FRICTION MODIFIERS FOR MOTORCYCLE WET CLUTCH APPLICATIONS: IS COMPROMISE NECESSARY?

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ABSTRACT

Most high performance motorcycles use a multiplate lubricated ("wet") clutch. The main reasons for the lubrication are cooling and to protect the steel and friction plates from excessive wear. Selecting a friction modifier for use in a standard transmission fluid is not difficult, generally compounds that; raise the friction, ensure friction increases with sliding speed, and increase the lifetime of the fluid are chosen [1]. However, for a motorcycle the choice becomes more complex [2]. This is due to the fact that the same reservoir supplies lubricant to the engine, transmission and gears. Therefore it must perform well in several, seemingly contradictory, environments.

1. Engine: should reduce frictional losses to improve fuel efficiency and reduce power loss.
2. Transmission: friction should be high at both low and high speed to ensure efficient torque transfer and quick clutch engagement respectively
3. Gears: effective wear protection is important here to increase component lifetime

As is currently the case in many walks of life one of the major drivers for the development of new motorcycle engine oils is that of lowering emissions and improving fuel economy. To achieve this there is a general trend towards lower viscosity engine oils with reduced levels of sulfur and phosphorous. This has the effect of reducing the coefficient of friction in the clutch and the antiwear properties of the lubricant. For these reasons the Japanese Automobile Standards Association (JASO) introduced a standard which grades engine oils based on their performance in the SAE no.2 test for clutch friction. Attaining the correct clutch friction is therefore extremely important when developing a new engine oil.

To streamline this process we have developed a benchtop screening method (see Figure 1). Here we show results obtained from tests of different friction modifiers (FMs) when used to toptreat a commercial motorcycle engine oil.

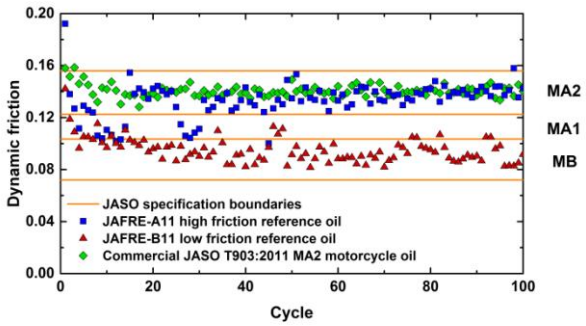

Figure 1: "Dynamic friction" coefficient (measured at 3.5 ms^{-1}) for the two JASO T903:2011 reference fluid, and an MA2 rated commercial motorcycle engine oil.

It is often the case that if a FM reduces friction in a steel/steel contact it will also reduce friction in a steel/friction material contact to at least some extent. Therefore it is usually viewed that there will be a necessary compromise between maximizing engine efficiency and maintaining efficient clutch performance. In this work we investigate whether we must always accept this compromise or whether, by careful selection of FM, it is possible to achieve both aims.

Secondly we propose a benchtop screening method for investigating gear pitting. This is recognized as a potential problem area for motorcycle oils as the trend towards lower viscosity continues. There have been discussions around including a gear pitting test in JASO specification for several years; however nothing had been decided as of the last revision in October 2016. The FMs that were screened for clutch performance are also then tested using an SRV method which investigates the performance of a lubricant in preventing gear pitting and wear.

These results highlight the importance of the surface chemistry and also roughness in determining the performance of a friction modifier.

REFERENCES

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