



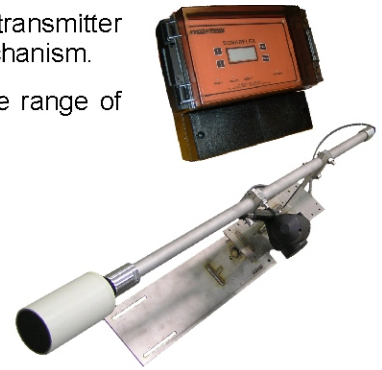
SONAR
ULTRASONIC INTERFACE
MEASUREMENT

SLUDGE BLANKET LEVEL & INTERFACE MONITORING

The Sonarflex Sonar, sludge blanket and interface controller is a microprocessor based transmitter combined with a high power multi frequency sonar transducer and an automatic cleaning mechanism.

Sonarflex is used to monitor and control the blanket level in settlement tanks for a wide range of industries on applications including:-

- Primary Sedimentation - Sludge blanket levels
- Secondary and Final Clarifiers - RAS blanket / FLOC level / Clarity
- Sludge Thickeners - Settling blanket level / Clarity suspended solids
- DAF Tanks - Settling blanket level / Floating bed level
- Sequential Batch Reactors (SBR) - Settling blanket level / RAS blanket
- Lammella clarifiers- Settling blanket level / Clarity suspended solids
- Counter current decantation (CCD) tanks - Blanket level / FLOC / Clarity
- Mining and Process settling ponds, lagoons, tailings dams, carbon columns



PRINCIPLE OF OPERATION



The Sonarflex transducer initiates a high powered acoustic pulse through the water (liquid) towards the blanket/interface at the bottom of the tank. The pulse is then reflected off the RAS or BED layer (blanket/interface) back to the Sonar Transducer, and is then processed by the transmitter. The specialist software then provides data relating to the RAS level, FLOC/FLUFF level, temperature in the tank and a basic guide to clarity if required.

Dual analogue outputs and COMMS based outputs are available to track both the RAS and FLOC layers simultaneously. This feature helps to identify other stratified interfaces or the FLUFF/FLOC layer (where such an interface moves independently of the sludge blanket/bed level and needs to be monitored to prevent overflow into the launders).

The Sonarflex processing software monitors the operating efficiency of the sonar transducer. As the efficiency drops off, due to build-up of scum, air bubbles, scaling, or fats, etc., on the transducer face, the automatic cleaning mechanism operates and restores the sonar transducer to its optimum efficiency.

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 mechanisms 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 transmitter.
- VISION system II, 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 Hycontrol service engineer.



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).**
- **REDUCE SITE OPERATIONAL COSTS SIGNIFICANTLY WITH IMPROVED PROCESS CONTROL.**
- **IMPROVED HEALTH AND SAFETY ON SITE (NO MANUAL DIPS REQUIRED)**

APPLICATIONS - PRIMARY / SECONDARY

In the water and 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 Hycontrol 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 Hycontrol transducer is capable of measuring two independent densities simultaneously.

The single crystal transducer (low power) is for use where the density of the interface is relatively low in suspended solids, for example in a Secondary Clarifier. The multiple crystal array transducer (high power) is designed for use on applications where the density of the bed is high in suspended solids. Typical applications with this characteristic are 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. Hycontrol 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.

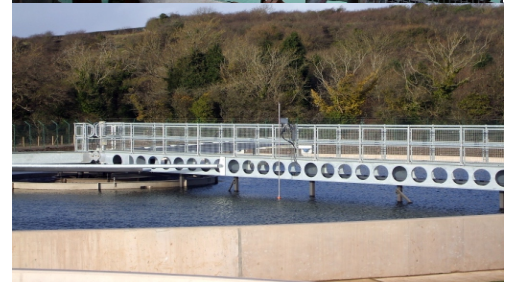


The second output from the Sonarflex can also be used for an indication of water clarity (suspended solids) or to track the hindered layer to provide either a pre-warning of process problems or to activate automatic dosing operations. The unique cleaning mechanism using the 'shear' action principle prevents build-up of scums and debris on the transducer face to maintain optimum performance.

