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Q: Discuss activated sludge process with the help of schematics.

Activated Sludge Process:

Activated sludge (AS) is a process dealing with the treatment of sewage and industrial wastewaters and developed around 1912-1914. There is a large variety of design, however, in principle all AS consist of three main components:

An aeration tank, which serves as bio reactor;

A settling tank ("final clarifier") for separation of AS solids and treated waste water;

A return activated sludge (RAS) equipment to transfer settled AS from the clarifier to the influent of the aeration tank (Fig. 1).

Atmospheric air or in rare cases pure oxygen is introduced to a mixture of primary treated or screened sewage (or industrial wastewater) combined with organisms to develop a biological flock ("Activated Sludge" AS). The mixture of raw sewage (or industrial wastewater) and biological mass is commonly known as Mixed Liquor. Typically, dry solids concentrations of mixed liquor (MLSS) range from 3 to 6 g/L. With all activated sludge plants, the concentration of biodegradable components present in the influent is reduced due to biological (and sometimes chemical) processes in the aeration tank. The removal efficiency is controlled by different boundary conditions, e.g. the hydraulic residence time (HRT) in the aeration tank, which is defined by aeration tank volume divided by the flow rate. Other factors are: Influent load (BOD₅, COD, Nitrogen,...) in relation to the AS solids present in the aeration tank (Food: Microorganism Ratio, F:M Ratio), oxygen supply, temperature, etc. At the effluent of the aeration tank, mixed liquor is discharged into settling tanks and the supernatant (treated waste water) is run off to be discharged to a natural water or undergo further treatment before discharge. The settled AS is returned to the head of the aeration tank (RAS) to re-seed the new sewage (or industrial wastewater) entering the tank and to ensure the desired MLSS concentration in the aeration tank. Due to biological growth (and solids present in the raw waste water which are only partly degraded), excess sludge eventually accumulates beyond the desired MLSS concentration in the aeration tank. This amount of solid (called Waste Activated Sludge WAS) is removed from the treatment process to keep the ratio of biomass to food supplied (sewage or wastewater) in balance and the F:M ratio in a defined range. WAS is stored away from the main treatment process in storage tanks and is further treated by digestion, either under anaerobic or aerobic conditions prior to disposal.

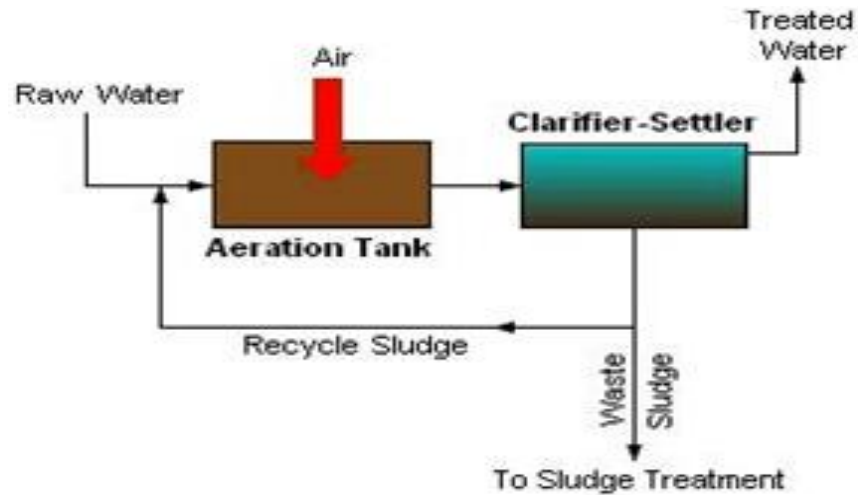


Figure1. The diagram of activated sludge process

Many sewage treatment plants use axial flow pumps to transfer nitrified mixed liquor from the aeration zone to the anoxic zone for de-nitrification. These pumps are often referred to as Internal Mixed Liquor Recycle pumps (IMLR pumps). The raw sewage, the RAS, and the nitrified mixed liquor are mixed by submersible mixers in the anoxic zones in order to achieve de-nitrification.

Purpose:

- In a sewage (or industrial wastewater) treatment plant, the activated sludge process can be used for one or several of the following purposes:
- oxidizing carbonaceous matter: biological matter.
- oxidizing nitrogenous matter: mainly ammonium and nitrogen in biological materials.
- removing phosphate.
- driving off entrained gases carbon dioxide, ammonia, nitrogen, etc.
- generating a biological flock that is easy to settle.
- generating a liquor low in dissolved or suspended material