different compounds of Formula (III)



wherein

R^1 and R^2 are identical or different and represent H, halogen, C_1 - to C_{10} -alkyl, C_5 - to C_{10} -cycloalkyl, C_7 - to C_{13} -aralkyl, C_6 - to C_{14} -aryl, $-OR^5$ or $-(CO)-O-R^5$, where

R^5 is H or C_1 - to C_4 -alkyl,

R^3 and R^4 are identical or different and represent H, C_1 to C_4 alkyl, C_5 to C_6 cycloalkyl, benzyl or C_6 to C_{14} aryl,

m is 1, 2 or 3 and

n is 1, 2, 3 or 4,

the bridge represents $-(CHR^{10})_p-\overset{\overset{O}{\parallel}}{C}-O-(Y-O)_q-\overset{\overset{O}{\parallel}}{C}-(CHR^{11})_p$, wherein

p is equal to 0, 1, 2 or 3,

q is an integer from 1 to 10,

Y is $-\text{CH}_2-\text{CH}_2-$, $-(\text{CH}_2)_3-$, $-(\text{CH}_2)_4-$, $-(\text{CH}_2)_5-$, $-(\text{CH}_2)_6-$, or $\text{CH}(\text{CH}_3)-\text{CH}_2-$ and

R^{10} and R^{11} are identical or different and represent H, C_1 - to C_4 -alkyl, C_5 - to C_6 -cycloalkyl, benzyl or C_6 - to C_{14} -aryl

and one or more different compounds of general Formula (II), according to claim 1,

5

wherein the content of the compounds according to Formula (III) and the content of the compounds according to Formula (II) in the mixture fulfils the following condition:

$$10 \quad \frac{\text{Content of the compounds according to Formula (III) in wt.\%}}{\text{Content of the compounds according to Formula (II) in wt.\%}} = \frac{0.2}{1} \text{ to } \frac{4}{1},$$

in compositions containing thermoplastic polymers for improving the extrusion
 15 properties to the extent that when extruding the compositions to form sheets a good quality in the surface of the extruded sheets is obtained.

Use of mixtures from compounds of Formula (I) and (II) or (III) and (II) in the sense of the above paragraphs does not inevitably mean that the compounds of Formula (I)
 20 and (II) or (III) and (II) must initially be mixed with one another before they are used to stabilise thermoplastic polymers against UV radiation. Every use which leads to compounds of Formula (I) and compounds of Formula (II) or compounds of Formula (III) and compounds of Formula (II) being simultaneously effective in thermoplastic polymers for UV protection is possible according to the invention. For example, the
 25 thermoplastic polymers can initially be supplied to compounds of Formula (I) and then compounds of Formula (II).

The object according to the invention is also achieved by a composition containing

30 thermoplastic polymers and
 one or more different compounds of Formula (I)

and one or more different compounds of Formula (II),

wherein the content of the compounds according to Formula (I) and the content of the compounds according to Formula (II) in the composition fulfil the following condition:

$$\frac{\text{Content of the compounds according to Formula (I) in wt.\%}}{\text{Content of the compounds according to Formula (II) in wt.\%}} = \frac{0.2}{1} \text{ to } \frac{4}{1}.$$

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This ratio is preferably $^{0.6}/_1$ to $^{1.6}/_1$.

The object according to the invention is also achieved by a composition containing

15 thermoplastic polymers and
one or more different compounds of Formula (III)

and one or more different compounds of general Formula (II)

20 wherein the content of the compounds according to Formula (III) and the content of the compounds according to Formula (II) in the composition fulfil the following condition:

$$\frac{\text{Content of the compounds according to Formula (III) in wt.\%}}{\text{Content of the compounds according to Formula (II) in wt.\%}} = \frac{0.2}{1} \text{ to } \frac{4}{1}.$$

25

This ratio is preferably $^{0.6}/_1$ to $^{1.6}/_1$.

30 Preferred compounds of Formulae (I), (II) and (III) are those where

R^1 is H, R^2 is C_1 - to C_8 -alkyl, particularly preferred R^2 is tert.-butyl or C_8 -alkyl, more particularly preferred R^2 is isooctyl, R^3 is H, R^4 is H, m is 1 and n is 4,

and

R^6 to R^9 identical or different H or CH_3 , X is C_6 -alkyl or C_8 -alkyl

5 and

R^{10} is H, R^{11} is H, p is 0, 1, 2 or 3, q is 1 to 8 and Y is $-(CH_2)_6-$ or $-(CH_2)_2-$.

In the compositions according to the invention, the sum of all compounds according to
10 Formula (I) and Formula (II) or according to Formula (II) and Formula (II) preferably
has a content of 0.05 to 15 wt.%, preferably 0.1 to 10 wt.%.

A composition in which the sum of thermoplastic polymers and compounds according
to Formula (I) and compounds according to Formula (II) and compounds according to
15 Formula (III) is 60 to 100 wt.% in the composition is preferred.

