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Evaluation Studies on Hybrid up Flow Anaerobic Sludge Blanket Reactor for Treating Dairy Effluent under Different Season.

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ABSTRACT
Dairy industries have shown us great growth in size and number in most countries of the world. In recent times, the dairy industries have started incorporating sophisticated processing equipments with CIP cleaning systems and PLC based process automation systems. The dairy mill effluent is characteristically biodegradable with BOD_5, of 2500-3500 mg/l and COD restricted to 4000-5000 mg/l and p^H from 5.6-8.6 .The biodegradability range of dairy effluent is from 0.63 to 0.72 .The hybrid anaerobic reactor is assessed with a pilot model (8 litres) for the treatment of dairy effluent .The present study evaluates the performance of hybrid anaerobic reactor under different seasons, viz , rainy and winter for treating dairy effluent .The model was made run under varying operating conditions , viz ,influent flow rate(2.083,2.500,3.571,5.000,8.330lit/hr) and influent COD (1599.88,2091.98,2564.46 mg/l), OLR(Rainy season) (0.025,0.031,0.036 kg/COD/m^2 day),(winter season)(0.018,0.026,0.032kg/COD/m^2 day) and HRT (6.00,10.00,14.00,20.00,24.00hrs)are interpreted for the respective conditions .The COD removal was observed for minimum of 78.10% starting from 78.86% for rainy season and maximum of 79.10% from 80.61%COD removal for winter season .
Key words-COD, Dairy wastewater, HRT, HUASBR, Microbial support media, OLR.

I. INTRODUCTION

The dairy industry wastewaters are primarily generated from cleaning and washing operations in the milk processing plants. It is estimated that about 2 % of the total processed milk is wasted into drains (Munavalli and Saler, 2009).Dairy wastewaters are characterized by high biological-oxygen demand (BOD) and chemical oxygen demand (COD) concentrations, and generally contain fats, nutrients, lactose, as well as detergents and sanitizing agents. A dairy effluent decompose rapidly and depletes the dissolved oxygen level of the receiving streams immediately resulting in anaerobic conditions and release of strong foul odours causing nuisance. The receiving water becomes breeding place for flies and mosquitoes carrying malaria and other dangerous diseases like dengue fever, yellow fever, chicken guniya (Demirel *et al.*, 2005).

In India near about annual production of processed milk is more than 200 million tonnes. The water requirements for washing and cleaning process lies within the range of 0.9 to 2.0 per litre of milk processed(Shirule et al., 2013) .The wastewater is having high strength COD and its biodegradable. The HUSBR process is seemed as one of the most cost effective & efficient anaerobic treatment. The present study was on the pilot scale anaerobic treatment a dairy industry wastewater using HUASBR. The performance of HUASBR was studied based on the efficiency of removing contaminants inside the wastewater with the aids from microorganism developed inside the reactors.

The conventional anaerobic digesters are attached growth systems with a random packing fill media to support sustain the microbial growth are brought to the anaerobic digesters, essentially to enhance the wastewater reduction efficiency. In this study, a system of HUASBR reactor is used to evaluate the removal of COD up to Rainy season 79.10%, winter season 80.61%.

II. EXPERIMENTAL SETUP

The experimental set up consists of HUASBR reactor having 5.00 litres of effective volume. The physical features and process parameters are listed in table-1. The schematic diagram of the experimental setup is presented in fig 1 and table 1.

The feed stock for the reactor was collected from Aavin dairy industry, sethiyathope, Cuddalore, Tamilnadu, India. A cylindrical vessel of 10cm diameter and 100 cm height is fabricated with fibre glass is provided with a five nozzles. Out of five nozzles one nozzle is provided for sampling port another one is provided for extra sludge and the another two nozzles are provided for outlet and last one is used for gas collection.

