

WASTEWATER TREATMENT AND RECYCLING IN REFINERY AND PETROCHEMICALS PLANT

By Praveen Gupta



Wastewater Treatment and Recycling Facility of Phase III Expansion

This plant has enabled water starved refinery to reuse 75% of their effluents generated.

Mangalore Refinery & Petrochemicals Limited (MRPL) is a subsidiary of ONGC. It is a State of Art Grass root Refinery located in a beautiful hilly terrain, north of Mangalore city in Karnataka. The Refinery has got a versatile design with high flexibility to process crudes of various API and with high degree of automation. MRPL has a designed capacity to process 15 million metric tons per annum and have 2 hydrocrackers producing premium diesel (High Cetane). It also has 2 CCRs producing unleaded petrol of high octane.

All the effluent treatment plants since MRPL's inception have been designed and executed by Paramount Limited and this case study is on Wastewater Treatment and Recycling facility of Phase III expansion project which is "a unique Refinery ETP with Recycle System" – first of its kind with combination of all latest technologies – SBR/MBR/UF/RO/VOC Control System/Bio Remediation/Wet Air Oxidation System. The key features of this wastewater treatment and recycling project are:

- ▶▶ Largest UF/MBR + RO Plant (24 MLD) of its kind in India.
- ▶▶ 75% of refinery effluent reused for cooling tower and DM water production.
- ▶▶ Combination of latest technologies of:
 - PT–SBR–MBR–RO for oily water treatment
 - PT – DMF – ACF – UF – RO for Cooling Tower Blow down Treatment (CTBD)
- ▶▶ Most eco friendly "VOC control technology and "Bio Remediation" oily sludge treatment technology.
- ▶▶ A unique Wet Air Oxidation (WAO) technology used in plant for high sulphide removal.
- ▶▶ Over 15000 m³ of RCC work.
- ▶▶ Over 1000 MT of site fabricated 6 nos. of storage tanks of capacities varying from 1100 m³ to 3500 m³.
- ▶▶ Fully DCS controlled plant.

Project Description

The overall project includes the following

packages consisting of all three treatments (primary, secondary and tertiary):

- ▶▶ Oily effluent treatment package
- ▶▶ Contaminated rain water treatment package
- ▶▶ Cooling tower blow down treatment package
- ▶▶ Sanitary sewer treatment package
- ▶▶ Bioremediation of oily and chemical sludge
- ▶▶ Volatile organic compound treatment

Fast Facts

- ▶▶ Project Assigned by: Mangalore Refinery & Petrochemicals (MRPL)
- ▶▶ Project: Wastewater Treatment and Recycling Facility of Phase III Expansion
- ▶▶ Technologies Used: SBR/MBR/UF/RO/VOC Control System/Bio Remediation/Wet Air Oxidation System

Feed capacity of plant is 1000 m³/hr (24MLD) which includes all the waste streams (oily water, cooling tower blow down & CRWS) generated in typical refinery and petrochemicals plant.

Average feed parameters are:

- ▶▶ Total Oil: 10000mg/l (free oil –9500mg/l & emulsified oil 500 mg/l)
- ▶▶ TSS: 300 mg/l
- ▶▶ COD: 1200 mg/l
- ▶▶ BOD: 600mg/l

The Effluent treatment facility consists of several packages as under:

- ▶▶ Primary Treatment comprising of API – TPI – DAF
- ▶▶ Secondary Treatment comprising SBR
- ▶▶ Tertiary Treatment comprising MBR – RO for oily water and UF – RO for CTBD

Scheme

The oily effluents are subjected to free oil and emulsified oil removal. Free oil is removed in API separator and TPI separator installed in series. Over all free oil removal efficiency achieved 95% in plant. The effluent treated for free oil in the API and TPI separators are further treated in DAF for removal of emulsified oil. Separated slop oil is collected and stored in the Wet slop tanks.

The de-watered slop oil is transferred as dry slop oil to the Refinery storage facility for further processing. The volatile organic compounds generated from oily effluent handling units API, TPI, DAF and sludge tank etc are vented to activated carbon based adsorbers for adsorption of hydrocarbons.

The sludge from the primary treatment units of oily effluent treatment package and Cooling Tower blow down treatment package is collected in a sump and thickened in sludge thickener.

This case study is on wastewater treatment and recycling facility – which is a first of its kind with combination of all latest technologies – SBR/MBR/UF/RO/VOC Control System/Bio Remediation/ Wet Air Oxidation System.



UF RO Skids

The thickened sludge (also called as oily and chemical sludge) is sent for Bio-remediation to make it suitable for land disposal. The oily and chemical sludge from the API, TPI and DAF units after thickening are treated in batch reactors for microbial action on the hydrocarbon attached to the oily sludge. The unit is designed to Bioremediate 1000 m³/annum of oily and chemical sludge in a bioreactor having a batch time of 14 days.

Primary treated oily water fed to secondary treatment plant consists Sequential Bio-reactor (SBR) followed by Membrane Bio reactor (MBR). Bio-sludge wasted from SBR and MBR units are de-watered in a centrifuge and sent for disposal.

Average outlet quality after SBR – MBR treatment is:

- ▶▶ TSS: 10 mg/l
- ▶▶ COD: 20 mg/l
- ▶▶ BOD: 5 mg/l
- ▶▶ TDS: 1650 mg/l

The tertiary treatment step is basically a polishing system, wherein the effluent is further treated in an Ultrafiltration followed by a Reverse Osmosis system. The effluent from the cooling tower blow down treatment package (after DAF – DMF – ACF treatment) along with DM-Neutralized effluent from the Refinery is treated in the UF unit. Average achieved recovery of UF system is 88%. MBR and UF permeate are further passed through RO system. Overall achieved recovery of RO system is 75%. www.paramountlimited.com

RO Permeate quality:

- ▶▶ TSS: <2 mg/l

- ▶▶ COD: BDL
- ▶▶ BOD: BDL
- ▶▶ TDS: 80mg/l
- ▶▶ Total Hardness: <5mg/l

The final permeate from RO is reused for cooling tower make – Up Water and DM Water requirement. This plant has enabled water starved refinery to reuse 75% of their effluents generated.

About the Author

Praveen Gupta is General Manager (Technology) at Paramount Limited.

Paramount Limited is India's one of the leading EPC/ DBO players in water and wastewater infrastructure and emission control space with history of pioneering and innovative technologies and landmark projects. Paramount holds specific leadership position in waste water treatment and recycling/reuse in oil & gas industry with its over 80 EPC executions in hydrocarbon industry. Based out Vadodara, it also has 2 manufacturing units with total plant area of 25000 m² having ASME U & S Code stamp accreditation and manufactures all water and wastewater equipments in-house. Paramount is also recognized globally by refineries as Project Management Consultant for their water and wastewater projects for its Design and Engineering competence par excellence.

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