Efficiency of Polyethene Non-Woven Fibre Filter for Treating Institutional Waste Water by Membrane Bio Reactor Process

S K Shivaranjani , S.Uma Sankari

Abstract: ***Treatment of waste water involves a variety of Advanced Oxidation Process. The most advanced one is Membrane Bio Reactor (MBR). The unique features of MBR are higher order MLSS in the range of 12,000 mg/l and reduces the sludge production. This process is efficient in removing Total Solids in waste water. Due to the fact that the membrane being too costly, an alternative approach was taken which featured Polyethylene Non-woven Fibre Filter that gave promising results. A laboratory scale Membrane reactor is fabricated for treatment of Institutional Waste water. A small scale reactor is formed by scaling with the treatment plant of capacity 3MLD in the ratio 1:4000. The process involves combination of activated sludge process and membrane filtration. The waste water is pumped to the aeration tank by peristaltic pump from the collection tank. The water is filled in the tank by leaving the freeboard space. The air is supplied by reverse process of peristaltic pump for 2.5 hrs (HRT). After the aeration process, the water is passed over the membrane for filtration. The organic impurities which are present in the membrane after treatment are returned to the aeration tank for the next process (3hrs HRT).The process is continued until the maximum removal efficiency is achieved by varying the run time. The BOD and Turbidity is tested for the treated water at various runtime The Hydraulic Retention Time (HRT) is varied in the range 2.5 - 6 hrs . The maximum BOD removal efficiency obtained was 98% and turbidity removal efficiency was 97% in the 6 hrs HRT. The MBR system offers many benefits, such as higher MLSS rate, exclusion of sedimentation unit, less sludge production compared to Activated Sludge Process. Various studies of MBR technology has compared with conventional activated Sludge process in terms of removal of pollutants from waste water. The drawback of MBR process is high installation and operation cost. Thus an alternative approach of replacing the membrane by Polyethylene non woven fibre membrane is used which gave the promising results.***

Keywords: Membrane Bio Reactor, Polyethylene Non-woven Fibre Filter, HRT.

I. INTRODUCTION

The shortage of water and accumulation of waste urges a demand in the treatment of waste water. Also there is a need in producing more pure water for drinking purpose and reuse of treated water. The Institutional waste water is from the source of domestic waste, which contains high amount of organic and inorganic impurities such as BOD, COD, and Turbidity. The treatment of waste water involves removal of BOD and Turbidity. In recent years, Membrane Bio Reactor has become one of the most needed waste water treatment methods. MBR is a modification of activated sludge process that utilizes both membrane bioreactor and membrane filtration technique. Thus effective removal of organic and inorganic contaminants from waste water is ensured by MBR method.

II. POLYETHYLENE MEMBRANE

The Nonwoven fibres are sheet structures bonded together by fibres or filaments. They provide specific functions such as strength, wash ability and filtration, use as a bacterial barrier and sterility. The cost of polyethylene fibre is very less compared to ordinary membrane. The pore size of membrane is 0.2 µm and is classified as micro filtration.

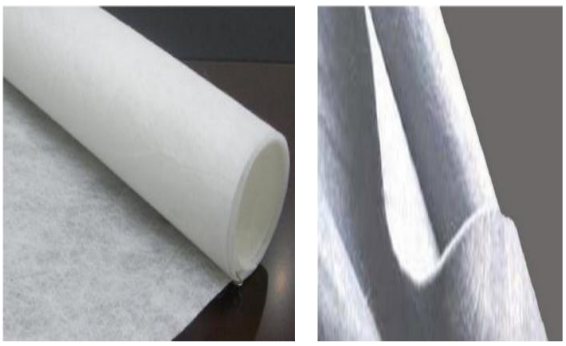

Figure 1. Polyethylene Membrane

A. Properties Of Polyethylene Fibre

The general properties of polyethylene fibre is given below,

- Strong
- Resistant to stretching and shrinking
- Quick drying
- Chemical resistant
- Abrasion resistant
- Wrinkle resistant
- Easily washed

The polyethylene fibre membrane has a disadvantage that it cannot be reused when it dries. To overcome this issue, backwashing of water is done to remove the clogged particles for a large scale process.

