The novel transparent polyolefin, polyester or polyamide article disclosed is stabilized against the effects of light, oxygen, heat and aggressive chemicals by addition of 0.005-0.30 % by weight the polymeric substrate of a hydroxyphenyl triazine UV absorber, and is characterized by its thickness between 1 and 500 μm. Preferred polyolefin articles thus stabilized are agricultural films containing as further stabilizer a sterically hindered amine. The novel compositions act as selective UV filter especially useful in agriculture.
TRANSPARENT POLYMER ARTICLES OF LOW THICKNESS

[0001] The invention relates to a novel polymer article of low thickness and good transparency having enhanced stability against the effects of light, oxygen, heat and aggressive chemicals, which is also effective as a selective UV filter for agricultural applications, and to some novel stabilizers suitable for this application.


[0003] Present invention pertains to a transparent polyolefin, polyester or polyamidic article stabilized by addition of 0.005-0.30% by weight the polymer substrate of a hydroxyphenyl triazine UV absorber, characterized in that the article has a thickness between 1 and 500 µm.

[0004] Preferred articles contain as a hydroxyphenyl triazine UV absorber a compound of the formula I

![Chemical Structure Image]

[0005] wherein

[0006] R₁ is H or OR₁;

[0007] R₄ and R₅ independently are H, C₁-C₉ alkyl,

[0008] OR₁;

[0009] R₄ and R₅ independently are H, C₁-C₉ alkyl, OR₁;

[0010] R₆ is H, C₁-C₉ alkyl, C₇-C₁₂ cycloalkyl, C₇-C₁₂ phenylalkyl, C₇-C₁₂ alkylphenyl, halogen, OH, OR₁;

[0011] R₇ is H; halogen; C₁-C₉ alkoxyl; C₁-C₉ alkyll; C₁-C₉ alkyl interrupted by oxygen and/or substituted by OH; or is NH—CO—R₁₄ or NH—COO—R₁₂;

[0012] R₄, R₅ and R₁₁ independently are H; C₁-C₉ alkyl; C₇-C₁₂ alkenyl; C₃-C₅ alkyl interrupted by oxygen and/or substituted by OH; or is C₅-C₁₂ cycloalkyl,

[0013] and R₇ also embraces a residue of formula II

[0014] wherein X is C₂-C₅ alkylene; —CH₂CH(OH)CH₂—; —CH₂CH(OH)CH₂O—D—CH₂CH(OH)CH₂;

[0015] (C₁-C₉ alkylene)—CO—O—D—O—CO—(C₁-C₉ alkylene); C=O—(C₂-C₅ alkylene)—CO;

[0016] C₃-C₅ alkylene interrupted by oxygen;

[0017] D is C₂-C₉ alkylene; C₆-C₉ alkylene interrupted by O; phenylene; biphenylene or phenylene-E-phenylene;

[0018] E is O, S, SO₂; CH₂; CO or —C(CH₃)₂—;

[0019] R₁₄ is H, C₁-C₁₂ alkyl; phenyl; phenyl substituted by 1-3 C₁-C₉ alkyl; C₇-C₁₂ cycloalkyl; C₇-C₁₂ phenylalkyl; C₇-C₁₂ alkenyl;

[0020] R₁₅ is H; C₁-C₅ alkyl; C₁-C₅ alkynyl; C₁-C₅ alkyl interrupted by oxygen and/or substituted by OH; or is C₁-C₅ cycloalkyl, C₇-C₁₂ phenylalkyl, C₇-C₁₂ alkly phenyl; phenyl;

[0021] R₁₆ and R₁₇ independently are H, C₁-C₉ alkyl; phenyl; phenyl substituted by 1-3 C₁-C₉ alkyl and/or C₁-C₉ alkoxy; C₇-C₁₂ cycloalkyl; C₇-C₁₂ alkenyl;

[0022] R₁₈ is C₁-C₁₂ alkyl; phenyl; phenyl substituted by 1-3 C₁-C₉ alkyl and/or C₁-C₉ alkoxy; C₇-C₁₂ cycloalkyl; C₇-C₁₂ alkenyl; C₁-C₁₂ alkoxy; or is NR₁₃R₁₄;

[0023] More preferably, in the hydroxyphenyl triazine UV absorber of the formula I

[0024] R₄ and R₅ independently are H or methyl;

[0025] R₇ is H;

[0026] R₈ is H; C₁-C₉ alkoxy; C₁-C₉ alkyl;

[0027] R₉, R₁₀ independently are H; C₁-C₉ alkyl; C₇-C₁₂ alkenyl; C₃-C₅ alkyl interrupted by oxygen and/or substituted by OH; or is C₅-C₁₂ cycloalkyl, C₁-C₁₂ phenylalkyl,

[0028] C₁-C₁₂ phenylalkyl, C₇-C₁₂ alkly phenyl; CH₂CH(OH)CH₂OR₁₃; C₁-C₉ alkyl substituted by COOR₁₅, CONR₁₃R₁₄, OCOOR₁₅, OH or halogen; or R₇ is a polymeric hydrocarbon residue of 10 to 1000 carbon atoms, preferably 20 to 500 carbon atoms.
C7-C12alkylphenyl; C7-C12alkyl substituted by COOR12, OCOR12, OH; or R5 is a polymeric hydrocarbon residue of 20 to 500 carbon atoms;

[0028] and R5 also embraces a residue of formula II, wherein X is C9-C12alkyl; —CH2CH(OH)CH2—;
—CH2CH(OH)CH(OH)O—D—OCH2CH(OH)CH2;

[0029] (C7-C12alkylene)—CO—O—D—O—CO—(C7-C12alkylene); CO2, CO—(C2-C18alkylene)—CO;

[0030] C2-C18alkylene interrupted by oxygen; D is C2-C12alkylene;

[0031] R5 is H; C7-C12alkyl; C3-C12alkenyl; C3-C12alkyl interrupted by oxygen and/or substituted by OH; or is C2-C12cycloalkyl, C7-C12phenylalkyl, C7-C12alkylphenyl; phenyl;

[0032] R5 is C7-C12alkyl; C5-C12cycloalkyl; C3-C12alkenyl;

[0033] especially OR3;

[0034] R3 is OR2;

[0035] R2 and R3 independently are H, methyl,

[0036] OR3,

[0037] R2 and R3 and R5 are H;

[0038] R5 is H; C1-C10alkoxy; C1-C4alkyl;

[0039] R2, R5 independently are C9-C12alkyl or C2-C12cycloalkyl;

[0040] and R5 also embraces a residue of formula II, wherein X is C2-C18alkylene.

[0041] Of utmost importance are compounds of the formula I, wherein R1 is OR2; R2 and R3 each are phenyl; R5, R5, and R6 are hydrogen; and R5 is C7-C12alkyl or C7-C12cycloalkyl or a residue of formula II, wherein X is C2-C18alkylene.

[0042] A halogen substituent is —F, —Cl, —Br or —I, preferably —F, —Cl or —Br and, in particular, —Cl.

[0043] Alkylphenyl is alkyl-substituted phenyl; C9-C14alkylphenyl embraces examples such as methylphenyl (tolyl), dimethylphenyl (xylyl), trimethylphenyl (mesityl), ethylphenyl, propylphenyl, butylphenyl, dibutylphenyl, pentylphenyl, hexylphenyl, heptylphenyl and octylphenyl.

[0044] Phenylalkyl is phenyl-substituted alkyl; C9-C14phenylalkyl embraces examples such as benzy1, α-methylbenzyl, α-ethylbenzyl, α,α-dimethylbenzyl, phenylethyl, phenylpropyl, phenylbutyl and phenylpentyl.

[0045] n-alkyl or alkyl-n is an unbranched alkyl radical.

[0046] Alkyl interrupted by O, NH, NR13, etc., can generally comprise one or more nonadjacent heteroatoms. Preferably, a carbon atom of the alkyl chain bonds to not more than 1 heteroatom. R9, R9, and R10, especially R9, as alkyl substituted by COOR12 is most preferably CH2—COOR12.
R12 is most preferably C7-C12alkyl, or C6-C12cycloalkyl; cycloalkyl is most preferably cyclohexyl or cyclooctyl.

[0047] Within the scope of the stated definitions, the radicals R4, R5, R6, R7, R11, R12, R13, R14, R15 as alkyl are branched or unbranched alkyl such as methyl, ethyl, propyl, isopropyl, n-butyl, sec-butyl, isobutyl, t-butyl, 2-ethylbutyl, n-pentyl, isopentyl, 1-methylpentyl, 1,3-dimethylbutyl, n-hexyl, 1-methylhexyl, n-heptyl, isohexyl, 1,1,3,3-tetramethylbutyl, 1-methylheptyl, 3-methylheptyl, n-octyl, 2-ethylhexyl, 1,1,3-trimethylhexyl, 1,1,3,3-tetramethylpentyl, nonyl, decyl, undecyl, 1-methylundecyl, dodecyl, 1,1,3,5,5-hexamethylhexyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl and octadecyl.

[0048] C7-C12alkyl is especially methyl, ethyl, isopropyl, n-butyl, 2-butyl, 2-methylpropyl or tert-butyl.

[0049] Within the scope of the stated definitions, R4, R5, R6, R7, R11, R12, R13, R14, R15 as alkenyl include alky1, isopropenyl, 2-butenyl, 3-butenyl, isobutene, n-penta-2,4-dienyl, 3-methyl-2,4-enediyl.

[0050] R4, R5 and R6 are most preferably hydrogen. R5 and R6 are most preferably phenyl or OR3, especially phenyl. R5 is most preferably C1-C4alkyl.

