Dispersant (Meth) acrylate copolymers having excellent low temperature properties

Dispergierende (Meth)acrylat-Copolymere mit ausgezeichneten Eigenschaften im Niedrigtemperaturbereich

Copolymère de (meth)acrylate dispersant avec d’excellentes propriétés à basse température

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(54) Dispersant (Meth) acrylate copolymers having excellent low temperature properties

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(56) References cited:
EP-A- 0 439 254
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EP-A- 0 750 031
Description

TECHNICAL FIELD

[0001] This invention relates to novel dispersant (meth) acrylate copolymers having excellent low temperature properties in a wide variety of base oils. The present invention also relates to the use of these copolymers as viscosity index improvers for lubricating oils.

BACKGROUND OF THE INVENTION

[0002] Polymethacrylate viscosity index improvers (PMA VII's) are well known in the lubricating industry. Many attempts have been made to produce PMA VII's that have the desired balance of high temperature and low temperature viscometrics, as well as the required shear stability for a given application. Obtaining suitable low temperature performance has become even more difficult recently with the movement away from API Group I base oils and the increased utilization of Group II and Group III base oils. Further, refiners who blend with different base oils desire a single product which performs effectively in all of these different base oils. The present invention is directed to novel dispersant (meth) acrylate copolymers which exhibit excellent low temperature performance in a wide variety of base oils.

[0003] U.S. Patent No. 5,112,509 teaches a method for making a methyl methacrylate-lauryl methacrylate copolymer. The '509 patent does not teach the copolymers of the present invention, which contain a dispersant monomer.

SUMMARY OF THE INVENTION

[0004] The present invention is directed to novel dispersant poly (meth) acrylates and their use as viscosity index improvers for lubricating oils.

[0005] The polyalkyl (meth) acrylate copolymers of the present invention comprise units derived from:

(A) 12 to 18 weight percent methyl methacrylate;
(B) 75 to 85, weight percent of a C₁₀⁻C₁₅ alkyl (meth) acrylate; and
(C) 2 to 5, weight percent of a nitrogen-containing dispersant monomer.

DETAILED DESCRIPTION OF THE INVENTION

[0006] The present invention is directed to polyalkyl (meth) acrylate copolymers comprising units derived from:

(A) 12 to 18 weight percent methyl methacrylate;
(B) 75 to 85 weight percent of C₁₀⁻C₁₅ alkyl (meth) acrylate(s); and
(C) 2 to 5 weight percent of a nitrogen-containing dispersant monomer.

[0007] The polyalkyl (meth) acrylate copolymers of the present invention comprise the reaction products of:

(A) from 12 to 18, weight percent methyl methacrylate;
(B) from 75 to 85, weight percent of C₁₀⁻C₁₅ alkyl (meth) acrylate(s); and
(C) from 2 to 5, weight percent of a nitrogen-containing dispersant monomer.

[0008] As used herein, C₁₀⁻C₁₅ alkyl (meth) acrylate means an alkyl ester of acrylic or methacrylic acid having a straight or branched alkyl group of 10 to 15 carbon atoms per group including decyl (meth) acrylate, isodecyl (meth) acrylate, undecyl (meth) acrylate, lauryl (meth) acrylate, myristyl (meth) acrylate, dodecyl pentadecyl methacrylate, and mixtures thereof.

[0009] The alkyl (meth) acrylate comonomers containing 10 or more carbon atoms in the alkyl group are generally prepared by standard esterification procedures using technical grades of long chain aliphatic alcohols, and these commercially available alcohols are mixtures of alcohols of varying chain lengths in the alkyl groups. Consequently, for the purposes of this invention, alkyl (meth) acrylate is intended to include not only the individual alkyl (meth) acrylate product named, but also to include mixtures of the alkyl (meth) acrylates with a predominant amount of the particular alkyl (meth) acrylate named.

