Claims

1. A flame retardant mixture comprising flame retardant and aluminum phosphites, wherein the aluminum phosphites comprise those of the formulae (I), (II) and/or (III):

$$Al_2(HPO_3)_3 \times (H_2O)_q \qquad (I)$$

in which

q is 0 to 4,

$$Al_{2.00}M_z(HPO_3)_y(OH)_v \times (H_2O)_w \qquad (II)$$

in which

M represents alkali metal ions

z is 0.01 to 1.5

y is 2.63 to 3.5

v is 0 to 2 and

w is 0 to 4,

$$Al_{2.00}(HPO_3)_u(H_2PO_3)_t \times (H_2O)_s \qquad (III)$$

in which

u is 2 to 2.99,

t is 2 to 0.01 and

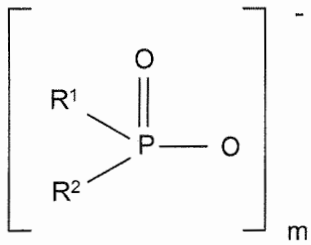
s is 0 to 4,

and/or mixtures of aluminum phosphite of the formula (I) with sparingly soluble aluminum salts and nitrogen-free extraneous ions, mixtures of aluminum phosphite of the formula (III) with aluminum salts, aluminum phosphite [$Al(H_2PO_3)_3$], secondary aluminum phosphite [$Al_2(HPO_3)_3$], basic aluminum phosphite [$Al(OH)(H_2PO_3)_2$*2aq], aluminum phosphite tetrahydrate [$Al_2(HPO_3)_3$*4aq], aluminum phosphonate,

$Al_7(HPO_3)_9(OH)_6$(1,6-hexanediamine)$_{1.5}$*$12H_2O$, $Al_2(HPO_3)^3$*xAl_2O_3*nH_2O where x = 2.27 - 1 and/or $Al_4H_6P_{16}O_{18}$.

2. The flame retardant mixture as claimed in claim 1, wherein the flame retardant comprises dialkylphosphinic acids and/or salts thereof; condensation products of melamine and/or reaction products of melamine with phosphoric acid and/or reaction products of condensation products of melamine with polyphosphoric acid or mixtures thereof; nitrogen-containing phosphates of the formulae $(NH_4)_y H_{3-y} PO_4$ and $(NH_4 PO_3)_z$, where y is 1 to 3 and z is 1 to 10 000; benzoguanamine, tris(hydroxyethyl) isocyanurate, allantoin, glycoluril, melamine, melamine cyanurate, dicyandiamide and/or guanidine; magnesium oxide, calcium oxide, aluminum oxide, zinc oxide, manganese oxide, tin oxide, aluminum hydroxide, boehmite, dihydrotalcite, hydrocalumite, magnesium hydroxide, calcium hydroxide, zinc hydroxide, tin oxide hydrate, manganese hydroxide, zinc borate, basic zinc silicate and/or zinc stannate.

3. The flame retardant mixture as claimed in claim 1 or 2, wherein the dialkylphosphinic acids or salts thereof correspond to the formula (IV)



(IV)

in which

R^1, R^2 are the same or different and are each linear or branched C_1-C_6-alkyl;

M is Mg, Ca, Al, Sb, Sn, Ge, Ti, Fe, Zr, Zn, Ce, Bi, Sr, Mn, Li, Na, K, H and/or a protonated nitrogen base;

m is 1 to 4.

4. The flame retardant mixture as claimed in one or more of claims 1 to 3, wherein the flame retardant comprises melam, melem, melon, dimelamine pyrophosphate, melamine polyphosphate, melam polyphosphate, melon

polyphosphate and/or melem polyphosphate and/or mixed poly salts thereof and/or ammonium hydrogenphosphate, ammonium dihydrogenphosphate and/or ammonium polyphosphate.

5. The flame retardant mixture as claimed in one or more of claims 1 to 3, wherein the flame retardant comprises aluminum hypophosphite, zinc hypophosphite, calcium hypophosphite, sodium phosphite, monophenylphosphinic acid and salts thereof, mixtures of dialkylphosphinic acids and salts thereof and monoalkylphosphinic acids and salts thereof, 2-carboxyethylalkylphosphinic acid and salts thereof, 2-carboxyethylmethylphosphinic acid and salts thereof, 2-carboxyethylarylphosphinic acid and salts thereof, 2-carboxyethylphenylphosphinic acid and salts thereof, oxa-10-phosphaphenanthrene (DOPO) and salts thereof and adducts onto para-benzoquinone, or itaconic acid and/or salts thereof.

