



DESIGN OF SEQUENTIAL BATCH BIO-FILM GRANULAR REACTOR (SBBGR) FOR REDUCTION OF THE SLUDGE

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Abstract:-Various methods have been used for the treatment of the waste water. Different technique like ASP, RBC, Trickling Filter, SBR etc are used to deal with several parameters like COD, BOD, and Ammonical Nitrogen etc in waste water. One of the burning issues in waste water treatment is removal of sludge, for which SBBGR is proved to be better technique in comparison to other technologies. SBBGR removes 50% of the sludge it means it reduces the load from the secondary clarifier. We have successfully reduced the COD 70% and BOD 65%. This technique is similar to SBR but the granules make it more efficient and effective.

Keyword- COD, BOD, Activated Sludge process, Sequential Batch Reactor, Trickling filter.

Introduction

The Sequential batch bio-film granular reactor(SBBGR) is a used for the secondary treatment of water/wastewater in place of the Activated Sludge process, Trickling Filter, Rotating biological contractor.Mainly until now this method has been used for the treatment of the water purification, wastewater treatment of textile industry and municipal sewage.And we are using for the treatment of the wastewater of the chemical industry, our main aim is to reduce the sludge generated from the ASP.SBBGR is quiet similar to the SBR, in sequential batch reactor is a fill-and-draw activated sludge treatment system. Although the process involved in the SBR is identical to the conventional ASP.

But it is a compact and time oriented system, and all the processes are carried out especially in the same tank.And our main aim is to reduce the sludge generated in the ASP and with the use of the SBBGR it can be achieved and better treatment can be provided as compare to other conventional method. By using the granules in the reactor all the sludge will be easily collected and a better efficiency would be provided.About 80% of the sludge can be easily removed and it also replaces the additional secondary clarifier by implanting it we would not have to set a clarifier.

The sequencing batch reactor (SBR) is a fill-and draw activated sludge system for wastewater treatment. In this system, wastewater is added to a single “batch” reactor, treated to remove undesirable components, and then discharged. Equalization, aeration, and clarification can all be achieved using a single batch reactor. To optimize the performance of the system, two or more batch reactors are used in a predetermined sequence of operations. SBBGR systems have been successfully used to treat both municipal and industrial wastewater.

Methodology used (theory)

Basic Treatment Process

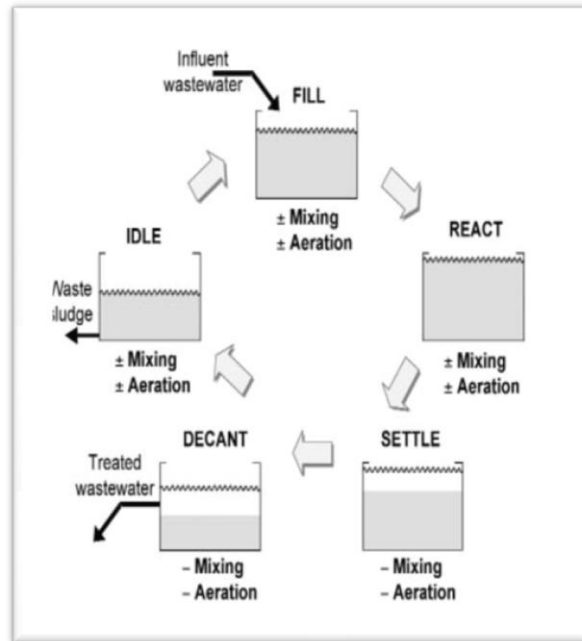


Fig: The operation of an SBBGR is based on a fill-and-draw principle, which consists of five steps—fill, react, settle, decant, and idle.

Fill

During the fill phase, the basin receives influent wastewater. The influent brings food to the microbes in the activated sludge, creating an environment for biochemical reactions to take place.

There are generally three types of filling based on the principle of mixing as follows:

Static Fill— There is no mixing or aeration while the influent wastewater is entering the tank. Static fill is used during the initial start-up phase of a facility, at plants that do not need to nitrify or denitrify, and during low flow periods to save power. Because the mixers and aerators remain off, this makes it an energy-saving component.

Mixed Fill— Here mechanical mixers are active, but the aerators remain off. The mixing action produces a uniform blend of influent wastewater and biomass. Because there is no aeration, an anoxic condition is present, which promotes denitrification. Anaerobic conditions can also be achieved during the mixed-fill phase. Under anaerobic conditions the biomass undergoes a release of phosphorus.

Aerated Fill— Here both the aerators and the mechanical mixing unit are activated. The contents of the basin are aerated to convert the anoxic or anaerobic zone over to an aerobic zone. No adjustments to the aerated-fill cycle are needed to reduce organics and achieve nitrification.

React

This phase allows for further reduction or "polishing" of wastewater parameters. During this phase, no wastewater enters the basin and the mechanical mixing and aeration units are on. Because there are no additional volume and organic loadings, the rate of organic removal increases dramatically.

Most of the carbonaceous BOD removal occurs in the react phase. Further nitrification occurs by allowing the mixing and aeration to continue—the majority of denitrification takes place in the mixed-fill phase.

