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[54] **LUBRICANT CONTAINING DISPERSANT-POUR DEPRESSANT POLYMER**

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[58] **Field of Search** ..... 252/51.5 A, 51.5 R; 260/80.6, 80.81, 80.73

[56] **References Cited**

UNITED STATES PATENTS

2,889,282	6/1959	Lorensen et al.	252/51.5 A
2,957,854	10/1960	Lorensen et al.	260/80.73 X
3,087,936	4/1963	Le Suer	252/51.5 A X
3,100,749	8/1963	Wittner et al.	252/51.5 A X
3,108,967	10/1963	Bailey	252/51.5 A
3,142,664	7/1964	Bauer	252/51.5 A X
3,147,222	9/1964	Bauer	252/51.5 A
3,179,591	4/1965	Herbert	252/51.5 A
3,210,282	10/1965	Bearden	252/51.5 A
3,418,296	12/1968	Bearden	260/80.73 X

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[57] **ABSTRACT**

Lubricating oil composition comprising a major proportion of lubricating oil and, as a dispersant-pour depressant additive, a minor proportion of a copolymer of (a) two or more C_6–C_{18} alkyl esters of acrylic or methacrylic acid, including at least one C_6–C_{12} alkyl ester and at least one C_{13}–C_{18} alkyl ester, and (b) a nitrogen-containing ethylenically unsaturated monomer. The polymeric additives have a number average molecular weight of about 2,000 to about 20,000, a nitrogen content of about 0.2 to about 5 percent by weight, and are prepared from a monomer mixture which initially is essentially free from polymer.

6 Claims, No Drawings

LUBRICANT CONTAINING DISPERSANT-POUR DEPRESSANT POLYMER

BACKGROUND OF THE INVENTION

The present invention relates to lubricating oil compositions containing polymeric dispersant-pour depressant additives, and to novel dispersant-pour depressant copolymers.

It is known that the pour point of a mineral lubricating oil can be lowered by blending therewith a minor amount of a polymer of one or more alkyl esters of an unsaturated monocarboxylic or dicarboxylic acid. For example, polyalkyl methacrylates are disclosed as pour point depressant additives for automatic transmission fluids in U.S. Pat. No. 2,710,842. Copolymers of vinyl acetate with mixed alkyl fumarates are described as lubricating oil pour depressant additives in U.S. Pat. Nos. 2,666,747 and 2,936,300; while U.S. Pat. No. 2,694,685 describes copolymers of vinyl acetate with mixed dialkyl maleates in which the alkyl radicals contain from about 10 to 18 carbon atoms, as pour point depressants.

Polymeric additives which improve both the dispersancy and the pour point of lubricating oils are also known. Dispersant properties are usually imparted to the copolymer by the inclusion of a nitrogen-containing ethylenically unsaturated monomer. For example, copolymers of a nitrogenous monomer with C_8 and C_{16} alkyl furmarates and vinyl acetate are disclosed as lubricating oil additives for various purposes, including improved detergency and lower pour point, in U.S. Pat. Nos. 3,058,956 and 3,342,788.

U.S. Pat. No. 3,304,260 describes the use of dispersant-viscosity index improver copolymers of mixed alkyl acrylates and polar (including nitrogenous) monomers.

The use of graft copolymers as lubricating oil additives is also known. For example, U.S. Pat. No. 3,089,832 discloses graft copolymers, prepared by grafting various monomers (including mixed acrylates and methacrylates) to a polymer, e.g., polyisobutylene, in the presence of ionizing radiation, as multifunctional lubricating oil additives. Thus, graft copolymers of polyisobutylene with methyl methacrylate were found to have good pour depressant and viscosity index improvement properties, while graft copolymers of polyisobutylene with vinyl pyrrolidone had good sludge dispersant properties. A polymeric additive which has both dispersant and pour point depressant action in lubricating oil can be prepared by polymerizing various monomers, e.g., mixed alkyl acrylates with poly-N-vinyl-2-pyrrolidinone, according to U.S. Pat. No. 3,214,498. Oil soluble graft copolymers having dispersant and pour depressant properties and containing a mixed alkyl acrylate backbone can be prepared according to U.S. Pat. No. 3,509,055.

