STUDY THE EFFICIENCY OF MOVING BED BIO-FILM REACTOR (MBBR) FOR DAIRY WASTEWATER TREATMENT

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ABSTRACT

-In this research, an experimental study to evaluate removal of COD and BOD from Dairy wastewater by treatment Moving Bed Bio-Film Reactor (MBBR). The paper discusses about Biological treatment. The objective of the study was evaluation of operational parameters and performance of reactor based on attached growth process by using MBBR. The result show removal efficiency of Biochemical oxygen demand (BOD), Chemical oxygen demand (COD) and PH was 89%, 84% respectively. The conclusions also indicate that MBBR with polypropylene media as biofilm carrier possess great removal Dairy wastewater. The MBBR tanks were filled with suspended plastic carriers , with a 30 to 50% filling ratio. Under optimum conditions, almost complete COD/BOD removal efficiency of 79 % was achieved.This study indicate that its demonstrated that use of this reactor results in removal from wastewater.

Keyword : *Dairy wastewater, Bio-film Media, Biological carrier, COD, BOD, Biomass*

1. INTRODUCTION

A steady rise in the demand for milk and milk products in many countries has led to advancements in veterinary science, which has subsequently led to steady growth in the production of milk per head of cattle. This has caused enormous growth of dairy industries in most countries of the world. Consequently, the amount of wastewater generated and discharged from these industries has also increased.

Two technologies are commonly used for biological treatment of sewage: activated sludge and trickling filters. A moving bed biological reactor (MBBR) is a compilation of these two technologies. The biomass in the MBBR exists in two forms: suspended flocks and a biofilm attached to carriers. It can be operated at high organic loads and it is less sensitive to hydraulic overloading. The first MBBR was installed in 1989. Although it is a relatively new technology to the United States (first introduced in 1995), there are now over 400 installations worldwide in both the municipal and industrial sectors with over 36 in North America.

1.1 Dairy wastewater

The dairy industry wastewaters are primarily generated from the cleaning and washing operations in the milk processing plants. It is estimated that about 2% of the total milk processed is wasted into drains. The wastewater generated from milk processing can be separated into two groups—the first group concerns wastewater having high flow rates and the second concerns the effluents produced in small milk transformation units (cheese production for

instance). Dairy wastewater is characterized by high biological-oxygen demand (BOD) and chemical oxygen demand (COD) concentrations, and generally contains fats, nutrients, lactose, as well as detergents and sanitizing agents. Nutrients lead to eutrophication of receiving waters, and detergents affect the aquatic life. Due to the high pollution load of dairy wastewater, the milk-processing industries discharging untreated/partially treated wastewater cause serious environmental problems. Moreover, the Indian government has imposed very strict rules and Regulations for the effluent discharge to protect the environment. Thus, appropriate treatment methods are required so as to meet the effluent discharge standards.

1.2 Moving Bed Bio-Film Reactor (MBBR)

The basic principle of the moving bed process is the growth of the biomass on plastic supports that move in the biological reactor via agitation generated by aeration systems (aerobic reactors) or by mechanical systems (in anoxic or anaerobic reactors). The supports are made from plastic with a density close to 1 g/cm3 letting them move easily in the reactor even when the capacity reaches 70%. The moving bed processes come from the current trend in waste water treatment, from the use of systems that offer an increased specific surface in the reactor for the growth of the biomass, achieving significant reductions in the biological reactor volume.

Some factors have been reported to affect the performance of MBBR. The high specific area of the carrier media controls the system performance which is as a result of very high biofilm concentrations presence in a small reactor volume. It was reported that typical biofilm concentrations range from 3000 to 4000 g TSS /m3, which is similar to values obtained in activated sludge processes with high sludge ages. The percentage of reactor volume comprised of media is limited to 70%, with 67% being typical (Odegaard et al.,2000). However, wastewater characteristics and specific treatment goals are the main factors determining the percentage of media required in the reactor

2. SCOPE OF THE STUDY

The scope of the study is to carry out a laboratory-scale study by conducting a series of experiments using a specific MBBR to treat dairy wastewater. The biofilm carriers used in these experiments were Polypropylene Biofilm.

