TURNAROUND WASTE WATER TREATMENT PLANT CASE STUDY - EQUATE PETROCHEMICALS CO.LTD, KUWAIT, (100 m^3/hr)-FULL SCALE

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Figure 1: Containerized plant picture

Figure 2 : Inlet Water Quality

Figure 3: Treated water quality

OVERVIEW

WOG has set up, Containerized Waste Water treatment plant for turnaround waste water treatment.

The Project aims for the treatment of wastewater generated during OL2K turn-around 2017 from Ethylene Unit-2, Aromatics unit, OL2K Run-off Pond & Spill Diversion tank (D-1121) due to decontamination to meet the EPA requirements before disposal to the Sea.
The objective of this project was done in two phases;
1. First phase is to treat the wastewater generated due to Vessel & equipment decontamination from Aromatics unit (Oct-20 to Oct 30, 2017) @ 100 m^3/h rate (Around 15,000 m^3).
2. Second phase is to treat the wastewater generated due to vessel & equipment decontamination from Ethylene Unit -2 (Nov-1 to Nov-10, 2017) @ 50 m^3/h rate (Around 6,000 m^3). Also to treat OL2K run off ponds & Spill diversion tank (D-1121) materials in case of any emergency spills (Around 5000 m^3).

TECHNICAL FEATURES

1. Plant is designed to treat High strength COD, which is not biodegradable.
2. Can treat Wide range of organics.

CHALLENGES

Benzene, Xylene present in the effluent was difficult to treat.

BENEFITS

- Easy to transport and operate
- Equipped with latest technological features such as Oil & Sludge removal mechanisms,
- Electro Oxidation and Resin based treatment
- Additional capacity to handle shock loads
- Can be an add on to the existing wastewater treatment facilities
- Support system for Sustainable Development
- Environment friendly approach

Table 1 : Design parameters and values for full scale plant

DESCRIPTION	VALUE	Inlet	Outlet
Flow rate	M3/hr	100	<100
pH		4-10	6-8
TOC	ppm	5000-9000	<50
Total Carbon	ppm	1000-10000	<65
Benzene, Toluene, Xylene	ppm	<1-500	<0.1
Phenol	ppm	<55	<0.5
COD	ppm	1000-20000	<150
TSS	ppm	1000-10000	<10
Colour		Turbid & Emulsified	Colourless
Oil & grease	ppm	10000	<10

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PROJECT BACKGROUND

During TA-2017, all vessel, columns, piping & equipment were opened for maintenance inspection & other requirements. For this purpose, the vessels will be decontaminated by a separate vendor and the wastewater generated from the decontamination was supplied through Episodic header by EQUATE for treatment.

The following facilities at EQUATE need the treatment:

Ethylene-2
Aromatics
Utilities WWTP Spill Diversion Tank
OL2K Run off Pond

UNIT WISE DETAILS:

Ethylene-2

Requires a treatment capacity of around 6000 m^3 along with required buffer vessels to treat all of EU-2's drained waste liquid from vessels, tanks and loops that will contain thick solids, coke, tar, Polymers, Amines, Benzene, H_2S, spent caustic, light ends etc., along with decontamination treatment chemicals. The discharge shall be discharged to the Gulf Sea meeting K-EPA regulations.

Aromatics

Requires a treatment capacity of around 15000 m3 along with required buffer vessels to treat all of Aromatics drained waste liquid from vessels, tanks and loops that will contain thick solids, aromatics, coke, tar, Polymers, Amines, Benzene, H2S, heavy ends, light ends etc., along with decontamination treatment chemicals. The discharge shall be discharged to Gulf Sea meeting K-EPA regulations.

Spill Diversion tank

The treatment unit should have the flexibility of treating off spec wastewater from Spill diversion tank with TOC of more that 5000-10000 ppm and oil& grease of >100 ppm. (Maximum expected water will be around 2000 m3).

OL2K Run Off Pond

Requires min. 3000 m3 of treatment capacity with pH correction skids, dosing chemicals, along with required buffer vessels to treat the waste water collection at the basins having high pH (> 10) and TOC of 500 ppm. This runs off pond will contain all the drained water from seawater, distilled water and cooling water systems for treatment during 20 days of TA duration. This shall be treated and dispose of directly to the Gulf Sea meeting the KEPA regulations.

