Secondary treatment

Secondary treatment depends on biological processes to further reduce the suspended and dissolved solids, which are remaining in the liquid effluent after primary treatment. **Secondary treatment** consists of biological degradation, in which the remaining suspended solids are decomposed by microorganisms and the number of pathogens is reduced. In this stage, the effluent from primary treatment usually undergoes biological treatment

secondary treatment (biological treatment) include :

1-activated sludge

2-areated lagoon

3-aerobic granulation

4-membrane bio reactor

5-constructed wet land

6-rotating biological contactor

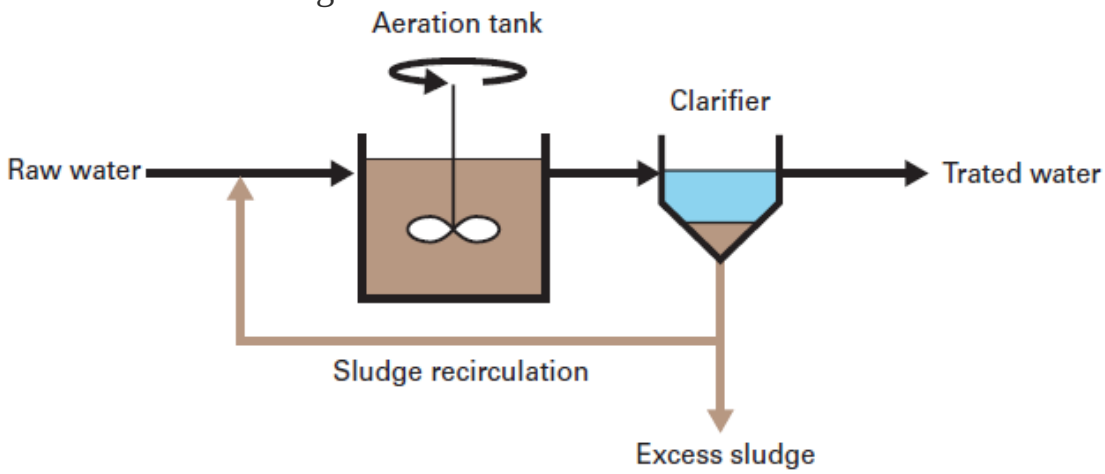
7-trickling filter

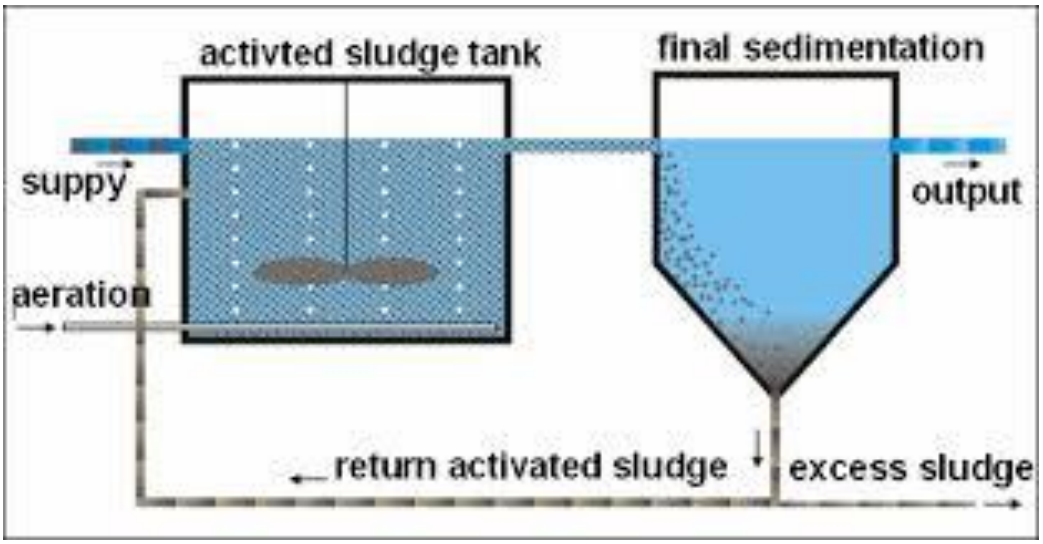
1-Activated Sludge

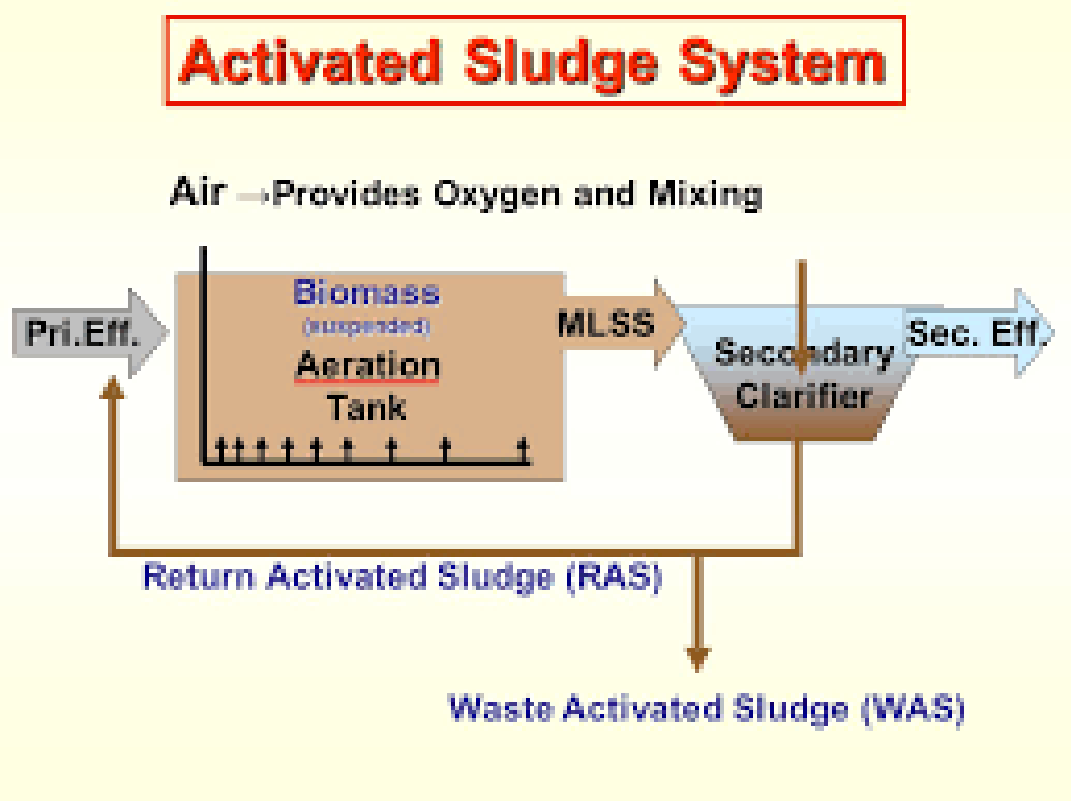
The activated sludge system (aeration and sedimentation tanks) is the main representative of the suspended-growth aerobic system. The activated sludge is the most widely used method to bring about stabilization in wastewater having organic matter constituents. The method depends on establishing and maintaining a population of degrading microorganisms and providing close contact of the degrading microorganisms and a supply of dissolved oxygen. The microorganisms feed and grow upon the oxidizable material in the wastewater and form a suspended floc of "activated sludge" in the water. Air bubbled through the water or absorbed by constantly renewing the air–water interface (by agitation) replenishes the oxygen needed for the biological oxidation. The mixture of wastewater and activated sludge, known as "mixed liquor", is then settled to separate the activated sludge solids from the treated (i.e. reduced BOD_5) water. Part of the

settled activated sludge is usually mechanically returned (by pump) to the aeration site (usually a tank or vessel).

