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COLD FORMING LUBRICANT

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No Drawing. Continuation-in-part of application Ser. No. 510,040, Nov. 26, 1965. This application Jan. 12, 1968, Ser. No. 697,317
The portion of the term of the patent subsequent to Mar. 5, 1985, has been disclaimed
Int. Cl. C10m *3/04, 3/38, 3/48*
U.S. Cl. 252—42.1 6 Claims

ABSTRACT OF THE DISCLOSURE

A lubricant concentrate composition which comprises from about 3 to 75 percent by weight of an alkali metal orthophosphate, about 15 to 97 percent by weight of an alkali metal fatty acid soap, containing from about 8 to 22 carbon atoms, and at least 0.1 percent by weight of a surface active agent selected from the group consisting of non-ionic ethylene oxide-alcohol condensates and amphoteric biodegradable surface active agents. Additionally, the concentrate composition may contain from about 0.1 to 80 percent by weight of a water dispersible diluent selected from water soluble and colloidally suspendable diluents, such as sugar and polyethylene glycol having a molecular weight from about 100 to 10,000. An aqueous lubricant composition containing from about 10 to 400 pounds of this concentrate per hundred gallons of solution may be used to form a lubricant coating on a chemically coated metal surface, such as a phosphate coated metal surface, which surface may then be deformed after the lubricant coating has been dried.

This is a continuation-in-part of our copending application Ser. No. 510,040, filed Nov. 26, 1965, now U.S. Pat. 3,372,117.

This invention relates to an improved lubricating composition and more particularly it relates to an improved soap-type lubricant which is useful in lubricating chemically coated metal surfaces prior to deformation.

In the art of cold forming metal, e.g., metal deformation or metal drawing, it is customary to provide a chemical coating on the metal surface to be deformed, such as a phosphate coating, an oxide coating, an oxalate coating, a sulfide coating, or the like. Additionally, prior to the actual deformation of the metal surface, the chemical coating on the surface is frequently treated with a lubricant, such as a hot, aqueous soap solution. Upon the application of pressure to the metal surface, during the deforming operation, the coating on the surface crushes to a continuous, unctuous film which has been found to be an excellent parting layer between the metal and the die during the deforming operation.

Generally, it is the practice to include in the composition of the lubricant materials, such as the aqueous soap solution, one or more inorganic materials which act as diluents in the lubricant composition and may also have a desirable effect on the lubrication properties of the composition. Often, when such lubricant compositions have been in use for a period of several days or weeks, separation or salting out of the soap and inorganic materials in the composition takes place. When this happens, the entire lubricant bath must be dumped and a new bath built up. This is, of course, undesirable, both from the cost standpoint as well as from the standpoint of time loss and interruption of production schedules.

It has been found that although an alkaline pH is desirable in the aqueous lubricant composition, the nature

of many of the inorganic pigment materials which have been used is such that there is an undesirable attack of the lubricant composition on the chemical coating on the metal surface, such as a phosphate coating. This has been found to be particularly troublesome where the phosphate coated pieces are continuously passed through a body of the aqueous lubricant composition. In such operations, there are often holdups or stoppages on the conveyor lines so that those pieces which happen to be immersed in the lubricant bath at the time of such stoppage, often remain therein for extended periods, e.g., several hours or more. Under these circumstances, with many of the prior lubricant materials which have been used, appreciable quantities of the phosphate chemical coating on the metal surface are dissolved by the lubricant.

It is, therefore, an object of the present invention to provide an improved lubricant composition for use in the cold forming of metal.

A further object of the present invention is to provide an improved lubricant for metal cold forming, which lubricant can be used for extended periods of time without separation or salting out of the components and has only a limited attack on phosphate or other chemical coatings on the metal surface.

Another object of the present invention is to provide an improved process for cold forming metal, which process utilizes the improved cold forming lubricant of the present invention.

