Preparing for ILSAC GF-6: Advantages of full-synthetic motor oils for boosting fuel economy

Boris Zhmud (Head of R&D) and Boris Tatievski (CEO)

BIZOL, Martin-Buber-Strasse 12, D-14163 Berlin, Germany

Over the past decade, improving vehicle fuel economy has been an important development target both for automotive OEMs and lubricant manufacturers, and it will certainly remain so in the future. Since a significant part of energy losses in the internal combustion engine comes from viscous dissipation, the trend has shifted toward low-viscosity oils from SAE 40 and 50 in the 1960s-1980s to current SAE 20 and 30 viscosity grades. This transition has been facilitated by availability of high-quality synthetic base oils which allow the formulation of thinner engine oils of 5W-20, 0W-16 or even lighter grades to achieve better fuel economy. While lowering viscosity does indeed reduce energy losses in the main bearing and piston/bore systems, losses and wear in valvetrain may increase. This makes a strong argument for deploying friction modifiers and EP/AW additives (see Fig. 1).

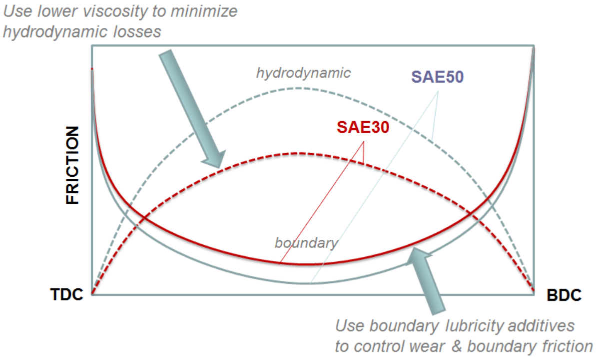

***Figure 1** / Standard practice: Reducing engine friction by using a lower viscosity oil in combination with boundary lubricity additives.*

However, development of a balanced formulation is not as straightforward as it appears, and numerous pitfalls may be encountered. One potential hurdle is that certain additives require high treat levels for fully revealing their tribological effect, and such high levels are not acceptable due to potential negative impact on emission control equipment. Finally, there is always a cost factor.

Another serious problem is that the definition of “fuel-economy engine oil” is rather vague, as it depends on choice of reference oil. At the moment, the assessment of fuel economy is usually based on the Sequence VID (ASTM D 7589) engine test using a 3.6L V6 gasoline engine and a 20W-30 reference oil. It is not unexpected that the results of this test turn to be largely misleading when extrapolated to modern heavily boosted low-displacement engines. The forthcoming ILSAC GF-6 specification will introduce the new Sequence VIE to close the gap.

Furthermore, the “fuel economy” performance of the same oil may change dramatically depending on the driving cycle, and the result will be different for different engines. In some extreme cases, oils showing good fuel economy in the NEDC may turn out to be inferior in the newer WLTP test cycle. For instance, a low viscosity oil may boost fuel economy at cruising speeds (high speed / low load limit) and degrade fuel economy during city driving (low speed / high load), especially for cars with a start-stop system (see Fig. 2).

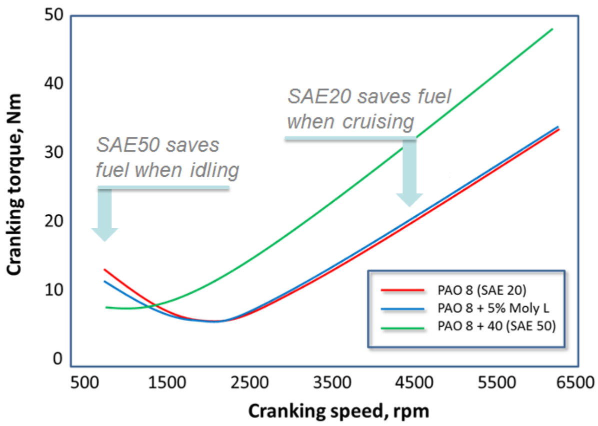

***Figure 2** / Friction torque measurements carried out for a common i4 production engine using model lubricants to mimic 0W-20 and 5W-50 motor oils.*

All the aforesaid circumstances are to be taken into account when trying to harmonize normative performance claims with customer expectations.

References:

1) B. Tatievski, B. Zhmud, "Fuel Economy Engine Oils: Scientific Rationale and Controversies", in Proc. 20th International Colloquium Tribology, Stuttgart, Germany, January 12-14, 2016.
2) B. Zhmud, Pursuit for Better Fuel Economy: Reducing Engine Friction Helps Maxing out Miles per Gallon, The Vehicle Component 5 (2012) 18.
3) B. Zhmud, Developing Energy-Efficient Lubricants and Coatings for Automotive Applications, Tribology and Lubrication Technology 67(9) (2011) 42.