

ACTIVATED SLUDGE PROCESS

To "Treat" Wastewater

Remove (reduce) Or "Stabilize"
The Material in Wastewater

SECONDARY TREATMENT

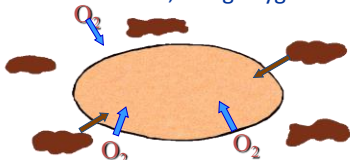
Biological Wastewater Treatment



SECONDARY TREATMENT

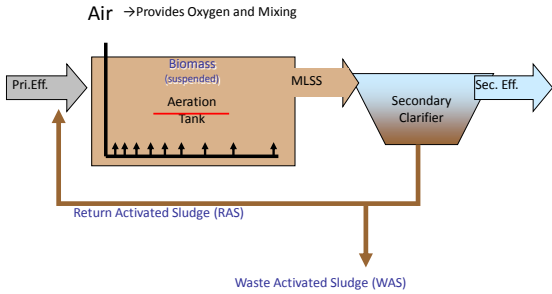
Biological Wastewater Treatment

Microorganisms consume organic matter from the wastewater, using oxygen for respiration



Millions of aerobic and facultative micro-organisms remove pollutants thru living and growing process

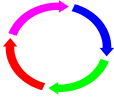
Activated Sludge System



Activated Sludge

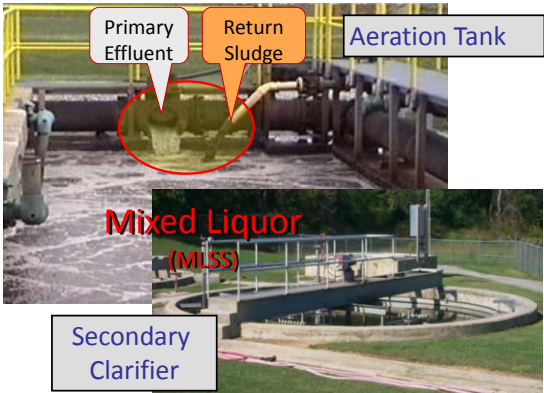
Suspended Growth,
Biological Treatment

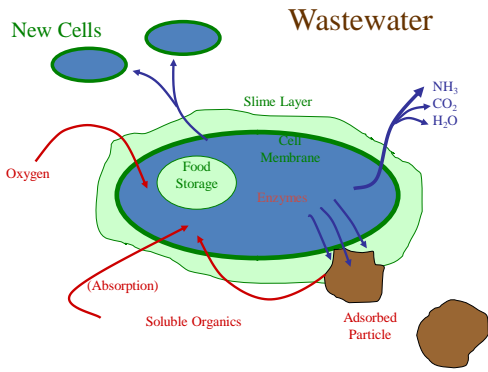
Need favorable conditions for growth and for
separation from the water

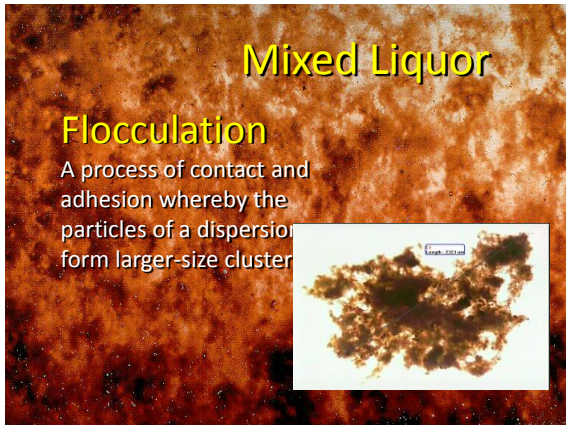


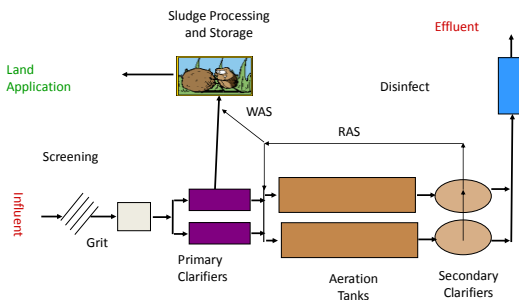
Biological solids are used
over and over

Growth rate produces about 0.7 lbs
of biological solids per
lb BOD removed









Typical Flow-Through Activated Sludge Plant

Biological Wastewater Treatment

Three Steps

1. Transfer of Food from Wastewater Cell. to

Adequate Mixing
Enough Detention Time

Biological Wastewater Treatment

2. Conversion of Food to New Cells and Byproducts.

Acclimated Biomass
Useable Food Supply
Adequate D.O.
Proper Nutrient Balance
100 : 5 : 1
C : N : P

Biological Wastewater Treatment

3. Flocculation and Solids Removal

Proper Mixing
Proper Growth Environment
Secondary Clarification

OXYGEN DEMAND

Biochemical Oxygen Demand B.O.D.

