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Comparative Study on Performance of Advance Sequential Batch Reactor and Activated Sludge Treatment Plant Situated at BIAL

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ABSTRACT: Sewage treatment is a multi-stage process designed to contain and treat sewage wastewater for improve human wellbeing and environmental protection. Municipal sewage contains wastes including domestic grey and black water. The characteristics of the sewage include, biological oxygen demand (BOD), Chemical Oxygen Demand (COD), Total Dissolved Solids (TDS), Total Suspended Solids (TSS) and pH. After the treatment, the reduction in BOD, COD, TDS, TSS and a neutral pH is expected. provide an overall vision ofComparative study on performance of advance sequential batch reactor and activated sludge process plant and effective management of sludge by biogas plant, there by converting waste to energy. Activated sludge plant operation was exiting and working efficiently. Due to generation of more wastewater in airport. New Advance sequential batch reactor of 3 MLD is constructed having higher working efficiency. Scientific way of managing and disposing the waste generated.Management of bio-waste from kitchens and restaurants, sludge from the airport treatment plant by introducing biogas plant for generation of electricity. Hence providing suitable solutions to organic waste generated.

Keywords: AdvanceSequenceBatchReactor, Activated sludge process, Biogas plant, etc.

INTRODUCTION:

Sewage treatment is a multi-stage process designed to contain and treat sewage wastewater for improve human wellbeing and environmental protection. Municipal sewage contains wastes including domestic grey and black water. The characteristics of the sewage include, biological oxygen demand (BOD), Chemical Oxygen Demand (COD), Total Dissolved Solids (TDS), Total Suspended Solids (TSS) and pH. After the treatment, the reduction in BOD, COD, TDS, TSS and a neutral pH is expected.

A sewage treatment plant's primary objectives are to treat the sewage and meet the plant's discharge standards. The treatment plant reduces the concentrations of suspended solids, organic matter, nutrients, pathogens and other pollutants in sewage. The discharge from the treatment plant must maintain the water pollution standards to protect the receiving water body. As the receiving water body can only absorb a certain level of pollutants before it begins to degrade. This may lead to the human health hazards and environment pollution.

One of the challenges of sewage treatment is that the physical, chemical and biological characteristics of sewage influent change with time. The temporal changes in sewage volume and its physical, chemical, and biological characteristics have seasonal, monthly, weekly or daily fluctuations. Other changes are long-term, being the results of alterations in populations, social characteristics, economies, and industrial production or technology. The quality of the receiving water and the public health and well-being may depend on a treatment plant operator's ability to recognize and respond to potential problems. These responsibilities demand a thorough knowledge of existing treatment facilities and sewage treatment technology.

Operation of ASBR
Process:

Four tanks are provided to ensure continuous operation; however, complete process takes place sequentially in each single reactor.

The system makes use of the variable volume treatment in combination with a biological selector and operated in a batch fed reactor mode. The complete biological operation is divided into various cyclic modes. Each basic cycle comprises of:

- Fill – Aeration:Aerated Fill is classified by aerating the contents of the reactor to begin the aerobic reactions completed in the React step. Aerated Fill can reduce the aeration time required in the React step. The biological reactions are completed in the React step, in which mixed react and aerated react modes are available.
- Sedimentation:Is a physical water treatment process using gravity to remove suspended solids from water. Solid particles entrained by theturbulence of moving water may be removed naturally.
- Decantation:Performance through the sedimentation process of suspended material in the wastewater, with the possible use of a suitable flocculent. The settling process causes a thickening of mud at the bottom of the settling tank, from where it is extracted, making it compact, dry and suitable for disposal.

Two Basins of Advance sequential batch reactor, each basin has 3 cycles/day i,e. 6 cycles/ day and treating 3MLD of wastewater.