6. The flame retardant mixture as claimed in one or more of claims 1 to 5, wherein q in the aluminum phosphite of the formula (I) is 0.01 to 0.1.

7. The flame retardant mixture as claimed in one or more of claims 1 to 5, wherein z in the aluminum phosphite of the formula (II) is 0.15 to 0.4, y is 2.80 to 3, v is 0.1 to 0.4 and w is 0.01 to 0.1.

8. The flame retardant mixture as claimed in one or more of claims 1 to 5, wherein u in the aluminum phosphite of the formula (III) is 2.834 to 2.99, t is 0.332 to 0.03 and s is 0.01 to 0.1.

9. The flame retardant mixture as claimed in one or more of claims 1 to 8, comprising 0.1 to 99.9% by weight of flame retardant and 0.1 to 99.9% by weight of aluminum phosphites of the formulae (I), (II) and/or (III) and/or mixtures of aluminum phosphite of the formula (I) with sparingly soluble aluminum salts and nitrogen-free extraneous ions and/or mixtures of aluminum phosphite of the formula (III) with aluminum salts.

10. The flame retardant mixture as claimed in one or more of claims 1 to 9, comprising 50 to 99.9% by weight of flame retardant and 0.1 to 50% by weight of aluminum phosphites of the formulae (I), (II) and/or (III) and/or mixtures of aluminum phosphite of the formula (I) with sparingly soluble aluminum salts and nitrogen-free extraneous ions and/or mixtures of aluminum phosphite of the formula (III) with aluminum salts.

11. A process for preparing flame retardant mixtures as claimed in one or more of claims 1 to 10, which comprises mixing pulverulent flame retardants with pulverulent aluminum phosphites of the formulae (I), (II) and/or (III) and/or mixtures of aluminum phosphite of the formula (I) with sparingly soluble aluminum salts and nitrogen-free extraneous ions and/or mixtures of aluminum phosphite of the formula (III) with aluminum salts.

12. The use of flame retardant mixtures as claimed in one or more of claims 1 to 10 as an intermediate for further syntheses, as a binder, as a crosslinker or accelerator in the curing of epoxy resins, polyurethanes, unsaturated polyester resins, as polymer stabilizers, as crop protection compositions, as sequestrants, as a mineral oil additive, as an anticorrosive, in washing and cleaning composition applications, in electronics applications.

13. The use of flame retardant mixtures as claimed in one or more of claims 1 to 10 in or as a flame retardant, especially in or as a flame retardant for clearcoats and intumescent coatings, in or as a flame retardant for wood and other cellulosic products, in or as a reactive and/or nonreactive flame retardants for polymers, for production of flame-retardant polymer molding compositions, for production of flame-retardant polymer moldings and/or for rendering polyester and pure and blended cellulose fabrics flame-retardant by impregnation, and/or as a synergist and/or as a synergist in further flame retardant mixtures.

14. A flame-retardant thermoplastic or thermoset polymer molding composition or polymer molding, film, filament or fiber comprising 0.1 to 45% by weight of flame retardant mixtures as claimed in one or more of claims 1 to 10, 55 to 99.9% by weight of thermoplastic or thermoset polymer or mixtures thereof, 0 to 55% by weight

of additives and 0 to 55% by weight of filler or reinforcing materials, where the sum of the components is 100% by weight.

15. A flame-retardant thermoplastic or thermoset polymer molding composition or polymer molding, film, filament or fiber comprising 1 to 30% by weight of flame retardant mixtures as claimed in one or more of claims 1 to 10, 10 to 97% by weight of thermoplastic or thermoset polymer or mixtures thereof, 1 to 30% by weight of additives and 1 to 30% by weight of filler or reinforcing materials, where the sum of the components is 100% by weight.

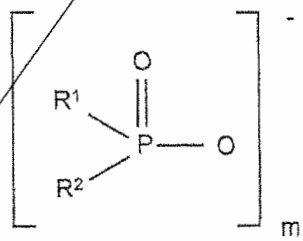
16. A flame-retardant thermoplastic or thermoset polymer molding composition or polymer molding, film, filament or fiber comprising flame retardant mixtures as claimed in one or more of claims 1 to 10, wherein the polymer comprises thermoplastic polymers of the HI (high-impact) polystyrene, polyphenylene ether, polyamide, polyester or polycarbonate type, and blends or polymer blends of the ABS (acrylonitrile-butadiene-styrene) or PC/ABS (polycarbonate/acrylonitrile-butadiene-styrene) or PPE/HIPS (polyphenylene ether/HI polystyrene) polymer type, and/or thermoset polymers of the unsaturated polyester or epoxy resin type.

