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LUBRICANT AND PROCESS FOR MAKING
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tion of DelawareNo Drawing. Application March 4, 1939,
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This invention relates to an improved lubricant and coolant for use in metal working and more particularly to an emulsified coolant for use in machining metals and alloys.

It is well known by those skilled in the art that in machining metals the use of appropriate lubrication and cooling means is necessary for the production of high quality products. The art, therefore, when machining metals reduces the friction between the tool and the metal by using a lubricant and reduces the heat generated by absorbing it with the lubricant or with water which has been included with the lubricant. Thus the use of the proper lubricant and coolant facilitates speed, quality, and economy in the machining of metals or alloys and in the production of machined parts. Further the use of these lubricants or coolants protects and prolongs the life of the tools being used. The art uses many different lubricants and coolants among which, for example, are liquids comprised of vegetable oils and fats in admixture with mineral oils, soap solutions, and water-oil emulsions. The art usually uses a liquid as an aid in machining metals and alloys that has both the necessary lubricating and cooling properties desired. These liquids may be composed largely of water, which due to its high specific heat allows the ready absorption of the heat generated by the friction between the tool and the metal, with minor per cents of lubricants and if necessary emulsifying agents, but often the art uses light mineral oils alone as lubricants and coolant with good results.

The object of this invention is to produce an improved coolant for use in machining metals. A further object of this invention is to produce a coolant which will also act as a lubricant and will allow a higher speed of operation and feed in the machining of metals. A further object of this invention is to produce a coolant which will protect and prolong the life of the tools used in machining the various metals and alloys now used in the industry. A still further object of this invention is to produce a lubricant with a very high film strength. A still further object of this invention is to produce a coolant which will more effectively wet the metal or alloy being machined. Other objects will appear hereinafter.

Now in accordance with this invention emulsions have been prepared which may be used as extremely effective coolants. The emulsions include admixtures of alkylolamine esters of higher fatty acids with appropriate dispersing

agents such as, for example, sulfonated oils, pine oil, or the like, and if desirable soaps such as sodium stearate, potassium stearate or the like. The emulsions when used in specific machining operations may also include vegetable, animal, or mineral oils depending upon the use for which the composition is intended. Thus the alkylolamine ester of a higher fatty acid is, in accordance with this invention, the active ingredient and, when admixed with dispersing oils and/or soap, a compound results which may be called a soluble oil because of the ease with which it is emulsified in water. This soluble oil when agitated with water produces the lubricant or coolant of this invention. The coolants of this invention are prepared by admixing the prepared soluble oil into water with vigorous agitation or if desired, but not necessarily, emulsifying the soluble oil and water by passing it through a colloid mill or a homogenizer. The best results will be obtained by adding the soluble oil, comprising an admixture of an alkylolamine ester of higher fatty acid, dispersing oils, and if desirable soaps, stepwise to the water volume with constant agitation.

The alkylolamine esters of higher fatty acids used as the active ingredient in the coolants of this invention may be prepared by heating an alkylolamine, for example, triethanolamine, diethanolamine, triisopropanolamine or the like with a higher fatty acid such as, linoleic, lauric, ricinoleic acid, etc. or the glycerides thereof, for example, castor, olive, linseed, coconut, or like oils, under anhydrous conditions, to a temperature of about 100° C. to about 130° C. for a period of about 2 to about 30 hours. The heating period is preferably from about 4 to about 10 hours depending upon the temperature. It will be understood that when the above ester is prepared it is not necessarily a pure alkylolamine ester, but may contain small per cents of reaction by-products such as glycerin or partially reacted glycerides and similar substances.

It will be understood that in accordance with this invention the term alkylolamine used above includes the various alkylolamines alone or in admixture with one another. Thus an alkylolamine may be a mono-, di-, or polyalkylolamine, for example, mono-, di-, or triethanolamine or the similar methanolamines, propanolamines, glycerolamines, and the like. It will be appreciated that the alkylolamines may be used in admixture and that, for example, various polyalkylolamines will contain some mono-, and/ or di-

alkylolamines especially where the commercial grade is used. Thus, for example, commercial triethanolamine, while it contains a preponderating proportion of triethanolamine, will also contain considerable quantities of mono-, and diethanolamine.

