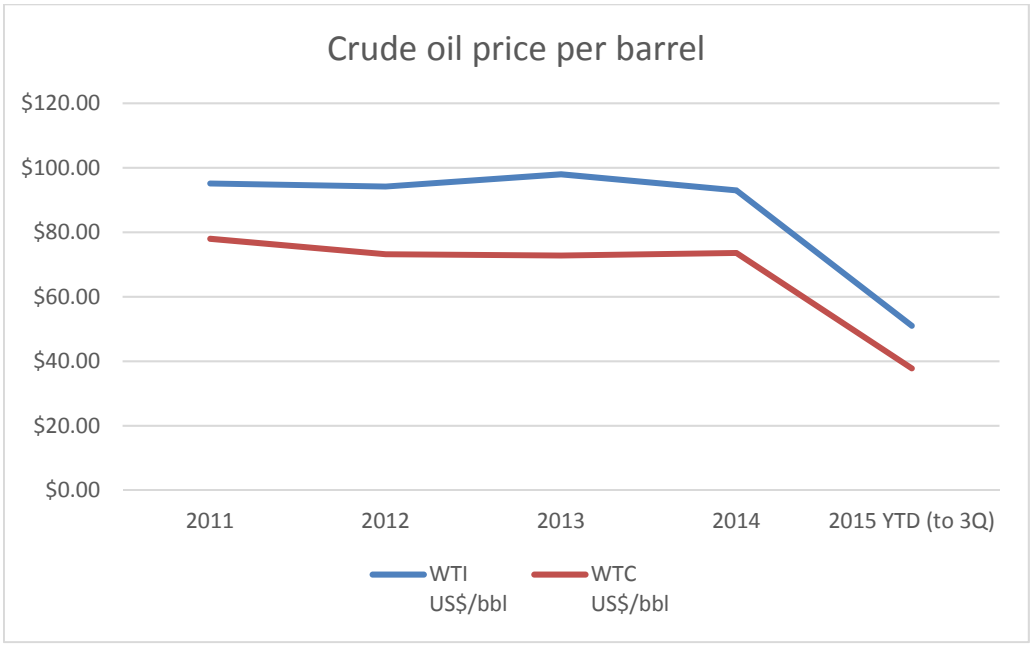
permasense
Experts in remote monitoring solutions

Continuous asset integrity monitoring supports cost reduction efforts for Canadian oil sands operators

1. Introduction

The severe fall in oil price has hit the profitability of non-integrated Canadian oil sands producers harder than many sectors of the oil and gas industry. Western Canadian Select is currently at the lowest price in 12 years. Whilst marginal costs for a new SAGD facility may be around $90/bbl, Industry experts quote operating production costs from existing assets of $20-60/bbl, with the lower end for steam assisted gravity drainage (SAGD) type production and the higher end for mining type production. The backdrop of current oil prices makes much production only marginally profitable. Recent reports have highlighted that at $24/bbl for WCS (price as of September 2015) only one quarter (~450 kb/d) of oil sands production is profitable.



Recent financial results posted by Cenovus, Devon Energy, CNRL show falls in revenue averaging 60% and reduced profitability up to 75% over the past year. More integrated companies such as Suncor have been slightly buoyed by higher refining profits offsetting reduced production margins but the region has certainly been hit hard by the current low price environment.

Permasense Ltd, Alexandra House, 100 Newton Road, Manor Royal, Crawley, RH10 9TT, UK
www.permasense.com permasense.sales@emerson.com +44 20 3002 3672

Oil sands production assets are very capitally intensive. Many oil sands projects were sanctioned during the boom time to 2014, when oil prices were running at $100/bbl or more, production was highly profitable and debt finance for such projects was freely available.

Non-integrated oil sands operators have been facing the perfect storm following the sharp fall in the oil price – increasingly unprofitable production, combined with the need to maintain (or even increase) production to continue to cover their fixed cost base as well as generating sufficient cash flow to continue servicing debts.

Cenovus Foster Creek SAGD facility (photo courtesy of Cenovus)

2. The push for increased production

With crude prices falling by 50% or more, all oil production operators have reported an equivalent reduction in revenues. One way of (partially) offsetting the revenue per barrel is to increase the number of barrels produced – however, with heavy oil sands this raises the risk of increased sand erosion, and with that the risk of a possible hydrocarbon leak. Sand erosion is a major issue for oil sands operators – increased production can break up sandstone formations within the well with the result that 'slugs' of sand are entrained in the oil passing through the processing equipment on the well pad and into processing. The sand scours the inside of the equipment walls, often in a non-uniform manner, and extremely high metal loss rates can occur.

> *"We have had incidents in SAGD production wells where the well geography has changed causing a flow of vapor and sand which has severely eroded our piping leading to failures and emulsion releases. We have determined that the erosion has gone through our 12.7mm thickness production piping in less than 8 hours. Due to these drastic, unanticipated increases in erosion rates, we are unable to ensure the ongoing integrity using conventional time-based interval UT. As we cannot predict these events we need to find a way to catch the increase in rates before we have a failure". (Oil sands producer, to Permasense)*

Thus, processing operations and the resulting integrity impact at the well pad can change dramatically over short time periods, and also in an often unpredictable manner. As most facilities have multiple well pads, spread over remote locations and over considerable distances, integrity monitoring is challenging at the best of times, but more so in the current economic environment.