According to the invention, any thermoplastic polymers can be used, in particular
those which can be processed to form transparent sheets. Thermoplastic polymers
selected from the group consisting of polycarbonate, polyester,
20 polymethylmethacrylate, transparent polyvinyl chloride, transparent polystyrene, SAN
and high impact polystyrene are preferred.

Polyester, in particular polyethylene terephthalate (PET) and copolyester made of
terephthalic acid, isophthalic acid, glycol and cyclohexane-1,4-dimethanol (for
25 example PETG) are particularly preferred.

Also particularly preferred is polycarbonate, in particular polycarbonate selected from
the group consisting of bisphenol A homopolycarbonate and copolycarbonates based
on the two monomers bisphenol A and 1,1-bis-(4-hydroxyphenyl)-3,3,5-
30 trimethylcyclohexane.

A composition according to the invention which additionally contains 0.01 to 0.5 wt.% ester or partial ester of monovalent to hexavalent alcohols is also preferred.

A composition according to the invention which additionally contains 10 to 3,000
5 ppm of thermostabilisers is also preferred.

In this case, the thermostabilisers are preferably selected from the group consisting of tris-(2,4-di-tert.butylphenyl)phosphite and triphenylphosphine.

The object according to the invention is also achieved by a product containing a
10 composition according to the invention.

The product according to the invention is preferably selected from the group consisting of single-layer solid sheet, multilayer solid sheet, multilayer multi-wall sheet, corrugated solid sheet, multi-wall profiled part, multi-wall profiled part with
15 tongue and groove, connecting system, sway for greenhouses, sway for conservatories, sway for bus stops, advertising hoardings, sign, safety screen, motor car sway, window and roofing.

A multilayer sheet is preferred, wherein at least one layer contains a composition
20 according to the invention.

A multilayer sheet is also preferred, wherein one of the outermost layers of the sheet or both outermost layers of the sheet contain a composition according to the invention.

25 In this case it is particularly preferred that the sheet has at least two layers and that at least one of the inner layers contains a composition according to the invention, the content of compounds according to Formula (I) and compounds according to Formula (II) or compounds according to Formula (III) and compounds according to Formula (II) of which is preferably 0.02 to 1 wt.% in total.

The preferred process for producing the sheets according to the invention is coextrusion. The compounds according to the invention can additionally contain conventional additives, in particular conventional processing auxiliary agents, in particular mould release agents and eluents and stabilisers, in particular
5 thermostabilisers.

For the sake of clarity, the compounds according to Formula (I), (II) and (III) are designated as UV absorbers in the context of the present invention.

- 10 The compositions according to the invention preferably contain a total of 0.05 to 15 wt.%, particularly preferably 0.1 to 10 wt.%, most particularly preferably 2 to 18 wt.% of UV absorber.

The compositions according to the invention and the products produced therefrom, in
15 particular sheets, have numerous advantages. The problems known from the prior art, such as deposition of volatile components from the compositions on calibrators or rollers during extrusion, do not occur. This advantage of the compositions according to the invention occurs particularly when the compositions according to the invention are used to produce multilayer sheets, wherein one or both of the outer layers of the
20 sheets consist of the compositions according to the invention or contain them. In this case, the UV absorber content in the compositions according to the invention is preferably 2 to 8 wt.% in the one or both outer layers. The compositions according to the invention are well protected against UV radiation.

- 25 The compositions according to the invention and the products produced therefrom also have numerous additional advantages. For example, the products according to the invention have good mechanical properties which substantially correspond to those of the thermoplastic polymer used. Furthermore, the products according to the invention have good optical properties, for example high transparency, when transparent
30 thermoplastic polymers are used.

The thermoplastic polymers which contain the compositions according to the invention have proved to be particularly advantageous in technical terms. They may be processed without difficulty and do not exhibit any impairments in the final product.

5

The weathering resistance of the sheets according to the invention corresponds at least to that of sheets which have been produced according to the prior art.

The compounds to be used according to the invention corresponding to Formula (I),
10 (II) and (III) are commercially obtainable. They may be produced by known processes.

The sum of weight contents of thermoplastic polymers and UV absorber in the compositions according to the invention is preferably 60 to 100 wt.%, particularly preferably 80 to 100 wt.%, most particularly preferably 90 to 100 wt.%.

15

The compositions according to the invention can contain additional conventional additives in the conventional quantities in addition to the explicitly mentioned components. A particularly preferred embodiment of the invention is given when, in addition to the explicitly mentioned components, the compositions according to the
20 invention do not contain any additional components, i.e. when the compositions according to the invention consist of the explicitly mentioned components.

Compounds of Formula (I) such as 2,2-methylenebis-(40(1,1,3,3-tetramethylbutyl)-6-(2H-benzotriazole-2-yl)phenol), are sold commercially under the name Tinuvin® 360
25 or Adeka Stab® LA 31. Compounds of Formula (II) are 2,4-bis(2,4-dimethylphenyl)-6-(2-hydroxy-4-n-octyloxyphenyl)-1,3,5-triazine (CYASORB® UV-1164) or 2-(4,6-diphenyl-1,3,5-triazine-2-yl)-5-(hexyl)oxy-phenol (Tinuvin® 1577). Tinuvin® are sold by Ciba Spezialitätenchemie, Lampertheim, Germany. Cyasorb is sold by Cytec Industrial Inc., West Paterson, New Jersey, USA.

