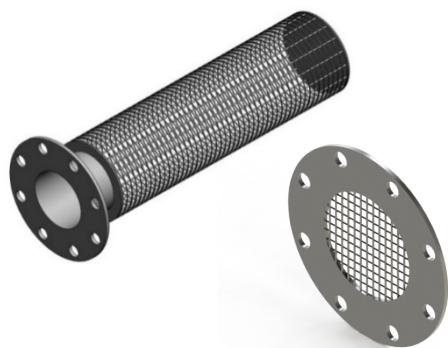


Refinery Water Treatment (Opportunity Crudes)

What are Opportunity Crudes?

Over the decade due to high competition in the oil and gas Industry, many refiners have been increasingly using crudes which are available at lower than benchmark process, and offer significant opportunities for margin enhancement. These crudes are known as opportunity crudes.

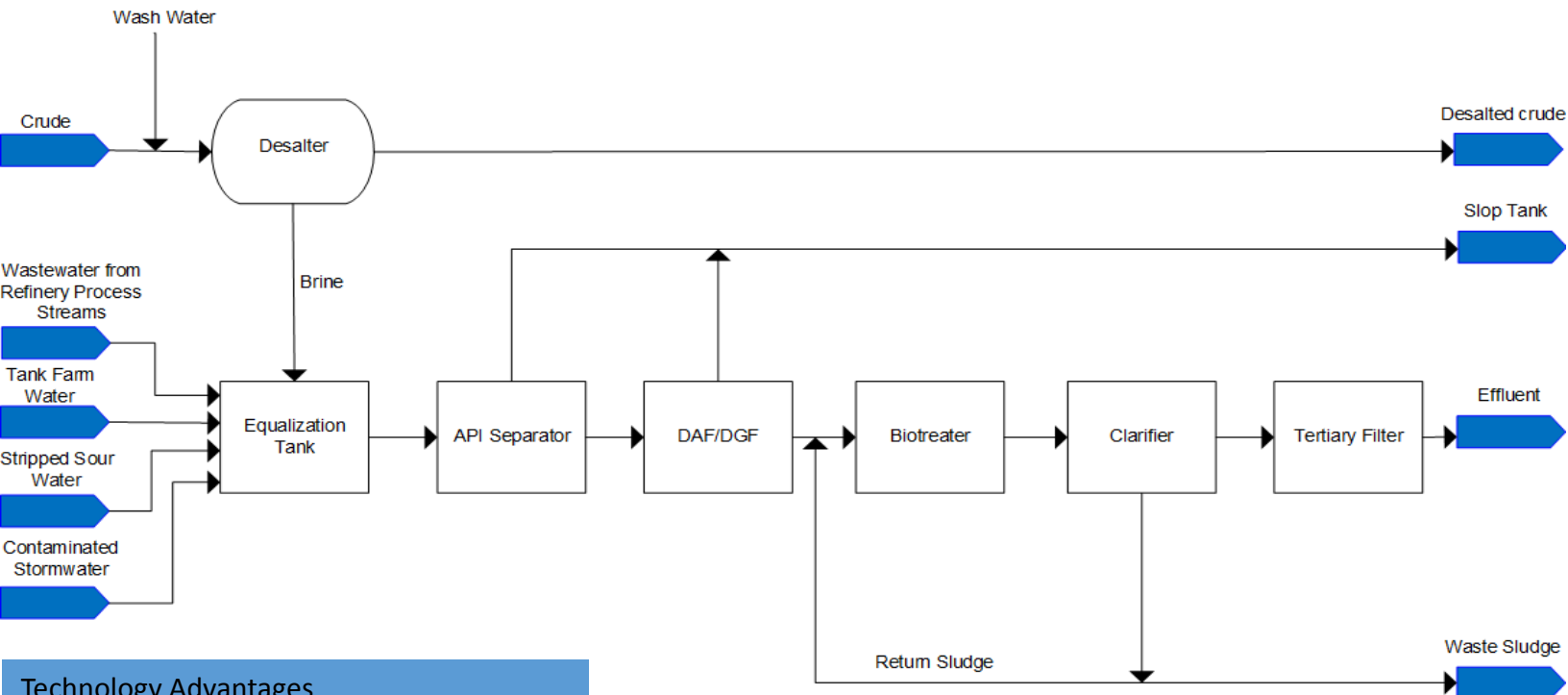


Why are Opportunity Crudes a concern?

Although the crudes have economic advantages they have challenges associated with processing, as follows:-

- High and low API gravities outside desirable range
- High viscosity, leading to high energy for liquid pumping and mixing
- Naphthenic acids content causing equipment corrosion and challenge to biotreatment of wastewater
- Metals concentrations, especially Ca and Fe, resulting in scaling and catalyst fouling.
- High filterable solids (FS) that deposit in process and wastewater treatment equipment, resulting in reduction in retention time and incomplete reactions
- High amines concentrations that adversely impact desalter operation and biological wastewater treatment process.

Process Flow Diagram



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.

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 Technology

- 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 high-density polyethylene(HDPE), and occupy 30 to 60% of empty tank volume. Its specific gravity is 0.95 to 0.9 and therefore floats in water.
- Headworks Bio has over 15 years of wastewater design experience.

