Comparative Analysis of CASP & MBBR with Various Medium on Municipal Waste Water

Ravindra P. Thanedar[1] Gaurav Kumar Singh[2]
[2]Phd Scholar
[1,2]Department of Civil-Environmental Engineering
[1]College of Engineering Pune, India [2]Sharda University, Greater Noida, India

Abstract— The study has been undertaken to evaluate CASP with and without medium and check its efficiency on the output quality. In the study four different mediums are made of polyethylene but are different in sizes, internal structure and PSA/TSA etc. have been taken and their efficiencies have been studied in terms of reduction in BOD & COD at the HRT of 3 hours and 5 hours. The municipal waste water used for the study has been brought on the daily basis to the college lab from the nearby CK Naidu Hospital Treatment Plant, Pune. The medium has been studied firstly at the HRT of the 3 hours and there results have been compared and then studied for HRT of 5 hours. The study showed that the MBBR (CASP with medium) removal efficiency in terms BOD and COD is better than the CASP.

Keywords: BOD- Biological Oxygen Demand, CASP-Conventional Activated Sludge Process, COD-Chemical Oxygen Demand, HRT-Hydraulic Retention Time, MBBR-Moving Bed Biological Reactor, SVI-Sludge Volume Index, PSA –Protective Surface Area, SST-Secondary Sedimentation Tank, TSA-Total Surface Area

I. Introduction

We have covered a long journey in evolution because of which mankind population has been growing at a very vast rate. To take care of the requirements of this growing population government authorities are spending a lot of money in the water sector i.e. drinking as well as waste water. This paper will be focusing on the waste water. The waste water collected from the cities can be treated and our dependency on the nature can be reduced. Sewage water which is generated after domestic use contains about 99.99% liquid and around 0.01% solid waste. Organic solids such as Organic matter, Carbohydrate, Fats, Proteins comprises around 70% of this solid waste and rest is Inorganic solids like Metals, Salts etc. The organics solids present in the waste water are the cause of concern because they deplete the dissolved oxygen of the water bodies which affects the aquatic environment. A typical waste water treatment plant consists of 4 stages of treatment process, 1) Preliminary 2) Primary 3) Secondary 4) Tertiary. The inorganic solids are removed at the primary stage while the organic solids are removed at the secondary stage. At the secondary stage the organic solids can be removed biologically or chemically. The biological methods such as Trickling filter (TF), Conventional Activated Sludge Process (CASP), Moving Bed Biological Reactor (MBBR) are cost effective and environment friendly as compared to the chemical methods of treatment. The biological methods can be further categorized into two categories: attached biomass or suspended biomass method. Conventional Activated Sludge Process (CASP) is a secondary stage treatment process for the organic solids. It is also a suspended biomass biological method of the treatment, with the advancement of science a relatively new method Moving Bed Biofilm Reactor (MBBR) which has the advantage of both the suspended and the attached system to treat the waste water. In this method the media or carrier elements are provided in the aeration tank to house the microorganisms on its porous surfaces. The medium are made of polyethylene. The microorganisms are attached over its surface in the presence of the artificial oxygen supplied from the bottom the tank because of which they are continuously moving which leads to higher concentration of biomass in the aeration tank leading to better treatment of effluent and increased efficiency than CASP. From the research it has been proved that MBBR has better characteristics when it comes to the higher BOD/COD ratio, sludge bulking and organic loading.

The Study has been undertaken to evaluate the performance of 4 different types of MBBR by comparing their performance with CASP on the parameters such as BOD, COD & SVI at first at the hydraulic retention time (HRT) of 3 hours and later at HRT of 5 hours. The study is a batch study means quantity of water to be treated is fixed for that particular HRT.

Central Pollution Control Board has fixed the following standard for the discharge of effluent in the water bodies

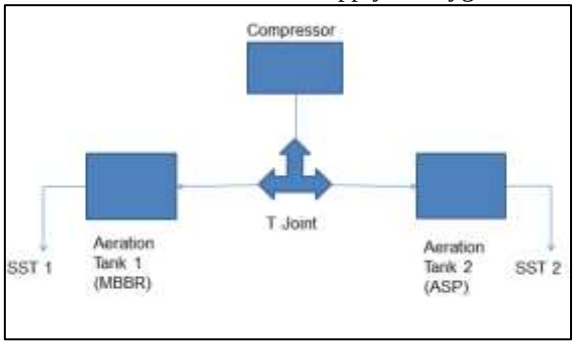
BOD: 20mg/L COD: 250mg/L

A. Research in Last Two Years

Since the study has been carried out in 2018 there has not been much work done on the municipal waste water.

