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Ras Al Khaimah Sewage Treatment Plant based on UASB Technology and Aerobic Bioreactor (UASB-ABR) Combination Process



Trantad Cowana Effluent Dand near CTD





PROJECT:

Phase-1: 10 MLD Capacity (commissioned in September 2006 only with Tanker Station, Sewerage Network Connected in March 2007)

Phase-2: 30 MLD Additional Capacity with Additional Aeration Capacity of 10 MLD only (commissioned in August 2010)

Phase-3: 20 MLD Capacity Aeration Tanks with Diffusers and Air Piping Grid and Air Blowers (under Planning)

CLIENT:

Govt of Ras Al Khaimah, Sewerage Authority/Public Works & Services Department, Ras Al Khaimah, UAE

CONSULTING ENGINEERS:

EarthCAD Environment FZ-LLC, UAE

In association with

Iram Earthcad Environment Pvt Ltd, New Delhi, India

SCOPE OF CONSULTANCY SERVICES:

Scope of Work for EarthCAD under this project included:

- Review of all relevant available data, reports, drawings and maps provided by PWSD;
- Preparation of a Project Inception Report and Master Workplan in consultation with PWSD;
- Establishment of Baseline Information for preparation of Designs and Detailed Engineering;
- Review and Analysis of Soil Investigations Report provided by PWSD; and Project Environmental Impact Assessment;
- Development of Process, Hydraulic, Electromechanical/Automation Designs and Preparation of a Preliminary Design Report;
- Finalization of Designs in accordance with British Standard Codes of Practice;
- Preparation of Detailed Design Report along with Detailed Structural/RCC, Electromechanical/Automation Drawings;
- Preparation of Bill of Quantities and Cost Estimates;
- Preparation of Tender Documents in accordance with FIDIC norms;
- Procurement Support for E&M Equipments of STP;
- Supervision of Construction, Testing and Commissioning and Project Management;
- Start-up and Stabilization, Monitoring of STP;
- Operation and Maintenance of STP since Sep 2006.

TREATMENT TECHNOLOGY:

A two stage biological treatment including followed by UASB (Upflow Anaerobic Sludge Blanket) technology followed by Aerobic Bioreactor post treatment has been adopted and disinfection by Chlorine gas to make the effluent suitable for unrestricted urban and agricultural irrigation. It is rich in N, P and K. *The UASB process is described, wherein the organic matter is digested, adsorbed, absorbed and metabolized into bacterial cell mass and Biogas. It is a combination of physical and biological processes. The main feature of the physical process is separation of solids and gases from the liquid and that of the biological process is degradation of decomposable organic matter under anaerobic conditions.*



Wastewater Treatment through UASB Reactor

The wastewater treated in a UASB reactor is suitable for discharge into water bodies or for irrigation after a suitable post treatment and disinfection by chlorinating or other means. The Biogas generated consists of Methane, Carbon Dioxide, Hydrogen, Nitrogen and traces of Ammonia, and can be utilized for generating electricity. Sludge produced is stable and has good NPK concentrations and can be used as manure.



RAK STP Performance and Treatment Efficiencies

Present Flow to STP : 20 MLD Average Influent BOD: 300 mg/l Average Influent TSS: 400 mg/l Average Influent COD 1000 mg/l Average Effluent BOD: <3-5 mg/l (97 % removal) Average Effluent TSS: <10 mg/l (96 % removal) Average Effluent COD: <50 mg/l (95% removal) Faecal Coliform: < 400 MPN/100 ml





Main Units of the STP

 Holding Tank at tanker station has been provided to balance the wastewater inflow being brought from Septic Tanks in the city by Tankers. Currently, about 3.0 MLD Wastewater is being collected by the Tankers. Holding Tank is equipped with Submersible Mixers to minimize settling of solids present in the wastewater.



- <u>Inlet and Screen Chamber:</u> At present about 20 MLD flow is reaching the RAK STP from the city sewerage system and tankers.
- <u>Screenings Removal System</u> has been provided to remove the solid waste present in the influent. Step type fine mechanical screens (2 nos) are provided in two channels The Third Channel is used for emergency. The screens are able to remove all waste materials above 3 mm size and 95% of the waste of size upto 2 mm. Collection, compacting and dewatering of the removed materials is done by a common Screw Wash Press and Screw conveyor.



