SUPERNATANT RETURN TERANG WTP

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ABSTRACT

Terang WTP Trident System consists of two up flow or adsorption clarifiers and two of multi media filters. Flow through the plant varies from 15L/sec 24 L/sec in each cell. Typical Raw quality is 1.50 to 3.50 NTU turbidity and 10 to 30 Hazen units, True Colour.

The primary water treatment chemical is Aluminium sulphate, which is supplemented, during the period of low raw water alkalinity, by a Cationic polymer. The addition of the Cationic polymer also improves filter and adsorption clarifier run time. Pre and Post pH correction is achieved with Soda Ash.

The waste system comprises of a 200 KL tank, which include sludge disposal systems and a polymer dosing system that is used to increase the Backwash and adsorption clarifiers waste floc size and to reduce the floc settling time. With the improvement in the supernatant quality the plant is able achieve supernatant return flows of between 15 and 50 % of the raw water plant inflows without a detrimental affect on the filtered water quality.

KEY WORDS
Adsorption Clarifier, Supernatant Return, Acid Soluble Aluminium, Waste water tank, Trident System, Citect

1.0 INTRODUCTION.

Terang WTP is supplied with raw water from the regulated North Otway system via Ewens Hill Reservoir; a 605 ML storage located 12 kms from the Treatment Plant. At the outlet of the storage the water is chlorinated to control weed growth in the pipeline. 25 % caustic soda is also dosed at the outlet of the storage to maintain the correct pH of between pH 6.90 and pH 7.20

Flow and thus pressure on the Nth Otway pipeline varies depending on demand requirements into Tank Hill Reservoir, which supply water to Purnim and Warrnambool. Supernatant return water is pumped into the chemically dosed raw water pipeline at a rate that was manually controlled on the discharge side of the pump by closing a butterfly valve to flow rate of 5.0 L/sec. Changes to the raw water pressure would require constant adjustments and also placed excessive backpressure on the centrifugal pump that has a maximum flow rating of 22 L/sec.

1.1 Adsorption Clarifier

The adsorption clarifiers replace the traditional mixing, flocculation and solids separation infrastructure with a single modular unit comprising solids adsorption media of polyethylene beads from which the pin flocc particles are formed and attach to this media. Experience has show that the pin floccs must be formed within 4 to 8 minutes to allow a suitable outlet water quality and to achieve a filter run time of between 24 to 30 hrs. Table 1 show the typical discharge water Quality for adsorption clarifier A & B compared to raw water Turbidity for May & June 2009.

Table 1: ***Water quality. Supernatant return pump not running***

	Raw water	Adsorption Clarifier A	Adsorption Clarifier B
Turbidity NTU	1.50 to 2.1	0.60 to 0.70	0.65 to 0.80
Apparent Colour	15 to 25	0 to 2	0 to 3

At between 3.5 to 5.0 hours run time the adsorption clarifier is in effect backwashed or flushed which contributes 20 KL of water to the waste water tank. The media should not be completely cleaned in order to allow for the attachment of new flocs to the existing solids within the media.

1.2 Backwash volumes

Backwashing to one of the multimedia filter contributes 60 KL to the waste water tank. At a supernatant return rate of 5.0 L/sec, it would take 66 mins to recycle the water from one adsorption clarifier flush and 200 minutes from a single filter backwash. In high demand periods this would lead to the plant switching to standby mode, as there was insufficient storage capacity for the next flush or filter backwash to occur as the waste water tank would be discharging its water to sewer at 6L/sec, or the operator would have to discharge it to the adjacent Wannon water land of which the volume was unmetered. The design parameter for the Trident system, percentage raw water treated the waste sludge disposal is 1.0%.

2.0 DISCUSSION

2.1 Plant Flows

Table 2: ***Plant flows, disposal & Supernatant return percentages***

Year	2001	2002	2007	2008
Raw water flow ML	572	697	584	644

As percentage of raw water volume

Sludge to sewer %	1.7*	0.75*	1.1	1.3
Supernatant Return %	7.7	8.2	10.4	10.4

* *Water discharged unmetered to Wannon Water property affecting actual volume.*

2.2 Supernatant Return Pump Control

The existing PLC program allowed for an adjustable settling time of the sludge in the waste water tank prior to the supernatant return pump starting. This time was set in Citect at 60 minutes, which would take in theory, 11hrs to empty the 200 KL waste water tank at its full capacity, at a return rate of 5.0 L/sec.

