A Review On Development Of Sequencing Batch Reactor For Hostel/Mess Kitchen Wastewater

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***Abstract*—Review discussed the sequencing batch reactor is a potential treatment method for treating domestics well as industrial waste water has been reviewed. From literature survey of SBR can used as treatment option for activated sludge process. The SBR is a essential treatment for nutrient removal such as nitrogen and phosphorus.**

Keywords*— Hydrolic Retention Time, Sludge Retention time, Biochemical Oxygen Demand, Chemical Oxygen Demand

I. Introduction

Sequential batch reactor has been employed as an efficient technology for wastewater treatment, especially for domestic wastewaters, because of its simple configuration (all necessary processes are taking place time sequenced in a single basin) and high efficiency in BOD and suspended solid removal. SBRs could achieve nutrient removal using alternation of anoxing and aerobic periods.

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. SBR systems have been successfully used to treat both municipal and industrial wastewater. They are uniquely suited for wastewater treatment applications characterized by low or intermittent flow conditions. Sequential batch reactor (SBR) is fill-and-draw activated sludge treatment system.

Although the process involved in SBR are identical to conventional activated sludge process, SBR is compact and time oriented system, and all the process are carried out sequentially in the same tank. SBR system is the upgraded version of the conventional ASP and is capable of removing nutrients from the wastewater. In its most basic form the SBR system is simply a set of tanks that operate on a fill-draw basis.

The tanks may be an earthen or oxidation ditch, a rectangular basin, or any other concert/metal type structure. Each tank in the SBR system is a filled during a discrete period of time and then operated as batch reactor. After desired treatment, the mixed liquor is allowed to settle and the clarified supernatant is drawn from the tank. Essential difference between the SBR and the conventional continuous flow activated sludge system is that SBR carries out functions such as equalization, aeration and sedimentation in a time rather in a space sequence.

II. Literature Review: SBR Apllicaton for Tretment FO Domestic and Industrial Wasterwater

P.G.Patil (2013), et al. Sequencing Batch Reactor (SBR) is a single vessel reactor with activated sludge system which operates in time rather than in space. SBR is filled and draw type system used for treating wastewater. SBR is used to treat the wastewater from chemical, dairy, industrial estate wastewater, landfill lechate, paper and pulp, petrochemical, petroleum, pharmaceutical, piggery, sewage, swine, synthetic wastewater, tannery, textile industries by using lab scale, pilot scale and industrial scales models. SBR is operated for different operating conditions. SBR is found to be low cost, efficient and flexible technology which can be atomized in treating different industrial wastewater.

Prodyot Kundan et al. , Slaughterhouse wastewater contains diluted blood, protein, fat, and suspended solids, as a result the organic and nutrient concentration in this wastewater is very high and the residues are partially solubilized, leading to a highly contaminating effect in riverbeds and other water bodies if the same is let off untreated. The performance of a laboratory-scale Sequencing Batch Reactor (SBR) has been investigated in aerobic-anoxic sequential mode for simultaneous removal of organic carbon and nitrogen from slaughterhouse wastewater. It was observed that from 86 to 95% of SCOD removal is accomplished at the end of 8.0 hr of total react period. In case of (4+4) aerobic-anoxic operating cycle, a reasonable degree of nitrification 90.12 and 74.75% corresponding to initial NH_4^+-N value of 96.58 and 176.85 mg/L, respectively, were achieved. The overall vision for this research is to optimize a cost- and space-effective biological nutrient removal (BNR) system to remove nitrogen from wastewater for water reuse. The ultimate goal is to protect natural water resources and reduce energy consumption in wastewater treatment.

Baikun Li (2012) et al.,the overall vision for this research is to optimize a cost- and space-effective biological nutrient removal (BNR) system to remove nitrogen from wastewater for water reuse. The deteriorated natural water resource is the main obstacle for water reuse necessary to save water consumption in Pennsylvania. Current research conducted in the Environmental Engineering Laboratories at Penn State Harrisburg aims at enhancing nitrogen removal by the sequencing batch reactor (SBR). Compared with conventional biological wastewater treatment processes, the SBR has several distinct advantages: 1. the SBR process converts the conventional wastewater treatment processes from space-course to time-course, which substantially reduces the space occupation. This feature especially makes the SBR suitable for small community wastewater treatment. 2. the SBR operation sections (aeration, anoxic reaction, settling, etc.) are auto-controlled which offer the easiness and flexibility to adjust the SBR operation for different treatment requirements.

