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GREASE STABILITY UNDER VIBRATING CONDITIONS

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Introduction

In Australian industry, centralised lubrication systems are used to deliver grease to various mechanical components, usually bearings. In many situations, the length of the delivery lines is in excess of 20 metres. These lines meander through other pieces of equipment and infrastructure. In some situations when these lines are attached to support devices that are subject to vibration, the delivery pipes have become "plugged" because the oil in the grease has leaked/separated from the grease matrix [1]. This scenario is very costly to the owner/operator of the equipment as a lack of lubrication can cause major repair/maintenance costs.

A laboratory test procedure has been devised to evaluate the suitability of various greases to remain stable under these conditions.

Experimental Equipment and Methodology.

There are two components of the overall test equipment: one is used to subject the test greases to vibrating conditions and the other is to determine whether the test grease has remained stable, that is, to establish whether oil has separated from the grease matrix during the vibrating conditions.

The component used to vibrate the greases consists of 16 glass tubes 7.6 mm inside diameter, 200 mm long assembled into a rigid support frame. The whole frame is mounted onto a shaker table and subjected to vibratory motion. Various frequency and amplitudes of vibration can be tested. The duration of the test is varied to establish grease separation: some tubes can be removed after two hours, some after four hours. The second component mounts individual glass tubes to be inserted into an Instron machine. A specially designed piston is fixed onto the moving platen of the Instron machine and inserted into the glass tube containing the grease. A force-extension plot is produced as the grease is "pushed" out of the tube through a predetermined orifice attached to the tube at a predetermined rate. In this case it was found that a 1 mm diameter orifice provided sufficient resistance to the piston motion to produce a "reasonable" force as the piston forced the grease through the orifice.

Since it is difficult to fill the glass tubes with grease and be sure that air was not included, it is important to establish the difference between air and oil (if it does bleed from the grease) in the force-extension plot. Prior to the grease being subjected to any vibratory motion, a syringe was used to inject air (or oil) into the grease in the tube. A pocket of air provided a very different "dip" in the force-extension plot to that of oil.

Three different greases were used to confirm that this technique for determining the existence of oil pockets in the sample: a NLGI 2 lithium grease, a NLGI 2 lithium grease with molybdenum disulphide and a NLGI 4 lithium grease.

Figure 1shows the distinction between air and oil pockets in the grease.

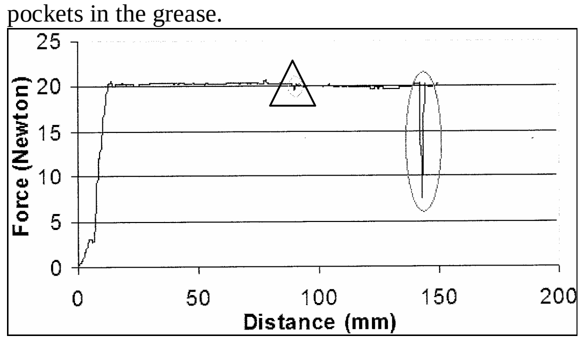

Fig 1 Force-Extension plot for lithium grease with MoS_2 after two hours vibration: triangle represents oil and ellipse represents air pocket.

Preliminary Test Results.

The shaker table ran for eight hours with four tubes removed every two hours. The shaker table was set with the frequency varied between 10 and 50 Hz but the acceleration was constant at 1.5g (approx 15 m/s^2). The Instron piston speed was 200 mm^2/s.

For the grease with MoS_2, nine tubes indicated that oil separated from the grease. Of the four tubes removed after two hours, three indicated oil separation. All four of the tubes removed after four hours indicated separation. Only one of the four removed after six hours and only one after eight hours exhibited oil separation. The reason for this result is not obvious. It would be expected that if oil separated after two or four hours, then it would also exhibit separation after longer times.

Conclusions

The experimental methodology developed as part of this research project has the potential to establish the stability of greases when subjected to vibratory conditions. Further work is required to extend the range of grease types and vibratory conditions. Depending upon the results, in particular whether oil separation is indicated in all or some of the tubes, an explanation for this observation is required.

References

[1] G Jones: Private communication, Lubricant Specialist to the Mining Industry, 2002.