137-13 CROSS REFERENCE SEARCH ROOM

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METHOD FOR LUBRICATING CONTACTING FRICTIONAL SURFACES IN EQUIPMENT HANDLING A VISCOUS SOLUTION

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The present invention relates to the movement of viscous solutions by means of pumps and the like equipment. More particularly, the invention is concerned with a method for conditioning packed pumps handling viscous solutions such as solutions of cellulose esters in volatile solvents to facilitate movement of the solutions and proper functioning of the equipment.

Considerable difficulty normally is experienced in the handling of cellulose ester solutions due to a number of factors. Generally, these solutions are highly viscous and difficult of movement through restricted passageways. The problems connected with movement of viscous solutions of cellulose esters are discussed in Milhorn U. S. Patent No. 2,132,873, issued October 11, 1938. This patent notes the demanding conditions imposed upon the impelling pumps and suggests an improvement comprising liquid lubrication of the boundaries between the viscous mass and the interior surface of the surrounding conduit. The desired effect may be obtained by introducing a compatible liquid into the intake of a pump or by bleeding the compatible liquid into the viscous mass at a point near the beginning of a restricted passage whereby to form a lubricating layer between the mass and the walls of the passage which will facilitate travel of the mass through the passage.

It has also been suggested that burdens imposed on the pumping equipment may be somewhat alleviated by heating the conduits carrying the viscous solutions whereby to obtain a decreased viscosity only in the outer region of the confined moving mass, the material of decreased viscosity serving to lubricate and facilitate movement of the main body.

With solutions of cellulose esters in volatile solvents, such solutions generally being known as dope, a portion of the solution usually finds its way from the interior of the pump through the packing material into the housing of the pump drive mechanism. There the volatile solvent eventually evaporates, leaving a hard crust of cellulose ester in solid form to interfere with the operation of the equipment and to prevent proper lubrication thereof. The same problem may arise to a varying extent with other types of cellulose ester solutions. The incrustation of the moving parts of pumping equipment is, of course, particularly bad where highly viscous solutions have already imposed exorbitant demands on the equipment. Even where freely flowing solutions are being handled, however, the detrimental effects to be suffered are obvious. The suggestions of Milhorn and others reduce the seriousness of the problem, but these suggestions do not represent a cure for internal pump difficulties.

Of course, proper employment of normal lubrication procedures is effective to a certain extent, but customary lubrication methods do not eliminate ester incrustation. Furthermore, there is generally some leakage of lubricant through the pump packing into the mass of material being propelled by the pump, particularly where the pump is operating under excessive stress. Since the usual lubricant compositions are not compatible with the plastic masses being transported, and may even cause highly detrimental effects therein, such leakage cannot be tolerated.

Accordingly, it is an object of the present invention to provide a method of facilitating the movement of viscous masses and of easing the strain on the pumping means which moves the mass.

It is another object of the present invention to provide a method for properly lubricating packed equipment, such as pumps, agitators, and the like, used in the handling of viscous masses such as cellulose ester solutions. It is a further object of the invention to provide means for continuous lubrication of surfaces of frictionally contacting moving parts within machinery adapted to handle solutions of cellulose esters, particularly cellulose triacetate, wherein said surfaces normally are separated from said solution by means of packing material. Still another object of the invention is to provide a lubricant which is satisfactory for the purpose described. Other objects will be apparent from the present specification and claims.

I have found that the objects of the invention may be accomplished by maintaining on the friction surfaces of propulsion equipment, such as pumps, agitators, etc. used in the transportation of viscous masses, such as dopes, pastes, and solutions, comprising organic materials and solvents and/or plasticizers therefor as the only lubricant a stable substantially nonvolatile, normally liquid, relatively high boiling substance which exhibits solvent properties for high acetyl cellulose esters and for said organic materials, if different. The movement facilitating substance of the invention should exhibit compatibility with the solvents and/or plasticizers in the sense that these materials should have no detrimental effect on the condition of the substance, and preferably, the substance should be miscible with at least such solvent and/or plasticizer components as are nonvolatile.

Among the species of the generic substance described above, I have found that 1,2-diacetoxyethane, γ-valerolactone, acetonylacetone, ethyl lactate, triethyl phosphate, ethyl tartrate, and methyl malonate are especially advantageous in facilitating movement of viscous solutions in the manner mentioned.

The invention will be described in terms of one of its most preferred embodiments in which is involved the transportation of a cellulose ester dope comprising a cellulose ester, e. g., cellulose triacetate, dissolved in a volatile solvent. In accordance with my method, there is continuously maintained in contact with those friction surfaces of the propelling pump which are interior of the pump housing and normally separated by means of packing from the dope being propelled, a film or bath of 1,2-diacetoxyethane, more commonly referred to as ethylene glycol diacetate.