Table 1HUASBR – The physical features and process parameters of experimental model

DESCRIPTION		MEASUREMENTS
Total volume of the reactor ,lit		8.00
Effective volume of the reactor, lit		5.00
Total height of the reactor , m		1.00
Effective height of the reactor ,m		0.64
Height of the microbial support media ,m		0.15
Peristaltic pump (miclin's make)		pp-30 model
Influent flow rate lit/hr		2.083,2.500,3.571,5.000,8.330
Influent average COD mg/l		1599.88, 2091.98,2564.46
Organic loading rate kg/COD/m^2 day		(Rainy season)(0.025,0.031,0.036), (winter season)(0.018,0.026,0.032)

The top of the reactor hermetically sealed to avoid any air entrapment. In the bottom portion of reactor packed with fujino support media to develop the microorganisms. The reactor is fed from the influent tank by means of a peristaltic pump of miclin's make and model pp-30 .The influent to the reactor is at its bottom and the reactants move from the bottom passing through packed media. The reactor is provided with sampling ports at zones viz., hydrolysis, acids genesis and methaogensis in the reactor. Separate ports were provided for desludge at bottom and for scum removal at top. The influent tank is provided with an agitator to ensure proper mixing of the wastewater. The treated effluent from the top of the reactor is obtained by overflow through effluent pipe, and at the top where the gas got separated and collected in a gas collector.

III. EXPERIMENTAL METHODOLOGY

The random samples were obtained from Aavin dairy industry, sethiyathope, Cuddalore, Tamilnadu, India, and analyzed for specific parameters. The synthetic sample was prepared to simulate the basis of studied factors value of samples. The experiment was started by treating the domestic wastewater, anaerobic systems for municipal sewage treatment is so far very limited. The predominant reason given for this is, that municipal sewage are to 3 weeks to maintain in the form of granules content in reactor. Synthetic wastewater is used for experimental study. The synthetic critical wastewater was allowed into the reactor with an average OLR 0.019 kg COD/m^2.day; during this investigation the COD was measured. The process performance was monitored and the COD removal efficiency of the reactor under different hydraulic retention time was noted. The following two conditions were used in particular for interpreting the reactor (HRT in hrs) hydraulic retention time and organic loading rate (OLR in kg/COD/m^2 day).

The performance of the reactor was studied and the steady state conditions were observed to attain with COD reduction for an average value of 80.61%

All samples were tested on a regular basis for pH, BOD, TSS, VSS, COD, and. 50 ml sludge samples were taken from the two lower sample ports and were tested for, TSS and VSS. All analyses were performed according to Standard Methods for the Examination of Water and Wastewater (APHA, 2005).

The synthetic dairy effluent is prepared using milk powder and introduced into the reactor after the process stabilization. The experiment ran for different operating parameters conditions , hydraulic loading rates ,m^3/m^2.day(0.280,0.180,0.140,0.100,0.040),organic loading rates(Rainy season) (0.025,0.031,0.036 kg/COD/m^2 day),(winter season)(0.018,0.026,0.032kg/COD/m^2 day) and HRT hrs (6.00,10.00,14.00,20.00,24.00). The overall COD removal efficiency observed for minimum of 78.10% starting from 78.86% for rainy season and maximum of 79.10% from 80.61%COD removal for winter season. Removal of COD efficiency was better during winter season when compared to rainy season.

