TACKLING SEASONAL INDUSTRIAL WASTEWATER LOADS AT A DOMESTIC WWTP

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ABSTRACT

Industries such as wineries and boutique food manufacturers are frequently being established in smaller towns and are capable of generating relatively high-strength waste streams. With continual external pressure for Water Authorities to treat such industrial wastes, key steps need to be taken to manage the additional loading.

As well as assessment of predicted loading data and subsequent updating of infrastructure, preparation and ongoing monitoring is critical to minimise unwanted environmental and social impacts.

This paper focuses specifically on the planning, industry collaboration, as-well ongoing operational controls for BOD and odour management at the Myrtleford WWTP during the 2006 wine vintage period.

KEY WORDS

BOD – Biochemical Oxygen demand; COD – Chemical Oxygen Demand; DO – Dissolved Oxygen; NEW – North East Water

1.0 INTRODUCTION

North East Water is a regional based water authority located in Victoria. The Authority supplies water and wastewater services many towns and villages across the North East. The Authority has 19 Scheduled Wastewater premises, all with accompanying EPA licences.

The Myrtleford WWTP is a lagoon-based system, which historically received substantial industrial loads from mainly timber processing. It formerly consisted of four large lagoons, with numerous aerators located throughout the lagoons. Over the past 20 years the heavy industry has subsided in the town resulting in significantly less effluent, changing the characteristics to primarily domestic with minor industrial loads. As a result of this, most of the infrastructure (aerators) was decommissioned, and typically the system was able to treat to EPA discharge limits (including odour) with minimal operator effort due to the extended detention (> 1yr Hydraulic Retention Time).

Since the late 1990's, wineries have emerged in the area, with two businesses in Myrtleford successfully negotiating tradewaste agreements (& discharge limits) with NEW. Of these, one of the wineries was planning to process 6,000 tonnes of fruit per annum, with a gradual increase in production expected. With this forecast, NEW planned a staged approach to an upgrade of the wastewater treatment facility, allowing annual seasonal assessments of the actual growth and subsequent effluent loads before to over-committing to an infrastructure upgrade. Since 2004, actual production has increased to approximately 11,000 tonnes per year, and the winery effluent loads discharged are graphed in figure 1.

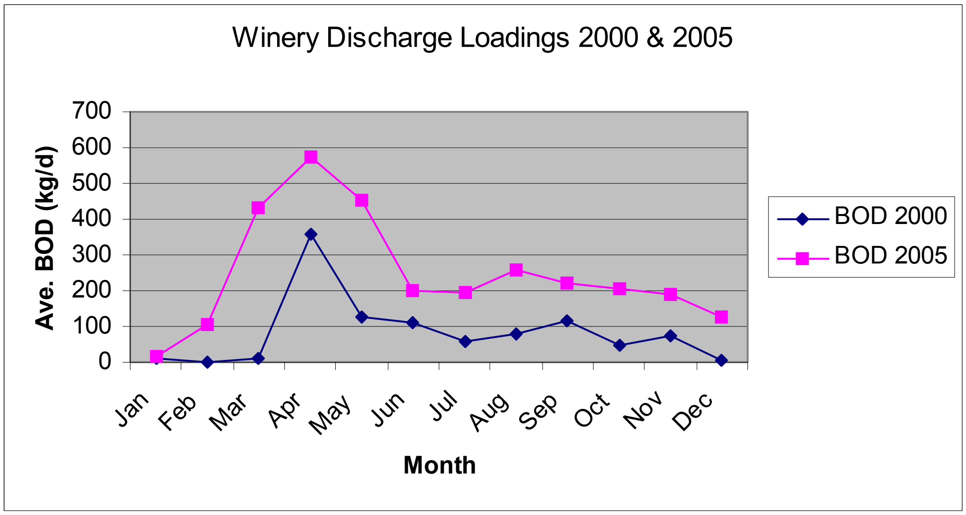


Figure 1: *Average BOD discharged from the winery in the years 2000 and 2005*

The upgrade plan included augmentation of the primary lagoon, and an upgrade of the aeration system. The primary lagoon was augmented in 2002, resulting in a system consisting of a 5ML primary aerated lagoon and a pair of parallel primary facultative (13 ML ea) lagoons. An existing maturation lagoon of approximately 100ML completed the treatment process. The aerator replacement program was to be implemented once the organic loading approached the operating capabilities, or the units were no longer serviceable and required decommissioning.

