PERFORMANCE EVALUATION OF MBBR (MOVING BED BIOFILM REACTOR) FOR TREATMENT OF SEWAGE

A Review Paper on Performance Evaluation of MBBR on Treatment of Municipal Sewage

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Abstract

Moving Bed Bio-film Reactor (MBBR) is a technology that has advantages and benefits of both fixed film and that of activated sludge processes. The MBBR process follows circular flowing of biocarriers in reactors. Many, small in size, high density polyethene (HDPE) carrier materials are added to provide surfaces for active bacteria attachment in a suspended growth medium. Moving Bed Bio film Reactor (MBBR) process improves reliability, ease operation and require less area than conventional wastewater treatment system. The need for wastewater treatment plants working under suitable and effective technologies is rising greatly on whole world scale, specially in those regions where availability of pure water is in not so good phase.

After literature review we found out that MBBR method for sewage treatment has been proven efficient and cost reliable over many conventional methods with are currently in use for municipal treatment of waste, also being cost efficient still the method is lesser known and used for large scale sewage treatment. Hence we found this method suitable for upgradation of Sewage Plant and chose this topic for our project.

The work carried out in this project presents the results of the performance evaluation of STP based on MBBR technology for handling and treating the wastewater from the Sewage Treatment Plant. The parameters which are to be monitored under the study included pH, Total Suspended Solids (TSS), Biochemical Oxygen Demand (BOD)

Key Words: MBBR, Biofilm, Aeration, Wastewater, BOD, TSS, Micro-Organisms

1.INTRODUCTION

Sewage Treatment Plants (STPs) are effective units which are used to reduce sewage quantities from the environment. STPs can treat sewage water up to a certain degree that it is fit for reuse. Proper setup of such plants with suitable equipment and machinery with required maintenance from time to time are necessary for desired results.

The Moving Bed Biofilm Reactor (MBBR)is a process which was invented and developed in the country of Norway, dated way back in the late 1980 and early 1990 by Prof. Odegaard of Norwegian University. The Moving Bed Biofilm Reactor (MBBR) represents a different vision in advanced sewage treatment. MBBRs are operated similarly to the conventional Activated Sludge process with the addition of biofilm media which then flows in circular motion under the effect of aeration bubbles. In the MBBR systems reactors that are filled with plastic biocarriers to provide a surface for bacterial growth. The carrier elements, which has density just below than than water, has 0.93-0.95 Specific gravity, provide a large surface for bacteria culture.

Reactors can be operated under aerobic condition during BOD removal and nitrification process and anaerobic conditions during denitrification process. During aerobic phase plastic carriers kept in constant circulation by air blowers system. MBBR is attached to biocarrier surface system so treatment capacity is the function of specific surface area of carriers. Over the last decades there has been a growing interest in biofilm processes for sewage treatment. There are several reasons for the fact that bio-film processes more and more often are being favoured instead of activated sludge processes, such as: The setup for treatment plant requires less space and the final treatment result is less dependent on biomass separation.

The layer of biofilm becomes more efficient (higher concentration of required micro-organisms) at a given time in the process , because there is no return of sludge. There are already other different bio-film systems in use, such as trickling bed filters, revolving biological contactors (RBC), fixed medium submerged biofilters, granular media bio-filters, fluidized bed reactors etc. They have all their advantages and disadvantages.

1.1 Aim:

The aim of this paper is to study Performance Evaluation of the STP after treating with MBBR technology and Comparison with other conventional method (Aerated Lagoons).

1.2 Objectives:

1. Collection and Testing of required parameters of the wastewater sample collected from Wastewater Treatment facility situated in Versova, Mumbai.
2. Determination of selected parameters for predicting performance of STP.
3. Constructing experimental model of the same and comparing obtained results with secondary method (Aerated Lagoons) used in wastewater treatment facility.

1.3 Future Scope of Work:

The scope of the project is strictly restricted to analysis of various parameters of sewage after treated with MBBR technique and comparing it with conventional Aerated Lagoons provided at the sewage plant process, thus evaluating the performance of both the methods and concluding the efficiency for the same. However, this method can actually be implemented for upgradation of the wastewater plant for better treatment of wastewater.

