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## Description

This invention relates to a lubricating composition having improved low and high temperature properties, to its method of preparation, and to its use, particularly as an open gear lubricant.

5 Frequently, lubricating compositions are used in applications that require satisfactory performance at both hot and cold temperature extremes. Examples of these applications include swing gears on mine shovels, large open gears on ball mills, and the like. A major complaint by users of this type of product is that it becomes very brittle at cold temperatures and tends to "run-off" at warmer temperatures.

10 Various combinations of additives have been suggested to rectify this problem. For example, U.S. Patent 3,705,853 discloses a grease composition comprising a lubricating oil, a thickener, and an ethylene terpolymer having a Melt Index in the range of 0.5 to 200. Although viscosity index agents may be present, there is no mention of the grease containing an ethylene copolymer (See also U.S. Patent 3,904,534).

15 However, ethylene copolymers have been incorporated into a variety of lubricating compositions. For example, U.S. Patent 4,115,343 discloses that the storage stability and anti-foaming tendency of organosiloxane polymers in mineral oil can be improved by adding ethylene-vinyl acetate copolymer (EVA) to the dispersion. As another example, U.S. Patent 3,250,714 discloses that EVA is a VI improver for mineral lubricating oils. However, no mention is made of the Melt Index of the polymer. In U.S. Patent 3,947,368, EVA having a Melt Index of from 5 to 580 is used as a pour point depressant in waxy lube oils. No mention is made, however, of a thickener being present.

20 Therefore, none of these references teach or suggest a lubricating composition having the excellent low temperature slumpability and high temperature adhesiveness of the composition described hereinafter.

This invention, in its broadest embodiment, concerns a lubricating composition having improved low temperature and high temperature properties. More specifically, a lubricating composition comprising (1) a lubricating oil, (2) a thickener, (3) a VI improver, and (4) a copolymer of ethylene with at least one compound selected from the group of vinyl acetate, alkyl acrylate, or alkyl methacrylate, has been found to have both excellent high temperature adhesiveness and low temperature slumpability. The ethylene copolymer used in this invention must have a Melt Index of at least about 40 g/10 mins. and should contain from 10 to 40 wt. % vinyl acetate, alkyl acrylate, or alkyl methacrylate. Preferably, the Melt Index should be between 40 and 10,000, more preferably between 40 and 5000, and most preferably between 40 and 2500, g/10 mins. The VI improver is either a polymer of isobutylene, or a copolymer of ethylene, propylene, butene or isobutylene with a C<sub>3</sub> to C<sub>30</sub> olefin.

30 In another embodiment, this invention concerns a method for increasing the slumpability of a lubricating composition at a temperature below about -20°C and increasing its adhesiveness at a temperature above about +20°C.

35 In a further embodiment this invention concerns the use of the above-defined copolymer as an additive in a lubricating composition to improve the low temperature slumpability and high temperature adhesiveness of the lubricating composition.

A wide variety of lubricating oils can be employed in preparing the composition of this invention. Accordingly, the lubricating oil base can be any of the conventionally used mineral oils, synthetic hydrocarbon oils, or synthetic ester oils. In general, these lubricating oils will have a viscosity in the range of 5 to 10,000 cSt at 40°C, although typical applications will require an oil having a viscosity ranging from 10 to 1,000 cSt at 40°C. Mineral lubricating oil base stocks used in preparing the lubricating composition can be any conventionally refined base stocks derived from paraffinic, naphthenic, and mixed base crudes. Synthetic lubricating oils that can be used include esters of dibasic acids such as di-2-ethylhexyl sebacate, esters of glycols such as a C<sub>13</sub> oxo acid diester of tetraethylene glycol, or complex esters such as the ester formed from 1 mole of sebacic acid, 2 moles of tetraethylene glycol, and 2 moles of 2-ethylhexanoic acid. Other synthetic oils that can be used include synthetic hydrocarbons such as polyalphaolefins; alkyl benzenes (e.g., alkylate bottoms from the alkylation of benzene with tetrapropylene, or the copolymers of ethylene and propylene silicon oils, e.g., ethyl phenyl polysiloxanes, methyl polysiloxanes, etc.); polyglycol oils (e.g., those obtained by condensing butyl alcohol with propylene oxide); and carbonate esters (e.g., the product of reacting C<sub>8</sub> oxo alcohol with ethyl carbonate to form a half ester followed by reaction of the latter with tetraethylene glycol, etc.). Other suitable synthetic oils include the polyphenyl ethers, e.g., those having from 3 to 7 ether linkages and 4 to 8 phenyl groups. (See U.S. Patent 3,424,678, column 3.) Normally, the lubricating oil will comprise a major amount of the lubricating composition. Typically, the amount of lubricating oil will range from above 50 to 90 wt. %, preferably from 70 to 85 wt. %, of the lubricating composition.