2.3 Improve water quality.

Trials where conducted in 2004 using a 1.0 to 2.0 % dose of a cationic polymer, initially just for the high rate filter backwash waste, but now includes the high rate flush to waste of the adsorption clarifier. The solution dosing tank has a capacity of 100 litres.

The dosing tank has a low level switch that activates an alarm within the Citect program (see figure 1).

The Cationic polymer solution strength is determined by the seasonal water temperature.

- A one percent solution, dosing from October to May
- A one point five to two percent solution, dosing from June to September

The speed of the dosing pump can also be changed to increase/decrease the dosing volume.

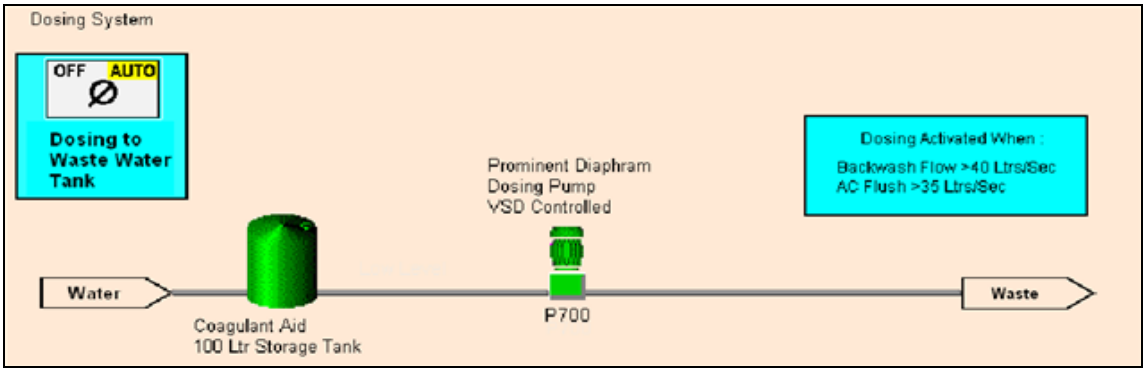

Figure 1: ***Waste Water tank Cationic Polymer dosing Citect graphic***

2.4 Improve Supernatant Return Volumes.

Improvements in the Supernatant return water quality allowed an increase in the return flow rate, and at a reduced settling time, the increase in return rate flow was achieved by the installation of a VSD to control the pump speed The settling time has been reduced to between 35 and 45 mins depending on water temperature and daily plant demand.

The return rate(s) are determined, and changed via Citect and are adjustable as follows.
Pump starts on low flow rate at a level of greater than 55 % in waste water tank operating for 15 minutes, sludge pump (P901) starts and stops via a timer adjustable via Citect
Pump increases in speed to a high return rate to a level of 45 % in waste water tank. At 45% a smaller sludge pump (P903) starts, and stops via a timer adjustable via Citect
The pump speed then slows to a Low Low flow rate to stop the supernatant pump lifting settled sludge from the bottom of the tank, the supernatant return pump is stopped, normally at 35% in the waste water tank.

The supernatant return pump floating suction hose/foot valve can raised or lowered via a simple cable operated winch. This serves two main purposes, one to assist in the maintenance of the hose assembly and secondly, to remove as much of the supernatant water prior to the tank cleaning.

These adjustable flow rates are listed below and adjusted in Citect (see Figure 2).

- Low 8-10L/sec.
- High 13-15 L/sec.
- Low Low 5-7 L/sec

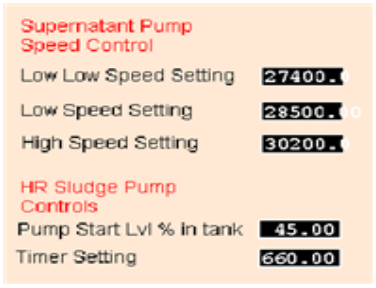

Figure 2: ***Supernatant return speed control, P903 sludge pump control***

Changes in either plant flow or the raw water pipeline pressure will change the return rate. Changes to the return rate can be made while the pump is running.

2.5 Removing solids.

As the Waste water tank has only 50 mm of fall into the sludge pump well the tank would have to be drained and emptied every 6-8 weeks which requires the plant to be stopped. Cleaning would take up to 4 hrs to complete.