2. MATERIALS AND METHODOLOGY

2.1 Moving Bed Biofilm Reactor

Moving bed biofilm reactor (MBBR) is defined as numerous polyethene biofilm carrier media operating in circular motion in an aerated sewage treatment process. Every biocarrier adds productivity because it provides an active surface area retaining and protecting bacteria and micro-organisms within protected cells. It is this high-density population of bacteria and micro-organisms that gives high-rate bio-decomposition productivity in the system. Figure 2.1.1 shows a typical diagrammatic representation of the MBBR process

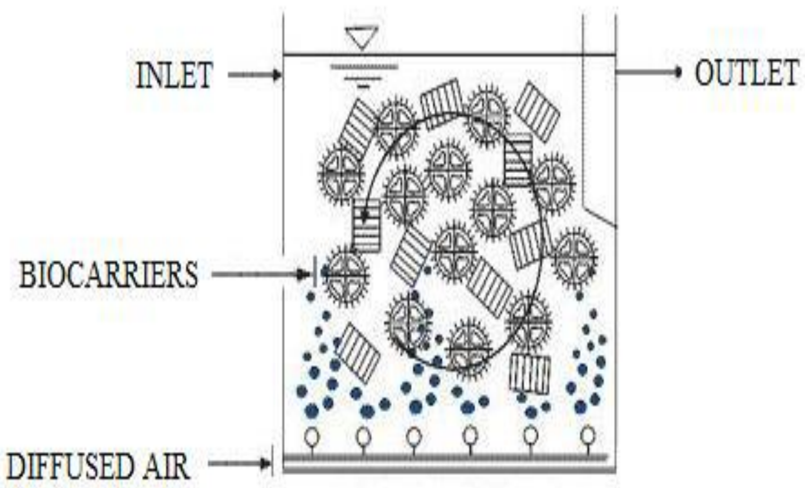

Fig 2.1.1: Moving Bed Biofilm Reactor

2.2 Biocarriers or Biofilm Media

Biocarriers is referred as “bed” in the moving bed biofilm process. It “carry” the micro-organisms throughout the reactors. It is made up of polyethene which has the density little less than that of water and are shaped like small cylinders. Internal cross section installed in each media increase the available surface area for sticking of biofilm to the media. Longitudinal fins which are made on the outer surface of the biofilm media increase the surface area available for biofilm growth on the biocarrier. Fig 2.2.2 shows different types of Biofilm shapes and sizes.