Flowchart of advance sequential batch reactor

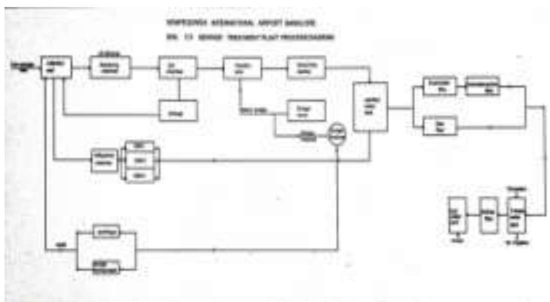
Operation of Activated sludge process

The activated sludge wastewater treatment process is widely used and relied on by many municipalities. This process utilizes a multi-chamber reactor unit that uses microorganisms as a method to remove nutrients from the water. Oxygen is used to establish and regulate aerobic conditions and to suspend the sludge. The activated sludge wastewater treatment provides many advantages, but it may not be appropriate in all situations.

The activated sludge process is an integral process used to treat wastewater. Air or oxygen is blown into raw sewage. It is most effective for large volumes of water. Wastewater is mixed and aerated in a special tank. This step in the process occurs by pumping air or oxygen into the activated sludge tank or using surface aerators. The process oxidizes organic matters in the wastewater, producing new cells, carbon dioxide, and water. The sludge particles can then be removed through the process of gravity settling.

Activated sludge sewage treatment is ideally completed in a centralized treatment facility. The treatment of activated sludge can occur in most climates. However, colder environments reduce the treatment capacity.

The activated sludge process in the treatment of wastewater involves blowing oxygen or air into raw, unsettled sewage. This process smashes the solids. The sewage is bubbled, and sewage liquor is discharged into an activated sludge chamber. Live bacteria settle to the bottom of the tank and dead bacteria float to the top. Clean water is discharged into a soakaway or watercourse while the live bacteria return to the digestion chamber. It is very long procedure for complete treatment of wastewater.



Activated sludge process flow chart

Characteristics of Wastewater at treatment plant

- pH of wastewater

In general, chemicals, minerals, pollutants, soil or bedrock composition, and any other contaminants that interact with a water supply will create an imbalance in the water's natural pH of 7. In short, environmental factors are the biggest contributor to water pH, whether high or low.

High pH causes a bitter taste, water pipes and water-using appliances become encrusted with deposits, and it depresses the effectiveness of the disinfection of chlorine, thereby causing the need for additional chlorine when pH is high. Low-pH water will corrode or dissolve metals and other substances

- Total Suspended Solids of wastewater

Total Suspended Solids of wastewater of raw sewage is high. These particles are solids in water that can be trapped by a filter. TSS can include a wide variety of material, such as silt, decaying plant and animal matter, industrial wastes, and sewage. High concentrations of suspended solids can cause many problems for stream health.

- Total dissolved solids of wastewater

Total dissolved solids levels is high, which can cause severe harm to wildlife and can make water unpalatable or even dangerous to human health. Elevated TSS levels can damage your wastewater equipment and affect its efficiency and operation. Purification is very essential for better quality of water.

- Chemical oxygen demand of wastewater

Chemical oxygen demand in wastewater is high due to greater amount of oxidable organic material, which will reduce dissolved oxygen levels. A reduction in DO can lead to anaerobic conditions, which is deleterious to higher quality of water.

- Biological Demand of wastewater

The higher the BOD value, the greater the amount of organic matter available for oxygen consuming bacteria. If the rate of DO consumption by bacteria exceeds, more oxygen is required, which is less for oxygen-demanding species to feed on, and signifies lower water quality.

- Oil and Grease of wastewater

Level is high in raw sewage, whereas treated water is low in oil and grease after complete treatment of wastewater.

