

Comparative Studies of Bitumen Oils

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1. Abstract

Bitumen-based lubricants have been used extensively in applications such as mining, railroad, railway, marine, and many others that call for good water and dust resistance, among other properties in order to keep the equipment working for longer periods of time. However, anticipated bright stock shortages, as well as increased environmental awareness, in the form of more stringent regulations, has encouraged the use of alternative lubricants. The base oils used for the manufacture of these alternative lubricants (known as bitumen oils) are the focal point in this work. Different tribological properties, as well as other relevant characteristics of the base oils are measured. Finally an attempt is made in order to correlate the oils' properties with their composition.

2. Introduction

Bitumen or asphalt oils have historically been used in applications where relatively low speeds and high loads are the norm (e.g. large mining and mineral processing applications, especially in the lubrication of gears, bushings, element bearings, and steel cables).¹⁾

These residual oils (as they are also known) are produced with tacky asphaltic material left over from the vacuum distillation of petroleum refining. These asphaltic residues are brown or black in color and can be nearly solid at room temperature depending on the raw oil from where they are obtained. Due to their high viscosity, these asphaltic materials are generally thinned with lower viscosity base oils or solvents, in order to facilitate their handling and application. However, increased environmental awareness has resulted in restrictions in some of the substances used for the production of these types of lubricants, opening the door for the developments of alternatives.

Heavy mineral oils can also be used in these types of applications where the sticky oil film separates the moving parts by hydrodynamic action.

3. Experimental methods

A Mini Traction Machine (MTM2) has been used to measure the lubricating properties of the oils in a mixed rolling/sliding contact. In this instrument a load is applied to a steel ball, and with a force transducer the traction force (friction) is measured as the ball is in contact with a steel disk (AISI 52100 steel). The mixed sliding/rolling contact is possible because the ball and the disk are driven independently.

Stribeck curves were obtained for the different oils at three different temperatures: 50°C, 70°C, and 90°C. The applied load was 20N, the chosen sliding to roll ratio (SRR) was around 40% and the mean speed at which the disk and the ball were driven was varied from 2000mm/s down to 1mm/s (the lowest speed that can be used in the MTM2), see Figure 1.

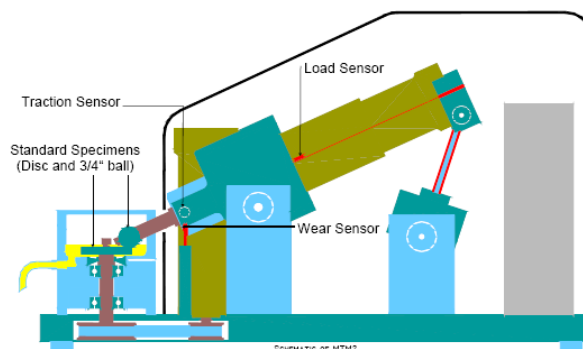


Figure 1. a schematic picture of MTM

The samples studied were based on two residues obtained from the processing of two different crude oils, which were blended with base oil having a kinematic viscosity at 40°C of around 110cSt. Some of the properties of the residues are listed in Table 1.

Table 1 Properties of the residues used for blends

Properties	Residue 1	Residue 2
Asphaltenes (%)	22	6
Kin. Viscosity 60°C (cSt)	–	6100
Penetration 25°C (mm/10)	16	–
Softening point R&B (°C)	61	–

4. Results

In Figure 2 it can be observed the Stribeck curves for two of the base oil–residue blends at 50 °C. The same base oil was used in both blends, but blend R2 contains Residue 2, while blend R1 contains the Residue 1. Both blends have a kinematic viscosity at 40°C of 700cSt.

It is evident from the figure how at low mean speeds the blend based on the residue 2, gives lower friction values than the one based on residue 1; but these differences become smaller as the mean speed increases, almost disappearing at high speeds.

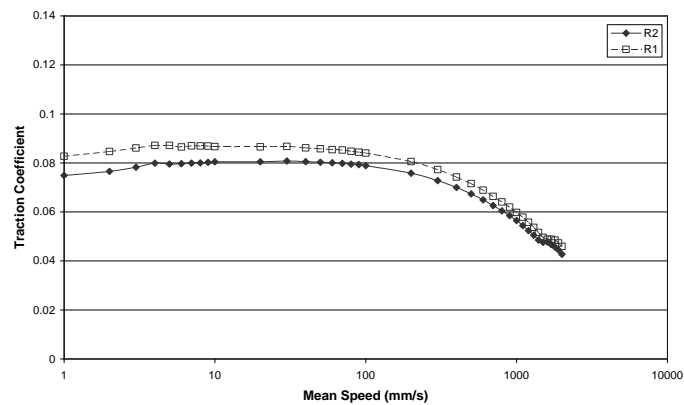


Figure 2 shows the Stribeck curves for the blends at 50°C

5. References

- [1] Johnson, M., "Lubricant construction: Semi-Fluid Lubricants," STLE. TLT, 64, 7, 2008, 32-35.
- [2] Hamrock, B. "Fundamentals of Fluid Film Lubrication," Mc Graw Hill, Inc., 1994.