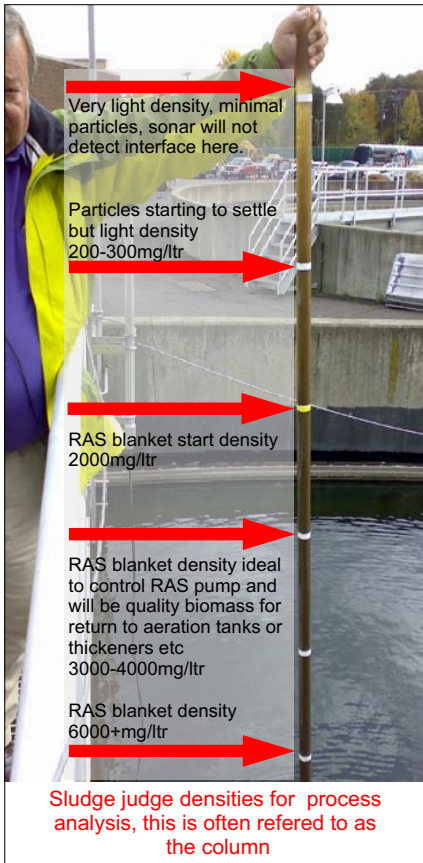
SEQUENTIAL BATCH REACTOR (SBR)



SBRs are typically installed where site space is at a premium and combines the primary sedimentation tank, the aeration process and the final (secondary) settlement all in the same tank. By the nature of their operation the physical levels in the tank change and a traditional 'fixed' device cannot cater for all level variations. Hycontrol 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 as much as 10 to 20%.



UNDERSTANDING THE BENEFITS



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

Hycontrol'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. Hycontrol's Sonarflex is unique in the fact it is capable of tracking two different densities within the same column, **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 1500 mm separation (see Fig 2).

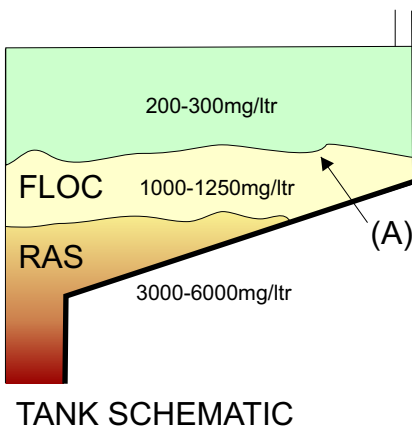
The diagram opposite shows a typical application in a secondary settlement tank and what a typical 'sludge judge' dip sample would display. The sludge within the tank decreases in density as you move from the bottom of the tank towards the top water level. The most dense sludge sits at the bottom of 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. 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 HYCONTROL MONITOR 3000-4000mg/ltr

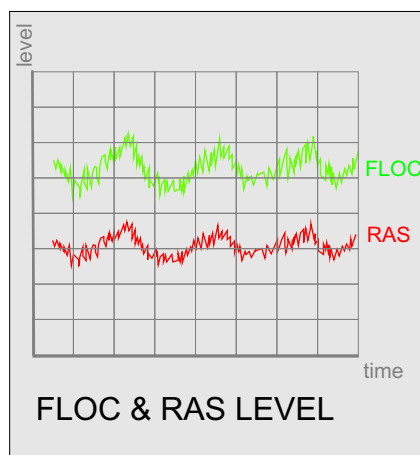
Fig 1 Displays a cross section of a typical settlement tank with average density layers.

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

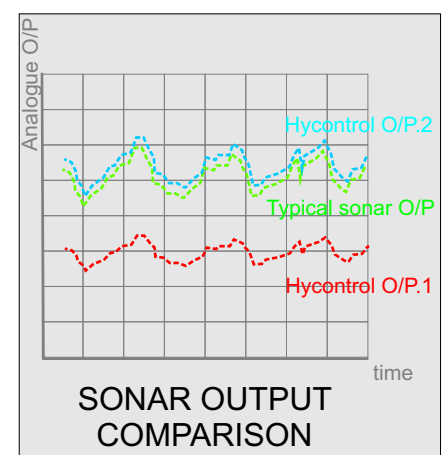
Fig 3 Displays an example of the outputs from two independent sonars, one 650-750khz and one Hycontrol 150khz high power device.