[0010] The nitrogen-containing dispersant monomers suitable for use in the present invention include dialkylamino alkyl (meth)acrylamides such as, N,N-dimethylaminopropyl methacrylamide; N,N-diethylaminopropyl methacrylamide; N,N-dimethylaminooethyl acrylamide and N,N-diethyldiminoethyl acrylamide; and dialkylaminomethyl (meth) acrylates such as N,N-dimethylaminomethyl methacrylate; N,N-diethylaminomethyle acrylate and N,N-dimethylaminooethyl thiometh-
In a preferred embodiment, the polyalkyl (meth) acrylate copolymers of the present invention consist essentially of the reaction products of (A), (B) and (C). However, those skilled in the art will appreciate that minor levels of other monomers, polymerizable with monomers (A), (B) and/or (C) disclosed herein, may be present as long as they do not adversely affect the low temperature properties of the fully formulated fluids. Typically additional monomers are present in an amount of less than about 5 weight percent, preferably in an amount of less than 3 weight percent, most preferably in an amount of less than 1 weight percent. For example, the addition of minor levels of monomers such as C₂-C₉ alkyl (meth) acrylates, hydroxy- or alkoxy-containing alkyl (meth) acrylates, ethylene, propylene, styrene, vinyl acetate and the like are contemplated within the scope of this invention as long as the presence of these monomers do not adversely affect the low temperature properties of the copolymers. In a preferred embodiment the sum of the weight percent of (A), (B) and (C) equals 100%.

The copolymers may be prepared by various polymerization techniques including free-radical and anionic polymerization.

Conventional methods of free-radical polymerization can be used to prepare the copolymers of the present invention. Polymerization of the acrylic and/or methacrylic monomers can take place under a variety of conditions, including bulk polymerization, solution polymerization, usually in an organic solvent, preferably mineral oil, emulsion polymerization, suspension polymerization and non-aqueous dispersion techniques.

Solution polymerization is preferred. In the solution polymerization, a reaction mixture comprising a diluent, the alkyl (meth) acrylate monomers, a polymerization initiator and a chain transfer agent is prepared.

The diluent may be any inert hydrocarbon and is preferably a hydrocarbon lubricating oil that is compatible with or identical to the lubricating oil in which the copolymer is to be subsequently used. The mixture includes, e.g., from about 15 to about 400 parts by weight (pbw) diluent per 100 pbw total monomers and, more preferably, from about 50 to about 200 pbw diluent per 100 pbw total monomers. As used herein, "total monomer charge" means the combined amount of all monomers in the initial, i.e., unreacted, reaction mixture.

In preparing the copolymers of the present invention by free-radical polymerization, the acryric monomers may be polymerized simultaneously or sequentially, in any order. In a preferred embodiment, the total monomer charge includes from 10 to 20, preferably 12 to 18, weight percent methyl methacrylate; 70 to 89, preferably 75 to 85, weight percent of at least one C₁₀-C₁₅ alkyl (meth) acrylate; and 1 to 10, preferably 2 to 5, weight percent of a dispersant acetate and the like are contemplated within the scope of this invention as long as the presence of these monomers do not adversely affect the low temperature properties of the fully formulated fluids. Typically additional monomers are present in an amount of less than about 5 weight percent, preferably in an amount of less than 3 weight percent, most preferably in an amount of less than 1 weight percent. For example, the addition of minor levels of monomers such as C₂-C₉ alkyl (meth) acrylates, hydroxy- or alkoxy-containing alkyl (meth) acrylates, ethylene, propylene, styrene, vinyl acetate and the like are contemplated within the scope of this invention as long as the presence of these monomers do not adversely affect the low temperature properties of the copolymers. In a preferred embodiment the sum of the weight percent of (A), (B) and (C) equals 100%.

Suitable polymerization initiators include initiators which dissociate upon heating to yield a free radical, e.g., peroxide compounds such as benzoyl peroxide, t-butyl perbenzoate, t-butyl peroctoate and cumene hydroperoxide; and azo compounds such as azoisobutyronitrile and 2,2'-azobis (2-methylbutanenitrile). The reaction mixture typically includes from about 0.01 wt% to about 1.0 wt% initiator relative to the total monomer mixture.

Suitable chain transfer agents include those conventional in the art, e.g., dodecyl mercaptan and ethyl mercaptan. The selection of the amount of chain transfer agent to be used is based on the desired molecular weight of the polymer being synthesized as well as the desired level of shear stability for the polymer, i.e., if a more shear stable polymer is desired, more chain transfer agent can be added to the reaction mixture. Preferably, the chain transfer agent is added to the reaction mixture in an amount of 0.01 to 3 weight percent, preferably 0.02 to 2.5 weight percent, relative to the monomer mixture.

