OPTIMISATION OF THE DORA CREEK IDEA WASTEWATER TREATMENT PLANT

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ABSTRACT

Wastewater from the Morisett, Bonnells Bay and Dora Creek areas is directed to the Dora Creek Wastewater Treatment Plant (WWTP) for treatment. The treatment process includes two Intermittent Decant Extended Aeration (IDEA) tanks and a treated water storage lagoon. The plant has Licence requirements of pH 6.5 to 8.5, BOD 30mg/L and TSS 20mg/L with the majority of the final treated effluent being used in cooling towers by the Eraring Power Station.

The plant has a history of operational problems which have proven hard to remedy using conventional wastewater treatment practices. This paper describes the problems encountered and the types of operational changes trialled and implemented in an effort to combat them, as well as discussing the results achieved over the past 4 years.

1.0 INTRODUCTION

1.1 Wastewater System Background

Dora Creek has a design capacity of 16,000 EP with an ADWF of 3.8 ML/d and a PWWF of 32 ML/d. Treatment of sewage is by screening followed by aeration using four surface aerators in each of two Intermittent Decant Extended Aeration tanks.

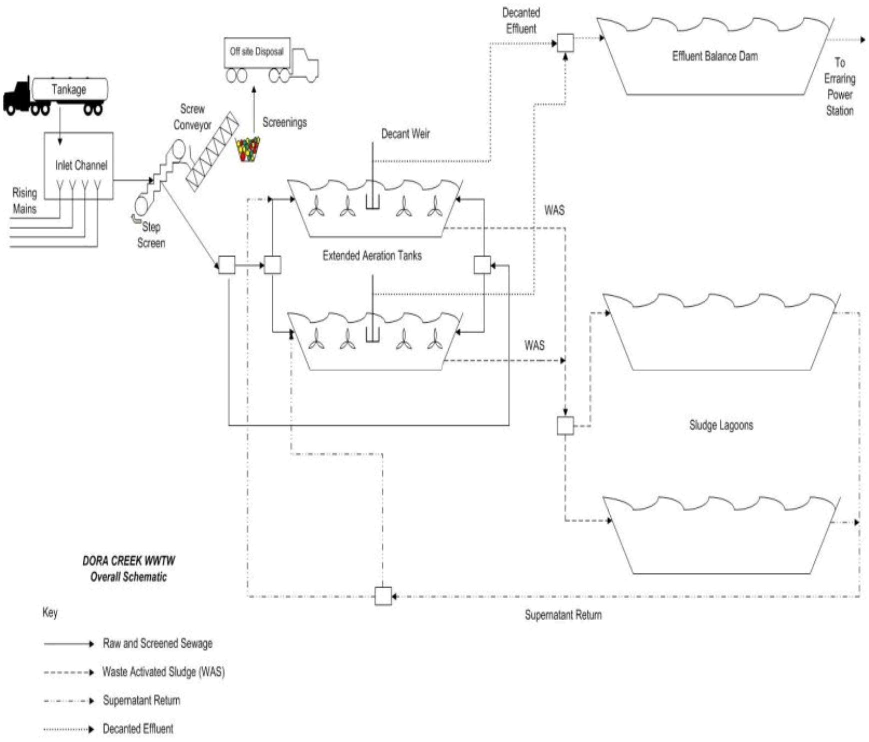

Figure 1: ***Schematic of the Dora Creek WTP***

Waste Mixed Liquor is directed to two Sludge Lagoons which are operator controlled. Recommended Sludge age was 25 days and a MLSS of around 2900.

Treated effluent is decanted to a storage pond. Eraring Power Station pump from this pond and use the treated effluent as Boiler Feed Water (used to produce steam and move turbines for electricity), which requires demineralised water to prevent scaling in the heat transfer pipes (i.e. **less frequency of boiler shutdown**).
The treated effluent is cheaper than potable water supply as well there is no residual Chlorine which means less chemical treatment is required. While it does requires large amounts of electricity for membrane filtration this is no problem for a power station.
The treated effluent may also discharges into Lake Macquarie as overflow during extended periods of wet weather and it would be desirable if it met stringent inland discharge limits.

1.2 Treatment Issues

The Dora Creek WWTP has a record of not responding to conventional IDEA plant operating procedures.

A number of samples were collected in December 2003 and the results are shown in Tables 1 & 2 below.

