CASE HISTORY
COMPLETE ON-LINE AUTOMATIC CONTROL OF Thickener CIRCUIT at Charbon Washery.

E.N. Tanos
CHEMTRACK Specialty Engineering (Formerly Of Nalco Chemical)

1) In August 1996 a Markland (Direct Reading) 502 Suspended Solids meter was purchased and commissioned at Charbon's Coal Preparation Plant, on a Hi-Rate Thickener. As a result of this installation, Thickener performance and control has improved dramatically, As a result of this installation and by continuously and reliably measuring **thickener feed solids Loading** and using it as the basis for feedforward floc control ; Sufficient information on the thickener operation was made available to firstly dose the correct amount of flocculent under all conditions, and secondly utilize the full capacity of the Thickener by reducing the Flocculant consumption by more than 40% over a six month period as compared with the previous three years consumption , reducing both chemical and handling costs proportionally. The problem of overdosing, resulting in the recycling of flocculant in clarified water with its deleterious effects on magnetite consumption , has been eliminated..

With feed back from the Markland 602 Sludge Blanket Controller enabled, further savings are envisaged.

2)When calibrated, Markland's 502 meters read mg/L or %SS by weight. The attenuation of the liquid vehicle (water) over the fixed length probe gap is the same .

Particles in suspension in the sound path attenuate the sonic beam in three ways:
1. Particle ROTATION.
2. Particle VIBRATION.
3. Sound beam DEFLECTION.
1&2 above remove energy from the beam, and 3 is a simple barrier deflecting the beam off to the side so that it does not reach the receiving transducer; With larger size particles will increase the energy absorbed (1&2) or deflected (3);

WE ARE MEASURING WEIGHT . AND SINCE FEWER LARGER PARTICLES ARE REQUIRED TO GET THE SAME WEIGHT, THE 502 READS FAIRLY ACCURATELY AS PARTICLE SIZE CHANGES IF THE PARTICLE SIZE DOES NOT CHANGE DRASTICALLY.

The calibration procedure can be carried out initially or on an as-required basis. However since the time required to calibrate is only 10 minutes, monthly calibration is recommended. (OR WITH CHANGING SEEMS).

The calibration procedure is:

i) Ensure that the thickener is performing satisfactorily at one instant of time. For example, vary the flocculant dose rate so as to achieve the desired settling velocity.

ii) Record the flocculant pump speed, and the % SS reading on the meter.

The flocculant solution pump is controlled by a 4-20 mA signal. Consequently it is necessary to calibrate the flocculant pump for l/m delivered Vs pump speed or mA.

If poor control were to occur , then this would suggest some sudden change due to such (or other) variations. This could be easily overcome by a recalibration of the system.

4- Feed-back Control :.

Markland 602 Sludge blanket level controller improves measurement accuracy and cuts costs and is already proving to be a significant advancment by accurately and reliably measuring slimes and bedlevel. Used for feedback control it can further fine-tune thickener performance. The # 602 relies on beam blockage in the gap)

Benefits of the system:

The **Markland 502** (High solids probes) can read high feed solids more than 10% without dilution , this would support insertion into the slurry line and it is a tremendous advantage in set-up, reliability and cost. Priced at $8,900.00 for the 502 - TP.
Since there are no moving parts , maintenance problems and costs are low, The system can be integrated within customer site-software to ensure that:

i) flocculant usage is optimized

ii) Thickener operating objectives are constantly achieved e.g. Rake torque, bed level and overflow clarity.

iii) Down time due to rake torque problems is eliminated.

iv) Satisfactory overflow clarity is achieved, which optimizes the performance of other process units e.g. magnetite recovery and flotation performance.

