Automatic flocculant dosing control for mining thickeners and clarifiers

Including: Tailings thickeners, CCD's, paste thickeners, HI-rate thickeners, lamella thickeners, high compression thickeners, clarifiers etc. Flocculant dosing control for mining thickeners and clarifiers is influenced by a number of process factors.

1. Flow rate into the thickener or clarifier

a) As the flow rate increases into the thickener or clarifier "retention time" decreases which causes a greater affect hydraulically on the settling solids. So as the flow rate increases it will generally mean an increase in flocculant dosing rate.

b) As the flow rate decreases into the thickener or clarifier the retention time increases which reduces the hydraulic affect on settling, improving settling rates. This will generally mean that as the flow rate decreases, we will decrease the flocculant dose rate.

2. Density of solids in suspension in the incoming media

As the solids concentration density increases in the incoming media, the flocculant dose rate will increase proportionally to compensate for the change in suspended solids loading. The above "flow rate" and "density of suspended solids" are used as a general look up table in the PLC to provide a "base flocculant dose rate" to compensate for these changes. However, in mining many different ore bodies are mined and processed at one site and what must be understood, is that different ore bodies have different settling characteristics and therefore "flow rate" and "suspended solids loading" process variables, are not enough to control flocculant dosing. We must monitor insitu process conditions in the thickener and clarifier that are being affected by settling changes caused by different ore bodies and the hydraulic affect that results. We therefore utilise in addition the following control.

3. ORCA Sonar bed level transmitter that monitors 2 different densities in the process thickener or clarifier

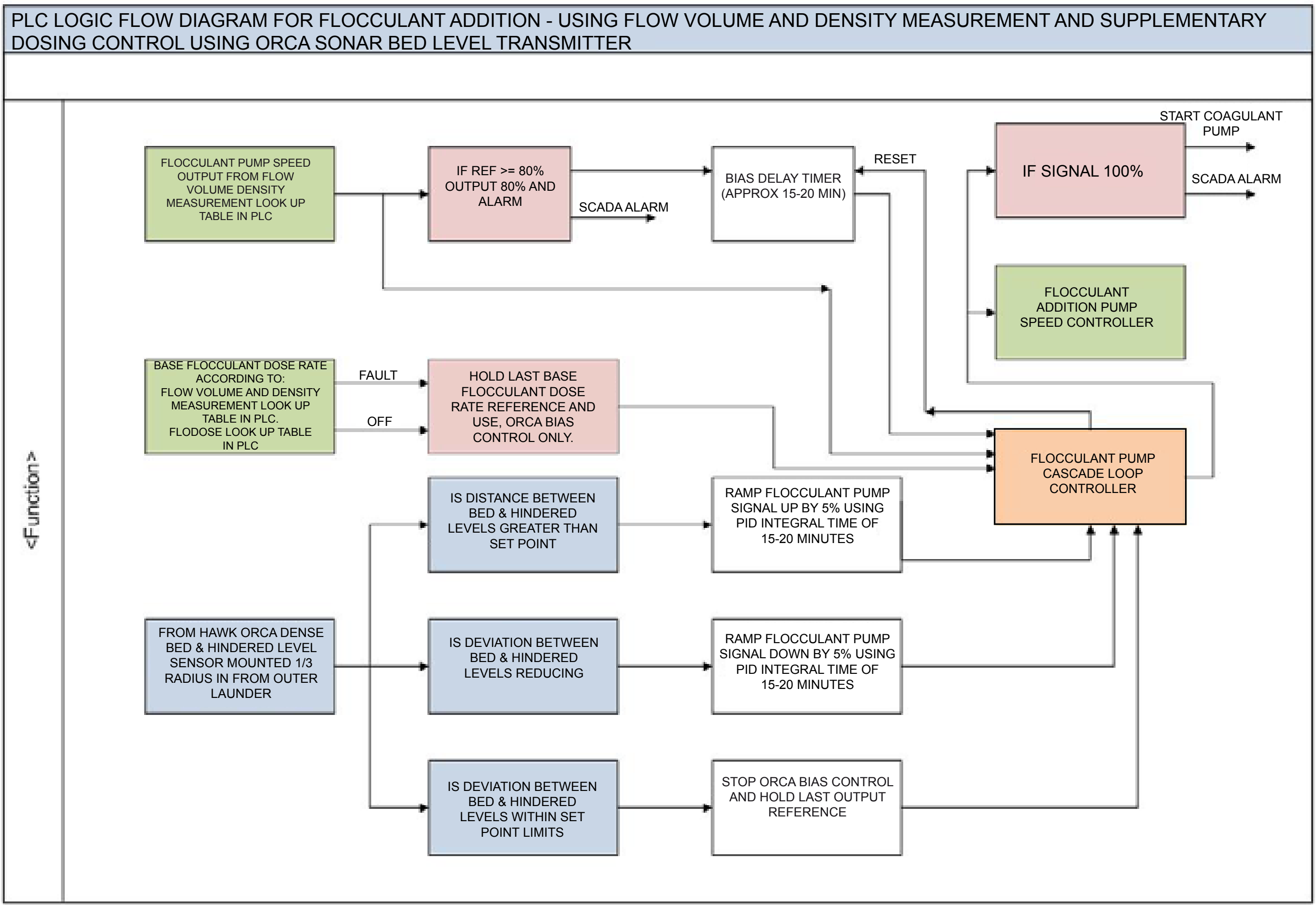
By monitoring the compact bed level (higher density) and the hindered/mud layer interface (lighter density) we are able to provide a supplementary dosing control to the "base flocculant rate" by monitoring the deviation distance between the two densities when they are affected by ore body changes, flow rate changes etc. This supplementary control will increase and decrease the "base flocculant dose rate" based on the process conditions seen in the thickener or clarifier.

