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Impact of Aerobic Treatment with Presence of Coconut Shell Media in Treating of Dairy Waste Water

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Abstract

The discharge of domestic and industrial waste water to surface or ground water is very dangerous to environment. The treatment of any kind of wastewater should produce effluent with good quality. In this regard choosing an effective treatment system is important. Sequencing batch reactor is a modification of activated sludge process which has been successfully used to treat municipal and industrial waste water. In this case SBR is modified (MSBR) with the application of coconut shell media which is distributed uniformly at the bottom of the aerobic reactor. The process could be applied for the removal of nutrients, high biochemical oxygen demand, chemical oxygen demand etc. Dairy wastewater is enriched in organic matter and also contains biodegradable carbohydrates. The inlet is connected to a feed pump having discharge capacity of 2 L per hour. The efficiency in removal of COD, BOD, and other parameters are checked for 24, 48 and 72 h respectively. The ammonia removal efficiency of MSBR is 85%. The BOD removal efficiency of MSBR in presence of coconut shell media is 79%, COD removal efficiency is 74%.

Keywords: *Dairy waste, MSBR, COD, BOD, coconut shell*

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INTRODUCTION

In recent year, modified sequencing batch reactor (MSBR) has been employed as an efficient technology for waste water treatment, especially for domestic waste waters, because of its simple configuration and high efficiency in BOD and suspended solids removal. SBR technology has gained more and more importance in wastewater treatment plants[1,2]. It is known to be a robust system that stands harsh conditions and often been used in order to treat the wastewater from industries[3]. The main advantages are easy operation, low cost, handling hydraulic fluctuation, no need for settling tank and sludge recycling as well as organic load without any significant variation in removal efficiency[4,5]. SBRs are a variation of the activated-sludge process. They differ from activated-sludge plants because they combine all of the treatment steps and processes into a single basin, or tank, whereas conventional facilities rely on multiple basins. SBR has been widely used to treat municipal waste water, landfill leachates and various industrial waste waters[6–10].

Protozoan taxa in waste water treatment plants can be classified as flagellates, amoeba and, in particular, ciliates. Majority of samples of activated sludge biomass reveal presence of larger organisms, small metazoan with generation times shorter than sludge age[11]. SBRs are used worldwide since the 1920s. With growing popularity of SBR in Europe, China as well as the United States, they are being used to treat both municipal and industrial wastewaters, particularly in areas characterized by low or varying flow patterns. Municipalities, resorts, casinos, and a number of industries, including dairy, pulp and paper, tanneries and textiles, are using SBRs as practical wastewater treatment alternatives.

The SBR is operated on a fill-and-draw principle, which consists of five steps: fill, react, settle, decant, and idle. These steps can be altered for different operational applications.

FILL-AND-DRAW PRINCIPLE

Fill

During this, the basin receives influent wastewater which brings food for the microbes in the activated sludge, creating an environment for biochemical reactions to take place. Mixing and aeration can be varied to create the following three different scenarios:

Static Fill

Under this, no mixing or aeration is provided while the influent wastewater is entering the tank. It is used during various set ups such as; 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. As the mixers and aerators remain off, it serves as an energy-savings component.

Mixed Fill

Under this, mechanical mixers are active, but the aerators remain off. The mixing produces a uniform blend of influent wastewater and biomass. As it lacks aeration, an anoxic condition is provided, which promotes denitrification. Anaerobic conditions can also be achieved during this phase.

Under anaerobic conditions, the biomass undergoes a release of phosphorous which is reabsorbed by the biomass once aerobic conditions are reestablished. This phosphorous release doesn’t take place with anoxic conditions.

Aerated Fill

Under this phase, both the aerators and the mechanical-mixing unit are activated and 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. However, to achieve denitrification, it is necessary to switch off oxygen which promotes anoxic conditions for denitrification. By switching the oxygen on and off during this phase with the blowers, we can create oxic and anoxic conditions, which allow nitrification and denitrification. Dissolved oxygen (DO) is monitored during this phase so it does not go beyond 0.2 mg/L ensuring that an anoxic condition will occur during the idle phase.

React

This phase allows further reduction or "polishing" of wastewater parameters. During this, no wastewater enters the basin and the mechanical mixing and aeration units are on. Due to lack of additional volume and organic loadings, the rate of organic removal increases dramatically. Most of the carbonaceous BOD is removed in this phase. Further nitrification takes place by continuing mixing and aeration and leads to the majority of denitrification. The phosphorus released during this phase, plus some additional phosphorus, is taken up during the react phase.