(Fig 1)



(Fig 2)



(Fig 3)

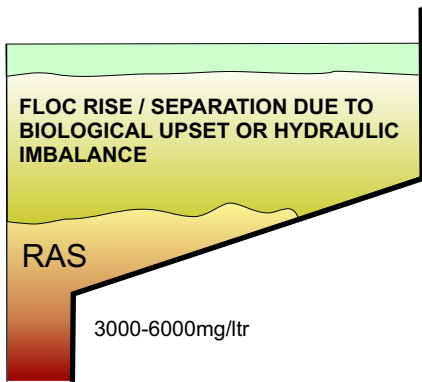
Above 3000-4000mg/ltr density the RAS contains 'good quality' biomass. It is essential to monitor this density as a basis to control the RAS pumps or the bell-mouth which will ensure that the plant is always returning 'good quality' biomass back to the aeration lanes and a consistent density sludge back 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 1500 mm

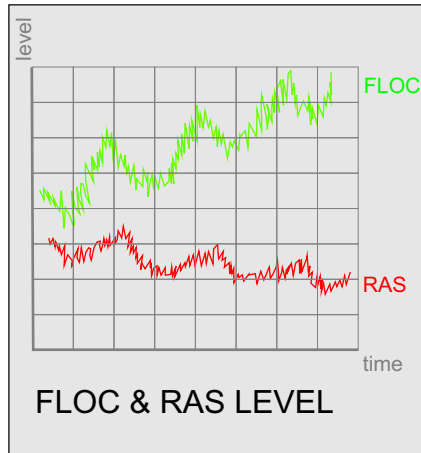
WHY IS HYCONTROL SONAR DIFFERENT?

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 from the RAS trend (see Fig 4). Traditional sludge blanket systems would indicate a rise in 'blanket' level (see Fig 6 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, in reality 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!

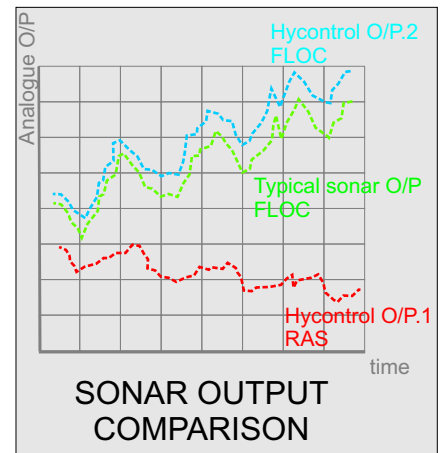
By monitoring both the RAS and the FLOC layers (see Fig 5 & 6) Hycontrol's Sonarflex can provide unique process data allowing the PLC to be programmed to track both densities and continually monitor the difference between them. Should the FLOC begin to 'lift' away from the RAS (see fig 5) alarms can be set to indicate that 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



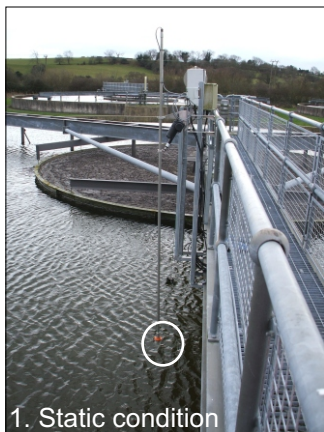
(Fig 5)



(Fig 6)

MAINTENANCE FREE SCUM CLEANERS - 5 YEAR 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 these issues can cause an attenuation of sound resulting in loss of signal; Hycontrol 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. Hycontrol also offer ATEX and fixed bridge options.

The actuator has a five year warranty and should 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.

SUSPENDED SOLIDS PENETRATION

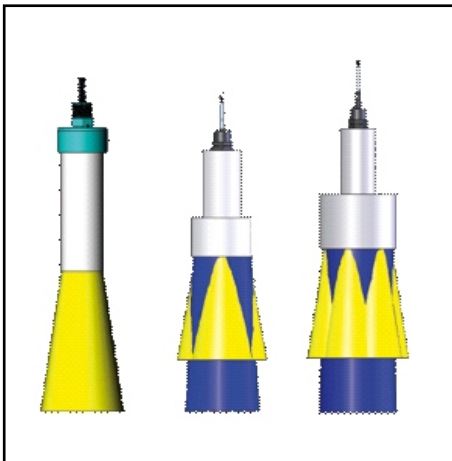
As with the water and waste water industries the choice of sonar transducer is equally important in the mining and minerals industries. These transducers differ slightly in their ability to penetrate through higher concentrations of suspended solids to give a reliable measurement of the heavier density BED level.