During the 2005 vintage, it became evident that it was time to commit to the aeration upgrade. Aerobic process control was lost, as peak loading into the plant was approaching 1,000kg BOD/day. At that stage, one "aged" aerator rated at 18kW was permanently operating whilst a second aerator of approximately 10kW was operating intermittently due to its poor condition. Dissolved Oxygen levels in the lagoon were < 0.1mg/L, and odour became quite substantial. A total of 5 odour complaints were made to the EPA, with numerous reported directly to NEW.

2.0 DISCUSSION

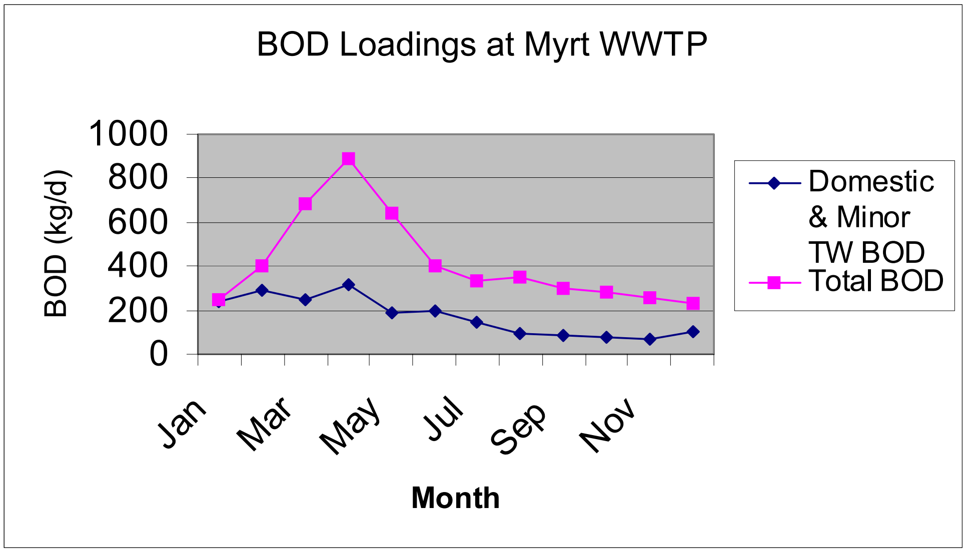
2.1 *Data Assessment & Aeration Upgrade*

An assessment of available data was required to design the aeration upgrade. Scoping also needed to include the potential future function of the aerated lagoon to achieve nitrogen reduction. Therefore, the aeration upgrade needed to ensure:

- Sufficient DO to treat predicted organic (Carbonaceous BOD) loads during maximum sustained periods ie. During peak wine vintage
- Supply required DO for Ammonia oxidation (Nitrogenous BOD)
- Supply sufficient energy to fully mix the 5 ML lagoon
- An ability to be cycled (ie. Stop / Start)

Influent loads were assessed using both monthly compliance (combined domestic & minor tradewaste) as well as the specific winery tradewaste data collated from the previous two years.

The data set was limited, and ideally an additional sampling program during the wine vintage period (eg. daily composites) would have been preferred. Due to the seasonal nature of the industry, assessment needed to occur on existing data, unless NEW were willing to risk another vintage without sufficient aeration. Often assessment data is limited due to infrequent compliance testing and that potential future industries can only provide estimates.



<u>Figure 2</u>: ***Influent BOD loads at the Myrtleford WWTP during 2004 & 05***

Figure 2 graphs the seasonal influent loads used to make the aeration assessment. The graph highlights the impact of seasonal loading into the Myrtleford WWTP as a result of the wineries production.

Total Nitrogen levels peaked at 70 kg/day.