[0051] Examples for highly effective compounds of the formula I are as listed below or in the following tables:

[0052] 2,4,6-tris(2-hydroxy-4-4octoxyphenyl)-1,3,5-triazine, 2-(2-hydroxy-4-octoxyphenyl)-4,6-bis(2,4-dimethylphenyl)-1,3,5-triazine, 2-(2,4-dihydroxyphenyl)-4,6-bis(2,4-dimethylphenyl)-1,3,5-triazine, 2,4-bis(2-hydroxy-4-propoxyphenyl)-6-(2,4-dimethylphenyl)-1,3,5-triazine, 2-(2-hydroxy-4-octoxyphenyl)-4,6-bis(4-methylphenyl)-1,3,5-triazine, 2-(2-hydroxy-4-dodecylphenyl)-4,6-bis(2,4-dimethylphenyl)-1,3,5-triazine, 2-(2-hydroxy-4-tricycloxyphenyl)-4,6-bis(2,4-dimethylphenyl)-1,3,5-triazine, 2-[2-hydroxy-4-(2-hydroxy-3-butyloxypropoxy)phenyl]-4,6-bis(2,4-dimethyl)-1,3,5-triazine, 2-[2-hydroxy-4-(2-hydroxy-3-octyloxypropoxy)phenyl]-4,6-bis(2,4-dimethyl)-1,3,5-triazine, 2-[4-(dodecyl oxide)tricycloxy-2-hydroxypropoxy)-2-hydroxypheyl]-4,6-bis(2,4-dimethylphenyl)-1,3,5-triazine, 2-[2-hydroxy-4-(2-hydroxy-3-dodecylpropoxy)phenyl]-4,6-bis(2,4-dimethylphenyl)-1,3,5-triazine, 2-(2-hydroxy-4-bicycloxyphenyl)-4,6-diphenyl-1,3,5-triazine, 2-(2-hydroxy-4-methoxyphenyl)-4,6-diphenyl-1,3,5-triazine, 2-(2-hydroxy-4-methoxyphenyl)-4,6-diphenyl-1,3,5-triazine, 2-(2-hydroxy-4-4methoxyphenyl)-4,6-diphenyl-1,3,5-triazine, 2-(2-hydroxy-4-4-hexyloxypheyl)-4,6-diphenyl-1,3,5-triazine, 2-[2-hydroxy-4-[3-(2-ethylhexyl)-1-oxo]-2-hydroxypropoxyphenyl]-4,6-bis(2,4-dimethylphenyl)-1,3,5-triazine.
TABLE 2

<table>
<thead>
<tr>
<th>Compounds of the formula (k)</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>compound</th>
<th>$R_7$</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>$\text{CH}_2\text{CH}_2\text{C}<em>6\text{H}</em>{11}$-$(\text{CH}_2)_n$-$\text{CH}_3$</td>
</tr>
<tr>
<td>b)</td>
<td>$\text{CH}_2\text{C}<em>6\text{H}</em>{11}$-$(\text{CH}_2)_n$-$\text{CH}_3$</td>
</tr>
<tr>
<td>c)</td>
<td>$n=\text{C}<em>2\text{H}</em>{13}$</td>
</tr>
<tr>
<td>d)</td>
<td>$n=\text{C}<em>3\text{H}</em>{17}$</td>
</tr>
<tr>
<td>e)</td>
<td>$n=\text{C}<em>4\text{H}</em>{19}$</td>
</tr>
</tbody>
</table>

In the above definitions, $n$ denotes a straight alkyl chain.

[0054] Further examples for highly effective compounds of the formula I are the compounds:

- h) CH-CH(OH)N=NNN=CH-CH-O
- i) H2C-CH(OH)N=NNN=CH2-O

[0055] or corresponding compounds wherein $X$ is $\text{C}_{13}^1$, $\text{C}_{23}^2$-alkylene; $(\text{C}_1-\text{C}_{13}^1$-alkylene$)$-CO$-$O$-$D$-$O$-$CO$-(C$_1$-C$_{13}^1$-alkylene$)$-$CO$--; $(\text{C}_{12}^1-\text{C}_{23}^2$-alkylene$)$-CO; $\text{C}_1-\text{C}_{23}^2$-alkylene interrupted by oxygen, especially $(\text{C}_1$-C$_{13}^1$-alkylene$)$-O-(C$_1$-C$_{13}^1$-alkylene$)$.
Some compounds of formula I are known, e.g. from WO 96/28431, U.S. Pat. No. 5,591,850, EP-A-434608; others, e.g. the compounds as well as (b), (f), (g) and (h) are novel compounds. They are conveniently prepared in analogy to procedures described in these references, especially to the method given in example 18 of WO 96/28431.

A particular useful application of polymer films, especially polyolefin films of present invention is their use as greenhouse films. Some types of crops are degraded by the UV-components of solar radiation which must be filtered off to obtain high quality and productivity of the crops. Additionally, some microorganisms such as fungi, e.g. Botrytis cinerea, Botryosporium, Cladosporium cucumerium, Endomyces geotrichium, Endomyces fimbriatus, Sphaerotheca pannosa, Erysiphe polygoni, Gonatobotrys, Cylindrocarpon, Fusarium, Thielaviopsis, Verticillium, and virus, e.g. Cucumovirus, Tombusvirus, etc. as well as some harmful insects, e.g. white flies, aphides, thrips or leafminers, proliferate under preferred specific UV-irradiation. These pests can be significantly reduced when UV light does not or to less extent reach the plants. [R. Reuveni et al., Development of photoscetive PE films for control of foliar pathogens in greenhouse-grown crops, Plasticulture No. 102, p. 7 (1994); Y. Antignus et al., The use of UV absorbing plastic sheets to protect crops against insects and spread of virus diseases, CIPA Congress March 1997, pp. 23-33]. On the other hand, bee activity, requiring a certain band of UV radiation, needs to be retained in greenhouses in order to ensure fructification on flowering plants, e.g. tomato, cucumber, pumpkin, melon, lemon, rose, strawberry, lettuce, grape, pepper etc. Present hydroxyphenyl triazine UV absorbers show excellent compatibility and persistence in the polyolefin, polyester or polyamide. The same time, these UV absorbers provide efficient and selective UV shielding for suppressing microbial proliferation in a protected environment, especially a plant cultivation, while retaining the UV irradiation necessary for bee, bumblebee activity. Thus, present invention also pertains to the use of a transparent polyolefin film as described above for suppressing microbial proliferation in a protected cultivation.

Examples for polyolefins to be used for manufacturing the articles of present invention include the following polymers:

1. Polymers of monooolefins and diolefins, for example polypropylene, polyisobutylene, polybut-1-ene, poly-4-methylpent-1-ene, polyisoprene or polybutadiene, as well as polymers of cycloolefins, for instance of cyclopentene or norbornene, polyethylene (which optionally can be crosslinked), for example high density polyethylene (HDPE), high density and high molecular weight polyethylene (HDPE-HMW), high density and ultrahigh molecular weight polyethylene (HDPE-UHMW), medium density polyethylene (MDPE), low density polyethylene (LDPE), linear low density polyethylene (LLDPE), (VLDPE) and (ULDPE).

Polyolefins, i.e. the polymers of monooolefins exemplified in the preceding paragraph, preferably polyethylene and polypropylene, can be prepared by different, and especially by the following, methods:

a) radical polymerisation (normally under high pressure and at elevated temperature).

b) catalytic polymerisation using a catalyst that normally contains one or more than one metal of groups
IVb, Vb, Vlb or VIII of the Periodic Table. These metals usually have one or more than one ligand, typically oxides, halides, alcohohates, esters, ethers, amines, alkyls, alkoxies and/or aryls that may be either π- or σ-coordinated. These metal complexes may be in the free form or fixed on substrates, typically on activated magnesium chloride, titanium(III) chloride, alumina or silicon oxide. These catalysts may be soluble or insoluble in the polymerisation medium. The catalysts can be used by themselves in the polymerisation or further activators may be used, typically metal alkyls, metal hydrides, metal alkyl halides, metal alkyl oxides or metal alkyl oxoanes, said metals being elements of groups Ia, Ila and/or IIa of the Periodic Table. The activators may be modified conveniently with further ester, ether, amine or sillyl ether groups. These catalyst systems are usually termed Phillips, Standard Oil Indiana, Ziegler (-Natta), INZ (DuPont), metalocene or single site catalysts (SSC).

[0065] 2. Mixtures of the polymers mentioned under 1), for example mixtures of polypropylene with polyisobutylene, and polypropylene with polyethylene as (for example PP/HDPE, PP/LLDPE) and mixtures of different types of polyethylene (for example LDPE/HDPE).

[0066] 3. Polyolefin copolymers: Copolymers of monoolefins and diolefins with each other or with other vinyl monomers, for example ethylene/propylene copolymers, linear low density polyethylene (LLDPE) and mixtures thereof with low density polyethylene (LDPE), propylene/but-1-ene copolymers, propylene/isobutylene copolymers, ethylene/but-1-ene copolymers, ethylene/hexene copolymers, ethylene/methylpentene copolymers, ethylene/hexene copolymers, ethylene/cyclopentene copolymers, ethylene/ethyl acrylate copolymers, ethylene/cyclopentene copolymers, ethylene/vinyl acetate copolymers and their copolymers with carbon monoxide or ethylene/ acrylic acid copolymers and their salts (ionomers) as well as terpolymers of ethylene with propylene and a diene such as heptadiene, cyclopentadiene or ethylidenenorbornene; and mixtures of such copolymers with one another and with polymers mentioned in 1) above, for example polypropylene/ethylene-propylene copolymers, LDPE/ethylene-vinyl acetate copolymers (EVA), LDPE/ethylene-acrylic acid copolymers (EAA), LLDPE/EVA, LLDPE/EAA and alternating or random polyalkylene/carbon monoxide copolymers and mixtures thereof with other polymers, for example polyamides.

[0067] Polysters to be used for manufacturing the articles of present invention are mainly those derived from dicarboxylic acids and diols and/or from hydroxycarboxylic acids or the corresponding lactones, for example polyethylene terephthalate, polybutylene terephthalate, poly-1,4-dimethylolcyclohexane terephthalate, polyalkylene naphthalate (PAN) and polyhydroxybenzoates, as well as block copolyether esters derived from hydroxyl-terminated polyethers; and also polyesters modified with polycarboxates or MBS. Preferred is polyethylene terephthalate (PET).

[0068] Polyamides are usually those derived from diamines and dicarboxylic acids and/or from amino carboxylic acids or the corresponding lactams, for example polyamide 4, polyamide 6, polyamide 6/6, 6/10, 6/9, 6/12, 4/6, 12/12, polyamide 11, polyamide 12, aromatic polyamides starting from m-xylene diamine and adipic acid; polyamides prepared from hexamethylene diamine and isophthalic acid and terephthalic acid and with or without an elastomer as modifier, for example poly-2,4,4-trimethylhexamethylene terephthalamide or poly-m-phenylene isophthalamide; and also block copolymers of the aforementioned polyamides with polyolefins, olefin copolymers, ionomers or chemically bonded or grafted elastomers; or with polyethers, e.g. with polyethylene glycol, polypropylene glycol or polytetramethylene glycol; as well as polyamides or copolyamides modified with EPDM or ABS; and polyamides condensed during processing (RIM polyamide systems).