In accordance with this invention two types of coolants may be prepared for use in machining metals. The first type of coolant has a viscosity similar to that of water and is suitable for use in drilling, tapping, grinding, and general cutting operations on the various metals and alloys. This first type coolant will be an aqueous emulsion containing about 1% to about 4% of a liquid which may include an alkylolamine ester of a higher fatty acid within the range of about 25% to about 60% in admixture with one or more dispersing oils, for example, pine oil, sulfonated castor oil, or the like. These mixtures may contain soaps to aid in emulsification, but, as will be noted in the examples given hereinafter, soap and sulfonated castor oil may be substituted for one another. The second type of coolant is a heavy bodied emulsion and is suitable for use in tapping, turning, and similar operations. This second type coolant will be an emulsion containing about 4% to about 8% of an alkylolamine ester of a higher fatty acid, about 30% to about 40% water, with the remaining percentages made up of one or more dispersing oils, for example, pine oil and sulfonated castor oil and one or more animal, vegetable, or mineral oils. This second type coolant may also contain small percentages of sodium oleate or similar soaps to aid in emulsifying the admixtures.

To illustrate the coolants of this invention, the composition and preparation of a few examples are shown below. The first nine examples are coolants having a viscosity similar to water while Examples 10 and 11 are heavy bodied coolants.

Example 1

An alkylolamine ester of a higher fatty acid was prepared by reacting one part by volume of commercial triethanolamine with two parts by volume of grade AA castor oil at 110° C. for five hours with vigorous agitation. This reaction product was used in preparing the coolant below.

Parts by weight	
Triethanolamine-castor oil reaction product	25
Pine oil	25
Neutralized sulfonated castor oil (65%)	50

Dilute 1 volume of this mixture with 50 volumes of water.

In the above example the reaction product prepared from an alkylolamine and a higher fatty acid as indicated hereinbefore may be called the active ingredient while the admixture of this ester with the dispersing oils may be called the soluble oil and the diluted product is the lubricant and coolant of this invention.

Further examples are now given.

Example 2

Parts by weight	
Triethanolamine-castor oil reaction product of Example 1	50
Pine oil	42.5
Sodium oleate	5.0
Water	2.5

Dilute as in Example 1.

Example 3

Parts by weight	
Triethanolamine-castor oil reaction product of Example 1	10
Neutralized sulfonated castor oil (65%)	10
Water	1000

Example 4

An alkylolamine ester of a higher fatty acid was prepared by reacting one volume of commercial triethanolamine with two volumes of olive oil for 14 hours at 130° C. with vigorous agitation. The reaction product was used in making up the coolant below.

Parts by weight	
Triethanolamine-olive oil reaction product	25
Pine oil	25
Neutralized sulfonated castor oil (65%)	50

Dilute as in Example 1.

Example 5

An alkylolamine ester of a higher fatty acid was prepared by reacting one volume of commercial triethanolamine with one volume of coconut oil for 13 hours at 100° C. with vigorous agitation. The reaction product was used in preparing the coolant below.

Parts by weight	
Triethanolamine-coconut oil reaction product	50
Pine oil	42.5
Sodium oleate	5

Dilute as in Example 1.

Example 6

An alkylolamine ester of a higher fatty acid was prepared by reacting 78 parts by weight of triethanolamine (98% grade) and 437 parts by weight of oleic acid for 21 hours at 100° C. with vigorous agitation. The reaction product was used in preparing the coolant below.

Parts by weight	
Triethanolamine-oleic acid reaction product	50
Pine oil	42.5
Sodium oleate	5

Dilute as in Example 1.

Example 7

An alkylolamine ester of a higher fatty acid was prepared by reacting 240 parts by weight commercial triethanolamine with 750 parts by weight of Grade AA castor oil for 21½ hours at 110° C. with vigorous agitation. The reaction product was used in preparing the coolant below.

Parts by weight	
The above reaction product which is crude triethanolamine diricinoleate	25
Pine oil	25
Sulfonated castor oil	50

Dilute as in Example 1.

Example 8

An alkylolamine ester of a higher fatty acid was prepared by reacting 201 parts by weight of commercial trisopropanolamine with 310 parts by weight of grade AA castor oil for 17 hours at 100° C. with vigorous agitation. The reaction product was used in preparing the coolant below.

