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Section A

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#01

Subject

Waste Water Engineering

Two basic design parameters of waste water treatment systems are hydraulic Retention Time (HRT) and Solids Retention Time (SRT).

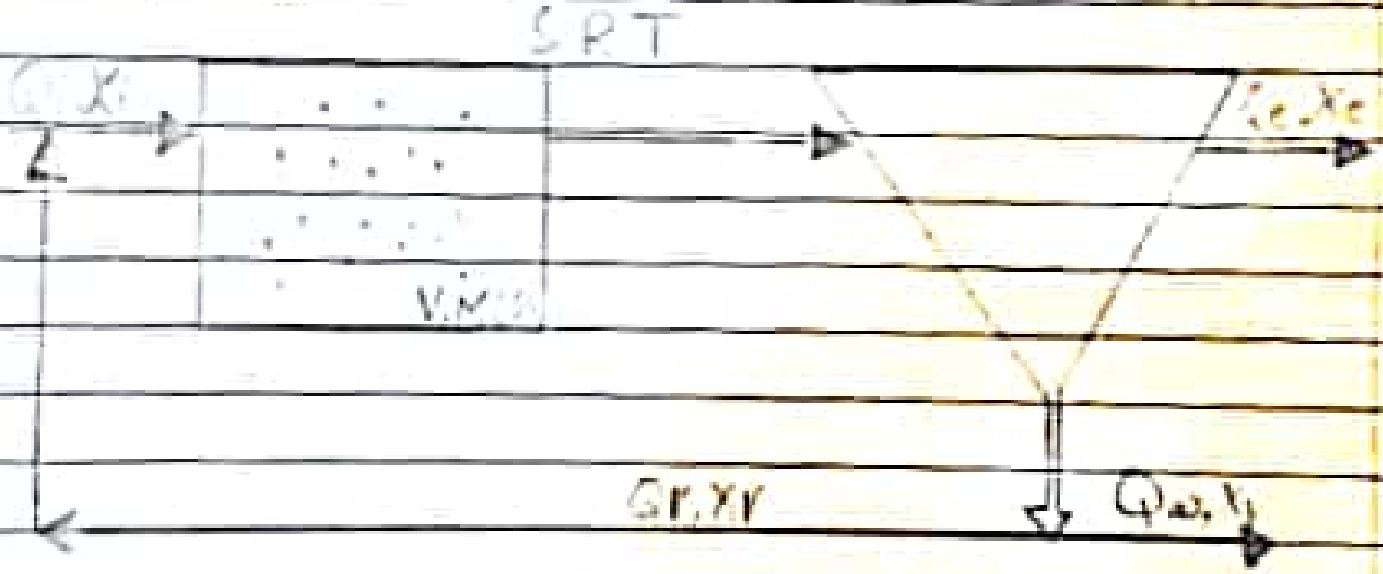
1) Briefly describe each one of these parameters?

Ans SOLIDS RETENTION TIME (SRT):

The Solids Retention time (SRT) is the average time the activated-sludge solids are in the system. The SRT is an important design and operating parameter for the activated-sludge process and is usually expressed in days. The SRT controls the concentration of bacteria throughout the treatment system. A higher SRT contributes to a higher bacterial concentration in the reactor, which gives rise to

1) Smaller reactor size
2) Larger separator size
3) Reduced sludge production
4) Higher aeration requirements due to the extra oxygen required for endogenous respiration.

Clearly, an optimum SRT exists, resulting from a trade-off between the gains and losses in various cost items. For municipal sewage treatment plants performing combined nitrification-denitrification, typical wasting ratios generally fall in the range 0.05-0.10 for a hydraulic retention time of 12-24 hours.



$$\text{SRT, Intrinsic} = \frac{(V)\cdot(MLSS)}{(Q_w \times X_r)+(Q_e \times X_e)}$$

Solid Retention time (SRT) is a critical activated sludge process design and operating parameter. The selection of SRT has many consequences related to process performance, sludge production, and oxygen requirements. The traditional

method for controlling SRT is to manually adjust the sludge wasting rate based on the food to microorganism (F/M) ratio or mixed liquor suspended solids (MLSS) concentration. The effectiveness of closed-loop of SRT has been demonstrated in many locations.

