IOSR Journal of Engineering (IOSR JEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
PP 50-54

"Performance Analysis and Life Cycle Cost Analysis of Moving Bed Biofilm Reactor (MBBR) – A Review"

Meena Khorwal[(1)], Jyoti Rajput[(2)], Saurabh Singh[(3)]
Meenakhorwal6963@gmail.com, jr476150@gmail.com, 2016pce5409@mnit.ac.in
[1]. *Ug Student, Civil Engineering Department, Skit, Jaipur, Rajasthan, India*
[2]. *Ug Student, Civil Engineering Department, Skit, Jaipur, Rajasthan, India*
[3]. *Assistant Professor, Civil Engineering Department, Skit, Jaipur, Rajasthan, India*

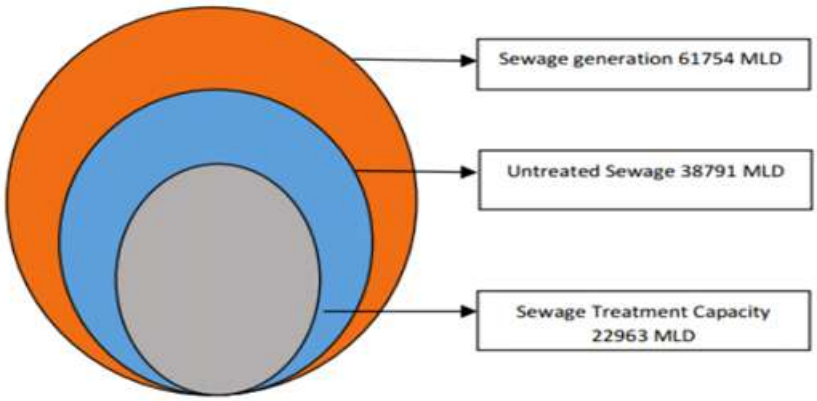
Abstract: *Today, increasing urbanization require new technology to treat waste water efficiently with low operation and maintenance cost. This paper mainly concern about new technology of treatment of waste water which is moving bed biofilm reactor (MBBR). It is a biological process for treatment of domestic as well as industrial waste. MBBR is a completely mixed and continuously operated biofilm reactor, where the biomass is grown on small carriers elements. Carriers are used for adhesion of microbial decomposers which forms biofilm. It is used for removal of organic substances, nitrification and denitrification. The MBBR gives the benefits of both fixed film and suspended growth process. In this study parameters such as PH, BOD, COD, TSS and Life cycle costs (LCC) were evaluated to analyse the efficiency of plants. These data would help in decision making for choosing appropriate technology for sewage treatment by comparing with data of other technologies.*

Keywords: *MBBR, carriers, sewage treatment, biofilm, microbial decomposer, nitrification, adhesion.*

I. Introduction

With increasing rapid urbanization in the country there has been a commensurate increase in the need for and use of water, one of the life's most essential necessities. Almost 80% of the water supplied for domestic use, comes out as waste water. Most of the cases waste water is let out untreated and it either sinks into the ground as a potential pollutant of ground water or is discharges into natural drainage system which is harmful for environment and aquatic life.

Present Status: It estimated that only 37% of generated sewage is treated in urban India.



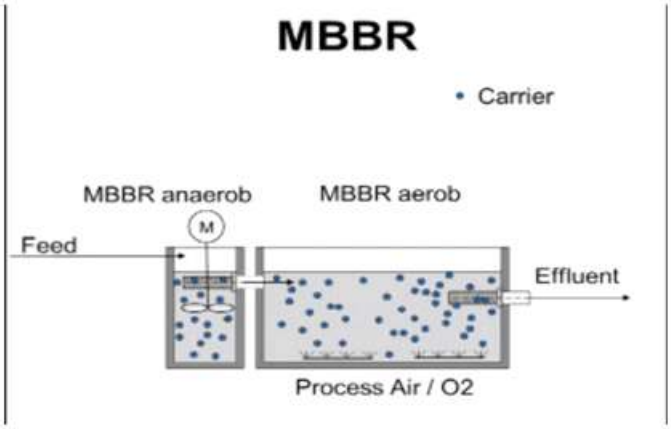
So, there is a urgent need for treating waste water using modern technology and recover as much usable water as possible. But the fact is that majority of towns and cities in India have either no sewerage and sewage treatment facilities or the treatment facilities are highly inadequate. So, new technology is to be used to treat waste water effectively and efficiently with lower operational and maintenance charges.

II. Literature Review

MBBR is one of the modern technology used for treatment of waste water. It is reliable and cost effective process. It was first invented in Norway at the Norwegian university of science and technology. The

first MBBR was installed in 1989. In United states it was first introduced in 1995. There are 400 installations all over the world in domestic and industrial sectors.

MBBR system is the efficient method to retain growing microorganisms in the form of biofilm. MBBR process contains growth of biomass by using special type of polythene carriers. Carriers are mainly used to provide large surface area for adhesion of microorganism to decompose the organic matter present in waste water. These carriers keep in suspension in aeration tank with high mobility by agitation promoted by aeration system. Coarse and medium size bubbles are generated in the system by which oxygen is absorbed by the microorganism used in decomposition of organic matters. The control variables of MBBR are same as activated sludge process. The material for carriers is use usually polypropylene or polythene whose density is less than density of water.