[0069] Most preferred are polyolefins such as polyethylene, especially LDPE or LLDPE, or polypropylene.

[0070] Preferably, the amount of hydroxyphenyl triazine UV absorber in the transparent polymer article of the invention is from 0.005 to 0.15%, more preferably from 0.005 to 0.06%, especially from 0.01 to 0.06% by weight the polymer substrate.

[0071] The transparent polyolefin, polyester or polyamide article of the invention usually is a film, fiber, ribbon or stretched tape, especially an agricultural film. Its thickness preferably ranges between 1 and 300 μm, especially between 1 and 200 μm. Films, ribbons or tapes of the invention usually are not biaxially oriented. The transparent polylefin, polyester or polyamide article of the invention often contains one or more further components, e.g. selected from further light stabilizers, processing stabilizers, fillers, clariiers, modifiers, acid scavengers, pigments, flame retardants or other additives known in the art. These components usually do not effectively block light transmission through the present polymer articles, which is usually more than 20%, often more than 50%, and preferably more than 80% of white incoming light. For sufficient transparency, present articles preferably do not contain crystalline components in an amount that would significantly impair this property; preferably they contain no pigments and no or merely minor amounts, e.g. 0-5% by weight of the polymer, of fillers or crystalline inorganic components having lower opaquing effect than pigments (e.g. hydrotalcites). Examples for additional components which may be contained in the polymer articles of the invention include the following:

[0072] 1. Antioxidants

[0073] 1.1. Alkylated monophenols, for example 2,6-di-tert-buty1-4-methylphenol, 2,4-di-tert-butyl-4,6-di-methylphenol, 2,5-di-tert-butyl-4-ethylphenol, 2,6-di-tert-butyl-4-n-butylphenol, 2,6-di-tert-butyl-4-isobutylphenol, 2,6-dicyclopentyl-4-methylphenol, 2-(α-methylcyclohexyl)-4, 6-dimethylphenol, 2,6-dioctadecyl-4-methylphenol, 2,6,4,4- tricyclicophenol, 2,6-di-tert-butyl-4-methoxyphenol, nonylphenols which are linear or branched in the side chains, for example 2,6-di-nonyl-4-methylphenol, 2,4-dimethyl-6-(1′-methylundec-1′-yl)phenol, 2,4-dimethyl-6-(1′-methylheptadec-1′-yl)phenol, 2,4-dimethyl-6-(1′-methyltridec-1′-yl)phenol and mixtures thereof.

[0074] 1.2. Alkylthiomethylphenols, for example 2,4-diocetylthiomethyl-6-tert-butylphenol, 2,4-diocetylthiomethyl-6-methylphenol, 2,4-dioctylthiomethyl-6-ethylphenol, 2,6-di-dodecythiomethyl-4-nonylphenol.

[0075] 1.3. Hydroquinones and alkylated hydroquinones, for example 2,6-di-tert-butyl-4-methoxy-phenol, 2,5-di-tert-
butylhydroquinone, 2,5-di-tert-amylhydroquinone, 2,6-diphenyl-4-octade-cyloxyphenol, 2,6-di-tert-butylhydroquinone, 2,5-di-tert-butyl-4-hydroxyanisole, 3,5-di-tert-butyl-4-hydroxyphenyl stearate, bis(3,5-di-tert-butyl-4-hydroxyphenyl) adipate.

[0076] 1.4. Tocopherols, for example α-tocopherol, β-tocopherol, γ-tocopherol, δ-tocopherol and mixtures thereof (vitamin E).

[0077] 1.5. Hydroxylated thiophenol ethers, for example 2,2-thiobis(6-tert-butyl-4-methylphenol), 2,2-thiobis(4-octy-phenol), 4,4′-thiobis(6-tert-butyl-3-methylphenol), 4,4′-thiobis(6-tert-butyl-2-methylphenol), 4,4′-thiobis(3,6-di-isocyanatophenol), 4,4′-bis(2,6-dimethyl-4-hydroxyphenyl) dibutylsulfide.

[0078] 1.6. Alkalylidenbisphenols, for example 2,2′-methylenbis(6-tert-butyl-4-methylphenol), 2,2′-methylenebis(6-tert-butyl-4-ethylphenol), 2,2′-methylenebis[4-methyl-6-(3-methylcyclohexyl)phenol], 2,2′-methylenebis[4-methyl-6-cyclohexylphenol], 2,2′-methylenebis[4-nonyl-4-methylphenol], 2,2′-methylenebis[4,6-di-tert-butylphenol], 2,2′-ethy-lidenbis[6-(α,α′-dimethylbenzyl)-4-nonylphenol], 2,2′-methylenebis[6-(α,α′-dimethylbenzyl)-4-nonylphenol], 4,4′-methylenebis[6-(α,α′-dimethylbenzyl)-4-nonylphenol], 2,2′-methylenebis[6-(α,α′-dimethylbenzyl)-4,6-di-tert-butylphenol], 4,4′-methylenebis[6-(α,α′-dimethylbenzyl)-4,6-di-tert-butylphenol], 1,1-bis[5-(tert-butyl-4-hydroxy-2-methylphenyl)butane], 2,6-bis(3-tert-butyl-5-methyl-2-hydroxybenzyl)phenol, 1,13-tris(3,5-di-tert-butyl-4-hydroxy-2-methylphenyl)butane, 1,1-bis(5-(tert-butyl-4-hydroxy-2-methylphenyl)3-n-dodecylmercapto-butanone, ethylene glycol bis(3,3′-dimethyl-4,4′-dihydroxyphenyl)butyrate], bis(3-tert-butyl-4-hydroxy-5-methyl-phenyl)di-cyclopenta-diene, bis[2-(3-tert-butyl-2-hydroxy-5′-methyl benzyl)-6-tert-butyl-4-methylphenyl] erephthalate, 1,1-bis(3,5-di-methyl-2-hydroxyphenyl)butane, 2,2-bis(3,5-di-tert-butyl-4-hydroxyphenyl) propane, 2,2-bis(3-tert-butyl-4-hydroxy-2-methylphenyl)4-n-dodecylmercapto-butane, 1,1,5,5-tetra-(3,5-di-tert-butyl-4-hydroxyphenyl) pentane.

[0079] 1.7. O—N— and S-benzyl compounds, for example 3,5,3′,5′-tetrater-t-butyl-4,4′-dihydroxybenzyl ether, octadecyl-4-hydroxy-3,5-dimethylbenzymercaptoacetate, tridecyl-4-hydroxy-3,5-di-tert-butylbenzymercaptoacetate, tris(3,5-di-tert-butyl-4-hydroxy-2-naphthyl)amine, bis(4-tert-butyl-3-hydroxy-6,6-dimethyl-2-isothiazolidinyl) erephthalate, bis(3,5-di-tert-butyl-4-hydroxybenzyl) sulfide, isooctyl-3,5-di-tert-butyl-4-hydroxybenzymercaptoacetate.

[0080] 1.8. Hydroxylated malonates, for example dioctadecyl-2,2-bis(3,5-di-tert-butyl-4-hydroxybenzyl) malonate, diocetyl-2-(3-tert-butyl-4-hydroxy-5-methyl benzyl) malonate, diocetylcaprocapethyloxy-2,2-bis(3,5-di-tert-butyl-4-hydroxybenzyl) malonate, bis[4(1,3,3-tetramethylbutyloxyl)]-2,2-bis(3,5-di-tert-butyl-4-hydroxybenzyl)malonate.

[0081] 1.9. Aromatic hydroxybenzyl compounds, for example 13,5-tris(3,5-di-tert-butyl-4-hydroxybenzyl)2,4,6-trimethylbenzene, 1,4-bis(3,5-di-tert-butyl-4-hydroxybenzyl)-2,3,5,6-tetramethylbenzene, 2,4,6-tris(3,5-di-tert-butyl-4-hydroxybenzyl)phenol.

[0082] 1.10. Triazine compounds, for example 2,4-bis(octylmercapto)-6-(3,5-di-tert-butyl-4-hydroxy-anilino)-1,3,5-triazine, 2-octylmercapto-4,6-bis(3,5-di-tert-butyl-4-hydroxyanilino)-1,3,5-triazine, 2-octylmercapto-4,6-bis(3,5-di-tert-butyl-4-hydroxyanilino)-1,3,5-triazine, 2,4,6-tris(3,5-di-tert-butyl-4-hydroxyphenoxy)-1,2,3-triazine, 1,3,5-tris(3,5-di-tert-butyl-4-hydroxybenzoyl) isocyanurate, 1,3,5-tris(4-tert-butyl-3-hydroxy-2,6-dimethylbenzoyl) isocyanurate, 2,4,6-tris(3,5-di-tert-butyl-4-hydroxyphenoxymethylyl)-1,3,5-triazine, 1,3,5-tris(3,5-di-tert-butyl-4-hydroxy-phenylpropionyl)-hexahydropyridazinone.
[0089] 1.17. Amides of β-(3,5-di-tert-butyl-4-hydroxyphenyl)proponic acid e.g. N,N'-bis(3,5-di-tert-butyl-4-hydroxyphenyl)propionyl)hexamethylenediamine, N,N'-bis(3,5-di-tert-butyl-4-hydroxyphenyl)propionyl)trimethylenediamine, N,N'-bis(3,5-di-tert-butyl-4-hydroxyphenyl)propionyl)hydracidine, N,N'-bis(2-(3,5-di-tert-butyl-4-hydroxyphenyl)propionyl)ethyl oxamide Naugeard® XL-1, supplied by Unioroyal.