The Quantity of Oxygen Used in the Biochemical Oxidation of Organic Material.



5 Day Test



OXYGEN DEMAND

Biochemical Oxygen Demand B.O.D.

Best to Use a "Moving Average" to Determine the Average Impact on a Treatment System.



5 Day Test

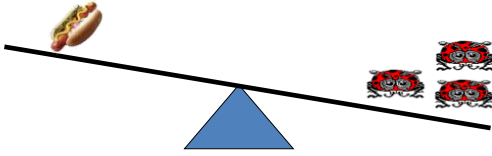


BOD Moving Average

Calculate the 7 day moving average of pounds of BOD for 10/5 and 10/6.

Date	Pounds of BOD			
		10/5	10/6	
		2281	13,525	
		2777	- 2281	
		1374	+ 1577	
		2459	12,821	
9/29	2281	960		
9/30	2777	1598		
10/1	1374	2076		
10/2	2459	13,525	12,821	
10/3	960		7	= 1832
10/4	1598			
10/5	2076	13,525		
10/6	1577	7		= 1932
10/7	2351			

Need to Balance Organic Load (lbs BOD) With Number of Active Organisms in Treatment System



Ratio Food to Microorganism

F:M or $\frac{F}{M}$

How Much Food ?

Primary Effluent BOD

Lbs/D BOD = FLOW (MGD) X 8.34 Lbs/Gal X P.E. BOD (mg/L)

F = Pounds BOD
(Coming into Aeration Tank)

How is M (Microorganisms) measured?

Mixed Liquor Volatile Suspended Solids (MLVSS)

M = Pounds MLVSS
(In Aeration Tank)

Mixed Liquor Suspended Solids (MLSS)
and

Mixed Liquor Volatile Suspended Solids (MLVSS)



A series of horizontal lines on the right side of the page, intended for handwritten notes or calculations.

Mixed Liquor Suspended Solids (MLSS)
and
Mixed Liquor Volatile Suspended Solids (MLVSS)



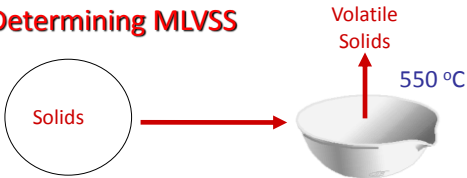
Determining MLSS

Solids

$$\frac{\text{Wt. of Solids + Paper, mg} - \text{Wt. of Paper, mg}}{\text{Wt. of Solids, mg}}$$

$$\frac{\text{Wt. of Solids, mg}}{\text{Volume of Sample, L}} \longrightarrow \text{MLSS, mg/L}$$

Determining MLVSS



$$\frac{\text{Wt. of Dish + Solids, mg} - \text{Wt. of Dish + Ash, mg}}{\text{Wt. of Volatile Solids, mg}}$$

$$\frac{\text{Wt. of Volatile Solids, mg}}{\text{Volume of Sample, L}} \longrightarrow \text{MLVSS, mg/L}$$

How Much Food (F) ? Pounds BOD

Lbs/D BOD =
FLOW (MGD) X 8.34 Lbs/Gal X Pri. Eff. BOD (mg/L)

How is **M** (Microorganisms) measured?

Mixed Liquor Volatile Suspended Solids (MLVSS)

M = Pounds MLVSS

CALCULATION OF POUNDS

Pounds =

Conc. x Flow (or Volume) x 8.34 Lbs/gallon

Concentration Of STUFF In the Water	X	Quantity Of Water The STUFF Is In	X	Weight Of The Water
--	---	--	---	---------------------------

Pounds of Volatile Solids in the Aeration Tank

Lbs MLVSS =

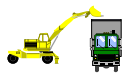
Volume Aeration Tank, MG X MLVSS, mg/L X 8.34 Lbs/gal

Example Problem:

Calculate the pounds of volatile solids in an aeration tank that has a volume of 0.471 MG and the concentration of volatile suspended solids is 1700 mg/L.

Lbs = 0.471 MG X 1700 mg/L X 8.34 lbs/gal

= 6678 lbs MLVSS



Food to Microorganism Ratio

The F/M Ratio for Best Treatment Will Vary for Different Facilities

Determined by Regular Monitoring and
Comparing to Effluent Quality
Often Will Vary Seasonally

Typical Range:

Conventional Activated Sludge

F:M 0.25 - 0.45

Extended Aeration Activated Sludge

F:M 0.05 - 0.15

Food to Microorganism Ratio

$$\frac{F}{M} = \frac{\text{Lbs of BOD}}{\text{Lbs of MLVSS}}$$

Calculate Often to Monitor/Control

- Monthly (Minimum)
- Weekly (Better)
- Use Moving Average