30

- Polycarbonates for the compositions according to the invention or the products obtained therefrom are homopolycarbonates, copolycarbonates and thermoplastic polyester carbonates. They preferably have means molecular weights $\overline{M}_w$ of 18,000 to 40,000, preferably of 26,000 to 36,000 and in particular of 28,000 to 35,000 g/mol, determined by measuring the relative solution viscosity in dichloromethane or in mixtures of identical weight quantities of phenol/o-dichlorobenzene calibrated by light scattering. In the event of coextrusion, the melt viscosity of the coextrusion masses should preferably be smaller than that of the substrates to which they are applied.
- Reference is made for the production of polycarbonates by way of example to "Schnell", Chemistry and Physics of Polycarbonates, Polymer Reviews, Vol. 9, Interscience Publishers, New York, London, Sydney 1964, to D.C. PREVORSEK, B.T. DEBONA and Y. KESTEN, Corporate Research Center, Allied Chemical Corporation, Moristown, New Jersey 07960, "Synthesis of Poly(ester)carbonate Copolymers" in Journal of Polymer Science, Polymer Chemistry Edition, Vol. 19, 75-90 (1980), to D. Freitag, U. Grigo, P.R. Müller, N. Nouvertne, BAYER AG, "Polycarbonates" in Encyclopedia of Polymer Science and Engineering, Vol. 11, Second Edition, 1988, pages 648 to 718 and to U. Grigo, K. Kircher and P.R. Müller, "Polycarbonate" in Becker/Braun, Kunststoff-Handbuch [Plastics Material Handbook], Vol. 3/1, Polycarbonates, Polyacetals, Polyesters, Cellulose Esters, Carl Hanser Verlag Munich, Vienna 1992, pages 117 to 299. Production is preferably by means of the phase interface process or the melt transesterification process and is described, for example, by the phase interface process.
- Bisphenols of general Formula HO-Z-OH, wherein Z is a divalent organic radical with 6 to 30 carbon atoms which contains one or more aromatic groups are compounds which are preferably used as starting compounds. Examples of such compounds are bisphenols which belong to the group of dihydroxydiphenyls, bis(hydroxyphenyl)alkanes, indanebisphenols, bis(hydroxyphenyl)ethers, bis(hydroxyphenyl)sulphones, bis(hydroxyphenyl)ketones and α,α' -bis(hydroxyphenyl)-diisopropylbenzenes.

Particularly preferred bisphenols which belong to the above-mentioned compound groups are bisphenol-A, tetraalkylbisphenol-A, 4,4-(meta-phenylenediisopropyl)-diphenol (bisphenol M), 4,4-(para-phenylenediisopropyl)diphenol, 1,1-bis-(4-hydroxyphenyl)-3,3,5-trimethylcyclohexane (BP-TMC) and optionally their mixtures.

5 Particularly preferred are homopolycarbonates based on bisphenol-A and copolycarbonates based on the monomers bisphenol-A and 1,1-bis-(4-hydroxyphenyl)-3,3,5-trimethylcyclohexane. The bisphenol compounds to be used according to the invention are reacted with carboxylic acid compounds, in particular phosgene or in the melt transesterification process diphenylcarbonate or
10 dimethylcarbonate.

Polyester carbonates are obtained by reacting the bisphenols already mentioned with at least one aromatic dicarboxylic acid and optionally carboxylic acid equivalents. Suitable aromatic dicarboxylic acids are, for example, phthalic acid, terephthalic acid,
15 isophthalic acid, 3,3'- or 4,4'-diphenyldicarboxylic acid and benzophenone-dicarboxylic acids. A portion, up to 80 mol %, preferably of 20 to 50 mol % of the carbonate groups in the polycarbonates can be replaced by aromatic dicarboxylic ester groups.

20 Inert organic solvents used in the phase interface process are, for example, dichloromethane, the various dichloroethanes and chloropropane compounds, tetrachloromethane, trichloromethane, chlorobenzene and chlorotoluene, chlorobenene and dichloromethane and mixtures of dichloromethane and chlorobenzene are preferably used.

25

The phase interface reaction can be accelerated by catalysts such as tertiary amines, in particular N-alkylpiperidines or onium salts. Tributylamine, triethylamine and N-ethylpiperidine are preferably used. The catalysts mentioned in DE-A 42 38 123 are preferably used in the case of the melt transesterification process.

