UPGRADED THICKENER OPTIMIZER BECOMES A DAILY TOOL AT BOLIDEN KEVITSA

ACT Thickener Optimizer controls key variables of Kevitsa thickening process and enhances overall thickener performance

The Kevitsa open-pit mine in northern Finland was acquired by Boliden in June 2016. The operation, which comprises a mine and a concentrator, went into operation in 2012. The Kevitsa deposit – first discovered in 1987 – is one of the largest ever mineral discoveries in Finland.

CHALLENGES

- Manual thickener operation due to problematic PI controller tuning
- Dissatisfactory underflow density
- Decreased filtration efficiency due to low underflow density
- Bursts of solid in thickener overflow cause disruption to floats

SOLUTION

- ACT Thickener Optimizer installed and commissioned on-site within 2 weeks

BENEFITS

- ACT Thickener Optimizer in automatic mode over 90% of time
- Underflow density variation reduced by 24%. Stable underflow density regardless of varying feed flow
- Underflow solids content increased by 3.5% w/w. Increased filtration efficiency
- Overflow turbidity was controlled under critical limit. 10% saving in polymer consumption

Background

The Kevitsa concentrator plant has significant variation in the feed ore grade and ore hardness, which results in a varying tonnage of nickel concentrate produced. This then results in varying feeds to the nickel concentrate thickener, making the thickener difficult to run.

Traditional PI controls at Kevitsa

Before the controller implementation project, the thickener had traditional PI control loops for bed pressure and underflow density. However, these controllers were very rarely used due to difficult controller tuning. According to site personnel, it was very challenging to tune the PI loops to achieve reactivity to production changes and long-term stability. The outcome was that most of the operators were running the thickener on manual, meaning that a lot of operator attention was needed when production conditions changed.

Traditional versus Advanced Control Tools (ACT)

Traditionally, thickener controls are implemented as single loop controllers in DCS/PLC systems. Single-loop PI controllers are not optimal for handling the behaviour of the thickening process. Slow response dynamics and cross-actions between the controlled variables make PI loops very challenging to tune, and compromises must be made between system robustness and the desired response speed.

The ACT Thickener Optimizer overcomes these limitations of traditional PI loops. The multivariable, model-based controller is fundamentally designed to handle processes with a multivariable nature and complex response dynamics. It also has the inbuilt ability to take into account the process constraints and support prioritization between controlled variables.

The Thickener Optimizer is built on the Outotec ACT platform. The controlled variables in the system are:

- Underflow density
- Overflow turbidity
- Thickener inventory level (bed pressure)

The controller manipulates the underflow pump speed and flocculant dosing rate. Information from the thickener feed line – the input flow rate and slurry density – can also be used as feed forward information when it is available. Rake torque is also taken into account so that control actions leading to critical rake loads are avoided.

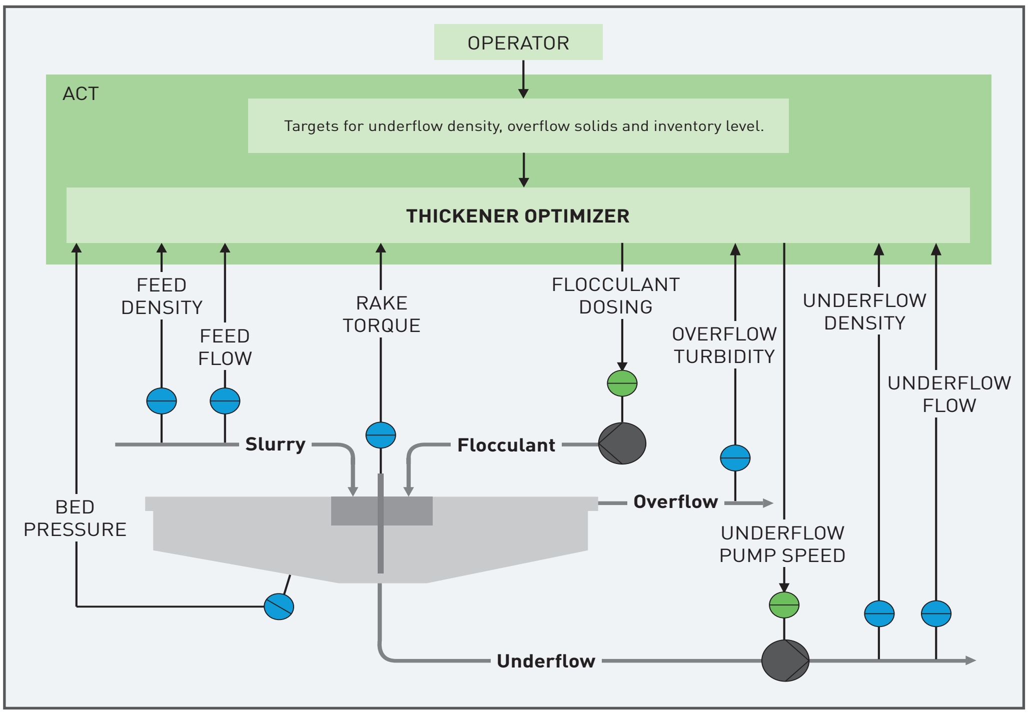
Challenges

The thickener at Kevitsa was unable to maintain the required bed pressure, resulting in lower underflow density. Often, the thickener tended to run too empty, with the consequence that underflow density was lost and re-circulation had to be turned on to increase the inventory level. Varying underflow density had a direct influence on concentrate filtration, because the decreased feed density decreased the filtration efficiency.

