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3,501,404

AQUEOUS LUBRICANTS FOR METAL WORKING
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9 Claims

ABSTRACT OF THE DISCLOSURE

A lubricant for metal working which is an aqueous emulsion containing an emulsifier and an olefin polymer having a molecular weight in the range of about 1,500 to 25,000, the olefin polymer being the major organic constituent of the emulsion and being present in an amount of about 0.1 to about 25 weight percent of the emulsion.

This application is a continuation of Ser. No. 514,121, filed Dec. 12, 1965, and Ser. No. 742,981, filed June 27, 1968, and now abandoned.

This invention relates to aqueous base lubricants in metal working applications.

A metal working lubricant performs two principal functions: (1) reduces the friction between moving metal surfaces in contact with each other, such as the chip and the toolface, for example, and (2) removes the heat generated during the time the metal is worked. In addition, a lubricant also prevents chip build-up on the cutting tool, washes away metal chips as they are formed, and also provides some degree of rust protection.

Metal working lubricants generally fall into two categories: (A) the so-called heavy-duty lubricants or fluids which comprise mineral oil and organic sulfur, chlorine, or phosphorus compounds added thereto, and (B) aqueous base lubricants. The former are employed with ferrous metal where high unit pressures and high localized temperatures are encountered in instances such as broaching, tapping, threading, etc. These heavy-duty lubricants are not employed for high speed operations where excessive heat is generated, because of their relatively poor heat transfer properties. In addition, the mineral oil base lubricants are not recommended for use on non-ferrous metals because of the possibility of corrosive attack and/or staining. The aqueous base lubricants, on the other hand, are well suited for high speed operations such as drilling and turning where during the machining operations the load is relatively light; however, heretofore aqueous base lubricants capable of satisfactory performance in heavy-duty applications have not been available.

It is an object of this invention to provide an aqueous base lubricant which is capable of heavy-duty performance such as broaching, tapping, threading, and the like, not only for ferrous metals such as steel and the various steel alloys, but also for non-ferrous metals such as copper, aluminum, brass, bronze, and the like.

It is another object to provide an aqueous base lubricant which possesses exceptional anti-wear and anti-weld properties.

It is a further object to provide a method for metal working employing aqueous base lubricants which attains machining results at least equivalent to those obtainable with mineral oil base lubricants and which at the same time provides improved heat transfer away from the machining area.

Still other objects of the present invention will become readily apparent to the skilled artisan upon reference to the ensuing specification and the claims.

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The foregoing objects are achieved by employing as a metal working lubricant an aqueous emulsion comprising as the major organic component from about 0.1 to about 25 weight percent of a polyolefin having a molecular weight in the range from about 1,500 to about 25,000 and also an emulsifying agent. Preferably the polyolefin is selected from the group consisting of polyethylene and polypropylene. It is also preferred that the amount of the polyolefin in the emulsion ranges from about 0.2 to about 3 weight percent. For heavy duty operation, however, the most preferred range is from about 1 to about 3 weight percent.

Any polyolefin can be employed to form the foregoing aqueous emulsions. In the various embodiments of this invention the performance of the polyolefin is independent of the breadth of the molecular weight distribution, the polymer density, or the polymer structure.

A suitable polyolefin for the purposes of the present invention is one having molecular weight in the range from about 1,500 to about 25,000 and a melting point which preferably does not exceed about 200° C. Typical of such polyolefins are the homopolymers and copolymers of an alpha olefin containing from 2 to about 12 carbon atoms such as ethylene, propylene, butylene, and the like. Because of their favorable emulsification properties, polyolefins containing on the average at least one polar group for every four polyolefin molecules are preferred.

The polyolefins may be obtained within the aforementioned molecular weight range by direct polymerization, emulsion polymerization, or by the pyrolysis of a higher molecular weight polyolefin.

