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DRAWING COMPOUND

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This invention relates to drawing compounds of the type used for lubricating and aiding in the art of metal forming.

The compounds of the present invention are particularly well suited for aiding in the drawing of seamless steel tubes which have first received an integral phosphate coating. In the art of metal forming, particularly where substantial deformations are to be made through the use of dies, it is becoming the practice more and more to first treat the tubes with a phosphating solution to form on the surface of the metal a closely adherent phosphate coating of a metal such as zinc or iron. The metal work is then coated with a lubricating composition before being passed through the forming dies.

For the drawing of seamless steel tubes, wet lubricants of the soap and fat or soap and fatty-oil type have been found to give good results particularly where the tubes are drawn immediately after coating with the lubricant. However, lubricants of this type have several objectionable features when used for the drawing of tubes in the manner described. When the tubes are coated with the soap and fat lubricants as normally used and are not immediately drawn but are stored for several days before drawing, it is necessary to recoat the tubes before satisfactory drawing can be obtained. This can be overcome by using a highly concentrated solution of the lubricant. However, this is wasteful of the lubricant and, as a result, is too expensive for satisfactory commercial operation.

A further objection to the use of lubricants of the soap and fat type for drawing metal stock which has first received a phosphate coating is that the lubricant in the container through which the tubes pass substantially decreases in viscosity with continued use. As a result, the tubes passing through the low viscosity lubricant do not drag out sufficient lubricant to give proper lubrication during the drawing operation. This is particularly true where the tubes being drawn are of relatively large diameter. The cause of this decrease in viscosity is not exactly known but is probably due to the introduction of salts and acids which are still present in small amounts on the treated tubes after the rinsing of the phosphated stock.

The change in viscosity is readily illustrated by the following: A lubricant containing 4.5% soap, 11.1% fatty material, 0.6% free fatty acid, and 83.8% water had a viscosity of 120 seconds at 150° F. with a #200 Ostwald Fenske viscosimeter before any stock has been immersed therein, i. e. before use. After using this lubricant for 144 hours, the viscosity of the lubricant was found to have dropped to 23 seconds.

We have discovered that by adding a small amount of starch to lubricants of the soap and fat type the viscosity of the lubricants is considerably stabilized so that large changes in viscosity on use of the lubricant are avoided. Also, if the starch containing soap and fat lubricant is formulated to have a viscosity of approximately 40 to 120 seconds at 150° F. as determined by an Ostwald Fenske

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#200 viscosimeter, the lubricated tubes can be stored for as long as 6 weeks without the necessity of relubricating before drawing.

The improvement in storability through the use of small amounts of starch is readily apparent from the following example: When using a lubricant concentrate analyzing 16% soap, 40% fat, 2% free fatty acid, and 42% water, in order to permit storage for periods over 2 days, without relubrication before drawing, the lubricant must be used in concentrations of 1 part concentrate to 2 parts water. Substantially the same lubricant base with the addition of starch analyzing 14.8% soap, 37.0% fat, 1.9% free fatty acid, 8% starch and 38.3% water will give excellent draws without relubrication after storage of the lubricated stock for periods in excess of 4 weeks when used in concentrations of 1 part concentrate to 5 parts water.

In order to obtain the desired results, the starch must be treated so as to swell its granules. This swelling of the starch granules may be obtained in any suitable manner. The starch may be swollen by heating in water before addition to the fat and soap mixture or the unswollen starch may be added to the fat, soap and water emulsion and the emulsion heated either before or after dilution for use. Also, certain swelling agents may be added which hasten the swelling of the starch granules. Among compounds which act in this manner are borax and sodium dihydrogen phosphate.

While various methods may be devised for incorporating the starch with the soap and fat, we prefer to add the starch as a powder to an emulsion concentrate of the soap and fat, the concentrate generally being in a pasty form. Though the lubricant has been described as being of the soap and fat type, in place of the fat one may use fatty oils, fatty esters, partial fatty esters or mixtures of these. The term "fat" or "fats" as used in this specification and in the appended claims is intended to include these somewhat similar materials.

The invention is not limited to any particular soap or fat (the term "fat" including fatty oils, fatty esters, and partial fatty esters), since any fats or water-dispersible soaps suitable for lubricating purposes may be used in preparing the compositions of our present invention. Thus, any of the water-dispersible soaps obtained from beef tallow, mutton tallow, lard oil, palm oil, etc.; or fats: beef tallow, mutton tallow, lard, degrass, etc.; fatty oils: lard oil, palm oil, cotton seed oil, olive oil, etc.; or fatty esters: esters of fatty acids with glycerine, sorbitol, ethylene glycol, polyethylene glycol, propylene glycol, diethylene glycol, etc.; or partial fatty esters of fatty acids with glycerine, ethylene glycol, sorbitol, polyethylene glycol may be employed. We prefer, however, for most purposes to use as the soap a tallow soap, and as the fat a tallow treated as by heating with a polyhydric alcohol in the presence of an alkali.