In addition to reducing variability in actual SRT, other benefits cited include reduced foaming, improved sludge setting characteristics, improved performance of downstream sludge thickening, and fewer laboratory process control measurements. Automated SRT control is likely to be of great benefit for overloaded or nutrient facilities. However, a big reason that automated SRT control is not more widely practiced is that understanding of the proper application of SRT control is needed.

2) HYDRAULIC RETENTION TIME (HRT)

The hydraulic retention time (HRT) is a measure of average length of time that a soluble compound remains in a constructed bioreactor.

The volume of aeration tank divided by the influent flowrate is ', the hydraulic retention time.

HRT is defined as the ratio between the reactor volume and the feed flowrate represents the average time the cells and substrates stay inside the reactor. HRT is key important parameter for the hydrogen and methane production in continuous mode. Very low HRT comports the washout of the reactor, which means all the active microorganisms escape out from the reactor. On the contrary, an adequate HRT results in abundant hydrogen and methane yields. This parameter is specific linked to the specific and different growth rates of hydrogen and methane-producing bacteria. Low HRT favored the washout of methanogens, guaranteeing the survival of hydrogen producers. Thus low HRT and slight acid pH(6.0-6.5) represent the best condition for hydrogen production.

on the contrary, the hydrogen fermentation pattern may shift the heterotrophic one when HRT is increased.
The choice of optimal HRT is clearly influenced by complexity of the organic molecules. complex substrate require greater HRT to guarantee an adequate time to decompose them. In CSTR vessels the typical HRT applied treating solid organic waste is in the range of 2-3 days, while with other reactor configuration of easily biodegradable substrates it is possible to used lower HRT (down to hours). There is not, however, a general criterion to determine the HRT, as fermentation is also influenced by other boundary conditions. Anyway the literature data show that the maximum hydrogen production rate can be obtained for HRT < 3 days.
The HRT in waste water treatment plant is a measure at an average length of time holding the waste water in a tank. It is also known as hydraulic residance time. The waste water treatment plant is mainly

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designed to handle the wastewater at normal load & also during check loads. The wastewater is retained in different treatment units at a particular time to achieve the desired parameters. The HRT followed in the Homogenisation tank is 12 to 24 hours. 24 to 48 hours in aeration tanks. 72 to 120 days in Anaerobic Reactors. 5 to 12 hours in Secondary Clarifiers. 3 to 5 hours in aeration tanks. 72 to 120 days in Primary clarifiers. 30 minutes in Chlorine contact tanks. 5 to 10 minutes in deep media filters, etc. During the design stage itself the HRT of wastewater in various stages are calculated in order to achieve the outlet parameters. If HRT is not properly maintained at a various stages, we may not get the desired parameters for discharge/ reuse.

2) What are methods used for decoupling SRT from HRT?

Ans. The methods which are used for decoupling SRT from HRT

1) Anaerobic Reactor Designs
2) Recuperative Thickening
3) Integrated Waste Management
4) Distillers Grains

1) ANAEROBIC REACTOR DESIGNS

Approaches that decouple the SRT from the HRT can be used via separating and recirculating a portion of the microbe/solids, or immobilizing the biomass. 2 Such approaches allow a high SRT to be maintained, thus preventing washout of slow-growing anaerobes, yet allow reduction in reactor size. Anaerobic reactor designs which decouple SRT from HRT. The design concepts were improved from classic reactors like septic tanks and anaerobic ponds, to modern high rate reactor configuration like anaerobic filters.

2) RECUPERATIVE THICKENING

Recuperative thickening increase the solid retention time (SRT) independently of the hydraulic retention time (HRT) by thickening a proportion of digestate to remove water and then returning the thickened sludge back to the digester

3) INTEGRATED WASTE MANAGEMENT

The function elements of waste integrated wastewater management system are generation and composition, collection, treatment (including sludge treatment) and disposal and reuse.

4) DISTILLER GRAINS

The distiller grains wastewater treatment and recycling biomass energy using Up-flow solid reactor (USR) was carried out. USR reactor was operated under thermophilic fermentation condition at 52°C.

3) What are the decorpbir Advantages of decoupling of SRT from HRT?

ADVANTAGES

1) To produce the solids free better quality effluents while the use of anaerobic biomass

2) The main advantage of decoupling SRT from HRT is that it will be separated and be easily clarified.

3) To investigate the effect of Hydraulic retention time.

4) By decoupling SRT from HRT the liquid wastewater can be processed faster.

5) Energy can be recovered, thus providing ecological and economical benefits.