The solids in an activated sludge system tend to build up due to accumulation of inert material and the growth of microorganisms. To control the amount of solids during aeration, the excess solids, i.e. “excess sludge” are wasted from the system regularly. Typically, the influent wastewater is mixed with about 20–30% by volume of activated sludge and approximately the same weight of suspended solids, which enter the treatment system each day, must be wasted as excess activated sludge.







2-Aerated Lagoons

Types of Aerated Lagoons:

Aerated lagoons are deep waste stabilization ponds in which sewage is aerated by mechanical aerators to stabilize the organic matter present in the sewage, rather than relying only on photosynthetic oxygen produced by algae. Thus aerated lagoons represent a system of sewage treatment that is intermediate between oxidation ponds and activated sludge systems.

Depending on how the microbial mass of solids is handled in the aerated lagoons the same are classified as:

(i) Facultative aerated lagoons and

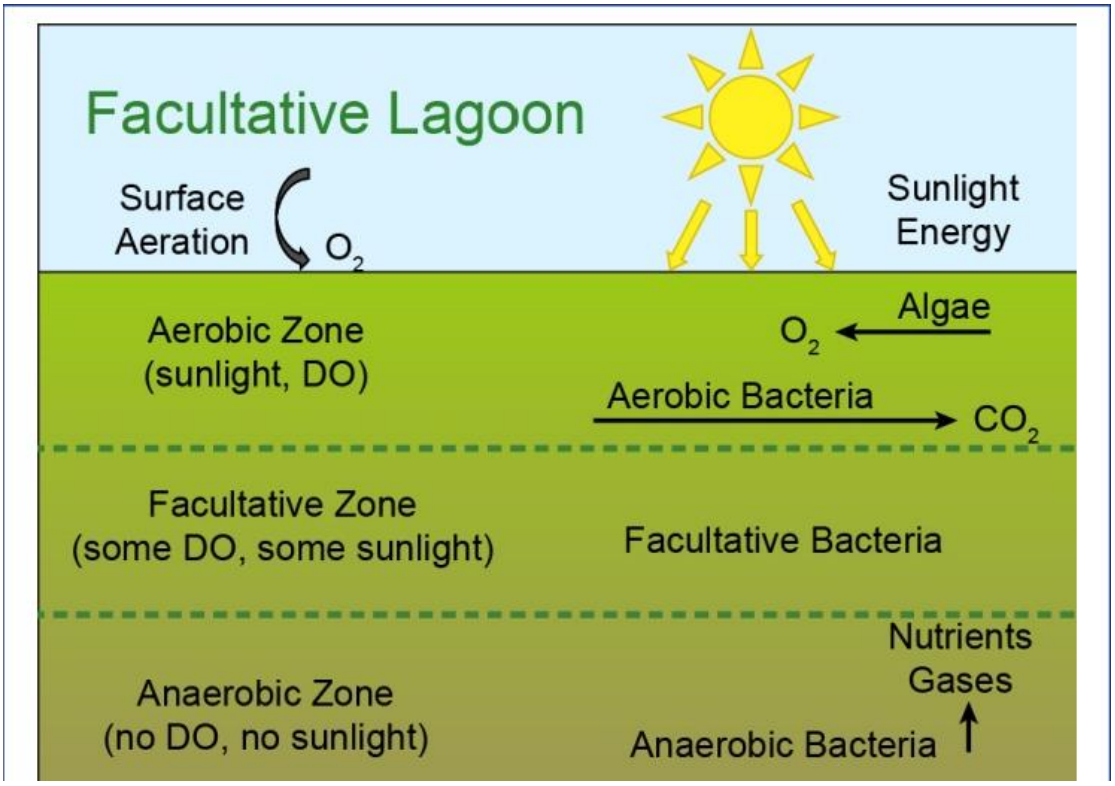
(ii) Aerobic aerated lagoons.