Settle

In this phase, activated sludge is allowed to settle under quiescent conditions i.e., no flow enters the basin and no aeration and mixing is performed. The activated sludge settles as a flocculent mass, forming a distinctive interface with the clear supernatant. The sludge mass is known as 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 phase and thereby degrading effluent quality.

Decant

In this phase, a decanter is used to eliminate 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. The decanter is of two types: floating and fixed-arm decanters. Floating decanters are those which maintain the inlet orifice slightly below the water surface to reduce the elimination of solids in the effluent removed during this phase. They also offer the operator flexibility to vary fill and draw volumes. Fixed-arm decanters are comparatively less expensive and can be designed to allow the operator to lower or raise the level of the decanter. It is optimal that the decanted volume is the same as the volume that enters the basin during the fill phase. It is also significant that no surface foam or scum is decanted and the vertical distance from the decanter to the bottom of the tank should be maximized to avoid disturbing the settled biomass.

EXPERIMENTAL PROGRAMS

Materials and Methods

Sample Collection

The waste water has been obtained from ASM dairy, which is located at Kangeyam, Tirupur district in Tamil Nadu. The waste water has high amount of COD, BOD and turbidity with acidic waste water lines. Some of the important waste water characteristics are given in Table 1.

Sampling

Sampling of waste water is done at the main collecting tank using grab sampling method, the sample bottles are of 50 L capacity which are cleaned three times with tap water then with distilled water and rinsed fully with 6N HNO_3 for removal of every signs of pathogens or odour. Samples collected are used immediately for the study. Before conducting the study, the initial parameters are noted.

Fig. 1: *Collection Site.*

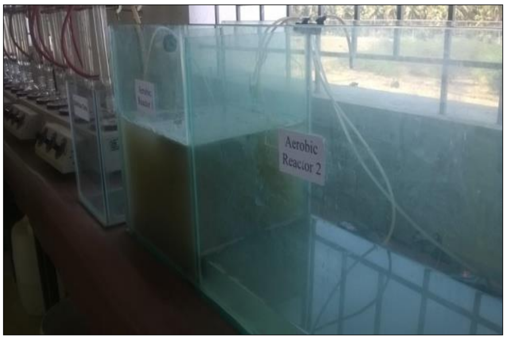

Fig. 2: *Aeration Chambers.*

Fig. 3: *Feed Pump (2 L/h).*

Fig. 4: *Sample Before and After Treatment.*

MSBR SETUP

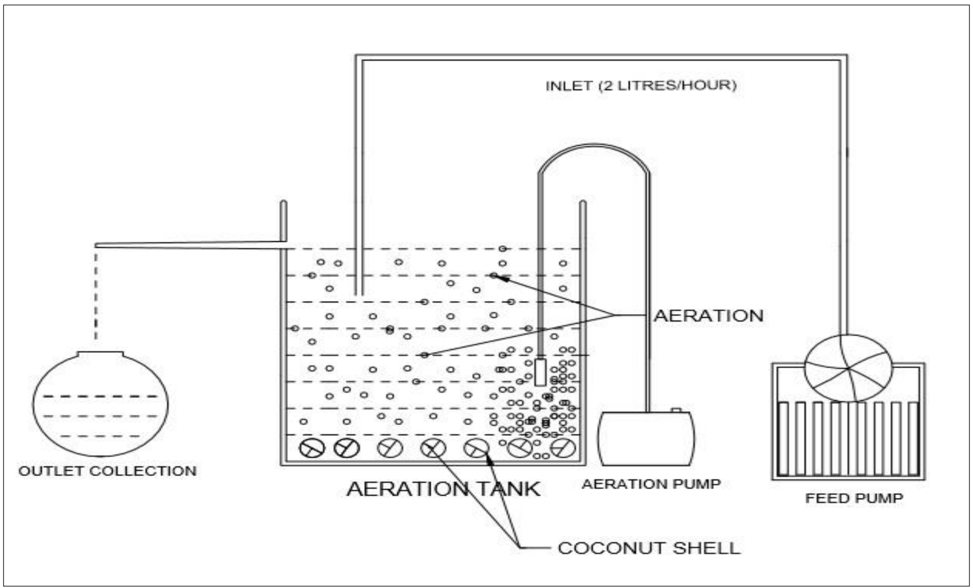

Fig. 5: *Modified Sequential Batch Reactor.*

RESULTS AND DISCUSSIONS

Table 1: *Dairy Waste Characteristics.*

S. No	Parameters	Initial Concentration	24 h Aeration	48 h Aeration	72 h Aeration
1	pH	5.6	5.9	6.4	6.8
2	Conductivity	5	4.7	4.1	3
3	TDS (ppm)	0.43x10000	0.59x10000	0.65x10000	0.73x10000
4	Turbidity (NTU)	220.5	157.3	65.8	35.7
5	Ammonia (mg/l)	3.5	2.8	1.2	0.5
6	BOD (mg/l)	530	430	220	110
7	COD (mg/l)	780.63	600	410.3	200
8	TS (mg/l)	4800	830	432	220
9	TSS (mg/l)	2500	1900	1200	600
10	Odour	Objectionable	Decreased	Nil	Nil
11	Colou	Greyish white	Greyish white	Partially white	Colour less
12	Oil and grease (mg/l)	65.5	48.3	29	15

