

RHEOLOGY SOLUTIONS

COMPARISON OF COMMERCIAL VISCOSITY MODIFIERS

PROBLEM

Viscosity modifiers are often added to base oils to improve their viscosity/temperature properties. These viscosity modifiers, which are solutions of polymers dissolved in the base oil with small amounts of antioxidants, pour point depressants and/or other minor ingredients, are generally characterized by their kinematic viscosity at 100°C (per ASTM Test Method D445). This single point viscosity measurement, however, is not really adequate for projecting the mixing and pumping properties of these modifiers because the modifiers do not exhibit Newtonian flow behavior, particularly as they become more concentrated.

SOLUTION

Controlled stress rheology provides a more complete characterization of viscosity modifiers. These rheology results enable the supplier to make highly concentrated modifier solutions (thereby minimizing cost) without adversely affecting mixing and pumping.

Figure 1, for example, shows the flow results for several different modifier solutions. The styrene/isoprene modifier solution is highly shear thinning (i.e., viscosity decreases with shear rate), whereas the ester solution is only slightly shear thinning, and a radial isoprene solution is almost Newtonian. Shear thinning behavior in these solutions

References:

1. H. F. George and D. P. Hedrick, SAE Fuels & Lubricants Meeting, October 1993.

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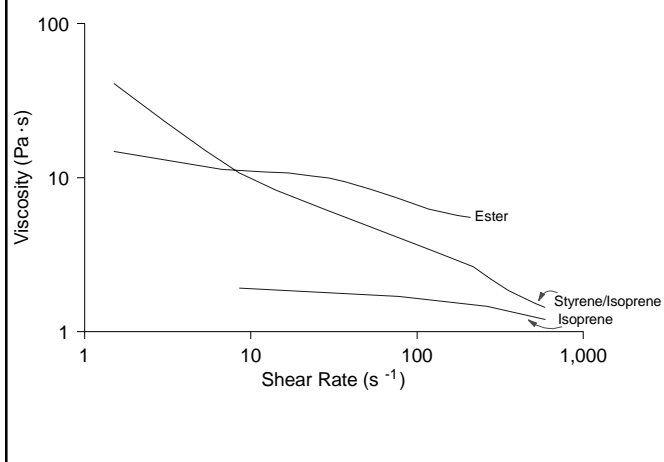
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relates to their ease of being pumped. Solutions that shear thin have lower viscosities at the higher shear rates experienced during pumping. The styrene/isoprene modifier is particularly interesting because it has the highest viscosity at low shear rates (i.e., at rest), yet shears to a lower high shear viscosity than the ester modifier.

Figure 1. VISCOSITY MODIFIER SOLUTIONS (Initial Flow Curves)



In addition to flow measurement, controlled stress rheology also provides tests (creep and oscillation) which yield further insight into the viscoelastic properties of these modifiers. [1].