30

The polycarbonates can be branched in a deliberate and controlled manner by using small quantities of branching agent. Some suitable branching agents are: phloroglucinol, 4,6-dimethyl-2,4,6-tri-(4-hydroxyphenyl)-heptane-2; 4,6-dimethyl-2,4,6-tri-(4-hydroxyphenyl)-heptane; 1,3,5-tri-(4-hydroxyphenyl)-benzene; 1,1,1-tri-
 5 (4-hydroxyphenyl)ethane; tri-(4-hydroxyphenyl)-phenylmethane; 2,2-bis-[4,4-bis(4-hydroxyphenyl)-cyclohexyl]-propane; 2,4-bis-(4-hydroxyphenyl-isopropyl)-phenol; 2,6-bis-(2-hydroxy-5'-methyl-benzyl)-4-methylphenol; 2-(4-hydroxyphenyl)-2-(2,4-dihydroxyphenyl)-propane; hexa-(4-(4-hydroxyphenyl-isopropyl)-phenyl)orthoterephthalic acid ester; tetra-(4-hydroxyphenyl)-methane; tetra-(4-(4-hydroxyphenyl-
 10 isopropyl)-phenoxy)-methane; α,α',α'' -tris-(4-hydroxyphenyl)-1,3,5-triisopropylbenzene; 2,4-dihydroxybenzoic acid, trimesic acid, cyanuric chloride; 3,3-bis-(3-methyl-4-hydroxyphenyl)-2-oxo-2,3-dihydroindole; 1,4-bis-(4',4''-dihydroxytriphenyl)-methyl)-benzene and in particular 1,1,1-tri-(4-hydroxyphenyl)-ethane and bis-(3-methyl-4-hydroxyphenyl)-2-oxo-2,3-dihydroindole.

15

The 0.05 to 2 mol % to optionally also be used, based on the diphenols used, on branching agents or mixtures of branching agents, can be used together with the diphenols, but can also be added in a subsequent stage of the synthesis.

20 Phenols such as phenol, alkylphenols such as cresol and 4-tert.-butylphenol, chlorophenol, bromophenol, cumylphenol or their mixtures are preferably used in quantities of 1 to 20 mol %, preferably 2 to 10 mol % per mol of bisphenol as chain terminators which can also be used. Phenol, 4-tert.-butylphenol and cumylphenol are preferred.

25

Chain terminators and branching agents can be added separately or also together with the bisphenol to the synthesis.

Production of the polycarbonates according to the melt transesterification process is
 30 described by way of example in DE-A 42 38 123.

The compositions according to the invention can also contain stabilisers.

Suitable stabilisers for the compositions according to the invention containing polycarbonate are, for example, phosphines, phosphates or Si-containing stabilisers and further compounds described in EP-A 0 500 496. Examples include triphenylphosphites, diphenylalkylphosphites, phenyldialkylphosphites, tris-(nonylphenyl)phosphite, tetrakis-(2,4-di-tert.-butylphenyl)-4,4'-biphenylene-diphosponite and triarylphosphite. Triphenylphosphine and tris-(2,4-di-tert.-butylphenyl)phosphite are particularly preferred.

10

The compositions according to the invention can also contain 0.01 to 0.5 wt.% of the esters or partial esters of monovalent to hexavalent alcohols, in particular of glycerol, of pentaerythritol or of guerbeta alcohols.

15 Monovalent alcohols are, for example, stearyl alcohol, palmityl alcohol and guerbeta alcohols.

A divalent alcohol is, for example, glycol.

A trivalent alcohol is, for example, glycerol.

20 Tetravalent alcohols are, for example, pentaerythritol and mesoerythritol.

Pentavalent alcohols are, for example, arabitol, ribitol and xylitol.

Hexavalent alcohols are, for example, mannitol, glucitol (sorbitol) and dulcitol.

The esters are preferably the monoesters, diesters, trimesters, tetraesters, optionally pentaesters and hexaesters or their mixtures, in particular statistical mixtures comprising saturated, aliphatic C₁₀- to C₃₆-monocarboxylic acids and optionally hydroxy monocarboxylic acids, preferably with saturated, aliphatic C₁₄- to C₃₂-monocarboxylic acids and optionally hydroxy monocarboxylic acids.

30 The commercially obtainable fatty acid esters, in particular of pentaerythritol and glycerol, can contain up to 60% of different partial esters, depending on production.

Saturated, aliphatic monocarboxylic acids with 10 to 36 carbon atoms are, for example, capric acid, lauric acid, myristic acid, palmitic acid, stearic acid, hydroxystearic acid, arachidic acid, behenic acid, lignoceric acid, cerotic acid and
5 montanic acids.

Preferred saturated, aliphatic monocarboxylic acids with 14 to 22 carbon atoms are, for example, myristic acid, palmitic acid, stearic acid, hydroxystearic acid, arachidic acid and behenic acid.

10

Saturated, aliphatic monocarboxylic acids such as palmitic acid, stearic acid and hydroxystearic acid are particularly preferred.

The saturated, aliphatic C₁₀- to C₃₆-carboxylic acids and the fatty acid esters to be
15 used according to the invention can be produced as such either from known literature or according to processes known from the literature. Examples of pentaerythritol fatty acid esters are the above-mentioned monocarboxylic acids which are particularly preferred.

20 Esters of pentaerythritol and glycerol with stearic acid and palmitic acid are particularly preferred.

Esters of guerbeta alcohols and of glycerol with stearic acid and palmitic acid and optionally hydroxystearic acid are also particularly preferred.