Revised Manuscript Received on December 28, 2018

S K Shivaranjani, Assistant Professor, Department of Civil Engineering, Kumaraguru College of Technology, Coimbatore, India
S.UmaSankari PG student, Department of Civil Engineering, Kumaraguru College of Technology, Coimbatore, India

III. METHODOLOGY

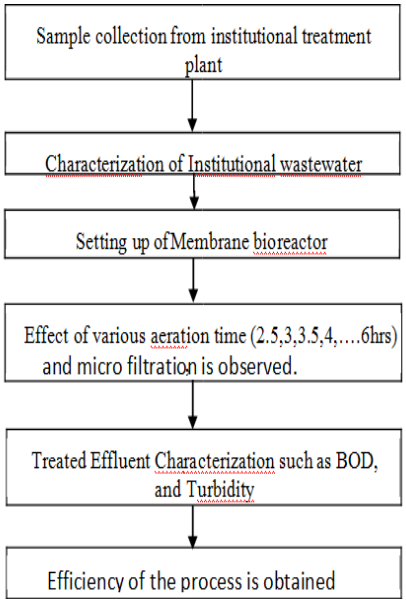

Figure 2. Methodology

IV. MEMBRANE BIOREACTOR:

Membrane Bioreactor (MBR) is the modern technology for degradation of impurities. MBR technology has been in widespread usage for waste water treatment.

A. Principle of MBR

MBR is generally used to outline wastewater treatment processes where a best and reusable membrane is integrated with an attached growth biological process. The MBR is the combined process of settling tank with aeration process. A membrane bio reactor is fundamentally a form of the conventional activated sludge (CAS) system. The settling tank function as the removal of suspended particles and the aeration tank removes the organic impurities in waste water by the mixed liquor suspended solids. The MLSS present in the aeration part will disintegrates the complex organic particles into simpler form.

B. Stages in MBR Process:

- Growth of Micro organisms
- Aeration process
- Membrane Filtration

A. Growth of Micro Organisms:

In the biological stage, the organic contaminants in waste water is being removed. The layer of sludge, cow dung over the media along with the urea in the aeration tank is kept open to the atmosphere for 24 hrs. Hence, the flocs particles are formed because of the microbial colonies. The capability of microorganisms to form flocs is dynamic for the waste water treatment. The multiplicity of microbial community in aeration process is very large, containing microorganisms. In this composite Microbial cluster, bacterial organisms plays an important role for treating waste water. MBR technology with biological and sludge reproduction will helpful in the consumption of organic particles, while some amount of sludge mass is decomposed by the higher rate of respiration. The higher rate of respiration will leads to the higher concentration level of sludge.

Figure 2. Growth of micro organism

B. Aeration Process:

Aeration is the technical process comes under the category of secondary treatment. It is based on providing mass of air into a tank, which helps the microbial growth in the wastewater. Aeration offers oxygen to microbial bacteria for treating and steadying the wastewater. Oxygen plays an major role in removal of organic contaminants and it is needed for the bacteria to permit biodegradation to occur. The supplied oxygen is used by the microbes in the aeration tank for disintegration of organic contaminants into carbon di oxide. Without the presence of appropriate oxygen, bacteria are not able to biodegrade the arriving organic matter in a practical time. In the absence of dissolved oxygen, the disintegration essentially occur under anaerobic conditions which requires more time, odorous, and produce imperfect conversions of pollutants. Biodegradation of organic matter is a very slow biological process in the absence of oxygen.

In this process, the HRT is varied from 2.5 hrs to 6 hrs till maximum efficiency is attained. Hence BOD content is reduced.

