Claims

1. Polyalkyl(meth)acrylate polymers, comprising the following monomers:
   (a) 10 to 25% by weight of esters of (meth)acrylic acid and a hydroxylated hydrogenated polybutadiene having a number-average molar mass M_n of 4,000 to 6,000 g/mol, preferably 4,500 to 5,000 g/mol;
   (b) 30% to 65% by weight of C_{1-4} alkyl (meth)acrylates;
   (c) 10% to 30% by weight of styrene;
   (d) 10% to 43% by weight of ~~C_{10-30} alkyl (meth)acrylates, preferably~~ C_{10-15} alkyl methacrylates, more preferably C_{12-14} alkyl methacrylates; and
   (e) 0% to 7% by weight of N-containing monomers selected from the group consisting of N,N-dimethylaminoethyl methacrylate (DMAEMA), N-(3-(dimethylamino)propyl)methacrylamide (DMAPMAm) and N-vinylpyrrolidinone (NVP), preferably DMAEMA,

   ~~characterized in that~~wherein the weight-average molecular weight is in the range of ~~100,000~~200,000 to ~~1,000,000~~700,000 g/mol.

2. Polyalkyl(meth)acrylate polymers according to Claim 1, comprising 55 to 65% by weight of monomers selected from the group consisting of methyl methacrylate, butyl methacrylate and styrene.

3. Polyalkyl(meth)acrylate polymers according to Claim 1, comprising the following monomers:
   (a) 10 to 25% by weight of esters of (meth)acrylic acid and a hydroxylated hydrogenated polybutadiene having a number-average molar mass M_n of 4,000 to 6,000 g/mol, preferably 4,500 to 5,000 g/mol;
   (b) 45% to 60% by weight of C_{1-4} alkyl (meth)acrylates;
   (c) 10% to 15% by weight of styrene;
   (d) 15% to 30% by weight of ~~C_{10-30} alkyl (meth)acrylates, preferably~~ C_{10-15} alkyl methacrylates, more preferably C_{12-14} alkyl methacrylates; and
   (e) 3% to 7% by weight of N-containing monomers selected from the group consisting of N,N-dimethylaminoethyl methacrylate (DMAEMA), N-(3-(dimethylamino)propyl)methacrylamide (DMAPMAm) and N-vinylpyrrolidinone (NVP), preferably DMAEMA.

4. Polyalkyl(meth)acrylate polymers according to Claim 1, comprising the following monomers:

(a) 10 to 25% by weight of esters of (meth)acrylic acid and a hydroxylated hydrogenated polybutadiene having a number-average molar mass M_n of 4,000 to 6,000 g/mol, preferably 4,500 to 5,000 g/mol;

(b) 30% to 45% by weight of C_{1-4} alkyl (meth)acrylates;

(c) 19% to 30% by weight of styrene;

(d) 15% to 30% by weight of ~~C_{10-30} alkyl (meth)acrylates, preferably~~ C_{10-15} alkyl methacrylates, more preferably C_{12-14} alkyl methacrylates; and

(e) 3% to 7% by weight of N-containing monomers selected from the group consisting of N,N-dimethylaminoethyl methacrylate (DMAEMA), N-(3-(dimethylamino)propyl)methacrylamide (DMAPMAm) and N-vinylpyrrolidinone (NVP), preferably DMAEMA.

~~5. Polyalkyl(meth)acrylate polymers according to Claim 1, 2, 3 or 4, characterized in that the weight-average molecular weight is in the range of 200,000 to 700,000 g/mol.~~

5. Polyalkyl(meth)acrylate polymers according to Claim 1, 2, 3 or 4, wherein the number-average molecular weight is in the range of 20,000 to 200,000 g/mol.

6. Polyalkyl(meth)acrylate polymers according to Claim 1, 2, 3 or 4, ~~characterized in that~~wherein the number-average molecular weight is in the range of ~~20,000 to 200,000 g/mol, preferably in the range of~~ 30,000 to 170,000 g/mol.

7. Use of a polyalkyl(meth)acrylate polymer according to Claim 1, 2, 3, 4, 5 or 6 for improving fuel economy, dispersancy and deposit formation of a lubricating oil composition.