The volume of the carriers inserted in the reactor from 20% - 70% of the volume of the reactor. If the volume of the carriers is less than 20% of the volume of reactor the MBBR process will not be efficient and if it is more than 70% it makes process uneconomical. These carriers also known as kaldness media. The biofilm is a microbial engineered community system which contain any type of microorganism including algae, fungi etc. These multiverse microorganisms require the presence of a surface to adhere to and grow on carriers.

III. Advantages

- MBBR is less sensitive to hydraulic loading to carriers.
- It operated at high organic loads.
- No sludge bulking problem is generated.
- It is flexible process.
- It can be retrofit in almost any size or shape of the tank.
- It requires less area for operation than activated sludge process.
- Efficiency of MBBR can be increased by increasing number of carriers.
- Low head loss.
- No need of periodic back washing.

IV. Performance Evaluation

Central Pollution Central Board (CPCB), zonal office – Bhopal conducted performance evaluation of 12 operating STPs of Rajasthan state during June to September 2015.

Sewage Treatment Plant Of Mbbr In Jaipur –

- STP at Jawahar circle in Jaipur :-

The 1 MLD STP is located at Jawahar circle for treating the nearly domestic effluent. The plant has been operated by the private consultant M/S pollution technologies Ltd, Noida. According to CPCB reports,

parameters	PH	TSS	COD	BOD	NH_3-N
influent	7.68	306	1102	366	30
effluent	7.63	28	34	11	8.9
% removal	-	91	97	97	98
O&M cost	4.4 LAKH				

STP at Ramnivas garden in Jaipur :-

The STP is contracted by RUIDP for supplying water to park and it is commissioned in year 2014.The STP was constructed by JDA and operated by M/S pollution technologies Ltd, Noida. The capacity of plant is 1 MLD. According to CPCB reports 2015,

Parameters	PH	TSS	COD	BOD	NH_3-N
Influent	7.93	228	600	193	30
Effluent	8.1	49	49	15	0.5
% removal	-	78	92	92	98

STP at Vidyadhar nagar in Jaipur :-

1 MLD STP is located for treating the hereby domestic influent. The STP was constructed by JDA and operated by the private consultant M/S hydro tub paryavaran (India) Pvt Ltd, Mohali. According to CPCB reports 2015,

Parameters	PH	TSS	COD	BOD	NH3-N
Influent	7.69	955	1535	490	35
Effluent	7.63	80	76	23	0.6
% removal	-	92	95	95	98
O&M cost	1,50,000				

V. Life Cycle Costs Of MBBR

LCC of MBBR technologie at different rate of interest for 20 years and the standard deviations are shown in table. After averaging the LCC values of all plants, electricity cost and O&M cost is found to be more for MBBR plants due to higher installed load of electrical units fitted but a lesser supervision is required.

s.no.	rate	MBBR
Influent BOD (mg\l)		<20
Average area, m^2 per MLD		450
Capital cost (in lakhs)		85.6222±22.769
Electricity cost in 2011 (in lakhs)		10.726±1.024
Electricity costs in 2031 (in lakhs)	10%	339.590±37.891
Maintenance costs in 2011 (in lakhs)		1.68±0.0561
Maintenance costs in 2031 (in lakhs)	10%	68.229±2.279
Manpower costs in 2011 (in lakhs)		0.3162±0.0410
Manpower costs in 2031 (in lakhs)	10%	12.902±1.675
Chemical costs in 2011 (in lakhs)		2.792±0.394
Chemical costs in 2031 (in lakhs)	10%	113.930±16.088
Total LCC cost/MLD (in lakhs)	10%	612.636±39.178

VI. Conclusion

This study confirmed that the MBBR is highly effective process. It can be used for small as well as large plants. The efficiency of this process can be increase without increasing the plant area. It can be say that it is a modified activated sludge process. It is effective and efficient method for treatment of domestic waste water. It is environment friendly technique.

References

[1]. Borkar R.P, Gulhane M.l, Kotangale A.J (2013), "Moving Bed Biofilm Reactor – A New Prospective in Wastewater Treatment", JESTFT volume 6, PP 15-21.

[2]. Ankit B. Pinjarkar, et.al (2017), "The Moving Bed Biofilm Reactor(MBBR)", IARJSET, volume 4.

[3]. Oliviera, Rabelo, et.al (2014); "Evaluation of a MBBR pilot plant for treatment of pulp and paper mill wastewater, volume 2, PP 220-225.

[4]. CPCB 2015, Performance Evaluation of Sewage Treatment Plants, Central Pollution Control Board, Bhopal.

[5]. Karmani M., et.al(2008), "Application of moving bed biofilm process for biological organic and nutrients removal from municipal wastewater", American Journal of Environmental Science , Volume 4(6) , PP 675-678.