PILOT TRIAL

WOG did the pilot run for validating the treatment process conceptualized by WOG in both Ethylene and Aromatic Units. The test run in Ethylene Unit was performed from 15 Dec 16 to 25 Dec 16, the run in the Aromatics was performed from 1st Jan 17 to 8th Jan 17. WOG achieved good results and validated the treatment process. Various effluents with extreme qualities were given to test the pilot run, however WOG did the run based on their

experience of treating similar kind of effluent. In turn, it was a good learning exercise for WOG which are now having a good know how of the effluent that will be generated in the main Turnaround.

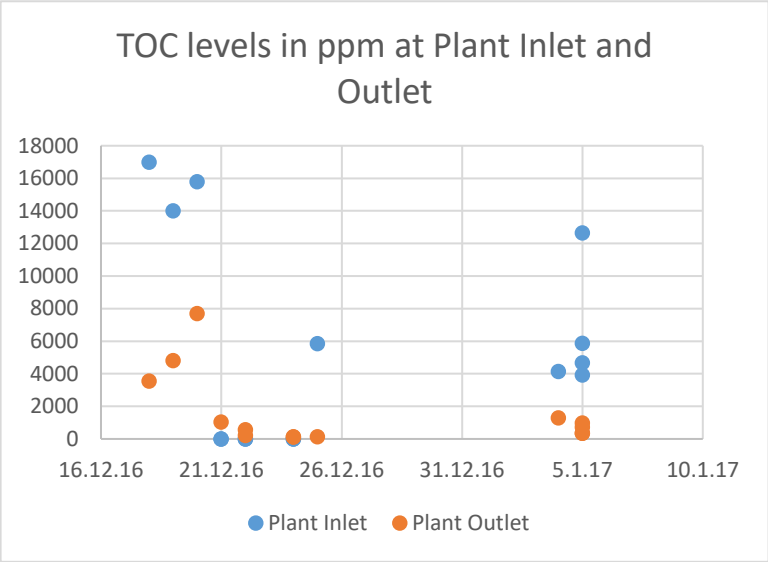


Figure 4 : Pilot trial TOC results.

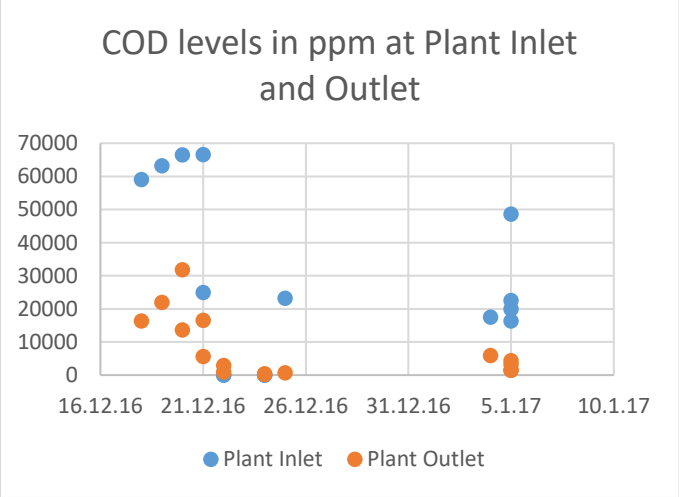


Figure 5: Pilot trial COD results.

PROCESS DESCRIPTION:

The primary treatment for turnaround wastewater is a physical operation, usually gravity separation, to remove the floating and the settleable materials in the wastewater. The primary treatment step will consist of an oil/water separator where oil, water and solids are separated. This is followed by a secondary oil/water/solids separation step in which a DAF unit is used for removal of emulsions aided by chemicals. This will be followed by residual oil removal by Oleophilic filters, Oxidation of pollutants by Electro Oxidation and polishing by filters. The process units shall be covered with the cover plates with vent system for VOCs.

Based on the pilot run, WOG proposes the below treatment units for the Turnaround Effluent Management. The treatment capacity shall be 100 m3/hr. The treatment steps are as mentioned below.

