

Hydraulic Oil Condition Monitoring Using Vectron ViSmart Viscosity Sensor

SenGenuity ViSmart™ was tested for hydraulic oil condition monitoring at the customer site; the samples are simply denoted at "Oil A" and "Oil B". Oil A has lower viscosity than Oil B. The primary goal of the closed-loop test was to verify the ability of the ViSmart™ to measure viscosity changes as a pure sample was contaminated by another.

Data points were taken continuously. The test was set up to demonstrate a step up variation as well as step down change. Both samples were tested until a stable value was reached and until the temperature began to level off; at that point one sample was deliberately contaminated by the other.

Data is shown in acoustic viscosity (AV) units ($AV = \text{viscosity in cP} \times \text{specific gravity}$) for the given tests. The ViSmart™ employs mineral oils as the calibration standard at its operating high shear rate (30,000 – 3,000,000 for the various liquids tested). Mineral oil begins to exhibit shear thinning at these shear rates and the degree of thinning that the standards exhibit is biased into the calibration functions. Materials that exhibit more shear thinning than mineral oils read lower than their expected "low shear" viscosity, while materials like water, isopropanol, and aromatics tend to exhibit less shear thinning than oils and read higher than expected. Mineral oil is employed as the standard due to the low reactivity, high stability and ability to measure from -40°C to $+140^{\circ}\text{C}$ over the required viscosity range with a single family of chemicals.

Four tests were conducted to observe the performance on the ViSmart™.

For Test 1, shown in Figure 1, the conditions were as follows:

- Pure Oil A (5 liter volume), at pressure = 190 psi
- Contamination of 114 mL of Oil B (time = 2385 secs)

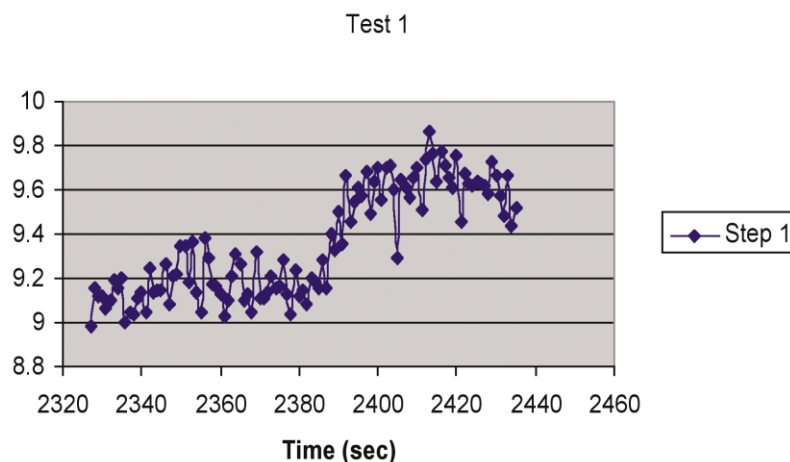


Figure 1: Oil condition monitoring data for Test 1

For Test 2, shown in Figure 2, the conditions were as follows:

- Pure Oil A (5 liter volume), at pressure = 190 psi
- Contamination of 250 mL of Oil B (in addition to the 114 mL from Test 1, at time = 2940 secs)

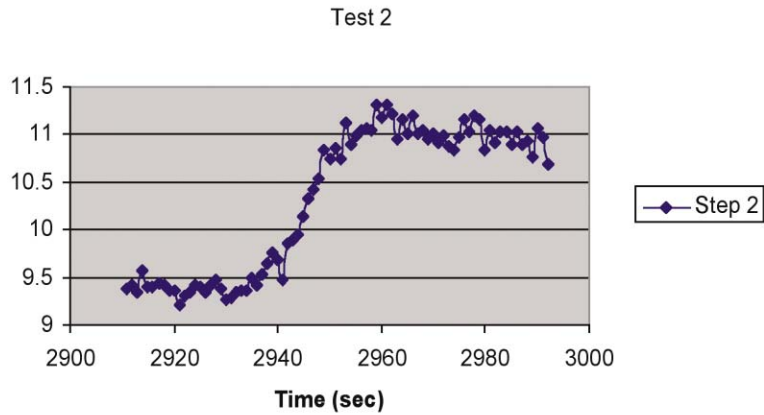


Figure 2: Oil condition monitoring data Test 2

Clearly, one can observe exactly at the point where the contamination mixing took place. The 1% – 2% reading fluctuation in Figure 1 are related to the minor temperature fluctuations (not shown) generated by the flow conditions in the closed-loop system.

For Test 3, shown in Figure 1, the conditions were as follows:

- Pure Oil B (3.5 liter volume), at pressure = 250 psi
- Contamination of 150 mL of Oil A (at time = 7400 secs)

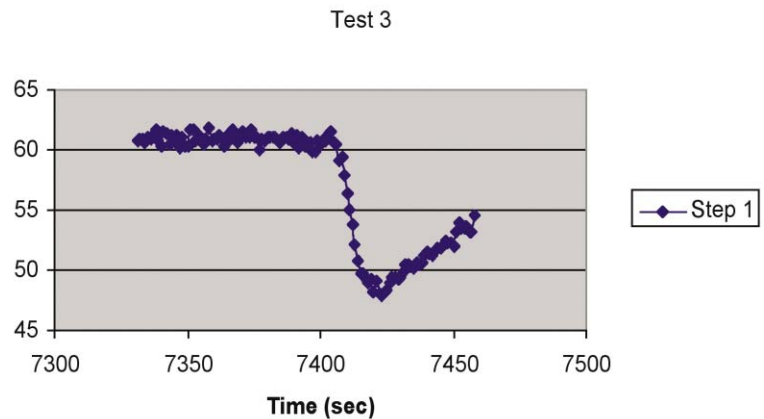


Figure 3: Oil condition monitoring data for Test 3