Compare and adopt suitable and effective treatment plant of wastewater

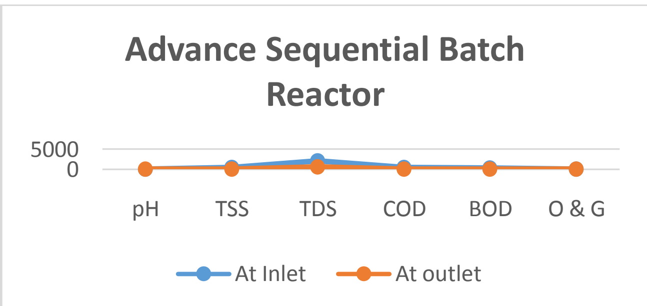
Comparison of Average of monthly Report

I. Advance sequential batch reactor – June 2022

Water Characteristics

Sl.no	Parameters	Unit	At Inlet ASBR	At outlet ASBR	At Inlet ASP	At Outlet ASP	KSPCB Standard
1.	pH	-	8.5	7.32	6.9	7.2	6.5-8
2.	TSS	Mg/L	424	6.5	292	12	> 30
3.	TDS	Mg/L	2100	596	888	620	> 2100
4.	COD	Mg/L	470	12.9	676	27	> 50
5.	BOD	Mg/L	300	3.5	285	4	> 10
6.	O & G	Mg/L	70	0	43	2	> 10

Water characteristics in ASBR



Comparison waste and treated water in Advance sequential batch reactor

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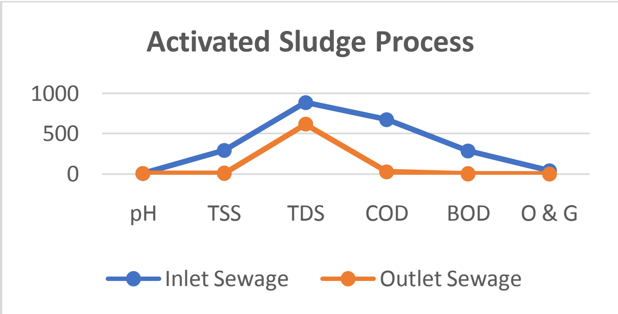
II. Activated Sludge Treatment Plant – May 2022
Wastewater Characteristics

Sl.no	Parameters	Unit	At Inlet	At Outlet	KSPCB Standard
1.	pH	-	6.9	7.2	6.5-8
2.	TSS	Mg/L	292	12	>30
3.	TDS	Mg/L	888	620	> 2100
4.	COD	Mg/L	676	27	>50
5.	BOD	Mg/L	285	4	>10
6.	O & G	Mg/L	43	2	>10

Water characteristics in ASP



Comparison waste and treated water in Activated sludge process

Upon comparison of wastewatercharacteristics

- Avoiding and carbon filter replacement by online filters in Advance sequential batch reactor.
- Quality of water is improved in Advance sequential batch reactor.
- Horticulture filter are not chocked in Advance sequential batch reactor.
- Ensuring 99% of treated water is being used, by improving quality of the water in Advance sequential batch reactor.
- For backwash of sand and carbon filter water required in ASP was 150 cum/day, whereas in Advance sequential batch reactor 30 cum/day is required.
- Man power dependency was more in ASP, whereas in Advance sequential batch reactor everything is automatic.
- Manpower consumption is more in ASP, whereas in Advance sequential batch reactor everything is automatic. Thus, less usage of manpower. Saving on man power cost.
- The tank cleaning of filter feed and treated water tank was weekly once whereas in Advance sequential batch reactor cleaning is 3 months once. i.e., wasting of water is reduced.
- Health benefit of workers in Advance sequential batch reactor, due to everything in closed enclave.

CONCLUSION

The performance studies on the Advance Sequential batch reactor and Active sludge Sewage Treatment Plant located at BIAL conducted indicated a positive efficiency of the system. The performance of both the plant were compared. The following conclusions can be drawn from the present study.

