TE PUKE WASTEWATER TREATMENT PLANT – IMPROVEMENTS TO GAINING BETTER DISSOLVED OXYGEN CONTROL

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ABSTRACT

The Te Puke Wastewater Treatment Plant services the township of Te Puke in the Western Bay of Plenty (population of approximately 7,000 people). The plant uses an activated sludge process and has an inflow of approximately 1,800m^3 of raw wastewater per day with little industrial effluent in the waste stream.

Wastewater effluent is firstly screened and is then split between two activated sludge aeration tanks where the wastewater is mixed with micro-organisms and oxygen. The micro-organisms effectively "eat" the organic matter in the wastewater. The solids and micro-organisms are then settled out of the water in a secondary clarifier. A large portion of the micro-organisms are then returned to the aeration tanks, while the treated wastewater is piped through a UV facility and wetlands before finally being discharged into the Waiari Stream. Sludge from the clarifier is dried mechanically onsite and then disposed to a vermicomposting farm.

The treatment plant was built in 1978, with an additional clarifier being added in 1998 due to the population growth of the town. Minor modifications to the treatment plant have also been undertaken to enhance the treatment operation.

Our roles as Trainee/Apprentice Treatment Plant Operators have provided exposure to a wide range of plant operational improvements. One of the most recent improvements has been to address the inadequate Dissolve Oxygen (DO) operational levels. The original plant design did not afford the ability to control the DO levels with any certainty.

This paper will present information and data showing the affects of inadequate DO controls and subsequently will present the improvements that have been implemented to achieve improved control and delivery. This project has allowed us to gain valuable insight into a common problem with a number of plants around the country.

KEYWORDS

Blower room, Dissolved Oxygen (DO) control, wastewater treatment plant upgrades

1 INTRODUCTION

The Te Puke Wastewater Treatment Plant services the township of Te Puke in the Western Bay of Plenty (population of approximately 7,000 people). The plant uses an activated sludge process and has an inflow of approximately 1,800m3 of raw wastewater per day with little industrial effluent in the waste stream.

Wastewater effluent is firstly screened and is then split between two activated sludge aeration tanks where the wastewater is mixed with micro-organisms and oxygen. The micro-organisms effectively "eat" the organic matter in the wastewater. The solids and micro-organisms are then settled out of the water in a secondary clarifier. A large portion of the micro-organisms are then returned to the aeration tanks, while the treated wastewater is piped through a UV facility and wetlands before finally being discharged into the Waiari Stream. Sludge from the clarifier is mechanically de-watered onsite and then disposed to a vermicomposting farm.

The treatment plant was built in 1985, with an additional clarifier being added in 1998 due to the population growth of the town. Minor modifications to the treatment plant have also been undertaken to enhance the treatment plant operation and assist in maintaining a reliable performance output.

There is still capacity in the Te Puke Wastewater Treatment Plant to cater for approximately 1,500 additional people. Current growth predictions suggest that full plant capacity will not be achieved until 2012. Looking ahead the resource consent for the Te Puke plant will expire in November 2016. It is anticipated that the existing resource consent conditions will be further “stretched” to ensure a high level of compliance is maintained.

A number of improvements have been incorporated in the Long Term Plan to facilitate future compliance levels. Recently a new UV system was installed and commissioned alongside the existing UV system.