In practicing our invention a pasty composition, which is hereinafter called a lubricant concentrate, is preferably first prepared containing 5 to 25 parts soap, 20 to 50 parts fat, 13 to 60 parts water and 4 to 12 parts starch. The starch is generally present in an unexpanded or partially expanded form. The proportion of ingredients should preferably be such that after dilution for use, with 3 to 7 parts water per part composition and expansion of the starch, as by heating, the viscosity of the lubricant emulsion lies between 40 to 120 seconds at 150° F. with a #200 Ostwald Fenske viscosimeter. The starch may be incorporated during the blending of the soap, fat and water or may be added to an emulsion of soap, fat and water. However, if the latter method is used, the starch should be thoroughly blended with the emulsion.

In our preferred concentrate compositions the starch

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is preferably present in amounts of 6 to 10 parts starch together with 12 to 16 parts soap, 35 to 42 parts fat, and 32 to 45 parts water. The lubricant concentrate is diluted 1 part concentrate to 3 to 7 parts water before treatment of the stock with the lubricant prior to drawing. In another concentrate system containing bentonite together with a filler, our preferred composition contains 4 to 8 parts starch, 10 to 14 parts soap, 28 to 35 parts fat, 0.5 to 10 parts bentonite, 10 to 25 parts filler and 10 to 45 parts water. These compositions are used in the same concentrations as the materials containing no filler.

In order to better illustrate the practice of our invention, the following examples are given. These examples however, are given for the purpose of illustration only and should not be considered in any way as limiting the invention thereto.

Example 1

A lubricant concentrate containing 14.8% of a potassium soap of tallow and lard oil, 37.0% tallow, 1.9% free fatty acid (calculated as oleic acid), 8.0% corn starch and 38.3% water was diluted 1 part concentrate to 5 parts water at the plant. This diluted lubricant was then boiled for approximately 3 hours after which time the viscosity on measuring was found to be 60 seconds at 150° F. with a #200 Ostwald Fenske viscosimeter. The bath was cooled to approximately 150° F., its use temperature, and then the tubes to be drawn were immersed in the bath and removed and stored. The tubes could have been drawn immediately; however, under the operating conditions encountered, the tubes were stored for several days before the actual drawing operation. When drawn, excellent lubrication was obtained.

Example 2

A lubricant containing 5% of a sodium soap of a single pressed stearic acid, 28% tallow, 2% free fatty acid, 10% potato starch and 55% water was diluted with approximately 5 parts water and boiled until a viscosity was obtained of 60 seconds at 150° F., with a #200 Ostwald Fenske viscosimeter, the boiling period being approximately 4½ hours. After the lubricant had reached this point, it was cooled to approximately 130° F. at which temperature it was used for lubricating stock. The stock lubricated, by immersing, was found to draw easily after a weeks storage.

For some particularly difficult drawing operations such, for example, as the drawing of certain alloy steels, it has been found beneficial to include with the starch a small amount of bentonite in the lubricant formulations. The bentonite may be included alone or together with suitable inert materials such as kaolin, mica, whitening or similar inert materials. An excellent lubricant suitable for such purposes can be prepared by adding with the starch 2 to 10 parts of bentonite with or without a filler material such as described. The following is an example of this type of formulation.

Example 3

A lubricant concentrate containing 12.3% soap, 30.0% tallow, 1.6% free fatty acid, 4.5% corn starch, 2.4% bentonite, 16.8% kaolin and 28.4% water was diluted 1 part concentrate to 4 parts water. The diluted solution was boiled for 3 to 4 hours until a viscosity of 58 seconds at 150° F. with a #200 Ostwald Fenske viscosimeter was obtained. This lubricant solution was used at a temperature of 150° F. to coat tubes made of 5% chromium steel which tubes were then stored for a period of 2 weeks before drawing. Excellent lubrication was obtained during the drawing operation.

The lubricant compositions of the present invention are not to be confused with those lubricant compositions to which starch has heretofore been added for entirely different purposes. These prior starch-containing compositions themselves differ substantially from the soap, fat

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and starch compositions of the present invention. We realize that starch and flour have heretofore been used as a lubricant for wire drawing. However, the use of starch as a lubricant in the early metal working art differs substantially from its use in the present compositions where the starch acts more as a modifying agent than as a lubricant itself. We are also aware of the fact that starch has been used as a binder, particularly in dry lubricants, for giving a firmer bond between the lubricant composition and the metal treated. Again the starch in the present composition does not serve the purpose of a binder but serves rather to actually modify the lubricant so as to change its characteristics by increasing its stability with respect to viscosity when used and by eliminating the necessity of immediately drawing the work treated. Other materials such as flour, sodium alginate, dextrin, glue, glucose, and proteins such as gelatin, when added to the soap and fat type emulsion lubricant, in place of starch, fail to give lubricants having the desirable characteristics obtained through the use of starch.