[0090] 1.18. Ascorbic acid (vitamin C)

[0091] 1.19. Aminic antioxidants, for example N,N'-diisopropyl-p-phenylenediamine, N,N'-di-sec-butyl-p-phenylenediamine, N,N'-bis(1,4-dimethylphenyl)-p-phenylenediamine, N,N'-bis(1-ethyl-3-methylphenyl)-p-phenylenediamine, N,N'-bis(1-methylheptyl)-p-phenylenediamine, N,N'-dicyclohexyl-p-phenylenediamine, N,N'-diphenyl-p-phenylenediamine, N,N'-bis(2-naphthyl)-p-phenylenediamine, N-isopropyl-N-phenyl-p-phenylenediamine, N-(1,3-dimethylbutyl)-N-phenyl-p-phenylenediamine, N-(1-methylheptyl)-N-phenyl-p-phenylenediamine, N-cyclohexyl-N-phenyl-p-phenylenediamine, 4-(p-toluene-sulfamoyl)diphenylamine, N,N'-dimethyl-N,N'-di-sec-butyl-p-phenylenediamine, diphenylamine, N-allylpiphenylamine, 4-isopropoxydiphenylanime, N-phenyl-1-naphthylamine, N-(4-tert-octylphenyl)-1-naphthylamine, N-phenyl-2-naphthylamine, octylated diphenylamine, for example p,p'-di-tert-octyl diphenylamine, 4-n-butylaminonaphthalen, 4-butylaminophenol, 4-nanoxylaminophenol, 4-dodecanolaminophenol, 4-octadecanoylaminophenol, bis(4-methoxyphenyl)amine, 2,6-di-tert-butyl-4-dimethylyaminomethylphenol, 2,4-diaminodiphenylmethane, 4,4'-diaminodiphenylmethane, N,N,N',N'-tetramethyl-4,4'-diaminodiphenylmethane, 1,2-bis(2-methylphenyl)amine, ethane, 1,2-bis(phenoxy)propane, (α,α')-biphenyl, bis(4(1,3-diaminobenzyl)biphenyl)amine, tert-octylated N-phenyl-1-naphthylamine, a mixture of mono- and dialkylated tert-butyl-tert-octyl diphenylamines, a mixture of mono- and dialkylated nonoxidiphenylamines, a mixture of mono- and dialkylated dodecylphenylamines, a mixture of mono- and dialkylated isophenyldiphenylamines, a mixture of mono- and dialkylated tert-butylphenylamines, 2,3-dihydro-3,3-dimethyl-4H,1,4-benzothiazine, phenothiazine, a mixture of mono- and dialkylated tert-butyl-tert-octylphenothiazines, a mixture of mono- and dialkylated tert-octyl phenothiazines, N-allylpiphenylamine, N,N,N',N'-tetraphenyl-1,4-diaminobut-2-ene, N,N'-bis-(2,2,6,6-tetramethyl-piperidin-4-yl)-hexamethylenediamine, bis(2,2,6,6-tetramethylpiperidin-4-yl)sebacate, 2,2,6,6-tetramethylpiperidin-4-one, 2,2,6,6-tetramethylpiperidin-4-ol.

[0092] 2. UV absorbers and light stabilisers

[0093] 2.1. 2-(2'-Hydroxyphenyl)benzotriazoles, for example 2-(2'-hydroxy-5'-methylphenyl)benzotriazole, 2-(3,5'-di-tert-butyl-2'-hydroxyphenyl)benzotriazole, 2-(5'-tert-butyl-2'-hydroxyphenyl) benzotriazole, 2-(2'-hydroxy-5'-1,1,3,3-tetramethylbutylphenyl)benzotriazole, 2-(3,5'-di-tert-butyl-2'-hydroxyphenyl)-5-chlorobenzotriazole, 2-(3'-tert-butyl-2'-hydroxy-5'-(2-methoxy carbonyl ethyl)phenyl)-5-chlorobenzotriazole, 2-(3'-tert-butyl-2'-hydroxy-5'-2-methoxy carbonyl ethyl)phenyl)-5-chlorobenzotriazole, 2-(3'-tert-butyl-2'-hydroxy-5'-2-methoxy carbonyl ethyl)phenyl benzo triazole, 2-(3'-tert-butyl-2'-hydroxy-5'-2-oxo-tyloxy carbonyl ethyl)phenylbenzotriazole, 2-(3'-tert-butyl-2'-hydroxy-5'-2-ethylhexyloxy carbonyl ethyl)phenylbenzotriazole, 2-(2'-ethylhexylcarbonyl ethyl)phenylbenzotriazole, 2-(2'-ethylhexyloxy carbonyl ethyl) phenylbenzotriazole, 2-(2'-tert-butyl-2'-hydroxy-5'-3-isooxytyloxy carbonyl ethyl)phenylbenzotriazole, 2,2'-methylenebis[4-(1,1,3,3-tetramethylbutyl)-6-benzotriazolyl-2-phenol], the transterification product of 2-(3'-tert-butyl-5'-2-methoxy carbonyl ethyl)-2'-hydroxyphenyl-2H-benzotriazole with polyethylene glycol 300;

[0094] where R =3'-tert-butyl-4'-hydroxy-5'-2H-benzotriazol-2-ylphenyl, 2-(2'-hydroxy-3-(α,α-dimethylbenzyl)-5'-(1,1,3,3-tetramethylbutylphenyl)benzotriazole, 2-(2'-hydroxy-3-(1,1,3,3-tetramethylbutyl)-5'-(α,α-dimethylbenzyl)phenylbenzotriazole.

[0095] 2.2. 2-Hydroxycinnamophenes, for example the 4-hydroxy, 4-methoxy, 4-octoxy, 4-decyloxy, 4-dodecyloxy, 4-benzoxyl, 4,2',4'-trimethylene and 2'-hydroxy-4,4'-dimethoxy derivatives.

[0096] 2.3. Esters of substituted and unsubstituted benzoic acids, for example 4-tert-butylphenyl salicylate, phenyl salicylate, octylphenyl salicylate, dibenzyl resorcinol, bis(4-tert-butylphenyl) resorcinol, benzyl resorcinol, 2,4-di-tert-butylphenol, 3,5-di-tert-butyl-4-hydroxybenzoate, hexadecyl 3,5-di-tert-butyl-4-hydroxybenzoate, octadecyl 3,5-di-tert-butyl-4-hydroxybenzoate, 2-methyl-4,6-di-tert-butylphenol 3,5-di-tert-butyl-4-hydroxybenzoate.

[0097] 2.4. Acrylates, for example ethyl α-cyano-β,β-diphenylacrylate, isooctyl α-cyano-β,β-diphenylacrylate, methyl α-carboxymethoxyccinnamate, methyl α-cyano-β-methyl-p-methoxyccinnamate, butyl α-cyano-β-methyl-p-methoxyccinnamate, methyl α-carboxymethoxy-p-methoxyccinnamate and N-(β-carboxymethoxy-β-cyano)vinyl-2-methylindoline.

[0098] 2.5. Nickel compounds, for example nickel complexes of 2,2'-thiobis[4-(1,1,3,3-tetramethylbutyl)-benzyl] phenol, such as the 1:1 or 1:2 complex, with or without additional ligands such as N-butylamine, triethanolamine or N-cyclohexylidethanolamine, nickel dibutyldioctanoate, nickel salts of the monoalkyl esters, e.g. the methyl or ethyl ester, of 4-hydroxy-3,5-di-tert-butylbenzylphosphonic acid, nickel complexes of ketoximes, e.g. of 2-hydroxy-4-methylen 1,4-lundecylketoxime, nickel complexes of 1-phenyl-4-lauroyl-5-hydroxy pyrazole, with or without additional ligands.

[0099] 2.6. Sterically hindered amines, for example bis(2,2,6,6-tetramethyl-4-piperidinyl)sebacate, bis(2,2,6,6-tetramethyl-4-piperidinyl)sebacate, bis(1,2,6,6-pentamethyl-4-piperidinyl)sebacate, bis(1,2,6,6-pentamethyl-4-piperidinyl)n-butyl-3,5-di-tert-butyl-4-hydroxybenzylmalonate, the condensate of 1-(2-hydroxyethyl)-2,2,6,6-tetramethyl-4-hy-
droxypiperidine and succinic acid, linear or cyclic condensates of N,N'-bis(2,2,6,6-tetramethyl-4-piperidyl)hexamethylenediamine and 4-tert-octylaminol-2,6-di-chloro-1,3,5-triazine, tris(2,2,6,6-tetramethyl-4-piperidyl)nitroliotriacetate, tetraakis(2,2,6,6-tetra methyl-4-piperidyl)-1,2,3,4-butanetetracarboxylate, 1,1’-(1,2-ethanediyl)-bis(3,3,5,5-tetramethylpiperazinone), 4-benzoyl-2,2,6,6-tetramethylpiperidine, 4-stearyloxy-2,2,6,6-tetramethylpiperidine, bis(1,2,2,6,6-pentamethylpiperidyl)-2-n-butyl-2-(2-hydroxy-3,5-di-tert-butylbenzyl)malonate, 3-n-octyl-7,7,9,9-tetramethyl-1,3,8-triazaspiro[4.5]decane-2,4-dione, bis(1-octyl-2,2,6,6-tetramethylpiperidyl)sebacate, bis(1-octyl-2,2,6,6-tetramethylpiperidyl)succinate, linear or cyclic condensates of N,N'-bis(2,2,6,6-tetramethyl-4-piperidyl)hexamethylenediamine and 4-morpholin-2,6-dichloro-1,3,5-triazine, the condensate of 2-chloro-4,6-bis(4-n-butylamino)-2,6,6-tetramethylpiperidyl)-1,3,5-triazine and 1,2-bis(3-amino propylamino)-ethane, the condensate of 2-chloro-4,6-di(4-n-butylamino)-2,2,6,6-pentamethylpiperidyl)-1,3,5-triazine and 1,2-bis(3-amino propylamino)-ethane, 8-acetyl-3-dodecetyl-7,7,9,9-tetramethyl-1,3,8-triazaspiro[4.5]decane-2,4-dione, 3-dodecyl-1(2,2,6,6-tetramethyl-4-piperidyl)pyrroline-2,5-dione, 3-dodecyl-1(1,2,2,6,6-pentamethyl-4-piperidyl)pyrroline-2,5-dione, a mixture of 4-hexadecyloxy- and 4-stearyloxy-2,2,6,6-tetramethylpiperidine, a condensate of N,N'-bis(2,2,6,6-tetramethyl-4-piperidyl)hexamethylenediamine and 4-cyclohexylamino-2,6 dichloro-1,3,5-triazine, a condensate of 1,2-bis(3aminopropylamino)ethane and 2,4,6-trichloro-1,3,5-triazine as well as 4-butylamino-2,2,6,6-tetramethylpiperidine (CAS Reg. No. [136504-96-6]); N(1,2,2,6,6-pentamethyl-4-piperidyl)-n-dodecysuccinimide, N(1,2,2,6,6-pentamethyl-4-piperidyl)-n-octylsuccinimide, N(2-undecyl-7,7,9,9-tetramethyl-1-oxa-3,8-diaza-4-oxo-spiro[4,5]decane, a reaction product of 7,7,9,9-tetramethyl-2-cycloundecyl-1-oxa-3,8-diaza-4-oxospiro[4,5]decane and epichlorohydrin, 1,1-bis(1,2,2,6,6-pentamethyl-4-piperidyl-oxo-carbonyl)-2,4-methoxyphenyl)ethene, N,N'-bisformyl-N,N'-bis(2,2,6,6-tetramethyl-4-piperidyl)hexamethylenediamine, a diester of 4-methoxymethylene malonic acid with 1,2,2,6,6-pentamethyl-4-hydroxy piperidine, poly(ethylene glycol)-3-oxa-4(2,2,6,6-tetramethyl-4-piperidyl) lialoxane, a reaction product of maleic anhydride-α-olefin copolymer with 2,2,6,6-tetramethyl-4-aminopiperidine or 1,2,2,6,6-pentamethyl-4-aminopiperidine.

