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Process Improvement in Manufacturing of Grease and Lube Oils

Dnyaneshwar L. Thombare[1], Dr. D. N. Raut[2]

[1]*M.Tech. Project Management, VJTI, Mumbai, India*

[2]Professor, Dept. of Production Engineering, VJTI, Mumbai, Maharashtra, India

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Abstract - *Grease is manufactured through various processes with the help of pressure vessels or open cooking kettles under high temperature and pressure. Grease-making can be a long, energy-consuming, high-maintenance and multi-step process but new technologies have been developed to reduce as these processes to very much extent. Using the new lithium hydroxide dispersion technology to make simple and lithium-complex greases is a single-step process. In open kettle, lithium hydroxide dispersion could save the grease manufacturer 40 to 60 percent in time compared to a conventional process. Manufacturing of grease require raw materials such as mineral oils, a thickener and additives to reduce the friction and temperature between moving components. Finished Lubricant is a blend of base oils and additives. Base oil is a major constituent of any lubricant. Lubricants are formulated for variety of applications by selecting proper 'base oils' of required viscosity and additive packages by using hot blends and cold blends methods. By using bottle blends we can minimize the rework, manufacturing cycle time and correction during the manufacturing of lube oils.*

Key Words: Grease, Consistency, Base Oil, Additives, Penetration etc.

1. INTRODUCTION

Grease is a semisolid lubricant. It is generally made from petroleum oil thickened with metal soaps, with lithium soap as the most widely used thickening agent. In addition, lubricating greases usually contain some performance additives. Generally, lubrication is achieved by oil. Oil viscosity decreases with increasing temperature hence the requirement for additives to support its duties at higher temperatures. The characteristic feature of greases is that they possess a high initial viscosity, which upon the application of shear, drops to give the effect of an oil-lubricated bearing of approximately the same viscosity as the base oil used in the grease. This change in viscosity is called thixotropy. Oil and grease are basically the same, with one important difference; oil is a fluid that flows readily by itself whereas grease is also an oil product but is made semi solid by combining it with mineral soap.

Manufacturing of grease is carried out either in pressurized vessels or open cooking kettles. There are several of methods that can be used to produce lithium and lithium-complex greases. The conventional manufacturing process typically uses either lithium hydroxide monohydrate solid or lithium hydroxide monohydrate water slurry and stearic acid in solid form. Lithium hydroxide is a very hazardous material. The process is lengthy, energy-consuming (it uses a great deal of water) and frequently poses a foaming hazard during saponification. It takes generally half hour for melting stearic acid. In the case of lithium-complex greases, a two-step process is frequently used in the conventional manufacture method. Using the new lithium hydroxide dispersion technology to make simple and lithium-complex greases is a single-step process.

In the lube oil manufacturing after manufacturing of lube oil and sending sample to quality control lab for testing corrections' are comes and then there is a need to correct that grade by adding additives. Due to addition of more additives cost increases. It increases the rework and

correction during manufacturing of lube oils and also increases manufacturing cycle time.

2. Process Improvement in Manufacturing of Grease and Lube Oils

Grease-making can be a long, energy- consuming, high-maintenance and multi-step process. A new lithium hydroxide dispersion technology is available for making simple lithium and lithium-complex greases in a variety of base oils, ranging from mineral oil, to poly alpha olefins (PAO), to esters, to vegetable oils. It revolutionizes the grease-making process and offers significant benefits every step along the way in the manufacturing process.

2.1. The Process Improvement in Manufacturing of Grease

There are several of methods that can be used to produce lithium and lithium- complex greases. The conventional manufacturing process typically uses either lithium hydroxide monohydrate solid or lithium hydroxide monohydrate water slurry. The process is lengthy, energy-consuming (it uses a great deal of water) and frequently poses a foaming hazard during saponification. In the case of lithium-complex greases, a two-step process is frequently used in the conventional manufacture method. Using the new lithium hydroxide dispersion technology to make simple and lithium-complex greases is a single-step process. In open kettle, lithium hydroxide dispersion could save the grease manufacturer 40 to 60 percent in time compared to a conventional process.