Whilst measuring the compacted BED level in paste thickeners, tailings thickeners, concentrate thickeners, CCD's, Lamella thickeners and Hi-rate thickeners, the environmental process conditions can vary considerably. Suspended solid concentrations between the launder and the BED level can change rapidly due to changes in ore types and their individual settling characteristics.

High frequency single crystal transducers will not penetrate high suspended solids in the thickener during these unsettled conditions. Therefore to achieve the necessary penetration both the frequency of the transducer and mechanical design (multiple crystals in array patterns) must be optimised to "increase penetration power" and decrease "beam spread" by reducing the beam angle of the sonar transducer.



TRANSDUCER DESIGN AND OPTIMISATION



The power of the sonar transducer is directly related to the operating frequency (wave length). Lower frequencies have more power but increase the beam spread and hence increase the beam angle. Penetration is improved by reducing the beam angle but this requires a larger transducer diaphragm but due to engineering and economic restrictions it is not feasible to produce ceramic crystals and transducers with large diameters especially in relatively small quantities.

Hycontrol overcome this by using multiple crystals in an array pattern to duplicate a large diameter transducer characteristic. The combination of these modifications result in the beam spread decreasing from 15° - 20° down to 6° degrees and 3° degrees depending on the array configuration and frequency of the transducers.

The Sonarflex transducer range has 15 different sonar transducers including 10 array transducers. Power increases of 300% to 600% over the standard sonar transducer range are typical.

IMPROVED CAPABILITY FOR THICKENERS



The multiple crystal array sonar transducer will allow the following improved capability in Thickeners and CCD's when monitoring BED level.

- 1. GREATER PENETRATION THROUGH THE CLARIFIER LEVEL.**
- 2. GREATER PENETRATION THROUGH THE FREE SETTLING ZONE.**
- 3. PENETRATION INTO THE HINDERED SETTLING ZONE**
- 4. SIMULTANEOUS MONITORING OF THE COMPACTED ZONE UTILISING SECOND OUTPUT OR COMM'S OPTIONS**

BED LEVEL, HINDERED LAYER & CLARITY (suspended solids)

The multiple crystal array technology ensures that each transducer can perform in the harshest conditions where the ore types and therefore settling characteristics and densities can continually vary. The multi crystal smart transducers have 2 analogue outputs and 4 outputs when using Bus communication protocols.

Output 1 can be used for tracking the COMPACTED BED LAYER allowing optimisation of the process by providing feedback of its position within the thickener to ensure a consistent density from the underflow pumps.

Output 2 can be used to track the HINDERED LAYER (the lighter layer which forms above the compacted layer) to provide process information warning of a degradation in settlement due to changes in ore types or flow volumes.

