Sonar System for the Water Industry

HAWK

Sonar Bed Level System

Principle of Operations

The ORCA Sonar Series transducer emits a high powered acoustic pulse, which is reflected from the interface density selected. The reflected signal is processed using specially developed software algorithms, that eliminate lighter floating densities and stratified layers, allowing measurement of “RAS” or “BED” levels. It can be calibrated to measure lighter densities like “FLOC” or one of the outputs could be used for a “CLARITY” output, similar to a basic turbidity transmitter measuring solids in suspension.

By choosing the correct sonar transducer frequency, the Orca sonar guarantees the optimized performance when measuring both light and heavy density interfaces.

Benefits

- **Improved efficiency and control of the treatment process.**
- **Fully automate plant systems with reliable blanket level monitoring.**
- **Advanced warning of biological upset or hydraulic in-balance.**
- **Reduced maintenance with 5 year cleaning mechanism warranty (no blades to replace).**
- **Reduced site operational costs significantly with improved process control.**
- **Improved health and safety on site (no manual dips required)**

Features

- Dual independent analogue outputs to track two different densities simultaneously with one transducer.
- Full range of transducers to optimize detection of heavy and light density interfaces.
- Simple and easy calibration to track specific densities.
- Four simultaneous outputs for RAS level, FLOC level, Clarity (suspended solids) and Temperature with COMMS option.
- Industrial scum cleaning mechanism’s that do not require maintenance. No wiper blade assemblies to wear and change.
- Radio link option for off bridge transmission of data.
- ATEX Hazardous area options for enclosed vessels.
- 500 metre separation possible between transducer and ORCA transmitter.
- HawkLink, Modbus, Profibus DP/PA, Foundation Fieldbus, DeviceNet, HART COMMS capability.
- Multiple outputs with 3 Relays for alarm and control output plus indication of cleaner operation.
- GSM module enables remote diagnostic support from Hawk service engineer.

Primary/Secondary

In the water, waste water industry process conditions will vary greatly between a primary sedimentation tank, secondary / final clarifier and a gravity thickener. Thickener bed levels, secondary RAS blanket, flocculent blanket etc, all have different densities and the water above these interface levels are subject to different process conditions that change. To optimize performance in each interface application under all process environments we choose a particular sonar frequency and power level from the 15 different frequency and power levels, in the ORCA Sonar transducer range.

To optimize performance under all process environments in each interface application we choose one transducer with a frequency and power level that is applicable to the density of the interface and process conditions expected in the tank. By selecting the correct sonar transducer, we can guarantee performance for controlling pumps etc, rather than for monitoring purposes only. Each ORCA Sonar transducer is capable of providing two independent functions simultaneously. the design of single crystal transducer's (low power) and multiple array crystal transducers
(high powered) are used where there are major differences in suspended solids densities.

The single crystal transducer (low power) is used where the density of the interface is relatively low and relatively low suspended solids, eg (secondary clarifier). The array multiple crystal transducer (high power) is used where the density of the bed is high and where there is relatively high suspended solids (thickeners).

Thickener Tanks

As thickeners are generally used after primary or secondary settlement the product density measured is in the range of 6000-8000 mg/ltr. Hawk's range of low frequency multi-array transducers allow penetration through a high concentration of suspended solids and can therefore be used to optimise the density of sludge which is pumped back to the filter presses or digesters. The second output from the ORCA Sonar can also be used for an indication of water clarity (suspended solids) or to track the hindered layer to provide either a pre-warning of process problems or to activate automatic dosing operations. The unique cleaning mechanism using the 'shear' action principle prevents build up of scums and debris on the transducer face to maintain optimum performance.

Sequential Batch Reactor SBR

SBR's are typically installed where site space is of a premium and they combine the primary sedimation tank, the aeration process and final /secondary settlement all in the same tank. By nature of their operation the physical levels in the tank change and a traditional 'fixed' device cannot cater for all level variations. Hawk offer a unique solution for this type of application in the fact that the sonar transducer actually floats on the surface enabling it to track the settling blanket as decant levels change. This enables the process to work far more efficiently as the settling times can be monitored with greater accuracy and improved batch sequence times can be achieved. Improving batch sequence times can result in improving the SBR capacity by figures as high as 10 to 20%.