The reason that PE carrier was selected to be used in this experiment over other media was the advantage of thin, distributed and smooth biomass growth on their surface. The results were compared and evaluated in terms of and chemical oxygen demand (COD), Biochemical oxygen demand removal efficiency to determine the optimal FLR, OLR , HRT and sequence batch reactor.

3. Review Of The Related Literature

The Moving Bed Bio film Reactor (MBBR) represents a different spectrum in advanced wastewater treatment. In the late 1900s, Moving Bed Bio film Reactor (MBBR) was introduced for biological treatment of different types of wastewater.

Odegaard *et al*. (2000), the fundamental characteristic of the MBBR was the specially designed Biofilm carriers, for which the geometry, sizing and materials of construction had been considered carefully to maximize performance. This was a key difference from the activated sludge process where treatment performance was more directly tied to reactor volume. In the MBBR, surface area could be increased by designing carriers with a higher specific surface area or by adding a greater quantity of carriers to a reactor volume. This offered flexibility for future treatment capacity upgrades without requiring the construction of additional reactors.

Bengoa Gorka Zalakain showed several advantages of Moving Bed Biofilm reactor from the operational point of view for small community compared to other conventional biological treatments. Processes studied had taken into account of Moving Bed Biological Reactors (MBBRTM) and hybrid processes (HybasTM).

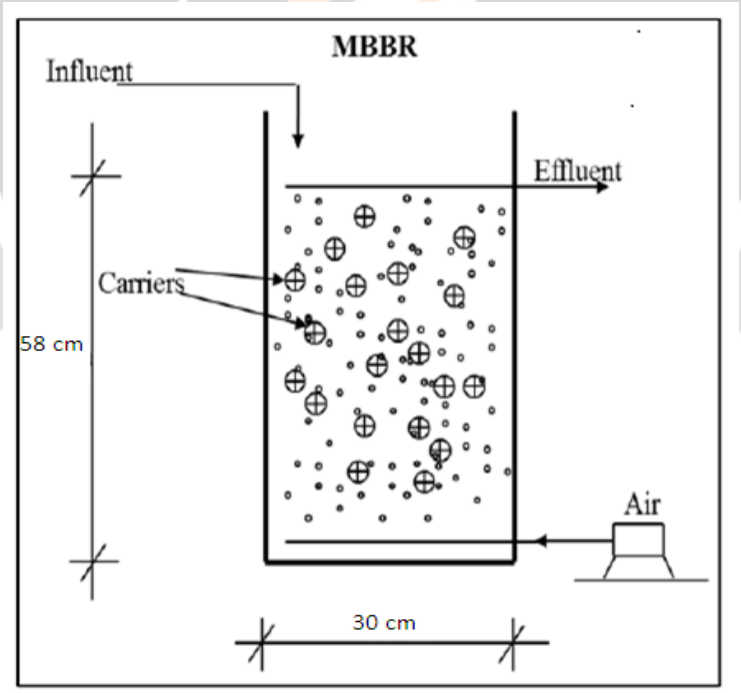
Borghei *et al.*, (2004) used Moving Bed Biofilm Reactors in treating different domestic and industrial wastewaters. Currently, there are more than 400 units of full scaled wastewater treatment plants based on this process.

Brinkley John investigated processes that would treat variable high strength wastewater in a small footprint and provided provisions for future expansion. He selected the MBBR process due to the success the process had for treating high strength wastewater for comparable pharmaceutical applications. The 0.5 million gallon per day (mgd) MBBR process consisted of two reactors operated in series designed to treat an influent and effluent Biochemical Oxygen Demand (BOD5) of 3,197 mg/L and less than 75 mg/L, respectively.

4. Materials And Methods

Experimental set-up:

The Moving Bed Biofilm Reactor (MBBR) technology is an attached growth biological treatment process based on a continuously operating, non-clogging biofilm reactor with low head loss, a high specific Biofilm surface area, and no requirement for backwashing. MBBR is often designed as aerobic system. Samples will be collected from low income and high income society and its parameters will be evaluated prior to treatment. The proposed experimental set-up for Moving Bed Biofilm Reactor can be made as shown in Fig. 1.