25

Examples of antistatics which can be included in the compositions according to the invention are cation-active compounds, for example quarternary ammonium, phosphonium or sulphonium salts, anion-active compounds, for example alkyl sulphonates, alkyl sulphates, alkyl phosphates, carboxylates in the form of alkali or
30 alkaline earth metal salts, non-ionogenic compounds, for example polyethylene glycol

ester, polyethylene glycol ether, fatty acid ester, ethoxylated fatty amines. Preferred antistatics are non-ionogenic compounds.

The compositions according to the invention can also contain organic dyes, inorganic
5 coloured pigments, fluorescent dyes and optical brightening agents.

All feed materials and solvents used for the synthesis of the coextrusion compounds according to the invention can be contaminated with corresponding impurities resulting from their production and storage, wherein the aim is to work with starting
10 materials which are as clean as possible.

The individual components can be mixed in a known manner both successively and simultaneously and, more precisely, both at ambient temperature and at elevated temperature.

15

The additives, in particular the UV absorber and additional above-mentioned additives, are preferably incorporated into the compositions according to the invention in a known manner by mixing the additives with polymer granules at temperatures for polycarbonate of preferably approximately 200 to 350 °C in conventional mixing units
20 such as internal kneaders, single screw extruders and double shaft extruders, for example by melt compounding or melt extrusion or by mixing the solutions of the polymer with solutions of the additives and subsequent evaporation of the solvents in a known manner. The additive content in the moulding compositions can be varied within wide limits and depends on the desired properties of the compositions. The
25 total additive content in the compositions is preferably approximately up to 20 wt.%, preferably 0.1 to 12 wt.% based on the weight of the composition.

The UV absorbers can also be incorporated into the compositions according to the invention for example by mixing solutions of the UV absorbers and optionally
30 additional above-mentioned additives with solutions of the plastics materials in suitable organic solvents. For polycarbonate these are, for example, CH₂Cl₂, halogen

alkanes, aromatic halogen compounds, chlorobenzene and xylenes. The substance mixtures are then preferably homogenised in a known manner by extrusion. The solvent mixtures are preferably removed in a known manner, for example compounded, by evaporation of the solvent and subsequent extrusion.

5

As the examples according to the invention prove, use of the compositions according to the invention as coextrusion compounds provides a significant advantage on any moulding compositions as base material.

- 10 The invention also relates to products which have been produced using the compositions according to the invention containing thermoplastic polymers. The compositions containing thermoplastic polymers can be used to produce solid polymer sheets and so-called multi-wall sheets (for example twin-wall sheets or triple-wall sheets). The sheets therefore also comprise those which have an additional outer layer
- 15 on one side or on both sides with the compositions according to the invention containing thermoplastic polymers with an increased UV absorber content.

The compositions according to the invention containing thermoplastic polymers allow for easier production of products, in particular of sheets and products produced

20 therefrom such as sways for greenhouses, conservatories, bus stops, advertising hoardings, signs, safety screens, motor car sways, windows and roofings.

Subsequent processings of the products coated with the compositions according to the invention containing thermoplastic polymers, such as deep drawing or surface

25 processing, such as finishing with scratch-resistant paints, water-spreading layers and similar are possible and the products produced by these processes are also the subject of the present invention.

Coextrusion is known as such from the literature (see for example EP-A 110 221 and

30 EP-A 110 238). In the present case, the procedure is preferably as follows:

Extruders for producing the core layer and the outer layer(s) are connected to a coextrusion adapter. The adapter is designed in such a way that the melts forming the outer layer(s) are applied in an adhesive manner as a thin layer to the melts of the core layer.

5

The multilayer melt strand produced in this way is then preferably brought into the desired shape (multi-wall sheet or solid sheet) in the subsequently connected nozzle. Subsequently, the melt is cooled under controlled conditions, preferably in a known manner by means of calendering (solid sheet) or vacuum calibration (multi-wall sheet) and subsequently cut to size. A tempering furnace can optionally be applied after calibration to eliminate tensions. Instead of the adapter applied upstream of the nozzle, the nozzle itself can also be designed in such a way that the melts merge there.

10

The invention will be described further by the following example.

Example

10 mm twin-wall sheets A to E, as they are described, for example in EP-A 0 110 238, were obtained from the following compositions containing polycarbonate: Makrolon®
 5 KU 1-1243 (branched bisphenol-A polycarbonate produced by Bayer AG, Leverkusen, Germany with a melt fusion rate (MFR) of 6.5 g/10 min at 300 °C and 1.2 kg load) was used as base material. This was coextruded with the compounds given in the Table based on Makrolon® 3100 (linear bisphenol-A polycarbonate produced by Bayer AG, Leverkusen, Germany with a melt fusion rate (MFR) of 6.5
 10 g/10 min at 300 °C and 1.2 kg load).

The thickness of the coextruded layer was approximately 50 µm in each case.