55 The lubricating composition will also contain a thickener dispersed in the lubricating oil to form a base grease. However, the particular thickener employed is not critical and can vary broadly. For example, the thickener may be based on aluminum, barium, calcium, lithium, sodium soaps, or their complexes. Soap thickeners may be derived from a wide range of animal oils, vegetable oils, and greases as well as the fatty acids derived

therefrom. These materials are well known in the art and are described in, for example, C. J. Boner, *Manufacture and Application of Lubricating Greases*, Chapter 4, Robert E. Krieger Publishing Company, Inc., New York (1971). Carbon black, silica, and clays may be used as well as dyes, polyureas, and other organic thickeners. Pyrrolidone based thickeners can also be used. Preferred thickeners are based on clay, a pyrrolidone, an aluminum soap, a barium soap, a calcium soap, a lithium soap, a sodium soap, or complexes of the soaps. Particularly preferred thickeners are based on lithium soap, calcium soap, aluminum soap, their complexes, or mixtures thereof. More preferred thickeners are based on lithium soap, calcium soap, their complexes, or mixtures thereof. Most preferred is a lithium or lithium complex thickener that incorporates an hydroxy fatty acid having from 12 to 24 (preferably from 16 to 20) carbon atoms. A preferred hydroxy fatty acid is an hydroxy stearic acid (e.g., a 9-hydroxy or a 10-hydroxy stearic acid) of which 12-hydroxy stearic acid is most preferred (See U.S. Patent 3,929,651). The amount of thickener in the lubricating composition will typically range from 1 to 15 wt.%. For most purposes, between 1 to 10 wt.%, preferably between 2 to 5 wt.%, of the thickener will be present in the composition.

A VI improver will be present in the lubricating composition as well. Viscosity modifiers are long chain, generally high molecular weight polymers that impart high and low temperature operability to the lubricating composition by permitting it to remain relatively viscous at elevated temperatures and fluid at low temperatures. Viscosity modifiers may also be derivatized to include other properties or functions, such as the addition of dispersancy properties. Oil soluble viscosity modifying polymers useful in this invention will generally have number average molecular weights of from 300 to  $10^6$ , preferably from 500 to  $10^4$ , and more preferably from 1,000 to 2,000. The amount of VI improvers present in the lubricating composition will vary depending upon the particular VI improver used, its molecular weight, and the like. Typically, however, from 5 to 40 wt.% (preferably from 10 to 30 wt.%) of the lubricating composition will be VI improver.

The VI improver is a polymer of isobutylene or a copolymer of ethylene, propylene, butene, or isobutylene with a  $C_3$  to  $C_{30}$  olefin. A polymer of isobutylene or a copolymer of butene and isobutylene are preferred, with a polymer of isobutylene being particularly preferred. The polymer may be degraded in molecular weight by mastication, extrusion, oxidation, thermal degradation, etc., and may contain oxygen.

The lubricating composition will also contain a copolymer of ethylene with at least one compound selected from the group of vinyl acetate, alkyl acrylate, or alkyl methacrylate. Vinyl acetate is the preferred ethylene copolymer. The copolymer must have a Melt Index of at least about 40 g/10 min and should have a copolymer content of from 10 to 40 wt.%, preferably from 10 to 30 wt.%. Preferably, the Melt Index should range from 40 to 10,000, more preferably from 40 to 5000, and most preferably from 40 to 2500, g/10 mins. The amount of copolymer added should range from 1 to 20 wt.% (preferably from 1 to 10 wt.%) based on total weight of the composition.

The particular VI improvers and polymers employed can be readily obtained in the marketplace from various chemical suppliers. Thus, their methods of preparation are well known to those skilled in the art.