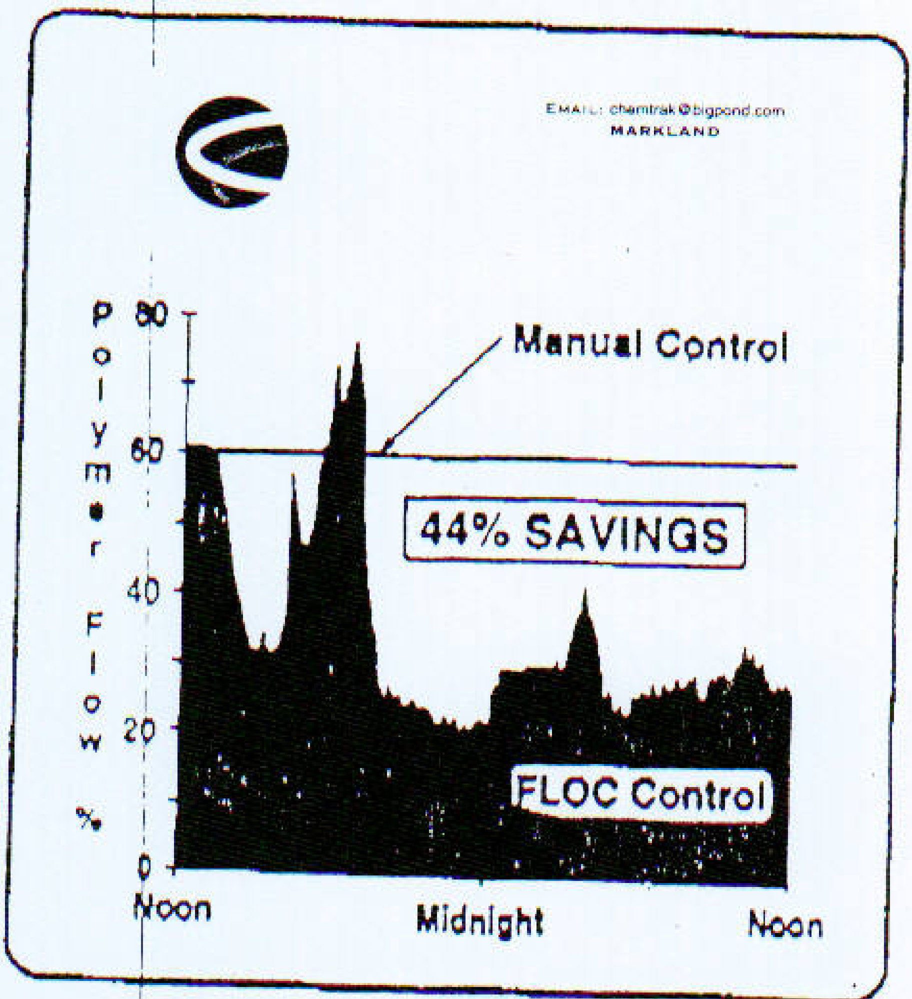
v) Operator involvement is minimized, which provided time for operators to optimize the performance of other unit processes.

The reduction in plant down-time can easily have significant cost benefits. For example, increase plant availability of 10 hours per annum for a plant producing 1000 t/h as a value of $50/tonne results in increased production of $500,000 per annum.

Conclusions

By using The Markland 502 correlation technique to sense Thickener feed solids and the Markland Model 602 Sludge Blanket interface to sense Sludge Blanket (including overdosing) and take automatic corrective action, the polymer dosage is constantly varied to determine the solids removed. A lack of appropriate response is a sign of overdosing, and the polymer dosage is reduced.

Markland 602/502 continues to use the time-proven method for determining the mud/clear water interface measuring suspended solids with *no moving parts*; This overcomes the major weakness and the poor reliability which is inherent with all other turbidity based control systems .



Both enhanced dewatering control and polymer control are demonstrated in this continuous twenty-four hour operation.

A MATHEMATICAL DESCRIPTION OF FACTORS AFFECTING SETTLING RATES OF SLURRIES

J R Macdonald[(1)] S A Mays[(2)*] E Gallagher[(2)] J E Lewis[(2)]

ABSTRACT

A semi-empirical quantitative model has been developed which satisfactorily describes the settling velocity (V) of a limited suite of raw coal thickener feed samples in terms of only three variables, namely, flocculant dose rate (D), solids concentration (C), and particle size distribution parameter (S). For interface settling the model is of the form:

$$V = \left[a_o + \frac{a_1}{C^n}\right] + \left[\frac{a_2 \exp(-bS)}{C^n} D\right]$$

where a_o, a_1, a_2, b and n are empirically determined constants.