Various copolymers containing alkyl acrylates or methacrylates can also be used as pour point depressants in fuel oil and middle distillate fractions. U.S. Pat. No. 3,447,915 discloses a terpolymer of ethylene, propylene, and $C_{1\text{-}12}$ alkyl esters of acrylic and methacrylic acids, while U.S. Pat. No. 3,445,205 discloses that $C_{8\text{-}24}$ alkyl acrylates and methacrylates are pour depressants in distillate fuel oil compositions. U.S. Pat. No. 3,462,249 discloses graft copolymers of ethylene grafted to various polymers, including lauryl acrylate-ethyl acrylate and C_8 oxoacrylate-butyl acrylate, as pour depressants in middle distillates and other petroleum fractions.

SUMMARY OF THE INVENTION

It has been found according to this invention that improvided sludge dispersancy and depressed pour point can be imparted to a mineral lubricating oil by adding thereto a minor amount of a copolymer formed by copolymerizing (a) a mixture of alkyl esters of acrylic or methacrylic acid in which the alkyl radicals contain from 6 to 18 carbon atoms, including at least one C_6–C_{12} alkyl ester and at least one C_{13}–C_{18} alkyl ester, and (b) a nitrogen-containing ethylenically unsaturated monomer, from a monomer mixture which initially contains no polymer. The polymeric products have a number average molecular weight of about 2,000 to about 20,000, and a nitrogen content of about 0.2 percent by weight to about 5 percent by weight.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The polymeric additives of this invention are dispersant-pour depressant additives for addition to lubricating oil and particularly mineral lubricating oil in minor amounts. The constituent monomers include a mixture of two or more alkyl acrylates or methacrylates, and a nitrogen-containing ethylenically unsaturated monomer. The mixture of alkyl radicals in the alkyl esters of acrylic and methacrylic acids in this invention differs significantly from the mixture of alkyl radicals which are known in the art. In most polymeric additives prepared according to the present invention, C_{12} alkyl (i.e., dodecyl) radicals are missing, while in polymeric additives in the art containing an alkyl (or dialkyl) radical of an unsaturated carboxylic acid, the C_{12} alkyl radical is frequently the predominant constituent.

The polymers prepared according to this invention include at least two C_6–C_{18} alkyl acrylates or methacrylates, including at least one C_6–C_{12} alkyl acrylate or methacrylate and at least one C_{13}–C_{18} alkyl acrylate or methacrylate. Monomers in the first or lower molecular weight group of acrylates and methacrylates (the C_6–C_{12} esters) include hexyl acrylate, octyl acrylate, decyl acrylate, dodecyl acrylate, hexyl methacrylate, octyl methacrylate, and decyl methacrylate and dodecyl methacrylate. Esters in the higher molecular weight group (the C_{13}–C_{18} alkyl acrylates or methacrylates) include tetradecyl acrylate, hexadecyl acrylate (cetyl acrylate), octadecyl acrylate, tetradecyl methacrylate, hexadecyl methacrylate, and octadecyl methacrylate. It is understood that the alkyl radical may have an odd number of carbon atoms, although esters in which the alkyl radicals have an even number of carbon atoms are generally used because only the alkyl alcohols having an even number of carbon atoms are abundantly available. All alkyl radicals herein are straight chain alkyl radicals.

Preferred monomer mixtures of alkyl acrylates and methacrylates are those containing one or more C_8 or C_{10} alkyl esters and one or more C_{14} and C_{16} alkyl esters. It is preferred that the heaviest member of the lower alkyl ester subgroup have an alkyl chain length of at least 4 carbons less than the lowest molecular weight member of the higher alkyl ester subgroup. Especially preferred mixtures are mixtures of C_{10} and C_{16} alkyl acrylates or methacrylates. Mixtures of C_8, C_{10},

C_{14} and C_{16} alkyl acrylates also give good results, but mixtures of C_8, C_{10} C_{14} and C_{16} alkyl methacrylates did not give good pour point lowering. Mixtures of C_{12} and C_{16} alkyl acrylates or methacrylates can be used in some cases, but are less preferred since the pour point depressancy obtained with such mixtures is not always good; when a mixture of C_{12} and C_{16} alkyl esters is used, the molar quantity of C_{16} esters should exceed the molar quantity of C_{12} ester. Ordinarily, all of the alkyl esters in a given polymer will have the same acid moiety; i.e., the mixture of alkyl esters will be a mixture of alkyl acrylates or a mixture of alkyl methacrylates.