A) Typical automatic flocculant dosing controls for mineral process thickeners and clarifiers using

1. Flow volume and density measurement of the incoming liquid media to process thickener or clarifier. This information is used to set up the "base" flocculant dose rate via a look table in the PLC.

2. Using the ORCA Sonar bed level transmitter as a supplementary control for the flocculant dosing pump to compensate for "real" process settling changes caused by different ore body settling characteristics as well as changes in flocculant/coagulant quality.

Example block diagram flocculant dosing control



Note:

1. If coagulant addition is utilized on site the same type of control philosophy can be used to automatically control the dosing of the coagulant addition rate for this settling agent.

2. Because coagulant is even more expensive than flocculant the logic diagram shows that coagulant addition is only called to start when the flocculant addition pump is running at 100% dosage rate and the hindered/interface layer is still rising in the thickener.

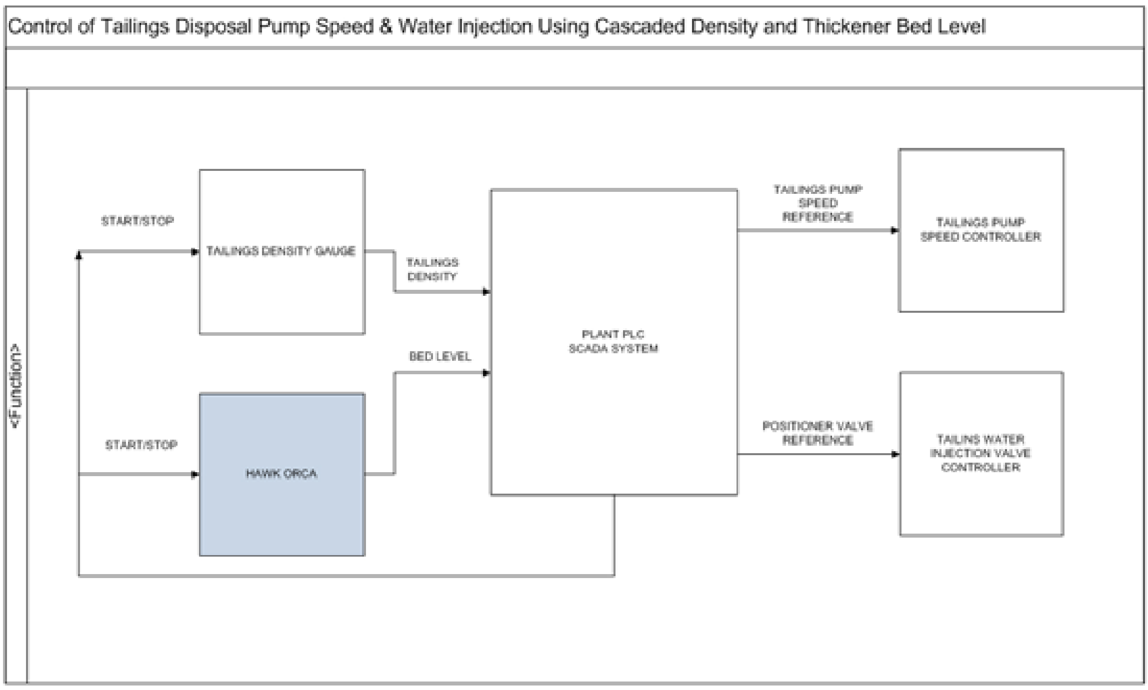
3. Some thickeners have turbidity transmitters located in or near the launder which could also be cascaded into the control loops above to further improve return water clarity.

4. Water pH transmitters to control acid/alkali addition to the thickener water feed outer launder will also help optimize and reduce the usage of flocculant.

B) Control of tailings disposal pump speed and water injection using cascaded density and thickener bed level.

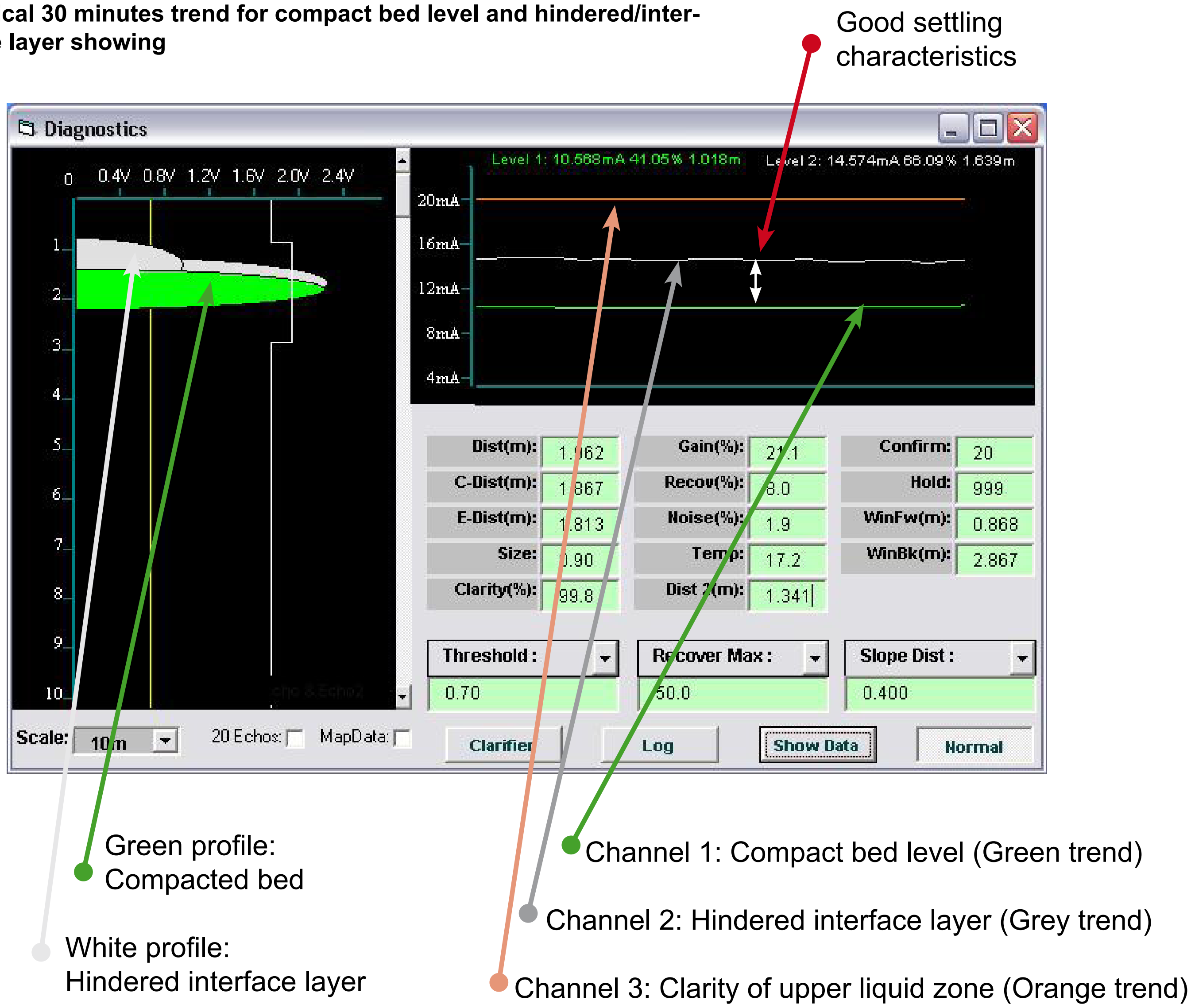
1. Analogue output 1, from the ORCA Sonar controlling the heavy density compact bed interface.
2. The compact bed level output is also used as the datum in conjunction with the hindered/interface layer for providing additional process feedback for controlling chemical dosing and alarms.

