Tecroveer Proposal

Seaview Waste water Treatment Works Proposal

P17-03-14
Process and equipment description

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1. Basis of Design

1.1 Introduction

Tecroveer we pride ourselves in offering innovative process solutions. We have been doing design and supply of wastewater treatment plants in South Africa for over 40 years. We do not offer package plants (predetermined solutions for all applications). Our innovative solutions are focused on optimising the on-site conditions with the latest proven technology.

1.2 Innovative Technology Offered

As part of our solution we have offered the following innovative technologies and techniques:

- Patented Horisontal aerator, which mixes and aerates the aerobic zone, and pumps the mixed liquor to the clarifier, replacing clarifier feed pumps.
- Return RAS from Clarifier (flow controlled with an adjustable hand sluice) Replace RAS pumps.
- Reactor/ clarifier configuration:
    - Compact design minimizes piping.

1.3 FLOW AND LOADING CRITERIA

The WwTP has been designed to the Employers requirements in terms of the design parameters to which the plant needs to comply. Our interpretation of the Design Basis is as follows:

Information given by the GILGAL Development Consulting Engineers:

- Low cost housing
- Number of households: 1050 hdd
- Average Daily Flow: 525 kl/d
- Effluent quality: To comply with DWA's General Limits

1.4 EFFLUENT DESIGN CRITERIA

Our process design is based on well-proven activated sludge principals and incorporates our latest patented technology in the application of the mechanical equipment. Various type applications were developed for different type effluent qualities. The Tec Type B plant offered would produce effluent quality that will meet the South African General Limit as per Table 3.2 below f if a N:C ratio >10 and a sustainable F:M ratio is maintained for discharge to a natural stream.

Deviations in the RAW feed from the general sewage characteristics can inhibits potential effluent quality if:

- C:N < 10
- Makes denitrification difficult
- F:M ratio must be sustainable. Raw must supply > 25% of design loading as a minimum.

GENERAL AUTHORISATIONS IN TERMS OF SECTION 39 OF THE NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998)

TABLE 2.1: Wastewater limit values applicable to discharge of wastewater into a water resource

SUBSTANCE/PARAMETER	GENERAL LIMIT	SPECIAL LIMIT
Faecal Coliforms (per 100 ml)	**1 000**	0
Chemical Oxygen Demand (mg/l)	**75***	30*
PH	**5,5-9,5**	5,5-7,5
Ammonia (ionised and un-ionised) as Nitrogen (mg/l)	**6**	2
Nitrate/Nitrite as Nitrogen (mg/l)	**15**	1,5
Chlorine as Free Chlorine (mg/l)	**0,25**	0
Suspended Solids (mg/l)	**25**	10
Electrical Conductivity (mS/m)	**70 mS/m above intake to a maximum of 150 mS/m**	50 mS/m above background receiving water, to a maximum of 100 mS/m
Ortho-Phosphate as phosphorous (mg/l)	**10**	1 (median) and 2,5 (maximum)
Fluoride (mg/l)	**1**	1
Soap, oil or grease (mg/l)	**2,5**	0

1.5 PROCESS DESCRIPTION

The process offered is the tender prescribed "Modified Ludzack-Ettinger" activated sludge treatment process. The plant is designed to produce effluent to comply with the General Limit as per the tender specficaition.

In order to optimise and economize our the design, the reactor is a pasveer reinforced concrete structure with the 45 degree side walls insito cast. The reactor is optimised by combining the anoxic and aerobic zone into one reactor, providing flexibility to increase the aerobic zone or anoxic zone depending on the inflow and aeration requirements. For aeration we make use of wo patented 15kW horisontal aerators, allowing maintenance to take place on one aerator while the plant remains operational.

