METITO

Commitment to a Cleaner Environment

A Case Study

Sewage Treatment Plant at the Greens, Dubai

Introduction

The existing sewage treatment plant at The Greens residential community in the emirate of Dubai was subject to a major increase in sewerage flow due to a rapid increase in population. There was therefore a need to augment the plant treatment capacity in the shortest possible time to meet the additional load. The job of augmentation however was fraught with many constraints such as:

- Lack of sufficient space for expansion
- The physical limits of a high traffic road at the southern boundary, a school at the eastern side and some infrastructure at the northern and western ends. These limitations presented major challenges in accommodating the plant within the small available footprint and catering for both odor control and aesthetic view of the structures
- The difficult task of integrating the new plant into the existing one without stopping the inflow, which could not be diverted elsewhere
- Incorporating the new equipment into the existing STP structures

Metito took up the challenge and proposed a solution using MBR (Membrane Bioreactor) technology that was a nascent new process in the Arabian Gulf region.

Metito was awarded the multi-million dollar utilities project to increase the treatment capacity of the existing sewage treatment plant at The Greens from 3,000 m^3/d to 10,000 m^3/d, by employing Membrane Bioreactor technology. The process scheme was developed to make the best possible use of the existing treatment plant structures and add minimal new ones. Project execution involved complying with the international standards and

specifications drawn by the consultants. Metito completed this most challenging task to the entire satisfaction of the owner, and the successful operation of this entire complex was subsequently managed by Metito's efficient and professional workforce.

Scope of Work

This included the detailed engineering, manufacture, supply, installation, testing, commissioning, start-up and training of personnel at site. It also included operation and maintenance of the plant for a period of three years.

Plant General Information

The sewage treatment facility comprises the following units:

- Inlet works
- Biological Treatment
- Sludge Handling
- Chemical cleaning
- Electrical and Control system

Plant Technical Characteristics

Raw sewage from the residential community is transferred by a force main then screened before entering the main sewage lift station.

Plant Data Summary

Average daily flow	10,000 m^3/d
Peak daily design flow	12,000 m^3/d
Peak factor	2.5
Peak hourly flow	1,042 m^3/h
Peak flow duration	2 hours

Influent Analysis

Parameter	Unit	Value
Temperature	C°	22-35
BOD_5	mg/l	300
COD	mg/l	700
TKN - N	mg/l	50
NH_3 - N	mg/l	40
Suspended solids	mg/l	325
Phosphates	mg/l	10
Alkalinity (Assumed)	mg/l	Min. 250
Oil & Grease (Assumed)	mg/l	< 25
pH		7 – 8.5
Sulphate	mg/l	90
Hydrogen Sulphide	mg/l	27

Effluent Quality

Parameter	Unit	Value
Temperature	C°	22-35
BOD_5	mg/l	< 10
COD	mg/l	< 50
TKN - N	mg/l	< 5
NH_3 - N	mg/l	< 3
Suspended solids	mg/l	< 10
Total N	mg/l	< 30
Total coliform	mg/l	< 10 c/100 ml

Process Description

Inlet works

Metered raw sewage from the mains is released into a concrete channel through two 25 mm perforated plate coarse screens operating on a duty/ standby basis, then through two 3 mm perforated plate fine screens also operating on a duty/ standby basis . The inclined screen basket separates floating and suspended materials from the wastewater. The screen surface is cleaned by spray nozzles as the basket is rotating. For clean and easy handling, the collected waste from the screens is compacted and dewatered up to 40% w/w. A Vortex type grit removal system with a grit classifier is installed after the screens to remove heavy grit particles.

Partially treated raw sewage enters the newly constructed lifting station, from where it is pumped to the existing balancing tank. The tank contents are constantly mixed by submerged mixers to maintain the sewage in agitation and prevent it from turning septic.

Downstream membrane treatment is divided into three process trains to cater for plant turndown and to provide flexibility in operation. The biological treatment of each process train comprises the following process units:

Anoxic Tank (Existing)

The existing STP had two primary settling tanks. One of the existing settling tanks was converted into an anoxic tank and the other into equalization/balancing tank. The anoxic tank receives partially pre-treated equalized sewage that has been intimately mixed with nitrate laden recycled flow from the membrane tanks. Soluble and particulate COD in the incoming sewage is utilized by bacteria to effect de-nitrification under anoxic conditions. Submerged mixers in each anoxic tank keep the bacteria in suspension, homogenously mixed with the soluble nitrate.

Aeration Tanks (Existing)

Sewage from the anoxic tanks passes to the aeration tanks by gravity. The existing tanks were maintained for this purpose and surface aerators were replaced by fine bubble type diffused aeration. The aeration tanks provide an aerobic environment to ensure nitrification of ammonia and oxidation of BOD. Air supply to the diffuser system is monitored and controlled automatically to maintain optimum residual dissolved oxygen (DO) concentration in the tanks.

Membrane Bioreactor Tanks (New Tanks)

Three membrane bioreactor tanks serve the function of solids separation, whilst also assisting in the provision of air for the biological degradation processes. Each membrane tank contains 14 membrane units arranged in a double-deck configuration. To prevent surface fouling, membranes are continuously scoured by air supplied through diffusers placed below the membrane blocks. Provisions were made to chemically clean the membranes, if and when required. A diffuser flushing system is used to periodically flux the coarse bubble diffusers. Flux rate control is a critical operational feature, hence flow through the membranes is controlled by modulating the permeate control valve to achieve the required flow rate.

