OPERATIONAL CHALLENGES AT THE KOORLONG WASTEWATER TREATMENT PLANT

Paper Presented by :

Derek de Waal
Kevin Murphy

Authors:

Derek de Waal, *Operations Manager,*
Gutteridge Haskins & Davey Pty Ltd

Kevin Murphy, *Manager Technical Services,*
Lower Murray Water

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Derek de Waal, *Operations Manager*, GHD
Kevin Murphy, *Manager Technical Services*, Lower Murray Regional Water Authority

ABSTRACT

This paper presents a synopsis of the key operational issues at the Koorlong Wastewater Treatment Plant. The plant provides primary treatment of wastewater only and is designed to essentially remove solids through a chemically assisted sedimentation process. Whilst the treatment train at the plant is relatively simple, the high variability of the wastewater flows and composition complicates the operation of the plant. The disposal of effluent through drip irrigation and maintenance of the plantation pose other significant operational challenges.

KEY WORDS

Primary settling; solids removal; wastewater composition variability; filtration; irrigation.

1.0 INTRODUCTION

The Koorlong Wastewater Treatment Plant (WWTP) treats domestic wastewater and industrial or trade waste. The trade waste comprises mainly wine, fruit and vegetable processing wastes and contributes about 40% of the hydraulic load, around 75% of the total solids load and in excess of 85% of the organic load into the plant. Trade waste is typically only discharged during weekdays when industries are operating with virtually no trade waste flow over weekends.

The combination of treatment and disposal methods employed at the plant is unique in Australia. The treatment train includes screening and grit removal, chemically assisted primary sedimentation followed by effluent flow balancing and direct filtration. There is also provision for effluent chlorination. The primary treated & filtered effluent is reused on 110 ha of drip-irrigated plantations. The primary sludge is stabilised in anaerobic digesters and sludge lagoons.

Although the treatment train is relatively simple, the operation of the plant is complex due mainly to the high variability in raw sewage inflow and composition and the selection of some process components.

2.0 DISCUSSION

2.1 Wastewater Flows and Composition

The variation of inflow to the plant is significant. Not only is there a typical monthly and daily variation due to normal seasonal and diurnal fluctuations respectively, but the variation is also significant on an hourly basis. This is caused by the trade waste flows where the processing periods, discharge patterns and composition of wastes from the various industries change constantly. The wastewater flow and composition from a specific industry may therefore vary significantly over the course of the day, depending on the type of crop processing undertaken.

The average dry weather flow (ADWF) treated at the plant is 4.2 ML/d which comprises a relatively constant domestic flow of 2.5 ML/d and average trade waste flow of 1.7 ML/d. The recorded dry and wet weather peaks (with respect to ADWF) are around 2.7 and 4.1 respectively.

The raw sewage pH is typically depressed due to long detention times in the sewer. The low pH also causes excessive corrosion of all plant equipment and facilities. The typical variability of the influent composition is illustrated in Table 1.

Table 1: ***Typical variability of influent composition***

Value	Parameter				
	pH	**EC (mS/cm)**	**COD (mg/L)**	**Settleable Solids (mL/L)**	**Suspended Solids (mg/L)**
Minimum	4.0	620	290	2	120
Maximum	8.5	5 000	2 550	980	690
Mean	5.8	1 600	1 340	40	320
Std Dev	0.8	520	680	70	120

2.2 Primary Sedimentation

The chemically assisted sedimentation (CAS) process comprises lime, alum and polymer dosing of the raw wastewater to settle the solids in the two primary settling tanks (PSTs). Due to hydraulic limitations the two PSTs are operated in series.

The wild fluctuation of pH complicates control of chemical addition for effective coagulation and solids removal. Typical jar tests to determine optimal coagulant dose are irrelevant at Koorlong, as doses would have to be adjusted continually. Lime dosing for pH correction is only marginally successful due to the configuration of the plant that offers short detention/reaction times. In addition, depending on the composition of the wastewater, the lime requirement at times exceeds the dosing capacity of the system. The typical removal efficiency of the PSTs is illustrated in Table 2.

Table 2: ***Typical removal efficiency across the PSTs.***

Removal Efficiency	Parameter	
	COD	**Total Solids**
Typical Range (%)	6 - 45	70 – 85
Mean	30	75

2.3 Sludge Handling

The geometry of the sludge collection sump or hopper and draw-off arrangement in the PSTs often leads to ‘rat-holing’ so that ‘watery’ sludge is removed from the PSTs to the digesters. The rate of sludge removal therefore has to be such that optimum solids removal across the PSTs is maintained whilst minimising the hydraulic load to the digesters. This is achieved through careful scheduling of sludge draw-off when the scrapers in the PSTs pass the sludge collection hopper thus ensuring the thickest possible sludge consistency.

