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Performance Of Mbr For Treating Sugar Mill Effluent– An Experimental Evaluation

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ABSTRACT

An experimental model of Membrane Bio Reactor (MBR) was used to evaluate the treatment of sugar mill effluent. The MBR is designed to have 109 litres of effective volume, incorporated with a MF membrane cartridge for clarification of effluent. The membrane package is submerged which allows the retention of MLSS to an average of 8000-9000 mg/l. The synthetic sugar effluent was used in the experiment and the model was run for varying Organic Loading Rates (OLR) from 0.12 to 1.35 kg COD/kg MLSS.day. The effluent flow was varied and the corresponding Hydraulic Retention Times (HRT) is 6.75,9, 10.8, 15.5, 21.6 and 36 hr. The treatment efficiency was found to vary between 73.53 to 95.89 %, which could be rated as the best among the available technologies in practice in India.

Keywords: MBR, MLSS, COD, OLR and HRT.

INTRODUCTION

The effluent from sugar mills is biodegradable. However, the seasonal operation of sugar mills and regular but intermittent chemical cleaning operations made the operation of conventional biochemical treatment plants difficult. The sugar mills require a very significant quantity of water for their grey areas like floor/vessel washing, boiler feed, cooling tower make-up etc. Hence, there is a need for more advanced treatment systems like Membrane Bio Reactor (MBR) to be tested and validated for treating the effluent to reusable characteristics.

MBR with a high rate aerobic reactor with UF/MF filter package for clarification is learnt to offer desirable treatment efficiency even at very high Organic Loading Rates(OLR). The retention of higher concentration of MLSS and available DO will enable MBR to treat high strength biodegradable waste streams like sugar for COD removal up to 95-99%.

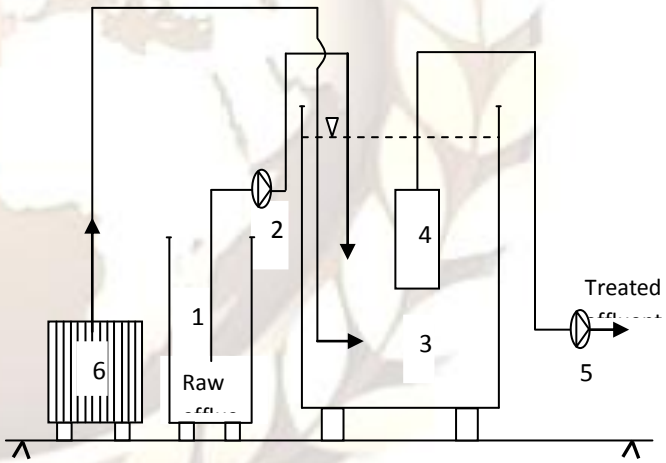
MBR is a hybrid bio chemical treatment that has an exceptional advantage of retaining very high acclimatized biomass. This will enable MBR to perform better in spite of chemical shock loads during the time of plant cleaning and seasonal operation of sugar mills.

EXPERIMENTAL SETUP

An experimental model of MBR, having an effective reactor volume of 108 lit, was used for the study to evaluate the treatment performance. The model is incorporated with Micron Filter (MF) membrane cartridge for retaining the biomass solids in the reactor while drawing the clear and treated effluent.

A modular air compressor (10 in-built divisions and each can supply 7 lit/minute) to supply air 7 to 70 l/minute was used with provision for changing desirable amount of air supply.This enabled to have required Dissolved oxygen (DO) at 2-3 mg/l in the MBR during the experiment.

The schematics of the experimental model is presented in **Fig.1.1**



Fig; 1.1 Schematics of the Experimental set-up
Legend:
1. Raw effluent feed tank
2. Peristaltic pump
3. MBR
4. MF Membrane Cartridge
5. Vacuum Pump
6. Modular Air Compressor

CHARACTERISTATION OF SUGAR EFFLUENT

As a case study, effluent samples were drawn on two occasions from an Integrated Milk Plant and analysed for primary parameters for characterizing the effluent.

The average values of the biochemical characteristics of the sugar mill effluent are listed in **Table 1.1.**
The biodegradability of sugar Mill effluent is assessed for 0.73.

SI.No	Parameters	Concentration
1.	pH	6.85
2.	TSS, mg/l	340
3.	TDS, mg/l	2055
4.	TS, mg/l	2395
5.	BOD_5, mg/l	1620
6.	COD, mg/l	2210
7.	Total Nitrogen, mg/l	13.35
8.	Total phosphorus ,mg/l	5.50

Table1.1; Characteristics of Sugar Mill effluent

EXPERIMENTAL METHODOLOGY

The experiment was conducted using synthetic effluent stimulating the real time characteristics of the sugar effluent.
A peristaltic pump was used to conduct the experiment for six different flow conditions viz.,3, 5, 8, 10, 12and 16 lit/hr. The corresponding Hydraulic Retention Times (HRT) are 36, 21.6, 13.5, 10.8, 9 and 6.75 hrs.

All the six different influent flow rates were used for experimentation with five different synthetic COD preparation. The influent COD that are used for experimental are 1491, 2051, 2484, 2979 and 3471mg/l. The Organic Loading Rates (OLR) is varied from 0.12 to 1.35 Kg COD/KgMLSS. day.

RESULT AND DISCUSSION

The performance of MBR has been evaluated in terms of COD removal efficiency under different influent flow rates and Organic Loading Rates. The MLSS concentration was observed to very between 7120 to 9450mg/l, during the experiment. The DO was observed for a maximum of 2.50mg/l and for a minimum of 1.50mg/l.

The maximum COD removal efficiency was observed for a flow rate of 3 l/hr that corresponds for a HRT of 36 hrs for the OLR of 0.12 Kg COD/Kg MLSS. day for 95.89%., The minimum COD removal was observed for 73.53% at OLR of 1.35 Kg COD/Kg MLSS. day which corresponds to the Volumetric Loading Rates (VLR) of 12.13kg COD/m^3.hr. and HRT of 16 hrs.
The varying performance of the RBC model during the experiment was presented in Fiq 1.2 to Fig 1.5. in respects of % efficiency Vs OLR, % efficiency Vs VLR, % efficiency Vs HRT and MLSS Vs OLR.

CONCLUSION

The MBR is experimentally found to offer a maximum of 95.89% of COD removal for OLR of 0.12 and 73.53% for 1.35 of OLR. The scale up of the model and diffuser systems of aeration, NF membrane package in place of MF and additional build up of MLSS, could further enhance the COD removal even for higher Organic Loading Rates.
Hence, it can be concluded that MBR is a credible alternative to reach the reusable standards for treating sugar mill effluent streams.

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REFERENCES

1. The MBR book, Simon Judd, 2011.
2. Sustainable reclamation and reuse of industrial wastewater including MBR technologies: Case studies, N.I.Galil.et.al, Desalination, 2005.
3. Characterization and performance of different types of hollow fibre membrane in a laboratory –scale MBR for the treatment of industrial wastewater, Barbara Bienati, et. al, IV IWA Conference on Membranes for Water and Wastewater Treatment,2007.
4. New configuration of a MBR for effective control of membrane fouling and nutrients removal in wastewater treatment, Yun-Young.et.al, Desalination, 2007.
5. Process efficiency and microbial monitoring in MBR and CASP treatment of tannery wastewater, Bio resource Technology,2008.