Alkyl acrylates or methacrylates in which the alkyl radical contains less than 6 carbon atoms are generally excluded, since the presence of lower alkyl acrylates or methacrylates in which the alkyl radical contains less than 6 carbon atoms tends to cause the copolymer to be partially insoluble in lubricating oil. On the other hand, alkyl esters in which the alkyl group contains 20 or more carbon atoms are also generally not used, since the resulting additives are prone to crystallize out of lubricating oil at low temperatures.

Conventional nitrogen containing ethylenically unsaturated monomers can be incorporated in the copolymers of this invention in order to obtain sludge dispersancy. Such nitrogenous monomers include, for example, N,N-dimethylaminoethyl acrylate, N,N-dimethylaminoethyl butyl fumarate, N,N-dimethylaminoethyl methacrylate, and 4-vinyl pyridine. The amount of nitrogenous monomer is sufficient to impart dispersancy to the resulting copolymer, and is generally an amount which will give a copolymer containing about 0.2 to about 5 percent by weight of nitrogen, preferably about 1 percent to about 4 percent by weight of nitrogen.

The polymeric additives of this invention have number average molecular weights of about 2,000 to about 20,000, as previously noted; preferred number average molecular weights are in the range of about 6,000 to about 10,000. Number average molecular weight can be correlated with intrinsic viscosity, as measured in heptane at 25°C., according to the equation:

$$[\eta]=(2.72)(10^{-5})(M_n^-)^{0.9}$$

The copolymers of this invention can be prepared by conventional free radical polymerization techniques, starting with a mixture of all of the constituent monomers which is essentially free of polymer. Thus, the polymers of this invention are random copolymers and are not graft or block copolymers. Conventional free radical polymerization catalysts, such as azobis (isobutyronitrile) and tert butyl hydroperoxide can be used.

Polymerization according to the present invention is preferably carried out in an inert solvent, such as hexane or heptane. Alternatively, bulk polymerization can be used. Polymerization must be carried out in an oxygen-free reactor. The desired atmosphere can be maintained by carrying out the polymerization in a nitrogen atmosphere as known in the art. Temperatures of about 65° to about 120°C., depending on the choice of initiator, can be used. Polymerization can be carried out at either atmospheric or super-atmospheric pressure. Polymerization can be carried out on either a batch or a continuous basis. Polymerization can be stopped when the desired degree of polymerization is reached by known techniques, such as adding inhibitors to the reaction mixture, or can be allowed to go to completion.

The polymeric additives of this invention are added to mineral lubricating oil in amounts ranging from about 0.2 percent to about 2 percent by weight of additive. Preferred amounts are ordinarily about 0.2 percent by weight to about 0.5 percent by weight of additive.

The lubricating oil base stocks used in the compositions of this invention may be straight mineral lubricating oils or distillates derived from paraffinic, naphthenic, asphaltic, or mixed base crudes, or, if desired, various blended oils may be employed as well as residuals, particularly those from which asphaltic constituents have been removed. The oils may be refined by conventional methods using acid, alkali, and/or clay or other agents such as aluminum chloride, or they may be extracted oils produced, for example, by solvent extraction with solvents of the type of phenol, sulfur dioxide, furfural, dichlorodiethyl ether, nitrobenzene, crotonaldehyde, etc.

The lubricating oil base stock ordinarily has a viscosity of about 40 to about 350 Saybolt seconds (SUS) at 100°F. These oils, in the absence of a pour point depressant, normally have pour points of about 15° to about 0°F. depending on the extent of dewaxing.

In addition to the polymeric additive of the present invention, other additives may also be used such as dyes, viscosity index improvers, heat thickened fatty oils, sulfurized fatty oils, organometallic compounds, metallic or other salts, any antioxidants, thickeners, detergents, and the like.

The compositions of the present invention can be prepared by first blending the polymer with an oil to prepare a concentrate, and then blending this concentrate with lubricating oil base stock to obtain the compositions of this invention. A typical concentrate will have a concentration of about 30 to about 60 percent by weight of polymeric additive in a suitable solvent, which may be the base oil itself or a solvent which is completely miscible with the base lubricating oil. The concentration of polymeric additive in the concentrate is not critical.