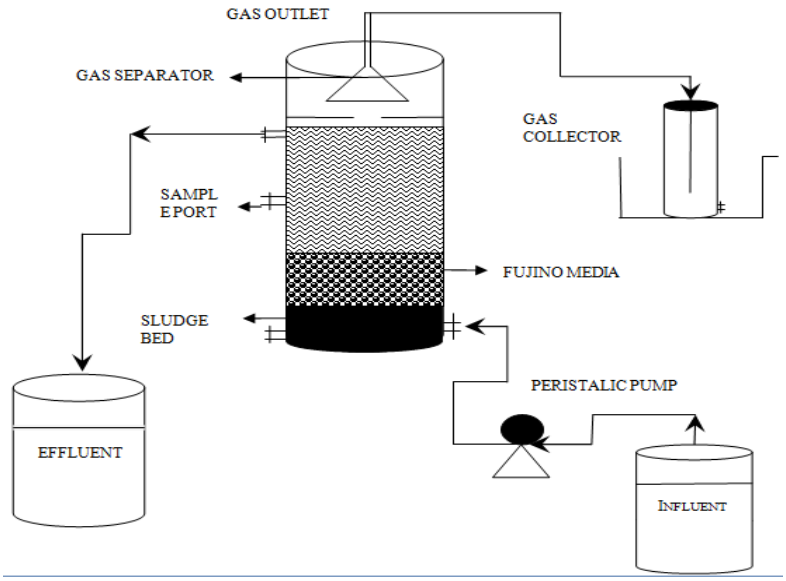

Fig 1.Experimental model of the hybrid UASB reactor

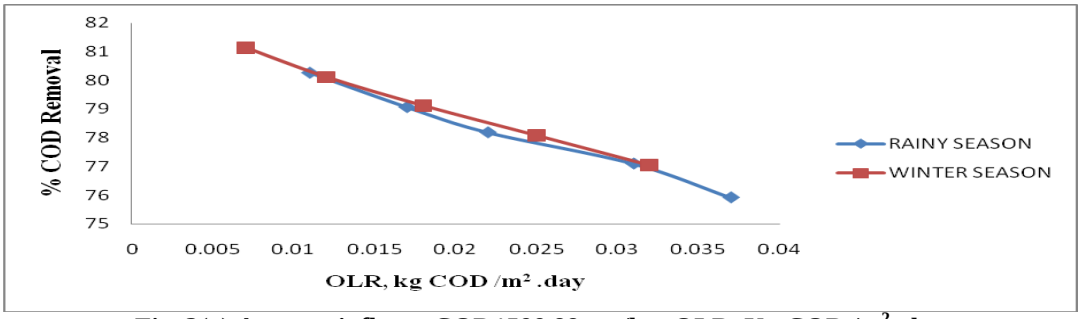

Fig .2(a) Average influent COD1599.88 mg/l vs OLR, Kg COD /m^2 .day

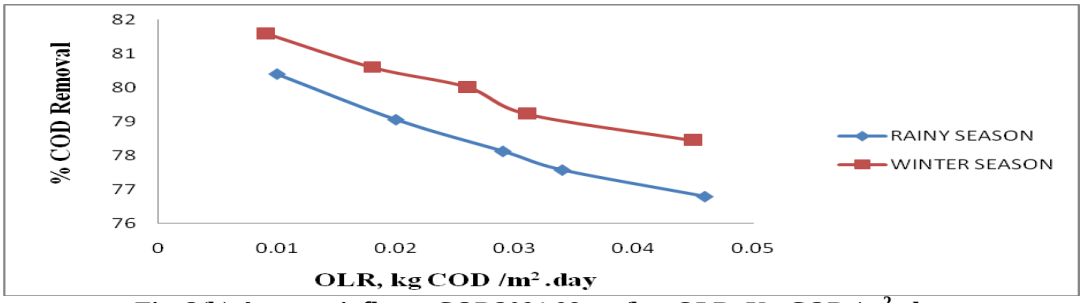

Fig .2(b) Average influent COD2091.98 mg/l vs OLR, Kg COD /m^2 .day

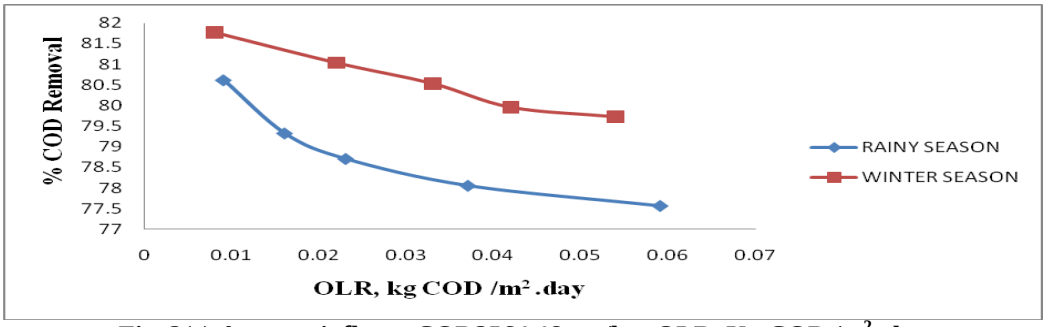

Fig .2(c) Average influent COD2564.46 mg/l vs OLR, Kg COD /m^2 .day

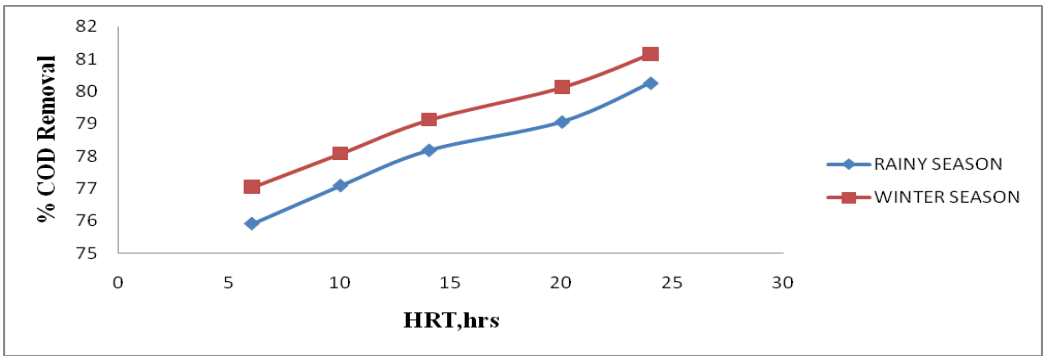

Fig .3(a) Average influent COD1599.88 mg/l vs HRT, hrs

Fig .3(b) Average influent COD 2091.98mg/l vs HRT, hrs

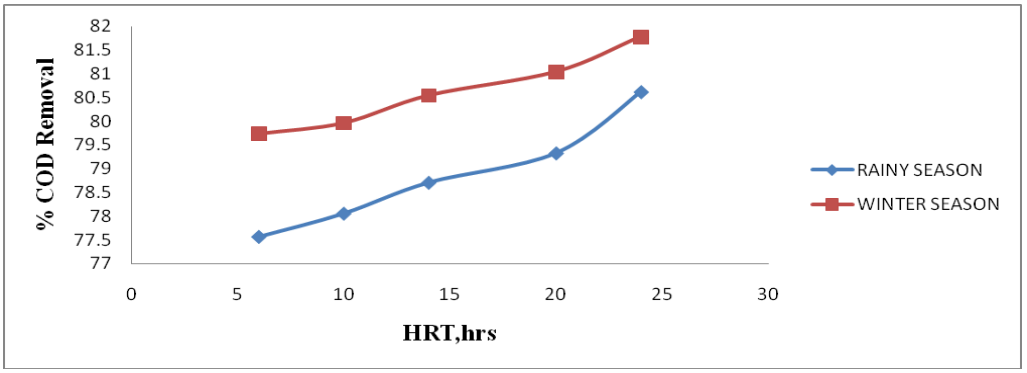

Fig .3(c) Average influent COD2564.46 mg/l vs HRT, hrs

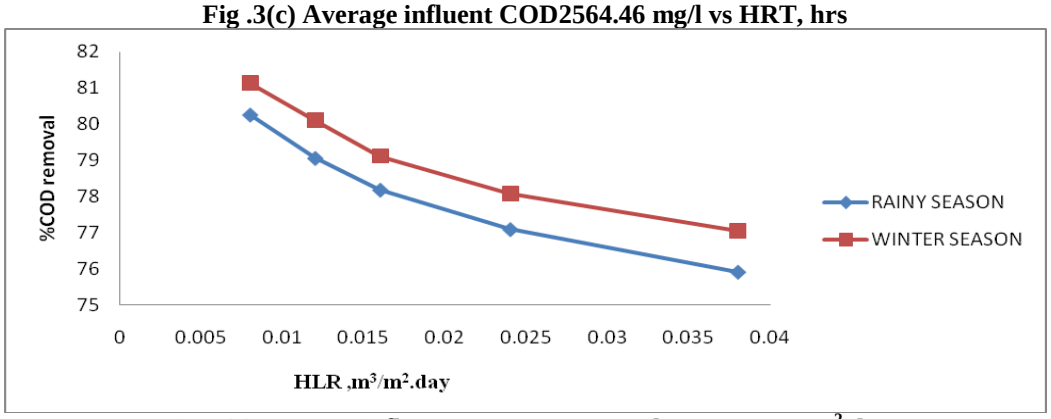

Fig .4(a) Average influent COD 1599.88mg/l vs HLR, m3/m^2.day