These and other objects will become apparent to those skilled in the art from the description of the invention which follows:

Pursuant to the above objects, the present invention includes a lubricant composition concentrate which comprises an alkali metal orthophosphate, a fatty acid soap and a surface active agent selected from the group consisting of non-ionic ethylene oxide condensates and amphoteric biodegradable surface active agents. This lubricant composition has been found to be especially useful in metal deforming operates when applied over a chemical coating on the metal surface to be deformed, such as a phosphate, oxide, sulfide, oxalate coating, or the like.

More specifically, the improved lubricant concentrate compositions of the present invention are comprised of a fatty acid soap in an amount within the range of about 15 to 97% by weight of the composition, an alkali metal ortho phosphate in an amount within the range of about 3 to about 75% by weight of the composition and a surface active agent, selected from the indicated group, in an amount of at least 0.1% by weight of the composition. Preferably, the lubricant composition of the present invention will contain the fatty acid soap in an amount within the range of about 35 to 80% by weight of the composition, the alkali metal orthophosphate in an amount within the range of about 15 to 60% by weight of the composition and the surface active agent in an amount within the range of about 0.5 to 20% by weight of the composition. With regard to the surface active agent, although the maximum amount of this component in the composition has not been found to be critical, amounts as high as 70 to 80% by weight of the composition having no adverse effect thereon, it has been found, in general, amounts of the surface active agent appreciably in excess of about 20% by weight of the composition do not appear to greatly improve the composition properties. For this reason, it is generally preferred that the surface active agent be present in the composition in amounts within the preferred ranges which have been given hereinabove, i.e., from about 0.5 to about 20% by weight of the composition.

The fatty acid soaps which may be used in the composition of the present invention are typified by those fatty

acid soaps containing from about 8 to 22 carbon atoms and are preferably fatty acid soaps containing from about 12 to about 18 carbon atoms. Specifically preferred for use in the present composition are the sodium tallow soaps. Additionally, it is to be appreciated that in referring to the present composition containing a soap, it is intended to include both those compositions which contain the soap, per se, as well as compositions which contain components which react to form the soap in situ in the composition, such as compositions containing a fatty acid, a fat, or an oil and an alkali, such as an alkali metal hydroxide or an alkali metal carbonate,

The alkali metal orthophosphate which may be used in the present composition is selected from the group consisting of mono-, di-, and tri-alkali metal phosphates, and mixtures thereof. It is to be appreciated that as used in the specification and claims, the term "alkali metal" is intended to refer to lithium, sodium, potassium, cesium, and rubidium. Of these, the preferred alkali metal is sodium and, for this reason, primary reference hereinafter will be made to this material. This is not, however, to be taken as a limitation of the alkali metals which may be used, as excellent results may also be obtained with other alkali metals such as potassium. Of the alkali metal orthophosphates which have been indicated hereinabove as being suitable for use in the present composition, the preferred material is trisodium phosphate.

As has been indicated hereinabove, the surface active agent which is a component of the present invention is selected from the group consisting of non-ionic ethylene oxide condensates and amphoteric biodegradable surface active agents. The nonionic ethylene oxide condensates which are suitable may be characterized generally as condensates of ethylene oxide with a hydrophobic base, such as one formed by the condensation of an alkylene oxide and an alkylene glycol. Typically, these surface active agents have a molecular weight within the range of about 2000–20,000, with molecular weights within the range of about 6000–10,000 being preferred. Particularly good results have been obtained when using a material prepared by condensing ethylene oxide with the condensate of propylene oxide and propylene glycol to form a compound having a molecular weight of about 8000.

Amphoteric, biodegradable surface active agents which may be used include aliphatic betaines, such as coco-, lauryl, decyl, tallow betaines and the like; lecithin; protein derivatives such as the polypeptides and alkali metal polypeptides; complex fatty amido compounds; fatty nitrogen ether carboxylates; N-cocoamido butyric acid and the alkali metal salts thereof; aliphatic esters of amino and imino propionic acid; aliphatic ammonium sulfonic acid betaines and the like. Of these, in many instances the betaine and propionic acid derivatives are preferred. Generally, these surface active agents will have carbon chain lengths or contain carbon atoms within the range of about 5 to about 50 and preferably about 10 to 30.

