Application Note

Refinery Wastewater: Oil& Grease Removal

Industry: **Refinery, Oil & Gas, Wastewater**
Product: **pH/ORP and Dissolved Oxygen Process Liquid Analyzers**

Background Information

Removal of free oil and grease from a wastewater stream reduces the potential for equipment problems to occur further downstream. There are three forms of oil encountered in wastewater treatment at a refinery. They are:

1) Free Oil or floating oil is removed by either skimming the surface in the skim tank or by gravity separation in the API separator.

2) Emulsified Oil is comprised of oil droplets in stable suspension within the wastewater. Removal requires chemical addition to lower the pH followed by addition of dissolved oxygen or nitrogen to remove the emulsified oils as they break free from the wastewater.

3) Dissolved Oil is a true molecular solution within the water and can only be removed with biological treatment.

Figure 1 shows a typical biological wastewater treatment schematic; however other treatment options do exist as well. Biological treatment systems are commonly used for “normal” industrial oily wastewaters streams, and can also be used to treat sanitary waste. A disadvantage is the difficulty sustaining the biomass environment due to high swings in wastewater concentrations, TDS and temperature.

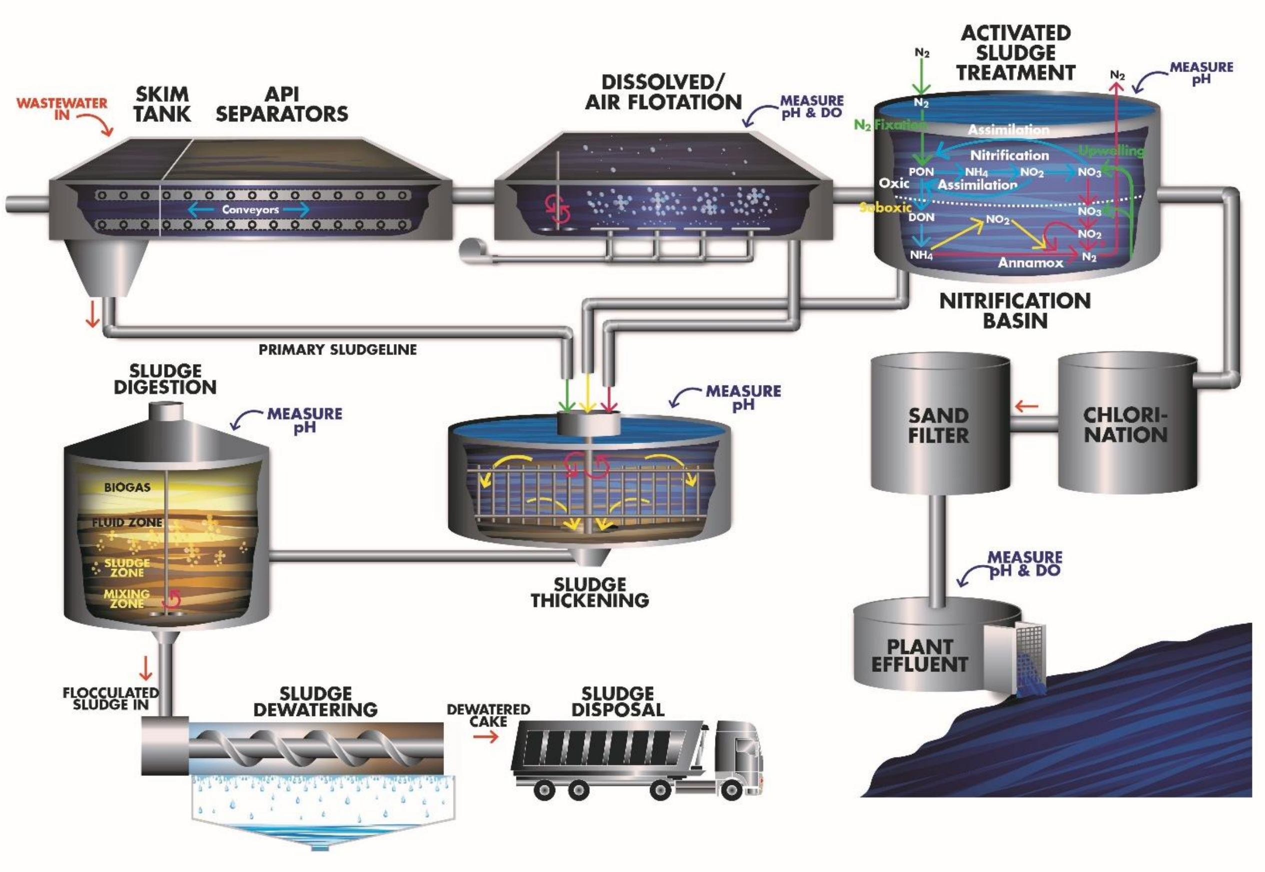


Figure 1.

