An Analysis of ProTec's Effect as a Metal Treatment
Thermo-fluid Dynamics I & II

Spring 2014

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What is ProTec?

ProTec anti-friction metal treatment is a unique metal treating chemical that claims to significantly reduce friction between moving metal parts by chemically treating the metal surfaces.

Figure 1: Falex Timken Machine

Abstract

Engines and motors lose potential rotational energy to friction caused by metal on metal contact. This contributes to engine inefficiency and can lower the miles per gallon output of a car. ProTec is a metal treatment rather than an oil additive and claims to treat the first few atoms of metal surfaces to help metal on metal surfaces glide with less friction. This metal treatment has been shown to be more effective than just oil. As students in EGR 250 and 450, we investigated how well ProTec works, including a comparison to competitors, a durability study (how long the effects of ProTec last), and a study to determine the ideal oil/ProTec ratio.

Industry Standards

There are two main apparatuses used to test the load capacity of lubricants: the Falex Timken and the Falex Four Ball Tester The Falex Timken machine is the one used in the following experiments. A picture of the machine can be seen in Figure 1. The Timken machine is used to test extreme pressures. The other commonly used machine is the Four Ball Tester seen in Figure 2. This is approved by ASTM to test the dynamic properties of oil.

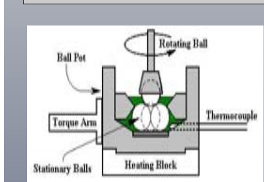

Figure 2: Falex Four Ball Tester

Experiment 1: ProTec Compared to Other Products

This experiment investigates how much force can be applied to the metal on metal surface contact using the Timken machine. This contact is created by applying a load to the lever arm which brings the bearing in contact with the rotating wheel. There were five situations that were compared:

1. A 14% ProTec to oil Mixture
2. Residue of the 14% ProTec to oil Mixture
3. Pure oil
4. Pure ProTec
5. Bare metal on metal contact

Each situation was tested by slowly increasing the weight applied to the lever arm. Weights were added one pound at a time. Ten seconds were waited in between adding weights. From the results shown in Figure 3, one can clearly see that ProTec, ProTec & Oil, as well as the ProTec & Oil Residue perform significantly better than the Oil and bare metal to metal tests. Compared to the additive MOA, ProTec compares favorably, and no statistically significant difference was found between ProTec and its direct competitor Prolong.

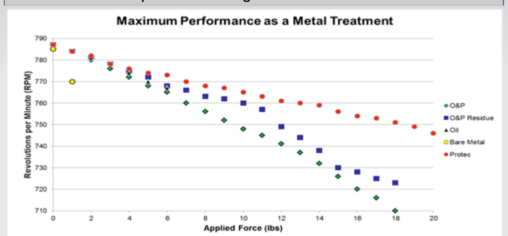

Figure 3: Maximum Performance as a Metal Treatment

Experiment 2: Optimal ProTec to Oil Ratio

This experiment was motivated by the results of Experiment 1 and attempts to determine if there is a point where the benefits of ProTec are at a maximum. Different ProTec to oil ratios were pooled in the reservoir and weights were added to the lever arm in the same way outlined in Experiment 1. The maximum stall load was tested and the results from this experiment can be seen in Figure 4. The relationship between the ratio of ProTec to oil and the maximum load is parabolic with the maximum performance being seen at a ratio of about 25%. This maximum is almost a 400% increase in stall load from what was seen from oil alone. In practice, the cost of the ProTec and the thermal properties of the oil must be taken into account when the optimal ratio is determined.

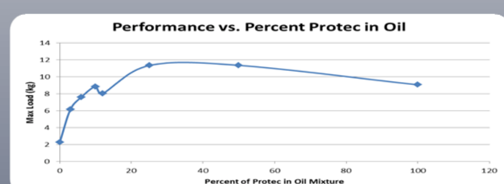

Figure 4: Performance vs. Percent ProTec in Oil

Experiment 3: Longevity Study of ProTec

Figure 5: Left to Right: Pure Oil, 3 lb Pretreatment, 5 lb Pretreatment

This experiment attempts to examine how much longer ProTec treated bearings will last compared to untreated bearings in the event of oil starvation. To simulate this, the metal was pretreated with ProTec using resistance weights of the lever arm, 3 pounds, and 5 pounds. The bearing and wheel were then wiped clean, three drops of oil were added to simulate residual oil left from oil starvation, and was then run to failure under a weight of 3 pounds, which represents the "stall" weight for bare metal found in experiment 1.

By running the pretreated metal under a weight of 3 pounds, we could recover the approximate amount of time it takes for ProTec to wear off. When all of the ProTec treatment wore off, the mechanism would stall, indicating bare metal on metal contact. The weight applied during pretreatment was varied to determine its effects on performance. In Figure 6, there are no data points for the pretreatment done with just the weight of the lever arm. Those tests lasted longer than 10 minutes with the longest trial lasting over 25 minutes. This was sufficient to show a continuation of the trend that can already be seen in Figure 6. As the pretreating weight increases, the positive effects of ProTec in terms of longevity start to decrease. The size of the pretreating "scar" increases as the pretreating weight increases. This results in a higher surface area that is exposed to the driving wheel. This larger exposed area decreases the amount of time to failure. The temperature of the apparatus increases proportionally with the time to failure. The consequence of this can be seen in Figure 5. The size of the "scar" and the amount of burning is related to the time to failure which is related to the temperature. In terms of time exposed, ProTec clearly outlasts plain oil.

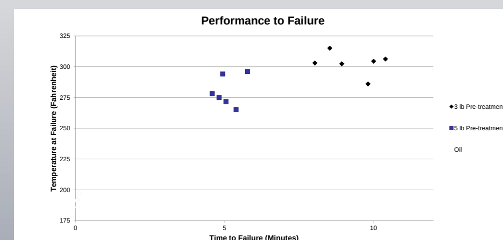

Figure 6: Performance to Failure

Concluding Remarks

Our limited experiments seem to indicate, that as claimed, ProTec significantly reduce friction between moving metal parts by chemically treating the metal surfaces. This reduces the wear on components and increases the maximum load under which they can be operated.