The lubricating composition may also contain small amounts of supplemental additives which include, but are not limited to, anticorrosive agents, extreme pressure antiwear agents, pour point depressants, tackiness agents, oxidation inhibitors, dyes, and the like, which are incorporated for specific purposes. The total amount of these additives will typically range from 2 to 5 wt.% based on total weight of the lubricating composition. In addition, solid lubricants such as molybdenum disulfide and graphite may be present in the composition - typically from 1 to 5 wt.% (preferably from 1.5 to 3 wt.%) for molybdenum disulfide and from 3 to 15 wt.% (preferably from 6 to 12 wt.%) for graphite.

One or more solvents (typically from 10 to 40 wt.%) may be added to the lubricating composition as a diluent to improve its dispensing properties. Suitable solvents include pure hydrocarbon solvents, mixed hydrocarbon solvents, chlorohydrocarbon solvents, or mixtures thereof, which will typically have an atmospheric boiling point between 30° and 300°C.

Suitable pure hydrocarbon solvents include toluene, ortho-xylene, meta-xylene, mesitylene, ethylbenzene, butylbenzene, hexane, heptane, octane, isooctane, or their mixtures. Typically, these solvents will have a solid (or melting) point below about -25°C (preferably below -40°C).

Suitable mixed hydrocarbon solvents include kerosine, varsol, naphtha, or their mixtures. Typically, these solvents will have a pour point below about -25°C, preferably below about -40°C.

Suitable chlorohydrocarbon solvents include n-propylchloride, isopropyl chloride, n-butylchloride, isobutylchloride, sec-butylchloride, pentylchloride, hexylchloride, dichloromethane, trichloromethane, 1,1-dichloroethane, 1,2-dichloroethane, trichloroethylene, chlorobenzene, and their mixtures, with 1,1,1-trichloroethane being particularly preferred.

The lubricating composition of this invention is usually prepared by first dispersing or mixing the thickener in the lubricating oil for from 1 to 8 hours or more (preferably from 1 to 4 hours) followed by heating at elevated temperature (e.g., from 60° to 260°C depending upon the particular thickener used) until the mixture thickens.

The mixture is then cooled to ambient temperature (typically about 25°C) during which time the VI improver, ethylene copolymer, and other additives are added. Although the VI improver and ethylene copolymer can be added together or separately in any order, it is preferred that they be added as described below to obtain a lubricating composition having the desired low and high temperature properties.

As the mixture is cooled, it is preferred to add the ethylene copolymer (e.g., EVA) at a temperature between 120° and 180°C. Although the ethylene copolymer can be added at a temperature outside this range, the copolymer will tend to coalesce at lower temperatures and not be suitably dispersed in the mixture. At higher temperatures, the copolymer may be thermally unstable. Preferably, the VI improver is added at a temperature between 80° and 190°C. Additional lubricating oil may also be added within the latter temperature range to obtain the desired grease consistency and oil viscometric properties. Other additives (such as the supplemental additives and solid lubricants mentioned above) are normally added at a temperature between 50° and 100°C. Finally, at a temperature between ambient and 50°C (preferably between 25° and 40°C), a solvent is added to the mixture to provide the required dispensibility. Lower temperatures are preferred for solvent addition to avoid excessive evaporation. Normally, the composition will be blended or mixed during addition of its components.

The components of the lubricating composition can be mixed, blended, or milled in any number of ways which can readily be selected by one skilled in the art. Suitable means include external mixers, roll mills, internal mixers, Banbury mixers, screw extruders, augers, colloid mills, homogenizers, and the like.

The lubricating composition of this invention may be suitably employed in essentially any application requiring good lubrication at both high and low temperatures. Examples of such applications include open gears, rollers, bearings, wire ropes, cables. The composition, however, is particularly well suited for use as an open gear lubricant.

In another embodiment, this invention concerns a method for increasing the slumpability of a lubricating composition at temperatures below about -20°C and increasing its adhesiveness at temperatures above about +20°C, wherein the composition contains:

- (a) a lubricating oil,
- (b) a thickener, and
- (c) a VI improver, which is a polymer of isobutylene, or a copolymer of ethylene, propylene, butene or isobutylene with a C<sub>3</sub> to C<sub>30</sub> olefin,

which method comprises adding a copolymer of ethylene with at least one compound selected from the group of vinyl acetate, alkyl acrylate, or alkyl methacrylate that has a Melt Index of at least about 40 g/10 min. (preferably from 40 to 10,000, more preferably from 40 to 5000, and most preferably from 40 to 2500, g/10 mins) and a vinyl acetate, alkyl acrylate, or alkyl methacrylate content between 10 and 40 wt.%, preferably between 10 and 30 wt.%, to said composition.