A major advantage of the dispersant-pour depressant additives of this invention is that they are compatible with ethylene-propylene and other ethylene-alpha olefin copolymer viscosity index improvers, such as those described in U.S. Pat. No. 3,551,336. Some other commercial pour depressant additives, on the other hand, have been found to be incompatible with these same ethylene-alpha olefin copolymer viscosity index improvers when tested at 4 percent (by weight) of viscosity index improver. Precipitation of pour depressant additive is observed in such instances. The compositions of the present invention include compositions comprising (1) a major proportion of lubricating oil; (2) a minor proportion, sufficient to improve the pour depressancy and dispersancy characteristics of said composition, of a copolymer of (a) at least two C_6–C_{18} alkyl esters of acrylic or methacrylic acid including at least one C_6–C_{12} alkyl ester and at least one C_{13}–C_{18} alkyl ester, and (b) a nitrogen containing ethylenically unsaturated monomer, said copolymer having a number average molecular weight of about 2,000 to about 20,000 and a nitrogen content of about 0.2 percent to about 5 percent by weight; and (3) a minor amount of an ethylene-alpha-olefin copolymer viscosity index improver. Ethylene-alpha-olefin copolymer viscosity

index improvers are known in the art; see, for example, U.S. Pat. Nos. 3,522,180; 3,551,336; and 3,598,738. Generally, the viscosity index improver is a copolymer of ethylene and a C_3–C_{18} alpha olefin containing about 30 to about 80 mole percent ethylene and having a viscosity average molecular weight of about 10,000 to about 200,000. Preferably, the viscosity index improving copolymer is an ethylenepropylene copolymer having an ethylene content and molecular weight as above stated. According to another preferred embodiment, the viscosity index improving copolymer is a copolymer formed by copolymerizing ethylene and a C_3–C_{18} alpha olefin as described in U.S. Pat. No. 3,551,336. Such polymer is characterized by an ethylene content within the range of about 60 to about 80 mole percent, a degree of crystallinity less than about 25 percent, a viscosity average molecular weight within the range between about 10,000 and 200,000, and no more than about 1.3 percent by weight of a polymer fraction which is insoluble in normal decane at 45°C. (Preferably there is no fraction which is insoluble in normal decane at 45°C.) Preferred copolymers of this type are ethylene-propylene copolymers having the above stated characteristics. The preparation of copolymers of this type is fully described in the aforesaid U.S. Pat. No. 3,551,336. Mixtures of two (or more) ethylene-alpha olefin copolymers can be used in lieu of a single copolymer as a viscosity index improver additive if desired. When mixtures are used, the preferred mixture is a mixture of two ethylene-alpha olefin copolymers (preferably ethylene-propylene copolymers) of different ethylene contents, one of which is a copolymer containing 60 to 80 mole percent ethylene as defined in U.S. Pat. No. 3,551,336, and the other of which is a copolymer of lower ethylene content. Such copolymer mixtures as V.I. improver additives are described and claimed in the copending application of Lawrence J. Engel et al., Ser. No. 42,869, filed June 2, 1970 and now U.S. Pat. No. 3,697,429.

This invention will now be described further with reference to the examples which follow.

EXAMPLE 1

A series of five polymers, designated 1 to 5 inclusive, were prepared by copolymerizing equimolar quantities of octyl acrylate, decyl acrylate, tetradecyl acrylate, and hexadecyl acrylate (0.02 moles each) with varying quantities of N,N-dimethylaminoethyl acrylate as indicated in Table I below. The monomer mixture for Polymer 5 also included isobutyl acrylate. All polymerizations were carried out at 60°C. in a solution of 25.0 grams of heptane containing 0.6 grams of azo-bis (isobutyronitrile) as a free radical initiator. Polymerizations were carried out in a nitrogen atmosphere. In each run, a mixture of monomers, free radical initiator, and solvent was charged to a 200-ml. glass pressure bottle and replaced air by purging with nitrogen. The bottle was then capped and immersed in an oil bath having a temperature of 65°F. for 6 hours. The polymerization mixture was stirred with a magnetic stirrer during this time. The polymeric products were washed with methanol to remove residual monomers. The polymers were then dried at 70°C. under vacuum. Yields and nitrogen analyses, both theoretical and experimental, in weight percent N are indicated in Table I below.