Steave Bungay (2015) et al., Sequencing Batch Reactors (SBR) are variable volume, non-steady state, suspended growth biological wastewater treatment reactors. The design and operation of an SBR must take into consideration; 1) the biological process requirement for treating the influent wastewater, 2) the hydraulic requirement to enable the throughput of the water through the reactor without compromising the quality of biological treatment. The importance of the interaction between these considerations will vary depending on the fill strategy, and the cycle time control strategy.This paper considers various operating strategies that are required to prevent loss of treatment capacity under high flow rates or where there is a significant rate of change in the influent flow rate.

Suresh Sundarmurty (2014)et al., this reviews mainly focuses an over view of sequential batch reactor (SBR) technology as an alternative method for treating industrial effluents.The review carried out here shows the efficiency and flexibility of this technology, as it is able to treat different kinds of effluents such as tannery, paper mill, automobile, distillery ,a quaculture, brewery, dairy, dye & textile ,petrochemical, poly aromatic hydrocarbon, complex chemical wastewater and other types of industrial wastewater etc., under different conditions. The review includes manufacture) and Skelly & Loy (the consulting firm supporting the equipment)

Shuokr Qarani Aziz (2013) et al., Sequencing batch reactor (SBR) process uses for treatment of different types of wastewaters such as municipal wastewater, landfill leachate, dairy wastewater, slaughterhouse wastewater etc. Operation parameters of SBR technique are cycle time, aeration rate, volume of reactor, hydraulic retention time (HRT) and other parameters. In this work, operational parameters and removal efficiencies of pollutants for SBR method were studied. In addition, boundaries for operational parameters in SBR process were explained as well.

Virendra Kumar (2014) et al, Pulp and paper industrial effluent is rich in recalcitrant compounds and causes pollution. For the treatment of such compounds activated sludge process is frequently used in which F/M ratio is kept low. This treatment results in effective biochemical oxygen demand removal but other waste water parameters are not reduced effectively due to lack of dissolve oxygen. In the present study sequential batch reactor was used for the removal of pollutant. The aim of present research is to identify the influences of F/M ratio and dissolved oxygen concentration on the microorganism's growth and pollutant removal. The process of bioremediation was optimized by Taguchi approach. Bioremediation experiment resulted in reduction of chemical and biochemical oxygen demand up to 72.3% and 91.1%, respectively. A significant reduction in color (55%), absorbable organic halides (45.4%), total dissolve solids (22%) and total suspended solids (86.7%) was also observed within 14hrs while, the sludge volume index was 52. The wastewater after the treatment process meets the standard given by regulatory agencies and can be discharged into the environment without any risks.

Lin et al. (2004), investigate the municipal sewage wastewater treatment by chemical coagulation and sequencing batch reactor (SBR) methods with an aim to elevating water quality to meet the standards required for agricultural irrigation. Both the conventional and modified SBR methods are considered. The conventional SBR technology is a batch process based on a single activated sludge treatment reactor. Chemical coagulation alone was able to lower the wastewater COD and color by up to 75 and 80%, (COD and NTU to below 20 and 2mg/l). The water quality was consistently excellent and was deemed suitable for agricultural irrigation.

Arrojo et al. (2005), gave a study on SBR process, in SBR process with help membrane process completely removes coliform bacteria and suspended solids, thus providing a higher quality effluent with respect to conventional processes. After SBR treatment neither found faecal coliforms nor E. coli were found in permeate. The removal efficiency of both bacteria and suspended solids by membrane filtration was 100%, suggesting that the experimented compact system (SBR + membrane filtration) could produce an effluent suitable for reuse in agriculture and could be a suitable technology for rural communities.

M. K. Jungles et al (2014), In this work, the performance of a sequencing batch reactor (SBR) on aerobic granular sludge wasstudied for urban wastewater treatment. The system was inoculated with aerobic activated sludge collected from a wastewater treatment plant and, after 30 days of operation, the first granules observed had an average diameter of 0.1 mm. The biomass concentration reached a maximum value around 4 g VSS L-1, and COD removal and nitrification efficiency achieved stable values of 90%.