Parts by weight	
Trisopropanolamine-castor oil reaction product	50
Pine oil	85
Sodium oleate	10
Water	4905

Example 9

An alkylolamine ester of a higher fatty acid was prepared by reacting 158 parts by weight of commercial diethanolamine with 465 parts by weight of grade AA castor oil for 4 hours at 100° C. with vigorous agitation. The reaction product was used in preparing the coolant below.

Parts by weight	
Diethanolamine-castor oil reaction product	50
Pine oil	42.5
Sodium oleate	5

Dilute as in Example 1.

The following examples are of heavy bodied coolants which are suitable for use in tapping, turning, and like operations on metals.

Example 10

Per cent	
Triethanolamine-castor oil reaction product of Example 1	6.3
Pine oil	10.3
Sodium oleate	1.2
Raw menhaden oil	5.9
Mineral oil (light bodied cylinder oil)	41.2
Water	35.1

In this example while emulsification is possible with vigorous agitation emulsification in a colloid mill gives preferable results.

Example 11

Per cent	
Triethanolamine-castor oil reaction product of Example 1	4.8
Raw menhaden oil	4.8
Pine oil	9.0
Sodium oleate	1.0
Cottonseed oil	43.8
Water	37.6

In this example while emulsification is possible with vigorous agitation emulsification in a colloid mill gives preferable results.

The various coolants described in the above examples have been tested in machining operations and have all been found superior to the coolants now used in the art. The coolants of this invention cool and lubricate the tool and the metal being machined very efficiently as is shown by the following tests:

The nickel-base cast alloy "Hybnickel" is so hard that with normal commercial coolants the edge of high speed drills are burned off after a very few revolutions. When the "Hybnickel" alloy was drilled using the coolant described in Example 1 or 2, it was possible to drill through a casting with a 3/4" high speed drill running at 162 R. P. M. and .005" feed without dulling the tool.

To further test the coolant of Example 2, a test was conducted on a nut cutting machine. The nut blanks were being cut from stainless steel (18% Cr—8% Ni type) rod and the blanks dropping from the machine were cool enough to handle when the coolant of Example 2 was used while they could not be touched if the commercial coolants now known to the art were used. The coolant of Example 2 also kept the tool in working condition for a half day run whereas when commercial coolants are used the tool must be resharpened two or three times during a half day run. The coolant of Example 2 was also used to tap the nut blanks with the same excellent results obtained during the blank forming operation.

The above tests with the coolant of Examples 1 and 2 show definitely that the coolants in accordance with this invention are much superior to the commercial coolants now used by the art. The coolants of this invention have the following advantages over commercial coolants: prolonging and protecting the life of the tools, the production of cool finished products, and the possibility of machining very tough or hard alloys.

A further test with the coolant of Example 2 produced the similar superior result effected in the preceding tests. Thus a test was made which consisted of drilling a 2" hole through a steel block using 80 R. P. M. and a feed of .003". The coolant, Example 2, kept the tool sufficiently cool in the above operation to allow it to be grasped with the bare hand upon removal from the drilled hole while with commercial coolants the drill became so hot that it could not be touched. Further, the steel shavings when using the coolant of Example 2 are smooth and continuous thus producing a smooth hole while with commercial coolants the steel shavings are rough and break into small pieces which produce a rough hole that must be refinished after the drilling operation.

A test in which the heavy-bodied coolant of Example 10 was used shows that 1/2" holes could be tapped in 1/8" steel, at a drill speed of 80 R. P. M. and a feed of .003" which had satisfactory threads. The same operation when using commercial coolants produces tapped holes in which the threads are so rough it is necessary to retap the holes by hand to produce a satisfactory product.

Similar tests to those described above show that the coolants given in the examples have many advantages over the commercial coolants now known to the art. The use of coolants of this invention produces cooler and smoother work, provides means whereby the machining operations may be speeded up, allows the machining of various tough or hard metals or alloys, and prolongs and protects the life of the tools.

It will be understood that the details and examples given hereinbefore are illustrative only, and in no way limiting on my invention as broadly described hereinbefore and in the appended claims.

