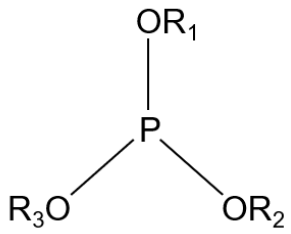
CLAIMS

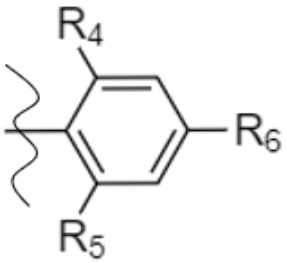
1. A hydrolytically stabilised phosphite composition, comprising:

    a. a phosphite antioxidant which is a liquid at ambient conditions and comprises a blend of at least two different phosphites of Formula I:



(I)

wherein R_1, R_2 and R_3 are independently selected alkylated aryl groups of Formula II:



(II)

wherein R_4, R_5 and R_6 are independently selected from the group consisting of hydrogen and C_1 to C_6 alkyl, provided that at least one of R_4, R_5 and R_6 in each phosphite is selected from the group consisting of tert-butyl and/or tert-pentyl; and

    b. a nitrogen-containing compound comprising a nitrogen atom, wherein the nitrogen atom:

        i. has a pKaH value of from about 7 to about 11; and

        ii. is sp^3 hybridised,

    and wherein the nitrogen-containing compound is absent any labile protons.

2. The hydrolytically stabilised phosphite composition according to Claim 1, wherein the hydrolytic stability of the phosphite antioxidant relative to the hydrolytic stability of the same phosphite antioxidant stabilised with an equivalent amount of triisopropanolamine (TIPA) is at least about 0.4 relative to an equivalently TIPA-stabilised phosphite antioxidant.

3. The hydrolytically stabilised phosphite composition according to Claim 1 or Claim 2, wherein the hydrolytic stability of the phosphite antioxidant relative to the hydrolytic stability of the same phosphite antioxidant stabilised with an equivalent amount of triisopropanolamine (TIPA) is at least about 0.5, at least about 0.6, at least about 0.7, or at least about 0.8 relative to an equivalently TIPA-stabilised phosphite antioxidant.

4. The hydrolytically stabilised phosphite composition according to any one of claims 1 to 3, wherein the amount of PTAP in the composition with 0.6 mole % of the nitrogen-containing compound after 48 days under nitrogen at ambient temperature is no more than about 3 times higher than the initial amount of PTAP, no more than about 2.5 times higher than the initial amount of PTAP, no more than about 2 times higher than the initial amount of PTAP, or no more than about 1.5 times higher than the initial amount of PTAP measured as the integral of the signal from the 2,6 hydrogens of PTAP in the ^{1}H NMR spectrum (doublet at 6.73 ppm) relative to the integral of signals from aromatic hydrogens resonating between 6.76 ppm and 7.7 ppm, with the sum of these 2 integrals set to 100 units and the chemical shift axis being calibrated to the internal

standard TMS at 0.0 ppm, with the sample analysed at 298 K as 100 µL dissolved in 700 µL deuterochloroform and the resonance frequency of ^{1}H being 400 MHz.

5. The hydrolytically stabilised phosphite composition according to any one of claims 1 to 4, wherein the nitrogen-containing compound comprises one or more electron-withdrawing groups.

6. The hydrolytically stabilised phosphite composition according to Claim 5, wherein the one or more electron-withdrawing groups are located 2, 3 or 4 covalent bonds away from the nitrogen atom.

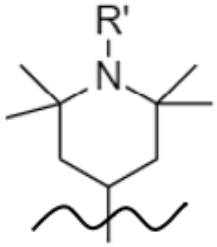
7. The hydrolytically stabilised phosphite composition according to Claim 5 or Claim 6, wherein the one or more electron-withdrawing groups are selected from halogens; oxygen-containing groups; and/or nitrogen-containing groups.

8. The hydrolytically stabilised phosphite composition according to any one of claims 5 to 7, wherein the one or more electron-withdrawing groups are selected from ketone, ester and/or ether groups.

9. The hydrolytically stabilised phosphite composition according to any one of claims 1 to 8, wherein the nitrogen atom of the nitrogen-containing compound has a pKaH value of from about 9 to about 11.