Preferably, when metal such as seamless steel tubing is formed through drawing operations wherein lubricants of our present invention are employed, the metal is first cleaned, then immersed in an acid phosphate bath, such as a zinc dihydrogen phosphate bath or an iron phosphate bath to form a phosphate coating thereon. After phosphating, the metal is rinsed and then coated with a lubricating solution prepared by adding 3 to 7 parts water to a lubricant concentrate of the present invention. If the starch of the concentrate has not been expanded, the lubricant emulsion is also heated, before using, preferably to 180 to 210° F. for 1 to 12 hours, lower temperatures, such as 150° F., being suitable where longer periods of heating are used. The tubes can then be drawn immediately by passing through the forming dies or can be stored, without the necessity of further lubrication, for several weeks before such drawing operation.

Though in describing our present invention the description has been drawn primarily to the lubricant concentrates, this being the form in which the lubricant compositions would normally be sold, the invention also includes the lubricant as actually used in its diluted form. Also, the use of the lubricant composition is not limited to those drawing operations wherein the metal has been given a phosphate coating prior to lubrication.

In describing the invention and particularly in the examples, applicants have described formulations in which specific fats and soaps have been employed and in which the soaps and fats have been used in specific proportions. The invention, however, should not be limited to these specific ingredients or proportions, nor should the invention be limited to the specific starches disclosed since applicants believe that any starches may be employed.

Having thus described our invention, we claim:

1. A lubricant composition in the form of an emulsion comprising 1 to 5 parts water-dispersible fatty acid soap, 5 to 12 parts fat, 0.5 to 2 parts of expanded starch and 80 to 92 parts water said starch having been expanded by heating in water for at least one hour at a temperature of at least 150° F.

2. A lubricant composition prepared by diluting a concentrate comprising 5 to 25 parts soap of the group consisting of sodium and potassium laurate, palmitate, oleate and stearate, 20 to 50 parts fat of the group consisting of lard oil, palm oil, mutton tallow, beef tallow, lard and mixtures of fatty acid esters of polyhydric alcohols, 4 to 12 parts starch and 13 to 60 parts water with 4 to 7 parts water, said starch in said lubricant having been expanded by heating to a temperature of at least 150° F. for not less than one hour.

3. A lubricant composition prepared by diluting a concentrate comprising 5 to 25 parts potassium stearate, 20 to 50 parts beef tallow, 4 to 12 parts starch and 13 to 60 parts water with 4 to 7 parts water, said starch in said lubricant having been expanded by heating to

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a temperature of at least 150° F. for not less than one hour.

4. A lubricant composition prepared by diluting a composition comprising 5 to 25 parts potassium stearate, 20 to 50 parts of a mixture of fatty acid esters of polyhydric alcohols, 4 to 12 parts starch and 13 to 60 parts water with 4 to 7 parts water, said starch in said lubricant having been expanded by heating to a temperature of at least 150° F. for not less than one hour.

5. A lubricant composition prepared by diluting a composition comprising 12 to 16 parts potassium stearate, 35 to 42 parts beef tallow, 6 to 10 parts of an expanded starch and 32 to 45 parts water with 4 to 7 parts water, said starch in said lubricant having been expanded by heating to a temperature of at least 150° F. for not less than one hour.

6. A lubricant composition prepared by diluting a concentrate comprising 5 to 25 parts water-dispersible fatty acid soap, 20 to 50 parts fat, 1 to 12 parts starch, 0.5 to 10 parts bentonite and 13 to 60 parts water with 4 to 7 parts water, said starch in said lubricant having been expanded by heating to a temperature of at least 150° F. for not less than one hour.

7. A lubricant composition prepared by diluting with 4 to 7 parts water a concentrate comprising 10 to 16 parts potassium stearate, 32 to 42 parts beef tallow, 4 to 10 parts of an unexpanded starch, 4 to 6 parts bentonite and 30 to 45 parts water said diluted concentrate being heated to a temperature of at least 150 to 212° F. for not less than one hour to expand said starch.

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8. A lubricant composition prepared by diluting a concentrate comprising 5 to 25 parts water-dispersible fatty acid soap, 20 to 50 parts fat, 13 to 60 parts water and 4 to 12 parts starch, with 4 to 7 parts water, said starch in said lubricant having been expanded by heating to a temperature of at least 150° F. for not less than one hour.

9. The lubricant composition of claim 8 wherein said starch has been expanded by heating at a temperature of approximately 212° F. for at least one hour.

10. In the preparation of metal prior to forming, the step which comprises covering the surface of said metal with an emulsion lubricant composition of claim 1 at a temperature of approximately 150° F. and thereafter letting the lubricant composition cool on said surface.

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