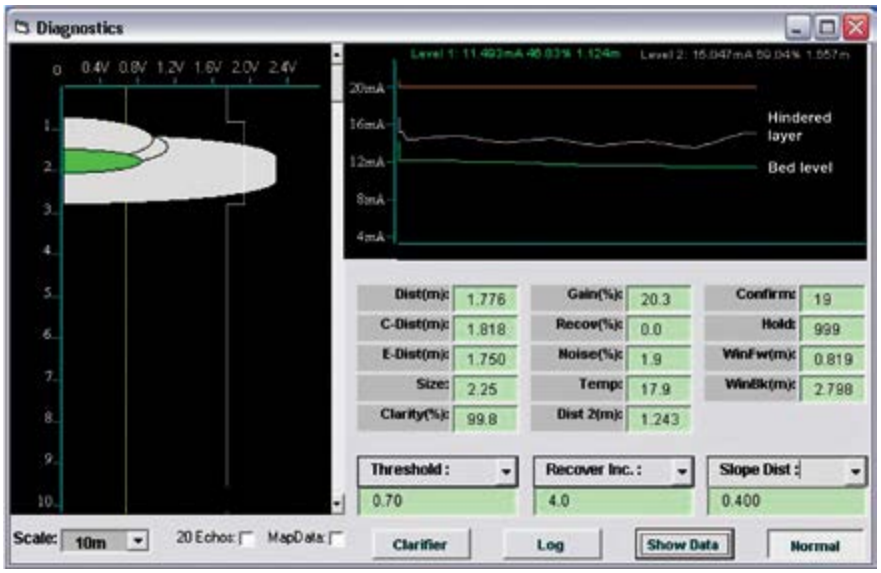
A PRECISE APPROACH

Jack Evans, Hawk Measurement (HAWK), USA, details technology advances to improve and optimise thickener performance.

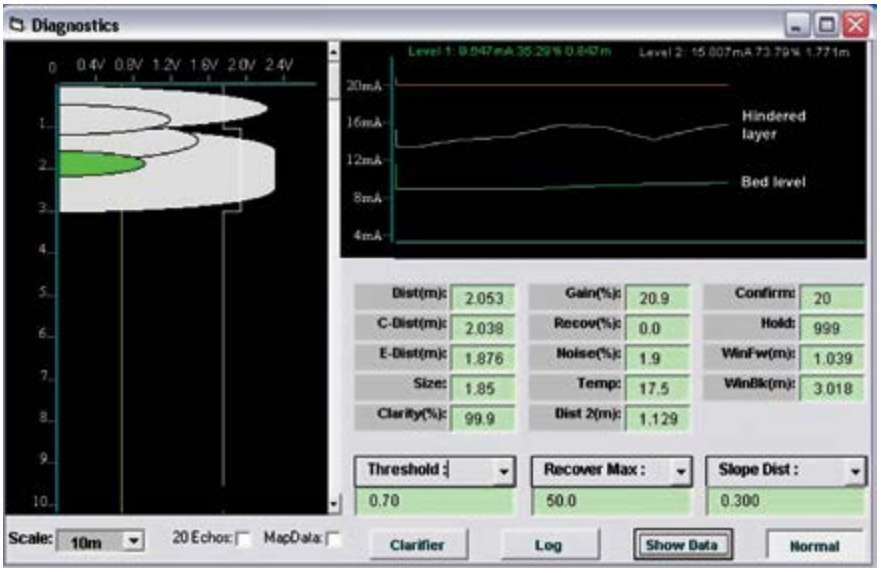
In many industries, there are situations where it is necessary to settle a solid material out of a slurry or mixed liquid. A sensor used in this situation has to be able to locate a level in the tank where there is a change in density - the difference between the dense, settled material at the bottom and the lighter liquid above it.

This can be especially challenging in the coal industry because the processed liquids can have a large percentage of heavy solids, include strong or corrosive chemicals, and require very high throughput. Various types of sensors have been tried in this demanding environment, but most have been inaccurate or unreliable.

