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LUBRICATING COMPOSITION

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This invention relates to lubricating compositions for service in the cold rolling or cutting of metals, as well as in other metal working operations such as grinding, drawing, and the like.

5 In operations of this character it is necessary to minimize friction by the presence of a lubricating film, while at the same time avoiding excessive temperature rise at the work area by continuously supplying a coolant such as water
10 in liberal quantity. To provide both of these functions, there have been proposed lubricating compositions in the form of so-called soluble oils comprising aqueous emulsions of mineral oil in varying degree of dilution. These have the advantage of supplying both lubricant and coolant
15 simultaneously in recoverable combination permitting recirculation, but are not entirely satisfactory in view of the relatively low strength and load carrying ability of the lubricating film.

20 It has also been proposed to use palm oil as the lubricant in such service, water being supplied independently to provide the necessary coolant. The palm oil of commerce is a greasy, tallow-like solid material, having a free fatty
25 acid content commonly of the order of 50% by weight, which ordinarily is melted before use and dripped over the parts to be lubricated. For minimizing friction, it has established effectiveness in metal working operations because of high
30 film strength and load carrying ability. Its utility is seriously impaired, however, by the inconvenience, waste, and high operating costs naturally attending the use of normally solid oleaginous material in the presence of large volumes
35 of water and under conditions permitting no recirculation of lubricant. Fresh quantities of lubricant must be supplied continuously to replace that carried to drainage by the large volumes of water flowed over the work area; and
40 further difficulties are encountered in the clogging and stoppage of drains by the accumulation of solid congealed oil in the drainage system.

It has now been discovered that the foregoing and other difficulties, heretofore encountered in
45 supplying both lubricant and coolant service for metal working operations, may be obviated by a novel lubricating composition combining the advantages of soluble oils and of palm oil without the defects of either. According to the invention, this desirable objective is attained by
50 providing an emulsified lubricant having both mineral oil and palm oil incorporated therein in such manner as to give a product characterized by high film strength comparing favourably with
55 that of palm oil per se, and by enduring stability

of the emulsion whether concentrated or dilute thus enabling continued recirculation without separation. Further advantages reside in the neutral, non-toxic, and non-irritating character of the composition, freedom from rancidity, and complete resistance to foaming regardless of the degree of agitation to which it is subjected. These and other objects and advantages will appear, to those skilled in the art to which the invention pertains, from the following description and illustrative examples which enable its novel and beneficial characteristics to be particularly ascertained.

As a general procedure, lubricating compositions according to the present invention are prepared by first bringing together suitable proportions of mineral oil and palm oil in a mixing kettle or other receptacle, and heating the so combined ingredients at moderately elevated temperatures with agitation until the palm oil melts and becomes thoroughly mixed with the mineral oil. Temperatures of the order of 70° F. to 140° F. are effective both at this and subsequent stages of the process. The mixture of palm and mineral oils is maintained at or about its formation temperature while a suitable saponifying agent is added slowly thereto with constant agitation. Considerable care is exercised to effect a close balance between the amount of added agent and the free fatty acid content of the palm oil; thus forming, at the end of this step, a clear solution of saponified palm oil in mineral oil with no material excess either of palm fatty acids or of saponifying agent.

The final step in the general procedure of the invention comprises the formation of an emulsion by aqueous addition to the oil-soap solution while the latter still remains at a temperature somewhat above 70° F. but preferably not substantially in excess of 140° F. An important factor for full success in preparing these novel lubricating emulsions is the addition of water, preferably warm, to freshly prepared oil-soap solution maintained at a moderately elevated temperature which conveniently may be the temperature at which the solution was formed. Likewise it is desirable to add the water in small amounts with thorough mixing after each addition. When these conditions are observed the final product comprises a perfect stable emulsion, which may be cooled and stored without impairment of desired properties, and which may be diluted to very considerable degree by further aqueous additions at ordinary temperatures.