This invention will be further understood by reference to the following Examples which are not intended to restrict the scope of the claims appended hereto.

#### Example 1 - Preparation of the Base Grease Composition

The base grease composition was prepared in a Hobart mixing apparatus. The open mixing vessel was equipped with heat tracing and thermal insulation. The vessel was charged with 300 grams of 12-hydroxy stearic acid and 915 g of 100 SUS at 37.8°C (100°F) hydrotreated naphthenic distillate (available commercially as Exxon oil 1502) and the mixture heated to 70°C with constant agitation. At 70°C, the mixture was neutralized by slowly adding 45 grams of LiOH·H<sub>2</sub>O in 150 grams of water over a one hour period, during which time the temperature was maintained between 70° and 110°C. After alkali addition was completed, the temperature was increased to 150°C and maintained at that temperature until dehydration was completed. The alkali content was determined by acid titration to be 0.2 mass% (expressed as NaOH equivalent), which indicates neutralization is complete. The temperature of the mixture was then increased to between 190° and 200°C and maintained within that range for about 30 minutes. Following this "cook-out", the mixture was then cooled to about 120°C by the slow addition of 500 grams of Pennsylvania Resin (2600 SUS at 98.9°C (210°F) and 500 grams of polybutene (800 cSt at 100°C), followed by the addition of 345 grams of Penn Resin and 86 grams of polybutene to obtain the desired oil viscosity (about 1000 cSt at 40°C). Additional oil (3000 grams) was then added in six 500 gram aliquots, each containing 195 grams of 1502 oil, 180 grams of Penn Resin, and 125 grams of polybutene to obtain softer grease consistency while maintaining the desired ratio of mineral oil to VI improver. Oil additions were performed slowly to avoid formation of a separate oil phase. The composition was then passed once through a Charlotte colloid mill. The milled product had a cone penetration of 298 mm/10 as determined by ASTM D217.

A 3000 gram aliquot of the 298 mm/10 penetration product was returned to the mixing vessel and six additional 500 gram aliquots of the 1502/Penn Resin/polybutene blend added. Because the mixing vessel was

too small to obtain a base grease having the proper consistency, about 1000 grams of product were removed from the mixing vessel and another 500 gram aliquot of the blend added to the remaining product. The resulting final base grease had a consistency of 367 mm/10 as determined by ASTM D217 and the following composition:

|    |                                        |           |
|----|----------------------------------------|-----------|
| 5  | Lithium Hydroxide•H <sub>2</sub> O     | 0.25 wt%  |
|    | 12-Hydroxystearic Acid                 | 1.69 wt%  |
|    | 100 SUS @ 100°F Hydrotreated           |           |
| 10 | Naphthenic Distillate                  | 38.22 wt% |
|    | Pennsylvania Resin (2600 SUS at 98.9°C | 35.31 wt% |
|    | (210°F))                               |           |
| 15 | Polybutene (800 cSt at 100°C)          | 24.53 wt% |

The lubricating compositions employed in Examples 2 and 3 (below) were prepared from this base grease as follows. About 400 g of base grease was mixed with the required amount of each of the following commercially available polymers at 125°C. The 60 strokes worked penetration of each mixture was then measured by ASTM D217.

Table 1

|    |                |                                                                             |                                        |
|----|----------------|-----------------------------------------------------------------------------|----------------------------------------|
| 25 | <u>Polymer</u> | <u>Description</u>                                                          | <u>Melt Index,</u><br><u>g/10 min.</u> |
|    | A              | Ethylene vinyl acetate,<br>14% VA                                           | 2500                                   |
| 30 | B              | Ethylene vinyl acetate, 28% VA                                              | 2500                                   |
|    | C              | Ethylene vinyl acetate, 12% VA                                              | 10                                     |
| 35 | D              | Ethylene vinyl acetate, 28% VA                                              | 39                                     |
|    | E              | Styrene-butadiene-styrene, 70%<br>butadiene/30% styrene (SBS)<br>MW 160,000 | -                                      |
| 40 | F              | Linear low density polyethylene<br>(LLDPE)                                  | 20                                     |

45 The mixtures were then cooled and mixed with trichloroethane to obtain a final solvent concentration of 25 wt.% in the compositions tested.