8. Process for improving deposit formation of a lubricating oil composition by adding a polyalkyl(meth)acrylate polymer, comprising the following monomers:

(a) 10 to 25% by weight of esters of (meth)acrylic acid and a hydroxylated hydrogenated polybutadiene having a number-average molar mass M_n of 4,000 to 6,000 g/mol, preferably 4,500 to 5,000 g/mol;

(b) 45% to 60% by weight of C_{1-4} alkyl (meth)acrylates;

(c) 10% to 15% by weight of styrene;

(d) 15% to 30% by weight of ~~C_{10-30} alkyl (meth)acrylates, preferably~~ C_{10-15} alkyl methacrylates, more preferably C_{12-14} alkyl methacrylates; and

(e) 3% to 7% by weight of N,N-dimethylaminoethyl methacrylate (DMAEMA),

~~characterized in that~~wherein the weight-average molecular weight is in the range of ~~100,000~~200,000 to ~~1,000,000~~700,000 g/mol.

9. Process for improving deposit formation of a lubricating oil composition by adding a polyalkyl(meth)acrylate polymer, comprising the following monomers:

(a) 10 to 25% by weight of esters of (meth)acrylic acid and a hydroxylated hydrogenated polybutadiene having a number-average molar mass M_n of 4,000 to 6,000 g/mol, preferably 4,500 to 5,000 g/mol;

(b) 30% to 45% by weight of C_{1-4} alkyl (meth)acrylates;

(c) 19% to 30% by weight of styrene;

(d) 15% to 30% by weight of ~~C_{10-30} alkyl (meth)acrylates, preferably~~ C_{10-15} alkyl methacrylates, more preferably C_{12-14} alkyl methacrylates; and

(e) 3% to 7% by weight of N,N-dimethylaminoethyl methacrylate (DMAEMA),

~~characterized in that~~wherein the weight-average molecular weight is in the range of ~~100,000~~200,000 to ~~1,000,000~~700,000 g/mol.

10. Additive composition, comprising:

(A) 60 to 80% by weight of a base oil, and

(B) 20 to 40% by weight of a polyalkyl(meth)acrylate polymer, comprising:

(a) 10 to 25% by weight of esters of (meth)acrylic acid and a hydroxylated hydrogenated polybutadiene having a number-average molar mass Mn of 4,000 to 6,000 g/mol, preferably 4,500 to 5,000 g/mol;

(b) 30% to 65% by weight of C_{1-4} alkyl (meth)acrylates;

(c) 10% to 30% by weight of styrene;

(d) 10% to 43% by weight of ~~C_{10-30} alkyl (meth)acrylates, preferably~~ C_{10-15} alkyl methacrylates, more preferably C_{12-14} alkyl methacrylates; and

(e) 0% to 7% by weight of N-containing monomers selected from the group consisting of N,N-dimethylaminoethyl methacrylate (DMAEMA), N-(3-(dimethylamino)propyl)methacrylamide (DMAPMAm) and N-vinylpyrrolidinone (NVP), preferably DMAEMA,

~~characterized in that~~wherein the weight-average molecular weight is in the range of ~~100,000~~200,000 to ~~1,000,000~~700,000 g/mol.

11. Additive composition according to Claim 10, ~~characterized in that~~wherein the polyalkyl(meth)acrylate polymer (B) comprises the following monomers:

(a) 10 to 25% by weight of esters of (meth)acrylic acid and a hydroxylated hydrogenated polybutadiene having a number-average molar mass M_n of 4,000 to 6,000 g/mol, preferably 4,500 to 5,000 g/mol;

(b) 45% to 60% by weight of C_{1-4} alkyl (meth)acrylates;

(c) 10% to 15% by weight of styrene;

(d) 15% to 30% by weight of ~~C_{10-30} alkyl (meth)acrylates, preferably~~ C_{10-15} alkyl methacrylates, more preferably C_{12-14} alkyl methacrylates; and

(e) 3% to 7% by weight of N-containing monomers selected from the group consisting of N,N-dimethylaminoethyl methacrylate (DMAEMA), N-(3-(dimethylamino)propyl)methacrylamide (DMAPMAm) and N-vinylpyrrolidinone (NVP), preferably DMAEMA.

