The present invention relates to lubricants and process of preparing the same, and refers more particularly to stable grease compositions comprising a mineral oil and vegetable oil soap.

It is an object of my invention to provide an improved, substantially anhydrous lubricating grease that is chemically and physically stable when subjected either to heat or to pressure or to both heat and pressure.

Therefore lubricating greases have been prepared by compounding mineral oil and a soap such as sodium stearate, sodium oleate and sodium palmitate at low temperatures. The soap was compounded in the presence of water, and a small percentage of water remained in the final grease composition. In such a grease the soap holds the oil as a sponge. When subjected to heat, as is frequently encountered in service, the grease decomposes and changes from a neutral or slightly alkaline composition to one having distinctly acid characteristics. In the decomposition process, the soap is destroyed, causing an ultimate breakdown of the grease. It appears that hydrolysis due to the presence of water in the grease contributes materially to its instability.

The improved grease compositions embodying my present invention employ, in place of water, an alkyl ether of diethylene glycol, such as, the monoethyl ether of diethylene glycol. The alkyl ethers of diethylene glycol act as a vehicle for uniting the alkali and fat, or fatty acid in the production of the soap constituent of the grease and apparently to some extent combine with these reacting ingredients. The anhydrous soap composition thus formed, which contains a minor proportion of an alkyl ether of diethylene glycol, or a derivative thereof, is compounded with a suitable mineral lubricating oil.

While various glyceride fats or oil, or fatty acids derived therefrom, or other saponifiable hydrocarbon, may be used in the formation of the soap constituent, I prefer to employ a mixture of drying, semi-drying and non-drying oils, the semi-drying oil preponderating over the other oils. For example, with about one to ten parts of drying oil, and a similar proportion of non-drying oil, I employ ten to fifty parts of a semi-drying oil, such as soya bean oil.

A preferred process of preparing the lubricating grease is as follows: a mixture consisting of 3 parts sodium hydroxide, 10 parts monoethyl ether of diethylene glycol, and a vegetable oil mixture consisting of 3 parts castor oil, 3 parts tung oil, 2 parts raw linseed oil and 10 parts soya bean oil is heated gradually to 280° C. The latter three oils have drying properties. The sodium hydroxide goes into solution at about 180 to 200° C. and a soap is formed when the temperature of the mixture rises to the range between approximately 260 and 280° C.

My invention includes the employment of other alkyl ethers of diethylene glycol, such, for example, as the methyl or butyl ethers in place of the ethyl ether of diethylene glycol.

The monooethyl ether of diethylene glycol, which has a boiling point within a range of about 185 to 205° C., is largely evaporated during this heating step but a small amount still remains in the composition either in its original state or else modified by chemical reaction. In any event the residue remaining is capable of acting as a bonding agent whereby such soap composition can be united or emulsified with mineral oil. Relatively large quantities of oil thus can be held as a stable emulsion which does not break down during severe use.

The mixture containing a small amount of an alkyl ether of diethylene glycol and in addition some gycerine which is formed during saponification, is allowed to cool to approximately room temperature and thereupon the desired form of mineral oil is added. For example, for heavy ball bearing grease, medium heavy oil of 10° F. cold test can be used. For special purposes requiring the grease to remain plastic at low temperatures, lighter oil having a cold test of minus 40° F., may be necessary. In general the conditions under which the lubricating grese is to be used will determine the character of the oil embodied in it. This oil and soap mixture in which mineral oil may constitute 83 to 90 per cent of the total mass is heated to a temperature within the range of about 200 to 220° C., until a clear solution is obtained. It is allowed to cool with constant stirring until the mixture thickens. If insoluble particles, such as overheated soap products are present, they are removed by filtration while the solution is hot and unthickenened.

In some cases, a fatty acid such as stearic acid may be incorporated with the other ingredients. For example, a mixture consisting of 30 parts sodium hydroxide, 110 parts monoethyl ether of diethylene glycol, 105 parts stearic acid, and a 45 vegetable oil mixture consisting of 4 parts castor oil, 6 parts tung oil, 4 parts raw linseed oil and 28 parts soya bean oil is heated gradually to 280° C. The sodium hydroxide goes into solution at about 180 to 200° C. and the soap is formed when the temperature of the mixture is between approximately 260 and 280° C. The resulting anhydrous soap product which contains a small amount of monoethyl ether of diethylene glycol, some gycerine and perhaps other decomposition products is compounded with a chosen mineral oil as already described.

