Energy Conserving Formulations with Reserved Fluid Value

The Super High Viscosity Index (VI) of biobase oils allows us to think non-conventional in our rheological thinking and can add performance value that can not be reached with conventional base oils. This summary report and graph below will explain the exceptional performance of Renewable Lubricants Biobased Technology in reducing energy and protecting equipment from wear.

High temperature and high pressure hydraulic systems can stress the hydraulic fluid providing thermal and permanent mechanical shear of the fluid viscosity. The different hydraulic system designs can also increase the mechanical shear at a faster rate depending on pump rpm, pump pressure, and hours of operation. This mechanical shear can be experienced in gear drive units that can also provide permanent loss of the fluid film. In addition, studies have shown that during pump stand tests and laboratory oxidation tests that the higher temperatures can also create permanent loss of viscosity in some synthetic ester based formulations.

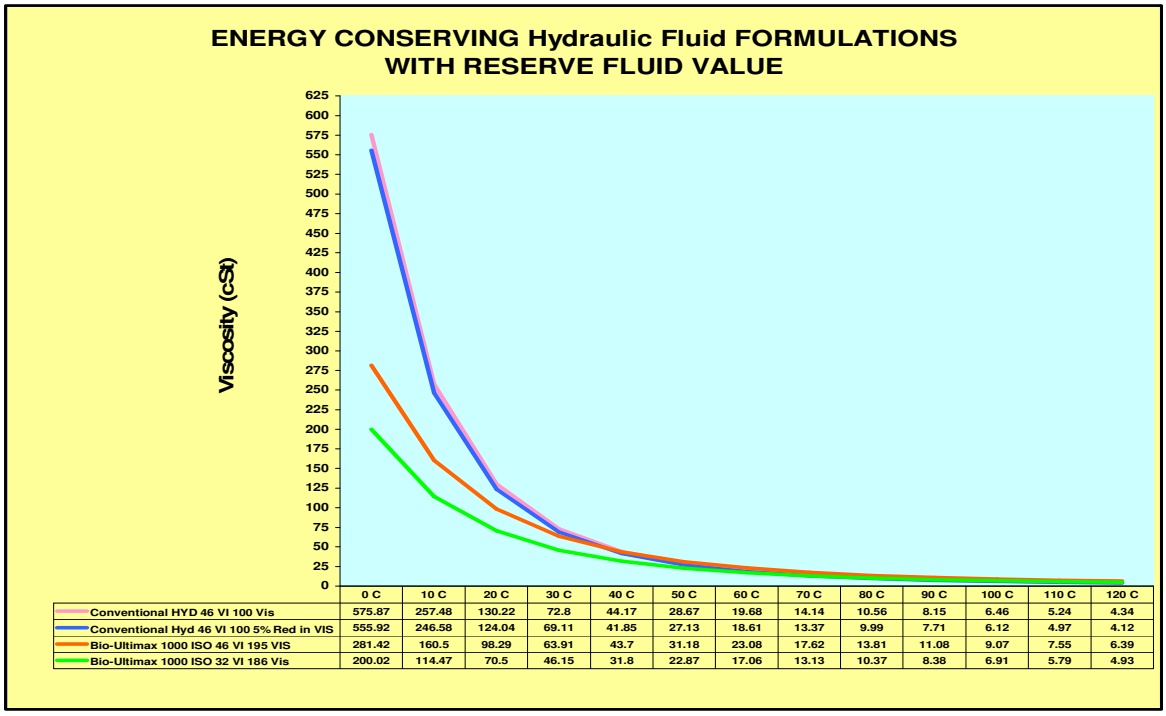
In designing formulations, understanding mechanical and thermal shear is important to providing the proper fluid film with energy conserving properties. Synthetic base oils with a higher (VI) between 125 to 200 are known in the industry to be able to improve these properties, but cost two to eight times that of biobase oils. Rheological studies can be conducted in the lab, but pump stand tests and field studies will give a more realistic understanding of the fluid performance. Pump stand tests and field studies have shown that permanent loss in viscosity varies from 5% and up to 30% within the first 100 hours of operation. In taking into consideration this fluid film shear and to prevent system failure, studying the viscosity at the actual operating temperature is most important. This is why higher VI formulations with reserved fluid film at higher temperatures (reduced thermal shear) can provide improved performance over a wider range of temperatures. These high VI formulations provide less lubrication friction in the start up mode and at the lower temperatures that can reduce energy, but provide improved lubrication fluid film at the higher pressures and operating temperatures between 50^{o} C and 120^{o} C or higher.

Today with energy conservation being a very important part of every industrial society, controlled thermal and mechanical shear can save energy by reducing lubricant friction. Lower operating temperatures have also been experienced through lower lubrication friction and improved heat transfer. Many original equipment manufacturers and lubrication engineers have experienced the improved performance of high VI, multi- grade formulations and have recommended one grade down in the ISO viscosity providing successful performance over conventional 100 VI petroleum formulas.

Permanent shear must be considered with every fluid design from straight weight ISO Grade formulations to multi-grade formulations containing VI improvers. The use of VI improvers can improve thermal shear and provide energy conserving properties, but care must be taken in choosing the proper VI improver and how much VI improver related to the base oils. A balanced formulation of shear stable VI improvers and high VI base oils can provide an energy conserving formulation with reserved fluidity to protect against mechanical and thermal shear.