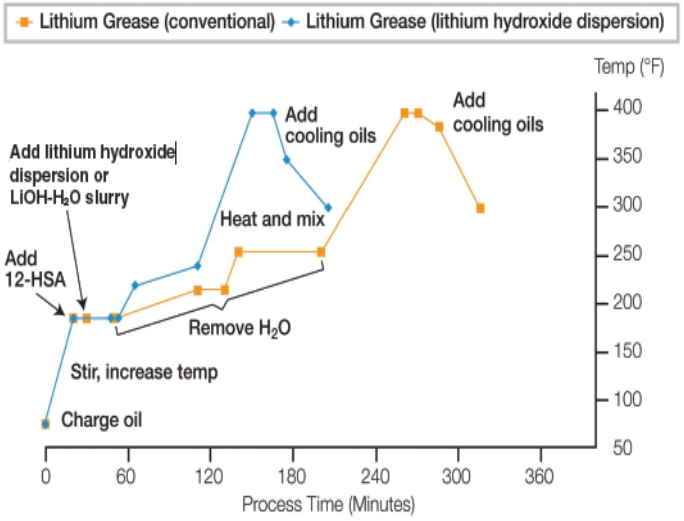

Chart -1: Process profiles: Simple Lithium Grease

In Contactor™, process time savings from using lithium hydroxide dispersion are not as significant as that achieved in an open kettle; however, less energy is used by not having to heat and evaporate the added water. In a continuous process, one of the challenges is getting the right amount of lithium hydroxide into the reaction zone. Due to poor water solubility of lithium hydroxide monohydrate, a large amount of water is needed to dissolve the lithium hydroxide. This requires removal of significantly more water during dehydration.

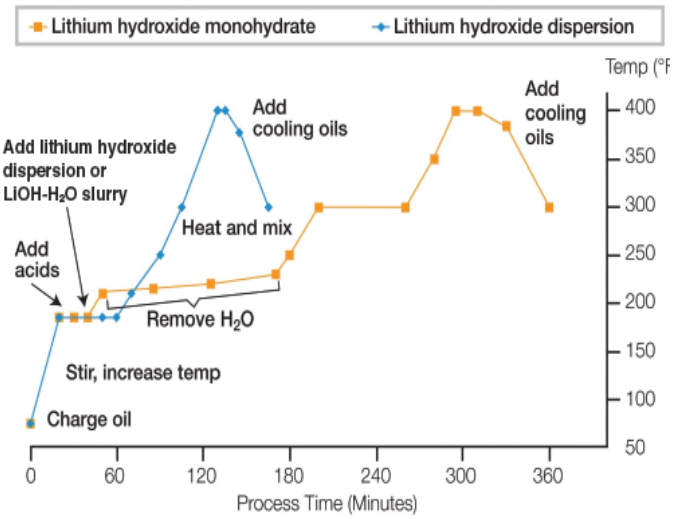

Chart -2: Process profiles: Lithium-Complex Grease

Typically, the lithium hydroxide monohydrate is mixed with only sufficient water to form slurry, which tends to be heterogeneous and creates difficulty controlling the amount

of lithium hydroxide being added to the mix. This lack of control results in greater difficulty in quality control and could lead to poor finished grease properties.

Because the lithium hydroxide dispersion is easily pumped into the reaction vessel, manufacturers have significantly greater control over the amount of lithium hydroxide metered into the reaction. This eliminates the need for employees to handle dusty, hazardous lithium hydroxide solids — also improving housekeeping — or to add it as slurry in water. Furthermore, it is very stable in storage and shows no evidence of reacting to carbon dioxide and moisture in the air.

2.2. Benefits

Micro technology is neither new nor particularly fancy compared to nanotechnology. The new, highly-engineered technology we're discussing here is an example of micro technology. It is a dispersion of micron-sized anhydrous lithium hydroxide solid in oil. Compared to conventional lithium hydroxide monohydrate, lithium hydroxide particles in this new technology are about 100 times smaller (less than ten microns versus 500 to 1000 microns). Put another way, that's the equivalent of a grain of rice compared to a basketball.

Table -1: Lithium Hydroxide Monohydrate compared to Lithium Hydroxide dispersion

	Lithium Hydroxide Monohydrate	Lithium Hydroxide Dispersion
Physical form	White crystals	Opaque dispersion in oil
% Lithium Hydroxide	57%; balance in water	36%; anhydrous
Packaging	Bags	Drums or bulk
Particle size	500-1000 microns	Less than 10 microns
Addition method	Added as per powder or as a slurry in water	Bottom

Smaller particle sizes expose a larger total surface area, greatly enhancing reactivity. Faster saponification and almost waterless reaction lowers overall energy consumption during the drying phase. It also reduces the foaming hazard during the grease-making process. Furthermore, its shorter manufacturing cycle time, as mentioned above improves manufacturing capacity without the need to alter or add to existing equipment. And in these economic times, manufacturers are looking for process improvements at little or no cost to enhance their competitiveness. In summary, simple lithium and lithium-complex greases made with this new lithium hydroxide dispersion technology exhibit good penetration and a high dropping point.