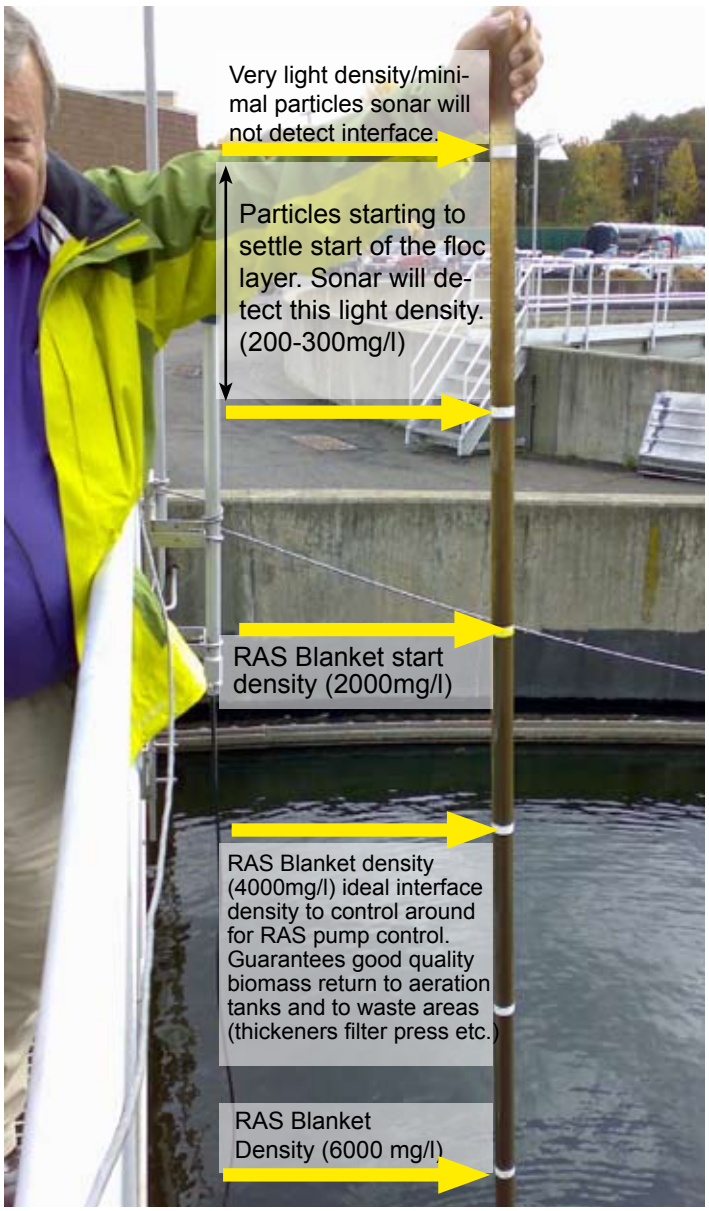
Benefits

Understanding the Benefits

Most traditional sludge blanket detectors, based on the Sonar principal when measuring a secondary tank, will monitor a density range around 1200 to 1500 mg/l. This is because many are unable to penetrate through the suspended solids which increase deeper into the column.

Hawk's instrument has a wide range of different frequency transducers with differing power levels and is capable of measuring through the suspended solids to reach the bottom of a secondary clarifier and monitor any density in between. Hawk's ORCA Sonar is unique in the fact it is capable of tracking two different densities within the same column. Therefore monitoring both the RAS layer at around 3,000 to 4,000 mg/ltr and the FLOC layer at around 1,000 mg/ltr. Under stable conditions both these layers will normally track each other with around 1000 mm separation(see Fig 2).