To move the cleaning frequency out to, between 4 and 6 month a small helical rotor pump was installed with a flexible suction hose and manifold that operates at 2.5 L/sec. there is also a compressed air spray system that triggers a short burst of air to loosen the settled solids and move them more readily into the pump suction manifold. This is located in the centre of the tank were the bulk of the solids settle.

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The sludge volume needs to be monitored closely as the supernatant pump can lift the settled solids. This in turn disturbs the adsorption clarifier attachment mechanism releasing the floc particles from the media and creating a "direct filter" reducing filter runtimes to between 8 to 10 hours. This is monitored by visual inspections and by monitoring the Citect filter(s) head loss trends.

2.6 Acid Soluble Aluminium.

During the period from July to November when the raw water is harvest from our protected catchment, the raw water Alkalinity can drop to as low as 5mg/L as CaCO3. Changes were made to treatment process and implemented to eliminate the > 0.2mg/L of acid soluble aluminium measured in the sample at the outlet of the CWS.

Pre and Post pH correction chemical changed from hydrated lime to soda ash.
Installed an additional Alum dosing point further towards the adsorption clarifiers/ supernatant return dosing point. This was required to separate the alum and soda ash dose points by greater than 30 pipe diameters.

Reduced the Alum dose rate and substituted it with a dose rate of between 0.5 to 0.8 mg/L of a cationic polymer 10 to 20 seconds after the supernatant return dosing point. The benefits of this are twofold, lower pre pH correction soda ash dose rate, which at high rates can affect the floc formation time within the adsorption clarifier, and increased backwash time interval for both the filters and the adsorption clarifiers and thus less waste water.

2.7 Graphs

Figure 3 shows the corresponding supernatant Return turbidity taken from the discharge side of the pump in relation to the detention time of the waste water tank after an adsorption clarifier flush.

Table 2 is the acid solid aluminium measured in mg/L taken at the outlet of the adsorption clarifier; 15 minutes after the samples were taken in Figure 3.

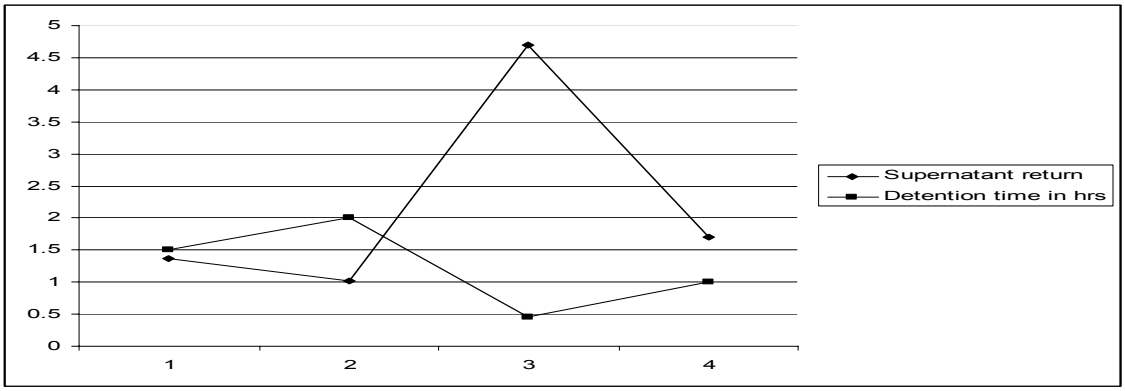

Figure 3: ***Supernatant Return Turbidity at detention time in hours***

Table 2: ***Acid soluble Aluminium measured from outlet of Adsorption Clarifier***

1	2	3	4
0.12	0.06	0.42	0.12

Figure 4 shows the in house testing for Acid Soluble Aluminium from the outlet of the filters whilst Figure 5 shows external Lab test results for the CWS outlet Acid Soluble Aluminium.

