STROMLO WATER TREATMENT PLANT
LIME SATURATOR OPERATION

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ABSTRACT

Stromlo WTP utilises a lime saturator designed to control the final pH (target 7.4) of treated water while meeting plant specification targets for alkalinity (>30 mg/L as $CaCO_3$) and turbidity (<0.3 NTU).

This paper discusses the principles of the lime saturator operation and the practical operational lessons learnt throughout the commissioning and ongoing operation of the system.

KEY WORDS
Lime, saturator, calcium carbonate precipitation potential, alkalinity.

1.0 INTRODUCTION

Before the major fires in 2003 water treated at Mount Stromlo was obtained from Bendora and Corin dams. This good quality water with turbidity less than 1 NTU normally and below 2 NTU after turnovers, required only chlorination, fluoridation and pH correction before it was delivered to the customers.

After the fires and the deterioration of water quality in the source water, there was a need to build a new treatment plant that could treat poor quality water. The New Stromlo Water Treatment Plant (WTP) was commissioned 2004. The ongoing drought forced the planners to identify the need to pump water from alternative sources without having to build any new dams.

Water treated at Stromlo WTP now comes from three different sources namely Bendora Dam, Cotter Dam and Murrumbidgee River. These when mixed together could have a turbidity of up to 15 NTU, alkalinity <20 mg/l and temperature ranging from 5^{o}C to 25^{o}C.

The incoming water main to the plant is injected with a combined dose of pre-lime and waste lime sludge from the lime saturator to increase alkalinity required for proper coagulation. The associated pH rise is controlled by adding carbon dioxide to the water, so as to maintain correct pH and not loose the alkalinity that's required for the coagulation process.

During the coagulation process the alkalinity is consumed and this water with low alkalinity and pH enters the dissolved air flotation filters. The filtered water low in pH further is disinfected by chlorine gas and remains very aggressive.

The design of the new lime saturator was required to provide the capability to treat the aggressive water, so as to maintain the correct stability (alkalinity and Calcium Carbonate Precipitation Potential (CCPP)) of water to safeguard the concrete lined distribution pipes from leeching and corrosion.

2.0 DISCUSSION

2.1 System Overview

The saturator system consists of post lime bin, feeder, slurry tank, slurry pump, saturator, lime water pumps, lime sludge pumps, milk of lime holding tank and milk of lime delivery pumps, and two delivery valves (one low rate and a high rate valve).

The post lime bin (30 tonnes capacity), feeders, slurry tanks, and slurry pumps were pre-existing plant and equipment that were not included in the scope of works for the post lime system upgrade.

The lime water pumps transfer filtered water from the clear water tank to the lime saturator where it is mixed with lime slurry from the post lime system. The mixture then runs into the stilling well while the mixer mixes the settled lime sludge from the floor of the saturation tank with the incoming lime water and slurry. The lime sludge also assists in crystallisation of inert and particulate impurities, improving flocculation and stability of the sludge blanket.

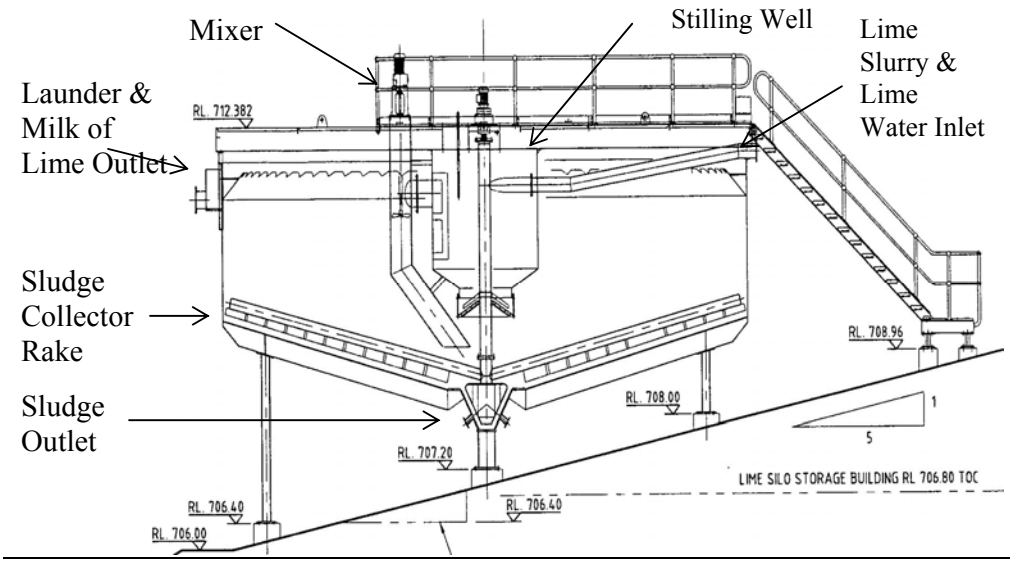

Figure 1: ***Stromlo lime saturator general arrangement***

The lime saturator clarifies and dissolves the lime slurry prior to dosing milk of lime solution, with a target alkalinity for the milk of lime of 1400 mg/L. The lime saturator also consists of a rake running at constant speed and a mixer with a variable speed drive. The saturator mixer and rake run continuously.

