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Anaerobic Sequential Batch Reactor for Treatment of Domestic Wastewater- A Review

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Abstract—*Anaerobic systems developed recently are applied successfully for treatment of low strength wastewaters such as domestic wastewaters and become alternative to conventional aerobic processes with the sequencing batch reactor (ASBR). The most obvious difference is that in SBR technology, the reactor volume varies with time, whereas it remains constant in the traditional continuous flow system. The process is also characterized by low biomass generation and very low (or no) external energy requirement. The anaerobic sequential batch reactor (ASBR) basically comprises the four phases fill, react, settle and decant. The proposed study is focused on treatment of domestic wastewater using ASBR for different mixing conditions, organic loading rates, hydraulic retention time and biomass concentrations. To studythe treatment of the domestic wastewater is to be performance by governing the above influencing factor to make treatment efficient and the removal efficiency of chemical oxygen demand or biochemical oxygen demand.*

Keywords: *sequential batch reactor, biomass concentration, organic loading rate, hydraulic retention time.*

1. INTRODUCTION

Water reuse is an attractive strategy that can significantly contribute to water conservation in areas suffering from water scarcity or overconsumption. This allows the use of reclaimed water for specific purpose, which depends upon the application requires different levels of treatment. Sewage treatment is employed to reuse the treated water.

Anaerobic treatment usually applied to high strength wastewater (COD>2000 – 2500 mg/lit.) [1]. However, anaerobic systems developed recently, are applied successfully for the treatment of domestic low and medium strength wastewater and become alternative to conventional aerobic process. Reduction of organic matter and generation of methane gas has the major concept behind anaerobic treatment. The treatment also characterized by low energy requirement. The anaerobic system for the treatment of low strength wastewater can be used in most of the developing countries at tropical and sub-tropical region (temperature > 20^0 C) as more suitable, economical and effective solution than the conventional aerobic treatment.

The anaerobic sequencing batch reactor allow typical biological anaerobic metabolism from substrate. It is the batch fed and decanted suspended growth treatment process. ASBR takes place in single tank, comparing to other system, this is relatively ease of operation, system flexibility and usage of same reactor for both reacting and settling of wastewater. Moreover, this batch process presents better quality control than continuous ones, mainly if used to treat wastewater produced intermittently. One of the most important characteristics that enable of utilization ASBR for wastewater treatment is the maintenance of high active biomass concentration inside the reactor which enables application of high organic loading rates and provision for high system performance and stability compared to conventional anaerobic treatment processes. The reactor sequencing through four step settle, decant, fill and react [2].

2. REVIEW OF PREVIOUS WORK DONE

2.1 Influence of agitation rate on performance of ASBR

Rodrigues et. al. [5] carried out the work on influence of agitation rate on performance of ASBR for low-strength wastewater. The work reports on the influence of the mechanical agitation rates on the performance of a stirred anaerobic sequencing batch reactor on the basis of (COD). The reactor containing granulated biomass treating synthetic domestic wastewater was operated at 300^0C and an 8-h cycle was applied to treat approximately 2 liters of the synthetic substrate with COD of nearly 500 mg/lit. The studied agitation rates ranged from no agitation to 75 rpm. The system attained non-filtered and filtered substrate removal efficiency of 80 and 88%, respectively, at the agitation rate of 50 rpm, presenting a relatively good solid retention and no granule break-up. The variation of agitation rate on the efficiency was not done in this study. An empirical equation and a first order kinetic model with a residual organic matter concentration were proposed to analyze the influence of agitation rates on the reactor's performance.

2.2 Performance of ASBR through variable stirring rate program

Rodrigues et. al. [6] studied the performance of an anaerobic sequencing batch reactor treating low strength wastewater through implementation of a variable stirring rate program. Two different stirring rate programs were implemented: a constant rate of 50 rpm and a variable rate consisting of 75 rpm for one hour, 50 rpm for four hours and 25 rpm for 0.5 hour. In cases, a very short start-up period and unfiltered and filtered substrate removal efficiencies of 81% and 88%, respectively. Use of the variable stirring rate enhanced efficiency of the reactor dynamics without impairing biomass morphology, thus resulting in a reduction in the total cycle time and a possible decrease in energy consumption

2.3 Treatment of domestic wastewater by ASBR

Sartiet. al. [7] studied the pilot scale anaerobic sequencing batch rector treating domestic sewage. The three ASBR reactor with 1.2 m^3 (total volume) each had different geometric characteristics and mixing types. Low retention of solids was the main problem met in less L/D ratio. The results shows that the two ASBR (ASBR1 and ASBR3) reactors operated under mixed liquor recirculation showed non-satisfactory results, attaining mean values of COD and TSS removals efficiencies of 40% and 65%, respectively. The mean effluent values were of COD 320 mg/lit. and TSS 85 mg/lit. The ASBR2 operated under mechanical mixing showed better results with average removal efficiencies of 60% and 80% for COD and TSS, respectively. But the further study of the agitation rate variation was not done by the author in this study. So there is scope to enhance the efficiencies by improving the agitation program.

2.4 Effect of biomass concentration on performance of ASBR

Kayranli and Ugurlu [4] carried out study on effect of temperature and biomass concentration on the performance of anaerobic sequential batch reactor treating low strength wastewater using domestic wastewater (290±10 mg COD/lit.). During these studies different organic loading rates (0.29 to 0.62 kg COD/m^3d), hydraulic retention times (11 to 25 h), temperatures (10 to 25 °C) and at different anaerobic sludge concentrations (about 5 gVSS/lit. and 10 gVSS/lit) in the reactor were applied and the performance of the reactor was tested. The result shows that treatment of low strength wastewater under low temperature was possible. The system achieved high COD removal efficiency (more than 93%) at 10 gVSS/lit. However, the system performance decreased up to 33% at 5 gVSS/lit. However the COD removal and methane production decreased with decreasing temperature and HRT.

2.5 Review the treatment of wastewater using sequencing batch reactor

Dohare and Kesharwani [3] was review the treatment of wastewater using sequencing batch reactor. The publication intends to provide an overall vision of SBR technology as an alternative method for treating waste water. SBR technology differs in various ways from conventional technologies used in biological treatment of wastewater**.** SBR processes are comparatively easy to operate and cost efficient and this process saves more than 60% of the expenses when compared to conventional activated sludge process.

3. DISCUSSION

The literature shows that the mixing mechanism highly influences the performance. The stirring mechanism is the influencing parameter in the performance of the anaerobic sequencing batch reactor. It basically affects the COD removal efficiency of the rector for the treatment domestic wastewater. i. e. upto 78 %. The reactor also has the factors,hydraulic retention time and biomass concentration, which influences the performance.

4. CONCLUSION

The complex nature of the domestic wastewater demands for the proper treatment. There was not enough study done in India for the treatment of domestic wastewater using anaerobic sequencing batch reactor.There is scope of applying various stirring configuration program for even better performance of the anaerobic sequencing batch reactor for the treatment of domestic wastewater. Also there is a scope of variation in the hydraulic retention time and biomass concentration for the treatment of domestic wastewater using anaerobic sequencing batch reactor to study the effect on COD removal efficiency.

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