Recycle Pump Control

The recycle rate is fixed at three times the average flow. The recycle pumps are designed for intermittent operation to ensure a maximum recycle rate in low flow conditions. Intermitten to peration is set according to the pre-determined schedule controlled by a PLC.

Disinfection

The main treatment process removes a wide spectrum of bacteria from the sewage. Chlorination using sodium hypochlorite is however imparted in to permeate streams to remove or inactivate any pathogenic bacteria that may grow in the final storage tanks.

Sludge Digestion and Handling (Existing)

Biological sludge is pumped to the sludge digesters. Sludge is digested and stabilized under aerobic conditions. Digested sludge is then pumped to a dewatering centrifuge to produce 20 – 25% dry sludge. Concentrate from the centrifuge is returned to the plant inlet for recovery.

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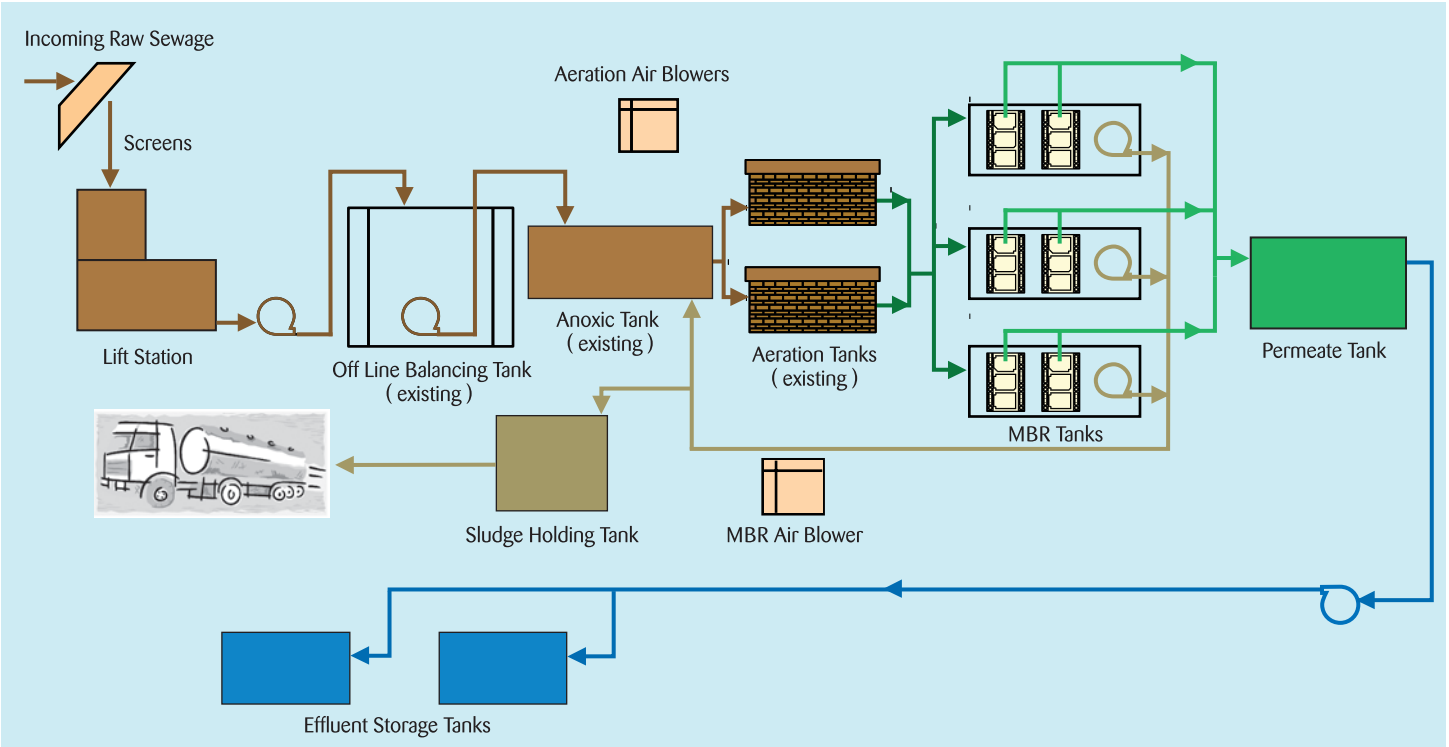
Electrical and Control Equipment (New)

This includes state-of-the-art SCADA system, PLC control panels, MCC's, cabling, wiring, earthing and plant lighting. Power to the STP plant is fed from a facility substation equipped with dual incomers (mains supply from DEWA as well as emergency supply from a fixed generator). The plant is completely powered, monitored and controlled from the STP control room. The design of the control equipment allows for separate and independent operation of the MBR streams, so that failures in the control equipment associated with one stream will result in the shut down of the affected stream only. This is achieved by efficient utilization of PLC I/O's. Important factors such as availability of plant, efficient use of manpower, high reliability and simplicity of maintenance have been considered in the design. The control system has been designed for full automatic operation with minimal observation from operator. Important process variables are logged in SCADA and can be viewed as historical/real time trends to review the performance of the plant.

Conclusion

The plant provided the advantage of minimum footprint and maximum utilization of existing structures whilst maintaining the overall architectural and aesthetic requirements. Technically it utilizes a modern up to date process that ensures a consistent quality of treated effluent.



Schematic Flow Diagram