2.3. Process Improvement in the Lube Oils

1. For manufacturing of any lubricant oil procedure is the base oils has to be taken into blending kettles according to the requirements and plans, then the additives are added to it to prepare the specific grades as per the standard formulation.

2. As per formulation the charging sheet is made.

3. There are many special types of lube oils i.e. grades which have certain procedure of manufacturing.

4. For many specialty grades general procedure is first take all the base oils in kettles. Then heat up to 50 deg. and then send sample to quality control lab for water ppm and kinematic viscosity at 40 deg.

5. If it is ok then remaining additives will be added. This consumes more time.

6. By installing viscometer at the return line of kettle in which the lube oil is manufactured testing time of kinematic viscosity get reduced, because we can analyze and get the value of kinematic viscosity at any temperature through viscometer.

7. It reduces the manufacturing cycle time and increases the production

8. In the lube oils viscosity is the most important parameter.

9. Every manufacturer of lube oils uses different types of additives to improve viscosity.

10. Additives are very costly so this increases the cost of production of lube oils.

11. For making every grade there is a standard formulation and procedure.

12. Foe every time base oils properties like viscosity, pour point are not same. It changes because base oil comes from refinery after some processing.

13. Before making charging sheets i.e. Formulation of grade manufacturing in which all the base oil quantities and additives quantity and procedure for manufacturing is given.

14. The previous batches charging sheets helps to understand the accurate quantities of base oils and additives.

15. But at the time of refining of the crude oil base oils elements contents and chemical properties changes.

16. Once the stock of base oils is over the new base oil comes from refinery through pipe line transfer. So the every time of pipeline transfer the base oil properties are different and according to that the formulation of grades also changes.

17. After manufacturing of lube oil and sending sample to quality control lab for testing corrections' are comes and then there is a need to correct that grade by adding additives.

18. Due to addition of more additives cost increases.

19. Bottle blend is the method for any grade. Bottle blend means making of lube oil in small quantity i.e. 1 kg as per formulation.

20. Before charging complete batch of critical lube oils by manufacturing 1-2 kg of bottle blend of that critical lube oil and sending sample to quality control lab we can check the results and parameters present in that lube oil.

21. If there is a correction then we can make correction by adding more additives and again sends sample to lab for testing.

22. If it is ok then we can charge the complete batch of that lube oil any quantity as per requirement.

23. After charging of complete batch it will pass in the first attempt and there is no correction.

24. This increases the first pass yield in process manufacturing of lube oils.

25. Thus by using bottle blends we can minimize the rework and correction during manufacturing of lube oils.

2.4. Viscosity Improvement in Some Specialty Grades

For some specialty grades to improve viscosity very costly additives need to be added. With the help of bottle blend we can analyze the results and achieved the improvement by replacing viscosity improvers i.e. additives with special type of base oils which has same properties and elements that does not affects on the quality of lube oils. It reduces the cost of production and also raw material handling cost. Also increases the production rate because there is no need of adding more additives which ae added manually.

Table -2: Experiment of Front fork Oil

Base Oil/Additive	Initial quantity	Additive added
150 SN	16300 liter	
500 SN	1500 liter	
Rapeseed Oil	540 kg	
Additin RC 8239		7 kg
Hitec 5708		185 kg
Hitec 7169		225 kg
LZ 859		5 kg
Viscosity @ 40(in cst)	34.02	36.12

2.5. Value added/Benefits

1. Reducing cost of raw material as we are adding less quantity of additives.
2. Product passes in first attempt so it reduces manufacturing cycle time.
3. It reduces and minimizes rework and corrections while manufacturing.

3. CONCLUSIONS

Grease-making can be a long, energy- consuming, high-maintenance and multi-step process, but with a new lithium hydroxide dispersion technology is available for making simple lithium and lithium-complex greases. Compared to conventional lithium hydroxide monohydrate, lithium hydroxide particles in this new technology are about 100 times smaller (less than ten microns versus 500 to 1000 microns). Faster saponification and almost waterless reaction lowers overall energy consumption. It reduces manufacturing cycle time. By using bottle blends we can minimize the rework, manufacturing cycle time and correction during the manufacturing of lube oils. Reducing cost of raw material as we are adding less quantity of additives.

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