Claims

1. A flame retardant mixture comprising flame retardant and aluminum phosphites.

2. The flame retardant mixture as claimed in claim 1, wherein the flame retardant comprises dialkylphosphinic acids and/or salts thereof; condensation products of melamine and/or reaction products of melamine with phosphoric acid and/or reaction products of condensation products of melamine with polyphosphoric acid or mixtures thereof; nitrogen-containing phosphates of the formulae $(NH_4)_y H_{3-y} PO_4$ and $(NH_4 PO_3)_z$, where y is 1 to 3 and z is 1 to 10 000; benzoguanamine, tris(hydroxyethyl) isocyanurate, allantoin, glycoluril, melamine, melamine cyanurate, dicyandiamide and/or guanidine; magnesium oxide, calcium oxide, aluminum oxide, zinc oxide, manganese oxide, tin oxide, aluminum hydroxide, boehmite, dihydrotalcite, hydrocalumite, magnesium hydroxide, calcium hydroxide, zinc hydroxide, tin oxide hydrate, manganese hydroxide, zinc borate, basic zinc silicate and/or zinc stannate.

3. The flame retardant mixture as claimed in claim 1 or 2, wherein the dialkylphosphinic acids or salts thereof correspond to the formula (IV)



M^{m+} (IV)

in which

R^1, R^2 are the same or different and are each linear or branched C_1-C_6-alkyl;

M is Mg, Ca, Al, Sb, Sn, Ge, Ti, Fe, Zr, Zn, Ce, Bi, Sr, Mn, Li, Na, K, H and/or a protonated nitrogen base;

m is 1 to 4.

4. The flame retardant mixture as claimed in one or more of claims 1 to 3, wherein the flame retardant comprises melam, melem, melon, dimelamine pyrophosphate, melamine polyphosphate, melam polyphosphate, melon polyphosphate and/or melem polyphosphate and/or mixed poly salts thereof and/or ammonium hydrogenphosphate, ammonium dihydrogenphosphate and/or ammonium polyphosphate.

5. The flame retardant mixture as claimed in one or more of claims 1 to 3, wherein the flame retardant comprises aluminum hypophosphite, zinc hypophosphite, calcium hypophosphite, sodium phosphite, monophenylphosphinic acid and salts thereof, mixtures of dialkylphosphinic acids and salts thereof and monoalkylphosphinic acids and salts thereof, 2-carboxyethylalkylphosphinic acid and salts thereof, 2-carboxyethylmethylphosphinic acid and salts thereof, 2-carboxyethylarylphosphinic acid and salts thereof, 2-carboxyethylphenylphosphinic acid and salts thereof, oxa-10-phosphaphenanthrene (DOPO) and salts thereof and adducts onto para-benzoquinone or itaconic acid and/or salts thereof.

6. The flame retardant mixture as claimed in one or more of claims 1 to 5, wherein the aluminum phosphites comprise those of the formulae (I), (II) and/or (III)

$$Al_2(HPO_3)_3 \times (H_2O)_q \qquad (I)$$

in which

q is 0 to 4,

$$Al_{2.00}M_z(HPO_3)_y(OH)_v \times (H_2O)_w \qquad (II)$$

in which

M represents alkali metal ions

z is 0.01 to 1.5

y is 2.63 to 3.5
v is 0 to 2 and
w is 0 to 4,

$$Al_{2.00}(HPO_3)_u(H_2PO_3)_t \times (H_2O)_s \qquad (III)$$

in which
u is 2 to 2.99,
t is 2 to 0.01 and
s is 0 to 4,

and/or mixtures of aluminum phosphite of the formula (I) with sparingly soluble aluminum salts and nitrogen-free extraneous ions, mixtures of aluminum phosphite of the formula (III) with aluminum salts, aluminum phosphite [$Al(H2PO_3)_3$], secondary aluminum phosphite [$Al_2(HPO_3)_3$], basic aluminum phosphite [$Al(OH)(H_2PO_3)_2$*2aq], aluminum phosphite tetrahydrate [$Al_2(HPO_3)_3$*4aq], aluminum phosphonate, $Al_7(HPO_3)_9(OH)_6$(1,6-hexanediamine)$_{1.5}$*$12H_2O$, $Al_2(HPO_3)^3$*xAl_2O_3*nH_2O where x = 2.27 - 1 and/or $Al_4H_6P_{16}O_{18}$.