Environmental monitoring of oil sands operations in Alberta is extremely stringent and government regulatory response to any kind of hydrocarbon leakage is rapid and focused, as was shown by the recent shutdown of a pipeline operated by Nexen following a leak.


CANADA

Nexen can resume more oilsands pipeline operations: Alberta regulator

By Staff The Canadian Press

Comments | Facebook 127 | Twitter 11 | Email | Print | ...

The site of a Nexen pipeline leak that spilled roughly five million litres of emulsion. Photo taken during a tour on July 22, 2015.

Shallima Maharaj, Global News

The need to maintain cash flow drives the need to maintain steady plant operations, and an enforced shutdown over an extended period for regulator investigation, because of the temporary rescinding of the operating license of the plant, is an issue that most operators would prefer to avoid – let alone increased regulatory attention once the plant returns to production.

3. The drive for cost reduction

Every oil sands operator has announced cuts in operating budgets in the past year to try to restore some degree of profitability to their operations. One of the prime mechanisms to achieve this has been to reduce contractor costs and the number of personnel directly employed. As an example, Cenovus has recently announced a further planned reduction in personnel headcount, bringing the total down by 24% from 5,200 in 2014 to 3,900 by 2016 - and this latest reduction includes field operating personnel. Fewer field-based personnel increases the workload on the remaining specialists – none more so than those personnel responsible for monitoring the ongoing integrity of the production plants. Costs for skilled inspection personnel prepared to work in remote and inhospitable areas, such as in Northern Alberta, can run at up to three times those in the US. So reducing inspection costs represents a prime area for cost reduction – however, these cutbacks increase the risk that the impact of increased sand erosion goes unnoticed, and raises the risk of a loss of hydrocarbon containment.

4. Tighter environmental regulations driving increased corrosion

Conventional oil sands production consumes water in large volumes, and this has attracted tighter environmental regulation around the operation of the tailing ponds. Tailing ponds contain considerable amounts of minerals and are largely recycled to the oil sands mining and processing operations, but require a certain amount of purging to neighbouring natural water courses to avoid an unacceptable build-up of these minerals. The maximum allowable purge rates have been steadily reduced by environmental regulators, with the result that the recycled water contains an increasing volume of, in particular, chlorides. These chlorides are, in turn, driving up corrosion rates in key areas of oil sands production facilities – especially in areas with stainless or carbon steel – requiring higher doses of anti-corrosion additives and closer corrosion monitoring, driving up operating costs and adding further to the workload of already stretched operating personnel.

5. Enhanced monitoring as a solution

One solution employed by oil sands operators is to attach acoustically-based sand detectors to the equipment to report when higher levels of sand are passing through the equipment. Whilst these systems will detect the elevated risk, they do not measure the impact of that risk: metal wall loss.

Not all sand is the same or has the same impact – "soft" sand can pass through equipment causing minimal damage; "harder" grades of sand can cause severe and rapid damage to equipment.

The application of Permasense ultrasonic wall thickness monitoring sensors provides an effective complement to traditional sand detection methods, by measuring the actual erosion occurring at critical locations, such as bends, elbows, tee pieces, reducers and expanders – areas where there is a change in shearing velocity at the metal wall, resulting in a concentration of the sand flow path through the equipment and an increased risk of that sand damaging the equipment. As the sensors continuously measure wall thickness, they are also able to detect changes in wall thickness due to both erosion and/or corrosion. Corrosion rates are affected by variations in chlorides, or changes in anticorrosion chemical injection rate, distribution or effectiveness. The high sensitivity and responsiveness of the Permasense sensors to small changes in wall thickness with time, enables oil

sands operators to push production and optimise chemical dosages with confidence that the integrity of the plant is not compromised – thereby maximising production and minimising costs – enhancing profitability. In situations where extreme short-term changes in erosion rates could be expected, the measurement acquisition rate can be increased to every few minutes to provide an early warning of a change in thickness, at the micrometre level of detection. This enables production personnel to tune or scale-back operations to reduce erosion rates before they have any significant impact on the equipment during periods where high erosion or corrosion rates are occurring.

The quality and frequency of data that is delivered by the Permasense system delivers the evidence to inform some of the complex decisions faced by oil sands operators.

Data from Permasense sensors is transmitted wirelessly (with a possible range of up to 16km (10miles)) to a local gateway which then stores the data on a computer or server. The data is accessible from anywhere on the company's network. Thus, this technology makes it feasible for integrity data across multiple locations at each well pad, and across the entire system of well pads and processing facilities to be monitored by integrity experts at a central location, such as at the company headquarters or technical centre. The Permasense data analysis software, DataManager, provides erosion and corrosion rate calculations and flags variations as they arise, enabling the end users to focus on issues / locations by exception. It also allows the association of erosion or corrosion episodes with the root causes of changes in production rate, processing conditions, or chemical injection rates or effectiveness, so that production can be optimised onstream to take account of these impacts on plant integrity, and mitigation put in place.