The milk of lime is stored in a 30 m^3 fibre-glass tank filling by gravity overflow from the saturator. The three dosing pumps have a design pumping capacity of 20 l/sec each and are operated in duty/standby modes.

The two flow control valves modulate to control the required volume of lime solution to the dosing point, based on online pH measurement and SCADA monitoring. Based on the

treated water and lime dose, both valves may be selected for duty to increase the stability and degree of control.
The lime sludge pumps transfer lime sludge from the saturator to the plant inlet. There is provision to flush pump suction pipe work and discharge pipe work with service water. The pump flushing valve provides auto flushing sequence as determined by timer controlled at the PLC.

2.2 Commissioning Issues

Lime feeders: During commissioning, the old lime feeders had to be fine-tuned because of higher feed rates so as to prevent fluidisation and rat-holing. Additional vibrators and change of design on feeder screw were the answer to the problem.

Sludge pumps: Two progressive cavity pumps were originally installed to pump lime sludge/grit up hill (10 m head and 100 m of pipe work), which failed to pump after 36 hours of running. Rotor and stator wore badly and were abandoned. These were replaced by Bradal hose pumps later, which have been much more successful.

Lime slurry lines: PVC pipes in permanent trenches and trays were installed that had to be removed very often as they were clogging every two weeks. They were replaced with flexible hoses and placed above ground for easy access.

Lime sludge dosing to raw water main: Lime sludge dose entering the raw water main which was under pressure frequently clogged at the entry point. This line was removed and replaced with larger diameter metal spear injector and valve arrangement reaching the centre of the main that could be removed after closing the valve for easy cleaning.

2.3 Operational and Maintenance Issues

Dosing lines: Continual blocking by build up of lime needs to be flushed on a weekly routine with CO_2 mixed water, with varied success.

Saturator: Requires routine monitoring of sludge dips, manual desludging, and extra monitoring in cold weather for turnover of sludge bed. Test for turbidity typically around 30 NTU and sludge solids around 10-15%. Plans for future optimisation using non-ionic polymer for improved turbidity is considered.

Dosing valves: Need to be exercised on a weekly basis to prevent build-up.

Dosing pumps: Over time there was a loss in pumping capacity due to restrictions and fittings in the pipework, and a build up of lime especially at the end of dosing pipeline and the long distance (100 m.) to travel uphill. Capacity dropped from design of 33 L/s to 23 L/s. This was overcome by taking away the 90 degrees bend and instead of the one large pipe discharging into tank up high in the air, three smaller diameter flexible pipes were introduced into the water of the CWS to increase flow velocity and there by reduce deposits not giving a chance to dry up. This gave longer run time between cleaning.

Dosing line: Recently the dosing line has been duplicated (providing standby for duty changeover and cleaning) with two larger diameter flexible pipes running at ground level, This has improved our pumping capacity of milk of lime with the same pumps from 23 L/s to 47 L/s.

Saturator mixer and tube: The mixer lifts the sludge from the bottom of the stilling well and discharges in to the top of stilling well to mix the sludge with the incoming water/ lime slurry. There is some energy lost due to the 90 degrees flow change and the inlet manifold suffers from deposits at that point which slowly build up to half the diameter of pipe in five to six months. This requires plant shutdown for cleaning.

Saturator launders: There is limited access provided to the launders. Over time the milk of lime deposits on the launders building up considerably. An access platform is to be constructed to provide maintenance access for future cleaning tasks. This also requires plant shutdown for cleaning to prevent turbidity carryover to milk of lime solution.

3.0 CONCLUSIONS

Managing the operation of the lime saturator following on from the commissioning issues and ongoing operational and maintenance issues has been a challenge for operations at Stromlo WTP.

The performance of the lime saturator in meeting final water quality targets is reasonable and achieves improved final turbidity compared to dosing lime slurry. It is critical to properly size the saturator to give flexibility in meeting flows and alkalinity targets. There is also the additional benefit of less sediment accumulating on reservoir floors, thus reservoir run period before cleaning has been extended.

4.0 ACKNOWLEDGEMENTS

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5.0 REFERENCES

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