By way of example and without limitation, the reaction mixture is charged to a reaction vessel that is equipped with a stirrer, a thermometer and a reflux condenser and heated with stirring under a nitrogen blanket to a temperature of about 50 °C to about 125 °C, for a period of about 0.5 hours to about 8 hours to carry out the copolymerization reaction.

In a further embodiment, the copolymers may be prepared by initially charging a portion, e.g., about 25 to 60% of the reaction mixture to the reaction vessel and heating. The remaining portion of the reaction mixture is then metered into the reaction vessel, with stirring and while maintaining the temperature of the batch within the above describe range, over a period of about 0.5 hours to about 3 hours. A viscous solution of the copolymer of the present invention in the diluent is obtained as the product of the above-described process.

To form the lubricating oils of the present invention, a base oil is treated with the copolymer of the invention in a conventional manner, i.e., by adding the copolymer to the base oil to provide a lubricating oil composition having the desired low temperature properties. Preferably, the lubricating oil contains from 1 to 20 parts by weight (pbw), preferably 3 to 15 pbw, most preferably 5 to 10 pbw, of the neat copolymer (i.e., excluding diluent oil) per 100 pbw base oil. In a particularly preferred embodiment, the copolymer is added to the base oil in the form of a relatively concentrated solution of the copolymer in a diluent. The diluent includes any of the oils referred to below that are suitable for use as base oils.

The copolymers of the present invention typically have a relative number average molecular weight, as determined by gel permeation chromatography using polymethyl methacrylate standards, between 5000 and 50,000, preferably 10,000 to 25,000.
The molecular weight of the alkyl(meth)acrylate polymer additive must be sufficient to impart the desired thickening properties to the lubricating oil. As the molecular weight of the polymers increase, the copolymers become more efficient thickeners; however, the polymers can undergo mechanical degradation in particular applications and for this reason, polymer additives with number-average molecular weights (Mw) above about 50,000 are generally not suitable for certain applications because they tend to undergo “thinning” due to molecular weight degradation resulting in loss of effectiveness as thickeners at the higher use temperatures (for example, at 100°C). Thus, the molecular weight is ultimately governed by thickening efficiency, required shear stability, cost and the type of application.

Those skilled in the art will recognize that the molecular weights set forth throughout this specification are relative to the methods by which they are determined. For example, molecular weights determined by GPC and molecular weights calculated by other methods, may have different values. It is not molecular weight per se but the handling characteristics and performance of a polymeric additive (shear stability, low temperature performance and thickening power under use conditions) that is important. Generally, shear stability is inversely proportional to molecular weight. A VII additive with good shear stability (low SSI value) is typically used at higher initial concentrations relative to another additive having reduced shear stability (high SSI value) to obtain the same target thickening effect in a treated fluid at high temperatures; the additive having good shear stability may, however, produce unacceptable thickening at low temperatures due to the higher use concentrations.

Conversely, although lubricating oils containing lower concentrations of reduced shear stability VI improving additives may initially satisfy the higher temperature viscosity target, fluid viscosity will decrease significantly with use causing a loss of effectiveness of the lubricating oil. Thus, the reduced shear stability of specific VI improving additives may be satisfactory at low temperatures (due to its lower concentration) but it may prove unsatisfactory under high temperature conditions. Thus, polymer composition, molecular weight and shear stability of VI improvers must be selected to achieve a balance of properties in order to satisfy both high and low temperature performance requirements.

The finished lubricating oil composition may include other additives in addition to the copolymer of the present invention, e.g., oxidation inhibitors, corrosion inhibitors, friction modifiers, antiwear and extreme pressure agents, detergents, dispersants, anti-foamants, additional viscosity index improvers and pour point depressants.

Base oils contemplated for use in this invention include natural oils, synthetic oils and mixtures thereof. Suitable base oils also include basestocks obtained by isomerization of synthetic wax and slack wax, as well as basestocks produced by hydrocracking (rather than solvent extracting) the aromatic and polar components of the crude. In general, both the natural and synthetic base oils will each have a kinematic viscosity ranging from about 1 to about 40 cSt at 100°C, although typical applications will require each oil to have a viscosity ranging from about 2 to about 20 cSt at 100°C.

Natural base oils include animal oils, vegetable oils (e.g., castor oil and lard oil), petroleum oils, mineral oils, and oils derived from coal or shale. The preferred natural base oil is mineral oil.