The diagram opposite shows a typical application in a secondary settlement tank and what a typical 'sludge judge' dip sample would display. The sludge within the tank decreases in density as you move from the bottom of the tank towards the top water level. The most dense sludge sits at the bottom of the tank and is around 6,000 mg/ltr plus. In a stable tank the sludge will gradually decrease in density to around 200 mg/l at the top of the column (often referred to as the column). Generally treatment works are interested in 'quality' sludge which has a density greater than 2,500 mg/ltr. This sludge at the bottom of the tank is referred to as RAS (Returned Activated Sludge). Sludge at this density is heavy enough not to move hydraulically up the tank when process problems occur and is also dense enough to be termed 'good quality' biomass which is used again in the aeration lanes for pre-treatment purposes. Any sludge lighter than around 2,000 mg/ltr can be referred to as FLOC or FLUFF. At the top of the FLOC layer is the water/sludge interface (see below point A).

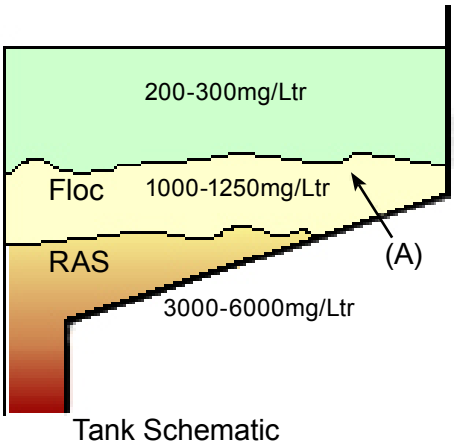


Why ORCA Sonar monitor's 3000-4000mg/ltr ?

Fig 1 Displays a cross section of a typical settlement tank with average density layers.

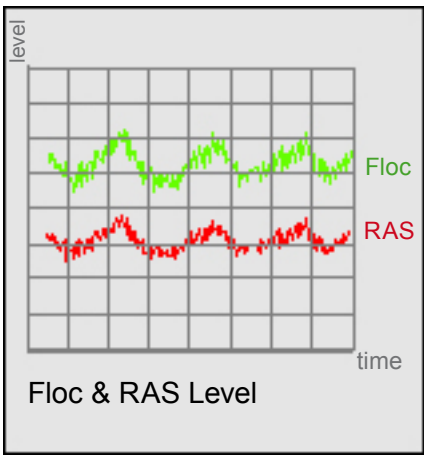
Fig 2 Displays the cyclic output for various peak and off peak times of the FLOC and RAS level

Fig 3 Displays an example of the outputs from two independent sonars. One 650-750khz and one ORCA Sonar 150khz High powered device.



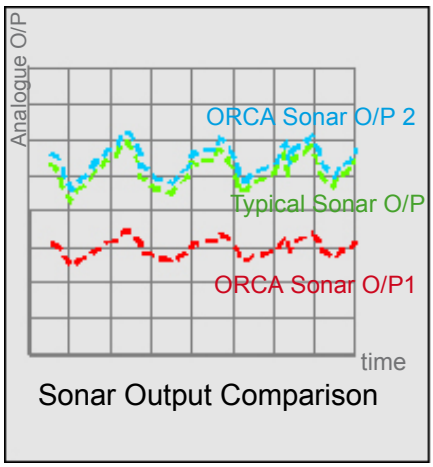
Tank Schematic

(Fig 1)



Floc & RAS Level

(Fig 2)

