Better Bitumen Recovery

Process Control of Separation Cells Delivers Big Improvements in Bitumen Yield and Environmental Performance

Abstract

In oil sands, an incremental improvement in bitumen recovery can have dramatic financial benefits. One area of loss occurs in bitumen extraction. Improved recovery occurs by maximizing the fraction of bitumen that is sent to upgrading and conversely minimizing the fraction that escapes to the tailings ponds. Honeywell’s level control solution delivers on this count by more accurately measuring level and applying superior process control to the problem.
Research Framework

The University of Alberta (U of A) Industrial Research Chair (IRC) initiative began in 2006 and one of the problems it tackled was the interface level estimation at Suncor's Extraction plant. With Honeywell's technology, along with financial support from NSERC and iCore, this unique partnership of research, development and implementation in parallel provided a well-focused, applications-oriented study. The separation cells (based on density induced separation of oil and water) have a direct impact on bitumen recovery. Controlling the interface between bitumen and sand + water holds the key to better recovery of bitumen. The U of A research team developed an image recognition algorithm that delivered a pinpoint estimate of the interface level.

Recovery Goals

In oil sands, an incremental improvement in bitumen recovery can have dramatic financial benefits. One area of loss occurs in bitumen extraction. Improved recovery occurs by maximizing the fraction of bitumen that is sent to upgrading and conversely minimizing the fraction that escapes to the tailings ponds. Honeywell's level control solution delivers on this count by more accurately measuring level and applying superior process control to the problem.

Roadblocks to Efficient Separation

In a typical bitumen extraction process, the point where you have control of the split between bitumen yield and tailings pond contribution is at the gravity separation cell. The level of the interface between the bitumen froth and middlings layers has these effects:

**Too high:**
- Sand will be skimmed along with the bitumen froth, degrading the froth quality.

**Too low:**
- Some bitumen will be missed by the skimmer bitumen in the middlings layer will enter the tailings ponds, causing both environmental problems and financial loss. Under the new regulatory directives regarding Tailings Performance Criteria, which includes bitumen discharge, minimizing this has become even more pressing.

Taking Control

For these reasons, it is important that the interface is maintained at an optimum level. This can be achieved by good feedback control—but only if useful sensor data is available. Reliably and accurately measuring the level of the interface had proven to be difficult in the past. The interface is highly mobile, the transition is usually indistinct and the material composition is highly variable.

Conventional sensors such as Nuclear Probe Sensors and Differential Pressure Sensors do not give sufficient accuracy or reliability for good control in this situation.

In fact, where these sensors are in use for bitumen froth level sensing, the level is often controlled manually, with no closed-loop control at all. On top of that, the sensors also required significant investment in up-front hardware and ongoing maintenance, including calibration.

A New Approach

Honeywell developed an image processing-based software-hardware sensor system to measure bitumen levels in separation cells. The sensor used a video image of the bitumen/middlings interface combined with special software and processing algorithms. When compared to the usual conventional sensor plus manual operator control it replaced, the Honeywell sensor and closed-loop process control system delivered far more accurate level information. The sensor, in combination with process control algorithms, made tight level control achievable. Honeywell’s solution greatly reduced process variability with level control five times better than the conventional system. Also, pump speed change commands were one-fifth as dramatic.

Results

Because the level variability was much lower, the level could be pushed closer to its desired operating point, rather than keeping it at a much lower average level to avoid the peaks. Bitumen losses in tailings were reported by Suncor to have dropped by 53.6% along with a 39.12% drop in bitumen losses to middlings. This had strong economic benefits and reduced the environmental impact of bitumen losses to the tailings ponds.
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Benefits
A reliable method of level measurement is established by applying this innovative approach to the separation cell process. This leads to a better working set point, reducing the environmental impact while increasing the profitability of the business.

Additional benefits are observed:
- Accuracy: average difference between sensor measurement and visual reading was less than 5%, which is good for level control
- Reliability: the process was designed to handle challenging situations: unclear level image, temporary image loss, network failure, power failure or bad lighting condition, etc.
- Maintenance: very low maintenance costs and frequency of repair replacement
- Cost: more economical than other types of sensors on the market
- Nonintrusive: no direct contact of liquid measured, which reduces safety risks where the liquid is highly corrosive or requires a sterile, airproof or pressurized environment

Honeywell's solution can sustain these benefits over the long term and does not require routine, ongoing maintenance or calibration. Installing the system required no modification to existing sensors or controllers, and no disruption to current operations. Honeywell's level control solution can be fully commissioned and produce results within three weeks.