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Performance evolution of different MBBR media in wastewater treatment

Shriyesh Mane [1], Rohan Kotwal [2], Sujit Mandave[3], Nikita Landge[4], Hema Kedari[5], Prof. Sachin Mane[6]

[1,2,3,4,5,6] *Savitribai Phule Pune University, D. Y. Patil College of Engineering, Akurdi, Pune, India*

ABSTRACT: *The moving bed biofilm reactor (MBBR) is a biological wastewater treatment process in which microorganisms grow as biofilm on suspended carriers. Conventionally, MBBRs are mainly designed and optimized based on the carrier surface area, neglecting the dynamic relationship between carrier design, reactor operation and biofilm characteristics, such as biofilm thickness and the composition of the microbial community. This paper evaluates performance of MBBR process for commercial waste water. We have used three different types of MBBR carriers viz. BI16, PP22, Mutag biochip 25TM. This study also compares percentage of BOD removal for different types of MBBR. The efficiency has been improved by improving the surface area per unit volume of the carrier element. It is suggested that the Moving Bed Biofilm Reactor technology could be used an ideal and efficient option for the treatment of domestic and industrial waste water, when the available area is minimum.*

Key Words*: *Wastewater treatment, moving bed biofilm reactor (MBBR), biochemical oxygen demand (BOD), Hydraulic retention time(HRT), Bio-film media, STP

INTRODUCTION

Water is one of the basic necessities of life. Wastewater has to be treated efficiently. The capacity and effluent quality of treatment plants must improve in order to meet the increased wastewater load, caused by growing populations. In addition to this, treatment plants often need to be compact, odor-free and almost invisibly incorporated into the city environment. In the recent year, the treatment of waste water is considered to be very essential before its discharge to the environment, as it needs public health protection from water borne diseases, environmental protection of our land and water. The waste water contains about 99.7% to 99.9 % liquid waste and 0.1 % to 0.3 %of solid waste and millions of micro-organisms. The organic solid which can be undergo decomposition by micro-organism will fix the characteristics of the sewage and measured in term of BOD (biochemical oxygen demand in mg/lit). Hence the organic solids and inorganic solids are to be removed by suitable treatment technologies.

The moving bed biofilm reactor (MBBR) is a biological wastewater treatment process in which microorganisms grow as biofilm on suspended carriers. This keeps check of BOD, COD, pH and many other parameters that would affect the quality of wastewater. MBBR process can be used effectively to treat water from lower concentration to higher concentration. This process promotes suspended growth as well as attached growth. Carriers are used here that helps bio-degradation of organic matter in wastewater, with the help of microbial bio-film that grows on its surface. Aeration system is used for continuous suspension of carriers. This process uses carriers of different size and shapes, covering different surface area, having different potential to form bio-film. Over last few years there has been a growing interest in biofilm process of wastewater treatment. There are several reasons for the fact that biofilm process more and more often are being favored such as:

- The treatment plant requires less space.
- The final treatment result is less dependent on biomass separation since the biomass concentration to be separated is at least 10 times lower.
- The attached biomass become more specialized (high concentration of relevant organism) at a given point in the process train, because there is no sludge return.

The desired objective of this paper is to investigate the reactor performance with respect to different size and shape of the carrier and HRT, i.e. 4hrs and 12hrs.

I. OBJECTIVE

- To analyze the performance of different carriers of MBBR in waste water treatment.
    - By changing aeration period
    - By changing the shape and size of carrier.

II. PROPOSED SETUP

1. 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. Sample will collected from STP plant which is located in our college campus and its parameters will be evaluated prior to treatment. Dimension of tank is 36*12*18. The moving bed biofilm reactor (MBBR) setup proposed for this study will be made up of plastic containing two compartments. The inlet arrangement given at top of tank. The outlet is provided at lower level than inlet. The proposed experimental set-up for moving bed biofilm can be made as shown in figure.

Fig1 : Experimental setup

Aerator:

Fish tank aerator is used to provide the necessary amount of air required by the bacterial to survive and to make the treatment process aerobic.

For waste water treatment in lab scale model, the fish tank aerator of 3.5 – 5 lit/min is used for aeration.

Fig2 : Blower (Aerator)

Types of MBBR carrier used are:

Fig3 : Mutag biochip 25TM **Fig4**: BI16

Fig5: PP22

2. Process Description:-

Here we have carried out a laboratory scale study by conducting a series of experiments using different size and shape of MBBR carriers to treat sewage water of an educational complex. Experimental set-up was constructed and MBBR media(carrier) were placed into suspended state, maintained by continuous aeration flow. HRT of 4hrs and 12hrs was maintained to treat the water.

The MBBR process uses floating plastic carriers within the aeration tank to increase the amount of microorganism to treat the wastewater. this microorganism consumes organic material the carrier provides increased surface area for biological microorganisms to grow in the aeration tank. The media will be in continuous suspension from the aeration system that adds oxygen at the bottom of the aeration tank. After treatment final treated effluent will be taken outside through outlet.

