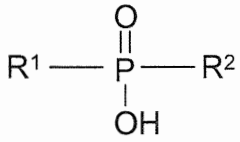
It is thus important to minimize the thermal expansion of test specimens in order to obtain a good, dimensionally stable product (finished printed circuit board).

It is therefore an object of the present invention to modify polymers for prepregs, printed circuit boards and laminates such that they are subject only to very low thermal expansion – if any at all – and dimensional stability is fulfilled.

~~This object is achieved by~~In one aspect, there is provided mixtures of at least one dialkylphosphinic acid of the formula (I)

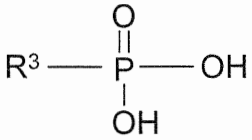


(I)

in which

$R^1$, $R^2$ are the same or different and are each independently $C_1$-$C_{18}$-alkyl, $C_2$-$C_{18}$-alkenyl, $C_6$-$C_{18}$-aryl, $C_7$-$C_{18}$-alkylaryl,

with at least one alkylphosphonic acid of the formula (II)



(II)

in which

$R^3$ is $C_1$-$C_{18}$-alkyl, $C_2$-$C_{18}$-alkenyl, $C_6$-$C_{18}$-aryl or $C_7$-$C_{18}$-alkylaryl.

Preferably, $R^1$ and $R^2$ are the same or different and are each methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl, tert-butyl, n-pentyl, isopentyl, n-hexyl, isohexyl and/or phenyl; $R^3$ is [independently of $R^1$ and $R^2$] methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl, tert-butyl, n-pentyl, isopentyl, n-hexyl, isohexyl and/or phenyl.

The mixtures preferably comprise 99 to 1% by weight of the mixture of dialkylphosphinic acids of the formula (I) and alkylphosphonic acid of the formula (II) as claimed in at least one of claims 1 to 11 and 1 to 99% by weight of synergist.

~~The invention also~~Another aspect relates to a process for preparing the mixtures as disclosed herein~~as claimed in at least one of claims 1 to 11~~, which comprises reacting a phosphorus source with an alkene and a free-radical initiator and, after addition of a mineral acid and workup, converting it to a mixture of dialkylphosphinic acid according to formula (I) with alkylphosphonic acid of the formula (II).

Preferably, the phosphorus source is sodium hypophosphite, the alkene is ethylene and the mineral acid is sulfuric acid.

Preferably, a solution of sodium hypophosphite is reacted with ethylene to give a salt of diethylphosphinic acid which is then converted by reaction with sulfuric acid, nitric acid, hydrochloric acid and/or acetic acid and subsequent concentration, filtration and distillation to a mixture of diethylphosphinic acid with ethylphosphonic acid.

The reaction temperature is preferably between 50 and 150°C.

~~The invention also~~ Another aspect relates to the use of the disclosed mixtures ~~as claimed in at least one 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 and 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 and in electronics applications.

~~The invention additionally~~A further aspect relates to the use of the disclosed mixtures of at least one dialkylphosphinic acid of the formula (I) and at least one alkylphosphonic acid of

the formula (II) ~~as claimed in at least one of claims 1 to 13~~ as a flame retardant, especially as a flame retardant for clearcoats and intumescent coatings, as a flame retardant for wood and other cellulosic products, as a reactive and/or nonreactive flame retardant 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 as a synergist.

~~The invention also~~ Another aspect relates to flame-retardant thermoplastic or thermoset polymer molding compositions and to polymer moldings, films, filaments and fibers comprising 0.5 to 45% by weight of mixtures as ~~claimed in at least one of claims 1 to 13~~disclosed herein, 55 to 99.5% 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.

~~The invention finally also~~Another aspect relates to flame-retardant thermoplastic or thermoset polymer molding compositions and to polymer moldings, films, filaments and fibers comprising 1 to 30% by weight of mixtures as ~~claimed in at least one of claims 1 to 13~~disclosed herein, 10 to 95% by weight of thermoplastic or thermoset polymer or mixtures thereof, 2 to 30% by weight of additives and 2 to 30% by weight of filler or reinforcing materials, where the sum of the components is 100% by weight.

Preferred two-component mixtures of at least one dialkylphosphinic acid of the formula (I) and at least one alkylphosphonic acid of the formula (II) are composed of

diethylphosphinic acid and ethylphosphonic acid,
diethylphosphinic acid and propylphosphonic acid,
diethylphosphinic acid and butylphosphonic acid,
diethylphosphinic acid and pentylphosphonic acid,
diethylphosphinic acid and hexylphosphonic acid,
ethylpropylphosphinic acid and ethylphosphonic acid,
ethylpropylphosphinic acid and propylphosphonic acid,