#### Example 2 - Effect of Various Polymers on Low Temperature Slumpability

50 The tendency of each polymer modified composition prepared in Example 1 to slump (i.e. flow) was determined from the Cone Yield Value. To determine the Cone Yield, a round 90 mm diameter by 60 mm deep container was filled with a sample of each composition and the surface smoothed with a spatula if required. Each sample was cold soaked for 4 hours at -40°C and then the penetration determined with a standard grease penetrometer, the description of which is given in ASTM D217. For this measurement, a special right-angle cone measuring 62 mm at the base was used. The total weight of the cone and shaft was 66.7 grams. The penetration at -40°C was measured after 10 seconds instead of the 5 seconds employed in the usual test with the standard cone. The measurement was made within one minute of removing the sample from the cold box to avoid undue warming of the sample. The Cone Yield was calculated from the penetration at -40°C using the formula shown

below:

$$\text{Cone Yield @-40°C} = \frac{(\text{weight of cone} + \text{shaft})}{\pi (\text{Pen @-40°C}/100)^2}$$

Past experience has shown that Cone Yield values of less than about 80 are characteristic of lubricants with good slumpability.

The Cone Yield Value of each sample was determined and the results obtained summarized in Table 2.

Table 2

| <u>Polymer</u> | <u>MI</u> | <u>Conc., wt%</u> | <u>X60 Pen.<br/>mm/10 (1)</u> | <u>Pen @-40°C,<br/>mm/10 (2)</u> | <u>Cone Yield,<br/>g/cm<sup>2</sup></u> |
|----------------|-----------|-------------------|-------------------------------|----------------------------------|-----------------------------------------|
| A              | 2500      | 2                 | 390                           | 60                               | 59                                      |
| B              | 2500      | "                 | 378                           | 55                               | 70                                      |
| C              | 10        | "                 | 358                           | 60                               | 59                                      |
| D              | 39        | "                 | 374                           | 39                               | 39 (3)                                  |
| E              | -         | "                 | 375                           | 53                               | 76                                      |
| F              | 20        | "                 | 355                           | 74                               | 39                                      |
| A              | 2500      | 6                 | 370                           | 92                               | 25                                      |
| B              | 2500      | "                 | 364                           | 51                               | 81                                      |
| C              | 10        | "                 | 347                           | 83                               | 30                                      |
| D              | 39        | "                 | 347                           | 29                               | -                                       |
| E              | -         | "                 | 240                           | 20                               | 532                                     |
| F              | 20        | "                 | (4)                           | (4)                              | (4)                                     |

- (1) 60 strokes worked penetration before solvent addition.
- (2) Penetration at -40°C on final product.
- (3) An average of duplicate samples which gave yields of 34 and 43.
- (4) Sample was not prepared because the polymer could not be dispersed in the base grease.

The data in Table 2 show that the samples containing polymers A-F have good slumpability at -40°C and a concentration of 2 wt.%. However, at a concentration of 6 wt.%, the sample containing polymer E had poor slumpability and the sample containing polymer F could not be prepared.

### Example 3 - Effect of Various Polymers on High Temperature Adhesiveness

The adhesiveness of the samples prepared in Example 1 was determined by spreading 10 grams of each sample on separate aluminum plates. The plates were then suspended vertically in a circulating oven for 24 hours at 65°C. The change in weight of each plate was then calculated on a solvent-free basis and the degree of surface coverage estimated visually. The results of these tests are shown in Table 3.

Table 3

| Polymer | MI   | Conc., wt% | X60 Pen.<br>mm/10 (1) | Weight Loss, wt% (2) | Bare Surface, Area % |
|---------|------|------------|-----------------------|----------------------|----------------------|
| None    | -    | -          | 367                   | 72                   | 80% bare patch       |
| A       | 2500 | 2          | 390                   | 54                   | Even coverage        |
| B       | 2500 | "          | 378                   | 48                   | Even coverage        |
| C       | 10   | "          | 358                   | 41                   | 20% bare patch       |
| D       | 39   | "          | 374                   | 40                   | Even coverage        |
| E       | -    | "          | 375                   | 76                   | 60% bare patch       |
| F       | 20   | "          | 355                   | 40                   | 40% bare patch       |
| A       | 2500 | 6          | 370                   | 69                   | Even coverage        |
| B       | 2500 | "          | 364                   | 66                   | Even coverage        |
| C       | 10   | "          | 347                   | 63                   | 60% bare patch       |

(1) Values from Table 2.