2. Design Approach:

The proposal consists of the following components:

- Scope of Work:
  - Tank dump facility complete with rock catcher pre Head of Works
  - Head of Works:
    - Civil: Reinforced concrete manual grit removal channels, flume for downstream control
    - Mechanical and Electrical:
      - Galvanized Manual hand rake Screen, with a screening bar spacing of 25mm.
      - Galvanized Rag Catcher,
      - Autento or equivalent Ultrasonic flow measurement complete with a data logger as per DWA requirements,
      - Galvanized Grit scoop for grit removal
  - Reactor:
    - Civil:
      - Reinforced pasveer concrete structure
    - Mechanical: 15kW installed power (18,5kW motor) Galvanized Tecroveer Horisontal patented Aeration system
  - Secondary Settling Tank (SST)
    - Civil: Reinforced concrete structure
    - Mechanical and Electrical:
      - 8.6m diameter dortmund cone clarifier
      - 0.8ADWF to 1.5 ADWF gravity Return Activated Sludge
  - Chlorination
    - Civil: Reinforced concrete structure
      - 30 min contact time at Average Dry Weather Flow (ADWF)
    - Mechanical: Pill chlorination (We have offered gas chlorination as an optional item)
  - Sludge Handling
    - Civil:
      - Drying beds complete with filter media and plastered brick walls
    - Mechanical and Electrical:
      - Supernatant return pump and pipe work
  - Effluent polishing
    - Reed beds.
  - Site lighting:
    - 2 x 6m timber pole complete with 2 x 400W lights

3. Description of the Process Component

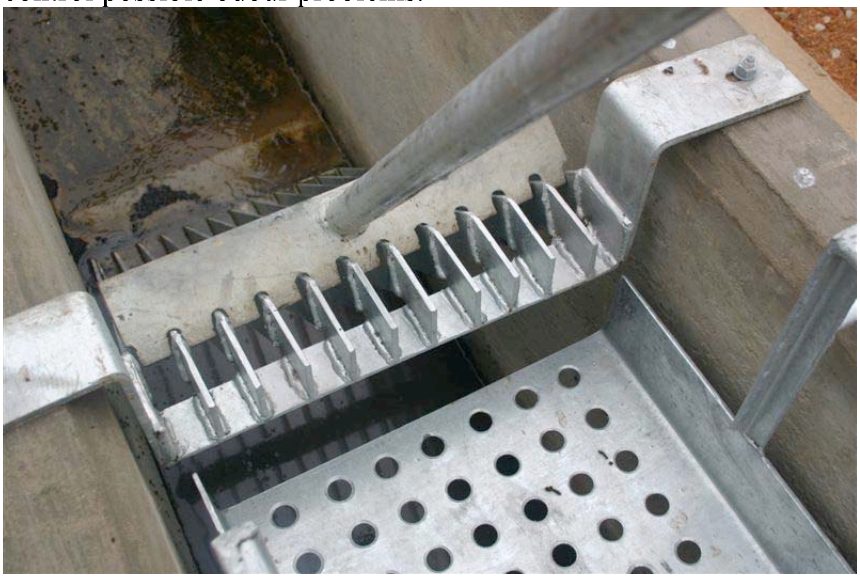
The process proposed for the delivery of a plant that complies with the requirements of the BOD and our interpretation thereof (as described above) is as follows. This proposal offering is based on the following plant design:

Tecroveer Reactor:	**Modified Ludzack-Ettinger** (MLE)
Total Volume Reactor Volume (Combined Anoxic and Aerobic)	824m³
Equipped with 2 patented Tecroveer Horisontal Aerators	2 off 15 kW
RAS Recycle rate	0.8 to 1.5 ADWF
Clarifier	
Number of clarifiers per reactor	1 off
Dortmund Cone Clarifier	8.6 m diameter

3.1 HEAD OF WORKS


Picture of Head of Works

The Head of Works consists of a manual screen, rag catchers, grit channels and an ultrasonic flow meter with a data logger. The manual screen along with the rag catchers removes large objects as well as floating and suspended material, this includes rags and other large foreign objects. The screenings are placed in a closed lid container, and once a week taken to a registered waste disposal site. If required lime can be added to the screenings disposal basin to control possible odour problems.



