EFFLUENT TREATMENT, RECYCLING AND ZERO LIQUID DISCHARGE IN A BULK DRUG PLANT

The EFFLUENT TREATMENT Plant treats effluents with extremely high COD, BOD and TDS to produce recycled water for beneficial use and achieves zero liquid discharge.

By Dilip R Shukla

Fast Facts

- **Project Assigned by:** Sanofi India Limited, Ankleshwar, Gujarat
- **Project:** Effluent Treatment Plant with Recycle & ZERO Liquid Discharge (ZLD)
- **Plant Capacity:** 200 m^3/day
- **Technologies Used:** DAF, MBR, RO, MEE, ATFD
- **Major Pollutants:** BOD, COD, TDS, NH4–N
- First plant in India with Teflon MOC submerged MBR membranes for treating bulk drug effluents with extremely difficult solvents

Sanofi India at Ankleshwar facility generates various wastewater streams with different characteristics in their bulk drug and pesticide manufacturing plant. Based on studies of basic characteristics of all individual streams and treatability of effluent at Paramount R&D lab, the effluent streams were classified into two major categories, which are high pollutant (HP) and low pollutant (LP) streams. Both the streams were treated as per their characteristics, keeping in view the economic feasibility of the treatment.

The treatment scheme involves mixing and treating high pollutant acidic streams with pH correction followed by Stripper, multiple effect evaporator and Agitated Thin Film Dryer (ATFD) to reduce TDS and COD (the high COD of the effluent is due to the volatile organic compounds,mainly solvents).

Secondary treatment (biological – MBR technology) involves treatment of low pollutant streams along with evaporator condensate of high pollutant as a combined stream Reverse Osmosis system for reuse and recycle of treated effluent.
The Zero Liquid Discharge is achieved by treating the RO reject mixed with high pollutant in Multiple Effect Evaporator.

The effluent streams containing high COD / TDS is mixed and treated as follows:

Parameter	Unit	Inlet Concentration		Outlet Concentration
		High Pollutant Stream	Low Pollutant Stream	
pH		<1	6.78	6.5 to 8.5
COD	mg/l	20000	3000	<100
TDS	mg/l	125000	954	250
BOD	mg/l	5000	400	<30
NH4–N	mg/l	2500	84	<50
TSS	mg/l	100	200	2.5

Inlet & Outlet Parameters of effluents

High pollutant streams having very low pH are neutralized by addition of 45% caustic soda solution. Neutralization tank is provided with air sparger to liberate volatile compounds to the extent possible. A VOC adsorber is provided to adsorb VOC gases produced in this tank.

The evaporation process involves continuous evaporation of effluent by using MP steam (at 11 kg/cm2) as heating media and condensation of the vapors by cooling water. A feed pre–heater system is provided to pre–heat the feed in order to reduce the steam requirement by utilizing partial heat carried by vapor / liquid stream. A stripping system is provided to strip off low volatile organic compounds. The pre–heated effluent is fed to stripper section. Stripper section is provided with re–boiler and steam is introduced to maintain required temperature for stripping of volatile organic compounds (solvents). The stripped solvent is then condensed and collected and is reused/ disposed/ incinerated by the client.

Additionally, a thermo vapor re–compression system is provided to economize the plant operation by reducing steam consumption. For economizing and optimizing the steam consumption, multiple effects (four effects) are installed in series so that the vapors generated in first effect are used in the next effect for effecting the evaporation so that no fresh steam is used for evaporating. The last effect vapors are condensed in a condenser using cooling water.

Treatment of Low Pollutant Stream

Primary Treatment:The Low Pollutant effluent stream containing low COD / TDS is pumped from existing tanks to an equalization tank prior to treatment. The equalized low pollutant stream is dosed in a flash mixer with coagulant (FeCl3). The effluent then overflows to flocculator for floc generation. The flocculated effluent overflows to by gravity to the dissolved air flotation (DAF) unit for removal of suspended solids. The DAF consists of increased surface area by way of plate packs. The DAF treated effluent is recycled through a saturation vessel by means of high pressure recycle pump where plant air is injected for saturation of this liquid with air.

The effluent after primary treatment overflows by gravity to the Membrane Bio–Reactor feed tank.

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Secondary Treatment by Membrane Bio–reactor (MBR) process: In secondary treatment, a composite unit consisting of aeration and membrane filtration (membrane bio–reactor) is provided for bio–logical treatment. The unit is designed to meet pollution control norms and / or to feed treated effluent to reverse osmosis unit.

Effluent from DAF is collected in a MBR feed tank. Condensate from MEE unit is also be fed to MBR feed tank. pH correction is carried out in flash mixer by addition of 33% HCl before feeding to MBR unit. The treated effluent is then fed to membrane bio–reactor. A large volume is recycled from MBR outlet back to MBR inlet (anoxic) basin. The recycle effluent containing slightly oxic sludge is quickly depleted of oxygen in the anoxic basin allowing de–nitrification process to occur. The denitrified mixed liquor flows to pre–aeration basin by gravity where additional biological treatment occurs. The mixed liquor is fed to membrane basin where effluent is filtered by submerged membranes. Pre–aeration basin is designed for oxidizing bio–degradable organic contaminants and for nitrification of ammonia. Aeration basin is provided with fine bubble diffusers for aeration.

The filtered effluent from MBR basin is collected in treated water sump. The treated water is pumped to RO system for tertiary treatment

Biological Sludge handling

The excess biological sludge produced from the biological process is wasted periodically to thickener for sludge thickening. The thickened sludge is pumped to centrifuge. The de–watered sludge is disposed secured landfill site

Tertiary Treatment

The outlet from MBR system is pumped to Micron cartridge filter. Dosing systems are installed to take care of scaling and biofouling.

Two stages of Reverse Osmosis (RO) system are provided to get the maximum possible recovery from the system. The approximate recovery of 2–stage RO system is 85% and the reject from the RO system is fed to multiple effect evaporators through neutralization tank to achieve zero liquid discharge. Permeate from both stages of RO membranes is collected in permeate tank and same is being used in Cooling tower make up water by the client.

About the Contributor

Dilip R Shukla is the Managing Director of Paramount Limited, the market leader in India in Waste Water Treatment and Reuse in Oil and Gas sector and one of the largest manufacturer of Water and Waste Water equipments with an ASME U Code stamp certified shop. Prior to this assignment he held leadership position in several leading Water Infrastructure companies including as Chief Executive – Water & Special Projects SBU of KEC International Limited, 1.5 billion USD infrastructure company of RPG group, as Whole time Director & CEO of Doshion Veolia Water Solutions etc. He is a mechanical engineer and has done post graduate diploma in Industrial engineering. He has over 33 years of experience of which over 20 years is at the helm in serving Engineering, Process & Infrastructure Industries.

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 wastewater 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.

To know more about the contributor of this case study, you can write to us. Your feedback is welcome and should be sent at: nisha@eawater.com.