Conductivity measurement saves costs

Real-time conductivity measurement resolves SDA dosing discrepancies and saves close to USD 100k per annum

A major Asian refinery with crude capacity close to 10ml approached Stanhope-Seta and D-2 Technologies to assess their options for automatic dosing of Static Dissipater Additive (SDA) in the Jet fuel stream. The following case study shows the technologies employed that resulted in an estimated annual saving of USD100k and a reduction of labour by 50%.

Current procedure

The system was based around a manual sampling procedure with sampling at a number of points in the pipeline. Samples were collected and analysed then, depending on the results, the SDA dosing system was initiated. During the additive injection stage the levels of conductivity were monitored and the dosing system manually controlled to give the correct dose rate.

The Stanhope-Seta/D-2 representatives conducted an appraisal of the site and its procedures. Each stage of the process was audited and suggestions for improvements were recommended.

Existing measurement and sampling

The refinery's existing procedure involved collecting samples from various line sampling points into a metal container. In accordance with ASTM D2624 this container was flushed three times before the sample was collected for measurement. The sample was allowed to stand for two minutes to 'relax' and allow any static charges to dissipate before the measurement was taken. During the measuring process it was observed that the longer the probe remained in the sample, with the meter active, the more the readings decreased in value. For this reason the length of time the probe was inserted and the sample was also recorded. The overall sampling and measurement process took in excess of 8 minutes and rapid sampling was not possible.

Typically three to four samples were drawn, taking over 30 minutes to total. The decrease in conductivity value during the measurement phase was attributed to the fuel polarisation. The graph in Figure 1 shows a typical example of the polarisation effect on the fuels and the associated change in conductivity readings. Specification levels for conductivity are in the range of 250 to 350 pS/m with absolute fuel specification limits of 25-600 pS/m.

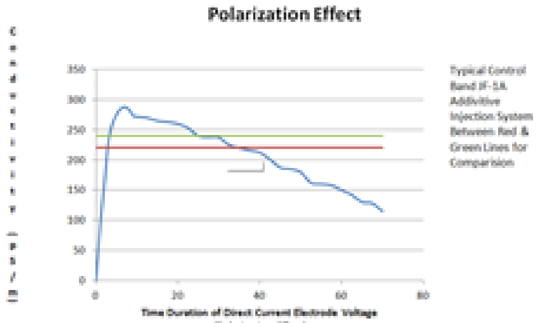

Figure 1

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Recommendations to improve measurement and sampling

The recommendation was to compare results using the Seta/D-2 Handheld Conductivity Meter, JF-1A-HH. The sampling procedure remained unchanged but the measurement could now be taken immediately, without a two minute delay while operators wait for the sample to dissipate any static charge. The JF-1A-HH Conductvity Meter works on AC measurement technology so any charges, or polarisation of the fuel, do not affect the conductivity readings. At the same time the AC measurement technology resolves the issues associated with reducing readings over time. The new JF-1A-HH Meter also stored the data for easy recall so no manual documentation was required.

The result

Overall the sampling time halved from over 30 minutes to 15 minutes. The benefits of the data being sent directly to the LIMS system via a PC interface resulted in labour savings of over 100 hours annually.

Automated real time conductivity improvement

Figure 2

With measurement consistency now achieved using the JF-1A-HH Handheld Conductivity Meter it was clear that the manual dosing system was providing inconsistent results. Handheld measurements showed ranges from 0 pS/m to over 2000 pS/m, the higher readings above 600 pS/m represented out of specification fuel which indicated the need for remedial action to get back to specification. Standard dosing rate for SDA should be in the range 0.5 to 1.5 ppm, on a concentration basis, with initial dosing never exceeding 3.0 ppm.

The refinery was keen to look at how the conductivity could be measured in real time before making a decision on any automation of the dosing system pumps. A specification based around the Seta/D-2 Real-Cond In-line Conductivity Sensor (JF-1A) was written. The Real-Cond system is called up in ASTM D2624, is fully ATEX approved and works on the same AC measurement principle as the JF-1A-HH Handheld Meter.