(2) Weight loss is based on the trichloroethane-free product.

The data in Table 3 show that the samples containing 2500 MI EVA's (polymers A and B) performed well at concentrations of 2 and 6 wt.%, with observed weight losses ranging from 48 to 69%. Most important, however, at the end of the test the remaining composition formed an evenly distributed adhesive coating on the plate, with no bare surface evident. The sample containing polymer D (39 MI EVA) also performed well at a concentration of 2 wt.%. Both samples containing the SBS 416 (polymer E) and the LLDPE (polymer F) performed poorly, with large bare areas visible at the termination of the test period. Thus, only a lubricating composition containing polymers A, B, and D provided good adhesiveness at 65°C.

The data in Tables 2 and 3 show that both good adhesion at high temperature and good slumpability at low temperature are obtained for the samples containing polymers A, B and D -- that is, ethylene-vinyl acetate copolymers having a Melt Index of at least about 40 g/mins. (most preferably from 40 to 2500 g/10 mins) and containing between 10 and 40 wt.% (preferably between 10 and 30 wt.%) vinyl acetate.

## Claims

1. A lubricating composition which comprises :

a) a lubricating oil,

b) a thickener,

c) a VI improver which is a polymer of isobutylene, or a copolymer of ethylene, propylene, butene or isobutylene with a C<sub>3</sub> to C<sub>30</sub> olefin, and

d) a copolymer of ethylene with at least one compound selected from the group of vinyl acetate, alkyl acrylate, and alkyl methacrylate, wherein the copolymer has a Melt Index of at least about 40 g/10 min. and a vinyl acetate, alkyl acrylate, or alkyl methacrylate content between 10 and 40 wt.%.

2. The composition of claim 1 which comprises :

a) from above 50 to 90 wt.% of the lubricating oil,

b) from 1 to 15 wt.% of the thickener,

c) from 5 to 40 wt.% of the VI improver, and

d) from 1 to 20 wt.% of the said copolymer.

3. The composition of claim 1 or 2 wherein the thickener is based on clay, a pyrrolidone, an aluminium soap, a barium soap, a calcium soap, a lithium soap, a sodium soap, complexes of the said soaps, or mixtures thereof.

4. The composition of claim 3 wherein the thickener is a lithium soap or a lithium complex soap based on an hydroxy fatty acid having from 12 to 24 carbon atoms.

5. The composition of claim 4 wherein the hydroxy fatty acid comprises a hydroxy stearic acid.

6. The composition of claim 5 wherein the hydroxy stearic acid comprises 12-hydroxy stearic acid.

7. The composition of any preceding claim wherein the copolymer in d) has a Melt Index in the range of 40 to 10,000 g/10 mins, preferably from 40 to 2500 g/10 mins.

8. The composition of any preceding claim wherein the said copolymer in d) comprises ethylene-vinyl acetate and the vinyl acetate content is between 10 and 30 wt.%.

9. A method for increasing the slumpability of a lubricating composition at temperatures below about -20°C and increasing its adhesiveness at temperatures about +20°C, wherein the composition contains :

a) from above 50 to 90 wt.% of a lubricating oil,

b) from 1 to 15 wt.% of a thickener, and

c) from 5 to 40 wt.% of a VI improver, which is a polymer of isobutylene, or a copolymer of ethylene, propylene, butene or isobutylene with a C<sub>3</sub> to C<sub>30</sub> olefin,

which method comprises adding to the lubricating composition from 1 to 20 wt.% of a copolymer, the copolymer consisting of ethylene with at least one compound selected from the group of vinyl acetate, alkyl acrylate, or alkyl methacrylate, wherein the copolymer has a Melt Index of at least about 40 g/10 min. and a vinyl acetate, alkyl acrylate, or alkyl methacrylate content between 10 and 40 wt.%.