Sheet	Tinuvin® 360 ^{*)}	Tinuvin® 1577 ^{***)}	Mould release agent	Ratio of the UV absorbers (calculated)
A (comparison)	5 %	0	0.25 % PETS ^{**)}	5/0
B	4 %	1 %	0.25 % PETS ^{**)}	4/1
C	3 %	2 %	0.25 % PETS ^{**)}	3/2
D	1 %	3 %	0.25 % PETS ^{**)}	1/3
E (comparison)	0	3.5 %	0.25 % PETS ^{**)}	0/3.5

- 15 ^{*)} 2,2-methylenebis-(4-(1,1,3,3-tetramethylbutyl)-6-(2H-benzotriazole-2-yl)-phenol, commercially available, Tinuvin® 360 produced by Ciba Spezialitätenchemie, Lampertheim, Germany; comes under Formula (I)
- ^{**)} Pentaerythritol tetrastearate, commercially available, Loxiol® VPG 861 produced by Cognis, Düsseldorf, Germany
- 20 ^{***)} 2-(4,6-diphenyl-1,3,5-triazine-2-yl)-5-(hexyl)oxy-phenol, commercially available, Tinuvin® 1577 produced by Ciba Spezialitätenchemie, Lampertheim, Germany; falls under Formula (II)

The machines and apparatus used to produce the compounds and for the subsequent production of multilayer multi-wall sheets are described below:

The device for compounding consisted of

5

- metering devices for the components
- a synchronous twin-shaft kneader (ZSK 53 produced by Werner & Pfleiderer) with a screw diameter of 53 mm
- a perforated nozzle for shaping melt strands
- 10 - a water bath for cooling and compacting the strands
- a granulator

The machines and apparatus used to produce multilayer multi-wall sheets are described below:

15

The device consisted of

- the main extruder with a screw of length 33 D and a diameter of 70 mm with degasification
- 20 - the coextruding adapter (feed block system)
- a coextruder for applying the outer layer with a screw of length 25 D and a diameter of 30 mm
- the special slot die with 350 mm width
- the calibrator
- 25 - the gravity roller conveyor
- the take-up device
- the cutting device (saw)
- the stacking table.

- 30 The polycarbonate granules of the base material were supplied to the feed hopper of the main extruder, the UV coextrusion material to the coextruder. Melting and

conveying of the respective material took place in the respective plasticising system cylinder/screw. Both material melts were merged in the coextrusion adapter and after leaving the nozzle and being cooled in the calibrator formed a composite. The other devices were used for transport, cutting to size and depositing the extruded sheets.

5

The sheets obtained were then subjected to a colorimetric evaluation. The following weathering process in accordance with ISO 4892-A was used in this case:

These sheets were weathered in the Weather-o-meter produced by Atlas, USA with a
10 6.5 W-Xenon burner with a cycle of 102 min exposure to light and 18 min spraying with demineralised water with exposure to light. The maximum blackboard temperature was 60 ± 5 °C. The sheets were matched after every 1,000 hours.

Coextrusion with A (comparison):

- 15 - first smaller deposits after 80 min
- shifting of the walls after 2 hours
Score: poor

Coextrusion with E (comparison):

- 20 - first smaller deposits after 45 min
- large area deposits occurring after 2 hours
Score: poor

Coextrusion with B:

- 25 - first smaller deposits after 90 min
- large area deposits occurring after 3 hours
Score: satisfactory

Coextrusion with C:

- first smaller deposits after 90 min which also do not noticeably increase after 3 hours

Score: good

5

Coextrusion with D:

- first smaller deposits after 90 min which also do not noticeably increase after 3 hours

Score: good

10

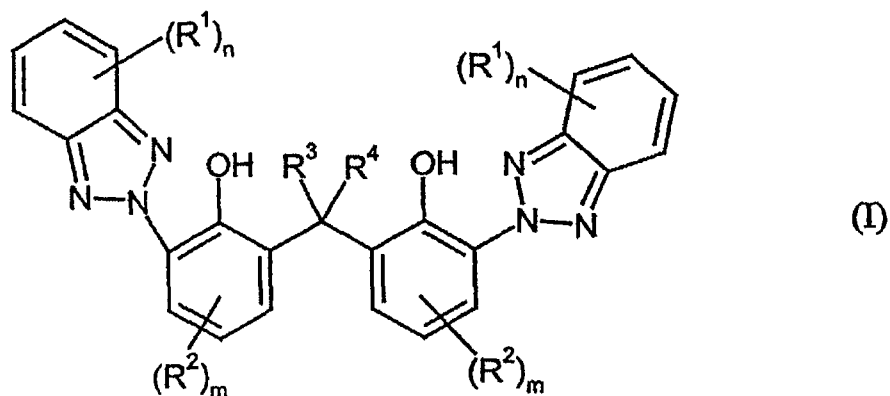
The following Table shows that sheets which are coextruded with the compositions according to the invention containing polycarbonate exhibit (Xe-WOM) approximately the same degree of yellowing (measured as yellowness index in accordance with ASTM-E 313) as the sheets (A and E) stabilised according to the prior art during artificial weathering.