[0100] 2.7. Oxamides, for example 4,4'-diocyctloyoxyxaniline, 2,2'-diethoxyxaniline, 2,2'-dioctoxroyoxyxaniline, 2,2'-didodecylxoxy-5,5'-di-tert-butoxaniline, 2-ethoxy-2'-ethoxylaniline, N,N'-bis(3-dimethylaminopropyl)oxamide, 2-ethoxy-5-tert-butyl-2-ethoxaniline and its mixture with 2-ethoxy-2'-ethyl-5,5'-di-tert-butoxaniline, mixtures of α- and ρ-methoxy-disubstituted oxanilides and mixtures of α- and ρ-ethoxy-disubstituted oxanilides.

[0101] 3. Metal deactivators, for example N,N'-diphenyl oxamide, N-salicylal-N'-salicyloyl hydrazine, N,N'-bis(salicyloyl)hydrazine, N,N'-bis(3,3-di-tert-butyl-4-hydroxyphenylpropiony)hydrazine, 3-salicyloylaminol-1,2,4-triazole, bis(benzylidene)oxaaryl dihydroxazide, oxanilide,
5. Hydroxylamines, for example N,N-dibenzylhydroxylamine, N,N-diethylhydroxylamine, N,N-diisopropylhydroxylamine, N,N-dilaurylhydroxylamine, N,N-ditetradecylhydroxylamine, N,N-dioctadecylhydroxyamine, N-hexadecyl-N-octadecylhydroxyamine, N-heptadecyl-N-octadecylhydroxyamine, N,N-diallylhydroxyamine derived from hydrogenated tallow amine.


7. Thiocyanogenists, for example dilauryl thiophosphorotri- or distearyl thiodipropionate.
[0117] Thin-walled articles of the invention, especially transparent polyolefin agricultural films, act as a selective UV filter enhancing plant growth and crop while suppressing the undesired proliferation of microorganisms. Light of the medium or far UV region (e.g. 200-360 nm, especially 300-340 nm) required by these microorganisms is effectively blocked. The same time, the activity of useful insects such as bees and bumblebees is not affected.

[0118] Preferably, the transparent polyolefin, polyester or polyamide article of the invention also contains a sterically hindered amine as further stabilizer in order to obtain optimum light stability of the substrate. The sterically hindered amine is usually contained in an amount of 0.01-6% by weight the polyolefin, polyester or polyamide, the weight ratio sterically hindered amine: hydroxyphenyl triazine UV absorber preferably ranging from 2:1 to 20:1.

[0119] Examples for sterically hindered amines preferably contained in the polyolefin, polyester or polyamide articles of the invention are given in the above list (item 2.6).

[0120] More preferred sterically hindered amines include the following compounds:

[0121] bis(2,2,6,6-tetramethyl-4-piperidyl)sebacate;

[0122] bis(1,2,6,6-pentamethyl-4-piperidyl)sebacate; the condensate of 1-(2-hydroxyethyl)-2,2,6,6-tetramethyl-4-hydroxyperidine and succinic acid (CAS-No. 65447-77-0);

[0123] N,N',N,N''-Tetrakis(4,6-bis(2,2,6,6-tetramethylpiperidin-4-yl)amino)triazin-2-yl) -4,7-di-azadecane-1,10-diamine (CAS-No. 106990-43-6);
wherein R and R’ independently are hydrogen or methyl, and at least the chemical bond of the oxygen atom and optionally a further chemical bond is linked to an organic residue while the remaining is/are saturated with hydrogen; or all 3 chemical bonds are linked to an organic residue. Examples for such compounds are described inter alia in U.S. Pat. Nos. 5,204,473, 5,216,156, or in GB-A-2347928.

Examples for the most preferred hydroxylamine ethers are compounds of the formula (1g-1)

\[
\begin{align*}
\text{(1g-1)} & \\
\end{align*}
\]

in which the index n ranges from 1 to 15, being especially from the range 3-9; \(R_{12}\) is \(C_2-C_{12}\) alkylene, \(C_2-C_{12}\) alkenylene, \(C_2-C_{12}\) cycloalkyylene, \(C_2-C_{12}\) cycloalkylene-di-(\(C_1-C_{12}\) alkylenedi), \(C_1-C_{12}\) alkylenedi-(\(C_1-C_{12}\) cycloalkylenedi), phenylethynedi-(\(C_1-C_{12}\) cycloalkylenedi) or \(C_2-C_{12}\) alkylene interrupted by 1,4-piperazinevaldehyde, —O— or \(>N—\), with \(X_1\) being \(C_2-C_{12}\) acyl or (\(C_1-C_{12}\) alkyl)-carbonyl or having one of the definitions of \(R_{14}\) given below except hydrogen; or \(R_{12}\) is a group of the formula (1b') or (1c');

with \(m\) being 2 or 3.

\(X_1\) being \(C_2-C_{18}\) alkyl, \(C_2-C_{12}\) cycloalkylenedi which is unsubstituted or substituted by 1, 2 or 3 \(C_{12}-C_{22}\) alkyl; phenyl which is unsubstituted or substituted by 1, 2 or 3 \(C_{12}-C_{22}\) alkyl or

\(C_2-C_{12}\) alkoxy; \(C_2-C_{12}\) phenylalkylenedi which is unsubstituted or substituted on the phenyl by 1, 2 or 3 \(C_{12}-C_{22}\) alkyl and

the radicals \(X_1\) being independently of one another \(C_2-C_{12}\) alkylene;

the radicals \(X_1\) being independently of one another \(C_2-C_{12}\) alkylene;

the radicals \(B\) are independently of one another \(Cl, —OB_{12}, —N(R_{12}) (R_{12})\) or a group of the formula (IIIId);

\[
\begin{align*}
\text{(IIIId)} & \\
\end{align*}
\]

\(R_{13}, R_{14}\) and \(R_{15}\), which are identical or different, are hydrogen, \(C_1-C_{22}\) alkyl, \(C_2-C_{12}\) cycloalkylenedi which is unsubstituted or substituted by 1, 2 or 3 \(C_{12}-C_{22}\) alkyl; \(C_2-C_{12}\) alkenylenedi, phenyl which is unsubstituted or substituted by 1, 2 or 3 \(C_2-C_{12}\) alkyl or \(C_2-C_{12}\) alkoxy; \(C_2-C_{12}\) phenylalkylenedi which is unsubstituted or substituted on the phenyl by 1, 2 or 3 \(C_2-C_{12}\) alkyl; tetrahydrofurfonyl or \(C_2-C_{12}\) alkyl which is substituted in the 2, 3 or 4 position by —OH, \(C_2-C_{12}\) alkoxy, di-(\(C_1-C_{12}\) alkyl)-amino or a group of the formula (Ie');

\[
\begin{align*}
\text{(Ie')} & \\
\end{align*}
\]

with \(Y\) being —O—, —CH_{2}, —CH_{2}CH_{2}— or >N—CH_{2}, or —N(R_{14})(R_{15}) is additionally a group of the formula (Ie');

\(X\) is —O— or >N—R_{35};
[0137] \( R_{16} \) is hydrogen, \( C_1-C_8 \)alkyl, \( C_3-C_9 \)alkenyl, \( C_7-C_{25} \)cycloalkyl which is unsubstituted or substituted by 1, 2 or 3 \( C_1-C_8 \)alkyl; \( C_7-C_9 \)phenylalkyl which is unsubstituted or substituted on the phenyl by 1, 2 or 3 \( C_1-C_8 \)alkyl; tetrahydrofurfuryl, a group of the formula (III),

\[
\text{(III)}
\]

[0138] or \( C_2-C_8 \)alkyl which is substituted in the 2, 3 or 4 position by \( -OH, C_1-C_8 \)alkoxy, \( \text{di}(C_1-C_8 \text{alkyl}) \)amino or a group of the formula (Ie); \( R_{15} \) has one of the definitions given for \( R_{16} \).