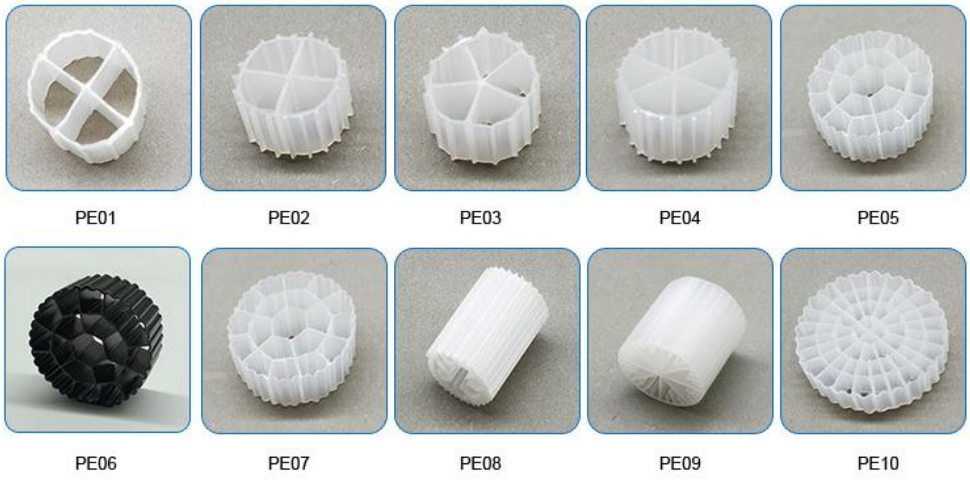

Fig 2.2.1: Different Types and Sizes of Biocarriers

2.3 Components of biofilm

Biofilms consist of three components. They are, Micro-organisms, Extracellular Polymeric Substances (EPS, glycolax) & Surface. Biofilms can contain many different types of microorganism, e.g. bacteria, archaea, protozoa, fungi and algae; each group performing specialized metabolic functions. EPS is an abbreviation for either extracellular polymeric substance or exopolysaccharide. This matrix protects the cells within it and facilitates communication among them through biochemical signals. Biofilms are usually found on solid substrates submerged in or exposed to some aqueous solution, although they can form as floating mats on liquid surfaces.

2.4 Mechanism Of Biofilm Process

Usually biofilms contain multiple layers of few too many µm. Nutrients and oxygen diffuse cells. While nutrients (substrates) and oxygen diffuse through the stagnant layer to the biofilm, biodegradation products diffuse outward from the biofilm to the moving mixed liquor. These "back and forth" diffusion processes are continuous. As the micro-organisms grow and multiply, the biomass on the biocarriers grows, or thickens. Fig 2.4.1 shows diffusion of nutrients through a biofilm in the oxygen through the biofilm produces aerobic, anoxic and anaerobic layers in the biofilm (Hwell 2006).

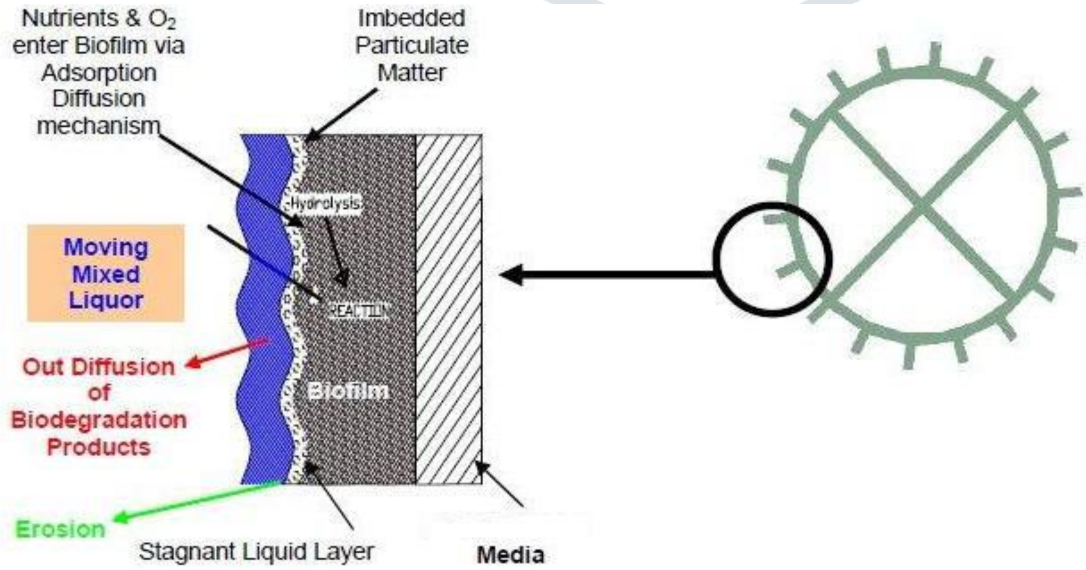

Fig 2.4.1: Nutrient path through Biofilm media

2.5 Feeding material

The effluent for this study was taken from the Versova Wastewater Treatment Plant situated in Andheri. The sample collected was after the primary treatment process is done on wastewater. The collection of effluent was done as per the standard sampling methods.

2.6 Compressor

Aeration was done with the help of pipe fittings and nozzle outlet fitted at the bottom through air blower. The air required for biodegradation of organic material was 0.2 lpm. But the air supplied should be sufficient to keep the biocarrier in moving state. The minimum capacity of 15 lpm air was supplied and it was increased according to the requirements. A fine bubble of air was uniformly diffused throughout the liquid for the biocarrier movement. Fig 2.7.1 shows the experimental setup used for process.

