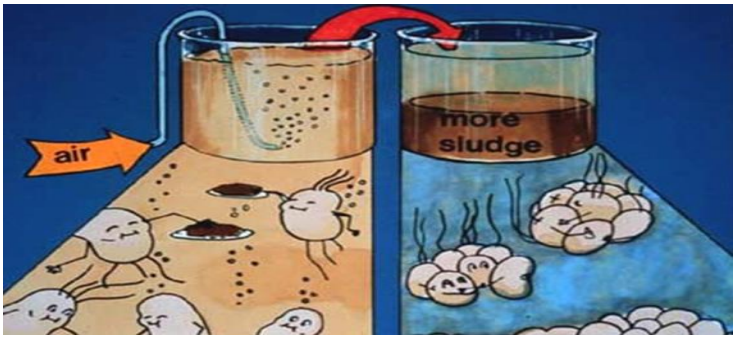
Napa Tiny Bubbles Solution Sheet



Calculating oxygen requirement and organic loading are two important factors treatment plant operators have to understand in order to operate the activated sludge process in a wastewater treatment plant.

Microorganisms are used to treat wastewater. Microorganisms in the treatment plant's activated sludge process treats or cleans the wastewater by using the contamination in the wastewater as their food source. The information the plant operators needs to understand are:

- How much contamination (in pounds) exists in the wastewater that needs treatment. Contamination is measured as pounds of Biochemical Oxygen Demand (BOD).
- How many microorganisms (in pounds) must be in the treatment process in order to oxidize, biodegrade or consume the contaminants the wastewater.
- How many pounds of oxygen (usually supplied as dry air) must be applied and maintained in the activated sludge process to support microbial respiration and metabolic functions.

Like humans, animals and other organisms, the microorganisms used to treat wastewater need the right amount of food in order to survive and thrive. Organic loading in wastewater is measured as BOD which is a measure of the strength of wastewater needing treatment. The BOD or organic load serves as food which the microorganisms consume and thereby remove from the wastewater. Treatment plant operator must understand and maintain the proper relationship between the contaminants (organic load) in the wastewater, the amount of microorganisms in the treatment system process, and the oxygen that must be supplied to the treatment process.

The comparison of pounds of BOD to pounds of microorganisms is referred to as the Food to Microorganism (F/M) ratio. Most treatment plants operate at an F/M ratio of 0.2 to 0.5 lbs. BOD/Lbs. MLVSS. This means for every 2 to 5 pounds of organic load in a volume of wastewater the treatment system must contain 10 pounds of microorganisms in order to stabilize and remove that organic load. In addition, the amount of oxygen that an operator will need to supply to an activated sludge process can vary with many factors such as water and air temperature, the BOD of the waste needing treatment, the level of treatment desired, the transfer efficiency of the oxygen delivered to the microorganisms, the system microbial waste rate, etc…. However, as a general rule the operator will need to supply between 0.7 – 1.5 lbs of O2/lb of BOD removed from the wastewater. With 1.10 Lbs of O2/Lbs BOD Removed being a typical value and we will use this value for this exercise.

1. Organic Loading (Food/Microorganism ratio)

a. Convert a concentration of wastewater contaminants to pounds.

i. A wastewater flow rate is 6 MGD (million gallons/day) has an organic loading concentration of 250 mg/l BOD (Biochemical Oxygen Demand).

BOD (food) = 12,510 Lbs/day = 8.34 (lbs/gal x L/Mmg) x 6 MGD x 250 mg/l

b. Determine microorganism population in pounds.

i. A wastewater treatment tank has a volume of 3.0 (MG) million gallons and has a solids concentration of 2500 mg/l (parts per million). The solids are 81% volatile (microorganisms).

{Lbs/day} = 8.34(lbs/gal x L/Mmg) x Vol, [MGD] x conc, [mg/L] x % Volatile.

= 8.34 (lbs/gal x L/Mmg) * 3MG * 2500 mg/l * 81%

Lbs. of Microorganisms = 50,665.5 = 8.34 (lbs/gal x L/Mmg) * 3MG * 2500 mg/l * 0.81

c. Comparing pounds of wastewater contamination to pounds of bacteria in the treatment system what is the Food to Microorganism Ratio?

0.24 = **12,510 lbs. of Wastewater Contaminants (BOD)/day**

50,665 Lbs. of Treatment Microorganisms

(Normal Food to Microorganism Ratio is 0.2 to 0.5)

3. **Oxygen Loading Rate**

- **Given:**
  - **The normal range of oxygen demand required to stabilize BOD in the carbonaceous stage varies from 0.7 to 1.5 lb O2/ Lb of BOD.**
  - **Air contains 78.09% nitrogen, 20.95% oxygen, 0.93% argon, 0.04% carbon dioxide, and small amounts of other gases.**
  - **1 lb of air is approximately 23.3% Oxygen or 0.233 lbs**
  - **Given 12,510 Lbs of BOD (wastewater contamination)**
- **Assume 1.1 Lbs of Oxygen (O2) per 1 Lb of BOD removed**

1.1Lbs Oxygen = X lbs Oxygen

1.0 BOD 12,510 lbs BOD

(X) (1.0) = (1.1) (12,510) = 13,761 Lbs Oxygen

Or

(1.1Lbs Oxygen)(12,510) = XLbs Oxygen = 13,761 Lbs Oxygen

(1.0)