10. Use of a copolymer of ethylene and at least one compound selected from the group of vinyl acetate, alkyl acrylate and alkyl methacrylate, wherein the copolymer has a Melt Index of at least about 40 g/10 min. and a vinyl acetate, alkyl acrylate or alkyl methacrylate content of between 10 and 40 wt.%, as an additive in a lubricating composition to improve the low temperature slumpability and high temperature adhesiveness of the lubricating composition.

**Patentansprüche**

1. Schmierstoffzusammensetzung, die
  - a) Schmieröl,
  - b) Verdickungsmittel,
  - c) VI Verbesserer, der ein Isobutylenpolymer oder ein Copolymer aus Ethylen, Propylen, Buten oder Isobuten mit einem C<sub>3</sub> bis C<sub>30</sub> Olefin ist, und
  - d) Copolymer aus Ethylen mit zumindestens einer Verbindung, ausgewählt aus der Gruppe von Vinylacetat, Alkylacrylat und Alkylmethacrylat, wobei das Copolymer einen Schmelzindex von mindestens etwa 40 g/10 min. und einen Gehalt an Vinylacetat, Alkylacrylat oder Alkylmethacrylat zwischen 10 und 40 Gew.% hat, enthält.
2. Zusammensetzung nach Anspruch 1, die
  - a) über 50 bis 90 Gew.% von dem Schmieröl,
  - b) 1 bis 15 Gew.% von dem Verdickungsmittel,
  - c) 5 bis 40 Gew.% von dem VI Verbesserer,
  - d) 1 bis 20 Gew.% von dem Copolymer enthält.
3. Zusammensetzung nach Anspruch 1 oder Anspruch 2, bei dem das Verdickungsmittel auf Ton, einem Pyrrolidon, einer Aluminiumseife, einer Bariumseife, einer Calciumseife, einer Lithiumseife, einer Natriumseife, Komplexen dieser Seifen oder Mischungen hiervon basiert.
4. Zusammensetzung nach Anspruch 3, bei dem der Verdicker eine Lithiumseife oder eine Lithiumkomplexseife, basierend auf einer Hydroxyfettsäure mit 12 bis 24 Kohlenstoffatomen, ist.
5. Zusammensetzung nach Anspruch 4, bei dem die Hydroxyfettsäure aus einer Hydroxystearinsäure besteht.
6. Zusammensetzung nach Anspruch 5, bei dem die Hydroxystearinsäure aus 12-Hydroxystearinsäure besteht.
7. Zusammensetzung nach einem der vorhergehenden Ansprüche, bei der das Copolymer in d) einen Schmelzindex im Bereich von 40 bis 10 000 g/10 min, vorzugsweise von 40 bis 2500 g/10 min aufweist.
8. Zusammensetzung nach einem der vorhergehenden Ansprüche, bei der das Copolymer in d) Ethylen-Vinylacetat enthält, und der Vinylacetatgehalt zwischen 10 und 30 Gew.% liegt.
9. Verfahren zur Erhöhung der Walkpenetration einer Schmierstoffzusammensetzung bei Temperaturen unter etwa -20°C und Erhöhung der Haftfähigkeit bei Temperaturen von etwa +20°C, wobei die Zusammensetzung
  - a) über 50 bis 90 Gew.% ein Schmieröl,
  - b) 1 bis 15 Gew.% ein Verdickungsmittel,
  - c) 5 bis 40 Gew.% einen VI Verbesserer, der ein Polymer aus Isobutylen, oder ein Copolymer aus Ethylen, Propylen, Buten oder Isobutylen mit einem C<sub>3</sub> bis C<sub>30</sub> Olefin ist,
 enthält, bei dem das Verfahren die Zugabe von 1 bis 20 Gew.% eines Copolymers zu der Schmierölmischung umfaßt, das Copolymer aus Ethylen mit zumindestens einer Verbindung ausgewählt aus der Gruppe von Vinylacetat, Alkylacrylat oder Alkylmethacrylat besteht, wobei das Copolymer einen Schmelzindex von mindestens etwa 40 g/10 min und einen Gehalt an Vinylacetat, Alkylacrylat oder Alkylmethacrylat zwischen 10 und 40 Gew.% aufweist.
10. Verwendung eines Copolymeren aus Ethylen und mindestens einer Verbindung ausgewählt aus der Gruppe von Vinylacetat, Alkylacrylat und Alkylmethacrylat, wobei das Copolymer einen Schmelzindex von mindestens etwa 40 g/10 min und einen Gehalt an Vinylacetat, Alkylacrylat oder Alkylmethacrylat zwischen 10 und 40 Gew.% hat, als Additiv in einer Schmierstoffzusammensetzung zur Verbesserung der Tieftemperatur-Walkpenetration und der Hochtemperatur-Haftfähigkeit der Schmierstoffzusammensetzung.