Picture of Manual Screen

Grit channels are installed downstream of the screens with the object of separating the inorganic material known as detritus from the less dense suspended organic solids, keeping unwanted grit from accumulating in the reactor, which over time reduces volume and capacity of Waste water Treatment Works. Two girt channels are constructed with isolating sluices, this allows for maintenance, where the grit is removed from the grit channel. The grit channel is cleaned on a regular basis, and the grit disposed of in the same basin as the rags.

Flow measurement and recording is an important DWA requirement at a sewage treatment works. Flow is measured by preceding the ultrasonic flow meter with down stream control flume. The Ultrasonic flow meter is also equipped with a data logger, which is essential for drawing up monthly flow reports as well as efficient operation of the WwTP.

3.2 REACTOR

Picture of a Pasveer Reactor – Reactor surface acts as a surge/ balancing tank

The reactor is a Pasveer shaped water retaining structure with a combined anoxic / aerobic reactor. Oxygen input and organic loading to the plant determines the ratio of these two zones automatically. The oxygen introduced into the mixed liquor over 24 hours is controlled by the average aerator submersion over 24 hours this is adjusted by adjusting the RAS ratio.

- Directly related control Ratio to inflow ratio:
- Aerator submerged rate and Aeration transfer rate
- Reactor to Clarifier transfer rate
- Effluent rate
- Aeration to RAS ratio

The aerobic-anoxic reactor is aerated by free span aerator bridges. The reactor surface area is used as a surge volume to absorb the peak inflow. This is obtained by allowing a variation in water depth of 110mm in the reactor. The energy input at minimum water level is 12 watt/m; for each aerator and is sufficient to keep the bio-mass in suspension. Mixed liquor transfer to the clarifier and sludge return to the reactor is achieved by means of Tecroveer patented process and equipment. A pump transfer launder is fitted over a segment of the rotor. Mixed liquor is pumped with the low lift high volume pump to the clarifier. Chocking the delivery pump header with a sluice controls transfer quantities. Mixed liquor is transferred via the aerator pump in controlled amounts to the clarifier. One aerator pump is 24 hour in use. This pumps' transfer is set for a sludge return rate of at least ADWF with a minimum outflow component at minimum submersion and the selected max discharge at the design peak up flow velocity of 0.63 m/hour in the clarifier at full submersion.

The discharge rate is set to disperse the morning peak volume through the system before the afternoon peak-time is reached. Should greater peak flows occur as result of peak wet-weather flow an emergency overflow mechanism is provided. This emergency overflow serves a double purpose, namely to protect the mechanical equipment from overload and will act as an outlet during long periods of power failure. The designed upward velocity in the clarifier can never be exceeded irrespective of the inflow volume. The result is a quality effluent regardless of the inflow conditions.

As the surge volume in the reactor is dissipated by means of a controlled transfer to the clarifier the water level in the reactor will drop. With the lowering in water level the pump capacity will drop down till mainly recirculating of mixed liquor takes place with a low discharge component.

The sludge density in the reactor determines the reactor volume. Research institutions empirically determined the sludge density for a specific sludge age. Tecroveer has proved that by using these guidelines conservatively a good quality effluent can be sustained.

We prefer to design our reactor volume for a sludge age of 20 days with a maximum sludge density of 3.5 kg/m3. This conservative approach has proved itself to be the only way to design a small sewage works with its fluctuating loads. Other design approaches will only produce a cheaper short-term solution but the process will fail once the system approach full design load capacity.

3.3 SECONDARY SETTLING TANK

The mixed liquor suspended solids is transferred via the patented horizontal aerator pump to the secondary settling tank, where solids separation between the effluent and the sludge takes place. The effluent flows over the v-notches and gravitates to the chlorination tank; the Return Activated Sludge is returned to the reactor by means of Tecroveer patented process and equipment. Scum will be trapped on the surface of the clarifier with a scum baffle. Scum will be drawn off to the sludge lagoons by means of a flush mechanism.

