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# A Review on Moving Bed Biofilm Reactor: A Promising Option for Wastewater Treatment

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## ABSTRACT

*The moving bed bio-film reactor (MBBR) system is an alternative and successful method for treating the domestic and industrial effluents. It is combination of two separate processes suspended and attached growth systems for the treatment in order to minimize the concentrations of the contaminated parameters at the required level for the reuse or final disposal. The MBBR has been proved to be effective in removing biochemical oxygen demand (BOD) and chemical oxygen demand (COD) with nutrients (N and P) from the effluent stream. The attached growth system is suitable for the treatment of domestic wastewater which is rich source of organic matter as well as nutrients in the form of nitrate and phosphate. The attached bio-film is responsible for the biodegradation of the organic matter which remains in continuous suspension form under the aerobic condition. This review covers many researchers opinion and the relevant work carried out at the laboratory and pilot scales.*

***Keywords:*** *Moving bed bio-film reactor (MBBR), biofilm, COD, BOD.*

## I. INTRODUCTION

Nowadays, water has become the major issue faced by the each and every part of the world. To overcome the issue it is necessary to treat the domestic wastewater which is rich source of organic waste as well as the nutrients in the form of nitrate and phosphate. In India, it is estimated that there is an immense difference between the production of domestic wastewater and the treatment of generated domestic wastewater. The direct discharge of domestic wastewater into the natural water bodies may lead to the water pollution which has various obstructive impacts on the environment and aquatic life. Due to which the greater and adverse impact on the water sources is increased.

The MBBR is highly effective biological treatment process for waste water treatment. It was developed in Norway at norweign University of science and technology in cooperation with Norweign company kaldnes miljoteknologi. There are more than 600 installations worldwide in both the municipal and industrial sector with about 36 in North America. Recently, Moving Bed Biofilm Reactor has brought increasing research interest in

practice for removal of biodegradable organic matter and its application which has undergone various types of modification and development. It uses the floating media i.e. MBC with HDPE which helps to create a larger surface area for growth of micro-organism by creating a biofilm. A biofilm is a well organized and co-operating community of microorganism; biofilm can be formed on all types of surfaces such as plastic, metal, glass and oil particles.

## II. NEED FOR WASTE WATER TREATMENT IN INDIA

As India hurtles towards a more developed economy, one of the casualties has been the deteriorating state of our environment. Rapid industrialization has, unfortunately, hiked up the number of pollutants in our surroundings. One of these pollutants is wastewater. Management of wastewater through wastewater treatment plants in India has become an imperative of our cities today.

Wastewater is contaminated water. The two main sources of water contamination are sewage and industrial waste. With both the population of India and its industrial landscape increasing at a phenomenal speed, wastewater volume is also at an alarming rise. Adding to this is the shrinking of freshwater sources like rivers, wells, and groundwater and we have an alarming situation. Some fear that very soon water may become a premium commodity.

Rising levels of wastewater has another consequence. Not only is it unfit for consumption, it can mix with other water sources and contaminate it as well. When this water runs downstream and joins other water sources like other rivers, the contamination further spreads. Wastewater also seeps into the ground, contaminating underground water sources. The result is that almost every water source is today heavily polluted from rivers and wells to coastal areas.

This would be disastrous. Water is too important for us to treat this situation with anything less than uttermost seriousness. Drinking water is essential for all humans. Water is vital for livestock, the food industry, and farming.

Image 1. Sewage treatment plant.

Image2. Waste deposited at river bank.

To a small extent, nature can deal with naturally produced contaminants like human and animal waste. However, the massive amount of wastewater today cannot be managed by nature alone.

To sum up, some of the effects of rising levels of wastewater are:

- Harmful effect on river and marine life
- Lack of drinking water
- Overabundance of certain harmful chemicals, some of which are chronic
- Adverse effect on groundwater
- Soil pollution
- Rise in chronic health conditions related to toxic chemicals like lead and mercury in all living creatures
- Rise of pollution in coastal area

## III. WASTEWATER MANAGEMENT

With this situation, wastewater management is our best option. Since the process of reducing contaminants will takes decades of dedicated effort, the better solution would be to manage the wastewater. Fortunately, technology can help us here. Today we have sophisticated methods to treat wastewater. Here are some of the common methods used by wastewater treatment plants in India.

***3.1 Physico-Chemical Treatment:*** Pollutants are usually classified according to size and different methods are used accordingly. For instance, larger particles are separated through gravity, flotation, or filtration. However, smaller particles are much more difficult to separate. This is where physico-chemical treatment is particularly useful.