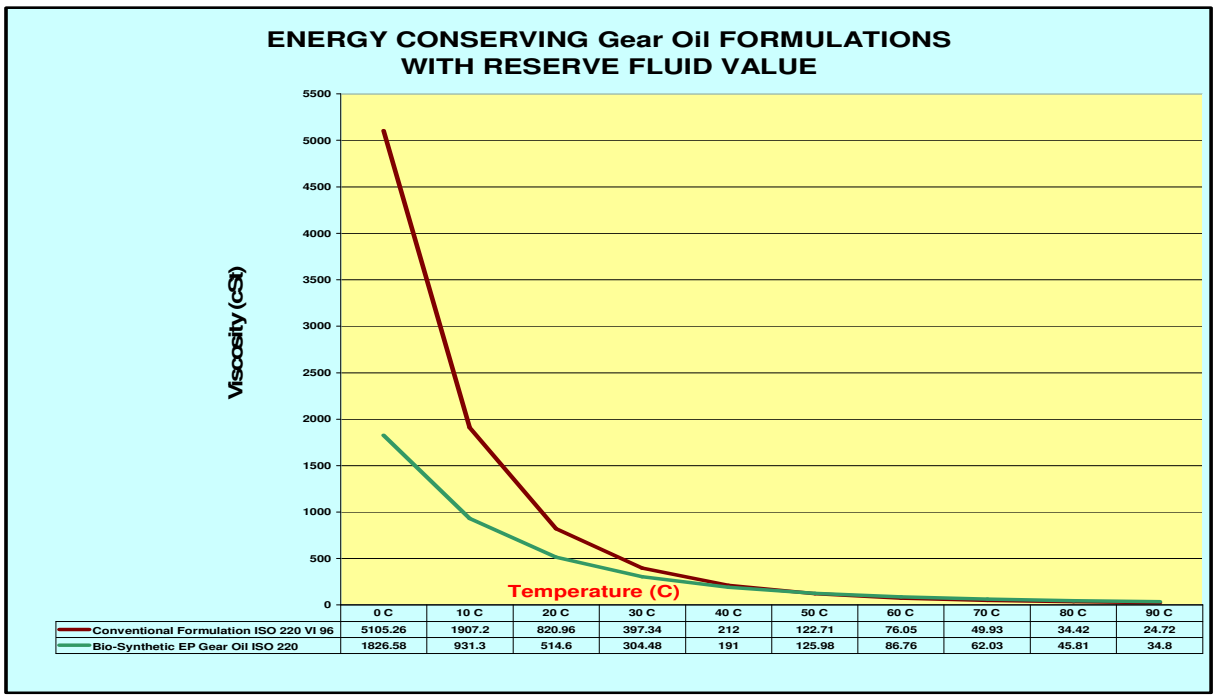
The use of Super High VI Biobase Oils (210 to 240 VI) can provide increased fluid film protection and additional energy conserving properties. In addition, because of their considerable lower viscosity at lower temperatures, they provide faster system warm-up and flow that prevents start–up system chatter, foam and air entrainment, and pump cavitations. The performance of these biobase oils, when properly formulated, can provide performance advantages in many applications including circulating, gear, and drive systems.

Below is **Graph #1** that compares the viscosities and VI of Bio-Ultimax 1000 ISO 46 with a VI of 195 and a conventional ISO 46 hydraulic fluid with a VI of 100. For the purpose of demonstrating mechanical shear, the conventional hydraulic fluid is also shown with a viscosity reduction of 5% which could be considered the limit for the fluid film for higher temperatures. In addition, the Bio-Ultimax 1000 ISO 32 is shown to give a comparison of a viscosity reduction of 27% compared to the ISO 46 formulations. Even with the 27% reduction, the Bio-Ultimax ISO 32 reological properties out-perform both conventional hydraulic fluids providing reserved fluid film at the higher operating temperatures. Both Bio-Ultimax Hydraulic fluids show considerable reduction in viscosities at the lower temperatures reducing energy and demonstrating exceptional reserved fluid value at the higher operating temperatures and pressures where the use of the viscosity is more valuable. Now consider the additional performance value of this technology if you take these Bio-Ultimax Hydraulic Fluids further in the cold temperatures of -30^{o} C with a Brookfield of only 2000 to 4000 cP to the higher temperatures of over 120^{o} C where fluid film is considered even more value added.



	0 C	10 C	20 C	30 C	40 C	50 C	60 C	70 C	80 C	90 C	100 C	110 C	120 C
Conventional HYD 46 VI 100 Vis	575.87	257.48	130.22	72.8	44.17	28.67	19.68	14.14	10.56	8.15	6.46	5.24	4.34
Conventional Hyd 46 VI 100 5% Red in VIS	555.92	246.58	124.04	69.11	41.85	27.13	18.61	13.37	9.99	7.71	6.12	4.97	4.12
Bio-Ultimax 1000 ISO 46 VI 195 VIS	281.42	160.5	98.29	63.91	43.7	31.18	23.08	17.62	13.81	11.08	9.07	7.55	6.39
Bio-Ultimax 1000 ISO 32 VI 186 Vis	200.02	114.47	70.5	46.15	31.8	22.87	17.06	13.13	10.37	8.38	6.91	5.79	4.93

Graph #2 compares the viscosities and VI of the Bio-Synthetic EP Gear Oil ISO 220 with a VI of 179 and conventional gear oil with a VI of 95. The Bio-Synthetic Gear Oil again shows considerable reduction in viscosity at the lower temperature reducing energy and reserved fluid value at the higher operating temperature of 50 ^{o} C and higher. This reserve fluid film is also an added cushioning value in the Extreme Pressure area of the gears.



	0 C	10 C	20 C	30 C	40 C	50 C	60 C	70 C	80 C	90 C
Conventional Formulation ISO 220 VI 96	5105.26	1907.2	820.96	397.34	212	122.71	76.05	49.93	34.42	24.72
Bio-Synthetic EP Gear Oil ISO 220	1826.58	931.3	514.6	304.48	191	125.98	86.76	62.03	45.81	34.8