7. The flame retardant mixture as claimed in one or more of claims 1 to 6, wherein q in the aluminum phosphite of the formula (I) is 0.01 to 0.1.

8. The flame retardant mixture as claimed in one or more of claims 1 to 6, wherein z in the aluminum phosphite of the formula (II) is 0.15 to 0.4, y is 2.80 to 3, v is 0.1 to 0.4 and w is 0.01 to 0.1.

9. The flame retardant mixture as claimed in one or more of claims 1 to 6, wherein u in the aluminum phosphite of the formula (III) is 2.834 to 2.99, t is 0.332 to 0.03 and s is 0.01 to 0.1.

10. The flame retardant mixture as claimed in one or more of claims 1 to 9, comprising 0.1 to 99.9% by weight of flame retardant and 0.1 to 99.9% by weight of aluminum phosphites of the formulae (I), (II) and/or (III) and/or mixtures of aluminum phosphite of the formula (I) with sparingly soluble aluminum salts and nitrogen-free extraneous ions and/or mixtures of aluminum phosphite of the formula (III) with aluminum salts.

11. The flame retardant mixture as claimed in one or more of claims 1 to 10, comprising 50 to 99.9% by weight of flame retardant and 0.1 to 50% by weight of aluminum phosphites of the formulae (I), (II) and/or (III) and/or mixtures of aluminum phosphite of the formula (I) with sparingly soluble aluminum salts and nitrogen-free extraneous ions and/or mixtures of aluminum phosphite of the formula (III) with aluminum salts.

12. A process for preparing flame retardant mixtures as claimed in one or more of claims 1 to 11, which comprises mixing pulverulent flame retardants with pulverulent aluminum phosphites of the formulae (I), (II) and/or (III) and/or mixtures of aluminum phosphite of the formula (I) with sparingly soluble aluminum salts and nitrogen-free extraneous ions and/or mixtures of aluminum phosphite of the formula (III) with aluminum salts.

13. The use of flame retardant mixtures as claimed in one or more of claims 1 to 11 as an intermediate for further syntheses, as a binder, as a crosslinker or accelerator in the curing of epoxy resins, polyurethanes, unsaturated polyester resins, as polymer stabilizers, as crop protection compositions, as sequestrants, as a mineral oil additive, as an anticorrosive, in washing and cleaning composition applications, in electronics applications.

14. The use of flame retardant mixtures as claimed in one or more of claims 1 to 11 in or as a flame retardant, especially in or as a flame retardant for clearcoats and intumescent coatings, in or as a flame retardant for wood and other cellulosic products, in or as a reactive and/or nonreactive flame retardants for polymers, for

production of flame-retardant polymer molding compositions, for production of flame-retardant polymer moldings and/or for rendering polyester and pure and blended cellulose fabrics flame-retardant by impregnation, and/or as a synergist and/or as a synergist in further flame retardant mixtures.

15. A flame-retardant thermoplastic or thermoset polymer molding composition or polymer molding, film, filament or fiber comprising 0.1 to 45% by weight of flame retardant mixtures as claimed in one or more of claims 1 to 11, 55 to 99.9% by weight of thermoplastic or thermoset polymer or mixtures thereof, 0 to 55% by weight of additives and 0 to 55% by weight of filler or reinforcing materials, where the sum of the components is 100% by weight.

16. A flame-retardant thermoplastic or thermoset polymer molding composition or polymer molding, film, filament or fiber comprising 1 to 30% by weight of flame retardant mixtures as claimed in one or more of claims 1 to 11, 10 to 97% by weight of thermoplastic or thermoset polymer or mixtures thereof, 1 to 30% by weight of additives and 1 to 30% by weight of filler or reinforcing materials, where the sum of the components is 100% by weight.

17. A flame-retardant thermoplastic or thermoset polymer molding composition or polymer molding, film, filament or fiber comprising flame retardant mixtures as claimed in one or more of claims 1 to 11, wherein the polymer comprises thermoplastic polymers of the HI (high-impact) polystyrene, polyphenylene ether, polyamide, polyester or polycarbonate type, and blends or polymer blends of the ABS (acrylonitrile-butadiene-styrene) or PC/ABS (polycarbonate/acrylonitrile-butadiene-styrene) or PPE/HIPS (polyphenylene ether/HI polystyrene) polymer type, and/or thermoset polymers of the unsaturated polyester or epoxy resin type.