

This issue of Update spotlights the most prestigious assignment of water and waste water management for the world's largest refinery - Reliance Jamnagar Export Refinery Project, Gujarat. It also features the notable contract awarded by Jindal Steel and Power Limited, an effluent treatment plant for their greenfield expansion project at Angul, Orissa. This issue also focuses on the emerging trend of treating municipal waste water for reuse.

Water & Waste Water Management at Reliance Jamnagar Export Refinery Project

Reliance Industries Limited has enhanced the capacity of the Jamnagar Refinery to 1,20,0000 barrels per stream per day (1200K BPSD) with the commissioning of the Jamnagar Export Refinery Project (JERP) in Gujarat. Speaking volumes for customer confidence in Ion Exchange's reliability and capability to execute the water management for this prestigious project, the contract for water treatment plant was awarded to Ion Exchange India, and for the effluent treatment plant to Ion Exchange Waterleau, a joint venture of Ion Exchange India and Waterleau of Belgium.



Demineralisation plant

Desalinated water is fed to the 13 x 388 m³/h demineralisation plant consisting of mixed bed units to demineralise water for the boiler water turbine and process use. The 3 x 388 m³/h condensate polishing units treat the return condensate at the refinery complex and captive power plant. The condensate, after treatment, is returned to the plant for reuse as polished feed water with low pressure and higher pressure steam generators. The return condensate is treated for removal of oil traces and low levels of dissolved solids by activated carbon filtration and ion exchange process.



Activated carbon filters

The waste water treatment is carried out in a dedicated state-of-the-art completely automated and PLC-operated effluent treatment plant. The effluent treatment area is designed to contain and treat all internal process/utility waste water and storm/fire water, with the objective of zero discharge from the new refinery complex. The treated water is recycled back to the high total dissolved solids (HTDS) treatment train or guard tanks, as required.

Effluents are segregated into four identical waste water streams designed for a treatment capacity of 500 m³/h each and maximisation of reuse.

The low total dissolved solids (LTDS) stream, a mixture of process/oily waters which includes non-phenolic waste water, is treated to an effluent quality adequate for reuse for cooling water as well as fire water make up and irrigation water for development & maintenance of the local green belt.

The HTDS stream is a mixture of process/oily waste water that has been in contact with process streams, such as in the crude unit desalters, and has absorbed or dissolved mineral ions such as sodium chloride. This stream also contains (treated neutralised) process solvents such as spent caustics, and phenolic waste water. This water is treated to an effluent quality adequate for reuse as partial make up in a sea water cooling tower.



Effluent treatment plant overview

The oily water sewer (OWS) stream is a mixture of process/oily water which includes oily condensates from various refinery units, sanitary sewage (after primary treatment), drainage from tanks, contaminated storm water, etc. The treated OWS effluent is used for horticulture.

The scope of treatment also includes three by-product streams generated during the treatment of refinery waste water - skimmed or slop oils, oily sludge and biological sludge. Skimmed oil is chemical and heat treated, with recovered oils transferred back to the refinery for reprocessing. Oily sludge is thickened and then



Slop oil tanks

transferred back to the delayed coker unit for reprocessing. Biological sludge is thickened, stabilised, dewatered and disposed off to landfill.

Each of the streams employ identical equipment for treating effluents.

- ✓ Guard tanks and equalisation tanks
- ✓ Free oil removal facilities including pre-deoiler and API separators, installed with continuous oil skimming and sludge removal facilities
- ✓ Solids and emulsified oil removal by dissolved air flotation (DAF) unit
- ✓ Two stage biological treatment – bio-tower with pH correction at outlet, and a plug flow nitrification/de-nitrification process with anoxic tank and aeration tank
- ✓ Clarification (with INDION polymer dosing to aid settlement)
- ✓ Dual media filtration
- ✓ Activated carbon adsorption (only for LTDS 1, LTDS 2 & OWS streams)
- ✓ Disinfection – with chlorine and chlorine dioxide
- ✓ Treated waste water storage
- ✓ Chemical dosing facilities (common)
- ✓ Sludge and oil handling (common)

The treatment scheme also includes an automatic belt filter press for dewatering biological sludge, two chemical houses, three analyser houses and twenty sampler skids for automatic sampling and analysis of critical effluent parameters on a continuous basis. Our scope includes supply of specialty INDION polymers and effluent treatment chemicals along with maintenance by a team of trained and competent process engineers.