The mineral oils useful in this invention include all common mineral oil base stocks. This would include oils that are naphthenic or paraffinic in chemical structure. Oils that are refined by conventional methodology using acid, alkali, and clay or other agents such as aluminum chloride, or they may be extracted oils produced, for example, by solvent extraction with solvents such as phenol, sulfur dioxide, furfural, dichlorodiethyl ether, etc. They may be hydrotreated or hydrorefined, dewaxed by chilling or catalytic dewaxing processes, or hydrocracked. The mineral oil may be produced from natural crude sources or be composed of isomerized wax materials or residues of other refining processes.

Typically the base oils will have kinematic viscosities of from 0.02 to 0.4 m²/s (2 cSt to 40 cSt) at 100°C. The preferred base oils have kinematic viscosities of from 0.02 to 0.2 m²/s (2 to 20 cSt) at 100°C.

The American Petroleum Institute has categorized these different basestock types as follows: Group I, >0.03 wt. % sulfur, and/or <90 vol % saturates, viscosity index between 80 and 120; Group II, ≤ 0.03 wt. % sulfur, and ≥ 90 vol % saturates, viscosity index between 80 and 120; Group III, ≤ 0.03 wt. % sulfur, and ≥ 90 vol % saturates, viscosity index > 120; Group IV, all polyalphaolefins.

Group II and Group III basestocks are typically prepared from conventional feedstocks using a severe hydrogenation step to reduce the aromatic, sulfur and nitrogen content, followed by dewaxing, hydrofinishing, extraction and/or distillation steps to produce the finished base oil. Group II and III basestocks differ from conventional solvent refined Group I basestocks in that their sulfur, nitrogen and aromatic contents are very low. As a result, these base oils are compositionally very different from conventional solvent refined basestocks. Hydrotreated basestocks and catalytically dewaxed basestocks, because of their low sulfur and aromatics content, generally fall into the Group II and Group III categories. Polyalphaolefins (Group IV basestocks) are synthetic base oils prepared from various alpha olefins and are substantially free of sulfur and aromatics.

Synthetic base oils include hydrocarbon oils and halo-substituted hydrocarbon oils such as oligomerized, polymerized, and interpolymerized olefins (such as polybutylenes, polypropylenes, propylene, isobutylene copolymers, chlorinated polyolefins, poly(1-hexenes), poly(1-octenes) and mixtures thereof); alkylbenzenes (including dodecylbenzenes, tetracyclodibenzene, dinonyl-benzenes and di(2-ethylhexyl)benzene); polyphenylenes (such as biphenyls, ter-
The sparge tube was replaced with a nitrogen blanket and the temperature was increased to about 78 °C. The reactor was cooled and the various polymer solutions were then stored at room temperature until testing.

The general procedure used for preparing the polymethacrylates in Table 1 was as follows: To a 2 liter resin kettle fitted with an overhead stirrer, a thermocouple, a sparge tube and a condenser was charged the total monomer charge listed in Table 1 for each polymer. The stirrer was set at 300 rpm and the temperature was increased to 40 °C for 1 hour. The reactor was cooled and the various polymer solutions were then stored at room temperature until testing.

EXAMPLES
Table 1 -

<table>
<thead>
<tr>
<th>PMA Composition</th>
<th>MMA</th>
<th>BMA</th>
<th>LMA</th>
<th>CEMA</th>
<th>DMA</th>
<th>Mn (approx.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VII-1*</td>
<td>10.7</td>
<td>82.6</td>
<td>3.1</td>
<td>3.6</td>
<td>11,000</td>
<td></td>
</tr>
<tr>
<td>VII-2*</td>
<td>13.8</td>
<td>79.6</td>
<td>3</td>
<td>3.6</td>
<td>11,000</td>
<td></td>
</tr>
<tr>
<td>VII-3*</td>
<td>11.3</td>
<td>85.1</td>
<td>3.6</td>
<td>11,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VII-4</td>
<td>14.2</td>
<td>82.1</td>
<td>3.7</td>
<td>11,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VII-5*</td>
<td>14.4</td>
<td>77</td>
<td>4.9</td>
<td>11,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VII-6</td>
<td>15</td>
<td>81.4</td>
<td>3.6</td>
<td>18,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VII-7</td>
<td>17.9</td>
<td>78.4</td>
<td>3.7</td>
<td>13,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Polymers outside the scope of the present invention.