For this application we offer a 8.6m diameter Dortmund cone clarifier:

- A cost effective and general purpose sloping floor clarifier for the settlement and removal of all types of sludges where a smaller diameter clarifier will suffice.
- The circular tank floor is sloped with an incline of up to 60º.
- Mechanical equipment consists of a stationary bridge spanning the full tank. The inlet column and flocculation chamber and scum removal equipment is suspended from the bridge.
- Sludge is collected in the tank centre from where it is discharged under hydrostatic head to an external collection chamber.
- Control of the sludge withdrawal rate may be achieved by adjustable telescopic bell mouth, sluice or gate valve.

3.3.1 Return Activated Sludge (RAS):

Sludge is returned in a straight sludge return pipe that extends from the bottom of the clarifier to the return box that is bolted onto the outside of the clarifier wall. The control sluice discharges into the reactor. The return rate is adjustable and measurable. The sludge return pipe can be flushed with the sliding sluice at its' lowest level namely 750 mm below the water level in the clarifier.

Tecroveer patents this method of sludge return. It eliminates a set of sludge return pumps and has proved to be a simple, low maintenance but reliable method of returning the sludge back to the reactor

3.4 SLUDGE HANDLING

The age of the Biomass inside the reactor must be controlled effectively in order to sustain a quality effluent. The system is designed to have a sludge age varying from 15 days to 25-day sludge age.

The age must be controlled in a simple but reliable method. A constant draw-off of sludge from the reactor to the sludge lagoons is not possible as a result of the relative small flow required. Sludge will be wasted from the reactor surface on a daily basis by hand. This can be automised at an additional cost.
Sludge age will be controlled by the amount sludge wasted per day.

3.5 SLUDGE DRYING BEDS

We have designed for a sludge drying bed area of $800m^2$.
The drying beds consists of the following basic features:

- Floor with a slope of 1:12
- Low brick walls provided for a series of beds
- Filter media grading from 20mm crushed stone at the bottom, and fine sand top

3.6 CHLORINATION

3.6.1Type Chlorination

Due to the flow through the plant, gas chlorination and sodium hypochlorite can be avoided by using HTH chlorination pills.

The HTH pills will be placed inside a SS pill basket. Due to the size of the plant we would recommend pill chlorination above gas chlorination and sodium hypochlorite:

- Danger of handling gas chlorination and Sodium Hypochlorite.
- Safety equipment required for gas chlorination
- Continuous Maintenance required for gas and sodium hypochlorite.
- Minimum training level required by law for local operating personal

- Sodium hypochlorite contains 12% soluble chlorine vs pill chlorination containing 60%, resulting in five times more sodium hypochlorite required in comparison to pill chlorination.

We recommend a simple, visual, reliable and affordable method of Chlorination namely Pill Chlorination.

For disinfection on bigger plants the cost saving can justify Gas Chlorination. We offered gas chlorination as an additional option.

3.6.2Flow Measurement

Variations to inflow are absorbed on the surface of the reactor. Sludge return is measurable and adjustable and transfer to the clarifier will be via the aerator pumps. The effluent achieved will be measured over a calibrated V-notch weir. Electronic flow measurement is priced as a provisional amount depending on operating site conditions.

3.7 MATURATION CHANNEL / REED BED

Effluent from chlorination basin will be discharged through a serious of maturation channels. The channels are constructed as informal structures that are shaped with the natural contours on site. The channels are approximately three metres wide with a maximum water depth of 300mm. Defined overflow structures will be spaced at regular intervals. These channels will be planted with reeds.