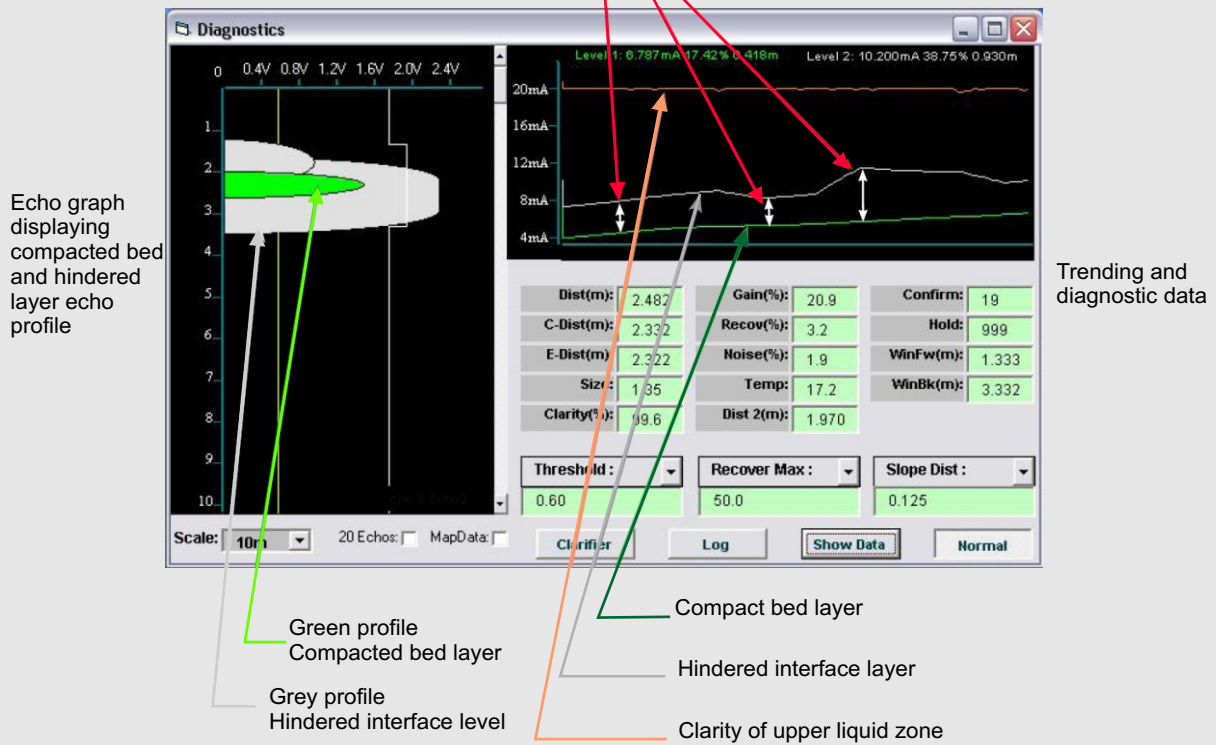
Alternatively Output 2 can be used to track CLARITY; providing an output of the concentration of suspended solids between the transducer face and the COMPACTED BED and therefore an indication of settlement conditions within the thickener. Both the HINDERED LAYER output and the CLARITY output can be used to control dosing as either a rise of the HINDERED LAYER away from the COMPACTED BED or a decrease in CLARITY (increase in suspended solids) can be an indication of poor settlement.

EXAMPLE BELOW DISPLAYS THICKENER SETTling

Good settling, flocculant dosing correct

Good settling, decreased deviation, reduce dosing

Increased deviation results in increased flocculant



OPTIMISED CONDITIONS RESULTS IN EFFICIENCY SAVINGS

When using one of the BUS communication protocols (Profibus PA or DP, Foundation Fieldbus etc) all three outputs can be obtained (see above screenshot).

1. The compacted BED level is building and 0.418 mm will guarantee a good optimised underflow density.
2. Comparing the deviation between the COMPACTED BED LAYER and the HINDERED LAYER on the trend shows typical settling changes caused by differing ore bodies.
3. Automatic changes to the flocculent dosing based on monitoring the evident deviation will produce the most optimised performance for the thickener.

Due to technology restraints this data has previously been unavailable but the development of the multi-array crystal transducers along with intelligent software algorithms have now made it possible. Sonarflex can now continually monitor all three parameters forming a detailed picture of the conditions below the top water level within the thickener. This information gives vital process feedback to operators allowing them to ensure a consistent density of material to the underflow pumps, immediately monitor the effects of any dosing and monitor settling conditions. The three outputs can even be linked into the PID loop as part of the control philosophy for the underflow pumps and the dosing system ensuring the site is utilising all available data to run the site at its most efficient.

SPECIFICATION DETAILS

Sonarflex Transmitter

Measurement Range

Minimum Density Range

Accuracy

Temperature

Display

Echo Processing

Outputs

- 0 to 60 metres
- <100mg/l
- $\pm 0.25\%$ of span
- -20°C to 70°C
- 2 x 8 digit LCD display.
- Advanced Hycontrol Algorithms
- 2 x Analog 4-20mA (Isolated) max. 750 ohms
- Relays: 3 x SPDT 0.5Amp
- Power driver for Auto scum cleaner
- Vision system II, HART, Modbus, Profibus DP, DeviceNet, Foundation Fieldbus & Profibus PA
- Multidrop mode can address 1-250 units over 4 wire
- Full operational diagnostics display
- IP65
- Reduced blanking distances
- Sun hood
- 90 - 260Vac 50/60Hz, 24Vdc
- <18VA @ 240Vac, peak power 180VA during actuator operation
- <12VA @ 115Vac, peak power 170VA during actuator operation
- <3W @ 24Vdc, peak power of 130W during actuator operation