Table 1: ***December 2003 Results from Aeration Tank #1***

Parameter	Week 1	Week 2
MLSS(mg/L)	2930	1870
Decant NFR(mg/L)	39	20
Decant pH	7.0	7.6
Decant BOD(mg/L)	34	20
Decant Ammonia(mg/L)	8.9	47.9
Decant TON (mg/L)	34	6.6

Table 2: ***December 2003 Results from Aeration Tank #2***

Parameter	Week 1	Week 2
MLSS(mg/L)	3700	2740
Decant NFR(mg/L)	12	12
Decant pH	7.1	7.1
Decant BOD(mg/L)	7.0	5.0
Decant Ammonia(mg/L)	3.8	4.9
Decant TON (mg/L)	11	9.0

Decanted effluent from Aeration Tank 1 (AT1) is always high in Ammonia while Aeration Tank 2 (AT2) results show high Total Organic Nitrogen. In normal treatment processes, high ammonias are usually handled by increasing the aeration and high TON by reducing the aeration but at Dora Creek this has not worked. MLSS builds up to very high levels, around 5000, and we get a bad foaming problem which we can control by wasting heavily. Unfortunately, this leads to loss of nitrifiers and never solves the problem.

2.0 INVESTIGATIONS UNDERTAKEN

Suggestions to rectify the operational problems have come thick and fast from engineers, operators, design experts and the like. A number of suggestions have been trialled over the years and their effectiveness in rectifying the problems are outlined below.

2.1 Increase Aeration Times

Increasing aeration times would add more DO which would help in the removal of ammonia in AT1 but due to design constraints, this can't be done. Both aeration tanks operate together with a fixed cycle for each tank. The only way to increase the aeration is to lower the aerators in AT1 while turning off an aerator in AT2.

After months of slowly lowering the aerators on AT1 and monitoring the results, we could see that the DO levels were increasing but we were not getting much reduction in Ammonia levels. In the end we trialled 200 litre drums onto the platforms to lower the aerators further into the MLSS and therefore increase the aeration.

There is one DO probe in each aeration tank but the readings never seemed to mirror what was happening with the process. DO levels before we started lowering the aerators were at 4 to 5 mg/L and rose to 6mg/L after lowering. We then used 200 litre plastic drums which are still there today to lower the aerators but still we were no closer to getting the results we should have been able to achieve with low ammonia.

2.2 Identification of Bacteria

We experienced bad foaming only in AT 1 on a number of occasions and thought this may be the cause of our process problems.

Maybe by identifying the bacteria causing the foam and checking the health of the bacteria was the way to go. We found that the foam was caused by Microthrix Parvicella. We also found AT 1 looked healthier with good numbers of Higher Organisms such as rotifiers, ciliates and amoeba than AT 2 after checking the MLSS under the microscope yet AT 1 was the problem tank. Wasting heavily to remove the Microthrix Parvicella bacteria was effective in reducing the foaming problem. After removing the foam by wasting heavily we found the problems with unstable NH_3 and TON results still existed. Also, by wasting heavily, we lost our nitrifiers and the MLSS took a long while to build up taking 3 sludge ages to be back to acceptable levels of 2900mg/L.

We summised and have since proved the foam was not causing the problems as we still had unstable NH_3 and TON results long after the foam was removed. The foaming has now not occurred for over 18 months so believe the foam was a by product of the process problems not the cause.

2.3 Septic Tank Waste

Tankers contracted by Lake Macquarie Council discharge septic tank waste into the plant. One thought was that the tankers were bringing in something which upset the process. We have up to 10 tankers delivering septic and industrial wastes. We took samples from tankers and influent and tested for chemicals. High BOD, NH_3, grease and phosphorus. Results were high at times but determined with the dilution of this waste with incoming influent this was not the main cause of our problems.

We did find out at a later date a local food manufacturer that was discharging wastes to our system was producing a product containing honey meaning their discharge BOD had increased considerably. This would explain our poor nitrifying results as much of the oxygen was being used to remove the BOD. Although they had only started discharging over the last year or so, it explained why we had started to get improvements then suddenly we struggled again to maintain a reasonable ammonia level. This trade waste was then diverted to another plant and it hasn't had an impact there due to the inflow being up to 8ML per day and Dora Creek being only 3ML. Once the extra BOD was diverted away, the plant operation did improve but it was still unsatisfactory.

2.4 Flow Distribution

The next investigation centred on whether there was uneven flow distribution between the two tanks and whether AT1 was being more heavily loaded with BOD than AT2. If this could be proven, we could adjust wasting and aeration accordingly, even though we didn't have much flexibility with the operator adjustable settings.

The inflow into the tanks was from both ends into both tanks and we did find more flow into AT1 but didn't believe it was significant enough to cause the problems we were having but could have been contributing.

While checking the inflow, we also found that the supernatant from the sludge lagoon seemed to favour AT1 and on further investigation, found that towards the end of the cycle, MLSS actually flowed back from AT1 to AT 2 during high flow periods. With more inflow and the supernatant flow from the sludge lagoons we had a higher demand for DO in AT1, although it was hard to work out why the loss of MLSS from AT1 to AT2 was not lowering the MLSS in AT1.