- Primary collection tank with hopper bottoms
- Preparator
- Tilted Plate Interceptor
- Flash mixer/ph Adjustment Tank
- Flocculation unit
- Dissolved Air Floatation Unit (DAF)
- Intermediate Break tank
- Oleophilic Filters

- Intermediate Break Tank/ EO unit feed tank
- Electro Oxidation Unit (EO)
- Intermediate Break Tank/Filter feed tank
- Dual Media Filter
- Activated Carbon Filter
- Treated water tank

Figure 6 : Containerized Waste Water Treatment Plant

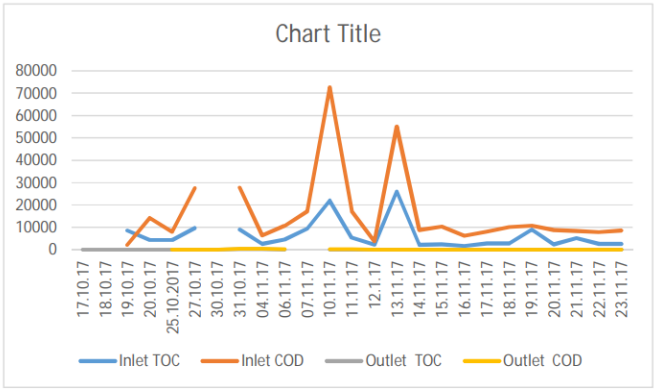
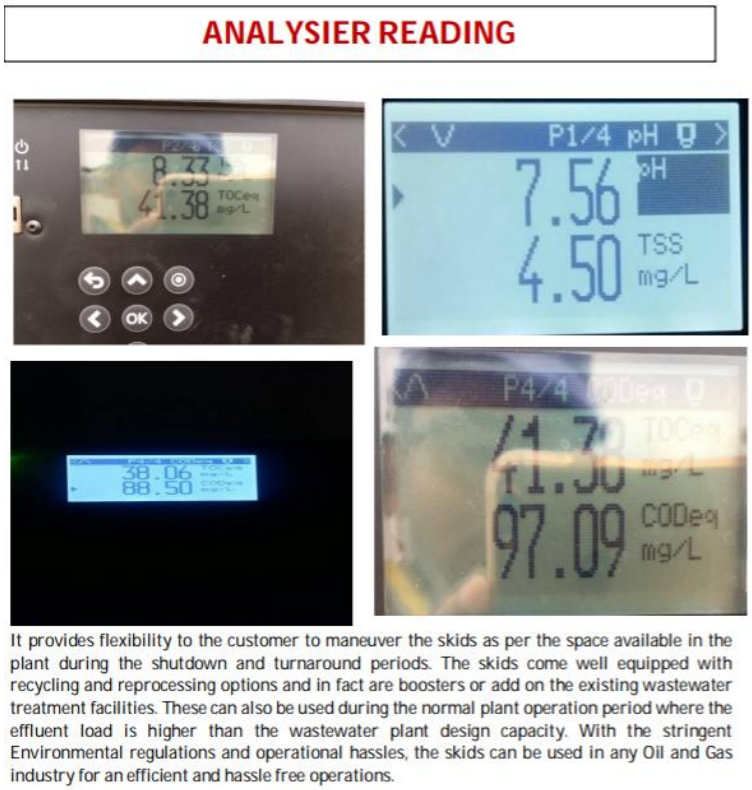


Figure 7 : Given here is a typical data set.The trends show the reduction in TOC and COD levels captured over a window of operation.



It provides flexibility to the customer to maneuver the skids as per the space available in the plant during the shutdown and turnaround periods. The skids come well equipped with recycling and reprocessing options and in fact are boosters or add on the existing wastewater treatment facilities. These can also be used during the normal plant operation period where the effluent load is higher than the wastewater plant design capacity. With the stringent Environmental regulations and operational hassles, the skids can be used in any Oil and Gas industry for an efficient and hassle free operations.

Figure 8: TOC, PH and COD readings from the online analyzer

WOG Also supplied and installed Geo membrane in the waste water collection tank (basin).

Figure 9 : Geo Membrane- Completely installed in the basin

ABBREVIATIONS

1. BOD: Biological Oxygen demand.
2. COD: Chemical Oxygen demand.
3. TOC: Total Organic Carbon.
4. EO: Electro Oxidation.
5. DAF: Dissolved Air Floatation.
6. VOC: Volatile Organic Carbon.
7. EPA: Environmental Protection Agency.