[0139] In these compounds, the end group bonded to the triazine residue can be, for example, a group \( B \) or \( -N(R_{15})-R_{12}-B \), such as chlorine or a group

\[
N\left(\text{CH}_2\right)_n N
\]

[0140] and the end group bonded to the diamino group can be, for example, hydrogen or a di-\( B \)-substituted triazinyl group, such as a group

\[
\text{or } \text{or}
\]

[0141] It may be convenient to replace the chlorine attached to the triazine by e.g. \( -OH \) or an amino group. Suitable amino groups are typically: pyrrolidin-1-yl, morpholino, \( -NH_2, -N(C_1-C_9 \text{alkyl})_2 \) and \( -NY'(C_1-C_9 \text{alkyl}) \) wherein \( Y' \) is hydrogen or a group of the formula

\[
\text{or}
\]

[0142] In the above shown oligomeric and polymeric compounds, examples of alkyl are methyl, ethyl, propyl, isopropyl, \( n \)-butyl, sec-butyl, isobutyl, \( t \)-butyl, 2-ethylbutyl, \( n \)-pentyl, isopentyl, 1-methylpentyl, 1,3-dimethylbutyl, \( n \)-hexyl, 1-methylhexyl, \( n \)-heptyl, isoheptyl, 1,1,3,3-tetramethylbutyl, 1-methylheptyl, 3-methylheptyl, \( n \)-octyl, 2-ethyl-hexyl, 1,1,3-trimethylhexyl, 1,1,3,3-tetramethylpentyl, \( n \)onyl, decyl, undecyl, 1-methylundecyl, dodecyl, 1,1,3,3,5,5-hexamethylhexyl, tridecyl, tetracetyl, pentadecyl, hexaacyl, heptadecyl, octadecyl, eicosyl and docosyl;

[0143] examples of cycloalkyl are cyclopentyl, cyclohexyl, cycloheptyl and cyclooctyl;

[0144] an example of \( C_7-C_9 \)phenylalkyl is benzyl; and

[0145] examples of alkylene are ethylene, propylene, trimethylene, tetramethylene, pentamethylene, 2,2-dimethyltrimethylene, hexamethylene, trimethylhexamethylene, octamethylene and decamethylene.

[0146] Another example for a sterically hindered amine ether advantageously to be used within present polymer articles is the compound of the formula

\[
\text{or}
\]

[0147] An example for a highly effective compound of formula (1g-1) is the compound of the formula (1g-2)
The additives of the invention and optional further components may be added to the polymer material individually or mixed with one another. If desired, the individual components can be mixed with one another for example in the melt (melt blending) before incorporation into the polymer.

The incorporation of the additives of the invention and optional further components into the polymer is carried out by known methods such as dry mixing in the form of a powder, or wet mixing in the form of solutions or suspensions. The additives of the invention and optional further additives may be incorporated, for example, before or after molding or also by applying the dissolved or dispensed additive or additive mixture to the polymer material, with or without subsequent evaporation of the solvent. They may be added directly into the processing apparatus (e.g. extruders, internal mixers, etc.) e.g. as a dry mixture or powder or as solution or melt.

The incorporation can be carried out in any heatable container equipped with a stirrer, e.g. in a closed apparatus such as a kneader, mixer or stirred vessel. The incorporation is preferably carried out in an extruder or in a kneader. It is immaterial whether processing takes place in an inert atmosphere or in the presence of oxygen.

The additives of the invention and optional further additives can also be added to the polymer in the form of a masterbatch which contains the components in a concentration of, for example, about 2.5% to about 25% by weight; in such operations, the polymer can be used in the form of powder, granules, solutions, suspensions or in the form of lattices.

The examples which follow describe the invention further without constituting any restriction. Parts and percentages therein are by weight; an example which mentions room temperature means thereby a temperature in the range 20-25°C. In the case of solvent mixtures such as those for chromatography the parts indicated are by volume. These definitions apply unless specified otherwise.

The following abbreviations are used:

- m.p.: melting point or melting range
- NMR: nuclear magnetic resonance
- Tg: glass transition temperature
- h: hours

Preparation of Hydroxyphenyl Triazine UV Absorbers

Synthesis of 2,4-bis-biphenyl-6-[2-hydroxy-4-(2-ethyl-hexyloxy)phenyl]-1,3,5-triazine

A yellow suspension of 2,4-bis-biphenyl-6-[2,4-dihydroxyphenyl]-1,3,5-triazine (11.2 g, 0.0227 mole) in dimethylformamide (30 ml) is heated under nitrogen at 70°C until a clear brown solution is formed. Anhydrous potassium carbonate (3.77 g, 0.0227 mole) is added and the brown suspension heated at 80°C for 30 minutes. 2-Ethylhexylbromide (5.70 g, 0.0295 mole) is added dropwise over 30 minutes, after which the suspension is heated at 110°C for a further 3 hours. Precipitated salts are filtered off and the
filtrate cooled to 0° C. Methanol (20 ml) is added and the precipitated product removed by filtration. After drying under vacuum, 2,4-bis-biphenyl-6-[2,4-dihydroxyphenyl]-1,3,5-triazine is obtained with mp 70°.

h) When in the above preparation the educt 2,4-bis-biphenyl-6-[2,4-dihydroxyphenyl]-1,3,5-triazine is replaced by the equivalent amount of 2,4-bis(4-methoxyphenyl)-6-[2,4-dihydroxyphenyl]-1,3,5-triazine, compound (h) of the formula

\[
\text{R} \quad \text{CH} \quad \text{OH} \quad \text{N} \quad \text{N} \quad \text{O} \quad \text{N} \quad \text{O} \quad \text{CH} - \text{O} - \text{CH}
\]

is obtained with mp 105° C.

The compounds shown in the following table are obtained when the above reaction (a) is repeated using corresponding amounts of other alkylbromides or alkylene-dibromides.

<table>
<thead>
<tr>
<th>Example</th>
<th>X</th>
<th>R-1</th>
<th>Mp: ° C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>b)</td>
<td>(CH2)3–3–</td>
<td>(CH2)3–3–CH3</td>
<td>OIL</td>
</tr>
<tr>
<td>c)</td>
<td>n–C6H13</td>
<td>178</td>
<td></td>
</tr>
<tr>
<td>d)</td>
<td>n–C6H17</td>
<td>160</td>
<td></td>
</tr>
<tr>
<td>e)</td>
<td>n–C5H11</td>
<td>146</td>
<td></td>
</tr>
</tbody>
</table>

Corresponding compounds wherein \( X \) is \( C_{12} \)-alkylene; \( C_{12} \)-alkylene; \( C_{12} \)-alkylene interrupted by oxygen, especially \( C_{12} \)-alkylene interrupted by oxygen, or dichlorides or dibromides of aliphatic \( C_{12} \)-alcohols.

I) Preparation of the compound of the formula:

In a manner analogous to Example 16 of WO 96/28431, a white powder is obtained from the starting material: 4-[4,6-bis-biphenyl-4-yl-(1,3,5)triazin-2-yl]-benzene-1,3-diol and alkyld bromide.

\(^{1}H\) NMR (300 MHz, CDCl3): \( \delta = 13.3 \) (s, 1H), 8.7-6.2 (aromatic signals, 21H), 6.1 (m, 1H), 5.3 (m, 2H), 4.3 (m, 2H).
m) Preparation of the oligomer of the formula:

![Oligomer Structure](image)

30 g (0.056 mol) of the compound from Example (I) and 30.2 g (0.320 mol) of norbornylene and 42.3 g (0.320 mol) of dicyclopentadiene and 0.49 g (0.6 mmol) of the catalyst bis(tricyclopentylphosphine)dichloro(3-methyl-2-butenyldiene) ruthenium (APT Cat ASMC 716) are added to 300 ml of toluene. The mixture is left to react for 24 hours at 300. The solution is then concentrated under vacuum and a pale brown solid is obtained.

Visual melting range: 168-180° C.; \( M_n \): 2216; \( M_w \): 4663; PDI: 2.10;

Elemental analysis:

<table>
<thead>
<tr>
<th></th>
<th>% C</th>
<th>% H</th>
<th>% N</th>
</tr>
</thead>
<tbody>
<tr>
<td>theory</td>
<td>87.5</td>
<td>8.4</td>
<td>2.3</td>
</tr>
<tr>
<td>found</td>
<td>85.8</td>
<td>8.6</td>
<td>2.1</td>
</tr>
</tbody>
</table>

n) Preparation of the hydrogenated oligomer of the formula:

![Hydrogenated Oligomer Structure](image)
To a solution of 92 g (0.050 mol) of the oligomer of Example (m) in 300 ml of xylene, 1.0 g of platinum on carbon (10% w/w) is added. The mixture is poured into an autoclave and hydrogenated for 24 hours at 65 bar (pH2) and 105°C. The hydrogenated mixture is purified from the catalyst by adding 10 g of Tonsyl® 414 FF at 80-90°C and left under vigorous stirring for 2 hours. After filtering off over a pad of 10 g of Tonsil, the filtered yellow solution is concentrated under vacuum and a pale yellow solid is obtained.

Visual melting range: 55-68°C; Mw: 2197; Mw/Mn: 4347; PDI: 1.98;

e(290 nm, toluene): 34574;

Elemental analysis:

<table>
<thead>
<tr>
<th></th>
<th>% C</th>
<th>% H</th>
<th>% N</th>
</tr>
</thead>
<tbody>
<tr>
<td>theory</td>
<td>85.8</td>
<td>10.2</td>
<td>2.2</td>
</tr>
<tr>
<td>found</td>
<td>84.7</td>
<td>10.2</td>
<td>2.0</td>
</tr>
</tbody>
</table>

APPLICATION EXAMPLES

In some of the application examples, the following sterically hindered amines (HALS) are employed:

- H-2 bis(2,2,6,6-tetramethyl-4-piperidyl)sebacate
- H-3 condensate of 1-(2-hydroxyethyl)-2,2,6,6-tetramethyl-4-hydroxypiperidine and succinic acid (CAS-No. 65447-77-0)
- H-4 N,N',N',N'-Tetakis(4,6-bis(butyl-(N-methyl-2,2,6,6-tetramethylpiperidin-4-yl)amino)triazin-2-yl)-4,7-diazadecane-1,10-diamine (CAS-No. 106990-43-6)
Example 1: Combination hydroxyphenyl triazine compound (a) with compound (1g-2)

[0176] In order to evaluate the UV-absorber characteristics of hydroxyphenyl triazine compound (a), when mixed with a commercial thermoplastic material, thin low density polyethylene (LDPE) films are prepared, containing, as a typical formulation, 0.15% by weight of the above compound (a) and 0.70% of the sterically hindered amine ether (1g-2), used as light stabilizer of the polymeric system in highly demanding environments for agriculture applications. To do so, properly weighted amounts of the compounds are mixed with ground LDPE (Polimeri Europa, supplied by Enichem, Milano, Italy), characterized by a density of 0.921 g/cm³ and a melt flow index (190° C./2.16 kg) of 0.6 in a turbo mixer. The mixture is extruded at a maximum temperature of 200° C. in a OMC® twin-screw extruder. The granules so obtained are blown in a lab scale Formac® blow-extruder at a maximum temperature of 210° C. to give a film of 150 μm thickness.