The latter technique is preferred since the pyrolysis of the relatively higher molecular weight polymers creates terminal vinyl unsaturation which is readily available for reaction with an ethylenically unsaturated polar monomer such as maleic anhydride or thioglycolic acid, as taught by U.S. Patents 2,766,214 and 3,144,348, thereby rendering the resulting polyolefin readily emulsifiable.

Another valuable technique for the preparation of emulsifiable polymers having a sufficient number of polar groups is by oxidation, with or without a catalyst, so as to create pendant carboxylic groups on the polymer chain along with ketone, aldehyde, and hydroxyl groups.

Other suitable emulsifiable polyolefins are the block copolymers formed by reacting ethylene oxide with polyethylene so as to produce hydroxyl terminated polymers in accordance with the teachings of U.S. Patent 2,921,920. Also suitable polyolefins are the ethylene-alcohol telomers reacted with maleic acid as taught by U.S. Patent 2,766,214.

Similarly, the requisite amount of polar groups can be introduced into the aforementioned homopolymers and copolymers of alpha olefins by the copolymerization of the resulting polyolefins with unsaturated monomers containing the ethylene linkage such as ethylene acrylate, styrene, bicycloheptene, vinyl acetate, acrylic acid, methacrylic acid, and the like.

In addition, the direct polymerization to and/or hydrolysis of the olefin polymers mentioned above can impart the necessary amount of polarity to the polymer chain so as to make the polymers emulsifiable and the resulting emulsion stable.

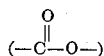
Emulsion polymerization can be carried out by emulsifying the olefin starting material in water by means of a suitable emulsifier and thereafter polymerizing the olefin at elevated pressures and temperature in the presence of a polymerization catalyst. Illustrative emulsion polymerization processes are set forth in U.S. Patents 2,342,400; 2,542,783; 2,592,526; and 2,703,794.

Thus it can be readily seen that many ways are known and are available for making polyolefins which are suit-

able for use in the present invention. The foregoing listing is illustrative only and is not intended to be in any way exclusive or limiting.

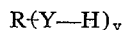
The aqueous polyolefin emulsions can be anionic, nonionic, or cationic. Thus any compatible emulsifying agent can be employed, however, non-ionic emulsifiers are preferred for metal working purposes.

The non-ionic emulsifiers contemplated herein are organic compounds of a relatively high molecular weight and consisting of a hydrophobic portion to which is attached a solubilizing or hydrophilic portion containing groups such as ether links ($-\text{C}-\text{O}-\text{C}-$), hydroxyl groups ($-\text{OH}$), carbonyloxy groups



and the like.

Specifically contemplated within the above definition are surfactants having as the hydrophilic moiety one or more chains containing one or more alkyleneoxy groups. These surfactants have the general formula



wherein R is the hydrophobic portion of an aliphatic alcohol containing from about 8 to 22 carbon atoms or an alkylated phenol containing from about 4 to about 22 carbon atoms in the alkyl group thereof, Y is an alkyleneoxy chain, H is a hydrogen atom bonded to an oxygen atom of the alkyleneoxy chain, and y is an integer from 1 to about 6, and preferably from 1 to 4.

Typical aliphatic alcohols are octyl alcohol, nonyl alcohol, decyl alcohol, "coco" alcohol (a mixture of C_{10} to C_{18} alcohols), dodecyl alcohol, oleyl alcohol, tallow alcohol (a mixture of C_{16} to C_{18} alcohols), octadecyl alcohol, 2,6,8-trimethyl-4-nonyl alcohol, and the like.

Typical alkylated phenols are butylphenol, pentylphenol, hexylphenol, octylphenol, nonylphenol, dodecylphenol, hexadecylphenol, octadecylphenol, nonadecylphenol, and the like.

By the term "alkyleneoxy chain" as used herein is meant a chain containing one or more alkyleneoxy groups which are divalent alkylene groups such as methylene, ethylene, propylene, butylene, and the like, bonded to an oxygen atom in a manner such that one of the valences of the alkyleneoxy group is from an oxygen atom and the other is from a carbon atom. Typical alkyleneoxy groups are methyleneoxy ($-\text{CH}_2\text{O}-$), ethyleneoxy ($-\text{C}_2\text{H}_4\text{O}-$), propyleneoxy ($-\text{C}_3\text{H}_6\text{O}-$), butyleneoxy ($-\text{C}_4\text{H}_8\text{O}-$) and the like.