II. Experimental Setup

Two aeration tanks were made in the lab of size 60*20*16 cm of 8mm thick Acrylic Sheet and air was pumped through a compressor. Further down the air flowing pipe a T-joint was provided where the air was divided in the two pipes, one was going to CASP and other was going to MBBR aeration tank. The oxygen was being supplied at the rate of 13lpm at the bottom of the tank. The size of pipe is 3/8 inches which has been used in the aeration tank in supply of oxygen.



III. MATERIAL & METHODOLOGY

For the study four different kinds of MBBR made up of polyethylene have been taken and their parameters are as follows-

Parameters	Media 1	Media 2	Media 3	Media 4
Height (mm)	12	16	18	18
Dia. (mm)	22	22	22	24
Void Ratio	NA	>98%	>80%	>75%
Shape	Cylin-drical	Cylin-drical	Cylin-drical	Cylin-drical
Density (gram /cc)	>0.97	0.95	0.93	0.93
TSA (m^2)	400	400	400	450-475
PSA/ TSA	NA	88	95	75
Specific Surface Area (m^2/kg)	0.412	0.421	0.43	0.48

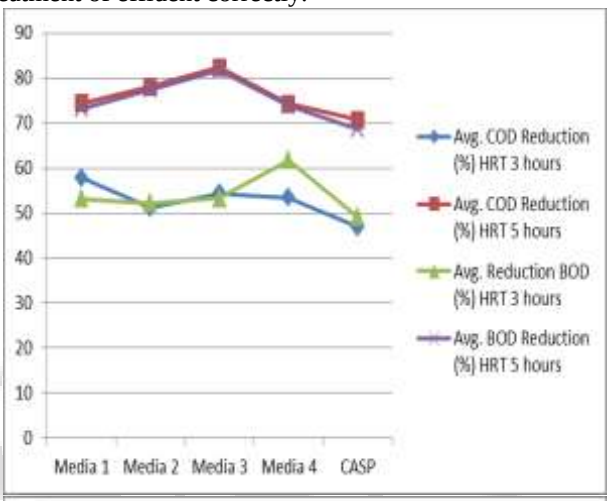
Following methodology has been adopted for evolution of the performance of various medium on the daily basis:-

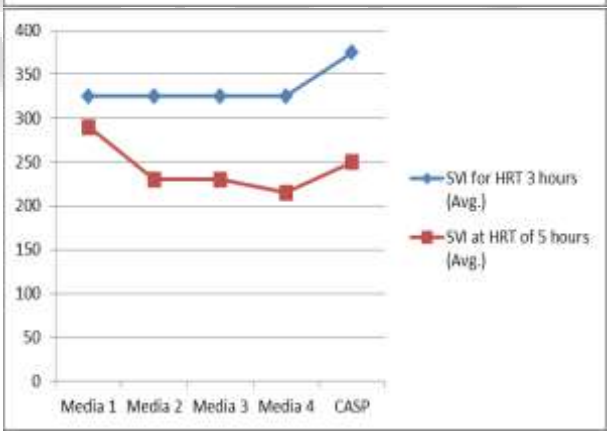
1.	Daily collection of effluents after Primary Clarifier (20 liters) and the Secondary Sludge (for recirculation) (5 liters) from CK Naidu Municipal Sewage treatment plant.
2.	Determination of BOD and COD of the sample before it was subjected to secondary treatment.
3.	Transfer of effluent in the two aeration tank (10 liters in each tank) and recirculation sludge with the ratio of 25%. For MBBR the filling ratio of 25% of the effluent has been adopted.
4.	Effluent has been subjected to aeration rate of 13lpm for the HRT of 3 hours and 5 hours.
5.	The aerated sewage from both the aeration tank was then transferred into SST for the fixed detention time of (half hours).
6.	Post settling the treated effluent was collected and again there BOD and COD was determined and compared. SVI of the effluent after SST was also determined.

Primary effluent is subjected for Aeration (13 liters per minute) fixed hydraulic retention time (Three hours and Five hours) as per adopted for the entire experimental study since the study is a batch study no feed has been taken out or added once the process is started. It has to be noted that the Secondary Sludge added once to the aeration tank of MBBR & daily in the aeration tank of CASP.

IV. RESULTS

The biofilm was grown properly and had played its role in the treatment of effluent correctly.