[0177] UV-Vis spectrum of the film as-obtained is recorded in the range 200-800 nm by means of a Perkin-Elmer lambda® 20 spectrophotometer, equipped with a RSA-PE-20 Labsphere® integrating sphere. At 0.15% loading, compound (a) imparts to the film a strong UV absorption feature, with a transmittance value less than 10% between 290 and 360 nm and less than 1% between 300 and 340 nm. The photostability of compound (a) is demonstrated by exposing the film sample to UV light in an Atlas Ci 65 Xenon Arc Weather-O-meter® (WOM, 63° C. black panel temperature, continuous dry cycle, according to ASTM G 26-96). After 1500 hours of WOM exposure the minimum transmittance displayed by the film is still around 1% at 320 nm.

[0178] Compound (a) is fully compatible in LDPE film; no blooming is observed after storage of the film for 6000 hours at room temperature. Same behavior is observed keeping the film for the same amount of time in oven at 60° C. After the same time of exposure in oven, no significant change in the UV-Vis absorption spectrum is observed, meaning there is no loss of additive, because of the high temperature.

[0179] WOM exposure of the formulation reported in this example is continuing, in order to evaluate the light stability performance of the polymer containing compound (a). Samples are also being exposed to natural weathering and are subed to treatments with pesticides, in order to evaluate the resistance to chemicals that can be employed in agriculture.

Example 2: Hydroxyphenyl triazine compound (c) as a UV Filter in a Polyethylene Agrofilm

[0180] In order to prepare thin LDPE films and to evaluate the spectral features imparted by the additive and its persistence, compound (c) is mixed with LDPE pellets (Rilsene FF 29, supplied by Polimeri Europa, Milano, Italy), characterized by a density of 0.921 g/cm³ and a melt flow index (190° C./2.16Kg) of 0.6) in a turbo mixer in order to give a formulation containing 0.15% by weight of the additive. The mixture is extruded at a maximum temperature of 200° C. in a OMC twin-screw extruder. The granules so obtained are blown in a lab scale Formac blow-extruder at a maximum temperature of 210° C. to give a film 150 μm thick. UV-Vis spectra are recorded in the range 200-800 nm by means of a Perkin-Elmer Lambda 20 spectrophotometer, equipped with a RSA-PE-20 Labsphere integrating sphere.

[0181] Results: The film displays a strong absorption band in the range 280-360 nm. In particular, transmittance is below 20% in the above mentioned range and below 5% in the range 295-345 nm.

[0182] In order to test the photostability of the additive upon exposure to light, a portion of the film is exposed in an Atlas Weather-o-Meter (WOM), model Ci65A (as per ASTM G26-96, irradiance 0.35 W/m², black panel temperature 63±3° C). After 1000 hours of exposure the film still displays a transmittance below 40% between 280 and 360 nm and below 25% between 295 and 345 nm.

Example 3

[0183] A film containing 0.15% by weight of compound (d) is prepared as described in example 2. The film displays a strong absorption band in the range 280-360 nm. In particular, transmittance is below 20% in the above mentioned range and below 5% in the range 295-345 nm.

[0184] After 1000 hours of exposure in the WOM (see example 2 for details), the film still retains the spectral features described above.

[0185] Another portion of the film is also exposed in a forced circulating air oven at 60° C., in order to evaluate the thermal persistency of the additive in the film. After 1000 hours of exposure the film still retains the initial spectral features.

Example 4

[0186] A film containing 0.15% by weight of compound (b) is prepared as described in example 2. The film displays a strong absorption band in the range 280-360 nm. In particular, transmittance is below 20% in the above mentioned range and below 5% in the range 295-345 nm.

[0187] After 1000 hours of exposure in the WOM (see example 2 for details), the film still retains the spectral features described above.

Example 5

[0188] A film containing 0.15% by weight of compound (g) is prepared as described in example 2. The film displays a strong absorption band in the range 280-360 nm. In particular, transmittance is below 20% in the above mentioned range and below 5% in the range 295-345 nm.

[0189] After 1000 hours of exposure in the WOM (see example 2 for details), the film still displays a transmittance below 25% between 280 and 360 nm and below 10% between 295 and 345 nm.

[0190] Another portion of the film is also exposed in oven at 60° C. After 1000 hours of exposure the film retains about 75% of the initial absorption.

Example 6

[0191] A film containing 0.15% by weight of compound (I) is prepared as described in example 2.

[0192] The film displays a strong absorption band in the range 280-360 nm. In particular, transmittance is below 20% in the above mentioned range and below 5% in the range 295-345 nm.
After 1000 hours of exposure in the WOM (see example 2 for details), the film still displays a transmittance below 25% between 280 and 360 nm and below 15% between 295 and 345 nm.

Example 7: Light stabilization of polypropylene (PP) cast films

100 parts of polypropylene powder (melt flow index 3.8 g/10 minutes, 230º C./2160 g) are blended in a barrel mixer with 0.05 parts of pentacyrthrityl-tetrakis-(3, 5-di-tert.butyl-4- hydroxyphenyl)-propionate, 0.05 parts of tris-(2,4-di-tert.butylphenyl)-phosphate, 0.1 parts of Ca stearate, 0.1 part HALS and the amount of UV absorber (compound j) indicated in the figures below. Then the blend is compounded in an extruder at temperatures of 180-220º C. The granules obtained on extrusion and granulation are transformed into films at 220-260º C. in a second extruder equipped with a flat sheet die. Samples of 60x25 mm are cut out of these 0.11 mm films and exposed in a WEATHEROMETER Ci 65 (black panel temperature 63±20º C., without water-spraying).

Periodically, these samples are removed from the exposure apparatus and their carbonyl content is measured with an infrared spectrophotometer. The exposure time corresponding to formation of a carbonyl absorbance of 0.1 is a measure for the stabilizing efficiency of the light stabilizer. The values obtained are plotted in FIGS. 1, 2 and 3. The following HALS are used (0.1 part of each per 100 parts PP):

FIG. 1: Low molecular mass HALS H-2 (bis(2,2, 6,6-tetramethyl-4-piperidyl)sebacate);

FIG. 2: Polymeric HALS H-3 (CAS-No. 65447-77-0, white circles);

polymeric HALS H-4 (white squares); and

blend of 1 part H-3 with 1 part H-4 (filled circles);

FIG. 3: non-polymeric high molecular mass HALS H-5.

The plots show that already small amounts of the hydroxyphenyl triazine UV absorber give considerable improvement of the UV stability conferred by HALS.

Example 8: Light stabilization of polypropylene tapes

100 parts of polypropylene powder (melt flow index 3.5 g/10 minutes, 230º C./2160 g) are blended in a barrel mixer with 0.05 parts of pentacyrthrityl-tetrakis-(3, 5-di-tert.butyl-4-hydroxyphenyl)-propionate, 0.05 parts of tris-(2,4-di-tert.butylphenyl)-phosphate, 0.1 parts of Ca stearate, 0.1% polymeric HALS H-3 (condensate of 1-(2-hydroxyethyl)-2,2,6,6-tetramethyl-4-hydroxy-piperidine and succinic acid (CAS-No. 65447-77-0)) and the amount of light stabilizer compound (j) indicated in the figure. Then the blend is compounded in an extruder at temperatures of 180-220º C. The granules obtained on extrusion and granulation are transformed into films at 220-260º C. in a second extruder equipped with a flat sheet die. The films are cut into
ribbons, which are drawn to achieve a stretch ratio of 1:6. The tapes obtained with this procedure are finally 50 µm thick and 2.5 mm wide.

[0203] The tapes are mounted without tension on sample holders and subjected to natural weathering in Florida (45° South, direct, approximately 140 kl/day/year). Periodically, the tensile strength of the exposed tapes is measured. The received energy (in kl/y) corresponding to a loss of 50% of the initial tensile strength is a measure for the stabilizing efficiency of the light stabilizer. The values obtained with a polymeric HALS and the hydroxyphenyl triazine UV absorber are plotted in FIG. 4.

![Graph showing the effect of various UV absorbers on the performance of HALS in PP tapes.](image)

**Table:**

<table>
<thead>
<tr>
<th>HALS</th>
<th>UV Absorber</th>
<th>T50 (h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>none</td>
<td>none</td>
<td>530</td>
</tr>
<tr>
<td>0.1% H-3</td>
<td>0.1% V-1</td>
<td>2150</td>
</tr>
<tr>
<td>0.1% H-3</td>
<td>0.1% V-2</td>
<td>2700</td>
</tr>
<tr>
<td>0.1% H-3</td>
<td>0.1% compound j</td>
<td>3800</td>
</tr>
<tr>
<td>0.1% H-4</td>
<td>none</td>
<td>3000</td>
</tr>
<tr>
<td>0.1% H-4</td>
<td>0.1% V-2</td>
<td>2900</td>
</tr>
<tr>
<td>0.1% H-4</td>
<td>0.1% compound j</td>
<td>4150</td>
</tr>
</tbody>
</table>

[0204] The results show that the contribution of the UV absorber to light stability is also marked in PP tapes that are less than half as thick as the PP films used in Example 7.

**Example 9:** Light stabilization of polypropylene tapes

[0205] 100 parts of polypropylene powder (melt flow index 3.5 g/10 minutes, 230° C/2160 g) are blended in a barrel mixer with 0.05 parts of pentaylthrityl-tetraakis(3,5-dinitrobutyl)-4hydroxyphenyl)-propionate, 0.05 parts of tris(2,4,6-tri-tert. butyl-phenyl) phosphite, 0.1 parts of Ca stearate and the amount of light stabilizers indicated in the below table. Then the blend is compounded in an extruder at temperatures of 180-220° C. The granules obtained on extrusion and granulation are transformed into films at 220-260° C. in a second extruder equipped with a flat sheet die. The films are cut into ribbons, which are drawn to achieve a stretch ratio of 1:6. The tapes obtained with this procedure are finally 50 µm thick and 2.5 mm wide.