Preferred non-ionic emulsifiers for the instant formulations are the polyalkylene glycol ethers containing from about 4 to about 80 moles of alkylene oxide. Illustrative preferred non-ionic surfactants are the nonylphenyl polyethylene glycol ethers containing about 4 moles of ethylene oxide, the trimethylnonyl polyethylene glycol ethers containing about 6 moles ethylene oxide, the nonylphenyl polyethylene glycol ethers containing about 7 moles of ethylene oxide, mixed polyalkylene glycol ethers containing about 60 moles of a mixture of ethylene oxide and 1,2-propylene oxide in a mole ratio of about 2:1, and the like.

Typical cationic emulsifiers suitable for the present emulsification method are the combination of an organic acid, such as acetic acid or the like, with an amine such as cyclic imidazoline, tertiary ethoxylated soya amine, tallow polyethoxylated amine having two ethoxy units in the polyethoxylated portion of the molecule, the oleyl polyethoxylated amines having two to five ethoxy units in the polyethoxy portion of the molecule, soya polyethoxylated amine having five ethoxy units in the polyethoxy portion of the molecule, and the like.

The anionic emulsifiers contemplated herein are amine soaps, and the like. These soaps are formed by the reaction of an amine with a fatty acid such as oleic acid,

palmitic acid, lauric acid, myristic acid, the tall oil acids, the palm oil acids, or the like, in about stoichiometric amounts and at room temperature or at a slightly elevated temperature. Suitable amine soaps are triethanolamine stearate, triethanolamine oleate, triethanolamine coconut oil soap, isopropanolamine oleate, N,N-dimethylethanolamine oleate, 3-methoxypropyl amine oleate, morpholine oleate and the like.

A wide variety of aqueous polyolefin emulsions has been investigated and their suitability for the practice of the present invention has been ascertained. These emulsions are characterized below and will be referred to subsequently by code letter in the interests of conciseness. In addition, the conventional cutting oils employed for purposes of comparison are similarly characterized.

CHARACTERIZATION OF CUTTING FLUIDS

Emulsion A—An aqueous, non-ionic emulsion of chemically inert, low molecular weight polyethylene emulsified by a polyoxyethylene derivative of an aliphatic compound.

Emulsion B—An aqueous, anionic emulsion of medium molecular weight polyethylene emulsified by a fugitive emulsifier.

Emulsion C—An aqueous, non-ionic emulsion of high-melt, high-density polyethylene (molecular weight: 6,500–8,400) which has been cracked and air-oxidized.

Emulsion D—An aqueous, anionic emulsion of cracked, high-density polyethylene (molecular weight: about 2000) modified with about 5 weight percent maleic anhydride and emulsified with an amine-fatty acid emulsifier.

Emulsion E—An aqueous, cationic emulsion of cracked, high-density polyethylene (molecular weight: about 2000) modified with about 5 weight percent maleic anhydride and emulsified with an ethoxylated primary fatty acid amine and acetic acid.

Emulsion F—An aqueous, non-ionic emulsion of cracked, high-density polyethylene (molecular weight: about 2000) modified with about 5 weight percent maleic anhydride and emulsified with a mixture of nonylphenyl polyethylene glycol ethers containing about 4 and about 7 moles of ethylene oxide and with morpholine.

Emulsion G—An aqueous, non-ionic emulsion of cracked, high-density polyethylene (molecular weight: about 2000) modified with about 5 weight percent maleic anhydride and emulsified with a mixture of nonylphenyl polyethylene glycol ethers containing about 4 and about 7 moles of ethylene oxide and with 2-methoxypropyl amine.

Emulsion H—An aqueous, anionic emulsion of low-density polyethylene (molecular weight: about 16,000) prepared by emulsion polymerization.