First decision was to put a stop board between AT1 and AT2 and just feed the sludge lagoon supernatant into AT2. Ammonia levels in AT2 have increased recently due to the supernatant from the sludge lagoons being of poor quality with the Sludge Lagoons in need of dewatering. After waiting for 2 sludge ages it became obvious we were no closer to producing a final effluent of decent quality.

2.5 Aeration Tanks

As there is no grit removal system onsite, we found a large build up of grit and sludge in the tanks and we decided to empty the aeration tanks to see if a loss of capacity was the problem.

We found a lot of grit and sludge in AT1 but AT2 was just as bad. After removing the grit and sludge and waiting 2 sludge ages we found still no change. It was getting increasingly frustrating as this had been going on for almost 4 years and was a taking a lot of time trying to solve.

While these investigations were being undertaken, we had damaged a number of decant rubbers. To allow the fitters to replace the decant rubbers, we had to empty one tank and overload the other tank. We then refilled the empty tank and waited for the MLSS and nitrifiers to recover and build back up.

2.6 Wasting

We could waste more from either tank but it was impossible to do accurately due to now WAS flow meter and we always went too much or not enough. We thought we were maybe pumping more through waste pump 2 than pump 1

Next step was to see if the WAS pumps were pumping different flow rates so we arranged for the fitters to swap pumps and waited. No improvement, so we decided to rod the pipes and send a camera up. We found the WAS pipe from AT1 joined into the pipe from AT2 at right angles. This could have been affecting flow rates but by how much was the next question.

We installed a flow meter onto the WAS line and found WAS pump 1 wasted at 16 L/sec while WAS pump 2 wasted at 25L/sec. Taking into account the uneven flows we are now able to adjust Sludge Age more accurately.

2.7 Dissolved Oxygen

We needed some control over the process as far as time zones to adjust aeration to DO demand. While management agreed to look into this it has not been done.

The other problem with using DO to operate the plant related to the type of instruments and probes installed. Our probes needed to be cleaned and calibrated weekly due to the consistent build up of fat and they were being damaged by this constant cleaning and calibration process. It is true to say that we lost faith in the results and we reverted to adjusting the plant on results from samples taken once a week. There are plans to replace the instruments and probes with a different brand which hopefully will perform better in this environment.

3.0 FINAL CONFIGURATION CHOSEN AND RESULTS

In reviewing all the data from the many trials completed, we have now set the Sludge Age at 14 days in AT1 and 20 days in AT2 and the MLSS are staying around 3,000 mg/L. The Ammonia levels in AT1 have improved dramatically and stabilized at around 1mg/L.

BOD samples are only taken at the final discharge point from the storage lagoon prior to use by the power plant and are consistently around 2.0 to 7.0 mg/L. We are maintaining Phosphorus Levels around 7mg/L.

A comparison of the results from 2003 and 2007 are shown in Tables 3 & 4.

Table 3: ***Results from Aeration Tank #1***

Parameter	2003	2007
MLSS(mg/L)	2930	3080
Decant NFR(mg/L)	39	5
Decant pH	7.0	7.3
Decant Ammonia(mg/L)	8.9	1.1
Decant TON (mg/L)	34	0.99

Table 4: ***Results from Aeration Tank #2***

Parameter	2003	2007
MLSS(mg/L)	3700	3360
Decant NFR(mg/L)	12	5
Decant pH	7.1	6.7
Decant Ammonia(mg/L)	3.8	1.1
Decant TON (mg/L)	11	12.3

4.0 CONCLUSION AND THE FUTURE

We have undertaken a considerable amount of work over the past few years to improve the performance of the Dora Creek WWTP and it is now performing significantly better than it was in 2003.

The cause of the poor results has not been narrowed down to any one cause. We have shown there were a number of contributing factors. By looking at the whole process and persevering, the operation and process can be improved at Waste Water Treatment Plants as this paper shows by the changes made and the results obtained.

The region is experiencing strong population growth at present and there is little if any reserve capacity within the existing treatment plant system. Add to this the fact that the Power Station has a limit in its consumption of effluent at just above

3ML/day and the current inflow at the plant is 3ML/day means that production of higher quality effluent suitable for an inland discharge is required.

Despite our best efforts to fully optimise the process, it is obvious that some major upgrades are required at the site in the near future. The Dora Creek plant will undergo a major upgrade involving installation of new inlet works with a flow equalisation tank, step screen and grit removal with screenings and grit washing. Additionally, clarifiers will be installed and the flow process changed from intermittent to a continuous aerated plant.

Hunter Water has just announced a reuse project with effluent being treated onsite and pumped to a reservoir for reuse as grey water at a new residential estate planned in the area. This is a 10 year plan but will be taken into account in the current upgrade.