Viscosity Loss Trapezoid - *A Powerful Way to Compare VI Improver*

A concept for comparing the different forms of viscosity loss was introduced by Theodore W. Selby of Savant, Inc. in 1991. This interesting and useful way of presenting viscosity loss data is called the Viscosity Loss Trapezoid (VLT). Advanced applications of this technique have been discussed by Mr. Selby in papers presented at the Society of Automotive Engineers (SAE) Fuels and Lubricants meetings.[1]

In his research, two instruments were utilized for generating the VLT -- the Tannas Tapered Bearing Simulator (TBS) Viscometer and the Tannas Basic Rotary (TBR) Viscometer, both of which produce true (or dynamic) viscosity values in centipoises (in contrast to kinematic viscosity values in centistokes which are a ratio of viscosity to density). The VLT is a graphical representation of four viscometric values of a lubricant -- high and low shear absolute viscosities both before and after shear degradation in some chosen mechanical device. When these four points are plotted versus shear rate and connected with lines, a trapezoid is produced, which inspired the name of the technique. Using the four viscometric values, five measures of viscosity loss can be determined, each of which has a significance in the evaluation of the particular VI improver used in the fluid.

These five measures are:

- Low Shear Permanent Viscosity Loss - The difference between low shear viscosity measured before and after polymer-disrupting shear degradation. This is frequently referred to simply as Permanent Viscosity Loss;
- Temporary Viscosity Loss - The difference between viscosity measured at low shear and at very high shear rates;
- High Shear Permanent Viscosity Loss - The difference between high shear viscosity measured before and after shear degradation;
- Degraded Temporary Viscosity Loss - The difference between the low shear and high shear viscosity of a shear-degraded fluid (residual orientation effect); and
- Overall Viscosity Loss (OVL) - The difference between the low shear undegraded viscosity and the high shear degraded viscosity.

These five viscosity parameters are shown as connecting lines between the four values of the Viscosity Loss Trapezoid as illustrated in Figure 1.

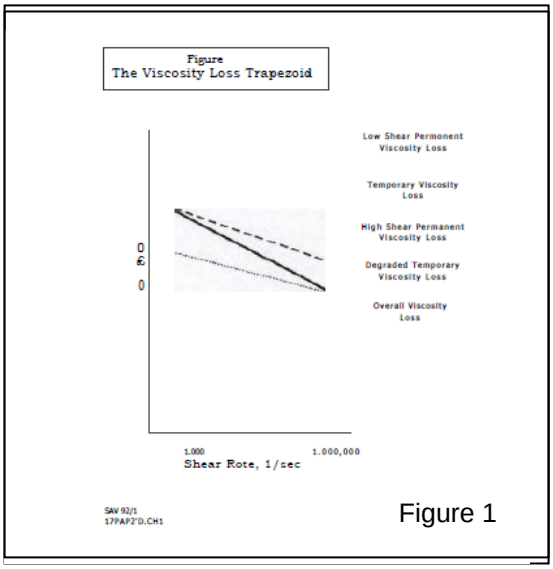

Figure 1

The result is a highly compacted portrait of a particular engine oil's viscosity characteristics and of the effectiveness of its polymeric additives in the face of orienting and/ or destructive shearing forces.

In Figure 2, the Viscosity Loss Trapezoids of two 10W-30 oils are compared, clearly illustrating their differences. The VLT of EO-4918 almost fits within the larger VLT of EO-4921. While both oils show both degradation and polymer orientation effects, EO-4918 has significantly fewer molecules available for degradation as shown by the differences between the two oils in both Low Shear Permanent Viscosity Loss and High Shear Permanent Viscosity Loss.

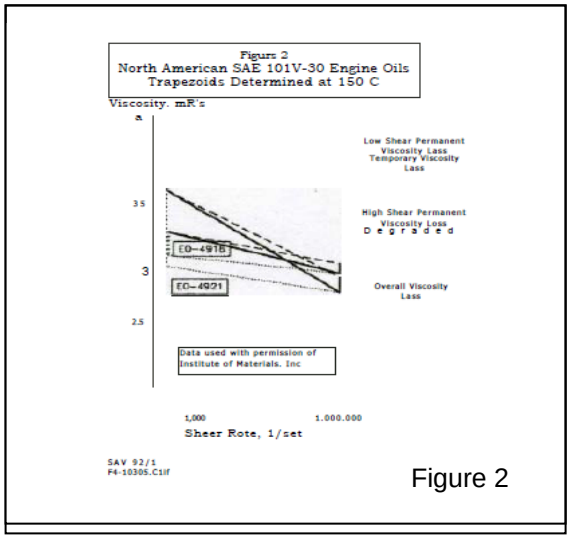

Figure 2

1. 'T.W. Selby, "The Viscosity Loss Trapezoid", Eighth International Conference on Viscometry of Automotive Lubricants, Dearborn, Michigan, September 29 - October 2, 1991; and T.W. Selby, "A Method of Generating and Appraising the Five Viscosity Loss Parameters of Lubricating Oils - The Viscosity Loss Trapezoid", Presented at the 8th International Symposium: Tribology 2000, January 14 - 16, 1992.