Emulsion I—An aqueous, non-ionic emulsion of low-density, polyethylene (molecular weight: about 24,000) prepared by emulsion polymerization.

Emulsion J—An aqueous, non-ionic emulsion of low density polyethylene.

Emulsion K—An aqueous, cationic emulsion of low density polyethylene.

Emulsion L—An aqueous, non-toxic emulsion of polyethylene having a relatively low content of emulsifiers.

Emulsion M—An aqueous, non-ionic emulsion of polyethylene.

Emulsion N—An aqueous, non-ionic emulsion of polypropylene.

Emulsion P—An aqueous styrene-butadiene copolymer latex.

Emulsion Q—An aqueous carboxylated styrene-butadiene latex.

Emulsion R—An aqueous polyisoprene latex (natural).

Emulsion S—An aqueous polyvinylidene chloride latex.

Oil A—A petroleum oil conventionally used neat for tapping and threading. Contains as active extreme pres-

sure agents about 3 weight percent sulfur and about 1 weight percent chlorine.

Oil B—A soluble cutting oil containing a very high percentage of extreme pressure and anti-weld fats and additives.

Oil C—Paraffin oil having a viscosity index of about 90. Contains no additives.

Oil D—Water insoluble polyalkylene glycol.

The evaluation of the lubricant formulations and the method of this invention were carried out using a Falex Tester. This test equipment comprises a replaceable 1/4-inch diameter shaft (No. 8 soft steel pin) which is revolved at 290 r.p.m. between two steel V-blocks. The shaft can be machined from SAE 3135 steel having a Rockwell B hardness of 87 to a 8–10 RMS finish, and the two V-blocks can be machined from AISI C–1137 steel having a Rockwell C hardness of 20 to a 6–8 RMS finish (Method I). In the alternative, the shaft can be machined from M–2 tool steel having a Rockwell C hardness of 60 to a 12–14 RMS finish, and the two V-blocks can be machined from 440C stainless steel having a Rockwell C hardness of 60 to a 12–14 RMS finish (Method II).

The V-blocks are positioned so that they can be forced against the shaft by a notched loading wheel. The adjustment of the loading wheel during the test in order to maintain a predetermined load is indicative of the wear on the test shaft. The adjustment of each notch or tooth on the loading wheel indicates 0.000057 inch of wear of the test shaft.

During a test both the shaft and the V-blocks are immersed in the lubricant to be tested.

The operational steps during the test are as follows:

(1) The test is commenced by revolving the shaft between the V-blocks for 3 minutes at 100 lb. load.

(2) The load is the increased each minute in 100 lb. increments up to 1000 lbs.

(3) After 1000 lbs. load is reached, further loading is done in 250 lb. increments each minute until seizure or a maximum load of 4500 lbs. is attained.

(4) Torque and temperature are recorded each minute, and

(5) During each one minute interval the wear on the test shaft is noted and recorded as the number of notches on the loading wheel that have to be adjusted in order to maintain the desired load.

After the test the average scar width on the V-blocks is measured microscopically and the contact pressure in pounds per square inch calculated from the following:

$$\frac{\text{Gauge load @ seizure}}{\sqrt{2}} = \text{bearing load, lbs.}$$
$$\frac{\text{bearing load, lbs.}}{\text{scar length, in.} \times \text{scar width, in.}} = \text{pounds per sq. inch}$$

scar length=0.5 inch

The present invention is further illustrated by the following examples.

Example 1

Using the Falex Tester and employing Method I described above various polymeric emulsions were evaluated for load carrying and anti-weld properties. The emulsions were aqueous and contained about 0.5 weight percent solids. The experimental results are set forth in Table I below.