Example block diagram compact bed level control



Example: Thickener settling characteristics (Good settling)

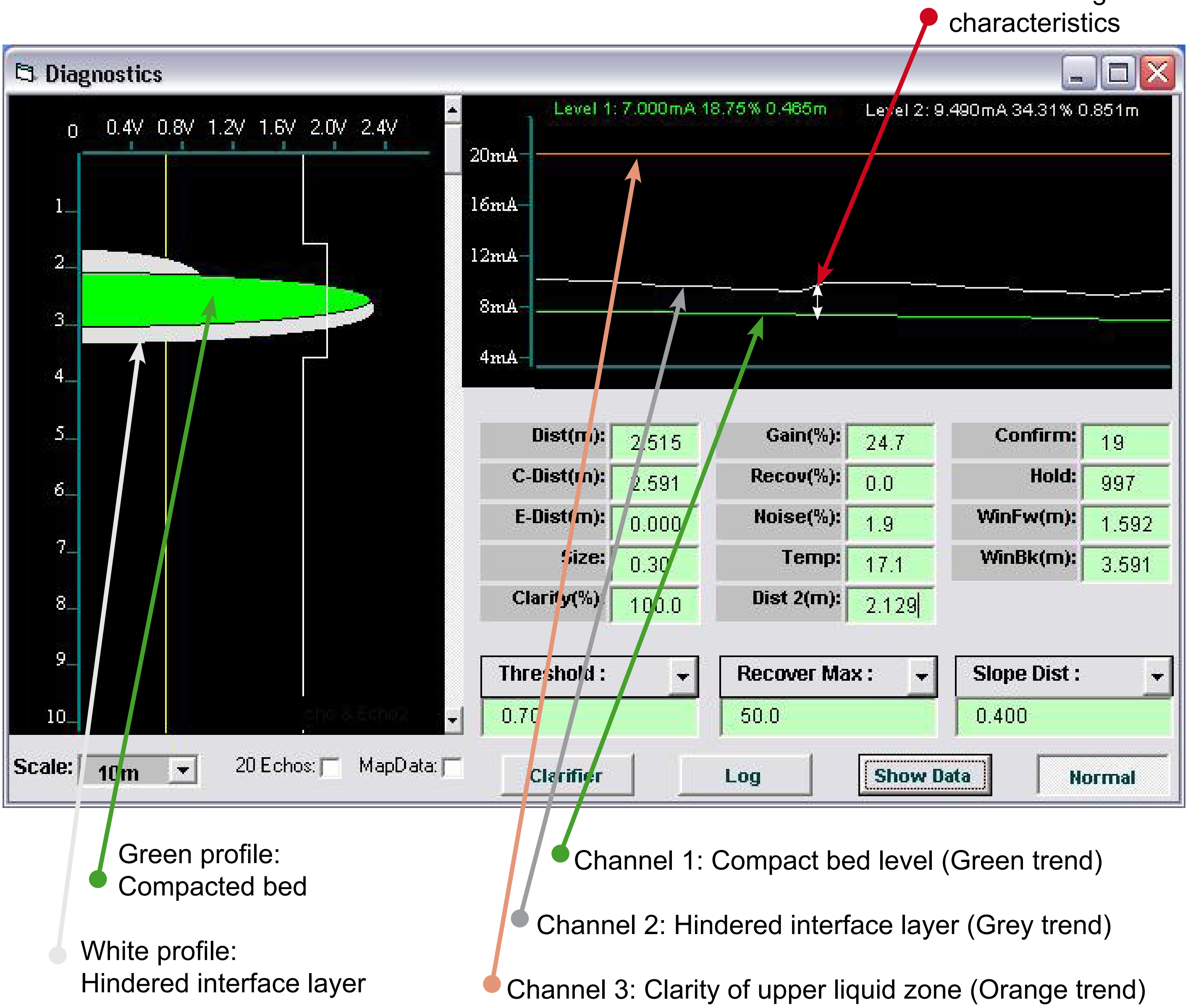
Typical 30 minutes trend for compact bed level and hindered/inter-face layer showing



1. Compact bed level, shows 1.018 m which shows a good level of bed guaranteeing an optimized underflow density.

2. Comparing the deviation distance between the compact bed (Green) and the hindered/interface layer (Grey trend) of 621 mm. This shows excellent settling conditions and a favourable flocculant dose rate.