The process followed is as follows:

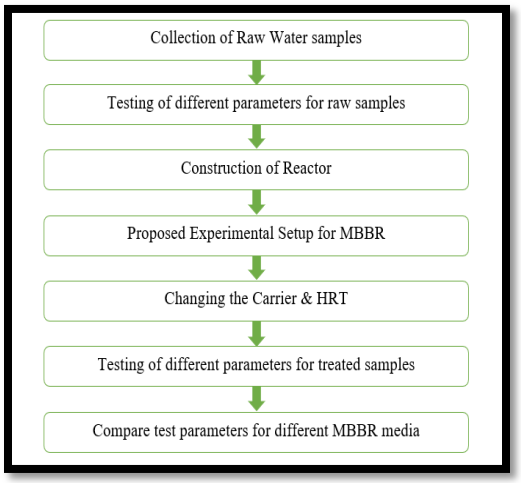


Fig6: Process Flowchart

III. RESULTS

1. Characteristics of influent:

pH	6.5
Color	Blueish black
BOD	205.8

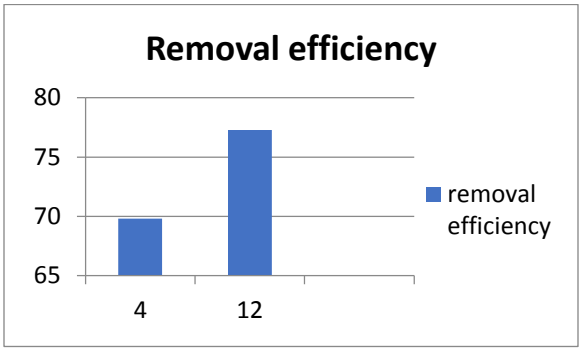
2. Characteristics of effluent:

Sr.	Name of carrier	HRT	BOD	Efficiency
1	BI16	4 hrs.	62.1	69.82%
		12 hrs.	46.5	77.29%
2	PP22	4 hrs.	78.8	62.13%
		12 hrs.	58.5	71.32%
3	Mutag biochip 25TM	4 hrs.	54.2	75.12%
		12 hrs.	32.1	84.40%

The performance evolution of MBBR was studied for the different HRT values i.e. 4hrs and 12hrs. While evaluating the performance BOD parameter were analyzed.

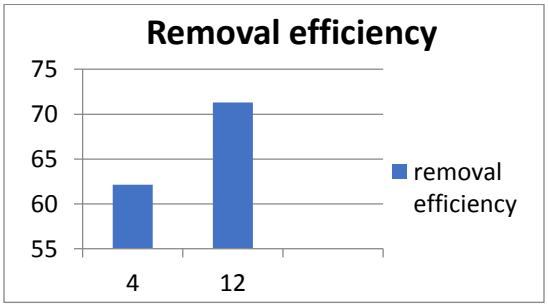
Media 1- BI16

The micro-organisms present in the wastewater uses the atmospheric oxygen for their survival. The lack of oxygen leads to the decrease in the removal efficiency. The BOD removal efficiencies under constant aeration flow rate for the retention time of 4 hrs. and 12 hrs. is seen up to 69.82% and 77.29% respectively. The BOD removal efficiency is shown as below.



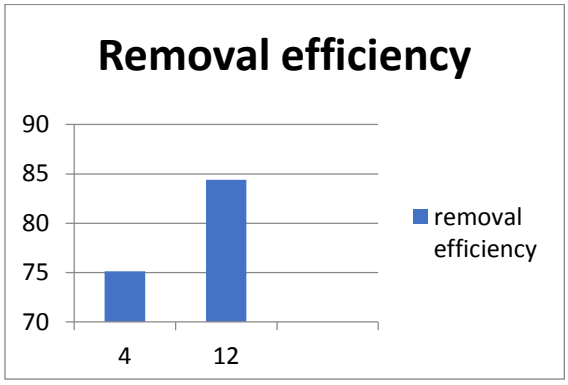
Media 2-PP22

The micro-organisms present in the wastewater uses the atmospheric oxygen for their survival. The lack of oxygen leads to the decrease in the removal efficiency. The BOD removal efficiencies under constant aeration flow rate for the retention time of 4 hrs and 12 hrs is seen up to 62.30% and 71.32% respectively. The BOD removal efficiency is shown as below.

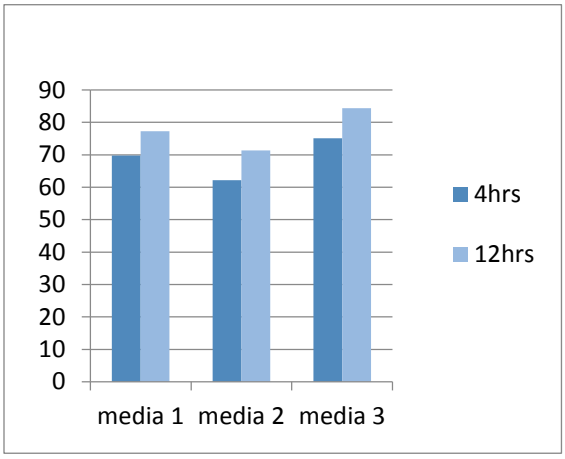


Media 3- Mutag biochip 25TM

The micro-organisms present in the wastewater uses the atmospheric oxygen for their survival. The lack of oxygen leads to the decrease in the removal efficiency. The BOD removal efficiencies under constant aeration flow rate for the retention time of 4 hrs and 12 hrs. is seen up to 75.12% and 84.40% respectively. The BOD removal efficiency is shown as below.



Comparison between BOD efficiency:



IV. CONCLUSION

The characteristics of the wastewater of have been obtained from the test conducted in laboratory. according to the observed value of various characteristics, it is seen that the wastewater has potential to pollute the water body considerably if disposal without treatment. It is essential to reduce the pollutant contains of wastewater for its safe disposal to water body under permissible limits specified by BIS.

The research study highlights the performance of different type of MBBR reactor. There are two parameters are studied to achieve the desired objectives suggested as per the standards. It is seen that the HRT has the greater impact on the cost of operation as well as maintenance. The carrier circulation is affected due to flow rate. As retention time decreases the flow rate increases which lead to rapid circulation of carriers.

1.The MBBR technique is suitable for the BOD removal efficiently.

2. The MBBR technique gives the more efficiency than other conventional method.

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