12. Additive composition according to Claim 10, ~~characterized in that~~wherein the polyalkyl(meth)acrylate polymer (B) comprises the following monomers:

(a) 10 to 25% by weight of esters of (meth)acrylic acid and a hydroxylated hydrogenated polybutadiene having a number-average molar mass M_n of 4,000 to 6,000 g/mol, preferably 4,500 to 5,000 g/mol;

(b) 30% to 45% by weight of C_{1-4} alkyl (meth)acrylates;

(c) 19% to 30% by weight of styrene;

(d) 15% to 30% by weight of ~~C_{10-30} alkyl (meth)acrylates, preferably~~ C_{10-15} alkyl methacrylates, more preferably C_{12-14} alkyl methacrylates; and

(e) 3% to 7% by weight of N-containing monomers selected from the group consisting of N,N-dimethylaminoethyl methacrylate (DMAEMA), N-(3-(dimethylamino)propyl)methacrylamide (DMAPMAm) and N-vinylpyrrolidinone (NVP), preferably DMAEMA.

13. Lubricating oil composition, comprising.

(A) 80 to 99.5% by weight of a base oil;

(B) 0.5 to 5% by weight of a polyalkyl(meth)acrylate based comb polymer, comprising:

(a) 10 to 25% by weight of esters of (meth)acrylic acid and a hydroxylated hydrogenated polybutadiene having a number-average molar mass M_n of 4,000 to 6,000 g/mol, preferably 4,500 to 5,000 g/mol;

(b) 30% to 65% by weight of C_{1-4} alkyl (meth)acrylates;

(c) 10% to 30% by weight of styrene;

(d) 10% to 43% by weight of ~~C_{10-30} alkyl (meth)acrylates, preferably~~ C_{10-15} alkyl methacrylates, more preferably C_{12-14} alkyl methacrylates; and

(e) 0% to 7% by weight of N-containing monomers selected from the group consisting of N,N-dimethylaminoethyl methacrylate (DMAEMA), N-(3-(dimethylamino)propyl)methacrylamide (DMAPMAm) and N-vinylpyrrolidinone (NVP), preferably DMAEMA,

~~characterized in that~~wherein the weight-average molecular weight is in the range of ~~100,000~~200,000 to ~~1,000,000~~700,000 g/mol; and

(C) 0 to 15% by weight of one or more further additives.

14. Lubricating oil composition according to Claim 13, ~~characterized in that~~wherein the polyalkyl(meth)acrylate polymer (B) comprises the following monomers:

(a) 10 to 25% by weight of esters of (meth)acrylic acid and a hydroxylated hydrogenated polybutadiene having a number-average molar mass M_n of 4,000 to 6,000 g/mol, preferably 4,500 to 5,000 g/mol;

(b) 45% to 60% by weight of C_{1-4} alkyl (meth)acrylates;

(c) 10% to 15% by weight of styrene;

(d) 15% to 30% by weight of ~~C_{10-30} alkyl (meth)acrylates, preferably~~ C_{10-15} alkyl methacrylates, more preferably C_{12-14} alkyl methacrylates; and

(e) 3% to 7% by weight of N-containing monomers selected from the group consisting of N,N-dimethylaminoethyl methacrylate (DMAEMA), N-(3-(dimethylamino)propyl)methacrylamide (DMAPMAm) and N-vinylpyrrolidinone (NVP), preferably DMAEMA.

15. Lubricating oil composition according to Claim 13, ~~characterized in that~~wherein the polyalkyl(meth)acrylate polymer (B) comprises the following monomers:

(a) 10 to 25% by weight of esters of (meth)acrylic acid and a hydroxylated hydrogenated polybutadiene having a number-average molar mass M_n of 4,000 to 6,000 g/mol, preferably 4,500 to 5,000 g/mol;

(b) 30% to 45% by weight of C_{1-4} alkyl (meth)acrylates;

(c) 19% to 30% by weight of styrene;

(d) 15% to 30% by weight of ~~C_{10-30} alkyl (meth)acrylates, preferably~~ C_{10-15} alkyl methacrylates, more preferably C_{12-14} alkyl methacrylates; and

(e) 3% to 7% by weight of N-containing monomers selected from the group consisting of N,N-dimethylaminoethyl methacrylate (DMAEMA), N-(3-(dimethylamino)propyl)methacrylamide (DMAPMAm) and N-vinylpyrrolidinone (NVP), preferably DMAEMA.