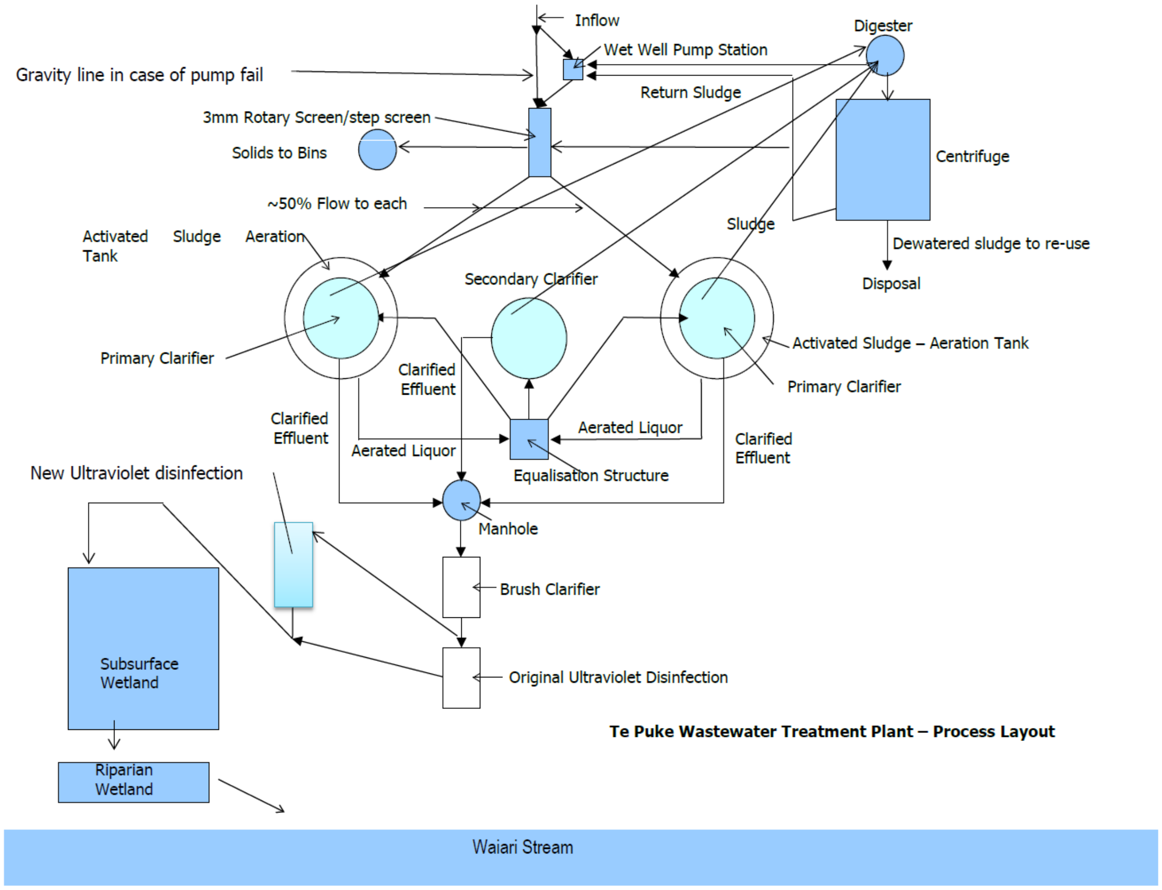
One of the most recent improvements has been to address the inadequate Dissolved Oxygen (DO) operational levels. Dissolved oxygen is a relative measure of the amount of oxygen that is dissolved or carried in a given medium. The original plant design did not afford the ability to control the DO levels with any certainty.

This paper will present information and data showing the affects of inadequate DO controls and subsequently will present the improvements that have been implemented to achieve improved control and delivery.

2 TECHNICAL BACKGROUND

The Te Puke Wastewater Treatment Plant consists of a rotary brush screening compactor, two carousel reactor-clarifier tanks, a third clarifier, a balance tank, sludge digester, centrifuge, UV channel and a wetland system. The final effluent is discharged into the Waiari River. Flows entering the plant are gravity fed into a pumping station located onsite it is then pumped to a header box, then gravity feed into a 3mm screening compactor that splits between the two anoxic/aeration zones after being processed it gravity feeds to three clarifiers, settled out solids are then pumped to the centrifuge (sludge removal) this de-watered sludge is taken off site where it is used in a worm farm. Effluent then gravity feeds to the brush clarifier for further solids removal before going through a UV disinfection process then flowing through to the wetlands system and discharged into the Waiari stream via a riparian rock filter.

Figure 1- Schematic diagram of treatment plant process



The original blower system consisted of three Hick Hargreaves blowers; two 45kw blowers, and a18kw blower. In 2008 one of the 45kw Hick Hargreaves blowers was replaced with a 45kw Nu-Con blower controlled by a VSD to ramp it up and down depend on DO levels. These blowers are located underneath the No.1 reactor-clarifier and provided air to both aeration tanks via a 250mm pipe. The air is discharged into the tanks via sparge pipes with coarse bubble diffusers. The airflow could be controlled into each individual sparge by saunder valves located on the top of each sparge pipe, but as these began to fail they were replaced with stainless steel ball valves. Over the past two years Council has replaced approximately 20 sparge pipes due to their deterioration and has repaired numerous others.

3 HISTORY OF DO PROCESS

One of the main problems with the current set up has been the lack of DO control along with the location of the blowers, at times providing more aeration to one aeration tank and less to the other tank. The DO is measured in each tank and an average is taken with this average figure controlling the blower speeds and resulted in periods of extreme high and low DO, which caused all sorts of operational problems, filamentous, pin flock etc. As well as the poor DO control another problem with the original system was that the three blowers provided air to both tanks with no way to vary the airflow into either tank or isolate one tank for maintenance, which meant the entire plant has to be shut down to carry out any maintenance. With the blowers being located under the aeration zone tank, it makes it difficult to carry out any maintenance. This is particularly so if the blower requires off site work as the blowers have to be lifted out through a small opening in the roof. Also if the aeration zone tank or pipework developed a leak and the drainage pump failed, it could flood the blower room.