The digester performance is directly linked to the solids removal efficiency of the PSTs so that digester volatile solids (VS) loading rates vary widely. Also, when the sludge withdrawal scheduling from the PSTs is not optimum, the digesters suffer hydraulic overload.

Digester VS destruction is therefore highly variable often resulting in only partially digested sludge being discharged to the sludge lagoons where it undergoes further digestion.

Under these operating conditions, the digesters produce a large flow of supernatant which is turbid and black due to the lack of proper settling. This stream is returned to the PSTs for further treatment.

2.4 Effluent Filtration

The plant was originally designed with screen and sand media pressure filtration systems. However, due to the head losses through these filters using the existing filter feed pumps, the available head to the irrigation system is diminished and the irrigation system does not operate at the design pressure and flow. Both filter streams are capable of providing adequate filtration over a range of effluent quality, but depending on the effluent quality (when the solids removal efficiency across the PSTs is poor), may require excessive backwashing. The sand filters typically require less backwashing than the screen filter, which is fitted with a continuous screen wash facility.

The solids removal efficiency of the PSTs directly impacts on the downstream filtration process. When the PST performance is poor the filtration plant is overloaded with solids resulting in high backwash rates. The backwash from the filters is redirected to the PSTs for re-treatment so that the solids loading on the PSTs is increased.

In order to limit the amount of backwash return, the operations staff continually has to review the primary settled effluent quality and determine the most appropriate filtration to use, often using a combination of both types of filters. Furthermore, in an attempt to minimise the occurrence of both recycle streams (filter backwash and digester supernatant) discharging to the PSTs simultaneously, operations staff regularly has to adjust and fine-tune the pump scheduling.

It is estimated that the combined recycle stream often comprises up to 15% of total plant inflow which further complicates treatment and operational control.

2.5 Effluent Disposal

Currently around 110 ha of plantation area, planted with various Eucalypt and Casuarina species, has been developed for irrigation with the primary treated and filtered effluent. The existing irrigation system consists of 58 irrigation sections or modules (header pipes feeding into a network of drip lines along the tree row) with the trees being irrigated by in-line drippers spaced at 0.5 m along each drip line. The irrigation runtime requirement for each module is calculated by sophisticated software and is based on the soil moisture content in each module as collected by field probes.

Unfortunately, under current flow conditions the plantation is over stressed during summer when the evapo-transpiration is very high. The varied species planted allows some sections of the plantation to be placed in a drought situation so that the remainder can be irrigated to diminish the level of stress. This has led to some species displaying diminished growth rates and more significant levels of insect attraction due to under irrigation. However, during winter (particularly in wet years) some of the irrigation area is over irrigated that could potentially impact on the ground water. The management of the irrigation scheme therefore requires intensive ongoing monitoring.

This entails an annual audit of the trees and the irrigation area to predict the sustainability of the area for effluent disposal. As a result, operating practices require constant adjustment to maintain this fine balance.

In addition, due to the limitations of the filter-and-pump combination, which causes low flow rates (and pressures) in the irrigation lines, the scouring velocity in the irrigation and drip lines is compromised. Consequently, solids are deposited in the pipeline causing dripper blockages. The relatively high BOD content in the effluent that will sustain biogrowth in the irrigation lines compounds this problem. The available chlorination system is inadequate to control this biogrowth. Chlorine doses in excess of 50 mg/L (dosed over a 24 hr period) resulted in no visible residual 50 metres from the plant. Consequently the chlorination system is not used.

As a result of the above, operations staff routinely needs to undertake the cumbersome task of flushing modules and replacing blocked drip lines.

3.0 CONCLUSIONS

Lower Murray Water is considering upgrading the Koorlong WWTP. The key drivers for the authority include (1) the ever increasing processing capacity of industries and housing development in the area which discharge wastewater to Koorlong, (2) the high variability of trade waste flow and composition due to the continuous change in crops being processed, (3) issues related to the long term sustainable disposal of effluent, as well as (4) the intensive operational input required at the existing plant.

Concepts for primary and secondary treatment have been developed to allow for winter storage of effluent and land disposal not only to the on-site plantation, but also to neighbouring agricultural enterprises.

Anaerobic lagoon treatment has been short listed as a potentially suitable technology capable of providing primary treatment of the highly variable flows and high organic strength loads. A pilot trial will commence shortly to investigate the biodegradability of the wastewater and other critical process parameters.

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