In addition to the fatty acid soap, alkali metal orthophosphate, and surface active materials, the lubricant compositions of the present invention may also contain one or more water dispersible diluent or adjuvant materials. These diluents may be incorporated in the composition in addition to or as a replacement for a part of the alkali metal orthophosphate component. Preferably, the diluent materials used are water soluble although non-water soluble diluents which will remain dispersed in the aqueous lubricant composition are also suitable. Desirably, the diluents are present in composition in amounts within the range of about 0.1 to 80% by wegiht of the composition, with amounts within the range of about 10 to about 50% by weight of the composition being preferred. These diluent materials may be either inorganic or organic in nature and include antimony oxide, antimony sulfide, arsenious oxide, arsenious sulfide, barium pyrophosphate, bismuth sulfide, boric anhydride, calcium tetraborate, calcium carbonate, cadmium pyrophosphate, cobalt sulfide,

chromium fluoride, copper sulfide, ferrous sulfide, ferrous phosphate, lead borate, lead chromate, lead molybdate, lead oxide, lead phosphate, lead metasilicate, lead sulfide, manganese pyrophosphate, manganese borate, mercury sulfide, mercury chloride, molybdic oxide, nickel sulfide, molybdenum sulfide, sodium tetraborate (borax), vanadium pentoxide, zinc borate, zinc phosphate, the alkali metal silicates and particularly sodium metasilicates, clays, diatomaceous earth, fuller's earth, bentonite, kaolin, mica, sugar, starch, polyethylene glycols, dextrin, gelatin, gum arabic, bitumin, and the like. Of these, the preferred diluent materials for use in the present composition have been found to be sugar and the polyethylene glycols. Typically, the polyethylene glycols have a molecular weight from about 100 to about 10,000, with the intermediate molecular weight of from about 2,000 to 8,000, being preferred. These and other diluent materials have been found to make the present lubricating composition easier to clean from the workpiece after the deforming operation and have also been found to reduce the attack of the lubricant composition on the chemical coating, such as phosphate coating, on the metal surface.

In addition to the components which have been set forth hereinabove, the lubricant composition of the present invention may also contain corrosion inhibiting materials such as the alkali metal nitrates, alkali metal nitrites, and the like. These and other corrosion inhibitors as are known to those in the art, when used, are typically present in amounts within the range of about 0.1 to about 5% by weight of the composition and are preferably present in amounts within the range of about 0.1 to about 3% by weight of the composition. Additionally, dyes, such as Bismarck brown, and the like, and perfumes and other materials for imparting a pleasant odor to the composition, such as pine oil and the like, may also be incorporated in the lubricant composition in amounts sufficient to impart the desired color and/or odor to the composition.

In addition to the above adjuvants, the lubricant concentrate compositions of the present invention may also contain water, the amount depending upon the physical form which is desired for the composition. Typically, water in amounts up to about 80% by weight of the total composition may be used, with amounts within the range of about 15 to about 75% by weight of the total composition being preferred. As will be appreciated by those in the art, in determining the physical form or consistency of the lubricant composition which is desired, consideration will be given to the manner in which the composition is to be handled, packaged and transported. Accordingly, the amount of water included in the concentrate composition may vary widely and, in some instances, may even exceed 80% by weight.

In some instances, even when water in an amount of 75% by weight of the lubricant composition is used, the concentration of the composition may still be sufficiently high as to be undesirable for many applications to metallic surfaces. Accordingly, in formulating a working composition for application to a metal surface, the concentrated lubricant composition as has been described hereinabove will frequently be further diluted with water. Typical working compositions may contain the above described lubricant concentrate in amounts within the range of about 10 to about 400 pounds per hundred gallons of solution, and preferably in amounts within the range of about 50 to about 200 pounds per hundred gallons of solution.

