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AN AEROBIC TREATMENT FOR DUDH SAGAR DAIRY, MAHESANA

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Key words : Anaerobic treatment, Anaerobic Baffled Reactor, Organic loading rate, COD removal, Dairy effluent.

ABSTRACT

The present study has been undertaken to evaluate the performance efficiency of the ABR (anaerobic baffled reactor) in treating effluent of dairy industries under anaerobic condition. The laboratory model of ABR of 12 liters capacity was fabricated by acrylic sheet material provided with gas space partition, was used to study the anaerobic treat-ability of dairy effluent. The raw dairy effluent with different organic loading rate was fed into the ABR and the effluent was analyzed for COD removal and biogas production. The maximum COD removal of 91% along with 0.82 L/d biogas was observed during the experiment.

INTRODUCTION

The dairy effluent contains high organic material due to incorporation of milk and milk products. The environmental impact of these dairy effluents can be very high due to the discharge of very large amount of wastewater with a high content of organic matter and nutrients. The dairy wastewater discharged into sewers or any other water body causes pollution in the environment in different ways depending on their bio degradability and solubility. There is a rapid growth of sewage fungi within the water bodies which cause decrease in dissolved oxygen level. Occasionally the waste carries the bacteria responsible for tuberculosis like sphaerotilusnatans, etc. The dairy wastewater normally characterized as fallows :

1) They are mainly diluted milk or milk products.
2) Cleaning compounds and sanitizers are the major constituents of dairy wastewater.
3) The contaminants are with a high organic strength and nutrients (N, P).
4) They have high BOD5, COD and total solids. The wastewater generated in the dairy industry has BOD more than 2000 mg/L, dissolved solids of 1800 mg /L and whey has a very high COD ranging from 30000 mg/L to 40000mg/L.
5) The use of acid and alkaline cleaning compounds may cause high pH variability. All compounds of dairy wastewater are biodegradable except protein and fat.

The biological treatment system (aerobic and/ or anaerobic) is being followed to treat industrial wastewaters. Aerobic treatment requires large energy consumption to produce biomass. High operation cost and disposal of large amount of sludge (incineration and as fertilizers) are the problems faced in

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this system. Anaerobic treatment is the best way of treating the industrial wastewater during the last two decades. Anaerobic treatment of wastewater occurs under natural conditions as organic matter decays in the presence of water and in the absence of oxygen. During the anaerobic process the certain facultative and anaerobic bacteria utilize the organic matter present in the waste water and break down the carbonaceous materials into water, methane and carbon-dioxide. Anaerobic process has emerged as an acceptable process in the perspective of energy conservation. The successful application of anaerobic systems to the treatment of industrial waste water is dependent on the development and usage of high rate anaerobic bio reactors. Among the high rate reactors ABR (Anaerobic Baffled Reactor) was recommended by several researchers as a promising system of industrial waste water treatment. The ABR has been described as a series of UASB reactors without granulation. Hence it has a very low startup time compared with other high rate reactors. It includes a series of alternative standing and hanging baffles, flowing through it, the wastewater comes into contact with a large amount of bio-mass as it passes through the reactor and the effluent is relatively free from biological solids. The aim of this study was to evaluate treat-ability performance of the ABR on the dairy effluent at various organic loading conditions.

MATERIALS AND METHODS

Experimental setup

The laboratory scale ABR was fabricated with 6 mm thick acrylic sheet material with overall dimensions of 60 cm long, 13 cm width and a depth of 24 cm with a liquid volume of 10.137 liters. The reactor was divided in to 10 equal compartments by vertical standing and hanging baffle walls. Each compartment was equipped with sampling ports that used to draw out the samples for analyzing. The reactor was kept at the room temperature. The produced gas was collected via porthole on the top of the reactor and the daily volume was determined using the gas liquid displacement technique.

Sampling and analysis

The waste water employed in this study was collected from a dairy industry in Chennai with the required feed of COD concentration. During the operation, the influent and effluent characteristics such as pH, BOD, COD concentration, bio gas production rate and TSS were monitored daily. All the analytical determinations were performed according to Standard Methods (APHA, 1998).