10. The hydrolytically stabilised phosphite composition according to any one of claims 1 to 9, wherein the nitrogen-containing compound comprises one or more 2,2,6,6-tetramethyl-piperidine derivatives.

11. The hydrolytically stabilised phosphite composition according to Claim 10, wherein the 2,2,6,6-tetramethyl-piperidine derivative comprises one or more groups having the following structure:



wherein R’ is hydrogen, CH_3, or CH_2R'' with R’’ comprising $-CH_2O(CO)CH_2CH_2CO_2-$ as a polymeric linker.

12. The hydrolytically stabilised phosphite composition according to any one of claims 1 to 11, wherein the nitrogen-containing compound is selected from one or more of bis(1,2,2,6,6-pentamethyl-4-piperidyl) sebacate; bis(2,2,6,6-tetramethyl-4-piperidyl) sebacate; mixtures of bis(1,2,2,6,6-pentamethyl-4-piperidyl) sebacate and methyl(1,2,2,6,6-pentamethyl-4-piperidinyl) sebacate; poly[[6-[(1,1,3,3-tetramethylbutyl)amino]-1,3,5-triazine-2,4-diyl][(2,2,6,6-tetramethyl-4-piperidyl)imino]hexamethylene[(2,2,6,6-tetramethyl-4-piperidyl)imino]]; 1,3,5-triazine-2,4,6-triamine, N2,N2’-1,2-ethanediylbis[N2-[3-[[4,6-bis[butyl(1,2,2,6,6-pentamethyl-4-piperidinyl)amino]-1,3,5-triazin-2-yl]amino]propyl]-N4,N6-dibutyl-N4,N6-bis(1,2,2,6,6-pentamethyl-4-piperidinyl)-; butanedioic acid, dimethyl ester,

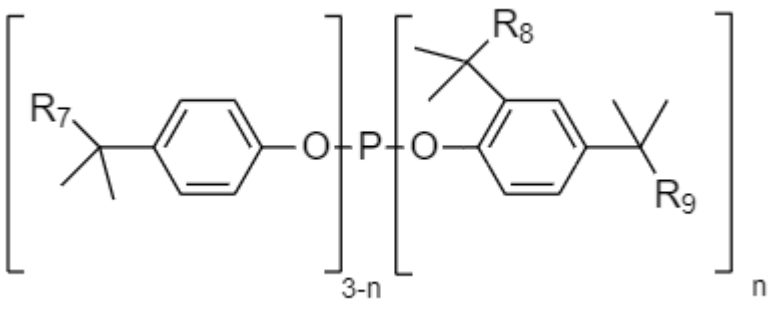
polymer with 4-hydroxy-2,2,6,6-tetramethyl-1-piperidine-ethanol; 1,6-hexanediamine, N,N'-bis(2,2,6,6-tetramethyl-4-piperidinyl)-, polymer with 2,4,6-trichloro-1,3,5-triazine, reaction products with N-butyl-1-butanamine and N-butyl-2,2,6,6-tetramethyl-4-piperidinamine; poly[(6-morpholino-1,3,5-triazine-2,4-diyl)((2,2,6,6-tetramethyl-4-piperidyl)imino)-hexamethylene((2,2,6,6-tetramethyl-4-piperidyl)imino)]; poly[[6-(4-morpholinyl)-1,3,5-triazine-2,4-diyl][(1,2,2,6,6-pentamethyl-4-piperidinyl)imino]-1,6-hexanediyl[(1,2,2,6,6-pentamethyl-4-piperidinyl)imino]]; 3-dodecyl-1-(2,2,6,6-tetramethyl-4-piperidyl)pyrrolidine-2,5-dione; 3-dodecyl-1-(1,2,2,6,6-pentamethyl-4-piperidinyl)pyrrolidine-2,5-dione; 2,2,6,6-tetramethyl-4-piperidinyl octadecanoate; N,N'-bis(2,2,6,6-tetramethyl-4-piperidinyl)-1,3-benzenedicarboxamide; 2,2,4,4-tetramethyl-7-oxa-3,20-diazadispiro[5.1.11.2]heneicosan-21-one; tetrakis(1,2,2,6,6-pentamethyl-4-piperidinyl) butane-1,2,3,4-tetracarboxylate; tetrakis(2,2,6,6-tetramethyl-4-piperidinyl) butane-1,2,3,4-tetracarboxylate; 1,2,3,4-butanetetracarboxylic acid, 1,2,2,6,6-pentamethyl-4-piperidinyl tridecyl ester; 1,2,3,4-butanetetracarboxylic acid, 2,2,6,6-tetramethyl-4-piperidinyl tridecyl ester; alpha-alkenes (C20 – C24) maleic anhydride-4-amino-2,2,6,6-tetramethylpiperidine, polymer; 1,3-propanediamine, N1,N1'-1,2-ethanediylbis-, polymer with 2,4,6-trichloro-1,3,5-triazine, reaction products with N-butyl-2,2,6,6-tetramethyl-4-piperidinamine; N,N'-bis(2,2,6,6-tetramethyl-4-piperidinyl)-1,6-hexanediamine polymers with morpholine-2,4,6-trichloro-1,3,5-triazine reaction products, methylated; N,N'-bis(2,2,6,6-tetramethyl-4-piperidyl)-N,N'-diformylhexamethylenediamine; 2,2,6,6-tetramethyl-4-piperidinyl stearate; 1,4-diazabicyclo[2.2.2]octane; diisopropyl ethylamine; triacetonamine; n-methyl-morpholine; 3,3,5,5-tetramethylmorpholine; 4-tert-butylmorpholine;