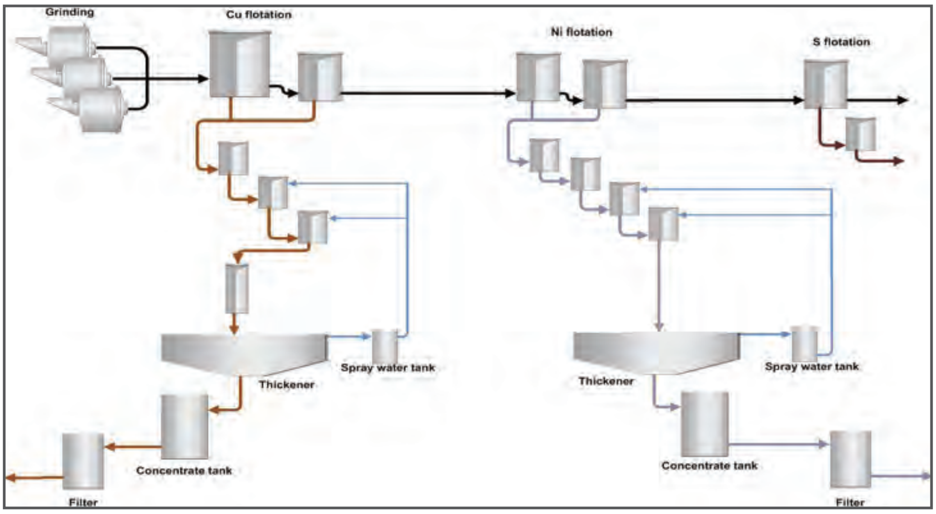
Another challenge of poor process controls emerged when more poorly-settling material came into the thickener. If the operator was unable to immediately react to the situation with a polymer dosage, the material did not settle properly, resulting in a burst of solids to the overflow. Because the overflow was re-circulated backwards in the process as flotation spray water, the flotation performance was also disrupted by the solids covered with polymers.

Implementation

When the thickener controller implementation project was started together with Outotec, the first actions concerned process instrumentation. A turbidity measurement was



ACT Thickener Optimizer - system structure.



Layout of the Boliden Kevitsa concentrator plant

installed into the overflow line to indicate the amount of solids in the overflow. In addition, a flow measurement was added to the incoming feed lines, so that better rejection of incoming disturbances could be achieved.

ACT Thickener Optimizer - installation

After an instrumentation review in 2014, the ACT Thickener Optimizer was installed and commissioned on-site.

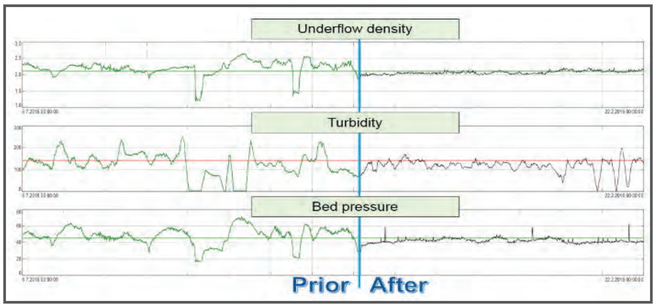
The complete commissioning, including hardware installation, DCS loop modifications, and controller commissioning was completed within 2 weeks. The controller was running more than 90% of the time immediately after commissioning, which was a dramatic change compared to the situation with the DCS controls.

Results post installation

After a period of fine-tuning, the controller performance was compared to the situation before the Thickener Optimizer. When similar operating points were compared, it was evident that a remarkable improvement in process performance had been achieved. All in all, the thickener optimizer was able to reduce the underflow density variation by 24%, allowing the system to run with 3.5% w/w higher solids content. Overflow turbidity was controlled so, that no major bursts of solids were caused to the circulating waters. Additionally, when the amount of solids in the overflow was below the set threshold, the controller decreased the polymer dosage, resulting in decrease of approximately 10% in average polymer consumption.

Conclusion

After one year of running, the experiences from the ACT Thickener Optimizer have been excellent. The application has been used continuously at an average usage rate of more than 90%. Feedback from the Kevitsa site personnel has been very good and the Thickener Optimizer has become a daily tool for operators, freeing up more of their time for more critical tasks. During the past years, the controller has required only minor software modifications. Naturally, in the long run, when process conditions are changed, some maintenance work will be required to keep the performance at the same level.



Thickening performance - manual control vs thickener optimizer

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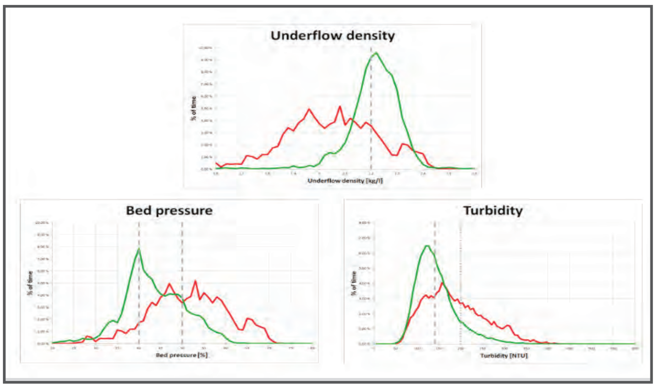

Relative distribution of underflow density, bed pressure and overflow turbidity - manual control (red curve) vs. thickener optimizer (green curve)

FOR FURTHER INFORMATION PLEASE CONTACT:
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