The model is not limited to raw coal thickener feed, having also been successfully applied to settling behaviour of a tailings feed to a solid bowl centrifuge and, in a more limited form, to settling of a laboratory grade sample of kaolin. In each case the data are satisfactorily described by the model, the differences between theoretical and observed settling velocities being within experimental error.

The mathematical procedure employed in developing the model has general application. However, the specific mathematical form presented is a first approximation only, because it is based on a relatively small set of data. Notwithstanding the limited data base, the functional form is expected to provide a suitable basis for curve fitting settling velocity data in general.

* Present Address: McNally (Australia) Pty Ltd, North Ryde, NSW

Table 1 gives dose response data for AIS raw coal slurries at two size distributions and at a number of concentrations. This set of data is used in the sample calculation.

Table 1: AIS Raw Coal Slurries (See Footnote)

S_1 = 26.8% -53 μm				S_2 = 35.3% -53 μm			
C_1=12.8% Solids		C_2=14.2% Solids		C_3=11.0% Solids		C_4=13.3% Solids	
D g/t	V m/h	D g/t	V m/h	D g/t	V m/h	D g/t	V m/h
7.0	9.2	7.0	7.0	2.7	3.2	3.0	2.1
14.1	18.1	14.1	14.7	5.4	5.1	6.0	3.2
21.1	30.2	21.1	23.8	8.2	7.3	9.0	3.9
28.2	38.1	28.2	31.1	10.9	7.3	12.0	5.0
35.2	43.5	35.2	34.2	13.6	7.3	15.1	5.2
				16.3	9.1	18.1	5.7

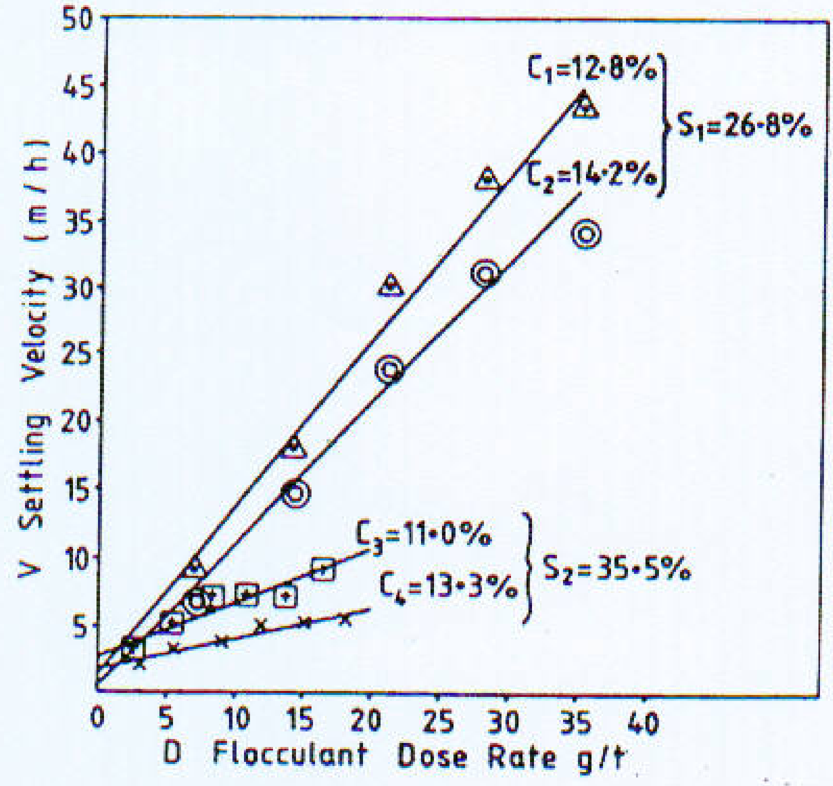


Figure 1 Dose Response Curves for A.I.S. Raw Coal Slurries Settling Velocity v's Dose Rate.

Footnote: Raw Data are given in Appendix II. Note that C_1 and C_3 are obtained from C_2 and C_4 respectively by dilution.