Whenever the ester solution seeps through the packing and into the housing of the working parts of the equipment, I have found that none of the usual difficulties result if ethylene glycol diacetate is the lubricant employed. The diacetate is not only compatible with the ester solutions, but as the solvents evaporate from the latter, the ester which otherwise would be deposited is dissolved in the diacetate with apparently no ill effect on the lubricating ability of the diacetate. Thus, I have determined that the diacetate has excellent lubricant properties for the purpose described, and, in addition, is able to prevent wear on the moving parts of the equipment by solid (cellulose ester) which would be formed by solvent evaporation from the dope solution when the latter leaks through the packing of the equipment. Since damage to the pump by the dope and damage to the dope by the lubricant both are obviated, the method facilitates both the transportation of the dope and the orderliness and success of the overall operation.

The nature of the ethylene glycol diacetate or other propulsion facilitating substance is of no particular importance to the invention in other respects than that it should be at least of a commercially pure grade. The diacetate may be that obtained from any one of a number of methods of manufacture.

In the pumping of viscous masses positive displacement pumps such as triple cylinder direct driven pumps normally are employed; however, the particular type of pump used is irrelevant to the basic concept of the invention, excepting of course that the invention has no applicability to fluid transport systems in which propulsion is supplied by devices which have no frictionally contacting surfaces in regions from which lubricant may

reach the fluid and vice versa. Thus, the invention will be useful with reciprocating or piston pumps, rotary pumps, spiral pumps, centrifugal pumps and certain types of agitators or stirrers.

The lubricant substance of the invention may be maintained in contact with the friction surfaces by any one of a number of suitable customary means. For instance, the substance may be applied by splash, forced-feed, or the like.

It will be obvious to those skilled in the art that, in addition to the cellulose triacetate dope with which the invention finds particular utility, the method will be of advantage with solutions of volatile solvents and other cellulose derivatives such as cellulose ethers and cellulose esters inclusive of cellulose acetate, cellulose acetate propionate or cellulose acetate butyrate. Likewise, the invention finds utility with acid or other nonvolatile solutions of these substances as well as with dopes, pastes, or solutions, particularly, but not necessarily, with volatile solvents, of other plastic and plastic-like organic materials such as the natural and synthetic resins.

Of the terms used in the claims, "relatively high boiling" refers to boiling points substantially in excess of 100° C., that is of the order generally of about 150° C. or more. It will be appreciated however that unusual conditions of use will allow relaxation of strict limits in this respect. The term "stable" is intended to mean substantially degradation resistant upon exposure to the solutions being handled and upon mechanical abuse. Thus the term includes also the condition of being substantially hydrolysis-free.

I claim:

1. In the transportation of a viscous mass comprising a normally solid high acetyl cellulose ester and a solvent therefor through a relatively restricted passage by means of a propelling device having moving parts with contacting frictional surfaces housed in a region accessible to normally limited quantities of said mass and from which normally limited quantities of a lubricant might reach said mass, an improved method for facilitating the propulsion of said mass comprising continuously maintaining in contact with said surfaces as the only lubricant therefor a normally liquid, relatively high-boiling, substantially nonvolatile stable non-hydrocarbon solvent for said normally solid cellulose ester compatible with the solvent contained in the viscous mass.

2. Method as defined in claim 1 wherein said only lubricant is γ-valerolactone.

3. Method as defined in claim 1 wherein said only lubricant is acetonylacetone.

4. Method as defined in claim 1 wherein said only lubricant is triethyl phosphate.

5. Method as defined in claim 1 wherein said only lubricant is methyl malonate.

6. Method as defined in claim 1 wherein said only lubricant is 1,2-diacetoxyethane.

7. Method as defined in claim 6 wherein the solvent constituent of the viscous mass is a volatile solvent.

8. Method for lubricating equipment handling a cellulose ester solution, which equipment comprises moving mechanical parts having surfaces in frictional contact, said parts being isolated from said ester solution by means of packing, said method comprising applying to said surfaces a composition comprising 1,2-diacetoxyethane.

9. Method as defined in claim 8 wherein said solution comprises cellulose triacetate dissolved in a volatile solvent.

10. Method for lubricating pumps for moving a viscous solution of an high acetyl cellulose ester in a solvent, said pumps having moving mechanical parts with surfaces in frictional contact which surfaces are normally separated from said solution by means of packing, said method comprising applying to said surfaces a normally liquid non-hydrocarbon lubricating composition essentially comprising a relatively high boiling, substantially nonvolatile stable substance exhibiting solvent power for high acetyl cellulose esters, said substance being compatible with all components of said viscous solution and being a solvent for at least all non-volatile components thereof.

11. Method as defined in claim 10 wherein said relatively high boiling substance is 1,2-diacetoxyethane.

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