SENGENUITY
Sensor Engines by Vectron International

Monitoring Aging in a Gearbox using ViSmart Viscosity Sensor

Commercializing technology based on quartz crystal acoustic wave research SenGenuity introduced the first commercially available solid state viscometer designed for integration into in-line, real-time viscosity oil condition monitoring for embedded mobile and fixed asset applications.

Contaminants in oil (water, solvents and fuel) and the constant temperature cycling are known to degrade viscosity of oil which in turn can cause damage to internal components of diesel assets, whether they are trucks or construction equipment. High water contamination levels in diesel fuel have been shown to be the reason for corrosion and pitting leading to increased metal wear particle counts. The presence of residual cleaning solvents and fuel contamination has caused seals to swell and create less then ideal engine operating situations. In fixed assets such as gearboxes and power generation sets, the challenging environment of plant operation over a course of time reduces the hydrodynamic lubricity of the oil due to the reduction of additives and detergents in the oil. The requirements placed on equipment readiness and safety has placed greater emphasis on onboard knowledge of lubricant condition and capability to prognosticate failure. Knowledge of viscosity in real time provides a significant benefit to measure the condition of oil during commercial operations and prevent incipient mechanical failure.

Conventional mechanical and electro-mechanical viscometers designed primarily for laboratory measurements are difficult to integrate into the control and monitoring environment. As a consequence, many companies rely on decisions based on intermittent "snapshot" data acquired from periodic sampling where conventional instrumentation can be affected by temperature, shear rate and other variables.

Acoustic wave sensors offer a number of advantages over conventional mechanical and electromechanical viscometers as they are small solid-state devices that can be completely immersed in the oil providing an instantaneous viscosity data stream for embedded OEM or end-user spot-check applications. The sensors are unaffected by shock or vibration or by flow conditions so they can be used in harsh operating conditions to measure viscosity of oil from 0 to 500 cP with a temperature range of -25˚C to 125˚C. At the same time, sensor measurements are not affected by particulates.

Measurements are made by placing a hermetically packaged quartz crystal chip with an abrasion resistant proprietary hard-coat surface in contact with the oil. The oil's viscosity determines the thickness of the oil hydro-dynamically coupled to the surface of the sensor. As the acoustic wave penetrates the oil, viscosity is calculated by measuring the power loss. Because the acoustic wave sensor is a solid-state device no bigger than a matchbox, it requires no calibration, contains no moving parts, and can be completely embedded for hardware integration to any control platform.

A customer that manufacturers industrial equipment decided to integrate the ViSmart viscosity sensor in order to continuously monitor the condition of the oil and in turn assist their own customers in preventative maintenance operations by providing current, accurate and reliable viscosity data.

Three tests were carried out. In the first test, a commercially available oil in new condition was tested for a viscosity versus temperature response. Then, as the equipment was operated for several months, the viscosity of oil was measured once again as a function of temperature. The figure below (see Fig 1) shows the difference in viscosity of the oil, and enables the customer to make a series of decisions to ensure the continued functioning of the equipment.