Often, NEW use the following "Rule of Thumb" formulae and factors as a guide to assess aeration requirements and plant capacities, including:

1. Aeration Oxygen Requirements (kgO_2/d) = Q x (1.25 x BOD + 4.6 x TN)
   Where, *Q = Flow (ML/d)*
   BOD and TN are measured in mg/L

2. Surface aerator Oxygen Transfer Efficiency - 1.5 kg O_2/kW.hr, unless specific details are provided

3. 6W /m^3 to achieve full mixing – unless specific details ate available

4. Facultative treatment capacity 90kg/ha.d; which assumes BOD reduction without odours and mechanical aeration

Note the above formulae and factors are useful as a tool to evaluate aeration and facultative lagoon systems, and should only be used as a guide. Temperature (Summer/Winter), Atmospheric pressure, lagoon design (eg. Depth, residence time), and other influent characteristics can influence oxygen transfer and the rate of BOD decay.
The assessed data determined that a total of 40 kW was required to achieve aeration capacity that would meet BOD and Ammonia-N oxygen requirements, as well as fully

mix the lagoon.

Competitive quotes were sought, with Aqua-Aerobic surface aerators selected through Liquitek. It was comforting that Liquitek made an independent assessment of the data that closely matched the requirements calculated in-house. Liquitek assessment also included a predicted aeration program for a potential Intermittently Decanted Aerated Lagoon (IDAL) process, which marginally increased the aeration requirement, due to cycling.

Fortunately, power requirements at the site were met, and only minor upgrade was required prior to the in-house installation. Finally, No. 3 x 15kW aerators were purchased, installed and operating late December 2005.

Although N-reduction is a future upgrade plan, as an interim the selection gives flexibility of primarily operating 1 or 2 aerators for the majority of the year, thus saving operational expenditure.

2.2 *Industry Collaboration*

The larger winery has a basic pre-treatment facility, consisting of a series of settling pits, an equalisation basin and a pH correction dosing system. During mid-stages of the 2005 vintage, the NEW tradewaste officer reported that the system was neglected. It was reported that the pre-treatment settling pits were overflowing with substantial solids loads discharging to the WWTP.

Discussions with winery management at the time were not pleasant, as they had production priorities. An eventual meeting at the WWTP site during the odour event generated positive action plans.

- The winery committed to:
- carrying out regular desludging and maintenance of the settling pits
- installation of drain covers within the winery to reduce solids losses
- improved employee awareness within the production area

Overall, the winery is considered a “best practice” operation, however the above commitments were incentive to reduce tradewaste fees, as well as appropriate corporate responsibility.

2.3 *Wine Vintage 2006*

Prior to the wine vintage, (January 06), only two aerators were required to operate as DO levels were constantly above the target of 2ppm. Despite the encouraging DO levels, visual checks of the aerated lagoon were concerning, as the colour was dark, particularly the wash. This observation was later investigated.

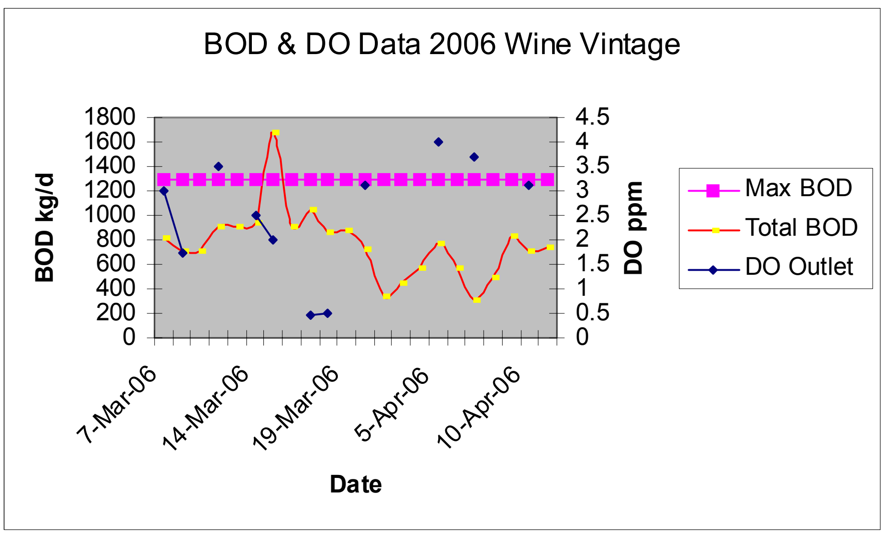
Wine production intensified mid-February 2006, resulting in doubling of organic loading into the system. In early March, composite sampler was installed specifically into the winery influent line, allowing a closer monitoring program.