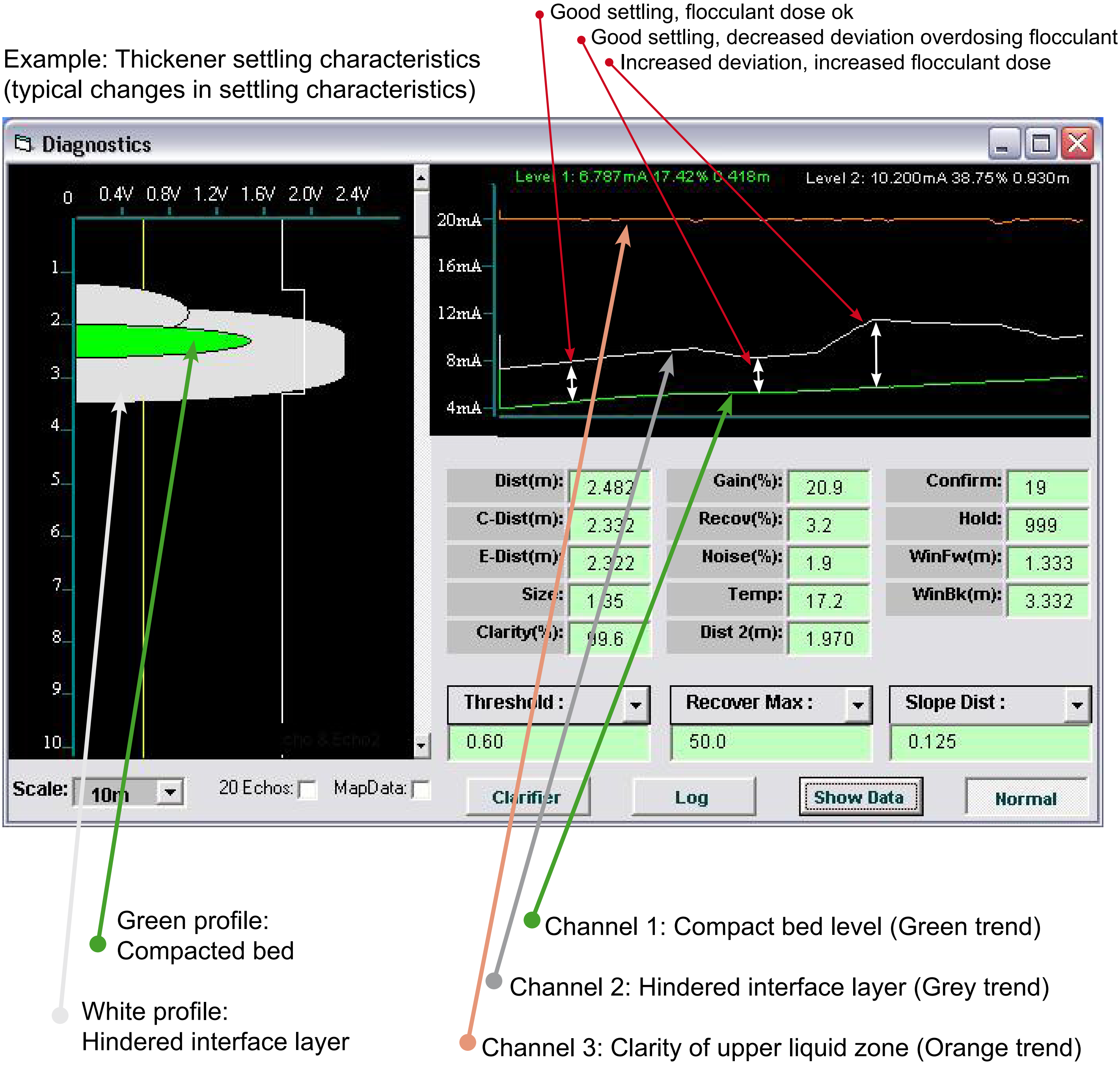
Example: Thickener settling characteristics (over flocculant dosing)



1. Compact bed level, shows 0.465 m which shows a good level of bed guaranteeing an optimized underflow density.

2. Comparing the deviation distance between the compact bed (Green) and the hindered/interface layer (Grey trend) of 386 mm. This shows excellent settling conditions but over flocculant dosing, increasing chemical costs and possibly affecting underflow density.

Example: Thickener settling characteristics
(typical changes in settling characteristics)