Zhang et al. (2006) studied the technical feasibilityof simultaneously nitrogen and phosphorus removing from swine manure was investigated in SBR. The 8 hr. per cycle SBR with alternating anaerobic–anoxic–anoxic/anaerobic–anoxic/aerobic conditions realized the reductions of TN, TP, COD, BOD5 and turbidity by about 98, 95, 96, 100, and 95%, respectively. The concentrations of NH4+–N and soluble phosphorus (SP) were also reduced by about 100 and 97%.

Moawada et al. (2009) investigated the treatability of the domestic sewage by an integrated system of anaerobic and aerobic treatment processes i.e. upflow anaerobic sludge blanket (UASB) followed by aerobic SBR produce wastewater suitable for irrigation. Three runs were experimented, which included 4 to 3 hrs variation of HRT of UASB and 6 to 12 hrs cycle variation of SBR in which the aeration period variation was from 2 to 9 hrs. The increase in HRT of SBR was beneficial for TN removal but it was not having any effect on TP as well as COD and BOD removal efficiencies. The removal efficiencies were 84 to 89%, 90 to 95.9 % and 85 to 93.9% of COD, BOD and TSS respectively which concluded that use of SBR as post treatment step after UASB is a promising technology.

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 no 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 require 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.

Freitas et al. (2009) proposed that short SBR cycles select and maintain a robust and active biomass, able to cope with typical disturbances occurring in wastewater treatment plants. In order to test this hypothesis, an SBR system was subjected to COD, N and P shock loads. It was shown that the sludge enriched in the SBR operated with short cycles was able to rapidly recover from the tested disturbances. COD and N removal recovered within 1–2 days for shock loads of 10 times the standard concentration. It was concluded that SBR operated with short cycles led to a robust sludge that was able to respond well to shock loads.

Mohini singh et al (2011), This review paper discusses the technical description and operational flexibility of SBR for the treatment of wide range of effluent under different operational conditions, together with its modifications that could increase the effectiveness of SBR system SBRs are variations of the activated sludge process that operates on a fill-and-draw basis. It combines both aerobic–anaerobic phases in one unit and saves up to 25% of the aeration costs concomitant with low sludge production. Consequently, simultaneous nitrogen and phosphorus removal from the wastewater could be achieved by adjusting the actual operating cycles in the future.

III. DISCUSSION

The performance of SBRs is typically comparable to conventional activated sludge systems and depends on system design and site specific criteria. Depending on their mode of operation, SBRs can achieve good BOD and nutrient removal. For SBRs, the BOD removal efficiency is generally 85 to 95 percent. SBR manufacturers will typically provide a process guarantee to produce an effluent of less than:

C 10 mg/L BOD

C 10 mg/L TSS

C 5 - 8 mg/L TN

C 1 - 2 mg/L TP

As the treatment of industrial wastewater is a major and complicated issue regarding the environmental pollution, one can have the better solution in the form of SBR. The wide variety of wastewaters can be treated using SBR as can be concluded from the literature review. The process modification is very easy due to flexible nature of the SBR. The cycles, HRTs, SRTs can be changed and hence it provides wide scope for treatment that is too in a single reactor which is most advantageous factor. Some modifications are tried like addition of perforated baffle plates for creating the conditions of continuous flow in a batch reactor (Lin S.H. and Cheng K.W. 2001) which was not so much to the benefit from treatment aspect. There is also example of modification in cycle as the additional nitrification is provided and eight steps process was created (Kim et al., 2008) which proved very much effective as the treatment efficiency increased but with low strength wastewater. Additional study related to various strength of wastewater with SBR is part of further scope. The change in steps in terms of aerobic, anaerobic, oxic, and anoxic also were tried (Kulikowska et al., 2007; Kargi and Uygur, 2003; Uygur and Kargi, 2004; Uygur, 2006; Zhang et al., 2006) which also were on positive side as the treatment is concerned. The alteration of cycle duration along with variation in phases would be further scope of study.

CONCLUSION

The wide variety of wastewaters can be treated using SBR as can be concluded from the literature review. The process modification is very easy due to flexible nature of the SBR. The cycles, HRTs, SRTs can be changed and hence it provides wide scope for treatment that is too in a single reactor which is most advantageous factor.

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