Introduction

API Separators: API or American Petroleum Institute Separators are normally the first and most important step in a refineries wastewater treatment. It uses the differences in oil and water's specific gravity to filter out the majority of free oil within the mixture. The lighter oils will remain at the top of the liquid and can be skimmed off, while the heavier oil will settle to the bottom.

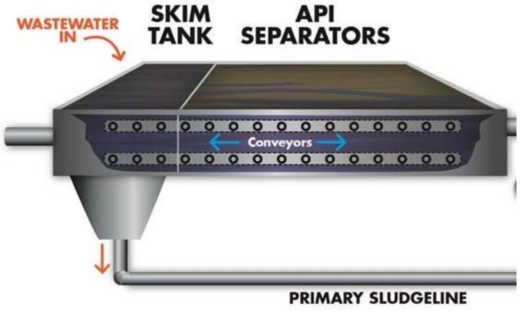


Figure 2.

The above figure 2 shows a detail drawing of a typical API separator. A conventional oil-water separator contains a conveyor to assist in the separation of the heavier oils and grease, a scraper/skimmer and a baffle.

pH is typically measured at the outlet as an indicator of potential problems, such as flocculation, in the secondary treatment. It is important to note that because emulsified oil is still present in the water mixture, coating will occur causing a sluggish reading.

At this point in the treatment process the emulsified oil is still in soluble form. The removal of the emulsified oil requires either a chemical addition to lower the pH or use of emulsion breakers.

Dissolved/ Air Flotation: Once treated, the wastewater often enters an air flotation unit to remove the emulsified oil as it begins to break free from the wastewater, using dissolved oxygen or nitrogen.

Bioreactors (Activated sludge treatment): At this phase the wastewater still contains dissolved oil in a true molecular form. The only way to remove the remaining dissolved oil is thru biological treatment. This and the remaining steps are the same as those found in a normal wastewater treatment facility.

Many components in the process must be in balance in order to obtain complete synergy such as, biomass blends, air, return activated sludge (RAS), waste activated sludge (WAS) and throughput. It is essential to monitor and control all factors which influence the efficiency of the biological conditions in the basin; for example:

Temperature: Most biomass achieves optimum efficiency in a temperature range between 10-40° C. Increasing or decreasing the temperature can result in the increasing or decreasing the rate at which the bugs eat and reproduce. All chemical reactions taking place are affected by the process temperature as well.

pH: For most systems the pH should be kept between 6.5 to 8.5 pH, when the pH is too high or too low, the biomass loses the ability to convert the food to energy and raw materials. A pH below 6.5 may cause growth of fungi and fungal bulking, and will have to be adjusted using a caustic, lime or magnesium hydroxide.

Low Nutrients: If nitrogen and phosphorus are not present in sufficient amounts it can limit the growth rate of the biomass. A sign of nutrient deficiency includes foam on the aeration basin.

Dissolved Oxygen: DO is a critical measurement and will be maintained between 1-3 mg/L. The concentration is an indication of the basin environment; whether it is in denitrification (excess nitrate, NO_3) or nitrification (excess ammonium, NH_4) environment. Essentially the DO measurement is used to minimize ammonium breakthrough. It is not uncommon to see NH_4 and DO measurements together.

Septicity/Toxicity: Septic wastes contain elevated amounts of sulfides and organic acids (such as acetic acid).Other organic materials and heavy metals are also toxic to the biomass, reducing their efficiency or even destroying them.

Summary

Maintaining proper pH measurements upstream and decrease problems seen downstream.

Product Recommendations

pH Measurement System

Process Liquid Analyzer:

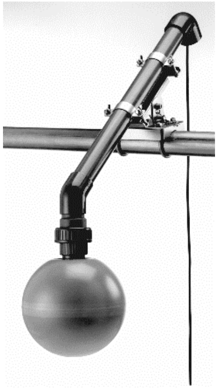
- 2-wire FLEXA pH/ORP Analyzer
- 4-wire PH450G pH/ORP Analyzer

Sensor Selection:

FU20//FU24 Wide Body Four-in-one pH sensor. Alternatively SENCOM sensor can be used FU20F/FU24F

Holders: (for FU20(F) sensor)

PB30 Floating Ball, when using S200256L8 adapter



Dissolved Oxygen Measurement System

Process Liquid Analyzer:

- 2-wire FLEXA Dissolved Oxygen Analyzer
- 4-wire DO402G Dissolved Oxygen Analyzer

Sensor Selection:

Option #1:

DO30G Galvanic Sensor

Holders:

- PB30 Floating Ball
- FD30 Immersion Fitting

Option #2:

- DO70G Optical DO Sensor
- Hamilton VisiFerm Optical DO Sensor

**Please note that an external 24 VDC power supply, like the Yokogawa DOX10, must be used with the sensor.*

Holders:

- PB30 Floating Ball **Available as special**
- FD40 Immersion with K1523JA adapter

Note: For additional information on this application contact the local Yokogawa Process Liquid Analyzer Department