(i) Facultative Aerated Lagoons:

Facultative aerated lagoons are those in which some solids may leave with the effluent stream and some settle down in the lagoon since aeration power input is just enough for oxygenation and not for keeping all solids in suspension. As the

lower part of such lagoons may be anoxic or anaerobic while the upper layers are aerobic, these are termed as facultative aerated lagoons.

Further the facultative aerated lagoons are also known as partially mixed type aerated lagoons because these are operated at a low rate of aeration which is not adequate to keep all the solids in suspension.



(ii) Aerobic Aerated Lagoons:

Aerobic aerated lagoons are those which are fully aerobic from top to bottom as the aeration power input is sufficiently high to keep all the solids in suspension besides meeting the oxygenation needs of the system. No settlement of solids occurs in these lagoons and under equilibrium conditions the new (microbial) solids produced in the system equal the solids leaving the system.

Thus in this case the solids concentration in the effluent is relatively high and some further treatment is generally provided after such lagoons. If the effluent is settled and the sludge recycled, the aerobic aerated lagoon, in fact, becomes an activated sludge or extended aeration type lagoon.

A few typical characteristics of the above types of aerated lagoons are given in Table 15.2.

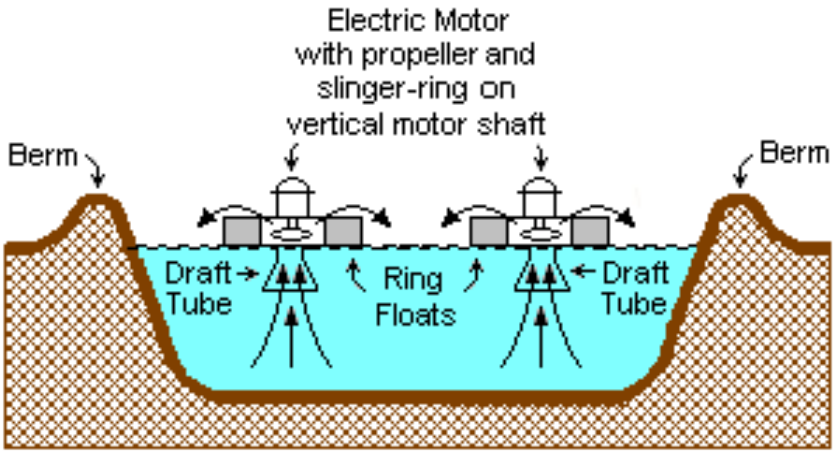
TABLE 15.2
Some Characteristics of Aerated Lagoons

S.No	*Characteristics*	*Facultative aerated lagoons*	*Aerobic aerated lagoons*	*Extended aeration system (for comparison)*
1.	Detention period, days	3–5	2–3	0.5–1.0
2.	Depth, m	2.5–5.0	2.5–4.0	2.5–4.0
3.	Land required, m^2/person	0.15–0.30	0.10–0.20	—
4.	BOD removal efficiency, %	80–90	50–60	95–98
5.	Overall BOD removal rate constant, *K* at 20°C (soluble only), per day	0.6–0.8	1–1.5	20–30
6.	Suspended solids (SS) in unit, mg/l	40–150	150–350	3000–5000
7.	VSS/SS	0.6	0.8	0.6
8.	Desirable power level watts/m^3 of lagoon volume	0.75	2.75–6.0	15–18
9.	Power requirement kWh/person/year	12–15	12–14	16–20

Facultative type aerated lagoons have been more commonly used the world over because of their simplicity in operation and minimum need of machinery. They are often referred to simply as ‘aerated lagoons’.