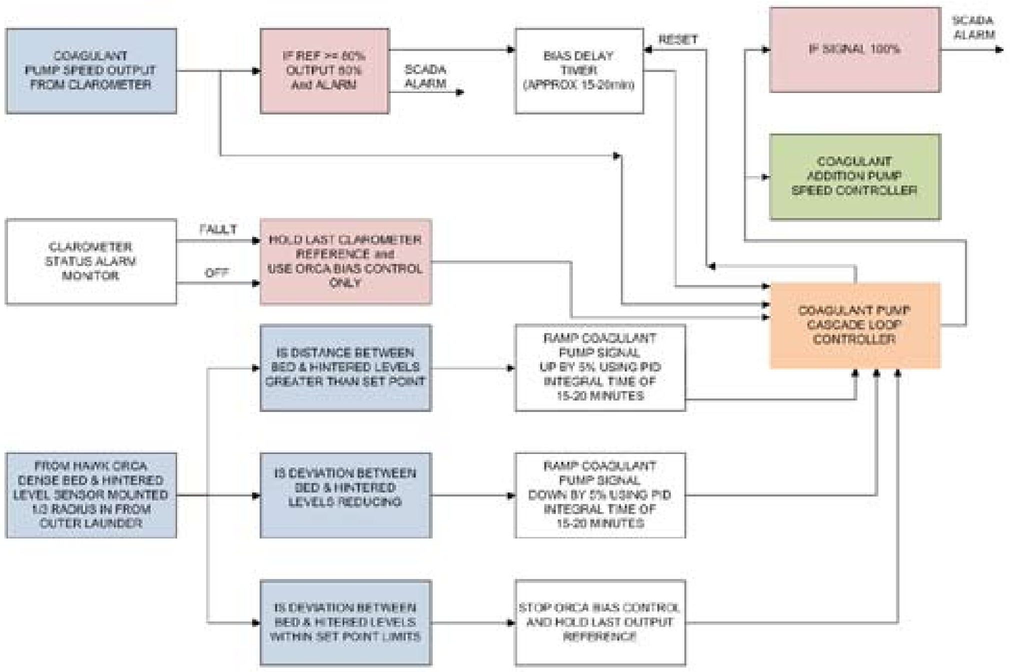


1. Compact bed level is building and 0.418 mm will guarantee a good optimized underflow density.

2. Comparing the deviation between the compact bed and the hindered/interface layer on this trend shows typical settling changes caused by different ore bodies, clay etc.

Automatic changes to the flocculant dosing, based on monitoring the evident deviation process changes, will produce the most optimized performance for the thickener.

Example block diagram coagulant dosing control



Note:

1. If coagulant addition is utilized on site the same type of control philosophy can be used to automatically control the dosing of the coagulant addition rate for this settling agent.

2. Because coagulant is even more expensive than flocculant the logic diagram shows that coagulant addition is only called to start when the flocculant addition pump is running at 100% dosage rate and the hindered/interface layer is still rising in the thickener.

3. Some thickeners have turbidity transmitters located in or near the launder which could also be cascaded into the control loops above to further improve return water clarity.

4. Water pH transmitters to control acid/alkali addition to the thickener water feed outer launder will also help optimize and reduce the usage of flocculant.