[6]. Rusten B. Hem., L.J., Odegaard, h. (1995), "Nitrification of municipal wastewater in moving – bed biofilm reactors." Water Environmental Research, 67(1), 75-86.

[7]. Central Pollution Control Board (2017) Ministry of Environment, Forest and Climate Change notification, Government of India. *Environment (Protection) Amendment, Rules*, New Delhi.

[8]. Gautam, S., Ahmed, S., Dhingra, A., and Fatima, Z. (2017) Cost-Effective Treatment Technology for Small Size Sewage Treatment Plants in India. *Journal of Scientific & Industrial Research*, 76(April): 249–254.

[9]. Khalil, N., Sinha, R., Raghav, A.K., and Mittal, A.K.(2008) UASB Technology for Sewage Treatment in India: Experience, Economic Evaluation and its Potential in Other Developing Countries. *Twelfth International Water Technology Conference*, pp. 1411–1427.

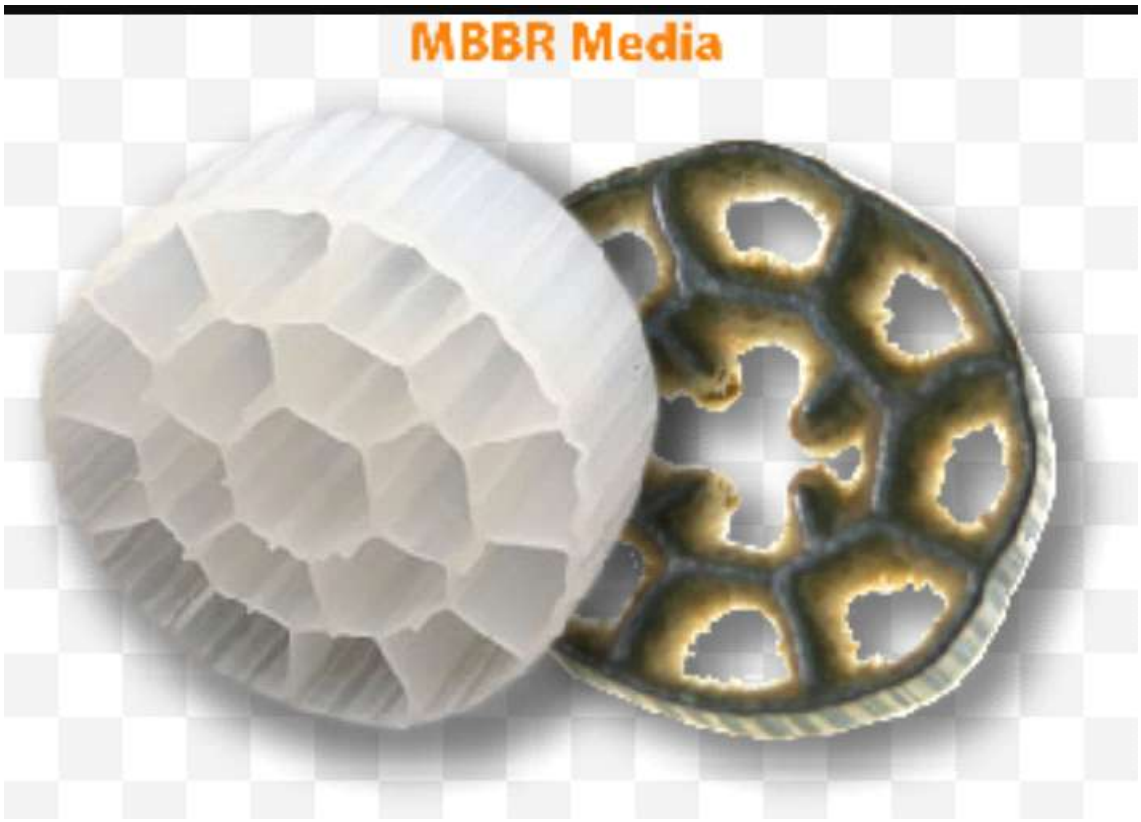
[10]. Koul, A. and John, S. (2015) A Life Cycle Cost Approach for Evaluation of Sewage Treatment Plants. *International Journal of Innovative Research in Advanced Engineering*,7(2): 2349–2163.

[11]. Pirani, S., Natarajan, L., Abbas, Z. and Arafat, H. (2012) Life Cycle Assessment of Membrane Bioreactor Versus Cas Wastewater Treatment : Masdar City and Beyond. *The Sixth Jordan International Chemical Engineering Conference*, (March): 1–10.

[12]. Verma, K. (2016) Hybrid Disinfection of Sewage Using Chlorine and UV/Ozone in Series to Optimize the Process. Ph.D. Thesis, Environmental Engineering, MNIT Jaipur.

[13]. Jafarinejad, S. (2017) Cost estimation and economical evaluation of three configurations of activated sludge process for a wastewater treatment plant (WWTP) using simulation. *Applied Water Science*. Springer Berlin Heidelberg, 7(5): 2513–2521. doi: 10.1007/s13201-016-0446-8.

++++++++++++++++++++++


MBBR Media