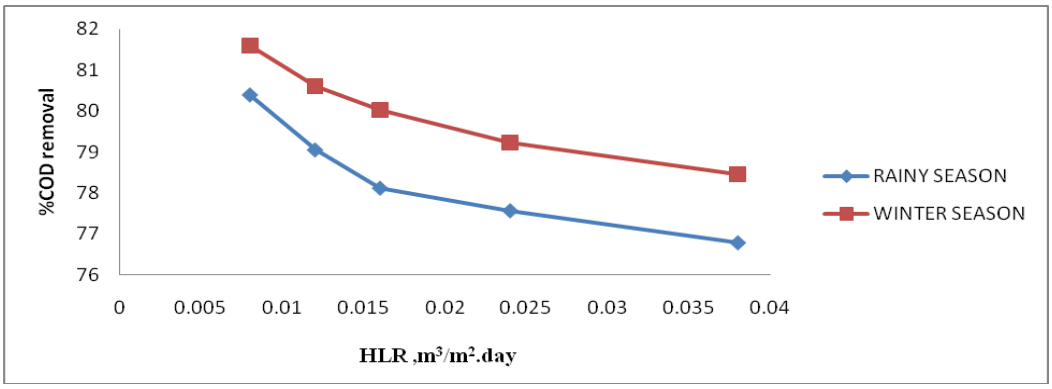

Fig .4(b) Average influent COD2091.98 mg/l vs HRT, hrs

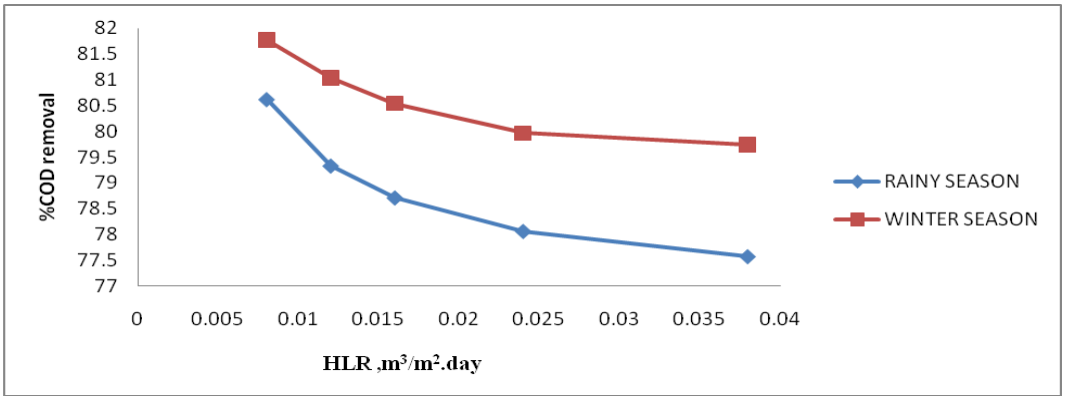

Fig .4(c) Average influent COD2564.46 mg/l vs HRT, hrs

IV. RESULTS AND DISCUSSION

Dairy effluent was prepared synthetically to represent the evaluated characteristics and used in different influents COD concentrations. The average influent cod values of three different synthetic preparations are **(**1599.88, 2091.98, 2564.46 mg/l**).**

The COD removal efficiency under different HRT (6.00, 10.00, 14.00, 20.00, 24.00hrs) for different COD (1599.88, 2091.98, 2564.46mg/l), as shown in fig4 (a,b,c) for being dairy mill effluent using hybrid anaerobic reactor rainy and winter season. The COD removal efficiency under different OLR(Rainy season) (0.025,0.031,0.036 kg/COD/m ^{2}day),(winter season)(0.018,0.026,0.032kg/COD/m^2) day for different COD(1599.88,2091.98,2564.46 mg/l), as shown in fig2(a,b,c) for being dairy mill effluent hybrid anaerobic reactor under varying rainy and winter season.

The COD removal efficiency under different HLR m^3/m^2.day (0.280,0.180,0.140,0.100,0.040), for different COD (1599.88,2091.98,2564.46 mg/l), as shown in fig3(a,b,c) for being dairy mill effluent. Dairy effluent was prepared synthetically to represent the evaluated characteristics and used

V. CONCLUSION

Maximum COD removal efficiency of 80.61%was observed, when the reactor was function using winter season .These values more than of COD removal efficiency. Hence, it can be calculated the winter season is better to rainy season.

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