Table 1 represents the study investigated the treatment efficiency of waste water treated by aerobic process. The extended aerobic process gave better removal efficiency of high oil and grease of 77%, COD of 74% and BOD of 79%. Other parameters such as ammonia, total suspended solids, total solids, turbidity, and conductivity were checked.

The aerobic treatment using MSBR gives more efficiency in the removal of harmful pollutants present in the dairy wastewater, the ammonia present in the dairy wastewater was reduced from 3.5 to 0.5 mg/L with an efficiency rate of 85%, while the turbidity range reduced from 220.5 to 35.7 NTU having an efficiency of 83% and the conductivity was reduced from 5 to 3 ms. Total suspended solids present in the dairy waste water were reduced from 2500 to 600 mg/L.

These results conclude that the MSBR setup poses high efficiency in treatment of dairy wastewater with the presence of coconut shell media. The sludge produced at the bottom of aeration chamber was more and can be used instead of fertilizers for the agricultural purposes.

CONCLUSIONS

The efficiency of MSBR in treating the dairy wastewater is determined. The aerobic treatment process is cheaper than any other conventional treatment methods. The major harmful parameters such as BOD, COD, ammonia, oil and grease present in wastewater were reduced to the satisfactory level. The sludge produced by the reactor contains high nutrient contents and can be used as an organic fertilizer for agricultural purposes. The materials used in this work pose low cost. Treatment using MSBR is more efficient and economical. The COD removal efficiency in MSBR is 74%. BOD removal efficiency clocks at 79%, ammonia is reduced upto 85% and the turbidity is reduced upto 83%. The other parameters of the wastewater were also reduced eventually which concludes that using coconut shell as media is more effective for treating diary waste water. In future the MSBR treatment will have more roles in the treatment of wastewaters.

REFERENCES

1. Schiegl C., Helmreich B., Frnta J., *et al.* Residual COD Elimination of Lignin from Paper Mil Effluent. Poster Presented at *IAWQ-Conferences* in Singapore. *Iran J Environ Health Sci Eng*. 2004; 1: 65–9p.
2. Franta J.R., Wildere P.A. Biological Treatment of Paper Mil Wastewater by Sequencing Batch Reactor Technology to Reduce Residual Organic. *Wat Sci Tech*. 1997; 35(3): 129–33p.
3. Herzbrun P.A, Irvine R.L., Malinowski K.C. Biological Treatment of Hazardous Waste in Sequencing Batch Reactors. *J. Water Pollut. Control Fed.* 1985; 57(12): 1163–7p.
4. Kolb F.R, Wildere P.A. Activated Carbon Sequencing Batch Reactor to Treat Industrial Wastewater. *Wat Sci Tech*. 1997; 35(1): 169–76p.
5. Keudel L.O, Dichtl N.J. Settling Characteristics of Activated Sludge in Sequencing Batch Reactors Obtained from Full-Scale Experiments. *2nd International Symposium on Sequencing Batch Reactor Technology*, France. 2000; 75–83p.
6. Droste R.L. *Theory and Practice of Water and Wastewater Treatment*. John Wiley & Sons, Inc., New York. 1997.
7. Lee C.C., Lin S.D. *Handbook of Environmental Engineering Calculations*. McGraw Hill. New York. 2000.
8. Lin S.D. *Water and Wastewater Calculations Manuel*. McGraw Hill, New York. 2001.
9. Ni B.S., Xie W.M., Liu S.G., *et al.* Modeling and Simulation of the Sequencing Batch Reactor at a Full-Scale Municipal Wastewater Treatment Plant. *Aiche J*. 2009; 55: 2186–96p.
10. Kim Y.H., Yoo C.K., Kim Y.S., *et al.* Simulation and Activated Sludge Model Based Iterative Learning Control for a Sequencing Batch Reactor. *Environ Engg Sci*. 2009; 26: 661–71p.
11. Ginoris Y.P., Amaralb A.L., Nicolaub A., *et al.* Recognition of Protozoa and Metazoa using Image Analysis Tools, Discriminant Analysis, Neural Networks and Decision Trees. *Anal Chima Acta*. 2007; 595: 160–9p.