[0206] The tapes are mounted without tension on sample holders and exposed in a WEATHER-O-METER Ci 65 (black panel temperature 63±2° C., without water-spraying). Periodically, the tensile strength of the exposed tapes is measured. The exposure time corresponding to a loss of 50% of the initial tensile strength (T50) is a measure for the stabilizing efficiency of the light stabilizer.

[0207] The values obtained are summarized in the below table.

**Example 10:** Absorption band and persistency in LDPE of compound (m)

[0208] Thin low density polyethylene (LDPE) films are prepared as described in example 2 but without addition of HALS. They are 150µm thick and contain 0.5% of the compound (m). UV-Vis spectra are recorded as described in example 2. The film displays a strong absorption in the range 280-360 nm. Transmittance values below 3% are detected in the range 290-350 nm.

[0210] The data show that the contribution of the hydroxyphenyl triazine UV absorber (compound j) to the light stability of the tapes is significant while the contribution of the benzotriazole or the benzophenone UV absorber (V-1 and V-2) remains small or not detectable.

**Example 11:** Thin low density polyethylene (LDPE) films are prepared as described in example 2 but without addition of HALS. They are 150µm thick and contain 0.5% of the compound (m). UV-Vis spectra are recorded as described in example 2. The film displays a strong absorption in the range 280-360 nm. Transmittance values below 3% are detected in the range 290-350 nm.

[0212] The persistency of the polymer in LDPE films is determined after exposure of the films at 60° C. in a forced circulating air oven and evaluated as described in example 3. No decrease of the absorbance value at the maximum is observed after 3000 hours at 60° C.

What is claimed is:

1. Transparent polyolefin, polyester or polyamide article having a thickness between 1 and 500 µm, which is stabilized against the effects of light, oxygen, heat and/or aggressive chemicals by addition of 0.005-0.30% by weight, based on the polyolefin, polyester or polyamide, of a hydroxyphenyl triazine UV absorber.

2. Transparant polyolefin article of claim 1 having a thickness between 1 and 500 µm, which is stabilized against the effects of light, oxygen, heat and aggressive chemicals by addition of 0.005-0.30% by weight, based on the polyolefin, of a hydroxyphenyl triazine UV absorber.
3. Transparent polyolefin, polyester or polyamide article of claim 1 containing as further stabilizer a sterically hindered amine in an amount of 0.01-6% by weight the polyolefin, polyester or polyamide.

4. Transparent polyolefin, polyester or polyamide article of claim 3 wherein the weight ratio sterically hindered amine : hydroxyphenyl triazine UV absorber ranges from 2:1 to 20:1.

5. Transparent polyolefin, polyester or polyamide article of claim 3 wherein the sterically hindered amine belongs to the class of hydroxylamine ethers.

6. Transparent polyolefin, polyester or polyamide article of claim 1 wherein the hydroxyphenyl triazine UV absorber conforms to the formula I

\[
\text{wherein}
\]
\[R_1 \text{ is } H \text{ or OR}_1;\]
\[R_2 \text{ and } R_3 \text{ independently are } H, C_1-C_6 \text{alkyl},\]
\[\text{OR}_0;\]
\[R_4 \text{ and } R_5 \text{ independently are } H, C_1-C_6 \text{alkyl, OR}_0;\]
\[R_6 \text{ is } H; \text{ halogen; } C_1-C_6 \text{alkoxy; } C_1-C_6 \text{alkyl; } C_2-C_5 \text{alkyl interrupted by oxygen and/or substituted by OH; or is } \text{NH—CO—R}_1 \text{ or NH—COO—R}_2;\]
\[R_7, R_8, \text{ and } R_9 \text{ independently are } H; C_1-C_6 \text{alkyl; } C_2-C_6 \text{alkenyl; } C_2-C_6 \text{alkyl interrupted by oxygen and/or substituted by OH; or is } C_5-C_7 \text{cycloalkyl; } C_7-C_12 \text{phenylalkyl; } C_7-C_12 \text{alkenylphenyl; } CH_2\text{CH(OH)CH}_{2}\text{OR}_3; \text{ C}_7-C_12 \text{alkyl substituted by COOR}_{12}, \text{CONR}_{12}, \text{R}_{14}, \text{OCOR}_{15}, \text{OH or halogen; or R}_{5} \text{ is a polymeric hydrocarbon residue of 10 to 1000 carbon atoms; and } R_7 \text{ also embraces a residue of formula II}
\]

\[
\text{wherein } X \text{ is } C_2-C_3 \text{alkylene;} \quad \text{—CH}_2\text{CH(OH)CH}_2—; \quad \text{—CH}_2\text{CH(OH)CH}_2\text{O—D—OCH}_2\text{CH(OH)CH}_2—;
\]
\[(C_1-C_{18} \text{alkylene})—O—O—D—O—CO—(C_1—C_6 \text{alkylene); CO—CO(1-C_2-C_4 \text{alkylene)—CO; ))};
\]
\[C_2-C_6 \text{alkylene interrupted by oxygen; D is } C_2-C_{12} \text{alkylene; } C_4-C_6 \text{alkylene interrupted by O; phenylene; biphenylene or phenylene-E-phenylene; E is O, S, SO_2, CH_2; CO or } —(\text{CH}_2)_n—;\]
\[R_1, R_2, R_3 \text{ is } H; C_1-C_6 \text{alkyl; phenyl; phenyl substituted by } 1-3\ C_1-C_6 \text{alkyl; } C_2-C_6 \text{cycloalkyl; } C_7-C_12 \text{phenylalkyl; } C_1-C_6 \text{alkenyl; } R_1, R_2, R_3 \text{ is } H; C_2-C_6 \text{alkyl; } C_2-C_6 \text{alkenyl; } C_2-C_6 \text{alkyl interrupted by oxygen and/or substituted by OH; or is } C_2-C_6 \text{cycloalkyl; } C_7-C_12 \text{phenylalkyl; } C_7-C_12 \text{alkylphenyl; phenyl; } R_1, R_2, R_3 \text{ independently are } H; C_1-C_6 \text{alkyl; phenyl; phenyl substituted by } 1-3\ C_1-C_6 \text{alkyl and/or } C_7-C_12 \text{cycloalkyl; } C_7-C_12 \text{alkenyl; } R_1, R_2, R_3 \text{ is } C_1-C_6 \text{alkyl; phenyl; phenyl substituted by } 1-3\ C_2-C_6 \text{alkyl and/or } C_7-C_12 \text{alkenyl; } C_2-C_6 \text{alkenyl; } C_2-C_6 \text{alkenyl; } C_2-C_6 \text{alkoxy; or is NR}_{12}R_{14};\]

7. Transparent polyolefin, polyester or polyamide article of claim 6, wherein in the hydroxyphenyl triazine UV absorber of formula I

\[
\text{R}_2 \text{ and } R_3 \text{ independently are } H, \text{ methyl,}
\]
\[\text{OR}_0;\]
\[R_4 \text{ and } R_5 \text{ independently are } H \text{ or methyl, especially } H; \]
\[R_6 \text{ is } H; \]
\[R_7 \text{ is } H; C_1-C_6 \text{alkoxy; } C_1-C_6 \text{alkyl; } C_2-C_6 \text{alkenyl; } C_2-C_6 \text{alkenyl; } C_2-C_6 \text{alkenyl interrupted by oxygen and/or substituted}
\]
by OH; or is C₆-C₁₂-cycloalkyl, C₇-C₁₂-phenylalkyl, C₇-C₁₂-alkylalkyl, C₁-C₇-alkyl substituted by COOR₁₂, OCOR₁₂, OH; or Rₙ is a polymeric hydrocarbon residue of 20 to 500 carbon atoms; and Rₙ also embraces a residue of formula II, wherein X is C₂-C₁₀-alkylene; —CH₂CH(OH)CH₂—;
CH₂CH(OH)CH₂O—D—OCH₂CH(OH)CH₂;
(C₇-C₈-alkylene)—CO—O—D—O—CO—(C₇—C₈-alkylene); CO; CO—(C₂-C₆-alkylene)—CO;
C₃-C₁₈-alkylene interrupted by oxygen; D is C₂-C₁₂-alkylene;
R₁₂ is H; C₁-C₂-alkyl; C₄-C₁₂-alkenyl; C₁-C₂-alkyl interrupted by oxygen and/or substituted by OH; or is C₇-C₁₂-cycloalkyl, C₇-C₁₂-phenylalkyl, C₇-C₁₂-alkylphenyl; phenyl;
R₁₅ is C₁-C₁₂-alkyl; C₄-C₁₂-cycloalkyl; C₃-C₁₂-alkenyl.
8. Transparent polyolefin, polyester or polyamide article of claim 1 which is a film, fiber, ribbon or stretched tape, especially a polyolefin agricultural film.
9. Transparent polyolefin, polyester or polyamide article of claim 8 having a thickness between 1 and 300 μm, especially between 1 and 200 μm.

10. Transparent polyolefin article of claim 1, wherein the polyolefin is polyethylene or polypropylene.
11. Transparent polyolefin, polyester or polyamide article of any of claims 1 to 10 additionally containing a further component selected from the group consisting of processing stabilizers, fillers, clarifiers, modifiers, acid scavengers, flame retardants and, especially, further light stabilizers.
12. Use of the transparent polyolefin film of claim 8 for suppressing microbial growth in a protected cultivation.
13. Process for suppressing microbial growth in a protected environment, which process comprises covering the environment with the transparent polyolefin film of claim 8.
14. Process of claim 13, wherein the protected environment is a plant cultivation.
15. A method for selectively screening solar and/or artificial light radiation to crops contained inside a green house which comprises covering said green house with the polyolefin film of claim 8.
16. A compound of one of the formulae a, b, f, g, h or k
wherein X is \(C_{15}-C_{24}\)alkylene; \((C_{1}+C_{24}\)alkylene\)\(\text{---CO---O\text{---D---O\text{---CO---(C}_{1}+C_{24}\)alkylene}\) \(\text{where D is} \ C_{2}\text{---C}_{12}\)alkylene; \(\text{CO---(C}_{15}\text{---C}_{24}\)alkylene\)\(\text{---CO;}

\[C_{15}\text{---C}_{24}\)alkylene interrupted by oxygen, especially \((C_{1}+C_{3}\)alkylene\)\(\text{---O---(C}_{1}+C_{3}\)alkylene).\]