Considered in greater detail, important and

distinctive features characterize the formation of lubricating compositions according to the present invention. Prominent among these is the preparation of the composition in the form of a rich or concentrated emulsion by aqueous addition to a warm freshly prepared mineral oil-palm oil soap solution. It has been discovered that the usual procedure in the production and marketing of soluble oils, which in brief comprises forming a substantially anhydrous solution of mineral oil and an emulsifying agent to be marketed as such for emulsification with water in desired degree of dilution, cannot be followed in the case of mineral oil-palm oil soap compositions. The oil-soap solution is readily formed by the procedure hereinbefore outlined, but if the solution is permitted to stand and cool separation occurs and the emulsifying properties of the solution are largely destroyed. It has been further discovered, however, that the mineral oil-palm oil soap solution while still at the moderately elevated temperature of its formation is capable of forming perfect stable emulsions which retain their stability upon cooling and storage. Emulsions, containing mineral oil and saponified palm oil, which are formed in this manner may be relatively very concentrated and exhibit great capacity for dilution by further aqueous addition without further use of heat. The invention thus makes available a stable concentrated product or base stock which may be marketed and stored and from which may be readily formed at the point of service the dilute lubricating emulsions containing palm oil which are desired for various metal working operations. In particular, the rich or concentrated emulsions are formed by slow and careful addition of water preferably warm to a still warm pre-formed oil-soap solution with frequent agitation. In the early stage of aqueous addition, agglomerates of emulsified material form throughout the mixture imparting a curdled appearance to the originally clear oil-soap solution. As the introduction of water is continued slowly and in small unit quantity, emulsion formation develops further throughout the solution until the entire mixture becomes a smooth whitish mass of homogeneous character and having the consistency of a heavy paste. It is then a complete, though very concentrated, perfect emulsion, this condition being reached at a point of aqueous addition corresponding to a water content in the paste of the order of 10% to 15% by weight. Greater additions of water have the effect of thinning out the emulsion or paste, and impart a more readily flowing character thereto which is sometimes desirable to facilitate handling the product both at the point of production and at the point of use. A further important feature of the invention is the careful balancing of saponifying agent against the amount of free fatty acid present in the mixture of palm oil and mineral oil formed as a first step in the process of preparing improved lubricating compositions as herein. This balance is observed to insure that the ultimate emulsified product be substantially neutral in character, any material excess either of acid or base in the emulsified lubricant being undesirable.

The saponifying agent selected preferably is an organic base such as the ethanolamines. It has been discovered that compounds of the character of triethanolamine are effective in imparting non-foaming characteristics to lubricating emul-

sions of the invention, and thus enhance the quality of the ultimate product. Inorganic bases such as sodium or potassium hydroxide may be used as the saponifying agent but are less advantageous.

Regarding the mineral oil used for compounding lubricant composition herein, any suitable hydrocarbon lubricating stock having a capacity for emulsification with saponified palm oil may be used. The mineral oil selected need not be highly refined, and distillate lubricating stocks of relatively low viscosity generally are preferred. Some oils will be more readily emulsified than others, Coastal red oil having a viscosity of 300 seconds Saybolt at 100° F. being an example of a satisfactory lubricating stock for the instant purpose.

Proportions of mineral oil to be incorporated in the lubricating compositions of the invention permit of some variance and depend, among other factors, to some extent upon the particular lubricating stock selected for use and the solubility of palm oil soaps therein. In the interest of economy a high proportion of mineral oil to palm oil is desirable, the maximum being of course dependent upon the soap content of the mixture and its capacity for holding mineral oil in the emulsified state with water. It has been found that substantially maximum proportions of mineral oil relative to formed soap can be used without unduly affecting the load carrying ability and film strength of the finished lubricating emulsion whatever its degree of aqueous dilution.

As stated hereinbefore, the palm oil of commerce may vary in free fatty content, and this must be considered in determining the amount of mineral oil to be used. Generally it is preferred to use high acid content palm oil (of the order of 50% to 80%) and, if this is not naturally available, it has been found that the acid content may be increased artificially by the addition of a desired amount of palm fatty acid such as palmitic or oleic. Amounts of triethanolamine sufficient to give a substantially neutral product by saponifying the total amount of free fatty acid present are used in such cases as in the case when the palm oil used has a naturally available high free fatty acid content. In this manner there is assured the presence of sufficient palm soap to carry a maximum proportion of mineral oil in the final emulsified lubricant.

For more specific illustration of the invention, reference may be had to the following example which exemplifies actual application of the invention but is to be understood as in no sense limitative thereof in the matter of particular details.

In this illustrative case the mineral oil used was a Coastal red oil of 300 Saybolt seconds viscosity at 100° F.; and the palm oil a commercial product having a free fatty acid content of approximately 80% by weight. The indicated formula for compounding of ingredients presents all proportions as by weight.