Table 2 sets forth some properties of the various base oils used in evaluating the low temperature performance of the polymers of Table 1.

Table 2 -

<table>
<thead>
<tr>
<th>Base Oil Properties</th>
<th>Group I</th>
<th>Group II</th>
<th>Group III(1)</th>
<th>Group III(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>API Class</td>
<td>SNO 70</td>
<td>SNO 100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>93</td>
<td>105</td>
<td>114</td>
<td>120</td>
</tr>
<tr>
<td>Pour Point (°C)</td>
<td>-21</td>
<td>-15</td>
<td>-21</td>
<td>-27</td>
</tr>
<tr>
<td>Paraffinic (%)</td>
<td>59.9</td>
<td>64.8</td>
<td>51.4</td>
<td>66.2</td>
</tr>
<tr>
<td>Naphthenics (%)</td>
<td>33.7</td>
<td>33.7</td>
<td>48.3</td>
<td>32.4</td>
</tr>
<tr>
<td>Aromatics (%)</td>
<td>6.4</td>
<td>1.5</td>
<td>0.3</td>
<td>1.4</td>
</tr>
<tr>
<td>Sulfur (%)</td>
<td>0.21</td>
<td>0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

1 The Group I base oil was a mixture of approximately 45 wt.% SNO 70 and 55 wt.% SNO 100
N/A Not available or not measured

[0044] To demonstrate the low temperature properties of the copolymers of the present invention, lubricant compositions were prepared containing the identical type and amount of detergent/inhibitor package. No pour point depressant was added. To demonstrate the effectiveness of the polymers of the present invention across a wide variety of base fluids, four different base oils were used. Details of the base oils are set forth in Table 2. The polymers were added to the oil in an amount such that the finished lubricants had a kinematic viscosity at 100 °C of approximately 7.6 cSt. The low temperature properties of these fluids were tested according to ASTM D 2983 and the Brookfield Viscosity (cP) at -40 °C is reported in Table 3.

Table 3 -

| Low Temperature Performance (Brookfield Viscosity (cP) at -40 °C)** |
|--------------------------|----------------|----------------|----------------|----------------|
|                          | Group I | Group II | Group III(1) | Group III(2)  |
| VII-1*                  | 34075   | DNT      | DNT           | DNT            |
| VII-2*                  | 52150   | DNT      | DNT           | DNT            |
| VII-3*                  | 37350   | 25075    | 15510         | 33250          |

* Comparative Examples
DNT Did Not Test
** 1 cP = 1 x 10^-3 Pas
Table 3 - (continued)

<table>
<thead>
<tr>
<th></th>
<th>Group I</th>
<th>Group II</th>
<th>Group III(1)</th>
<th>Group III(2)</th>
<th>Avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>VII-4</td>
<td>30400</td>
<td>21850</td>
<td>14810</td>
<td>18320</td>
<td>21345</td>
</tr>
<tr>
<td>VII-5*</td>
<td>32950</td>
<td>33975</td>
<td>15920</td>
<td>35225</td>
<td>29518</td>
</tr>
<tr>
<td>VII-6</td>
<td>24750</td>
<td>16660</td>
<td>12520</td>
<td>13790</td>
<td>16930</td>
</tr>
<tr>
<td>VII-7</td>
<td>31700</td>
<td>21750</td>
<td>16440</td>
<td>20025</td>
<td>22479</td>
</tr>
</tbody>
</table>

* Comparative Examples
DNT Did Not Test
** 1 cP = 1 x 10^-3 Pas

[0045] It is clear, from the above Table 3, that lubricant formulations comprising the polymethacrylate viscosity index improvers of the present invention (VII-4, VII-6 and VII-7) exhibit superior low temperature properties across the range of base oils compared to polymethacrylate viscosity index improvers outside the scope of the present invention (VII-1, VII-2, VII-3 and VII-5) as evidenced by the superior Brookfield Viscosity results.

Claims

1. A polyalkyl (meth) acrylate copolymer comprising units derived from:
   (A) 12 to 18 weight percent methyl methacrylate;
   (B) 75 to 85 weight percent of at least one C_{10}-C_{15} alkyl (meth) acrylate; and
   (C) 2 to 5 weight percent of at least one nitrogen-containing dispersant monomer.