Tailings Thickener

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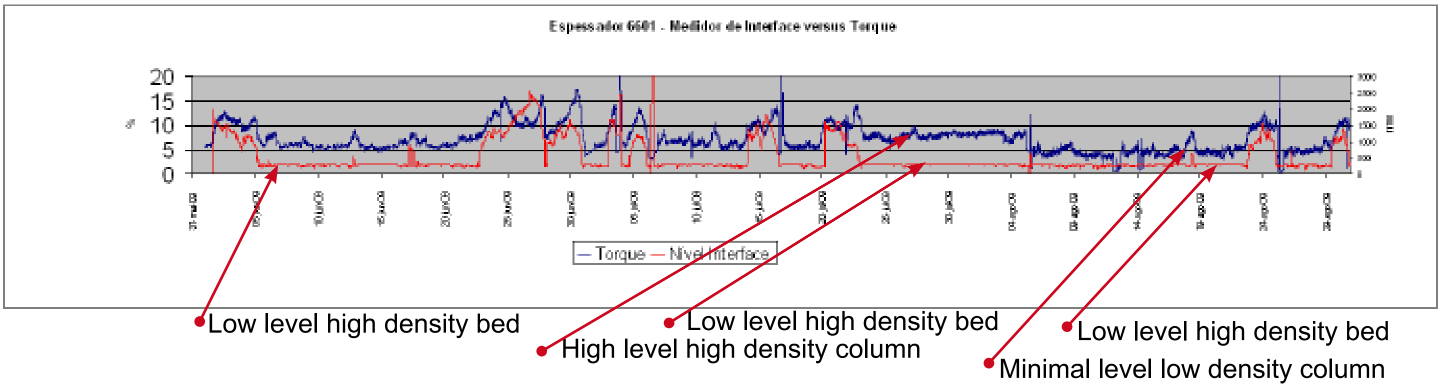
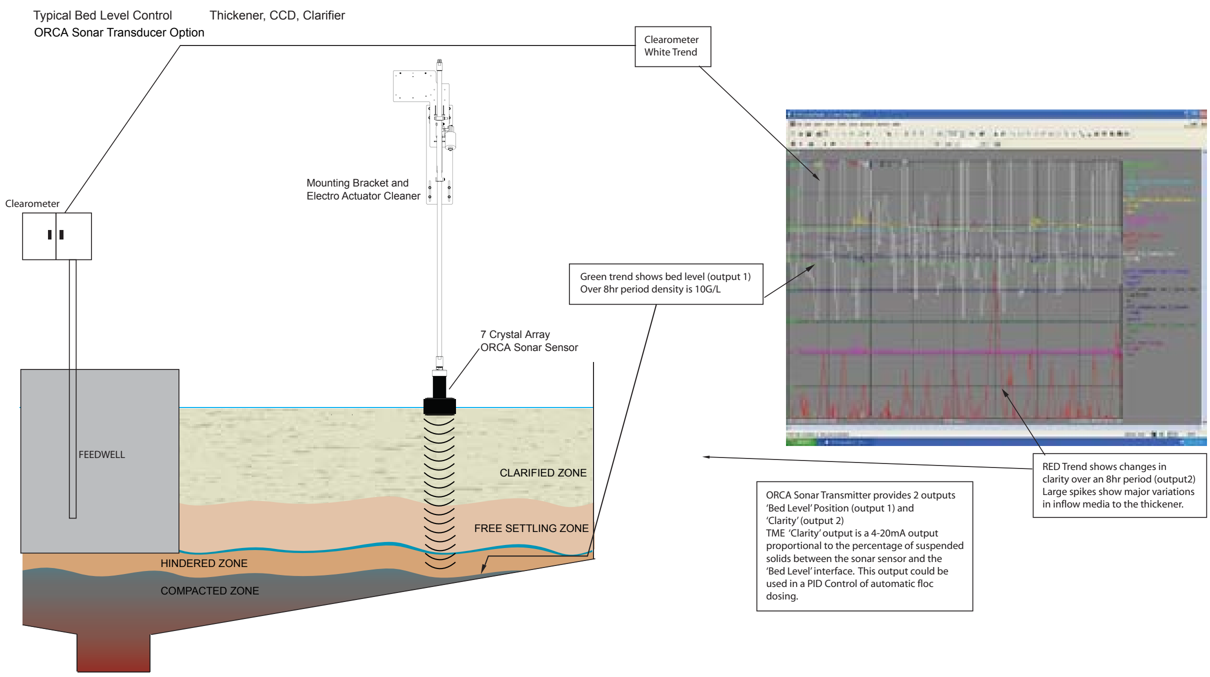
Comparing Sonar bed level to rake torque in thickener operation



- Rake torque measures the load factor on the scraper
- Rake torque load cannot distinguish between high density interfaces in the thickener.

Operators of thickeners have in the past used “Rake Torque” and “Bed Pressure” to determine what the pump rate for the underflow pump should be. Both rake torque and bed pressure are affected by density changes in the thickener interface column and therefore cannot be used in a closed loop control. Using the sonar bed level transmitter to control compact bed height allows for optimum underflow density to be pumped.

Mining Thickeners - choosing the correct transducer



Sonar transducer penetration capability depending on power level.

Single crystal: PN Clarifier, clarifiers, tailings dam
3 crystal array: Tailings thickeners, paste thickener, hi-rate thickener, CCD’s
7 crystal array: Concentrate thickeners, CCD’s

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