Pour points and dispersancy characteristics of lubricating oils containing each of the polymer additives prepared according to this example were determined. Two reference oils, designated Base Oil A and Base Oil B, respectively, were used in making these determinations. Base Oil A was a solvent extracted, neutral, paraffinic type oil having a viscosity of 150 SUS at 100°F., containing a small amount of solvent extracted, neutral, paraffinic type oil having a viscosity of 330 SUS at 100°F., and also containing a detergent additive, and having a pour point of 0° to −5°F. Base Oil B was a blend of 99 percent by weight of Base Oil A and 1.0 percent by weight of a viscosity index improver, and had a pour point of 0° to −5°F. The viscosity index improver was an ethylene-propylene copolymer containing about 67 percent by weight of ethylene and having a viscosity average molecular weight of about 40,000. Each polymer was blended with Base Oil A to give lubricating oil compositions containing 0.35 percent by weight of additive, and with Base Oil B to prepare lubricating oil compositions containing 0.35, 0.5 and 1.0 percent by weight of additive.

Pour points were determined by the Frigistor Autopour Unit manufactured by DeLaRue Frigistor S.A. A test sample (22 ml.) is initially heated to a pre-set temperature of 180°F. and then progressively cooled automatically at a controlled rate of 2°F/min. The sample temperature is continuously monitored by a probe immersed in the sample. The probe is caused to rotate at regular intervals during cooling by an electromagnetically applied torque. At pour point, the viscosity of the sample rises sharply, and the sample resists rotation of the probe. The pour point temperature is held on display until the next test is begun. The unit was calibrated against a known oil sample and checked with a standard once a day. Reproducibility of pour points determined by this instrument is excellent; differences are less than 1°F.

Dispersancy characteristics were evaluated in the sludge inhibition bench (SIB) test. The sludge inhibition bench test was carried out as follows: A used lubricating oil having an original viscosity of about 325 SUS at 100°F. and relatively free from additives is obtained by pooling the oil drained from the crankcases of a fleet of cabs in New York City. This used engine oil is placed in centrifuge tubes and spun in a centrifuge at 3600 r.p.m. for one-half hour to separate the sludge. The clear supernate thus obtained is used in this test. A predetermined quantity of the polymeric additive to be tested is weighed into a 30-ml. beaker and 10 ml. of the oil supernate is added to the beaker. An equal quantity of a standard commercial sludge dispersant additive, in this case the condensation product of polyisobutenyl succinic anhydride and tetraethylenepentamine, having a molar ratio of 2.8 and containing 1.1 percent by weight of nitrogen, is added to a second 30-ml. beaker, and 10 ml. of the oil supernate is added. A third 10-ml. portion of the oil supernate is added to a third 30-ml. beaker containing no additive. The beakers are heated to about 60°C. on a hot plate until all additive is dissolved. Then the contents of each beaker are poured into a pre-weighed centrifuge tube, and the tubes are stored at 138°C. (280°F.) for 16 hours. The tubes are placed in the centrifuge and spun at 3600 r.p.m. for one-half hour. (The centrifuge holds up to 16 tubes, so that a given additive can be tested simultaneously at several concentrations if desired). The oil supernate is discarded. The tubes are inverted from 1–15 minutes to drain excess oil. The tube walls are then washed with

25 cc. of n-pentane, disturbing the sludge as little as possible. The tubes are centrifuged 5–10 minutes in a refrigerated centrifuge to spin down any disturbed sludge. The clear pentane solution is poured off. Again, 25 cc. of pentane is added to each tube, dispersing the sludge in the pentane and dissolving a portion of the sludge. The tubes containing the sludge dispersions are centrifuged at 3600 r.p.m. for 15–20 minutes and the supernates discarded, taking care not to pour off any black dispersed sludge. The outsides of the tubes are washed with acetone. The tubes are dried to constant weight at room temperature (about 1 hour). The tubes are weighed, and the weight of sludge is obtained by difference.

Each additive is given a numerical rating from 0 to 3+, depending on its sludge dispersant activity relative to that of the standard (or reference) commercial dispersant at equal concentrations according to the following scale:

0	No activity
1	Shows activity
2	Shows good activity but less than that of the standard dispersant.
3	Shows activity equivalent to that of the standard dispersant.
3+	Shows greater activity than the standard dispersant.