2. A polyalkyl (meth) acrylate copolymer comprising the reaction product(s) of:
   (A) from 12 to 18 weight percent methyl methacrylate;
   (B) from 75 to 85 weight percent of at least one C_{10}-C_{15} alkyl (meth) acrylate; and
   (C) from 2 to 5 weight percent of at least one nitrogen-containing dispersant monomer.

3. A copolymer according to claim 2 obtained by the sequential or simultaneous free-radical polymerization of (A), (B) and (C).

4. The copolymer of claim 3 wherein the copolymer has a number average molecular weight of from about 5000 to about 50,000.

5. A lubricating oil composition comprising:
   (A) an oil of lubricating viscosity; and
   (B) a polyalkyl (meth) acrylate copolymer according to claim 2.

6. The lubricating oil composition of claim 5 wherein component (B) is present in an amount of from 1 to 20 parts by weight of active copolymer per 100 parts by weight of oil.

7. The lubricating oil composition of claim 5 further comprising at least one additive selected from the group consisting of oxidation inhibitors, corrosion inhibitors, friction modifiers, antiwear and extreme pressure agents, detergents, dispersants, antifoamants, additional viscosity index improvers and pour point depressants.

8. A method for improving the low temperature properties of an oil, said method comprises adding to an oil of lubricating viscosity a polyalkyl (meth) acrylate copolymer according to claim 2.

9. A method for increasing the viscosity index of an oil, said method comprising adding to an oil of lubricating viscosity a polyalkyl (meth) acrylate copolymer according to claim 2.
10. An automatic transmission fluid comprising:

(A) an oil of lubricating viscosity;
(B) a polyalkyl (meth)acrylate copolymer according to claim 2; and
(C) a detergent/inhibitor package, wherein the detergent/inhibitor package comprises at least one additive selected from the group consisting of oxidation inhibitors, corrosion inhibitors, friction modifiers, antiwear and extreme pressure agents, detergents, dispersants, anti-foamants, and pour point depressants;

wherein the automatic transmission fluid has a percent shear stability index, as determined by the 20 hour Tapered Bearing Shear Test, in the range of 1% to 80%.

11. The automatic transmission fluid according to claim 10, wherein said automatic transmission fluid has a percent shear stability index in the range of 2% to 20%.

Revendications

1. Copolymère poly[(méth)acrylate d'alkyle] comprenant des unités issues de :

(A) 12 à 18 pourcent en poids de méthacrylate de méthyle ;
(B) 75 à 85 pourcent en poids d'au moins un (méth)acrylate d'alkyle en C_{10}-C_{15} ; et
(C) 2 à 5 pourcent en poids d'au moins un monomère dispersant azoté.

2. Copolymère poly[(méth)acrylate d'alkyle] comprenant le(s) produit(s) de réaction de :

(A) 12 à 18 pourcent en poids de méthacrylate de méthyle ;
(B) 75 à 85 pourcent en poids d'au moins un (méth)acrylate d'alkyle en C_{10}-C_{15} ; et
(C) 2 à 5 pourcent en poids d'au moins un monomère dispersant azoté. -

3. Copolymère selon la revendication 2 obtenu par la polymérisation non radiculaire, séquentielle ou simultanée, de (A), (B) et (C).

4. Copolymère de la revendication 3, lequel copolymère a un poids moléculaire moyen en nombre d'environ 5000 à environ 50000.

5. Composition d'huile lubrifiante comprenant :

(A) une huile ayant une viscosité adaptée à la lubrification ; et
(B) un copolymère poly[(méth)acrylate d'alkyle] selon la revendication 2.

6. Composition d'huile lubrifiante de la revendication 5, dans laquelle le composant (B) est présent en une quantité de 1 à 20 parties en poids de copolymère actif pour 100 parties en poids d'huile.

7. Composition d'huile lubrifiante de la revendication 5, comprenant en outre au moins un additif choisi dans le groupe constitué par des inhibiteurs d'oxydation, des inhibiteurs de corrosion, des agents de modification de la friction, des agents anti-usure et de pression extrême, des détergents, des dispersants, des anti-mousses, des agents supplémentaires améliorant l'indice de viscosité et des agents abaissant le point d'écoulement.

8. Procédé d'amélioration des propriétés à basse température d'une huile, ledit procédé comprenant l'addition à une huile ayant une viscosité adaptée à la lubrification, d'un copolymère poly[(méth)acrylate d'alkyle] selon la revendication 2.