The aqueous working lubricant composition containing the lubricant concentrate in amounts within the range of about 10 to about 400 pounds per hundred gallons of solution will have a Babcock number within the range of about 0.3 to 13 and a titration number within the range of about 1.4 to 58. The Babcock number is obtained by the following procedure:

A 100 milliliter cassia flask is provided with a 50 milliliter sample of the working solution and to this sample, 20

milliliters of 50% sulfuric acid is added and thoroughly admixed. The flask is then placed in a hot water bath having a temperature between about 82 degrees centigrade and the boiling point of the solution. After 10 to 20 minutes or more, sufficient hot boiled water is added to the cassia flask to bring the level of the solution into the graduated neck. When the oily layer has separated sharply, usually in about ½ an hour, the difference between the readings of the lower and upper edges of the oily column in the neck is the Babcock number.

The titration number is obtained by the following procedure:

50 milliliters of the hot lubricant solution is put into a beaker with about 120 milliliters of hot water. This solution is then titrated with 0.88 NH_2SO_4. The titration number is the number of milliliters of sulfuric acid needed to titrate the lubricant solution to the bromcresol green endpoint.

The aqueous working lubricant solution as described above may be applied to the metal surfaces to be deformed in various ways, such as by roller application, flow coating, spraying, or by immersing the metal surface in the lubricant solution. In such applications, the lubricant temperature may vary widely, from about room temperature up to about 100 degrees centigrade. Typical temperatures for application by immersion technique are within the range of about 60 to 100 degrees centigrade while temperatures from about room temperature up to about 60 degrees centigrade are typical for roller application. In some instances, it has been found that in the use of roller applications, it may be desirable to use the lubricant composition as a concentrate, with no further dilution. In this technique, the concentrate composition may be applied to the applicator rolls with air pressure, a reciprocating piston pump, or a centrifugal pump. It is believed that the details of the various techniques whereby the present lubricant compositions may be applied are sufficiently familiar to those in the art that further description of the details of such method are not necessary.

In forming metal articles in accordance with the process of the present invention, the lubricant compositions are applied to a chemically coated metal surface using the application techniques described above, to obtain the desired amount of lubricant on the surface. Generally, the lubricant coating is then dried and the coated surface is, thereafter, subjected to drawing, cold forming, or other deformation operations. The chemical coating on the metal surface, such as a phosphate, oxide, sulfide, or oxalate coating, may be applied using various application techniques as are known in the art, such as spraying, immersion, flowing, roller coating, and the like. Generally, the application of the chemical coating to the metal surface is preceded by a cleaning or pickling step and a rinse to remove the cleaning or pickling solution. Frequently, between the application of the chemical coating and the lubricant coating, the chemically coated surface is also rinsed to remove any unreacted coating material. Although this latter rinse may be a water rinse, alkaline or neutralizing rinses are also frequently used. It is believed that the composition and nature of the various chemicals' coating materials, as well as the specific details of the processes of applying them to the metal surface and the details of various metal deforming operations are all sufficiently well known to those in the art that a further detailed description of these compositions and processes is not necessary.

It has been found that in using the lubricant compositions of the present invention, the metal deforming operations are easily and economically performed. It has further been found that with these lubricant compositions, there is little or no problem of separation or salting out of the components of the lubricant compositions so that a bath of the lubricant can be used for extended periods of time with only periodic replenishment of the lubricant which is used. Additionally, it has been found that where the chemically coated metal parts are immersed in the lubricant for extended periods of time, there is only slight attack by the lubricant on the chemically coated surface.

In order that those skilled in the art may better understand the present invention and the manner in which it may be practiced, the following specific examples are given. In these examples, unless otherwise indicated, temperatures are in degrees centigrade and parts are by weight.