What I claim and desire to protect by Letters Patent is:

1. An aqueous emulsion coolant for use in metal working that includes an alkylolamine ester of a higher fatty acid and a dispersing agent.
2. An aqueous emulsion coolant for use in metal working that includes an alkylolamine ester of a higher fatty acid and a dispersing oil.
3. An aqueous emulsion coolant for use in metal working that includes an alkylolamine ester of a higher fatty acid, a dispersing oil, and a soap.
4. An aqueous emulsion coolant for use in metal working that includes an alkylolamine ester of a higher fatty acid and a mixture of sulphonated oil and pine oil.
5. An aqueous emulsion coolant for use in metal working that includes an alkylolamine ester of a higher fatty acid and a mixture of sulphonated castor oil and pine oil.
6. An aqueous emulsion coolant for use in metal working that includes a triethanolamine ester of a higher fatty acid and a mixture of sulphonated castor oil and pine oil.
7. An aqueous emulsion coolant for use in metal

working that includes an ester obtained by the interaction of triethanolamine and castor oil and a mixture of sulphonated castor oil and pine oil.

8. An aqueous emulsion coolant for use in metal working that includes a triethanolamine ester of a higher fatty acid and dispersing oil.

9. An aqueous emulsion coolant for use in metal working that includes an ester obtained by the interaction of triethanolamine and castor oil and a dispersing oil.

10. An aqueous emulsion coolant for use in metal working that includes an ester obtained by the interaction of triethanolamine and castor oil and a sulphonated vegetable oil.

11. An aqueous emulsion coolant for use in metal working that includes an ester obtained by the interaction of triethanolamine and castor oil and sulphonated castor oil.

12. An aqueous emulsion coolant for use in metal working that includes an ester obtained by the interaction of triethanolamine and castor oil, a dispersing oil and a soap.

13. An aqueous emulsion coolant for use in metal working that includes an ester obtained by the interaction of triethanolamine and castor oil, pine oil, and a soap.

14. An aqueous emulsion coolant for use in metal working that includes an ester obtained by the interaction of triethanolamine and castor oil, pine oil, and sodium oleate.

15. An aqueous emulsion coolant for use in metal working that contains about 1% to about 4% of a liquid which includes an alkylolamine ester of a higher fatty acid within the range of about 25% to 60% in admixture with at least one dispersing agent.

16. An aqueous emulsion coolant for use in metal working that contains about 4% to about 8% of an alkylolamine ester of a higher fatty acid, about 30% to about 40% water and at least one dispersing agent.

17. A method of preparing an aqueous emulsion coolant including the steps of reacting an alkylolamine to form an ester of a higher fatty acid, adding to the reaction product formed at least one

dispersing agent and emulsifying the admixture in water.

18. A method of preparing an aqueous emulsion coolant including the steps of reacting an alkylolamine to form an ester of a higher fatty acid adding to the reaction product formed at least one dispersing agent, a soap, and emulsifying the admixture in water.

19. A method of preparing an aqueous emulsion coolant including the steps of reacting an alkylolamine to form an ester of a higher fatty acid adding to the reaction product formed a mixture of dispersing agents and emulsifying the admixture in water.

20. A method of preparing an aqueous emulsion coolant including the steps of reacting at between about 100° C. and about 130° C. an alkylolamine and a higher fatty acid to form an ester of the higher fatty acid, adding to the reaction product formed at least one dispersing agent and emulsifying the admixture in water.

21. A method of preparing an aqueous emulsion coolant including the steps of reacting at between about 100° C. and about 130° C. for a period of about 2 hours to about 30 hours an alkylolamine and a higher fatty acid to form an ester of the higher fatty acid, adding to the reaction product formed at least one dispersing agent and emulsifying the admixture in water.

22. A method of preparing an aqueous emulsion coolant including the steps of reacting at between about 100° C. and 130° C. an alkylolamine and a glyceride of a higher fatty acid to form an ester reaction product, adding to the reaction product formed at least one dispersing agent and emulsifying the mixture in water.

23. A method of preparing an aqueous emulsion coolant including the steps of reacting at between about 100° C. and 130° C. for a period of about two hours to about thirty hours an alkylolamine and castor oil to form an ester reaction product, adding to the reaction product formed at least one dispersing agent and emulsifying the mixture in water.

EMIL OTT.

Patent No. 2,238,478.

CERTIFICATE OF CORRECTION.

April 15, 1941.

EMIL OTT.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, second column, line 32, after "ricinoleic" insert the comma and word --, oleic--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 13th day of May, A. D. 1941.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.

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