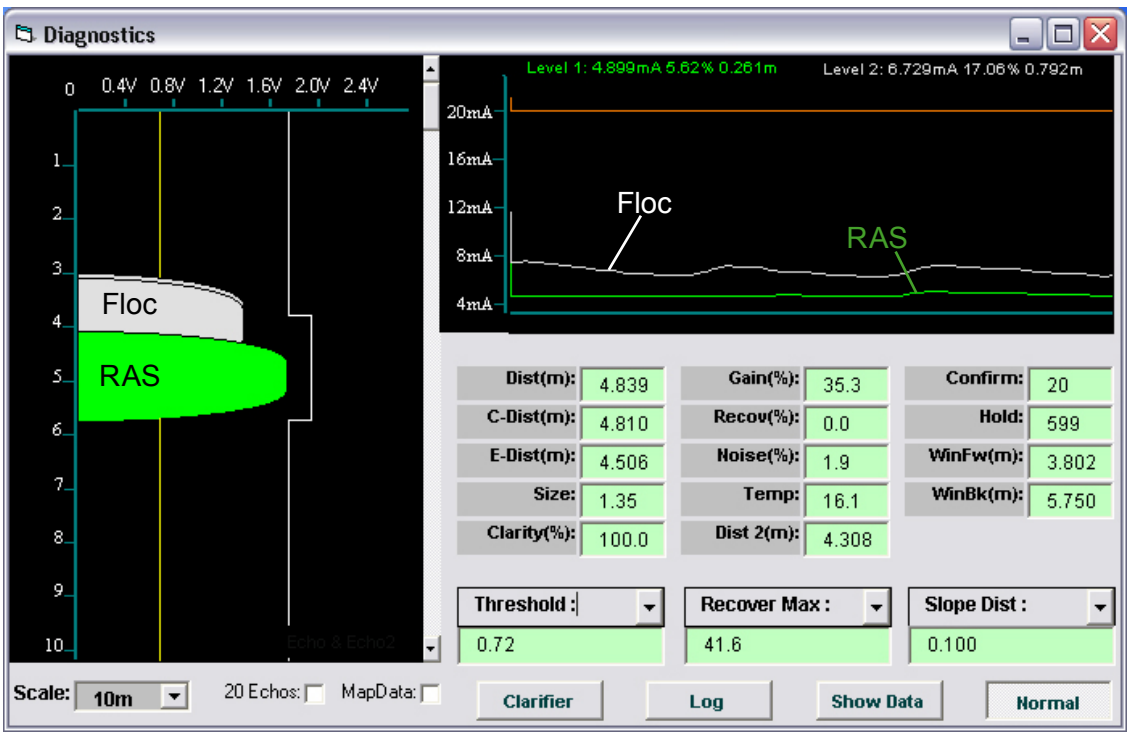


Sonar Output Comparison

(Fig 3)

Above 3000-4000mg/ltr density the RAS contains 'good quality' biomass. It is essential to monitor this density as a basis to control the RAS pumps or the Bell-mouth which will ensure that the plant is always returning 'good quality' biomass back to the aeration lanes and a consistent density sludge back to filter presses and thickeners. This can improve the efficiency of the aeration process and reduce mechanical wear on filter/ belt presses both of which are a significant cost in the running of a plant.

As the majority of traditional sludge blanket systems cannot penetrate through the suspended solids they tend to track the lighter FLOC layer. If the tank is stable this can provide a good indication of the RAS layer as the FLOC will usually track around 1000 mm above the RAS layer. However, under a biological or hydraulic upset the lighter FLOC may rise up the tank away from the RAS!

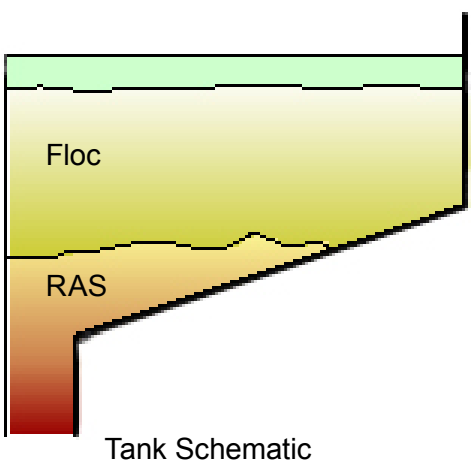


Typical trends for 2 hours period

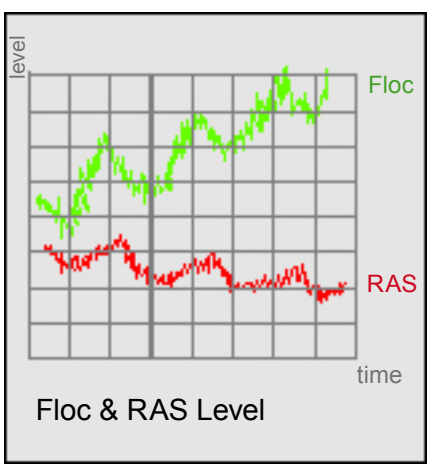
Why is ORCA Sonar Different?