This tertiary treatment process is fairly inexpensive, with almost no maintenance but a very effective means of polishing the final effluent. Due to the reeds and the additional contact time, the residual chlorine is removed from the effluent by the time it leaves the reed beds. It can also act, as an additional backup treatment should long periods of power failures occur.

3.8 ELECTRICAL

3.8.1 Electrical Control Panel

The electrical control panel will be designed by a professional Electrical Engineer and will be a freestanding 3CR12 kiosk type panel and will comply to IP55 standards.

The plant is designed to accommodate power failures. The mechanical aerators will reset itself after a power failure or temporary power drop thus resulting in continues unattended operation.

3.8.2 Site Lighting

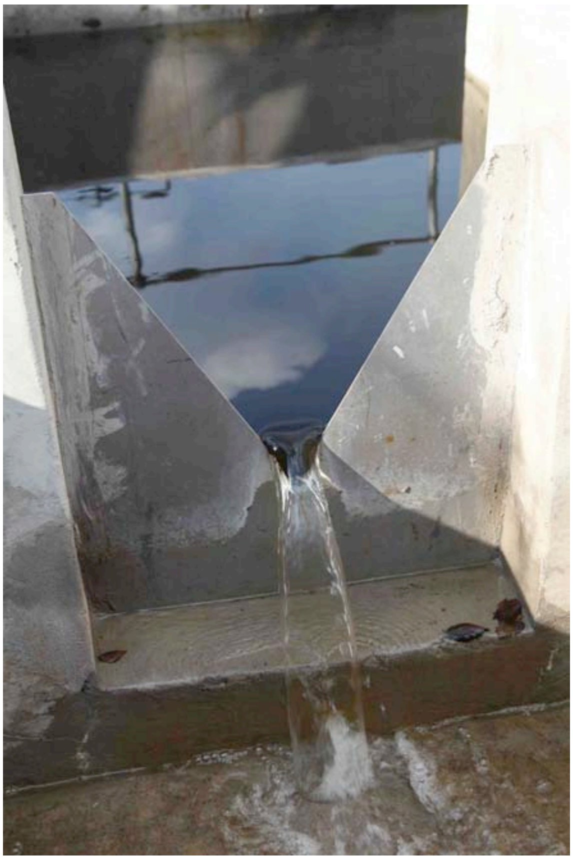
We have allowed for a six-meter high treated timber pole with Two - 400 W mercury vapour lights activated with a day/night control.

4. Description of the Proposed Process

The process is a conventional wastewater treatment works, with a Head of works, single aerobic-anoxic reactor, secondary settling tank, RAS recycle from the SST to the aerobic-anoxic reactor and chlorine disinfection.

- The RAW sewage gravitates or is pumped to the head of works.
  - The screenings and grit is stored in a closed container and transported once a week to a licensed waste disposal site.
- The sewage gravitates from the Head of Works into the aerobic-anoxic reactor, which consists of a single basin reactor for aerobic nitrification and anoxic denitrification.
- The MLSS is then pumped from the aerobic-anoxic reactor to the secondary settling tank by the Horizontal aerator.
- Scum is drawn of the reactor surface and gravitated to the sludge-drying beds.
- The effluent flows over the v-notches in the secondary settling tank, and gravitates to the disinfection tank.
- The Return Activated Sludge is returned to the aerobic-anoxic reactor by means of Tecroveer patented process and equipment.
- A constant draw-off of sludge from the SST to the sludge drying beds is possible through the use of the Tecroveer cam used for scum draw off in the SST. Sludge will be wasted from scum box in Clarifier and scum draw off on reactor, which is then gravitated, to the sludge-drying beds.
- Scum is drawn of the secondary settling tank surface and gravitated to the sludge-drying bed.
- In the chlorine disinfection tank, pill chlorination takes place, where the required chlorine concentration is maintained by adding a specified amount of chlorine tablets to the basket per week.
- Effluent polishing takes place throughout the reed bed channel.

Clean water for future generations



Picture: Effluent from similar Tecroveer Plant