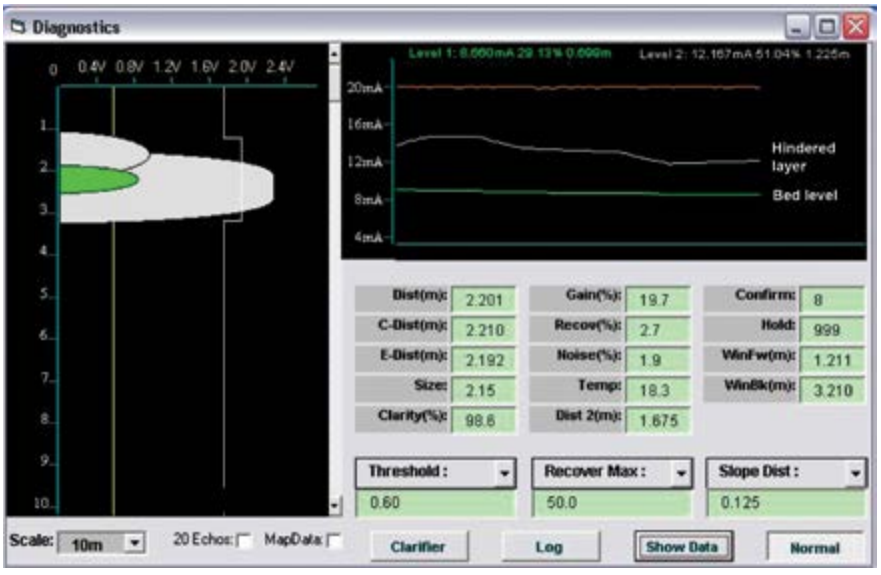
Optimised tailings thickener control



Typical settling characteristics in a thickener.



Poor settling, incorrectly dosed hindered layer.



Hindered layer recovers.

Most tailings thickeners are operated at less than their optimum design capability. Control room operators rely on torque rake characteristics to control the compact bed level. This level is generally lower in the thickener than the optimised level that will produce a higher density underflow. Flocculent overdosing and lack of automatic control dosing of coagulants are frequently seen at sites.

Most coal preparation plants at some time need to decrease production levels to allow time for the tailings thickener to gain stability and settle the suspended solids to improve the turbidity of the return water.

Process water is treated by removing suspended solids and then returning the water back to the concentrator or coal preparation plant. The solids are pumped to a tailings dam. Most tailings thickeners do not run efficiently due to a number of factors, such as:

1. Thickener does not have a reliable bed level interface transmitter that will work under all environmental conditions and is not affected by density change.
2. Thickener does not have a turbidity or suspended solids transmitter that will provide feedback to the control room operator on how the flocculent dosing system is working.

By not using a bed level transmitter that is not affected by density, tailings thickener bed levels are generally run too low in the cone of the thickener, reducing the underflow density that is pumped to the tailings dam and pumping too much water in the tailings.

The net effect is that the tailings dams will fill in volume faster with the additional cost of pumping the water back from the tailings dam to the concentrate or preparation plant. Most tailings thickeners use an automatic flocculent dosing system that takes samples of feedwell water and carries out an automatic jar settling test. This is important where multiple ore types are processed through the plant because each has different characteristics and settling rates. However the observers or clarometers that flocculate batch systems fail from time to time and the tailings thickener can change very quickly, not allowing the suspended solids to settle out.

The clarity output from a HAWK ORCA Sonar Transmitter can send this condition as an alarm to an operator in the control room. It can also be used in the control loop for the flocculent dosing system as a backup.

The use of a sonar bed level transmitter will allow the tailings thickener to be run automatically in conjunction with the underflow density transmitter and torque amps from the rake/scraper.

This will reduce costs in:

1. Flocculent dosing,
2. Return water pumping costs from the tailings dam,
3. Reduce tailings volume to the tailings dam, and
4. Increase the quality.

Using a HAWK ORCA Sonar transmitter to monitor the heavy compact bed level and the hindered interface layer provides on-line process feedback to the control room, programmable logic controller, etc, on how well the tailings thickener is operating. Information now available to process operators includes:

- Changes in coal type or ore type - affecting settling characteristics,
- Changes to inflow due to expansion at the site - affecting hydraulics of the thickener, and
- Changes in broad spectrum flocculent - affecting settling efficiency.

The HAWK ORCA Sonar transmitter provides valuable process feedback hours before a major problem occurs.