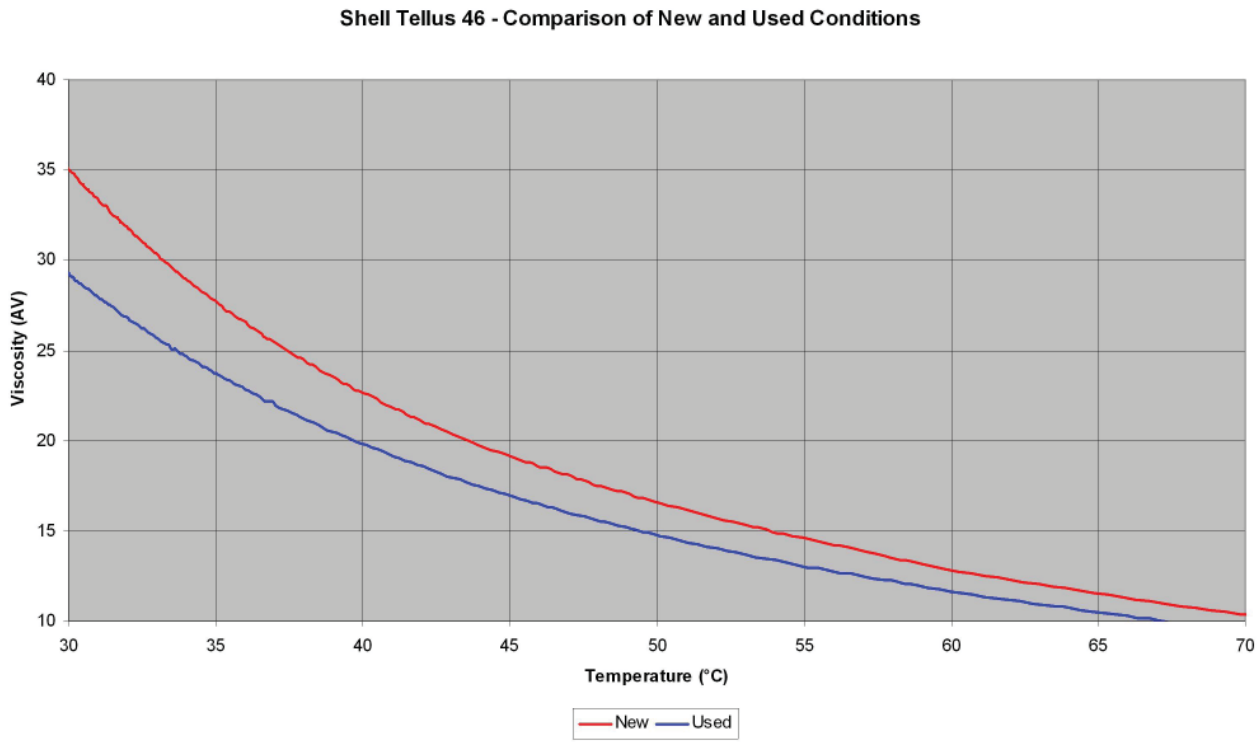

Figure 1: Monitoring of oil condition as a function of use and temperature using the Vismart

The second test was to measure the viscosity of two different grades of commercial oil (see Figure 2) being mixed in order to determine the sensitivity of the sensor for identifying the correct type of specific oil is used in the equipment.

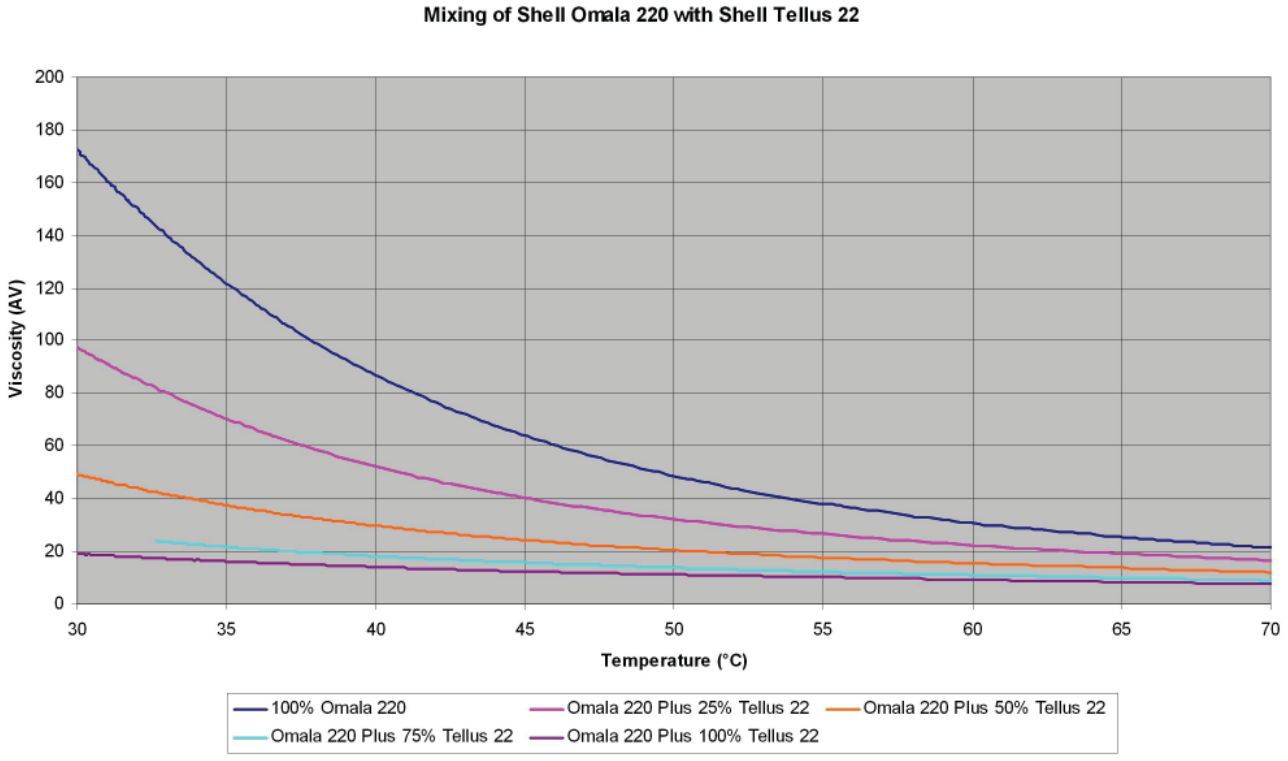

Figure 2: Monitoring the viscosity of two different grades of oil using the ViSmart