15

Sheet	Yellowness Index	Yellowness Index
	0 hours	10,000 hours
A	2.1	6.1
B	2.0	6.2
C	1.9	5.9
D	1.8	5.8
E	1.9	5.9

Claims

1. Use of mixtures containing one or more different compounds of Formula (I)



5

wherein

R^1 and R^2 are identical or different and represent H, halogen, C_1 - to C_{10} -alkyl, C_5 - to C_{10} -cycloalkyl, C_7 - to C_{13} -aralkyl, C_6 - to C_{14} -aryl, $-OR^5$ or $-(CO)-O-R^5$, where

10

R^5 is H or C_1 - to C_4 -alkyl,

R^3 and R^4 are identical or different and represent H, C_1 - to C_4 -alkyl, C_5 - to C_6 -cycloalkyl, benzyl or C_6 - to C_{14} -aryl,

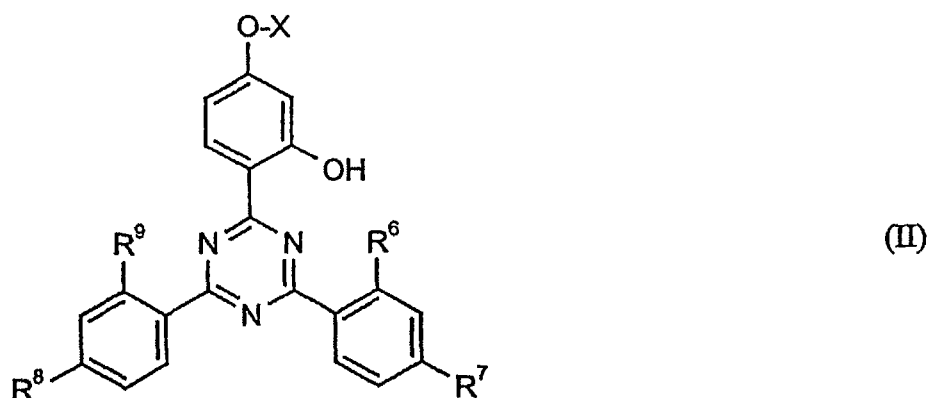
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m is 1, 2 or 3 and

n is 1, 2, 3 or 4,

20 and

one or more different compounds of Formula (II)



wherein

R⁶ to R⁹ are identical or different and are H or alkyl or CN or halogen and

5

X equals alkyl,

wherein the content of the compounds according to Formula (I) and the content of the compounds according to Formula (II) in the mixture fulfils the following condition:

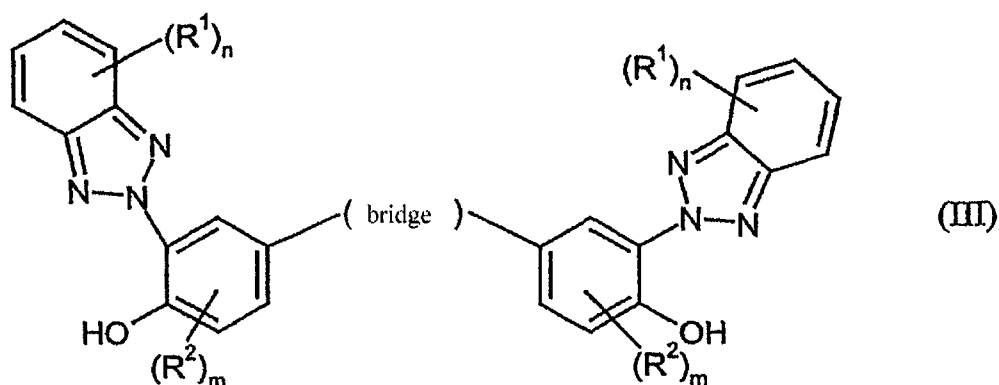
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$$\frac{\text{Content of the compounds according to Formula (I) in wt.\%}}{\text{Content of the compounds according to Formula (II) in wt.\%}} = \frac{0.2}{1} \text{ to } \frac{4}{1},$$

15 in compositions containing thermoplastic polymers for improving the extrusion properties to the extent that when extruding the compositions to form sheets a good quality in the surface of the extruded sheets is obtained.

2. Use of mixtures containing one or more different compounds of Formula (III)

20



wherein

5

R^1 and R^2 are identical or different and represent H, halogen, C_1 - to C_{10} -alkyl, C_5 - to C_{10} -cycloalkyl, C_7 - to C_{13} -aralkyl, C_6 - to C_{14} -aryl, $-OR^5$ or $-(CO)-O-R^5$, where

R^5 is H or C_1 - to C_4 -alkyl,

10

R^3 and R^4 are identical or different and represent H, C_1 - to C_4 -alkyl, C_5 - to C_6 -cycloalkyl, benzyl or C_6 - to C_{14} -aryl,

m is 1, 2 or 3 and

15

n is 1, 2, 3 or 4,

the bridge represents $-(CHR^{10})_p-C(=O)-O-(Y-O)_q-C(=O)-(CHR^{11})_p$, wherein