Improving the efficiency of the tailings thickener in coal prep plants

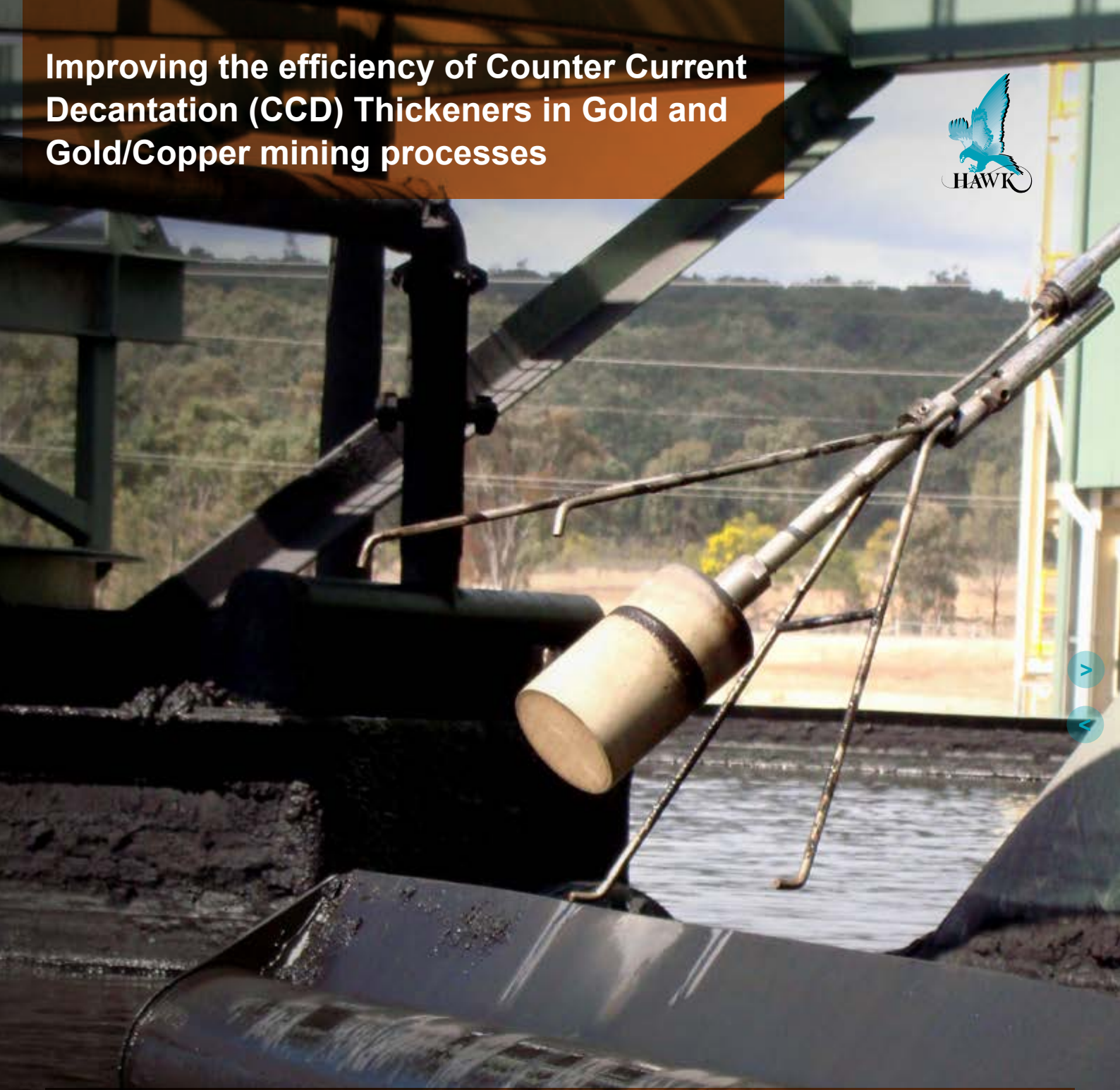
A customer had multiple coal types that were processed through the coal prep plant. Some of the coal types had different settling characteristics. This affected the tailings thickener efficiency and the clarometer instrument that tested settling rates in the incoming feed well failed from time to time, which meant that the flocculation rate changed and the suspended solids increased, decreasing the quality of the return water back to the prep plant.

HAWK supplied a high powered 150 kHz Sonar transducer with automatic scum cleaning impact plate.
The two outputs of the Sonar system provided:

1. *Bed level (heavy density compacted interface)*
   This heavier bed level output was used as one of the input loops to control the underflow pump, guaranteeing an optimized density outflow being pumped to the tailings dam.

