



*“We Can Sense It”*

## Monitoring Fuel Dilution in Diesel Oil Using ViSmart Viscosity Sensor

Commercializing technology based on quartz crystal acoustic wave research Vectron International 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 than 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 global customer in the automotive and trucking industry decided to integrate the ViSmart viscosity sensor in order to continuously monitor the condition of the oil as a function of the fuel dilution in order to ensure and extend the warranty period on the engines by providing current, accurate and reliable viscosity data.

An extended test on an engine test stand was carried out. Commercially available oil was monitored for a baseline viscosity performance. Then, as the equipment was operated specific percentage levels of fuel was introduced and 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 as a function of percentage levels of fuel dilution across the temperature range. The final goal of the customer to enable the end user to make a series of decisions to ensure the continued functioning of the equipment was achieved on the test stand.

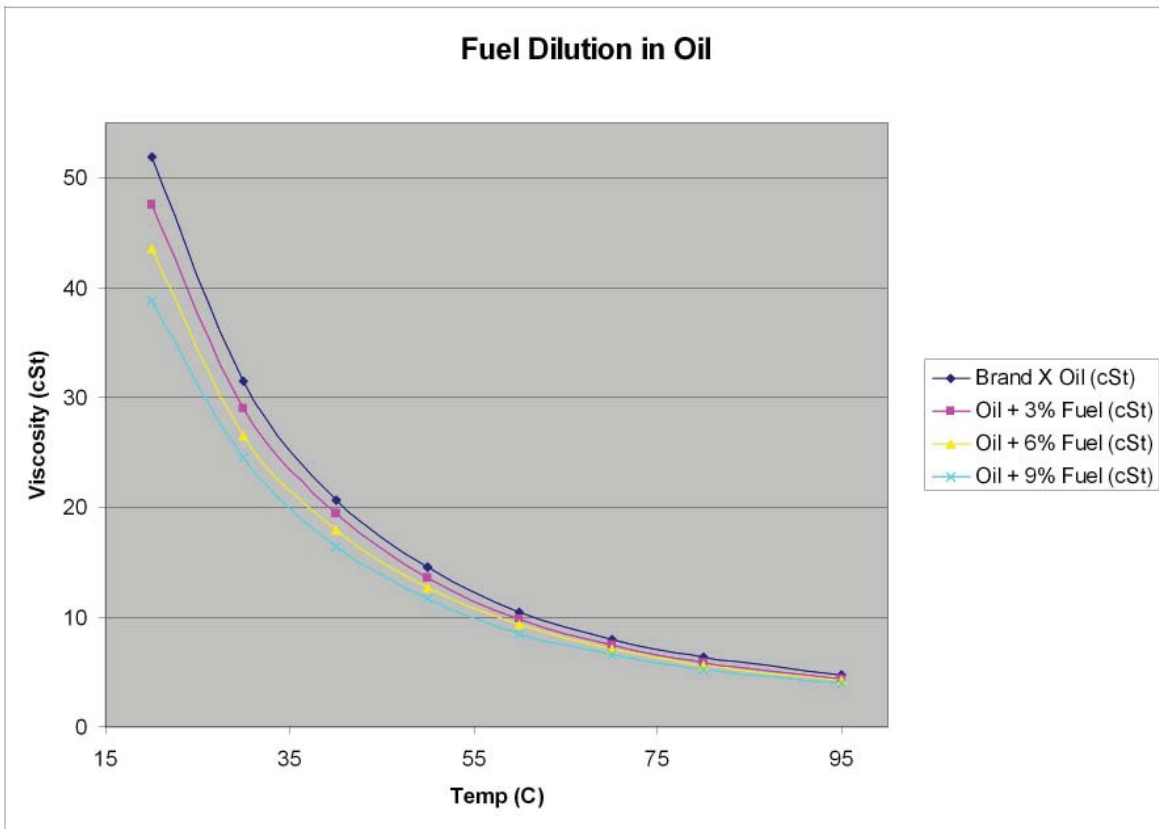


Figure 1: Viscosity changes as a function of fuel dilution across a temperature range using the ViSmart

Vectron, as a strategic partner, is now working with the customer on integrating the ViSmart viscosity sensor to the engines and assisting in bringing a valued-added solution to the end customer. As part of its continuous efforts to embed additional function to the sensor, Vectron is working on detecting water and soot concentrations within the same sensor platform.

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