hexamethylenetetramine; 4-(1-methyl-1-phenylethyl)N-[4-(1-methyl-1-phenylethyl)phenyl] aniline; and/or mixtures thereof.

13. The hydrolytically stabilised phosphite composition according to any one of claims 1 to 12, wherein the nitrogen-containing compound is present in an amount of from about 0.01 wt. % to about 10 wt. %, from about 0.1 wt. % to about 5 wt. %, or from about 0.3 wt. % to about 3 wt. % by weight of the hydrolytically stabilised phosphite composition.

14. The hydrolytically stabilised phosphite composition according to any one of claims 1 to 13, wherein the phosphite antioxidant comprises a blend of at least four different phosphites of Formula I.

15. The hydrolytically stabilised phosphite composition according to any one of claims 1 to 14, wherein the phosphites in the blend each independently have the structure of Formula III:



(III)

wherein R_7, R_8 and R_9 are independently selected from methyl and ethyl groups, and wherein n is 0, 1, 2 or 3.

16. The hydrolytically stabilised phosphite composition according to any one of claims 1 to 15, wherein the phosphites in the blend are independently selected from tris(4-tert-butylphenyl) phosphite; tris(2,4-di-tert-butylphenyl) phosphite; bis(4-tert-butylphenyl)-2,4-di-tert-butylphenyl phosphite; bis(2,4-di-tert-butylphenyl)-4-tert-butylphenyl phosphite; tris(4-tert-pentylphenyl) phosphite; tris(2,4-di-tert-pentylphenyl) phosphite; bis(4-tert-pentylphenyl)-2,4-di-tert-pentylphenyl phosphite; and/or bis(2,4-di-tert-pentylphenyl)-4-tert-pentylphenyl phosphite.

17. The hydrolytically stabilised phosphite composition according to any one of claims 1 to 16, wherein the phosphites in the blend are independently selected from tris(4-tert-pentylphenyl) phosphite; tris(2,4-di-tert-pentylphenyl) phosphite; bis(4-tert-pentylphenyl)-2,4-di-tert-pentylphenyl phosphite; and/or bis(2,4-di-tert-pentylphenyl)-4-tert-pentylphenyl phosphite.

18. The hydrolytically stabilised phosphite composition according to any one of claims 1 to 17 which is a liquid at ambient conditions.

19. Use of the hydrolytically stabilised phosphite composition according to any one of claims 1 to 18 to stabilise a polymer.

20. A stabilised polymer composition, comprising:

    a polymer; and

    the hydrolytically stabilised phosphite composition according to any one of claims 1 to 18.

21. The stabilised polymer composition according to Claim 20, wherein the hydrolytically stabilised phosphite composition is present in an amount of from 0.01% to 10% by weight of the stabilised polymer composition.

22. The stabilised polymer composition according to Claim 20 or Claim 21, wherein the nitrogen-containing compound is present in an amount of from 0.0001% to 0.05% by weight of the stabilised polymer composition.

23. A useful article made from the stabilised polymer composition according to any one of claims 20 to 22.