PETROLEUM REFINERY WASTEWATER TREATMENT

What is the function of a petroleum refinery?

A large range of highly valuable products are produced by refining of crude petroleum. Fuels produced by refineries are the sources of transportation energy for automobiles, marine engines, and aviation jet engines. Petroleum products accounted for the generation of close to 30% of all electrical energy in the US in 2017. Lighter fractions from refining operations are further processed to produce chemicals that are essential as raw materials for other industries. These include consumer goods, automobile components, packaging materials, medical devices, fertilizers, and numerous other items for day to day use. Contribution of refined petroleum products is immense to the modern society.

Role of water in petroleum refining

Water plays a critical role and is extensively used to support petroleum refining operation. Some of the important uses for water are:

- Process water – water and steam used in chemical processes
- Cooling water – water for coolers and heat exchangers
- Boiler feed water – water to produce steam for power generation and chemical processes
- Drinking and sanitation water – water for human consumption and use by the refinery staff

EFFLUENT TREATMENT FROM REFINING OPERATIONS

Process water and process steam come in contact with, and become contaminated by chemicals, which are often hazardous and toxic. Combined together, these streams form process wastewater, requiring treatment for safe disposal. Refinery wastewater consists of various organic contaminants, as well as small quantities of hydrogen sulfide, ammonia, cyanides, heavy metals, and salts.

Segregation and collection of waste streams is the first step before combining them for treatment. The wastewater treatment process consists of multiple steps in series - primary treatment, secondary treatment, and tertiary treatment. Primary treatment is performed by API and DAF (Dissolved Air Flotation) separators to remove oil and solids from wastewater streams. Separated oil and sludge are collected, and the aqueous phase is sent to secondary treatment.

Secondary treatment is comprised of biological removal of organic contaminants for meeting the discharge requirements for chemical oxygen demand (COD) and biological oxygen demand (BOD). Treatment process is mediated by a microbial population in a bioreactor. Biomass is separated from liquid by a gravity clarifier, or a secondary dissolved air floatation (DAF) separator and the treated effluent is discharged for final disposal.

Tertiary treatment comprises of enhancement of the effluent quality to meet specific requirements for disposal and/or reuse. Typically, it consists of addition of a final filtration step to ensure achievement of effluent total suspended solids (TSS) below 10 mg/L consistently by multimedia filters to make it suitable for land application, irrigation and/or cooling or fire water make-up. Membrane processes, e.g. ultrafiltration (UF) and reverse osmosis (RO) are sometimes added to produce high purity water suitable for use as boiler feed make up water for high-pressure steam generation.

HEADWORKS TECHNOLOGY

Headworks ActiveCell Moving Bed Bioreactor (MBBR) is one of the latest developments and a state-of-the-art biological treatment technology. MBBR removal rates for BOD and COD are superior to the conventional activated sludge (CAS) process in reactors of the same volume. The special features of this technology can be summarized as follows:

- Moving Bed Bioreactor (MBBR) is an innovative and state-of-the-art-technology used to overcome challenges posed by characteristics of concern associated with opportunity crudes.
- Headworks has developed in-house media which is the main component of this system. This has high surface area and therefore provides high surface for degradation of solids in the wastewater.
- The media is made of virgin high-density polyethylene (HDPE), and occupies 30 to 60% of empty tank volume. Its specific gravity is 0.95 to 0.98 and therefore it floats in water.
- Headworks International has over 15 years of wastewater design experience.

TECHNOLOGY ADVANTAGES

- Stable Process – Due to attached growth, toxic upsets and hydraulic 'wash out' events affect only the top layers of the biofilm containing the microbial population, thus process recovery is fast and smooth.
- Improve Sludge Quality – Nitrification in the IFAS system occurs at low suspended-sludge age, resulting in better sludge settling properties.
- Resilient to peak flows and shock loads.
- Attached growth biomass is resistant to toxic and shock loads.
- More effective in breaking down hard-to-degrade organic constituents present in refinery wastewater than other traditional biotreatment processes.
- Biomass in attached growth are less vulnerable to bulking and foaming compared to suspended growth.

END-USER BENEFITS

Cost-Effective
Lower capital and operation costs than conventional alternatives.

Small Footprint
Allows for expansion / upgrade without additional tankage.

Low Maintenance
Self-regulating process automatically responds to fluctuations in organic loads, without the need for operational adjustments.

Expandable
The IFAS process allows gradual, multi-step, plant expansion, due to the progressive addition of media.

Headworks® INTERNATIONAL

QUALITY THAT **NEVER QUITS**

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WANT TO KNOW MORE?

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