TABLE I

Emulsion	Type of emulsion	Seizure load, pounds	Emulsifier type (1)
P-----	Styrene-Butadiene (SBR)-----	2,500	a
R-----	Natural Latex-----	2,500	a
Q-----	Carboxylated SBR-----	2,750	a
S-----	Polyvinylidene Chloride-----	1,750	a
F-----	Modified Polyethylene-----	>4,500	n+a
A-----	Polyethylene-----	>4,500	n
D-----	Modified Polyethylene-----	>4,500	a+a
C-----	Polyethylene-----	4,500	n
B-----	do-----	4,000	a
I-----	do-----	4,000	n
H-----	do-----	3,750	a
J-----	do-----	4,250	n
K-----	do-----	>4,500	c
M-----	do-----	4,500	n
L-----	do-----	4,250	n
N-----	Polypropylene-----	4,250	n

1 n=Nonionic; a=Anionic; c=Cationic.

From the data in Table I it is readily apparent that polyolefin emulsions possess excellent load carrying and antiweld properties.

Example 2

The anti-wear properties of aqueous polyolefin emulsions were evaluated using the Falex Tester and employing Method I described above. The experimental results are compiled in Table II below.

TABLE II

Wt. percent emul. solids	Emulsion	Emulsifier type (1)	Seizure load in pounds	Cumulative teeth adjusted to compensate for wear at load increments of—			
				3,000 lbs.	3,500 lbs.	4,000 lbs.	4,500 lbs.
0.5-----	J	n	4,250	95	185	>1,000	-----
0.5-----	K	c	>4,500	45	115	220	570
0.5-----	I	n	4,000	160	540	-----	-----
0.5-----	H	a	3,750	20	110	-----	-----
0.5-----	M	n	4,500	15	125	435	>815
0.5-----	L	n	4,250	70	190	520	-----
0.5-----	C	n	4,500	70	170	400	>660
0.5-----	B	a	4,000	0	0	Seized	-----
0.5-----	A	n	>4,500	0	0	20	170
0.5-----	D	a	>4,500	0	0	15	155
0.5-----	F	n+a	>4,500	0	30	125	270
0.5-----	N	n	4,250	15	180	760	-----
0.2-----	B	a	1,750	>110	-----	-----	-----
0.2-----	A	n	>4,500	0	0	10	165
0.2-----	D	a	1,500	>20	-----	-----	-----
0.2-----	F	n+a	4,000	20	110	-----	-----

1 n=Nonionic; a=Anionic; c=Cationic.

Data in the foregoing table demonstrate that the aqueous polyolefin emulsions of this invention possess good anti-wear properties. The data also show that several of the emulsions possess excellent anti-wear properties even at very low solids concentrations in the emulsion.

Example 3

The performance of a polyethylene emulsion at various solids concentrations was evaluated in the Falex Tester employing Method I. The experimental data are compiled in Table III below.

TABLE III

Emulsion A Diluted with Water to:	Seizure load in pounds	Cumulative teeth adjusted to compensate for wear at load increments			
		3,000 lbs.	3,500 lbs.	4,000 lbs.	4,500 lbs.
3.0 wt. percent solids-----	>4,500	0	30	95	380
1.0 wt. percent solids-----	>4,500	0	35	95	405
0.5 wt. percent solids-----	>4,500	0	0	20	170
0.2 wt. percent solids-----	>4,500	0	0	10	165
0.1 wt. percent solids-----	2,500	0	-----	-----	-----

The data indicated that at concentrations of from about 0.2 to 3.0 wt. percent solids the anti-weld properties exceed the limit of the test equipment. Optimum anti-wear properties were obtained at 0.2 to 0.5 wt. percent solids, but the anti-wear properties at higher concentrations are still very good.

Example 4

The contact pressures for various prior art lubricants and for the lubricants of the present invention were determined in a Falex Tester employing Method II described above. The experimental results are shown in Table IV, below.