2. *Hindered/fluffy layer (low density interface)*
   The hindered/fluffy layer output was used to monitor the deviation distance between it and the heavier compact bed level. As the deviation moved greater than a set distance, flocculent dosing increased. As the deviation decreased, flocculent dosing decreased. The high powered ORCA array transducer penetrated the suspended solids even under poor settling conditions. The hindered/fluffy layer output could also be used in the flocculent dosing control loop to automate this function if the clarometer failed.

Improving the efficiency of Counter Current Decantation (CCD) Thickeners in Gold and Gold/Copper mining processes



A customer at a large Gold/Copper mining company wanted to improve the automation control of its CCD circuit of five thickeners. The problem was inconsistency of the flocculent dosing chemical to the CCD circuit which was causing settling problems in each thickener. Problems increased as different ore bodies of the mine were processed because of their different settling chara cteristics.

HAWK first specified correct transducers to each thickener, based on the compacted bed level density.
HAWK then provided each Sonar transmitter with two analogue outputs so the customer could monitor:

1. Compacted bed level (high density interfaces)
2. Hindered/Mud layer (lower density interface)

HAWK's Sonar transmitter tracked the two density interfaces. If the trends from the two interfaces tracked parallel, the flocculent chemical dosing rate was correct. If the trends parted with the lighter hindered/mud layer moving upwards in the thickener and the heavier compacted bed level moving downward in the thickener, the system increased the flocculent chemical dosing rate until the output trends again ran parallel.

Overdosing flocculent chemical can also reduce the compacted bed level density, so a feed back control loop is required for automatic dosing control.

Automatic control for tailings thickeners

A major coal export mine wanted to automate its tailings thickeners to reduce operator influence in controlling the underflow pumps and chemical dosing.

The mine just installed and commissioned their ORCA Sonar bed level transmitter on their third tailings thickener. The ORCA Sonar transmitter provided control of the underflow pumps in conjunction with the underflow density transmitter. It also provided supplementary control for the clarometer flocculent dosing to provide overall improved utilization of the thickeners which has decreased downtime in the coal preparation plant due to high turbidity water.

Efficiency of the tailing thickener has improved due to feedback on settling characteristics from the ORCA Sonar transmitter.

Optimizing performance by monitoring dense bed level and providing information feedback to upstream process

A customer from the mining industry wanted to optimize its Concentrate Thickener on site.

They wanted to monitor the heavy dense bed level to further optimize the underflow density being pumped to concentrate filter presses. They also wanted to use the heavy dense bed level measurements for inventory control analysis, as well as improved information on the suspended solids levels in the recovered liquid flowing over the launders for upstream process feedback.

Concentrate thickeners generally use gravity (no chemical ‘floccing’) only to settle out the concentrate particles. Therefore a higher powered 150 kHz ORCA Sonar transducer use supplied to penetrate the suspended solids to monitor the heavy density bed level. This provided adequate control and monitoring for the underflow pump to guarantee a high density bed being pumped to the concentrate filter press.

By monitoring the heavy density bed, it allowed repeatable measurement for inventory analysis on a programmed basis. The second output of the ORCA Sonar transmitter can be used to monitor the turbidity of suspended solids between the heavy bed density and the launder level, giving the process engineers feedback to their upstream process conditions.

Normally, concentrate thickeners utilize a surface boom scum rake that rotates around the surface of the thickener to remove settled out scum/slag build up. HAWK utilizes an impact plate cleaning mechanism for the ORCA Sonar transducer to ride over the surface boom.

For nearly 30 years HAWK has developed a unique range of Slurry Level Technologies to solve the most difficult level applications for which competitors struggle to provide solutions. HAWK's technological advances in Sonar design provide much higher power on signal propagation through difficult air or liquid media. A blend of exceptional transducer design and advanced signal processing with automatic control allows HAWK to work on almost every level measurement application.

HAWK's ORCA Sonar transducers are designed to improve the sensing of levels in thickeners, settling tanks, and CCD's. The latest ORCA Sonar sensors offer big improvements in overall power, penetration, and calibration density range. The ORCA Sonar can be used in all applications from water clarifiers to mining thickeners.

Also, the HAWK ORCA transducer design produces a very narrow sonar beam and can operate at frequencies down to 150 kHz. This gives the ORCA transducer better penetration, higher sensitivity, and better overall performance. Since the HAWK ORCA Transmitter offers an accurate real time output, it can be used for process control, not just monitoring. This can result in significant savings in power usage or processing materials.