V. CONCLUSION

- In terms of removal efficiency MBBR is better than CASP.
- MBBR is giving almost equal removal efficiency for COD & BOD.
- Removal efficiency of MBBR is more than ASP by around 7-8% for COD & 8-9% for BOD.
- The plant is giving better efficiency for 5 hours of HRT; it will be advisable to run the plant for this HRT, though sludge quality is not that good. Since sludge quality is not good, it will be recommended to use the recirculation ratio of more than 25%.

– Though the all mediums are more or less giving the same removal efficiency, third medium will be preferred.

ACKNOWLEDGMENT

The research work was carried out through "Professor Thomas Kailath and Sara Kailath Endowment Funds" for socially relevant project. I thank the Alumni Association and the Director of College of Engineering, Pune for the financial support. I am extremely grateful to the CK Naidu Wastewater Treatment Plant Shivaji Nagar Pune for providing me the required samples on daily basis and for other support.

REFERENCES

[1] Ahmet Aygun, Bilgehan Nas, Ali Berktay (2008) ''Influence of High Organic Loading Rates on COD Removal and Sludge Production in Moving Bed Biofilm Reactor" Environmental Engineering Science.
[2] Asmita Shrestha (2013) "Specific Moving Bed Biofilm Reactor in Nutrient Removal from Municipal Wastewater." Open Publication of UTS Scholars
[3] A.M. Ingale (2016) "Moving Bed Biofilm Reactor Leading Edge Wastewater Technology", International Journal of Innovative and Emerging Research in Engineering , Volume 3, Special Issue 1, ICSTSD
[4] Bjerkey A, Fiksdal L. (2008) "Characterization of Bio Fouling On Hollow Fiber Membranes Using Confocal Laser Scanning Microscopy and Image Analysis" Federation Of European Microbial Society
[5] Borkar R.P, Gulhane M.L, and Kotangale A.J (Nov. - Dec. 2013), "Moving Bed Biofilm Reactor – A New Perspective in Wastewater Treatment", IOSR Journal Of Environmental Science, Toxicology And Food Technology (IOSR-JESTFT)e-ISSN: 2319-2402,p-ISSN: 2319-2399. Volume 6, Issue 6, PP 15-21
[6] B.C. Punmia et al (2001) Wastewater Engineering (2nd edition)
[7] C.-Y. Cao, and Y.-H. Zhao (2012), "The Comparison of MBBR and ASP for Treatment on Petrochemical Wastewater" Petroleum Science and Technology 30 (14) (May 31): 1461–1467
[8] Chu L., & Wang J. (2011) "Nitrogen removal using biodegradable polymers as carbon source and biofilm carriers in a moving bed biofilm reactor" Chemical Engineering Journal, 170(1), 220–225
[9] Kusiak A., & Wei X. (2012) "Optimization of the activated sludge process" Journal of Energy Engineering, 139(1), 12-17.
[10] Lariyah MOHD SIDEK (2014) "Experimental Comparison between MBBR and CAS for River Purification Treatment Plant" International Conference on Global Sustainability and Chemical Engineering (ICGSE).
[11] M. Rodgers, X. Zhan (2003) "Moving bed biofilm reactors, review in environmental science and biotechnology", National University of University of Ireland, Ireland, pp217
[12] Mangesh Gulhane, Ashwini Ingale (2015), "Moving Bed Biofilm Reactor: A Best Option for Wastewater Treatment", IJSRD - International Journal for Scientific Research & Development| Vol. 3, Issue 01.
[13] Mangesh Gulhane , Ashwini Ingale (2015) "Modified Moving Bed Biofilm Reactor", Journal of Environmental Research And Development, Vol. 9 No. 3A, January-March 2015
[14] Maurer M., et al (2001) "Moving-bed biological treatment (MBBT) of municipal wastewater: denitrification", Water Science and Technology Vol 43 No 11 pp 337–344.
[15] Metcalf & Eddy, 1991. Wastewater Engineering - Treatment Disposal Reuse - 3rd Edition, McGraw-Hill
[16] Ødegaard. H. (2000) "Advanced Compact Wastewater Treatment Based On Coagulation And Moving Bed Biofilm Process", Water Science and Technology,42(12): 33–48.
[17] Kaur, R., Wani, S. P., Singh, A. K., & Lal, K. (2012, May). , "Wastewater production, treatment and use in India", In National Report presented at the 2nd regional workshop on Safe Use of Wastewater in Agriculture.