TABLE IV

Composition of lubricant in water	Gage load, lbs. at seizure	Avg. scar width, inches	Contact Pressure, p.s.i.
Oil A-----	3,750	.037	140,000
Oil B diluted 15/1 with water-----	4,000	.029	200,000
Oil C-----	3,000	.024	180,000
Oil D-----	2,500	.016	220,000
1.0 wt. percent solids, Emulsion F-----	4,000	.021	270,000
0.2 wt. percent solids, Emulsion F-----	2,500	.015	240,000
1.0 wt. percent solids, Emulsion A-----	4,500	.019	330,000
0.2 wt. percent solids, Emulsion A-----	3,000	.016	260,000
0.2 wt. percent solids, Emulsion D-----	2,750	.016	240,000
1.0 wt. percent triethanolamine (soap)-----	2,750	.026	150,000
0.2 wt. percent triethanolamine (soap)-----	2,500	.018	200,000
1.0 wt. percent solids, Emulsion N-----	3,500	.018	290,000
0.2 wt. percent solids, Emulsion N-----	3,250	.018	270,000

The foregoing data indicate that only with aqueous polyethylene and polypropylene emulsions contact pressures above about 220,000 p.s.i. could be obtained. For this reason these emulsions are preferred.

Example 5

The anti-wear and anti-weld properties of polyolefin lubricating fluids were also evaluated in a tapping performance test. The performance of the lubricating fluids of this invention was compared with that of Oil A, a cutting oil normally employed for tapping of stainless steel.

Testing details:

Machine data—4' radial drill; American-Hole Wizard.

Bar stock—304 stainless steel, 2½ x 1¼ x 12 inches.

Blind holes—Drilled with No. 7 (.201 in. dia.) drill, 1½ inches deep, @ 610 r.p.m. and 0.004 in/revolution feed; dilute water-soluble oil coolant.

Tap—¼ x 20 N.C.; H.S. grd. H3. 4 Flt. plug special for stainless steel, mfd. by Winter Bros., Rochester, Mich.

Tapping fixture—Adjustable torque clutch, Swedish Model SPV-SA-1E.

Lubricant evaluation:

- (1) Tap full one inch deep blind hole to top of flute (an 80% thread, one inch deep).
- (2) Tap speed 70 r.p.m.
- (3) Lubricant is applied to completely fill the blind hole.
- (4) After applied torque causes the tapping fixture to slip, the tap is reversed, and the hole cleared of chips and lubricant with an air hose (one tapping cycle completed).
- (5) Lubricant is applied again and an additional attempt to tap is made (next tapping cycle).
- (6) The number of cycles required to tap full one inch depth is taken as the criteria of performance.

Conventional aqueous metal working fluids and other such as aqueous suspensions of graphite or haloalkane resins could not be employed to successfully tap under the above conditions. Similarly, suspensions of non-emulsifiable polyethylene, maleic anhydride modified polyethylene in kerosene, mineral seal oil, or mineral spirits were not satisfactory. The tapping results using Oil A and various aqueous polyolefin emulsions are compiled in Table V below.

TABLE V

Tapping lubricant evaluated in water	Cycles nec. to form full 1 in. thread	Hole numbers
Oil A-----	3, 3, 3	57, 66, 112
Do-----	4, 4, 4	78, 106, 107
15 wt. percent solids, Emulsion G-----	2, 2, 2	51, 53, 61
3 wt. percent solids, Emulsion G-----	4	52
1 wt. percent solids, Emulsion G-----	4	49
3 wt. percent solids, Emulsion D-----	5	50
1 wt. percent solids, Emulsion D-----	2	72
25 wt. percent solids, Emulsion E-----	2	75
3 wt. percent solids, Emulsion E-----	3	74
1 wt. percent solids, Emulsion E-----	2	62
20 wt. percent solids, Emulsion F-----	3, 3	63, 71
3 wt. percent solids, Emulsion F-----	3	64
1 wt. percent solids, Emulsion F plus 3 wt. percent triethylene glycol-----	2	70
0.5 wt. percent solids, Emulsion F plus 3 wt. percent triethylene glycol-----	5	108

The above data illustrate the suitability of aqueous polyolefin emulsions as lubricants for tapping operations.