Finally, a third test was carried out, where the viscosity of oil of a selected commercial oil was measured across the applicable temperature range multiple of times in order to ensure repeatability of viscosity data. The data demonstrated a repeatability of 1.8%.

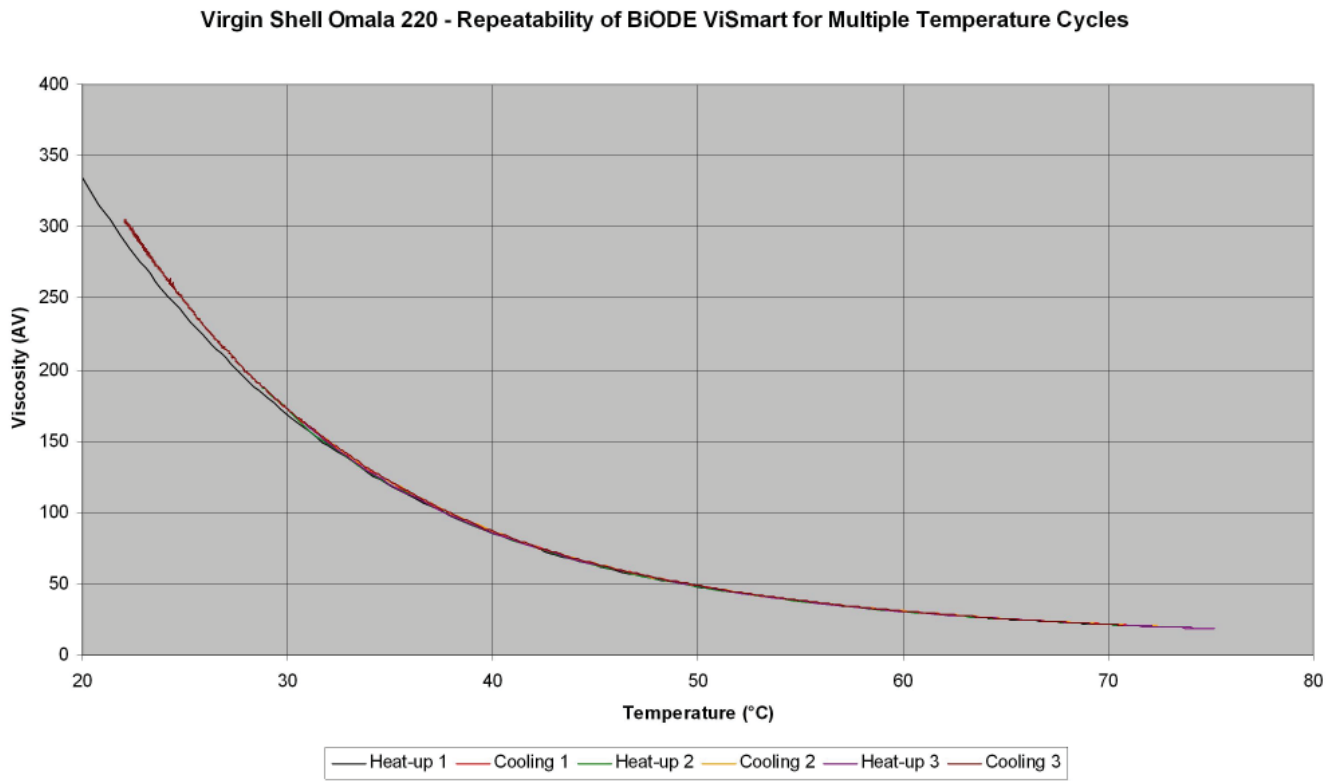

Figure 3: Repeatability of viscosity data using the ViSmart

SenGenuity, as a strategic partner, is now working with the customer on integrating the ViSmart viscosity sensor to the industrial equipment and assisting in bringing a valued-added solution to the end customer.

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