Chemicals known as flocculants and coagulants are used to separate them. This is a commonly used method to treat industrial waste. It is ideal for the removal of suspended matter like heavy metals, inorganic substances, oil, and grease, as well as dissolved substances.

***3.2 Biological Treatment:*** Unlike physico-chemical methods, biological treatment use organisms to treat pollutants. Over the years, scientists have developed various aerobic or anaerobic processes to treat wastewater.

***3.3 Recycle and Reuse:*** In this method, wastewater is recycled using the membrane-based system. Membrane bioreactors use the simple science of ultrafiltration with a bioreactor to treat wastewater. In short, the method combines physic processes with biological methods. This is a commonly used method in industrial and municipal wastewater management. Treated water is recycled for various purposes, such as irrigation.

***3.4 Zero Liquid Discharge System:*** Many people view this as cutting-edge technology in wastewater management. It removes all dissolved solids from the wastewater, giving us distilled water. Methods like RO are used to purify the water.

There are many areas where the need for wastewater management is dire. Some of the areas of operation for wastewater treatment plants in India are:

- Municipal water management for towns and cities

- For use in rural areas, such as irrigation
- Industrial sector
- Desalination
- Large building societies or colonies
- Some of the challenges still faced in India are:
- Lack of awareness
- Lack of public-private partnership on wastewater management
- Apathy by some governments
- Lack of a cohesive nationwide campaign
- Imbalance in the amount of wastewater and treatment plants

## IV. CLASSIFICATION OF VARIOUS MAJOR AEROBIC FIXED FILM PROCESSES USED IN WASTEWATER TREATMENT

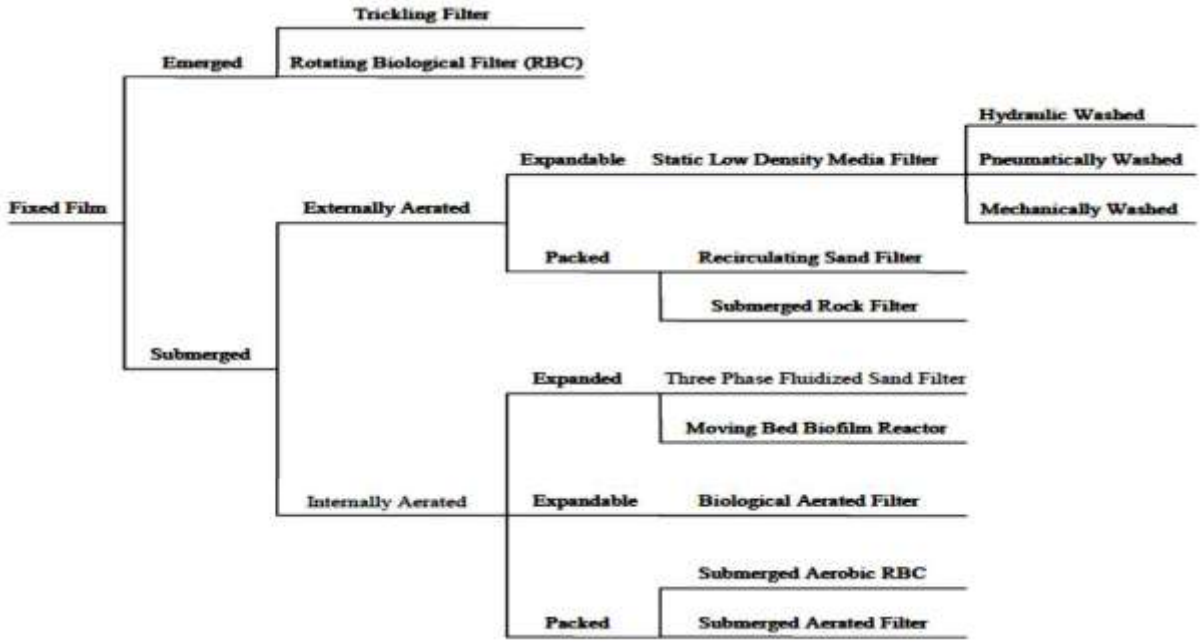


Image 3. Classification of aerobic film processes.