The effluent treatment plant is treating 100 per cent effluent generated by the refinery since its commissioning in December 2008 and consistently producing treated effluent (pH 6 - 8.5, sulphide <0.5 ppm, COD <50 ppm, oil & grease <5 ppm, phenol <0.35 ppm) meeting guarantee parameters for reuse for various applications mentioned earlier.

Effluent Treatment Plant for Jindal Steel and Power

Jindal Steel and Power Limited (JSPL) is setting up a 6 MTPA integrated steel plant project at Angul, Orissa. JSPL has envisaged a coal gasification based reduction gas facility and the synthesis gas produced here will be used in the gas based DRI plant for the production of iron.

Crude synthesis gas obtained from the coal gasification plant is used for producing purified synthesis gas. During this process, liquid effluents are generated. These effluents contain fluorides, cyanides, sulphides, thiocyanates, nitrogen, phenols and various heavy metals. Other parameters are biological oxygen demand (BOD) up to 4,000 mg/l, chemical oxygen demand (COD) up to 6,500 mg/l, total suspended solids (TSS) 125 mg/l and oil & grease up to 50 mg/l. These toxic contaminants are harmful to the environment and aquatic life and hence cannot be discharged without treatment. They are also extremely challenging to treat.

JSPL, out of concern for environment sustainability, has planned a state-of-the-art effluent treatment plant to address this issue. Apart from meeting stringent pollution control board (PCB) norms, JSPL specified that the treated effluent should also meet World Bank standards. Ion Exchange Waterleau Ltd. was selected to set up a turnkey effluent treatment solution that would meet these requirements.

Design Philosophy

The effluent treatment plant is designed to treat a combined flow of 400 m³/h consisting of stripped gas ammonia liquor (SGAL – effluent post ammonia stripper) – 350 m³/h and oily waste & rainwater – 50 m³/h. The treated effluent will meet the discharge norms of the PCB and World Bank.

Treatment Philosophy

Liquid Effluent Streams: The oily waste water and contaminated rain water streams are passed through a tar and oil gravity separator. The treated water is added to the SGAL collection tank, and the oil and tar collected in the oil collection tank and tar collection sump respectively.

The SGAL stream is collected in the collection tanks and, after passing through the equalisation tanks, it is pumped through a heat exchanger with side stream cooling tower. The heat exchanger brings down the temperature of the stream from above 40° C to atmospheric temperature. The cooled

effluent is then taken through the flash mixer, where lime and FeCl₃ is added for pH adjustment. The neutralised effluent is then treated in customised dissolved air floatation (DAF) unit for removal of heavy metals, emulsified oil, etc. The oil-free effluent is passed through an oxidation tank for cyanide and sulphide removal before advanced biological treatment (ABT).

The ABT has several stages of anoxic and aeration to significantly reduce BOD, COD, TKN, trace phenols and cyanides. The effluent is further subjected to a tertiary treatment process that includes a secondary clarifier, multi grade filter, activated carbon filters and chlorine dosing system. The final treated effluent is pH neutral, containing BOD <30 ppm, COD <150 ppm, TKN <10 ppm, NH₃N <5 ppm, oil and grease <10 ppm, cyanide <0.2 ppm, fluoride <2 ppm, sulphide & phenol <1 ppm.

Solid Waste: The effluent treatment plant also includes two belt filter presses (BFPs) for treating solid waste (chemical & biological sludge) generated during treatment. Solids will be concentrated to 18 – 20 per cent slurry for safe disposal. The excess water drained from the BFPs is recovered and treated in the main effluent treatment plant.

Auxiliary Process Equipment with Air Treatment:

Since the process envisages usage of a large quantity of lime, a sophisticated and automated lime handling, solution preparation and dosing system are provided with a lime dust handling system to meet the stringent air/particulate emission limits. The system has a sophisticated dust/particulate handling process.

The scope of the contract includes turnkey civil design, complete electricals, instrumentation and a remote monitoring system in line with stringent design and safety criteria specified by MECON, Ranchi, JSPL's consultant for this project.

Ion Exchange Waterleau will thus deliver a world class, environmentally sustainable technology solution for the complex liquid waste generated in JSPL's greenfield expansion project.