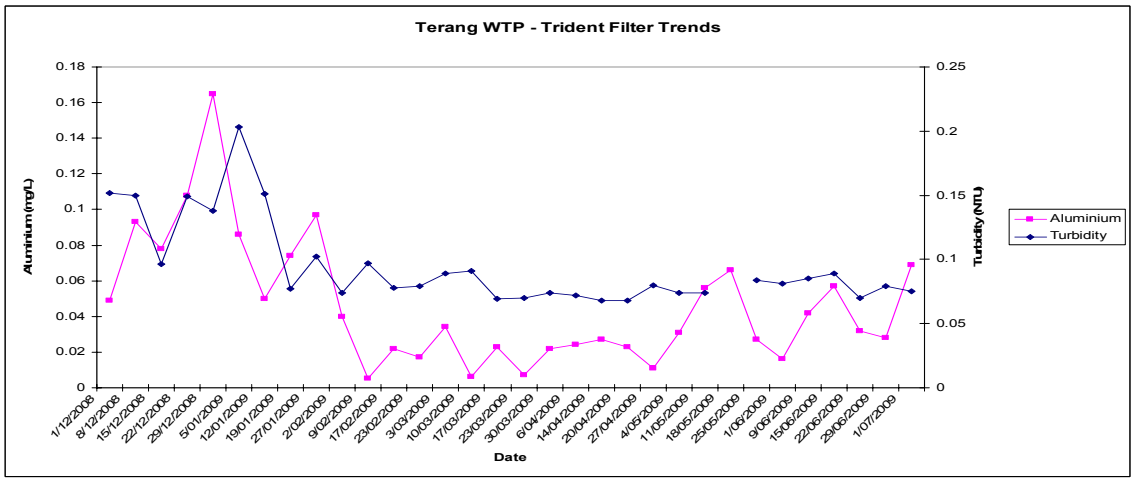

Figure 4: ***In house results. Outlet of filters, January 2009 to July 2009***

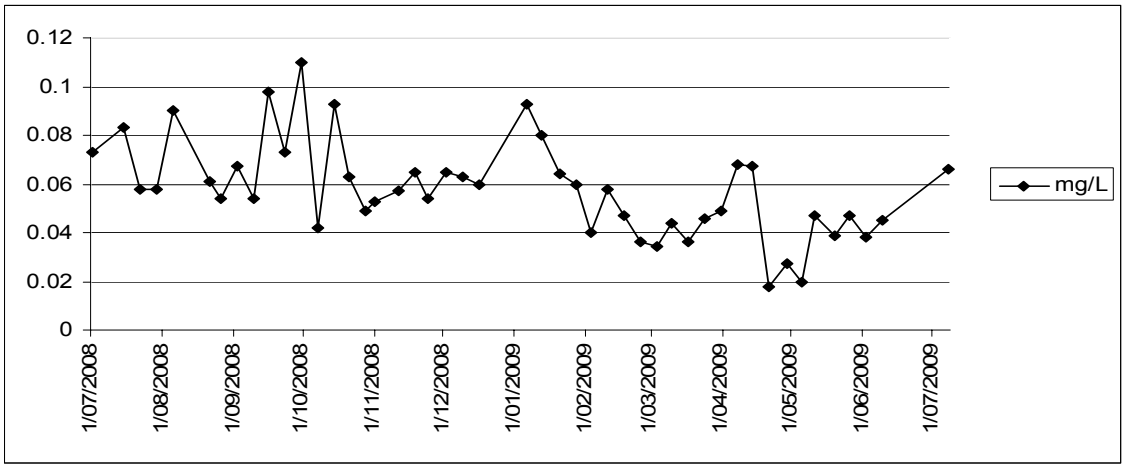

Figure 5: ***External laboratory results, acid soluble Aluminium. July 2008-July 2009***

3.0 CONCLUSIONS

Improvement made to the Supernatant return system have basically eliminated the plant stopping while the Waste water tank volume is been lowered and discharged to sewer the exception being two to three time per year during extreme water use days of plant flows around 3.5 to 4.0 ML/day.

Able to adjust the Supernatant return pump speed while it is running. This depends on both the raw water and or supernatant return water quality and to lesser extent on the plant flow rate.

The raw water pipeline pressure relief valve outlet was redirected back into the Waste water tank. This volume is up to 8ML per year.

Able to recycle up to 10 KL per day of sample water from the inline monitoring instruments into the Waste water tank that previously was discharged to sewer.

4.0 ACKNOWLEDGEMENTS.

Changes made to the PLC, Citect and Hardware by our Operations Support team.
All those people to numerous the mention in Treatment Services team.

5.0 REFERENCES.

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