

## Activated Sludge Process, Design Criteria, Advantages & Disadvantages

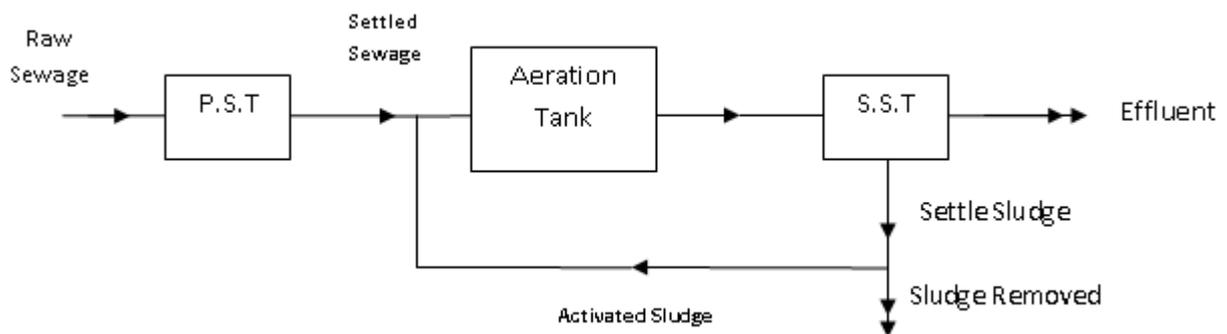
- [Activated Sludge](#)
- [Sewage](#)
- [Wastewater](#)

### Definition of Activated Sludge

**Activated sludge** may be define as the sludge which settled down after the sewage has been agitated freely in the presence of abundant atmospheric oxygen. Activated sludge contains a large number of aerobic bacteria and other organism and acts as a fertilizing constituent (agent) when it is mixed with raw sewage containing sufficient  $O_2$ , the bacteria perform two functions.

1. It oxidizes organic solids.
2. Promotes coagulation and flocculation and converts colloidal and dissolved solids into settleable solids.

The flow diagram of activated sludge process is shown in the figure below:



### Explanation

The **settled sewage** from P.S.T is mixed with required amount of activated sludge coming from S.S.T. The resultant mixture is called “Mixed Liquor Suspended Solid (MLSS)”.

MLSS is passed through aeration tank where it is mixed with air for 4-8 hours. The sewage is oxidized by bacteria in the presence of  $O_2$  due to which BOD of sewage is reduced. The aerated MLSS is then sent to S.S.T where it is allowed to settle. The effluent is discharged off and some of the settled sludge is recirculated as activated sludge and the rest is disposed of after treatment.

The effluent of S.S.T is sparkling clear water and contains very small amount of organic matters and can be disposed of without any further treatment except chlorination which is employed occasionally.

### Design Criteria of Activated Sludge

**Mixed Liquor Suspended Solid (MLSS)** It represents the strength of mixed liquor suspended solid in term of conc of micro organism in aeration tank. Its value in A.T varies from 1500-3000 mg/l and the permissible limit being 2100-2500 mg/l. MLSS above (75000-10000) mg/l is too much.

**F/M Ratio.** It represents the food to micro organism ratio and is given by

$$F/M = \text{BOD}/\text{MLSS} \cdot (V/Q) = \text{BOD}/\text{MLSS} \cdot t_d \text{ (day}^{-1}\text{)}$$

$$V = \text{Volume of AT (m}^3\text{)}$$

$$Q = \text{flow rate (m}^3\text{/day)}$$

$$T_d = \text{detention time (day)}$$

BOD (mg/l) and MLSS (mg/l)

Its allowable value is (0.2 – 0.5) day<sup>-1</sup>

A great value means more food which is wasted and less value means less food and death of bacteria.

### **Sludge Volume Index (S.V.I)**

It is the volume in ml occupied by 1gm of settled suspended solid. It is used to indicate the degree of concentration of sludge reflecting the physical state of sludge and also shows the settleability of sewage. It is found with the help of Imhoff. One liter of sample collected at the outlet of A.T is placed at rest for about 30 minutes in Imhoff tank. The volume of settled sludge ( $V_s$ ) is found and Sludge Volume Index (SVI) is calculated from

$$\text{S.V.I} = (V_s \times 1000)/\text{MLSS} \quad (\text{ml/g})$$

The value of SVI ranges from 50-150 ml/g means good settleability.

**Sludge Recirculation Ratio (r).** It is the ratio of return sludge to sewage flow. It is also called **return sludge ratio**.

$$\text{Return sludge ratio} = Q_r/Q = V_s / (1000 - V_s)$$

Where

$V_s$  = volume of settled sludge in Imhoff cone. Its value varies from 0.25 to .5 ml/l.

Detention time =  $t_d = 4 - 8$  hrs (in A.T)

Air supply =  $10 \text{ m}^3/\text{m}^3$  of sewage treated / day

L : B = 5 : 1

Depth of A.T = 3.5 m

Dissolved oxygen level (D.O) < 2mg/l

Minimum number of A.T = 2

## Aeration and Methods of Aeration in Activated Sludge Process

The process of absorbing oxygen from air is known as aeration. High amount of O<sup>2</sup> is provided in the aeration tank because of high BOD in sewage. This cannot be provided naturally therefore aerators are used to provide O<sup>2</sup> artificially. When the dissolved oxygen level (D.O) falls below 2mg/l anaerobic activities starts.

There are three methods for aeration in activated sludge process.

1. Diffused air aeration
2. Mechanical aeration
3. Combine aerator

## **Advantages and Disadvantages of Activated Sludge Process**

### **Advantages of Activated Sludge Process**

1. Low installation cost
2. Good quality effluent
3. Low land requirement
4. Loss of head is small
5. Freedom from fly and odor nuisance high degree of treatment

### **Disadvantages of Activated Sludge Process**

1. Not very flexible method (If there is sudden increase in the volume of sewage or if there is sudden change in the character of sewage, there are adverse effects on the working of the process and consequently the effluent of bad quality is obtained).
2. Operation cost is high
3. Sludge disposal is required on large scale
4. This process is sensitive to certain industrial wastes
5. Skilled supervision is required to check that the returned sludge remains active