The diagrams below show a common scenario during a hydraulic or biological upset within a secondary clarifier. The denser RAS has stayed at the bottom of the tank whereas the lighter FLOC has ‘lifted’ and separated away from the RAS trend. Traditional sludge blanket systems would indicate a rise in ‘blanket’ level (see fig 6 typical sonar output in green)and an operator could interpret this as a rising blanket and would automatically either ‘drop’ the Bell-mouth or increase the RAS pump to try and counteract this. However, what is really happening is the lighter FLOC has moved up the tank but the denser, more stable, RAS, containing the ‘Good Quality’ biomass, has remained at the bottom of the tank. By increasing the RAS pumps or ‘dropping’ the Bell-mouth the operator is only exaggerating the problem as eventually all the ‘Good Quality’ biomass will be pumped away and less dense, ‘low quality’ biomass will be returned to the aeration lanes which in turn could affect the dissolved oxygen (DO) levels and could contribute further problems to the process!

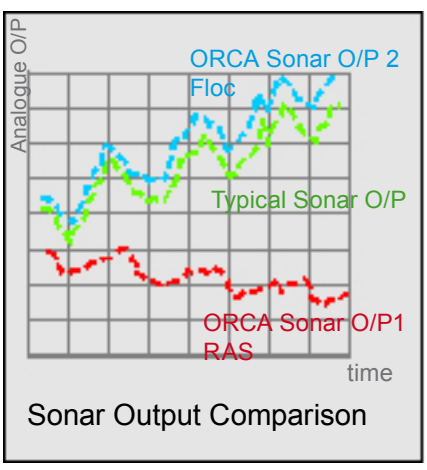
By monitoring both the RAS and the FLOC layers (see Fig 5 & 6) Hawk’s Orca Sonar can provide unique process data allowing the PLC to be programmed to track both densities and continually monitor the difference between them. Should the FLOC begin to ‘lift’ away from the RAS (see fig 5) alarms can be set to indicate a process problem is due to occur, action can then be taken much quicker to avoid a total upset and the plant can then even be run automatically.



Tank Schematic
(Fig 4)



Floc & RAS Level
(Fig 5)



Sonar Output Comparison
(Fig 6)

Scum Cleaner

Maintenance Free Scum Cleaner - 5 Years Warranty

For any Sonar system to perform well it needs to have a cleaning system to ensure that the face of the transducer is kept free from scum build-up, algae and air bubbles. All of these issues can cause an attenuation of sound resulting in loss of signal. Hawk utilise a 'water shear' action to perform this process. The transducer is pushed through the water by an electric actuator and then returned to its start position. This movement causes a 'shear' action across the face of the transducer removing any scum build-up, algae or air bubbles.

The frequency of actuation is set on a time basis via the keypad or is triggered automatically when the unit senses a reduction in signal strength. Hawk also offer ATEX (Ex) and fixed bridge options. The actuator has a five year warranty and does not require any parts to be replaced during this period unlike traditional wiper systems which must be removed from the process, cleaned, wiper blade replaced and then refitted.

1. Static condition

2. Shear clean action

3. Clean return action

Contact

Hawk Measurement Systems (Head Office)
15-17 Maurice Court
Nunawading VIC 3131
Australia
Phone: +61 3 9873 4750
Fax: +61 3 9873 4538
info@hawk.com.au

Hawk Measurement
7 River Street
Middleton, MA 01949
USA
Phone: +1 888 HAWKLEVEL (1-888-429-5538)
Phone: +1 978 304 3000
Fax: +1 978 304 1462
info@hawkmeasure.com

Represented by:

Global representatives on www.hawkmeasure.com

Rev 1.0, Maj 2009