**Revendications**

1. Une composition lubrifiante qui comprend
  - a) une huile lubrifiante,
  - b) un épaississant,
  - c) un améliorant d'indice de viscosité qui est un polymère d'isobutylène, ou un copolymère d'éthylène, de propylène, de butène ou d'isobutylène avec une oléfine en C<sub>3</sub> à C<sub>30</sub> et
  - d) un copolymère d'éthylène avec au moins un composé choisi dans le groupe des acétate de vinyle, acrylate d'alkyle et méthacrylate d'alkyle, le copolymère ayant un indice de fluidité d'au moins environ 40 g/10 min. et une teneur en acétate de vinyle, acrylate d'alkyle ou méthacrylate d'alkyle entre 10 et 40% en poids.

2. La composition selon la revendication 1 qui comprend
  - a) de plus de 50 à 90% en poids de l'huile lubrifiante,
  - b) de 1 à 15% en poids de l'épaississant,
  - c) de 5 à 40% en poids de l'améliorant d'indice de viscosité et
  - d) de 1 à 20% en poids dudit copolymère.
3. La composition selon la revendication 1 ou 2, dans laquelle l'épaississant est à base d'argile, d'une pyrrolidone, d'un savon d'aluminium, d'un savon de baryum, d'un savon de calcium, d'un savon de lithium, d'un savon de sodium, de complexes desdits savons ou de leurs mélanges.
4. La composition selon la revendication 3, dans laquelle l'épaississant est un savon de lithium ou un savon complexe de lithium à base d'un acide gras hydroxylé comportant 12 à 24 atomes de carbone.
5. La composition selon la revendication 4, dans laquelle l'acide gras hydroxylé comprend un acide hydroxystéarique.
6. La composition selon la revendication 5 dans laquelle l'acide hydroxystéarique comprend de l'acide 12-hydroxystéarique.
7. La composition selon l'une des revendications précédentes, dans laquelle le copolymère dans d) possède un indice de fluidité dans la gamme de 40 à 10.000 g/10 min., de préférence de 40 à 2.500 g/10 min.
8. La composition selon l'une des revendications précédentes, dans laquelle ledit copolymère dans d) comprend de l'éthylène-acétate de vinyle et la teneur en acétate de vinyle se situe entre 10 et 30% en poids.
9. Un procédé pour augmenter la pénétrabilité d'une composition lubrifiante à des températures inférieures à environ -20°C et accroître son adhésivité à des températures d'environ +20°C, dans lequel la composition contient
  - a) de plus de 50 à 90% en poids d'une huile lubrifiante,
  - b) de 1 à 15% en poids d'un épaississant et
  - c) de 5 à 40% en poids d'un améliorant d'indice de viscosité qui est un polymère d'isobutylène ou un copolymère d'éthylène, de propylène, de butène ou d'isobutylène avec une oléfine en C<sub>3</sub> à C<sub>30</sub>,lequel procédé consiste à ajouter à la composition lubrifiante de 1 à 20% en poids d'un copolymère, le copolymère consistant en éthylène avec au moins un composé choisi dans le groupe des acétate de vinyle, acrylate d'alkyle ou méthacrylate d'alkyle, le copolymère possédant un indice de fluidité d'au moins environ 40 g/10 min. et une teneur en acétate de vinyle, acrylate d'alkyle ou méthacrylate d'alkyle entre 10 et 40% en poids.
10. Utilisation d'un copolymère d'éthylène et d'au moins un composé choisi dans le groupe des acétate de vinyle, acrylate d'alkyle ou méthacrylate d'alkyle, dans laquelle le copolymère a un indice de fluidité d'au moins 40 g/10 min. environ et une teneur en acétate de vinyle, en acrylate d'alkyle ou méthacrylate d'alkyle comprise entre 10 et 40% en poids, comme additif dans une composition lubrifiante afin d'améliorer la pénétrabilité à basses températures et l'adhésivité à hautes températures de la composition lubrifiante.