EXAMPLE 1

A lubricant concentrate composition was formulated containing 45 parts of sodium tallow soap, 22.5 parts sugar, 22.5 parts sodium phosphate, 5 parts polyethylene glycol, molecular weight 6000 and 5 parts of a nonionic ethylene oxide surface active agent having a molecular weight of 8000 and prepared by condensing ethylene oxide with a condensate of propylene oxide and propylene glycol. A working lubricant composition was built up from this concentrate using 170 pounds of the concentrate per hundred gallons of the working solution. Steel, blanks for automobile axle spindles were cleaned and then coated by immersion in a conventional zinc phosphate coating solution and were immersed in the working lubricant composition for 5 minutes, the composition being at a temperature within the range of about 80 to 85 degrees centigrade. Thereafter, the blanks were removed from the lubricant composition and dried at room temperature. The weight of zinc phosphate coating on the blanks was within the range of about 1000 to 1100 milligrams per square foot and the weight of lubricant on each blank was within the range of about 1700 to 1900 milligrams per square foot. These spindle blanks were subjected to a cold forming operation and in each instance a satisfactory axle spindle was obtained.

EXAMPLE 2

The procedure of Example 1 was repeated with the exception that for the nonionic ethylene oxide surface active agent there was substituted an amphoteric, biodegradable surface active agent which was the sodium salt of N-tallow beta imino dipropionate. Upon subjecting the spindle blanks coated with this lubricant composition to the deforming operation, a satisfactory axle spindle was obtained in each instance.

EXAMPLE 3

Lubricant compositions were formulated by combining 10 grams of the nonionic ethylene oxide surface active agent of Example 1 or 10 grams of the amphoteric biodegradable surface active agent of Example 2 with 758 grams of trisodium phosphate and 254 grams of sodium tallow soap and adding sufficient water to make one gallon. These compositions were heated at about 90° centigrade during the day and allowed to cool down to room temperature over night. At the end of four days, there was no evidence of separation or salting out in either lubricant, while a similar composition, but without the surface active agent salted out after one day.

The procedure of the above examples is repeated using lubricant concentrates containing disodium phosphate, monosodium phosphate, 50–50 mixtures of trisodium phosphate and disodium phosphate, and containing as diluents, bentonite, starch, sodium metasilicate, sodium tetraborate, kaolin and mica, to obtain similar results.

While there have been described various embodiments of the invention, the compositions and methods described are not intended to be understood as limiting the scope of the invention, as it is realized that changes therewithin are possible and it is further intended that each element recited in any of the following claims is to be understood as referring to all equivalent elements for accomplishing the same result in substantially the same

or equivalent manner, it being intended to cover the invention broadly in whatever form its principle may be utilized.

What is claimed is:

1. A lubricant composition concentrate which comprises about 3 to 75 percent by weight of an alkali metal orthophosphate, about 15 to 97 percent by weight of an alkali metal fatty acid soap, containing about 8 to 22 carbon atoms, and at least 0.1 percent by weight of a surface active agent consisting of non-ionic ethylene oxide-alcohol condensates of molecular weight 2000–20,000 the components being present in amounts sufficient to total 100 percent.

2. The composition as claimed in claim 1 wherein there is also present at least one water dispersible diluent, selected from the group consisting of sugar and polyethylene glycol having a molecular weight from about 100 to 10,000, in an amount within the range of about 0.1 to 80% by weight.

3. The composition as claimed in claim 2 wherein the soap is a sodium tallow soap, and the alkali metal orthophosphate is trisodium phosphate.

4. An aqueous lubricant composition containing the lubricant concentrate as claimed in claim 1 in an amount within the range of about 10 to about 400 pounds per hundred gallons of solution.

5. The composition as claimed in claim 4 wherein there is also present in the concentrate at least one water dispersible diluent, selected from the group consisting of sugar and polyethylene glycol having a molecular weight from about 100 to 10,000, in an amount within the range of 0.1 to 80% by weight of the concentrate.

6. The composition as claimed in claim 5 wherein the soap is a sodium tallow soap, and the phosphate is trisodium phosphate.

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U.S. Cl. X.R.

252—49.3, 49.5

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,556,996 Dated January 19, 1971

Inventor(s) Frederick W. C. Jones et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading to the printed specification, after line 5 should read -- Assignors to Hooker Chemical Corporation, Niagara Falls, N. Y., a corporation of New York --.

Signed and sealed this 12th day of December 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Pate