CAI 334 IRRIGATION WATER QUALITY AND WASTE WATER MANAGEMENT

UNIT IV NOTES

Package treatment plant

Package treatment plant is a method of sewage treatment which uses physical, chemical and biological processes to remove physical, chemical and biological pollutants/contaminants. Package sewage treatment plant is beneficial for the areas like small town ships, hotels, villas, restaurants in their premise. Small sewage treatment plant used in minimal land area and for small/less population.

The major objective of mini sewage treatment plant is to produce an effluent (treated wastewater) and solid waste/sludge which is suitable for reuse or dispose back into the natural environment. The package plant includes fine screening, suspended growth biological treatment, and membrane filtration. Ultraviolet disinfection can easily be added to these systems for complete treatment.

Package plants for biological wastewater treatment with activated sludge are a great way to achieve advanced wastewater treatment results in an economical manner. Alfa Laval package plants can be configured using a variety of processes and designed for either batch or continuous operation. This provides excellent flexibility in wastewater treatment options. Package plants of up to (approximately) 200,000 GPD for rectangular and 3 million GPD for field erected circular designs are available.

Sewage treatment plants are available in a modular or package form. Small wastewater treatment plant involves three stages namely primary, secondary and tertiary treatment.

1. Primary Treatment: It is used prior to biological treatment. This treatment removes material that will either float or readily settle out by gravity. It involves grit chamber to slow down the flow so that sand, grit, eggshells, grease, small plastic material, will settle out of water and these are removed from a tank called sedimentation tank or primary clarifiers. The settled sludge is known as primary sludge and it is pumped out to sludge handler for removal. In this treatment about 60-70% suspended solids are removed but still the waste water is not fit for reuse hence further level of treatment is very much required. The partially treated wastewater from the primary tank then flows to the secondary treatment system.

2. Secondary Treatment: Treated wastewater from primary treatment is pumped to next stage of treatment

called secondary treatment where it is aerated and biologically treated. It uses a process called activated sludge process. When the air is supplied to aeration tanks mixes with wastewater and the growth of microorganisms will be increased and break down of organic matter takes place. The aerated wastewater enters into a settling tank called secondary clarifier where heavy solids settle down and called as secondary sludge. Some part of it is again sent to aeration tank and the remaining is added with primary sludge for further processing called as sludge handler. Secondary treatment of small wastewater treatment plant removes up to 80-90% of BOD.

3. Tertiary Treatment: Package sewage treatment plants usually don't involve pre-treatment or tertiary treatment. However, during reuse or disposing of wastewater into watercourses tertiary treatment is very much essential. This treatment is also known as advanced treatment which can use physical and/or chemical and/or biological processes to remove contaminants which cannot be removed by secondary and/or primary treatment. Since this treatment includes disinfection process, it is also called as disinfection treatment. It can be done with chlorine treatment or ultraviolet treatment.

Features

Compact Design

- One of the most significant advantages of packaged sewage treatment plants is their compact design. Unlike traditional systems, which often require extensive space for various treatment stages, PSTPs integrate all necessary components into a single, compact unit. This space-efficient design is ideal for urban areas where land is at a premium. The compact footprint also makes PSTPs suitable for installation in basements, rooftops, or other confined spaces, offering flexibility in site selection without compromising performance.

Prefabrication

- Packaged sewage treatment plants are typically prefabricated in a controlled factory environment. This prefabrication process ensures high-quality construction and adherence to strict manufacturing standards. Prefabrication also significantly reduces on-site construction time and costs, as the units arrive at the installation site ready to be connected and commissioned. This method minimizes the disruptions associated with traditional construction activities and allows for quicker deployment of sewage treatment solutions.

- **Mobility**

- The mobility of PSTPs is another critical feature that sets them apart from conventional systems. These plants are designed to be easily transported and relocated, making them a versatile solution for temporary or semi-permanent installations. For instance, PSTPs can be employed at construction sites, remote mining operations, or military bases where wastewater treatment needs may change over time. The ability to move the plant as required ensures continuous compliance with environmental regulations, regardless of location changes.

- **Treatment Processes**

- Packaged sewage treatment plants incorporate a variety of treatment processes to effectively manage and treat wastewater. These processes typically include primary treatment (screening and sedimentation), secondary treatment (biological processes such as activated sludge or membrane bioreactors), and tertiary treatment (filtration, disinfection, and nutrient removal). Advanced technologies such as Moving Bed Biofilm Reactors (MBBR) or Sequencing Batch Reactors (SBR) can also be integrated into PSTPs, ensuring high-quality effluent that meets stringent regulatory standards.

Advantages

Minimum power and chemical requirement

Low operating cost

Process

Primary Settlement: Sewage enters the primary settlement tank. The tank incorporates lamella parallel plates which aid in reducing the suspended solids by 75% and the BOD by 25%. This zone is relatively maintenance-free and contains no moving mechanical or electrical devices

Aerobic Treatment: The effluent then enters the aerator bio-zone which is a combined fixed film reactor and active aeration system mounted on a horizontal shaft. The aerator provides a solid surface area for micro-organisms to attach themselves; these then feed on the organic matter present in the effluent. Rotation of the drums aerates the liquid. The bio-zone is self-cleansing and does not require extraneous pumping or sludge return.

Final Settlement: The treated effluent then moves to the settlement area. This area contains a lamella parallel plate assembly for settling finer particles. The submersible pump removes sludge to the sludge storage compartment on a regular timed basis.

Applications

Hotels & Restaurants • Holiday Resorts • Golf & Country Clubs • Townships & Housing Complexes • National Parks • Industrial Estates • Existing Plan Upgradation A

Design Requirement

a) All calculations regarding the inlet works, outlet works, biological processes and hydraulics shall follow the design criteriastandards.

b) All units of package sewage treatment plant and foundation shall be designed to meet the extreme case scenario as follows: i) When the tanks are fully emptied; ii) During high groundwater conditions.

c) The structural design of a tank shall consider all factors that can affect the strength and integrity of the tank, like soil conditions, area of installation, etc. All tanks shall be structurally designed to withstand the maximum earth load and hydrostatic pressure equivalent to a backfill depth of 1 m.

d) All civil works of blower house, pump house and control panel room shall follow guide lines

e) The minimum design life span of the components of the package sewage treatment plant shall be as Table

Table Minimum Design Life Span of Package Sewage Treatment Plant Components

Component	Design Life Span
Prefabricated tank and other structural components	> 50 years
Civil	> 50 years
Mechanical & Electrical	10 years