20

p is equal to 0, 1, 2 or 3,

q is an integer from 1 to 10,

25 Y is $-CH_2-CH_2-$, $-(CH_2)_3-$, $-(CH_2)_4-$, $-(CH_2)_5-$, $-(CH_2)_6-$, or $CH(CH_3)-CH_2-$ and

R^{10} and R^{11} are identical or different and represent H, C_1 - to C_4 -alkyl, C_5 - to C_6 -cycloalkyl, benzyl or C_6 - to C_{14} -aryl

and

- 5 one or more different compounds of general Formula (II), according to claim 1,

wherein the content of the compounds according to Formula (III) and the content of the compounds according to Formula (II) in the mixture fulfils the following condition:

$$10 \quad \frac{\text{Content of the compounds according to Formula (III) in wt.\%}}{\text{Content of the compounds according to Formula (II) in wt.\%}} = \frac{0.2}{1} \text{ to } \frac{4}{1},$$

- 15 in compositions containing thermoplastic polymers for improving the extrusion properties to the extent that when extruding the compositions to form sheets a good quality in the surface of the extruded sheets is obtained.

3. Composition containing

- 20 thermoplastic polymers and
one or more different compounds of Formula (I) according to claim 1

and

one or more different compounds of Formula (II) according to claim 1,

25

wherein the content of the compounds according to Formula (I) and the content of the compounds according to Formula (II) in the composition fulfil the following condition:

$$30 \quad \frac{\text{Content of the compounds according to Formula (I) in wt.\%}}{\text{Content of the compounds according to Formula (II) in wt.\%}} = \frac{0.2}{1} \text{ to } \frac{4}{1}.$$

4. Composition containing

thermoplastic polymers and

one or more different compounds of Formula (III) according to claim 2

5

and

one or more different compounds of general Formula (II) according to claim 1

wherein the content of the compounds according to Formula (III) and the content of
10 the compounds according to Formula (II) in the composition fulfil the following
condition:

$$\frac{\text{Content of the compounds according to Formula (III) in wt.\%}}{\text{Content of the compounds according to Formula (II) in wt.\%}} = \frac{0.2}{1} \text{ to } \frac{4}{1},$$

15

5. Composition according to claim 3, wherein the sum of all compounds
according to Formula (I) and Formula (II) in the composition have a content of 0.05 to
15 wt.%.
20

6. Composition according to claim 4, wherein the sum of all compounds
according to Formula (III) and Formula (II) has a content in the composition of 0.05 to
15 wt.%.
25

7. Composition according to any one of claims 3 to 6, wherein the sum of
thermoplastic polymer and compounds according to Formula (I) and compounds
according to Formula (II) and compounds according to Formula (III) is 60 to 100 wt.%
in the composition.
30

8. Composition according to any one of claims 3 to 7, wherein the thermoplastic
polymer polycarbonate is selected from the group consisting of bisphenol A

homopolycarbonate and copolycarbonates based on the two monomers bisphenol A and 1,1-bis-(4-hydroxyphenyl)-3,3,5-trimethylcyclohexane.

9. Composition according to any one of claims 3 to 7, wherein the thermoplastic
5 polymer is selected from the group consisting of PET and PETG.

10. Composition according to any one of claims 3 to 9, wherein the composition additionally contains 0.01 to 0.5 wt.% ester or partial ester of monovalent to hexavalent alcohols.

10

11. Composition according to any one of claims 3 to 10, wherein the composition additionally contains 10 to 3,000 ppm of thermostabilisers.

12. Composition according to claim 11, wherein the thermostabiliser is selected
15 from the group consisting of tris-(2,4-di-tert.butylphenyl)phosphite and triphenylphosphine.

13. Process for producing the composition according to any one of claims 3 to 12 by mixing the thermoplastic polymer with the remaining components of the
20 composition.

14. Use of the composition according to any one of claims 3 to 12 for producing single layer or multilayer sheets by extrusion or coextrusion.

25 15. Process for producing single layer or multilayer sheets, wherein at least one layer contains a composition according to any one of claims 3 to 12, by extrusion or coextrusion.

16. Product containing a composition according to any one of claims 3 to 12.

30

17. Product according to claim 16, selected from the group consisting of single-layer solid sheet, multilayer solid sheet, multilayer multi-wall sheet, corrugated solid sheet, multi-wall profiled part, multi-wall profiled part with tongue and groove, connecting system, sway for greenhouses, sway for conservatories, sway for bus stops, advertising hoardings, sign, safety screen, motor car sway, window and roofing.
18. Multilayer sheet, wherein at least one layer contains a composition according to any one of claims 3 to 12.
19. Multilayer sheet, wherein one of the outermost layers of the sheet or both outermost layers of the sheet contain a composition according to any one of claims 3 to 12.
20. Multilayer sheet according to claim 19, wherein the thermoplastic polymer is polycarbonate and wherein the sheet has at least two layers and wherein at least one of the inner layers contains a composition according to any one of the preceding claims and in addition a further polycarbonate.