

Claims

1. Method for the preparation of polyalkyl (meth)acrylate polymers having a weight-average molecular weight in the range of 100,000 to 1,000,000 g/mol and comprising:
- 5 (a) 8 to 25% by weight of esters of (meth)acrylic acid and hydroxylated hydrogenated polybutadienes;
- (b1) 60% to 80% of C₁₋₄ alkyl (meth)acrylates;
- (b2) 10% to 20% by weight of C₁₀₋₃₀ alkyl (meth)acrylates, preferably C₁₀₋₁₅ alkyl methacrylates, more preferably C₁₂₋₁₄ alkyl methacrylates; and
- 10 (b3) 0% to 10% by weight of styrene;
- based on the total amount of the polyalkyl (meth)acrylate polymers,
- the method comprising the steps of:
- (i) preparing a monomer mixture 1 comprising 115 to 125% of the targeted content of monomers (a) and 95% to 100% of the targeted content of monomers (b), the
- 15 concentration of the monomers in mixture 1 being 30 to 40%;
- (ii) adding a monomer mixture 2 comprising 115 to 125% of the targeted content of monomers (a) and 95% to 100% of the targeted content of monomers (b), the concentration of the monomers in mixture 2 being 30 to 40%; and
- (iii) adding a monomer mixture 3 comprising 110 to 120% of the targeted content of
- 20 only monomers (b), the concentration of the monomers in mixture 2 being 2 to 6%,
- characterized in that monomer mixture 1 comprises 38 to 45% of the total amount of monomers used in the process, monomer mixture 2 comprises 38 to 45% of the total amount of monomers used in the process and monomer mixture 3 comprises 15 to 20% of the total amount of monomers used in the process.
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2. The method according to claim 1, wherein the polyalkyl (meth)acrylate polymer comprises:
- (a) 8 to 15% by weight of esters of (meth)acrylic acid and hydroxylated hydrogenated polybutadienes;
- (b1) 70% to 80% of C₁₋₄ alkyl (meth)acrylates;
- 30 (b2) 10% to 20% by weight of C₁₀₋₃₀ alkyl (meth)acrylates, preferably C₁₀₋₁₅ alkyl methacrylates, more preferably C₁₂₋₁₄ alkyl methacrylates; and
- (b3) 0% to 1% by weight of styrene,
- based on the total amount of the polyalkyl (meth)acrylate polymers.
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3. The method according to claim 1, wherein the polyalkyl (meth)acrylate polymer comprises:
- (a) 8 to 15% by weight of esters of (meth)acrylic acid and hydroxylated hydrogenated polybutadienes;
- (b1) 70% to 80% of C₁₋₄ alkyl methacrylates;

(b2) 10% to 20% by weight of C₁₀₋₁₅ alkyl methacrylates, more preferably C₁₂₋₁₄ alkyl methacrylates; and

(b3) 0% to 1% by weight of styrene,

based on the total amount of the polyalkyl (meth)acrylate polymers.

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4. The method according to any one of the preceding claims, wherein the weight-average molecular weight of the polyalkyl(meth)acrylate polymers is in the range of 400,000 to 800,000 g/mol.

10 5. The method according to any one of the preceding claims, wherein the monomer mixtures further comprise a base oil selected from the group consisting of API Group I, II, III, IV or V oils and mixtures thereof.

6. The method according to any one of the preceding claims, wherein the monomer mixtures
15 further comprise a base oil that comprises a mixture of API Group III and API Group V oils.

7. The method according to any one of the preceding claims, wherein
mixture 1 comprises 65% to 75% by weight of API Group III oil or mixtures thereof and
25% to 35% by weight of Group V base oil and mixtures thereof, based on the total amount of base
20 oil used in mixture 1;

mixture 2 comprises 65% to 75% by weight of API Group III oil or mixtures thereof and
25% to 35% by weight of Group V base oil and mixtures thereof, based on the total amount of base
oil used in mixture 2; and

25 mixture 3 comprises 100% by weight of API Group III oil or mixtures thereof, based on the
total amount of base oil used in mixture 3.

8. Polyalkyl (meth)acrylate polymers, prepared according to a method described in any one of
claims 1-6.

30 9. Use of a polyalkyl (meth)acrylate polymer prepared according to any one of claims 1 to 6 to
improve the kinematic viscosity and HTHS performance of lubricating oil compositions, especially
of engine oil formulations.