Diagnostics

Protection

Option

Operating Voltage

Power Consumption

Sonarflex Transducer

Transducer Selection

- HYC002 – 150kHz
 - HYC003 – 300kHz
 - HYC004 – 450kHz
 - HYC005 – 700kHz
 - HYC007 – 30kHz
- Please consult Hycontrol for correct transducer selection.

- IP68 (Fully encapsulated)
- 150mm (5.9") minimum
- Internal max. 70°C Standard
- High temperature 150°C (option)
- Polypropylene, Fiberglass, PVDF (Kynar), Teflon and PVC
- G1 (BSPP)
- Belden 3084A
- 3.5kg (7.7lb)
- ATEX Cat.1 (Intrinsically Safe consult factory)

Sealing

Special Blanking

Temperature Sensor

Housing

Mounting

Cable

Weight

Approvals

Auto Scum Cleaner

Construction

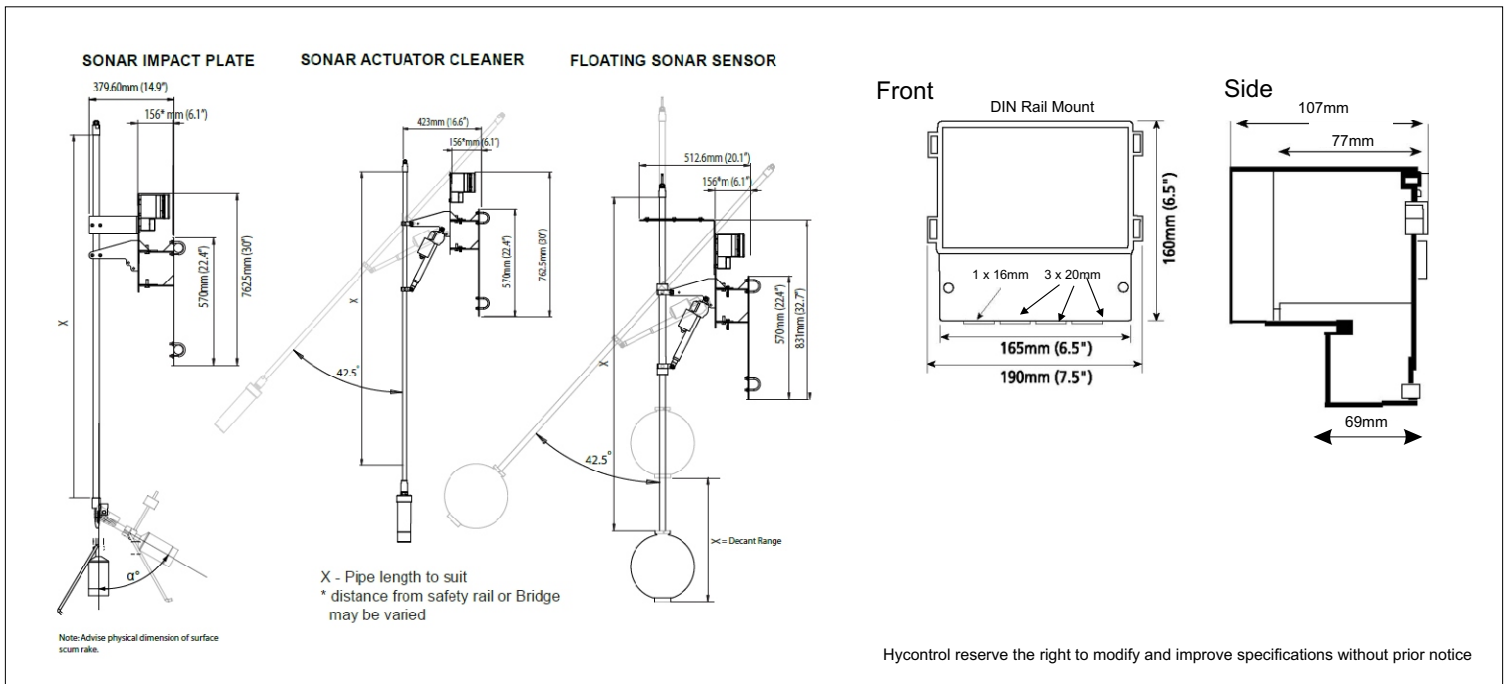
Mounting

Actuator

Weight

- Stainless Steel
- Base mount x 4 holes. (See drawing)
- Electric 24Vdc (NON ATEX)
- Pneumatic (ATEX option)
- Impact Plate
- 5Kg (11lb)

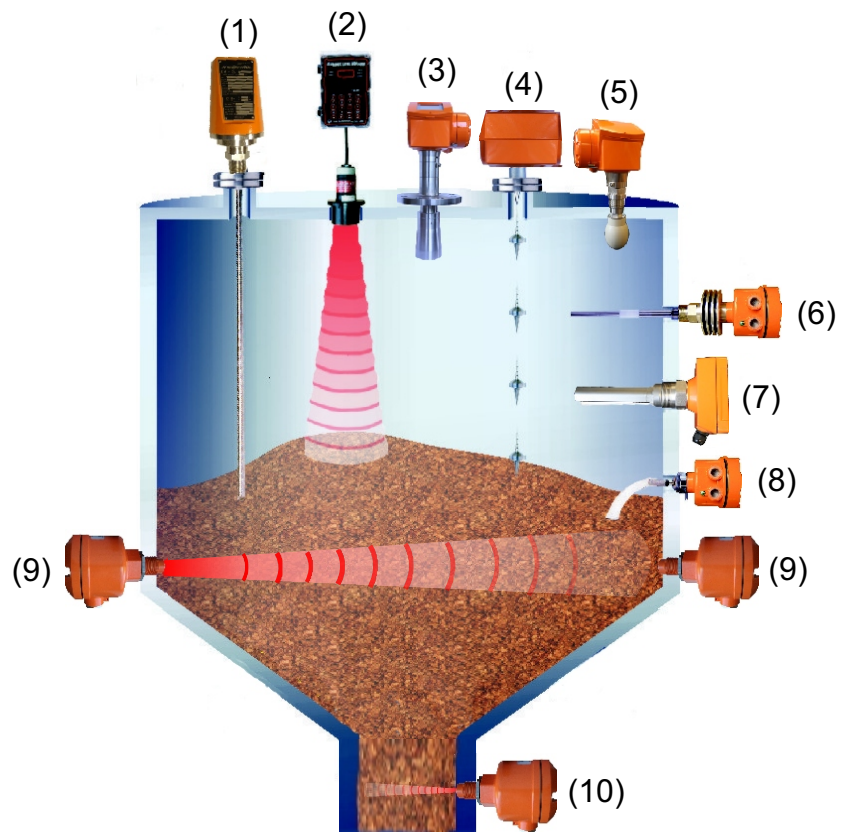
DIMENSIONS



HYCONTROL LEVEL TECHNOLOGIES

Product Range For Solids :-

- (1) TDR Radar For Solids
- (2) Ultrasonic, 'Through Air'
- (2) 2 Wire Ultrasonic Transmitter
- (3) FMCW 2 Wire Radar
- (4) Continuous 'Servo' Level Indicator
- (5) FMCW 2 Wire Radar
- (6) Capacitance Level Switch
- (7) Vibrating Probe Level Switch
- (8) Rotating Paddle Level switch
- (9) Microwave Level Switch
- (10) Doppler Flow Switch



Product Range For Liquids :-

- (1) By-Pass Level Indicator With Radar
- (2) TDR Radar For Liquids
- (3) 2 Wire Ultrasonic Transmitter
- (4) FMCW 'Horn' Radar 2 Wire
- (5) Magnetic Float Switches
- (6) FMCW 2 Wire Radar
- (7) Capacitance Level Switch
- (8) RF Admittance Level Switch
- (9) Side Mounting 316 SS Float Switch
- (10) Tuning Fork Level Switch
- (11) Tuning Fork Level Switch
- (12) Ultrasonics 'Through Wall'
- (13) Mini Magnetic Float Level Switch