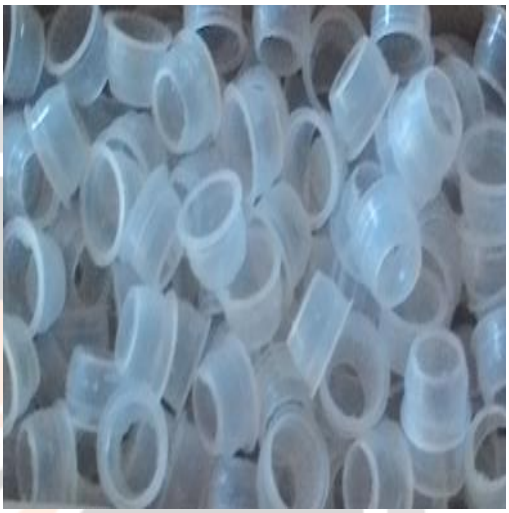
(Figure 1- Moving Bed Bio film Reactor experimental setup)

The Moving Bed Bio-film reactor (MBBR) setup proposed for this study will be made up of plastic containing one compartment. The inlet arrangement for influent after primary treatment of dairy wastewater will be given at the top of tank. The Outlet will be provided at lower level than inlet. The proposed experimental set-up for Moving Bed Biofilm Reactor can be made as shown in above Figure.

The Moving Bed Bio-film reactor (MBBR) process uses floating plastic carriers (media) within the aeration tank to increase the amount of microorganisms available to treat the wastewater compared to conventional secondary treatment. The microorganisms consume organic material. The media provides increased surface area for the biological microorganisms to attach to and grow in the aeration tanks. The increased surface area reduces the footprint of the tanks required to treat the wastewater. The media will be continuously agitated by bubbles from the aeration system that adds oxygen at the bottom of the compartment of the aeration tank. The microorganisms consume organic material. After treatment, final treated effluent will be taken outside through outlet.

(Figure-2 Characteristics of the bio media)

Polypropylene carrier



Surface area - 7.144 cm2 , cost 340 per/Kg

(Figure-3 Top view of experimental setup)