9. Procédé d'augmentation de l'indice de viscosité d'une huile, ledit procédé comprenant l'addition à une huile ayant une viscosité adaptée à la lubrification, d'un copolymère poly[(méth)acrylate d'alkyle] selon la revendication 2.

10. Fluide pour transmission automatique comprenant :

(A) une huile ayant une viscosité adaptée à la lubrification ;
(B) un copolymère poly[(méth)acrylate d’alkyle] selon la revendication 2 ; et
(C) un ensemble détergent/inhibiteur, ce dernier comprenant au moins un additif choisi dans le groupe constitué par les inhibiteurs d’oxydation, les inhibiteurs de corrosion, les agents de modification de la friction, les agents anti-usure et de pression extrême, les détergents, les dispersants, les anti-mousses, et les agents abaissant le point d’écoulement ;

le fluide pour transmission automatique ayant un indice de stabilité au cisaillement exprimé en % et déterminé par le Test de Cisaillement du Palier Conique de 20 heures, situé dans la plage de 1% à 80%.

11. Fluide pour transmission automatique selon la revendication 10, lequel fluide pour transmission automatique a un indice de stabilité au cisaillement exprimé en %, situé dans la plage de 2% à 20%.

Patentansprüche

1. Polyalkyl(meth)acrylat-Copolymer, umfassend Einheiten abgeleitet von:
   
   (A) 12 bis 18 Gew.-% Methylmethacrylat;
   (B) 75 bis 85 Gew.-% von mindestens einem C_{10-15}-Alkyl(meth)acrylat; und
   (C) 2 bis 5 Gew.-% von mindestens einem Stickstoff enthaltenden Dispergiermittelmonomer.

2. Polyalkyl(meth)acrylat-Copolymer, umfassend das/die Reaktionsprodukt(e) von:
   
   (A) 12 bis 18 Gew.-% Methylmethacrylat;
   (B) 75 bis 85 Gew.-% von mindestens einem C_{10-15}-Alkyl(meth)acrylat; und
   (C) 2 bis 5 Gew.-% von mindestens einem Stickstoff enthaltenden Dispergiermittelmonomer. -

3. Copolymer gemäß Anspruch 2 erhältlich durch sequentielle oder gleichzeitige Radikalpolymerisation von (A), (B) und (C).

4. Copolymer gemäß Anspruch 3, wobei das Copolymer ein Zahlenmittel des Molekulargewichts von etwa 5000 bis etwa 50000 aufweist.

5. Schmierölzusammensetzung, umfassend:
   
   (A) ein Öl mit Schmierfähigkeitviskosität; und
   (B) ein Polyalkyl(meth)acrylat-Copolymer gemäß Anspruch 2.

6. Schmierölzusammensetzung gemäß Anspruch 5, wobei die Komponente (B) in einer Menge von 1 bis 20 Gewichtsteilen des aktiven Copolymers pro 100 Gewichtsteile Öl vorhanden ist.


8. Verfahren zur Verbesserung der Kälteeigenschaften eines Öls, wobei dieses Verfahren die Zugabe eines Polyalkyl (meth)acrylat-Copolymers gemäß Anspruch 2 zu einem Öl mit Schmierfähigkeitviskosität umfasst.


10. Automatikgetriebeöl, umfassend:
   
   (A) ein Öl mit Schmierfähigkeitviskosität; und
   (B) ein Polyalkyl(meth)acrylat-Copolymer gemäß Anspruch 2; und
   (C) eine Reinigungsmittel/Hemmstoff-Einheit, wobei die Reinigungsmittel/Hemmstoff-Einheit mindestens ein Additiv ausgewählt aus Antioxidationsmitteln, Korrosionsinhibitoren, Reibungsmodifikatoren, Antiverschleiß-
und Höchstdruckmitteln, Reinigungsmitteln, Dispergiermitteln, Anti-Schaummitteln und Stockpunktverbesserungsmitteln umfasst;

wobei das Automatikgetriebeöl einen prozentualen Scherstabilitätsindex, wie durch den 20-Stunden-Kegellagerscherversuch (20 hour Tapered Bearing Shear Test) ermittelt, im Bereich von 1% bis 80% aufweist.

11. Automatikgetriebeöl gemäß Anspruch 10, wobei das Automatikgetriebeöl einen prozentualen Scherstabilitätsindex im Bereich von 2% bis 20% aufweist.