- Quality of water is improved in Advance sequential batch reactor. Advance sequential batch reactor requires less space compared to Activated sludge process plant.
- Horticulture filter are not chocked in Advance sequential batch reactor.
- Ensuring 99% of treated water is being used, by improving quality of the water in Advance sequential batch reactor.
- For backwash of sand and carbon filter water required in ASP was 150 cum/day, whereas in Advance sequential batch reactor 30 cum/day is required.
- Man power dependency was more in ASP, whereas in Advance sequential batch reactor everything is automatic.
- Manpower consumption is more in ASP, whereas in Advance sequential batch reactor everything is automatic. Thus, less usage of manpower. Saving on man power cost.
- The tank cleaning of filter feed and treated water tank was weekly once whereas in Advance

sequential batch reactor cleaning is 3 months once. i.e., wasting of water is reduced.

- Health benefit of workers in Advance sequential batch reactor, due to everything in closed enclave.
- Equalization, primary classification, biological treatment and secondary clarification can be achieved in a single reactor chamber in Advance sequential batch reactor, Thus conserves space and economical.
- Operating flexibility and control with low running costs in Advance sequential batch reactor than ASP.
- The BOD removal efficiency is generally 98-99% in Advance sequential batch reactor.
- Efficiency of Advance sequential batch reactor is 99%.

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LITERATURE REVIEW:

Li and Zang (2002) studied the SBR performance for treating dairy wastewaters with various organic loads and HRTs. At 1 day HRT and 10000mg/l COD, the removal efficiency of COD, Total solids, Volatile solids, Total Kjeldal Nitrogen (TKN) and nitrogen was reported to be 80.2,63.4,66.3,75 and 38.3% respectively. Uygur and Kargi (2004) experimented with four step SBR (anaerobic, oxic, anoxic, and oxic phases with HRT of (1 h/3 h/1 h /1 h) for investigation of nutrient removal from synthetic wastewater at different phenol concentrations ranging from 0 to 600 mg/l. It was observed that the nutrient removal efficiency was almost 90% and 65% for nitrogen and phosphorus respectively and above 95% for COD removal for phenol concentration up to 400 mg/l. The performance of SBR was drastically affected above 400 mg/l concentration of phenol. There was similar observation in case of SVI as there was drastic increase from 45 ml/g to 90 ml/g.

Catalina et al. (2011) carried evaluation of nitrogen removal in wastewater from a meat products processing company, using a SBR at pilot scale. The complete cycle of the SBR (filling, reaction, settling and draw) was 8 h, with three cycles performed per day. It was concluded that the SBR was an appropriate treatment system to perform the joint removal of organic matter and ammonia nitrogen in wastewater from a meat processing company products, demonstrating the SBR system to operate with discharges that present strong variations in composition.

Kim et al. (2008) researched the treatment of low strength swine wastewater with municipal wastewater in enhanced SBR which involves eight steps of treatment i.e. fill, contact, settle, decant, nitrification, refill, react and idle. It was proved that independent nitrification can be achieved by incorporating the contact period within the system and nitrification in the external reactor. The COD, TN and TP removal were 87%, 81 % and 60 % respectively which can be considered far better than conventional treatments. As the ammonia nitrogen was nitrified 70% in the external reactor, this system does not require any externally added carbon for effective removal of nutrients and biodegradation of organic matter. Finally it was concluded that the system is best suited for regular as well as advanced wastewater treatment particularly for low strength wastewaters.

Nardi et al. (2011) carried the research work for advanced wastewater treatment of poultry slaughterhouse for its reclamation. The advanced treatment consisted of use of SBR, chemical-DAF and UV disinfection. The wastewater was given anaerobic pretreatment in the form UASB. The use of SBR was aimed denitrification. he total denitrification efficiency was more than 90%, also the TCOD removal was 54±24% and TP 43%. The sludge also presented good settling characteristic with SVI 118 ± 35 mL g-1. Authors concluded that the SBR system along with chemical-DAF and UV disinfection is appropriate for anaerobically pretreated poultry wastewater.

CONCLUSION

SBR has wide applicability for treating domestic wastewater. SBR is efficient biological treatment for domestic wastewater when it is assessed for the effect of variations in operating parameters. Further studies are required to assess its performance by varying operational parameters like F/M, OLR, cycle time and time-periods of various phases in a cycle.

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