Start up of the anaerobic baffled reactor

The aim of the start up period was to acquire bio film formation within the reator. The system was opperated in a semi continuos mode and placed in the room temperature at 35+_2 °C. The ABR was filled with water and then the digested cow dung (inoculums) was fed in, up to 50% of the reactor, volum, then the waste water was fed in. The reactor was operated with the influnt COD range of 3000 mg/L to 10500 mg/L and the characteristics results are shown in the Tables 1 - 2. Initially the organic loading rate of the reactor was kept at 1.2 kg of COD/L/d. It attains the steady state level at the 48 th day. Then the OLR was increased gradually to 2.1 kg of COD/L/d, 3.5 kg of COD/L/d and 4.5 kg of COD/L/d for 40 days.

RESULT AND DISCUSSION

The reactor was operated for 3 months. Because of different OLR and HRT employed during the operation period, the COD removal rate and bio gas release were increased with the increase in OLR .The pH reduction level in the reactor also followed in a similar manner throughout the experiment. In this study the best reactor performance was observed in the 4.5 Kg of COD/L/d resulting 91% of COD removal along with 0.82 L/d of bio gas production at a HRT of 0.51 days.

The removal efficiencies of the anaerobic baffled reactor based on the various organic loading rates for dairy waste water are illustrated in the profiles. Thus the treatability performance of ABR on dairy effluent was evaluated as functions of COD removal and bio gas production rates. The predicted results indicate that the laboratory scale of ABR is capable to treat the dairy effluent successfully at the different organic loading rates.

CONCLUSION

The following conclusions can be drawn from the present study.

The anaerobic treatment of the wastewater from the dairy factories was successfully carried out. The performance evaluations showed that the dairy effluent could be treated using anaerobic baffled re-

Table 1. Organic loading rate 2.8 kg of COD /L/d

No.of days	Initial Characteristics					Effluent Characteristics						
	BOD mg/L influent	COD mg/L influent	pH	TSS mg/L	BOD mg/L effluent	TSS mg/L	COD mg/L effluent	pH	%of BOD removal	%of COD removal	%of TSS removal	Volume of fed L/d	Volume of gas yield	HRT in days
1	6391	8256	9.2	2064	3515	874	4375	8.2	45.0	47.0	59.00	3.80	0.32	0.32
2	6010	7989	9.2	2022	3245	809	4194	8.1	46.0	47.5	60.00	4.20	0.39	0.35
3	5255	7109	9.1	1693	2628	635	3128	7.7	50.0	56.0	62.50	4.73	0.46	0.39
4	5165	7021	8.8	1560	2463	515	2176	7.7	67.0	69.0	67.00	4.79	0.48	0.4
5	5085	6981	8.7	1454	1424	444	1745	7.5	72.0	75.0	69.46	4.81	0.69	0.4
6	5050	6900	8.5	1327	1086	365	1311	7.6	78.5	81.0	72.50	4.90	0.71	0.42
7	4110	6545	8.5	1259	575	255	1221	7.5	86.0	81.4	79.80	5.14	0.75	0.44

Table 2. Organic loading rate 4.5 kg of COD /L/d

No.of days	Initial Characteristics					Effluent Characteristics						
	BOD mg/L influent	COD mg/L influent	pH	TSS mg/L	BOD mg/L effluent	TSS mg/L	COD mg/L effluent	pH	%of BOD removal	%of COD removal	%of TSS removal	Volume of fed L/d	Volume of gas yield	HRT in days
1	6391	8256	9.2	2064	3515	874	4375	8.2	45.0	47.0	59.00	3.80	0.32	0.32
2	6010	7989	9.2	2022	3245	809	4194	8.1	46.0	47.5	60.00	4.20	0.39	0.35
3	5255	7109	9.1	1693	2628	635	3128	7.7	50.0	56.0	62.50	4.73	0.46	0.39
4	5165	7021	8.8	1560	2463	515	2176	7.7	67.0	69.0	67.00	4.79	0.48	0.4
5	5085	6981	8.7	1454	1424	444	1745	7.5	72.0	75.0	69.46	4.81	0.69	0.4
6	5050	6900	8.5	1327	1086	365	1311	7.6	78.5	81.0	72.50	4.90	0.71	0.42
7	4110	6545	8.5	12591	575	255	1221	7.5	86.0	81.4	79.80	5.14	0.75	0.44

actor. No purges were carried out during the whole operational period of 3 months, which indicates that the excess of bio mass can be successfully removed automatically from the reactor and without any inhibition effects.

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