Lube-Tech

No.62 page 1

PUBLISHED BY LUBE: THE EUROPEAN LUBRICANTS INDUSTRY MAGAZINE

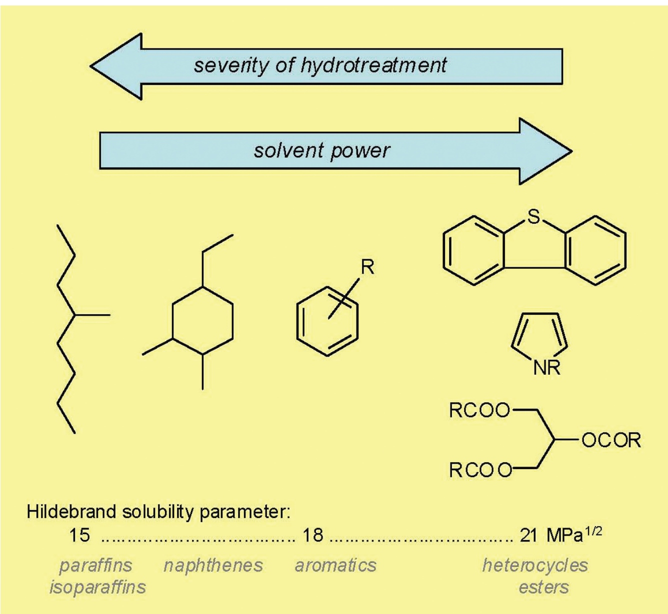
New base oils pose a challenge for solubility and lubricity

Broad commercialisation of hydrocracking, catalytic dewaxing and hydrofinishing technologies in the past two decades have created an abundant supply of API Group II and Group III base oils. However, despite the many undisputed advantages over the Group I in terms of viscosity index (VI), sulphur content, volatility, pour point and antioxidant response, the new base oils are winning the market much slower than many analysts predicted at the rise of the hydrotreatment technology.

Why is it that difficult? Serious formulators are skillful in property -blending, preparing "cocktails" with desired specs being a daily routine for them. There must be something that accounts for formulators' reluctance to interchanging their base oils.

It appears that, when discussing technical implications of the base oil interchange, very little attention is normally given to solubility and lubricity issues. However, the fact remains that, the greater the degree of hydrotreatment, the lower the solubility:

Scheme 1



Severely hydrotreated base oils, as well as GTL (gas-to-liquid) base stocks and PAO (polyalphaolefins), are often regarded as "dry" base oils because they only contain fully saturated non-polar hydrocarbon (isoparaffin) molecules.

This trend can be easily seen if aniline point values are compared. Lower aniline point means higher solvent power. For high-aromatic products, such as aromatic extracts, the aniline point is around 20-40°C; for naphthenic base oils, 70-100°C depending on the degree of refining and viscosity; for Group I paraffinic base oil, 90 to 110°C; and for Group II-IV base oils, 100-130°C or higher. It is interesting to note that the aniline point steadily increases with the increasing viscosity of the oil for oils with identical polarity. For instance, in the series PAO 2, 4, 5, 6, 8, 10, 40, it raises from ca 100°C for the lightest to ca 160°C for the heaviest homologue. This is because, as can be shown by thermodynamic arguments based on the Hildebrand solubility theory, aniline point depends upon the product $V_M(\delta_{anil}-\delta_{oil})^2$ where V_M is the average molecular volume, and δ_{anil} and δ_{oil} are the Hildebrand solubility parameters for the aniline and for the oil, respectively. Increasing the average molecular volume raises the aniline point.

Low solubility not only makes it difficult to dissolve some essential additives, but it also compromises some essential quality parameters, such as dispersancy and seal compatibility. For instance, PAOs are unbeatable in terms of pour point and volatility, and at the same time, have the lowest lubricity and solubility ranking.

This is normally compensated by using solubility improvers in finished lubricant formulations. Theoretically, any chemical