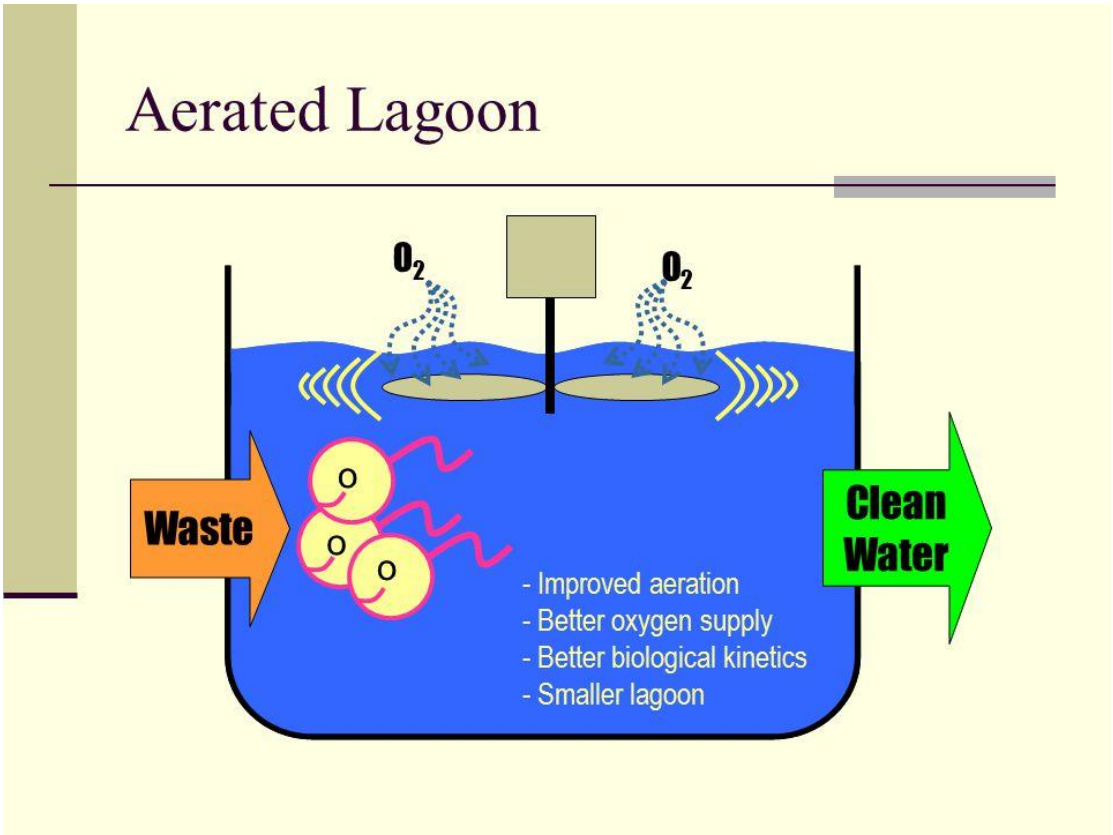
Their original use came as a means of upgrading oxidation ponds overloaded due to industrial wastes without adding to the land requirement. Further as the aerated lagoons are deeper than the oxidation ponds, and as they are artificially aerated, less land and less detention period are required for aerated lagoons as compared to oxidation ponds.

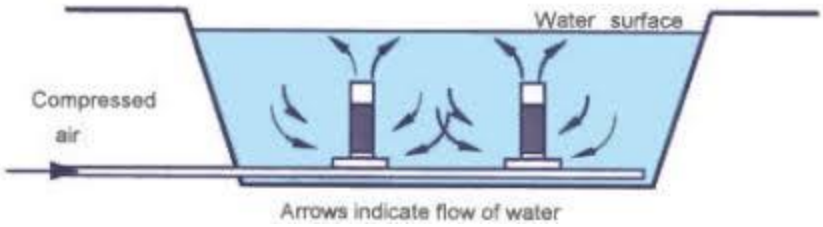
Flow conditions in aerated lagoons are neither ideal complete-mixing nor ideal plug-flow in nature.



A TYPICAL SURFACE – AERATED BASIN

Note: The ring floats are tethered to posts on the berms.





Arrows indicate flow of water