Example VI

The performance of aqueous polyolefin emulsions was also evaluated in a single point threading lathe operation which comprises the threading of a 304 stainless steel rod one inch in diameter with an 8 point thread at 67 r.p.m. on a 16 x 54 inch Axelson engine lathe. The experimental results are compiled in Table VI below.

TABLE VI

Fluid and Dilution Ratio	Performance data		
	Roughing cuts	Finish cuts	Overall rating ¹
Oil A-----	Fine tears-----	Excellent-----	Excellent.
Oil B (30/1 dilution)-----	Tears badly-----	Fair-----	Fair.
1 wt. percent, Emulsion F-----	Fine tears-----	Good-----	Excellent.

¹ Fair, Good, Excellent.

The experimental results show that aqueous polyolefin emulsions are at least equivalent in performance to heavy duty mineral oil base lubricants.

In addition to the active constituents discussed above in detail the lubricating compositions of this invention can also contain various additives which are conventionally employed to impart certain desired properties to the compositions. Among such additives are corrosion inhibitors, anti-foam agents, antibacterial agents, and the like.

The corrosion inhibitors that can be used are morpholine, the alkali metal nitrites (e.g., potassium nitrite and sodium nitrite), the alkali metal mercaptobenzothiazoles (e.g., the sodium salt of mercaptobenzothiazole), the polyphosphates (e.g., hexametaphosphate), and the like.

Illustrative anti-bacterial agents are the chlorophenols, the neomycin sulfates, 6-acetoxy-2,4-dimethyl-m-dioxane, and the like. An aqueous solution containing di(phenyl mercuric) ammonium propionate in an amount sufficient to provide about 6 wt. percent of mercury.

Illustrative anti-foam agents are alcohols in the C₆ to C₁₀ range such as 2-ethyl hexanol, surfactants having a low hydrophile/lipophile balance, and the like.

The manner in which the compositions of this invention are produced is in no way critical. That is, the components of the compositions can be mixed in any convenient sequence and in any suitable apparatus. The techniques applicable to producing conventional aqueous lubricant compositions can be employed in producing the compositions of this invention.

The foregoing discussion and the examples are intended as illustrative of the present invention. Other variations and modifications within the spirit and scope of this invention will readily present themselves to the skilled artisan. For example, while the foregoing examples illustrate the use of the instant method with ferrous metals, a very severe test, the method of the instant invention is equally applicable to the working of metals such as copper, aluminum, bronze, brass, and the like, where at least two metal surfaces are in movable contact with each other.

We claim:

1. In the method for metal working which comprises providing at least two metal surfaces in moveable contact with each other and applying thereto a lubricating composition, the improvement consisting essentially of using as the lubricating composition an aqueous olefin polymer emulsion containing an emulsifier and an olefin polymer having a molecular weight in the range of about 1,500 to about 25,000, the olefin polymer being the major organic constituent of the emulsion and being present in an amount in the range of about 0.1 to about 25 weight percent of the emulsion.
2. The method in accordance with claim 1 wherein the olefin polymer is an ethylene polymer and is present in an amount in the range from about 0.2 to about 3 weight percent of the emulsion.
3. The method in accordance with claim 1 wherein the olefin polymer is a propylene polymer and is present in an amount in the range from about 0.2 to about 3 weight percent of the emulsion.
4. The method in accordance with claim 1 wherein the emulsifier is non-ionic and the olefin polymer is polyethylene, present in an amount in the range from about 0.2 to about 3 weight percent of the emulsion.
5. The method in accordance with claim 1 wherein the olefin polymer is an isoprene polymer.
6. The method in accordance with claim 1 wherein the olefin polymer is a styrene-butadiene copolymer.

7. The method in accordance with claim 1 wherein the olefin polymer is a carboxylated styrene-butadiene copolymer.

8. The method of claim 1 wherein the olefin polymer contains on the average at least one polar group for every four olefin polymer molecules.

9. The method of claim 2 wherein the ethylene polymer contains on the average at least one polar group for every four ethylene polymer molecules.

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