### Examples of Applied Reactors in MBBR:

a) Aerobic

b) Anaerobic/Anoxic

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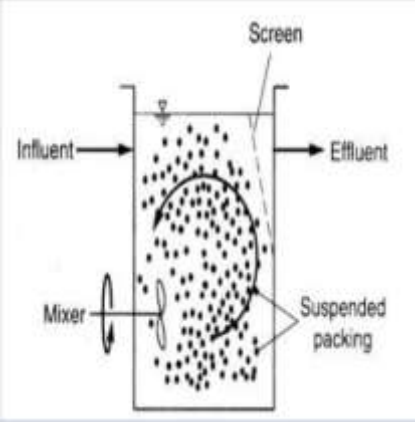


Image 4. a) Aerobic Reaction

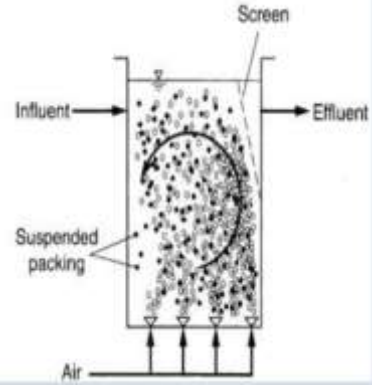


Image5. Anaerobic Reaction5

## V. BOD / COD REMOVAL

- High loads
- Up to 6000 mg/l
- Small foot print
- Single pass treatment
- No recycle
- No operator adjustments
- Biology self regulating
- Low BOD effluent
- 50% to 80 % reduction in 30 minutes
- < 10 mg/l BOD (after clarification)

Image6.BOD/COD Removal

## VI. BIOLOGICAL PHOSPHOROUS REMOVAL

- Decreases tank volume required for BOD/COD and Nitrification
- Allowing room for Bio-P and De-nitrification.
- Allows for the suspended growth sludge age to be tailored for
- Maximum phosphorus removal.
- Nitrification biology grows on media and is not affected by low
- Sludge ages of suspended growth.


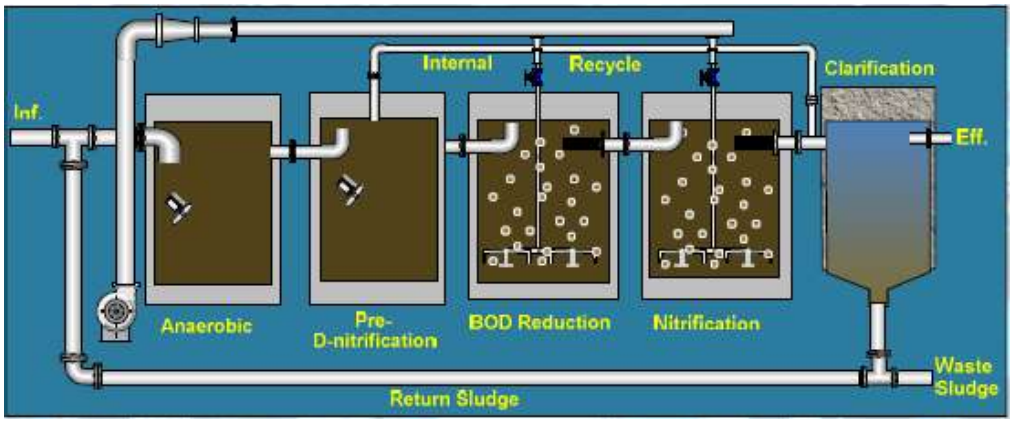


Image 7. Biological Phosphorus Removal

## VII. APPLICATIONS OF MBBR:

- Self regulating biomass.
- Flexible Design that allows for increased capacity.
- No operational adjustments, only equipment maintenance.
- Stable under large load variations.
- Smaller foot prints.
- Low investment Cost.
- Single pass treatment.
- Multiple applications.
- Extremely compact and simple biological treatment system.

## VIII. CONCLUSION

The Moving Bed technology may help to check the feasibility of waste water treatment by using both attached growth system and suspended growth system combinely which cannot be done with the conventional treatment process. This technology may be conducted to get low concentration of solids leaving the biological reactors, the absence of filamentous bulking and good settling characteristics of the sludge. The change in the type of

media carriers during the experimental work may help to get the expected results in a very beneficial manner as compare to conventional activated sludge process. Looking towards the present scenario, MBBR found to be a very valuable technology which can be used for small scale and even in large scale treatment of waste water.

The MBBR Technology helps in treatment of waste water as following:

1. The MBBR technique is suitable for the COD and BOD removal efficiently.
2. The post treatment is necessary to remove the suspended solids and dissolved solids effectively.
3. The provided carrier filling rate is suitable for the treatment of domestic wastewater.
4. It is environment friendly technique.
5. The mesophilic condition (temperature range between 10° C to 35°C) is suitable for the domestic wastewater treatment.

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