	Parts
Mineral oil.....	83.2
Palm oil.....	11.2
Triethanolamine.....	5.6
Total.....	100.00

The mineral oil and palm oil in the proportions indicated were placed in a mixing kettle provided with suitable stirring mechanism, and the mixture heated at a temperature of about 140° F.

with constant and thorough agitation until all of the palm oil had melted and was well mixed with the mineral oil. The formula quantity of triethanolamine then was added slowly with continued stirring while the temperature of the mix was maintained between 120° F. and 140° F. During this stage substantially complete saponification of the palm fatty acids was effected and a clear oil-soap solution resulted. Thereupon water in small unit quantity was added slowly with constant agitation and without material temperature drop. When the aqueous addition comprised about 12% of the entire batch (including the water) the mix was a perfect emulsion in the form of a thick heavy paste which can be further diluted at this point to impart better flowing characteristics to the product if desired. Alternatively, however, the more concentrated paste can be cooled and stored for later dilution to any desired degree without further heating and without impairing the quality or stability of the emulsion.

In the instant example, the aqueous addition was continued during the initial formation of a rich or concentrated lubricating emulsion according to the invention until a product was obtained having a formula proportion of ingredients as follows:

	Parts
Mineral oil-----	54.08
Palm oil-----	7.28
Triethanolamine-----	3.64
Water-----	35.00
Total-----	100.00

It will be noted that the ratio of mineral oil to the total of free fatty acids and triethanolamine used in the foregoing example is approximately 6 to 1. Despite this high relative proportion of mineral oil, the product in varying degree of dilution with water exhibited high film strength and load carrying ability comparing favorably in this respect with straight palm oil. The paste product was found to have an enduring stability of emulsion upon storage, and under various extreme test conditions, such as prolonged chilling and prolonged heating. It showed non-corrosive to steel, was non-foaming, and maintained its desirable properties upon extended dilution after storage. Thus, leaner emulsions formed by diluting the above 35% water content paste to the extent of 1 part of paste to 4 parts of water, and of 1 part of paste to 20 parts of water were subject to exhaustive test work with excellent results.

I claim:

1. Lubricating composition suitable for use in metal working operations, which comprises a substantially neutral aqueous emulsion containing mineral oil and a saponified component derived from the fatty acid mixture obtainable from a palm oil.

2. Lubricating composition suitable for use in metal working operations, which comprises a substantially neutral aqueous emulsion containing mineral oil and a saponified component derived from a fatty acid mixture conforming substantially to the mixture of fatty acids obtainable from a palm oil.

3. Lubricating composition suitable for use in metal working operations, which comprises a substantially neutral aqueous emulsion containing mineral oil and saponified palm fatty acids, at least a portion of said acids being derived

from palm oil introduced as an ingredient in the preparation of said emulsion.

4. Lubricating composition suitable for use in metal working operations, which comprises a substantially neutral aqueous emulsion containing mineral oil and saponified palm fatty acids and having a water content of at least 10% by weight, at least a portion of said acids being derived from palm oil introduced as an ingredient in the preparation of said emulsion.

5. Lubricating composition suitable for use in metal working operations, which comprises a substantially neutral aqueous emulsion containing mineral oil and palm oil the free fatty acid content of which has been fully saponified, said emulsion having a water content of at least 10% by weight.

6. Lubricating composition suitable for use in metal working operations, which comprises a substantially neutral aqueous emulsion containing mineral oil and saponified palm-oil.

7. Lubricating composition suitable for use in metal working operations, which comprises an aqueous emulsion formed with mineral oil, palm oil, an organic saponifying agent, and water, the amount of saponifying agent being so proportioned to the free fatty acid content of said palm oil as to give a substantially neutral product.

8. Lubricating composition suitable for use in metal working operations, which comprises a non-foaming aqueous emulsion formed with mineral oil, palm fatty acids derived at least in part from palm oil as an ingredient, triethanolamine, and water, the amount of triethanolamine being so proportioned to the total free fatty acid present as to give a substantially neutral product.

9. Lubricating composition suitable for use in metal working operations, which comprises a substantially neutral, non-foaming aqueous emulsion containing as ingredients only mineral oil, palm oil, triethanolamine in amount sufficient to fully saponify the free fatty acid content of said palm oil, and water.

10. Lubricating composition suitable for use in metal working operations, which comprises a substantially neutral, non-foaming aqueous emulsion containing as ingredients only mineral oil in maximum proportion relative to other non-aqueous ingredients, palm oil, triethanolamine in amount sufficient to fully saponify the free fatty acid content of said palm oil, and water in proportion of at least 10% by weight.

11. Method of preparing lubricating compositions suitable for use in metal working operations, which comprises forming a substantially neutral solution of saponified palm fatty acids in mineral oil at moderately elevated temperatures, and adding water to said solution while still warm.

12. Method of preparing lubricating compositions suitable for use in metal working operations, which comprises forming a substantially neutral solution of saponified palm fatty acids in mineral oil at moderately elevated temperatures, and while said solution is still warm adding thereto water in amount at least sufficient to form a perfect emulsion.