10. Additive composition comprising:

35 (A1) 40 to 76% by weight, preferably 56% to 67% by weight, of API Group III oils and
mixtures thereof;

(A2) 4% to 20% by weight, preferably 8% to 14% by weight, of API Group V oils or
mixtures thereof; and

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(B) 20% to 40% by weight, preferably 25% to 30% by weight, of a polyalkyl(meth)acrylate polymer prepared according to any one of claims 1-7, based on the total weight of the additive composition.

5 11. Method for the preparation of polyalkyl (meth)acrylate polymers according to claim 1, wherein the polyalkyl (meth)acrylate polymer comprises:

- (a) 8 to 25% by weight of esters of (meth)acrylic acid and hydroxylated hydrogenated polybutadienes;
- (b1) 60% to 80% of C₁₋₄ alkyl (meth)acrylates;
- 10 (b2) 10% to 20% by weight of C₁₀₋₃₀ alkyl (meth)acrylates, preferably C₁₀₋₁₅ alkyl methacrylates, more preferably C₁₂₋₁₄ alkyl methacrylates; and
- (b3) 0% to 10% by weight of styrene;

based on the total amount of the polyalkyl (meth)acrylate polymers,

the method comprising the steps of:

- 15 (i) preparing a monomer mixture 1 comprising 8% to 17% by weight of monomers (a), 70% to 75% by weight of monomers (b1), 12% to 17% by weight of monomers (b2) and 0% to 1% by weight of monomers (b3), based on the total amount of monomers in mixture 1, in a base oil, the concentration of the monomers in mixture 1 being 30 to 40%;
- 20 (ii) adding a monomer mixture 2 comprising 8% to 17% by weight of monomers (a), 70% to 75% by weight of monomers (b1), 12% to 17% by weight of monomers (b2) and 0% to 1% by weight of monomers (b3), based on the total amount of monomers in mixture 2, in a base oil, the concentration of the monomers in mixture 2 being 30 to 40%; and
- 25 (iii) adding a monomer mixture 3 comprising 81% to 86% by weight of monomers (b1) and 15 to 19% by weight of monomers (b2), based on the total amount of monomers in mixture 3, in a base oil, the concentration of the monomers in mixture 3 being 2 to 6%.

30 characterized in that monomer mixture 1 comprises 38 to 45% of the total amount of monomers used in the process monomer mixture 2 comprises 38 to 45% of the total amount of monomers used in the process and monomer mixture 3 comprises 15 to 20% of the total amount of monomers used in the process, wherein

35 mixture 1 comprises 65% to 75% by weight of API Group III oil or mixtures thereof and 25% to 35% by weight of Group V base oil and mixtures thereof, based on the total amount of base oil used in mixture 1;

mixture 2 comprises 65% to 75% by weight of API Group III oil or mixtures thereof and 25% to 35% by weight of Group V base oil and mixtures thereof, based on the total amount of base oil used in mixture 2; and

mixture **3** comprises 100% by weight of API Group III oil or mixtures thereof, based on the total amount of base oil used in mixture **3**.

12. The method according to claim 11, wherein the polyalkyl (meth)acrylate polymer
5 comprises:
- (a) 8 to 15% by weight of esters of (meth)acrylic acid and hydroxylated hydrogenated polybutadienes;
 - (b1) 70% to 80% of C₁₋₄ alkyl (meth)acrylates;
 - (b2) 10% to 20% by weight of C₁₀₋₃₀ alkyl (meth)acrylates, preferably C₁₀₋₁₅ alkyl
10 methacrylates, more preferably C₁₂₋₁₄ alkyl methacrylates; and
 - (b3) 0% to 1% by weight of styrene,
based on the total amount of the polyalkyl (meth)acrylate polymers.
13. The method according to claim 11, wherein the polyalkyl (meth)acrylate polymer
15 comprises:
- (a) 8 to 15% by weight of esters of (meth)acrylic acid and hydroxylated hydrogenated polybutadienes;
 - (b1) 70% to 80% of C₁₋₄ alkyl methacrylates;
 - (b2) 10% to 20% by weight of C₁₀₋₁₅ alkyl methacrylates, more preferably C₁₂₋₁₄ alkyl
20 methacrylates; and
 - (b3) 0% to 1% by weight of styrene,
based on the total amount of the polyalkyl (meth)acrylate polymers.