Fig 2.6.1: Experimental Setup

3. RESULTS AND DISCUSSION

3.1 Characteristics of Feed

The effluent for this study was taken from the Versova Wastewater Treatment Plant situated in Andheri. The sample collected was after the primary treatment process is done on wastewater. The collected sample was analysed for pH, BOD and TSS as per standard methods. Table 3.1.1 shows the analysed parameters and their values.

Table 3.1.1: Feed Sewage Characteristics

Sr. no	Parameters	Value
1	pH	8.0
2	BOD	183mg/lit
3	TSS	116mg/lit

3.2 Characteristics of Biocarrier used

Fig 3.2.1 shows the type of biocarriers used and table 3.2.2 shows the characteristics of biocarriers used.

Fig 3.2.1: Biocarriers used

Table 3.2.2: Characteristics of Biocarriers

Material type	Proflex
Shape	Cylindrical with fins
Colour	Black
Density	0.95 g/cm^3
Height	16mm
Diameter	22mm
Effective surface area	450 m^2/m^3
Max. Operating temperature	80°C
No of pieces per m^3	62000

3.3 Filling Percentage of Biocarriers

The percentage of biocarriers in this study was maintained at 20% of the total volume of the experimental aeration tank used for the evaluation of treatment process. However, percentage of biocarriers can be varied to achieve suitable efficiencies of certain parameters of sewage.

3.4 Hydraulic Retention Time (H.R.T)

The Hydraulic Retention Time for this study was 2.5 hrs. However, greater retention periods can be used to achieve increased efficiency.

3.5 Characteristics of Treated Effluent

Following were the characteristics of the effluent treated wastewater obtained after final treatment process at wastewater plant where aerated lagoons are used as a secondary treatment method. Table 3.5.1 shows the analyzed parameters and their values.

Table 3.5.1: Primary Effluent Characteristics

Sr. no	Parameters	Value
1	pH	7.6
2	BOD	37mg/lit
3	TSS	15mg/lit

4. CONCLUSION

Based on study and design of experimental setup and volume of biofilm media used, it is expected that overall efficiency of 83-88% can be achieved in removal of BOD, TSS and pH of sewage sample which is to be treated as compared to 78% efficiency of Aerated lagoons used as secondary treatment method at the wastewater treatment facility.

The moving bed bio film reactor has proved itself as a robust and compact reactor method for waste water treatment. The efficiency of the reactor has been demonstrated in many process combinations, both for BOD-removal and COD-removal. It has been used for small as well as large plants. The rate of BOD-COD has been reduced by use of this technology. Cost benefit analysis is yet to be done for this method since MBBR achieves efficiency in terms of BIS standards for safe disposal.

5. REFERENCES

[1] Hem, L., Rusten, B., Ødegaard, H. (1994) Nitrification in a moving bed biofilm reactor. Water Research, Vol. 28, No 6, 1425-1433.

[2] Mosey, F.E. (1996):"Biofilms on Kaldnes carrier particles". Proc. from seminar organised ny Anglian Water. Cambridgeshire, UK 27-29 November 1996

[3] Norris, D., Parker, D. Daniels, M. and Owens, E. (1982) High-quality trickling filter effluent without tertiary treatment. Journ. WPCF, Vol. 54, No. 7, pp. 1087.

[4] The paper published "The Moving Bed Biofilm Reactor" by H.Ødegaard Faculty of Civil and Environmental Engineering.

[5] "Environmental engineering." Book by S.K.Garg.

[6] A Paper on "The Moving Bed Biofilm Reactor", Jawaharlal Darda Institute, Yavatmal, Maharashtra by Ankit Pinjarkar and Rushikesh Jagtap

[7] Kunal Majmudar, Jaini Nagar, Shivangi Pabari , Paper on COD Reduction by MBBR, Shroff S.R Rotary Institute of Chemical Technology.

[8] "Moving Bed Biofilm Reactor Process" , Wikipedia