The strategy was to maintain the existing lagoon monitoring program, as DO and pH levels at the inlet and outlet were routinely conducted approximately three times per week.

During the first two weeks of increased loads from the winery, the expected DO levels

(> 2ppm) were not being achieved, despite measured organic loads (COD) well below the theoretical treatment capacity. It was difficult to determine what was causing the poor DO levels, which caused some anxiousness, and further investigation. Initially our concerns were that the aerators were not effectively transferring oxygen in accordance with specifications. By referring to the literature, as well as discussion with the Liquitek, it was determined that existing accumulated sludge was competing with the fresh BOD for the dissolved oxygen. The lagoon was not desludged prior to the aerator upgrade, due to its short operating life. It appeared that the previous 2-3 years of loading and inadequate mixing resulted in a substantial volume of sludge in the primary lagoon. This is referred to as Sediment Oxygen Demand (SOD), where sediment or sludge that is not fully stabilised acts as a DO sink. Fortunately, this detrimental phenomenon was only observed for a week or two.

Figure 3 illustrates the data captured during the 2006 peak wine production. It should be noted that COD data was collected, however converted to BOD to maintain consistency of data presentation. A ratio of COD = 1.6 x BOD is used. It trends the total BOD entering the primary aerated lagoon (Note: domestic component based on monthly composite results) as well as the maximum theoretical BOD loading for the system. Dissolved oxygen levels are also overlayed with the second Y axis showing the concentration scale. The chart identifies a spike in loading during mid-March which resulted in a subsequent drop in dissolved oxygen. It also highlights the reduced loading during April, which was not expected when compared with previous seasonal data.



<u>Figure 3:</u> ***BOD (actual & Maximum loading) & DO data from the 2006 wine vintage period***

To avoid sustained loss of aerobic process during mid-March, the winery waste was diverted to the maturation pond for duration of 48 hours. This ensured a recovery period for the primary aerated lagoon, whilst having little detrimental impact on the maturation pond. As shown in figure 3, lagoon DO levels recovered to a level of 3ppm within two days after the organic load exceeded plant capacity.

Despite processing a similar quantity of fruit to 2005, winery staff indicated that the losses had reduced and the effluent collection area was maintained routinely.
This was verified in the tradewaste data, and reflected with a 25% reduction in tradewaste bill for the vintage period.

Another interesting observation resulting from monitoring program was that the organic loading for the 2006 season peaked in March, where previous data had indicated that April had significant peak loads. This actually related to the production of white, mixed blends and reds respectively. Although actual COD concentrations were higher for red wine waste, the volume discharged was significantly less, hence the reduced organic loading (kg) into the WWTP. The reduced solids losses from the settling pits at the winery also contributed to the load reduction during April.

Overall, during March / April of the 2006 wine vintage, the Myrtleford WWTP treated 10 ML containing 31 tonnes (as BOD) of winery effluent, as well as domestic and other minor tradewaste influent, without an odour complaint.

3.0 CONCLUSION & FUTURE PLANS

Although aeration upgrades and load assessment are regarded as day-to-day operations for the water industry, it can be worthwhile going back to basics.
For example:

- key "thumb rules" calculations are reasonable to make assessments of existing lagoon systems, as well as potential impacts on systems in which future tradewaste customers or domestic developments are proposed
- ad-hoc aeration upgrades will not necessarily overcome treatment issues
- existing sludge present in lagoons will compete with fresh organic influent (BOD) for dissolved oxygen
- diverting or splitting flows of raw wastewater to larger maturation ponds for short periods can assist primary lagoon recovery

Another key future function of the plant is the ability to achieve consistent Nitrogen reduction. NEW are currently investigating the possibility of converting primary aerated lagoon into an IDAL system. Once installed, further research to establish suitable conditions to achieve nitrification and possibly denitrification will be conducted.

There are also plans to incorporate a chemical Phosphorous removal facility, which will eventually result in a process train consisting of: primary IDAL, facultative, maturation, CAS, discharge.

4.0 ACKNOWLEDGEMENTS

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