Figure 3 Aeration process

C. Membrane Filtration:

Solid particles from the waste water can be filtered by membrane filtration. The membrane used in this process is "Polyethylene Nonwoven Fibre Filter". The pore size of the membrane is 0.2µm and hence it is classified as micro filtration. The Total Dissolved Solids is removed and hence Turbidity value decreases in this process. The membrane cannot be used again once it the particles get clogged after the treatment process. Hence replacement of membrane is essential. But in large scale, this is not feasible and hence back flushing of water is essential.

Figure 4 Polyethylene Filter

V. CHARACTERISTICS OF WASTE WATER

HRT (hrs)	BOD (mg/l)	Turbidity (mg/l)
2.5	74.2	196.9
3	67.5	170.5
3.5	53.8	136.4
4	39.2	114.7
4.5	29.98	93
5	19.58	68.2
5.5	9.7	40.3
6	2.8	9.3

Table 1. CHARACTERISTICS OF WASTE WATER

VI. RESULT

The process is continued till the maximum efficiency is attained by varying the run time. The BOD and Turbidity is tested for the treated water at various runtime (HRT). The CPHEEO 2012 Permissible limit for irrigation is 200 NTU for turbidity and 100(mg/l) for BOD.

A. Comparison of HRT

PARAMETER	VALUE	PERMISSIBLE LIMIT
pH	8.6	6.5 – 8.5
Turbidity	310 NTU	<10 NTU
Chlorides	690.2 mg/l	< 1000 mg/l
Sulphates	72 mg/l	50 mg/l
COD	260 mg/l	< 3 mg/l
BOD	139.9 mg/l	< 5mg/l
Total Solids	1.6 mg/l	-
Volatile Solids	2.4 mg/l	-
Fixed Solids	4 mg/l	-
DO	6.9 mg/l	4 – 6 mg/l

Table 2 Comparison of HRT

VII. CONCLUSION

Based on this project work on treatment of waste water by Membrane Bioreactor, the following results are concluded:

- After the treatment process the treated water characteristics like pH, Turbidity.
- Hardness, Iron and Dissolved Oxygen were found to be within the limits specified by the IS 10500 (drinking water standards).
- The characteristic like BOD was reduced to 2.8 mg/l at 98% efficiency and Turbidity was reduced to 9.3 NTU at 97% efficiency (The specified limit as per IS 10500.)
- The polyethylene nonwoven fibre membrane is cost efficient when compared to usual membrane used for the process of membrane bioreactor. Also, it provided an promising result.
- Thus treatment of Institutional wastewater using low cost membrane for BOD and Turbidity reduction is found to be a very effective and economical method.
- Thus Membrane Bioreactor can be used for treating waste water which can be used for drinking purpose.

REFERENCES

1. Saima Fazal, Beiping Zhang (2014),” Treatment of Industrial Waste Water by MBR”, Pollution Research Paper, 33(03):499-503.
2. Franca Zanetli, Giovanna Re Luca (2012),”Full Scale MBR treatment on Municipal waste water”, International Journal on Chemical, Environmental and Pharmaceutical Research, 3:52-57.
3. T. Melini, B. Jefferson (2012),” Treatment of water and reuse by MBR”, Journal of Saudi Chemical Society.
4. Jia Ju Tian, Hing Liang (2012),”Submerged Ultrafiltration MBR”, Journal of Experimental Sciences, 3(9):21-26.
5. Bharat Gupta, Patrick Paulier(2010),”Pilot MBR for sewage plant”, Journal of hazardous materials, 177(1):70-80.
6. Andrea Achilli, Tzahi Y Cath(2006),”Forward Osmosis MBR Technology”, Bioresource Technology, 97(9):1061-1085.
7. G.L.Sathyamoorthy (2017), “ A Novel Approach to treat Sago Industrial Wastewater using Anaerobic Hybrid Reactor (AHR)”, International Journal of Civil Engineering and Technology (IJCIET), Volume 8, Issue 7, July 2017.
8. A.Gandhimathi (2017) , “An Experimental Study On Behaviour Of Modified Bitumen Using Recycled Plant” , International Journal of Civil Engineering and Technology (IJCIET), Volume 8, Issue 8, August 2017.