The grease made in accordance with my invention is extremely stable and is particularly adapted for high temperature and high pressure use.
For example, a grease composed of 1 part (12.5%) soap prepared in accordance with the preferred process and 7 parts (87.5%) heavy medium mineral lubricating oil had the following characteristics:

<table>
<thead>
<tr>
<th></th>
<th>Before heat treatment</th>
<th>After heat treatment for 96 hours at 120° C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melting point</td>
<td>218° C.</td>
<td>140° C.</td>
</tr>
<tr>
<td>Free NaOIl</td>
<td>1.05%</td>
<td>1.05%</td>
</tr>
</tbody>
</table>

The addition of the high boiling dispersing agent, such as the monoethoxy ether of diethylene glycol, performs at least two functions. First, it allows the alkali to go into solution at a lower temperature previous to the formation of the soap, and secondly, while much of the alkyl ether of diethylene glycol is evaporated during the gradual temperature rise, the mixture still retains a small amount in a somewhat different form that acts as a binding agent between the mineral oil and soap. If an alkyl ether of diethylene glycol is not used, the soap is only capable of holding a small quantity of mineral oil, the excess oil separating as the temperature rises and the lubricating properties of the grease thus being destroyed. Each time, when an alkyl ether of diethylene glycol is used and a small amount of an alkyl ether of diethylene glycol or derivative thereof remains as a bonding agent after the soap formation, an improved lubricating grease composition free from oil separation tendencies, and composed of a major portion of mineral oil and a minor portion of soap, is formed.

The boiling point of the dispersing agent used in carrying out my invention should be above 180° C. at which temperature the alkali goes into solution. The boiling point should be below 280° C. as it is essential that only small amounts of the dispersing agent should remain in the mixture after the formation of the soap. The alkyl ethers of diethylene glycol or the like lost by evaporation may be reclaimed by condensation and used again.

Although I have illustrated my preferred lubricating grease employing certain materials, my invention is not limited to the specific ingredients previously disclosed. Other alkalis or mixtures of the same may be used in place of sodium hydroxide, such as potassium hydroxide, calcium hydroxide and the like. However, as is well known to the art, the physical properties of a grease, and its practical utility for a particular condition of lubrication, are dependent, among other influencing factors, upon the particular alkali or alkalis used in making the soap. As is commonly known, a grease containing a sodium soap of a particular fatty oil has a higher melting point than a grease containing a calcium soap, or a mixture of calcium and sodium soaps, of the same fatty oil. For high temperature conditions of lubrication and for which a heat-resisting lubricant is required, greases containing sodium soaps are therefore preferred. Various drying, semi-drying and non-drying vegetable oils may also be employed. Where extreme pressure lubricants are desired the drying oils may be readily chlorinated or sulphurized.

All parts or percentage proportions mentioned herein are by weight.

All modifications obvious to those skilled in the art and coming within the true spirit and scope of my invention are meant to be covered in the claims appended hereto.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. The process of making a stable lubricant which comprises preparing anhydrous soap by heating to a reaction temperature, a non-aqueous mixture consisting of alkali, a glyceride oil, and an alkyl ether of diethylene glycol, cooling the mixture, and adding a preponderant proportion of mineral lubricating oil to the reaction products.

2. The process of making a stable lubricating grease which comprises preparing anhydrous vegetable soap by reacting a non-aqueous mixture consisting of an alkali, an alkyl ether of diethylene glycol and vegetable oil, heating the reaction products gradually to a temperature in excess of 180° C. to convert the mixture, with a preponderant proportion of mineral lubricating oil to the reaction products, and heating the mixture until a clear solution is obtained.

3. The process of making stable, high temperature lubricating grease which comprises preparing anhydrous vegetable soap by reacting a non-aqueous mixture consisting of sodium hydroxide, monoethoxy ether of diethylene glycol and a mixture of vegetable oils comprising castor, tung, linseed and soya bean oils, heating the reaction products gradually to a temperature of about 280° C., cooling the mixture, adding a preponderant proportion of mineral lubricating oil to the reaction products, and heating the mixture until a clear solution is obtained.

4. A process of making a lubricant which comprises compounding a mineral oil with an alkali metal soap prepared by heating to reaction temperature a non-aqueous mixture consisting of a soap-forming compound of an alkali metal, fatty material, and an alkyl ether of diethylene glycol.

5. A process of making an alkali metal soap grease which consists in compounding a major proportion of mineral lubricating oil and a minor proportion of an anhydrous alkali metal soap prepared by heating to reaction temperature a non-aqueous mixture consisting of an alkali metal hydroxide, fatty material, and an alkyl ether of diethylene glycol.

6. A stable, heat-resisting alkali metal soap grease consisting essentially of a major proportion of mineral lubricating oil and a minor proportion of an anhydrous alkali metal soap composed of the reaction product of a non-aqueous mixture consisting of an alkali metal hydroxide, fatty acid, drying and semi-drying oils and castor oil, and sufficient alkyl ether of diethylene glycol to leave in the product a residue of same as a binding agent.

7. A stable, heat-resisting alkali metal soap grease consisting essentially of a preponderant proportion of mineral lubricating oil and a minor proportion of an anhydrous alkali metal soap composed of the reaction product of a non-aqueous mixture consisting of an alkali metal hydroxide, fatty acid, drying and semi-drying oils and castor oil, and sufficient alkyl ether of diethylene glycol to leave in the product a residue of same as a binding agent.

8. A stable, heat-resisting sodium-soap grease consisting essentially of at least about 85 percent mineral lubricating oil and the remainder consisting of an anhydrous sodium soap composed of the reaction product of a non-aqueous mixture consisting of sodium hydroxide, stearic acid, castor oil, tung oil, linseed oil and soya bean oil, and sufficient monoethoxy ether of diethylene glycol to leave in the product a residue of same as a bonding agent.

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