6. Advantages of Permasense technology to oil sands operators

Permasense has recently released a new model sensor, the ET210, as an addition to its highly successful and widely deployed WT range of waveguide-based sensors. Based on well-established EMAT (electromagnetic acoustic transduction) principles, Permasense has pioneered the development of a low-power variant, with the result that this type of technology can, for the first time, be permanently deployed in areas of hydrocarbon processing facilities zoned hazardous (FM, ATEX, IECEx intrinsic safety approval).

The ET210 is wireless and battery operated, so has no requirement to install cables for power supply or communications or to provide cable trays. This variant also uses the WirelessHART communications protocol, so can form a wireless mesh with other WirelessHART devices such as temperature and pressure sensors and use commercially available gateways – for plants that already use this increasingly popular wireless protocol, the wireless connection of these sensors is then very simple.

In addition, mounting of the sensor is a trivial matter - it is fixed to the pipe surface by integral magnets, with a restraining strap simply to prevent dislocation, as shown in the following pictures.

These innovations result in an installation and commissioning procedure that can be completed in just a few minutes, without the need for the presence of multiple installation trade specialists (mechanical, instrument/electrical, welding, etc.) in the field - a major advantage when the cost of these specialists working in remote and inhospitable environments is so high. A complete facility monitoring system of 25 or more sensors can be installed and commissioned, and sending first data, within a day. This provides a real advantage when working outside in extreme ambient conditions, or working in areas where environmental regulations limit access to the monitoring locations, or where personnel are limited.

With a battery life of over 5 years, Permasense sensors are designed to be both robust for use in industrial environments, at extremes of ambient temperatures, and to be low maintenance – so are ideal for installation in remote and difficult-to-access locations.

7. Cost: benefit of a Permasense installation

A 10% increase in production at a typical 20 kbpd oil sands facility, by using Permasense technology to enable tighter sand erosion monitoring and control, would raise production by 700,000 bbls per year. At marginal revenues of even $20/bbl from this incremental oil, this generates $14 Million/year – to service debts incurring (as an example) 7% interest per year, or almost $1 Million/year.

Avoiding a 30 day regulator-enforced shutdown to investigate the root cause of a hydrocarbon leak could easily double this figure.

On this basis, a typical ET210 system would pay for itself in as short a time as two months.

8. Summary

1) Falling oil prices have impacted the profitability of non-integrated oil sands operators even more than many other sectors of the oil and gas production industry. These operators face the combined challenges of reducing costs, in a low oil price environment, while trying to maintain cash flow to service debt. This is driving the need to raise oil production rates to increase revenues, raising the risk of sand erosion and the potential for loss of hydrocarbon containment.
2) Government regulators act rapidly and stringently to investigate any environmental issues from oil sands operations - they can, and have, shutdown operations for extended periods for investigations, which can severely impact operational revenue and cash flow.

3) Tightening environmental regulations associated with water recycling are increasing corrosion issues, such chlorides within the production plant, and are driving up corrosion rates to unprecedented levels adding to chemical costs and the need for tighter integrity monitoring.
4) Personnel headcount reductions have been widely publicised, and increasingly are including field-based operations personnel and contractors. Specialist inspection costs in Northern Alberta are up to three times higher than in the US making this a common cost reduction focus. This increases the pressure on remaining staff to cover all of the plant operations, raising the risk that sand erosion events or increased corrosion may go unnoticed until a leak actually occurs.
5) Some oil sands operators use sand monitors to detect changing sand rates in the oil. However, not all sand is the same and these monitors do not measure the physical impact of the sand on the metal walls of the equipment, only detect its presence.
6) Permasense ultrasonic wall thickness monitoring systems measure the actual integrity impact of changes in the sand production and hardness, as well as detecting and measuring increased corrosion rates from higher chloride levels.
7) The latest Permasense ET210 sensor, is particularly simple and inexpensive to install - full instrumentation of a well pad or processing unit, to first data transmission to desk, in one day.
8) Data from sensors across multiple well-pads spread over wide distances and remote locations can be centralised to enable monitoring of all production facilities by a small group of integrity experts, increasing the efficient use of these skilled and increasingly scarce personnel.
9) Permasense Data Manager data visualisation and analytics software highlights erosion rate excursions or corrosion events, by single location and by area, with a very high degree of sensitivity, so that operational changes can be made to limit the impact on equipment integrity or so that maintenance shutdowns can be timed and work scope planned accurately without risking danger of a hydrocarbon leak or unplanned outages, maximising availability.
10) Payback within a month or two can be expected from the application of Permasense systems through increased production rates, optimised chemical inhibitor addition rates, and reduction in the number of shutdowns, while effectively managing the associated equipment integrity risks.

Contact:

For more information about Permasense continuous corrosion and erosion monitoring solutions, please contact us: permasense.info@emerson.com

Call us on:

+44 (0) 20 3002 3672 *(Europe and MENA)*

+1 281 724 3774 *(Americas)*

+60 3 6200 0788 *(Asia Pacific)*