Monomer feeds and results are indicated in Table I below.

TABLE I

	Polymer				
Monomer Feed, mols	1	2	3	4	5
Alkyl acrylate					
C_8	0.02	0.02	0.02	0.02	0.02
C_{10}	0.02	0.02	0.02	0.02	0.02
C_{14}	0.02	0.02	0.02	0.02	0.02
C_{16}	0.02	0.02	0.02	0.02	0.02
Isobutyl acrylate					0.04
N,N-dimethylaminoethyl acrylate, mols	0.03	0.04	0.05	0.08	0.04
Polymer:					
Yield, %	70.6	71.2	71.0	43.1	76.1
Number average mol. wt.		7700			
Wt. % N, theoretical		2.3	2.6		
Wt. % N, by analysis		2.2	2.5		
Lubricating Oil:					
Pour point, °F.					
0.35% by wt. in Base Oil A	−37	−34	−32	−9	−24
0.35% by wt. in Base Oil B	−26	−23	−20	−3	−15
0.5% by wt. in Base Oil B		−30			
1.0% by wt. in Base Oil B		−35			
S.I.B. Test Rating	2	3+	3+	0	0

Detailed S.I.B. test data for Polymers 1 and 2 above are given in Table I-A below.

TABLE I-A

	Sludge, mg	Additive conc., g/cc	S.I.B. Rating
Blank	29.2	0 (Blank)	
Standard	0.4	1%	(3)
Polymer 1	6.3	1%	2

TABLE I-A – Continued

	Sludge, mg	Additive conc., g/cc	S.I.B. Rating
Blank	21.6	0 (Blank)	0
Standard	2.9	1%	(3)
Polymer 2	2.1	1%	3+

Polymers 1, 2 and 3 prepared according to this invention had excellent pour point and dispersancy characteristics. Polymer 2 had the best overall performance, giving outstanding results in the S.I.B. test as well as an appreciable pour point depressancy in both Base Oils A and B. Polymer 1 gave slightly greater pour point depressancy, but not as good dispersancy. Polymer 3 also gave good pour point depressancy and dispersancy. Polymer 4 was not satisfactory from the standpoint of either pour point or dispersancy; this is attributed to the large amount of nitrogenous dispersant monomer used in preparing this polymer.

Polymer 5, which was similar to Polymer 2 in composition except for the inclusion of isobutyl acrylate, failed the S.I.B. test and had a higher pour point than Polymer 2. This suggests that the inclusion of a lower alkyl acrylate is undesirable.

EXAMPLE 2

Five comparison polymers, designated Polymers 6 to 10, inclusive, were prepared according to this example. Polymers 6 through 10 were prepared at temperatures of about 50° to 55°C. in the same manner as Polymers 1 through 4, except that varying quantities of N,N-dimethylaminoethyl butyl fumarate in varying quantities were used as the nitrogeneous monomer instead of N,N-dimethylaminoethyl acrylate. Azobis

TABLE III

	Polymer					
Monomer feed, mols:	11	12	13	14	15	16
Alkyl methacrylate						
C_{10}	0.02	0.02	0.02	0.02	0.02	0.02
C_{16}	0.02	0.02	0.02	0.02	0.02	0.02
N,N-dimethylamino-ethyl methacrylate	0.01	0.01	0.015			
4-vinyl pyridine				0.005	0.005	0.0085
Dodecyl mercaptan, gm.		0.2				
Polymer:						
Yield, %	93.3	93.2	93.0	88.3	93.6	92.3
Intrinsic viscosity dl/g (heptane, 30°C.)		0.08			0.093	
Number av. mol. wt.(VPO)		7000			8300	
$[\eta]\times C$		0.028			0.033	
Lubricating Oil:						
Pour Point, °F.						
Oil A + 0.35% (wt.) polymer	−39	−25	−18	−39	−30	−34
Oil B + 0.35% (wt.) polymer	−24	−17	−18	−29	−22	−21
S.I.B. Test	3+	3+	3+	3+	—	3+

(isobutyronitrile) was used as the polymerization initiator. Monomer feed compositions and results are shown in Table II below:

TABLE II

	Polymer				
Monomer feed:	6	7	8	9	10
Alkyl acrylate, mols					
C_8	0.02	0.02	0.02	0.02	0.02
C_{10}	0.02	0.02	0.02	0.02	0.02
C_{14}	0.02	0.02	0.02	0.02	0.02
C_{16}	0.02	0.02	0.02	0.02	0.02
N,N-dimethylamino-ethyl butyl fumarate, mols	0.005	0.01	0.01	0.015	0.02
Polymer:					
Yield, %	87.0	86.1	38.9	84.6	78.7
Number av. mol. wt.	—	6900	14800	7000	10500
Wt. % N, theoretical	0.32	—	—	—	1.2
Wt. % N, by analysis	0.31	0.39	—	0.44	0.49
Lubricating Oil:					
Pour point, °F.					
0.35% by wt. in Oil A	−21	−26	−26	−30	−36
0.35% by wt. in Oil B	−16	−18	−17	−22	−24
S.I.B. Test	1	2	1	1	1

Polymers 6 to 10 were generally similar to Polymers 1 to 4 in composition, except for the use of a different nitrogenous monomer. It will be noted that the dispersancy characteristics of Polymers 6 to 10 were unacceptable and were much lower than the dispersancy characteristics of Polymers 1 to 4. The nitrogen containing monomer was not copolymerized as successfully as in polymer 1 to 4. These nitrogen containing monomers were also found to be not as active as expected based on nitrogen level. Pour points were generally acceptable, although slightly higher than the pour points of Polymers 1 to 4.

EXAMPLE 3

The procedure of Example 1 was repeated except that the n-heptane solvent contained 0.2 g. of azobis (isobutyronitrile) (plus 0.2 g. of dodecyl mercaptan, a chain transfer agent, in the preparation of Polymer 12 only) and the monomer feed consisted of 0.02 moles each of decyl methacrylate and hexadecyl methacrylate, and quantities of N,N-dimethylaminoethyl methacrylate or 4-vinyl pyridine, as indicated in Table III below.

Monomer feed compositions, polymer properties and properties of lubricating oil compositions containing these polymers as dispersant-pour depressant additives are given in Table III below.

The above table shows that polymers having good pour point and sludge dispersancy characteristics are obtained by copolymerizing decyl and hexadecyl methacrylates with either dimethylaminoethyl methacrylate or with 4-vinyl pyridine.

What is claimed is:

1. A lubricating oil composition comprising a major amount of a mineral lubricating oil, a viscosity index improving oil soluble copolymer comprising essentially ethylene and propylene, having a viscosity average molecular weight in the range of about 10,000 to 200,000 and containing about 60 to 80 mole percent ethylene, and a minor amount of a pour depressing and dispersing oil soluble acrylate copolymer, compatible with said ethylenepropylene copolymer of (a) a mixture consisting essentially of at least one C_8 or C_{10} alkyl ester and at least one C_{14} or C_{16} alkyl ester, said esters being esters of an acrylic acid selected from the group consisting of unsubstituted acrylic acid and methacrylic acid, wherein all of the alkyl esters have the same acid moiety and said alkyl groups are straight chain, and (b) a nitrogen-containing ethylenically unsaturated monomer selected from the group consisting of N,N-dimethyl aminoethyl methacrylate and 4-vinyl pyridine, said acrylate copolymer having a number average molecular weight in the range of about 2,000 to about 20,000, and a nitrogen content of about 0.2 percent to about 5 percent by weight, said acrylate copolymer being produced from a monomer mixture which initially is essentially free of polymer, and wherein said ac-

rylate copolymer is the sole acrylate copolymer present in said composition.

2. A composition according to claim 1, in which said acrylate copolymer is a copolymer consisting essentially of C_8, C_{10}, C_{14} and C_{16} alkyl acrylates and N,N-dimethyl aminoethyl acrylate, and wherein said molecular weight is about 6,000 to 10,000.

3. A composition according to claim 1, in which said mixture consists essentially of C_{10} and C_{16} alkyl acrylates or methacrylates, and said molecular weight is about 6,000 to 10,000.

4. A lubricating oil composition according to claim 1, wherein said mixture is a mixture of about equi molar proportions of C_{10} alkyl methacrylate and C_{16} alkyl methacrylate.

5. A composition according to claim 4, wherein said nitrogen monomer is N,N-dimethyl aminoethyl methacrylate.

6. A composition according to claim 4, wherein said nitrogen monomer is 4-vinyl pyridine.

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