 <u>Grit Removal System with Grit Classifier</u>: The latest technology based grit equipments have been provided to remove the grit, which may include mud, ash, sand, clinkers and inert inorganic materials. Grit is removed from wastewater to prevent any damage to moving parts of mechanical equipment in the subsequent stages of treatment, as well as passage of this inorganic material into the UASB Reactors and Sludge. There are two Grit Removal Systems one Conventional and one Coanda Type to deal with 40 MLD Flow



Grit Removal System of STP



Top View of UASB Reactor

UASB Reactors: The Main Biological treatment of the wastewater is Anaerobic and takes place in the UASB Reactors. There are 4 UASB Reactors each of 10 MLD capacity. The flow is distributed to the Reactor through Division and Distribution Boxes, and within the Reactor, influent is received in the FRP Feed Inlet Boxes. Downtake pipes originating from the Feed Inlet Boxes distribute the influent over the Reactor bed.



Aeration Tanks: The UASB treated effluent needs polishing which is done in an Aerobic Bioreactor (ABR). The ABR includes Aeration Tanks, where the UASB effluent is retained for a short duration and oxygen is transferred from Air Blowers through Plate/Disc Type Fine Bubble Diffusers. The existing Aeration Tanks are of 20 MLD capacity and 20 MLD capacity aeration tanks will be added soon.



Ras Al Khaimah Sewage Treatment Plant





 <u>Settling Tanks</u>: The ABR also includes Settling Tanks, to facilitate sedimentation of the biological flocs produced in the Aeration Tank. Four Settling Tanks of 40 MLD capacity with 24 m in diameter have been provided.



Chlorine Tanks: Chlorination System is being used for Disinfection of the effluent before it can be used for unrestricted irrigation. This system brings down the Coliform Count below 400 MPN/100 ml, which is permissible as per WHO norms for irrigation.



 Sludge Handling System: Excess sludge from the UASB Reactors is collected everyday in the UASB Sludge Pump House and is pumped into the Sludge Drying Beds (SDBs) for dewatering and disposal. Aerobic Sludge Pump House receives excess aerobic sludge from the Settling Tanks and we can pump it into the UASB Reactors for stabilization. A centrifuge of 10 m3 per hour capacity is being provided soon to supplement this facility.



• <u>Environmental Laboratory</u>: The STP has an environmental lab equipped with state of the art instruments and equipments for testing and analysis for different wastewater and water parameters including microbiology tests. This includes a dry lab and a wet lab with Spectrophotometer, BOD Track apparatus and other instruments for testing and analysis.



Treated Sewage Effluent of STP; The STP has attained the design final effluent values. The treated effluent is being used by RAK SA for tanker/drip irrigation for agriculture and horticulture in RAK city.







Operations and Control by SCADA System

The RAK STP and its Electro-mechanical equipments/ units are being controlled by a SCADA System using a state-of-the-art Programmable Logical Controller (PLC) and Software. Each Electrical Control Panel (MCC) has a PLC compartment where Siemens input/output modules (ET200M) and the respective Digital and Analogue I/O Cards along with accessories are provided to automation. All the MCC are connected with each other in series through Modules (ET200M) and Profibus Cable. The SCADA system PCs are also connected with the main PLC by using Industrial Ethernet Network.

The SCADA System is located in the Operations & Control room of the STP. There are three PCs used for STP Operations & Control namely, HMI, Engineering Station and Historian Server. The HMI Station is being used for Monitoring and Operations of E&M Equipment. The Engineering Station is being used for application development and for the adjustments and modifications in control parameters (Set Points). The Historian Server is being used for storage of online data as a backup for SCADA System.



SCADA System (Control Station) of STP



Treated Sewage Effluent Pumping Station

A Treated Sewage Effluent (TSE) Pumping Station has been provided within the STP for pumping of Treated Sewage Effluent into Pumping Main for utilization as irrigation water for the Golf Course and the Creek Area Development as well as other RAK City areas.



Treated Sewage Effluent Pond



Treated Sewage Effluent Pumping Station at RAK STP