4 OPTIONS AVAILABLE

An in-house team discussion focused on the various options that could be implemented.

4.1 OPTION 1 – KEEP STATUS QUO

4.1.1 ADVANTAGES

- Would make funding available from not doing the upgrade which could be spent on other projects

4.1.2 DISADVANTAGES

- Would not meet future demand limits
- Access for maintenance and general repair would remain poor
- Inadequate DO control
- Floodable room
- Health and Safety concerns
- Consent conditions may not be met in the future
- Replacement parts for the older blowers are harder to source and are expensive

4.2 OPTION 2 – MODIFY CURRENT DO CONTROL SYSTEM AND MAINTAIN CURRENT LOCATION

4.2.1 ADVANTAGES

- No real advantage here. Financially may have been a cheaper option but the main issues would still remain.

4.2.2 DISADVANTAGES

- We would still have the issues of the location ie; not being able to access the blowers for maintenance, blowers would still be in a floodable room and Health and Safety concerns would still need to be addressed.
- Access of new blower equipment through the access hatch would have been near impossible. To achieve this stripping the equipment down would have made the warranty invalid.
- Lack of space in current location would limit the type of blower we would require.

4.3 OPTION 3 – CONSTRUCTION OF NEW BLOWER BUILDING

4.3.1 ADVANTAGES

- Better control of our dissolved oxygen
- Aeration zones can be run individually
- Maintenance carried out with ease; should a blower need to go offsite we will not need to get a crane in having more room in a new shed
- Extra storage available
- A number of Health & Safety concerns would be addressed
- Room for future development

- Electrical equipment separated from the blower room thereby minimizing health and safety hazards

4.3.2 DISADVANTAGES

- Financial costs

4.4 CHOSEN OPTION

Option 3 was the chosen option as the benefits outweighed the other options. The new blower system is being constructed out of the need to have better aeration control with the advantage being that we can now have the availability of running each aeration zone individually. The new blower room is a large sound proofed skyline garage 13m x 6m built with future planning in mind. There is room to house four blowers, store the portable generator and to have easy access for maintenance. In addition to three of the original blowers, a new one has been purchased. All four blowers will be running off individual VSD drives. The system will operate with two 45kw blowers providing aeration to an individual aeration tank and there will be two standby blowers with the ability to cover peak demand periods when DO levels drop. Stainless steel pipe work has been configured underground with a galvanized mild steel manifold. An extractor fan has been installed to address heat issues in the building and better access has been allowed for by providing a concrete driveway to the building.

5 PROGRAMME

The timing of the start of the upgrades was delayed due to consent conditions needing to be met. Once these conditions were met, inclement weather caused the project to be delayed by 8 weeks as we needed fine weather to construct the concrete foundations. At the time of this document going to print, the project was still behind schedule but as we are able to operate the plant to some degree using the current system the delay has not been a major problem. The setback is more of a nuisance than anything but will be finished in due course. At present the project is moving along well and we are looking to run a test with new blower by September 2013.

6 ANTICIPATED OUTCOME

When the new blower system is operational and has given us the ability to run the aeration zones individually we are hoping for the following results; much better control from being able to run both zones off the automated dissolved oxygen sensor, both aeration zones having better DO, better operating sludge age, sludge volume index, retention time etc. We are hoping this will also create a better environment for the bugs giving us a better age, flock and increased activity which in turn is reducing our solids content and the amount of solids we are having to waste through the de-watering system. We will also have ease of servicing and will be able to maintain the new and old blowers to a better standard. There is a very minimal chance of the blower room flooding.

7 RESULTS TO DATE

In its present set up, we can see the benefits of having the system relocated to the new blower room as access has been improved and good storage for our mobile generator is already provided.

Further details on the success of this project will hopefully be outlined during our presentation at the Water New Zealand Conference in October 2013, which will incorporate survey results on the DO levels and operational improvements gained.

8 CONCLUSIONS

At the time of this paper being submitted (22 August 2013), the blower room was still not operational so we are unable to provide a conclusion to this paper.

ACKNOWLEDGEMENTS

We would like to thank everyone from the Western Bay of Plenty District Council Utilities team that has put in the extra effort in the construction of the blower room and helped us with our paper.

We would also like to take this opportunity to thank the contractors that put in the long hours and hard work to get this project completed.

- Tiaki Engineering Consultants (designers)
- Pumps R&M (mechanical)
- GDS Industries (fabrication)
- Skyline Building Te Puna (building construction)
- City Care Electrical (electrical installation)
- Armadillos (foundations)
- Rayner Consultants Ltd (fire design report and ventilation engagement)

REFERENCES

http://en.wikipedia.org/wiki/Oxygen_saturation - Definition of Oxygen Saturation or Dissolved Oxygen (DO)