Settle

During this phase, activated sludge is allowed to settle under quiescent conditions—no flow enters the basin and no aeration and mixing takes place. The activated sludge tends to settle as a flocculent mass, forming a distinctive interface with the clear supernatant. The sludge mass is called the sludge blanket. This phase is a critical part of the cycle, because if the solids do not settle rapidly, some sludge can be drawn off during the subsequent decant phase and thereby degrade effluent quality.

Under this phase only we are going to have a packing of the granules which collect all the or most of the sludge before decanting phase of waste water. In this phase we will have a packing of granules through which a waste water will pass and sludge will be retained in the voids and will stick on the granules so that only pure effluent a liquid will enter in the decant phase.

Decant

During this phase, a decanter is used to remove the clear supernatant effluent. Once the settle phase is complete, a signal is sent to the decanter to initiate the opening of an effluent-discharge valve. There are floating and fixed-arm decanters. Floating decanters maintain the inlet orifice slightly below the water surface to minimize the removal of solids in the effluent removed during the decant phase. Floating decanters offer the operator flexibility to vary fill and draw volumes. Fixed-arm decanters are less expensive and can be designed to allow the operator to lower or raise the level of the decanter.

Idle

This step occurs between the decant and the fill phases. The time varies, based on the influent flow rate and the operating strategy. During this phase, a small amount of activated sludge at the bottom of the SBBGR basin is pumped out—a process called wasting.

Methodology used (practical)

PROCEDURE

1. First fill the wastewater in the filling tank (25 LTR). This is simple static filling no aeration or other treatment is provided in it, after once it is filled fully then opens the valve of the outlet.
2. Then the wastewater from the filling tank enter in to the react tank or Aeration tank -1(AT-1) by the gravity flow. The flow is maintained such that the waste water gets the sufficient detention time before the overflow in the AT-1, so that the sufficient treatment or the reaction can take place.
3. Here in the aeration tank we have use the bacteria ETL-60 for the treatment of the wastewater. Then the similar process occurs in the Aeration Tank-2(AT-2). The overflow of the AT-1 enters in to the AT-2 from bottom.
4. The overflow of the AT-2 enters into the Granular tank which is the main stage of our process as the wastewater from passes from the granular bed the sludge and the solid content in the wastewater get trapped into the packing of the granules and the fresh water is received into the decanting tank.
5. Then the treated wastewater collect in the decant tank and sent for the further secondary treatment required.



Fabrication Work

We have upto now decided we will have four tanks of 20 litre each and we will use them for the fill, react, settle, idle and decant.

We will have a packing of bed in the settle tank, and will take a granules of different sizes and having plastic coating on it to protect from sticking of granules or to avoid growth of culture on it.



Fig Cutting and assembling of the setup parts (workshop)

Calculation

Tanks:-

Waste water feed in each tank = 25 liter

Total capacity of all the four tanks = $24 * 4 = 100 \text{ cm}^3$

The flow rate from the filling tank is around $Q_{in} = 0.16$ lit/min (for the first run)

Granular Bed:-

It consist of 7 kg of the plastic granules

Granules:- Cylindrical in shape

Dimension : height = 0.5cm Diameter = 0.2cm

Cyclic time:-

We run the setup for four different detention times

The detention time for Aeration tank 1 and Aeration tank 2 is **5h , 10hr, 15hr, 20hr** respectively.

Three aerators are provided in each aeration tank, for the proper aeration.

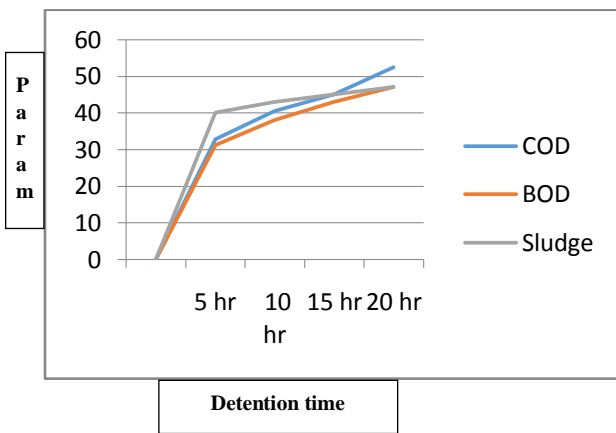
The food: mass ratio is maintained to 0.3

Temperature:-

30 – 35 °c

Result

Parameter (%reduction)	Detention time			
	5 hr	10 hr	15 hr	20 hr
COD	49 %	53%	62%	70%
BOD	43%	50%	55%	65%
Sludge	40%	43%	45%	50%



Graph showing the reduction of the **Parameters vs Detention Time**

Conclusions

From our practical approach (or setup) we have concluded that the SBBGR is a very good and efficient treatment method for the waste water and it reduces the sludge from about 50 % and it also saves the money of an additional clarifier(to some extent). In addition to this it also gives the very good treatment (reduction) to the other important parameter of waste water such as COD 70% reduction and BOD 65% reduction.

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