As shown in Figure 2, the Real-Cond JF-1A Sensor was linked via its standard 4-20 mA intrinsically safe (IS) output directly to the refinery Digital Control System (DCS). The Real-Cond JF-1A also reported to the DCS the product line temperature via its built in 4-20 mA temperature output current loop. The system was installed in the pipeline via a standard gate-valve fitting mounted off a 1″ weldolet fitting so no down-time or drainage required. Installation took just a few hours with data being reported back immediately.

Figure 3

Real-time display 'at pipeline'

The system reported the conductivity and temperature via the current loop; however the customer expressed a need to see the display locally in order to make comparisons with the values recorded at the sampling points.

A real-time display was installed on the Real-Cond head unit to enable data to be read directly and an immediate comparison made to handheld samples (figure 3).

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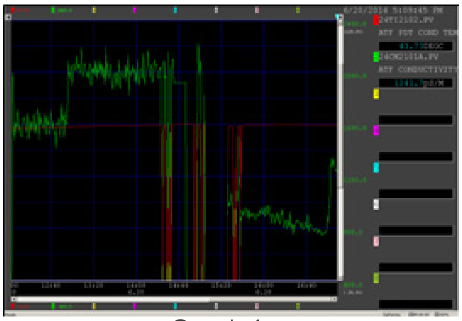
Real-time temperature and conductivity displays

The Real-Cond Sensor was linked via the 4-20mA current loop to the refinery control system. Once calibrated the output from the sensor was logged and plotted. The results mirrored the JF-1A-HH Handheld figures but were more detailed and clearly showed spikes in the dosing, these were attributed to the manually controlled SDA injection system.

The high variability of conductivity can be seen in the DCS system data plat shown in Graph 1. When spot sampling occurred on such high variability data it was quickly evident to the operators why there were randomly getting fuel that was either reported under dosed or over dosed by hand taken samples.

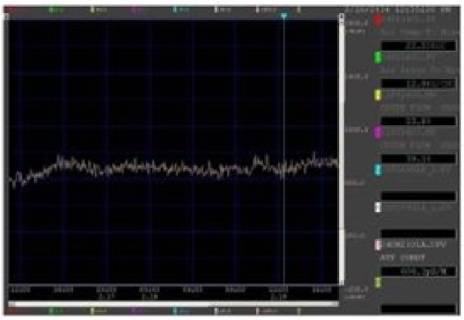


Graph 1

Interfacing the Real-Cond to the SDA Dosing System

Seta D-2 offer a range of skids for automated injection however the refinery wanted to continue to use the existing injection system. A simple interface was developed to enable the output of the Real-Cond Sensor to control the SDA injection system. Parameters were stored for the control of the injection system and the system went live approximately two months after installation of the first Real-Cond In-line Sensor. The results were immediately apparent with a reduced and tightly controlled dosing pattern,

Graphs 1 and 2 show the effect of the In-line Sensors. Graph 1 shows the irregular dosing attributed to manual control of the system; graph 2 shows the fine control achieved by the automated injection system.



Graph 2

Result: six month payback on investment

As well as better control the system provided an estimated saving on SDA of USD 20,000 within the first three months of commissioning. Capital cost recovery was expected within a six month period simply based on reduced SDA additive costs with additional savings being made on labour costs from less hand sampling. It was also recognised that the high cost, and associated liability, of out of specification fuel leaving the facility were negated with the use of the Real-Cond In-line Conductivity Sensor.

Reduced manual sampling was needed and it was noted that ASTM D3984 MSEP values also became more predictable. SDA in high concentration can reduce MSEP values below the required 75 value as SDA is a weak surfactant.

Ongoing support and calibration

Figure 4 - Probe

Figure 5 - Calibration Kit

The Seta/D-2 system requires little maintenance. The design of the probe assembly (figure4) enables it to be removed from the pipeline when required with no downtime and no exposure to fuel. Verification and calibration of both the Handheld Meter and In-line Sensor is possible with the unique 'Active Calibration tool'. This device simply fits over the probe assembly and allows local calibration and verification of the devices (figure 5).

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