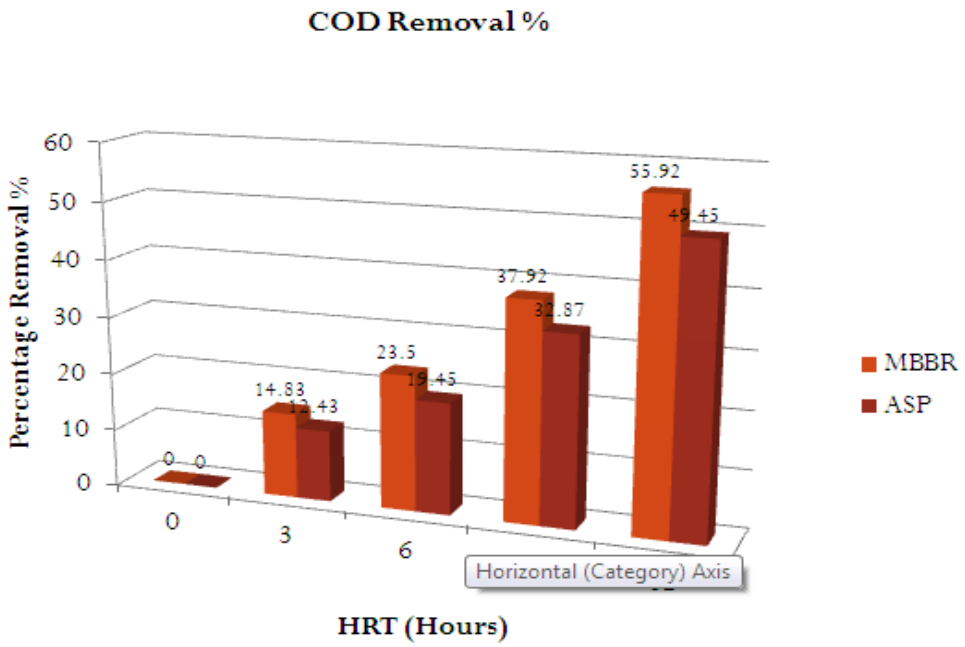
6. RESULTS

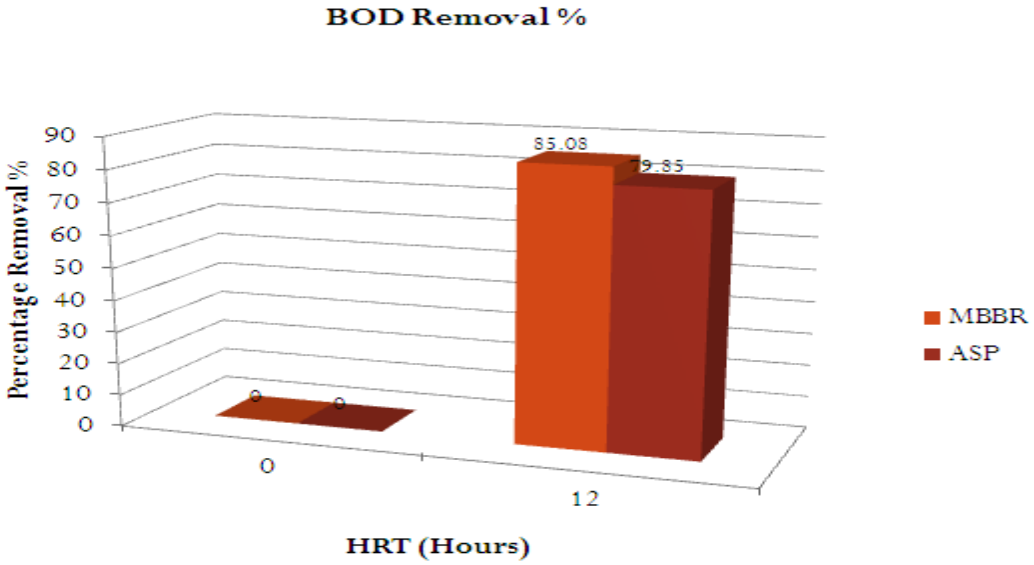
The characteristics of dairy wastewater taken from after primary settling tank are described in the table. The various tests were conducted on the wastewater as per procedure laid down in standard

Table - 1 Characterization of sample

Sr no	Para--meter	Method specification	Permi--ssible limit	Unit	Result at different sampling days					Average value
					15/2/16	16/2/16	17/2/16	18/2/16	19/2/16	
1	pH	Standard Method by APHA Ed.22nd .2012,4500 - H+B	6.5-8.5	-	8.2	8.0	7.8	8.0	7.5	7.9
3	COD	Standard Method by APHA Ed.22nd .2012,5220 – B	250	Mg/l	980	950	870	935	1050	957
4	BOD	Standard Method by APHA Ed.20th .1998,5210 - B	30	Mg/l	435	450	470	506	525	478

(Chart -2 compression of COD Removal % between MBBR and ASP)





(Chart -2 compression of BOD Removal % between MBBR and ASP)

7. CONCLUSIONS

This study confirmed that the MBBR was highly effective on removing BOD up to 71 mg/L and COD at up to 171 mg /L at 12 hours detention time with a removal efficiency of BOD is 85%, and COD is 55% for dairy wastewater. Reductions in TDS and TSS were not significant. And as compare to Asp this treatment as best giving and for more biomass grow its more effective result more 90% as less duration . Initially the pH of Dairy waste sample was more alkaline but due to the techniques implemented the pH was brought up much near to the neutral axis. Organic matter removal was generally higher in systems, suggesting that plants may play an important role in removing organic matter from MBBR. So the treated waste can be effectively used for irrigation and local purpose. Hence, the MBBR treatment process may prove to be a handy solution for the organic effluents from food based industries.

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8.Web site

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