13. Method of preparing lubricating compositions suitable for use in metal working operations, which comprises heating together mineral oil and palm oil containing free fatty acids to form a completely liquid mixture, maintaining said mixture at moderately elevated temperatures while adding saponifying agent thereto in amount sufficient to give a substantially neutral solution,

and thereafter adding water to said solution while still warm to form a perfect emulsion.

14. Method of preparing lubricating compositions suitable for use in metal working operations, which comprises forming with the aid of heat and agitation an intimate fully liquid mixture of mineral oil and palm fatty acids, maintaining said mixture at moderately elevated temperatures while adding organic saponifying agent thereto in amount sufficient to give a substantially neutral solution, and thereafter adding water to the still warm solution to form a perfect emulsion of desired degree of dilution.

15. Method of preparing lubricating compositions suitable for use in metal working operations, which comprises forming with the aid of heat and agitation an intimate fully liquid mixture of mineral oil and palm fatty acids introduced at least in part as the free fatty acid content of palm oil, maintaining said mixture at moderately elevated temperatures while adding organic saponifying agent thereto in amount sufficient to give a substantially neutral solution, and thereafter adding water to the still warm solution to form a perfect emulsion of desired degree of dilution.

16. Method of claim 15, further characterized in that the addition of water to said oil-soap solution is effected with constant agitation.

17. Method of claim 15, further characterized in that the addition of water to said oil-soap solution is effected portion-wise in small unit quantity with constant agitation.

18. Method of preparing lubricating compositions suitable for use in metal working operations, which comprises forming with the aid of heat and agitation an intimate fully liquid mixture of mineral oil and palm fatty acids introduced at least in part as the free fatty acid content of palm oil, maintaining said mixture at moderately elevated temperatures while adding triethanolamine thereto in amount sufficient to fully saponify said palm fatty acids, and thereafter adding water to the still warm oil-soap solution to form a perfect emulsion of desired degree of dilution.

19. Method of claim 18, further characterized in that said mineral oil ingredient is used in maximum proportions relative to other non-aqueous ingredients.

20. Method of preparing lubricating compositions suitable for use in metal working operations, which comprises forming with the aid of heat and agitation an intimate fully liquid mixture of mineral oil of the character of a Coastal red oil having viscosity of 300 seconds Saybolt at 100° F. and palm oil having a relatively high free fatty acid content, maintaining said mixture at moderately elevated temperatures of the order of 70° F. to 140° F. while adding triethanolamine thereto with

continued agitation and in amount sufficient to fully saponify the free fatty acid content of said palm oil, the proportions of ingredients being so adjusted that the ratio of mineral oil to the combined amounts of free palm fatty acids and triethanolamine is of the order of 6 to 1, adding water to the still warm oil-soap solution with constant agitation and in small unit quantity to a total proportion sufficient to form a concentrated but perfect emulsion, cooling said concentrated emulsion to ordinary atmospheric temperature, and thereafter forming dilute emulsions therefrom by further aqueous addition to desired degree of dilution without further required heating.

21. Lubricating compositions suitable for use in metal working operations and having effective lubricant and coolant characteristics, which comprises an aqueous emulsion prepared with formula ingredients comprising mineral oil, palm oil, a saponifying agent, and at least sufficient water to form a stable, homogeneous emulsion.

22. Lubricating compositions suitable for use in metal working operations and having effective lubricant and coolant characteristics, which comprises an aqueous emulsion prepared with formula ingredients comprising viscous mineral oil, palm oil, an organic saponifying agent, and at least sufficient water to form a stable, homogeneous emulsion.

23. Lubricating compositions suitable for use in metal working operations and having substantially the lubricant and coolant characteristics of an aqueous emulsion prepared with formula ingredients comprising by weight approximately 80 parts of mineral oil, approximately 10 parts of palm oil having a free fatty acid content of about 80% by weight, and approximately 5-6 parts of triethanolamine, the foregoing ingredients being associated with added water in amount at least sufficient to form a stable, homogeneous emulsion.

24. Lubricating composition suitable for use in metal working operations and comprising 100 parts by weight of the formula

	Parts
Mineral oil	83.2
Palm oil (80% by wt. free fatty acids)	11.2
Triethanolamine	5.6

and at least sufficient added water to form a stable, homogeneous emulsion.

25. Lubricating composition suitable for use in metal working operations and having formula ingredients by weight comprising

	Parts
Mineral oil	54.08
Palm oil (80% by wt. free fatty acids)	7.28
Triethanolamine	3.64
Water	35.00

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