# Activated Sludge Process With MBBR Technology At ETP

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**ABSTRACT**

The upgradation of Effluent treatment plant with new technology of Moving Bed Bio-Film Reactor with diffused aeration System has shown great potential in reducing the pollution load of final treated effluent discharge by 50% over surface aeration system.

Of the many processes available for Biological Waste Treatment, the Activated Sludge process has been by far the most popular. ITC Ltd - Paper Boards & Specialty Papers division, Unit : Bhadrachalam took up ETP upgradation/modernization in the year 2006-07 along with the projects new Fiber line with Ozone bleaching, Paper Machine -6 , Chemical Recovery plant and Power House, and completed the ETP Upgradation project in the year 2008-09. During the modernization period the utmost importance was given to reduce the pollution at source in various sections of the mills by introducing environment friendly technologies in addition to introduction of new technology for effluent treatment.

This paper deals with description of Moving Bed-Bio Film Reactor (MBBR) Technology with Cooling Tower installed for pulpmill effluent stream after primary clarification and our experiences in setting up new effluent treatment plant as a case study.

### An Introduction To Biofilm Waste Water Treatment

The main feature of the upgraded E.T.P is Moving Bed Bio-Film Reactor with Diffusion Aeration System, first of its kind in integrated Pulp and Paper industries in India.

When communities of microorganisms grow on surfaces, they are called biofilms. Microorganisms in a biofilm wastewater treatment process are more resilient to process disturbances compared to other types of biological treatment processes. Thus, biofilm wastewater treatment technologies can be considerably more robust especially when compared to conventional technologies like activated sludge.

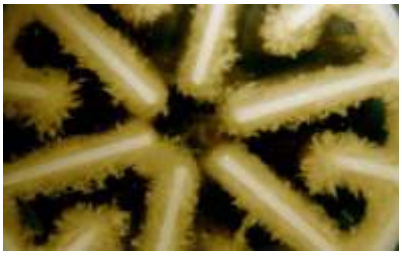
The process is based on the biofilm principle, and the core of the process is the biofilm carrier elements made from polyethylene with a density slightly below that of water. These are designed to provide a large protected surface for the bacteria culture.

The very first biofilm process, the trickling filter, was invented towards the end of the 19th century. The trickling filter can be considered reliable and stable but does suffer from one serious drawback; it easily becomes clogged and septic even under moderate loading conditions.

The MBBR process is simple and robust and eliminates concerns about filamentous growth and bulking sludge that is often a problem plaguing conventional activated sludge and SBR processes. The reactors/tanks are filled up to 67% of their volume with these carrier elements. The biofilm carrier elements are being kept suspended in the water by air from the diffusers in the aerobic reactors, and by means of a mixer in the reactors.

In the MBBR™ biofilm technology the biofilm grows protected within engineered plastic carriers, which are carefully designed with high internal surface area. These biofilm carriers are suspended and thoroughly mixed throughout the water phase. With this technology it is possible to handle extremely high loading conditions without any problems of clogging, and treat industrial and municipal wastewater on a relatively small footprint.

The MBBR™ biofilm technology is efficient, compact and easy to operate. It can be an excellent solution as a stand-alone process, a Moving Bed™ biofilm reactor, or it can be used to specifically enhance or upgrade treatment potential of activated sludge processes. The MBBR™ biofilm technology can be used as a preliminary treatment stage (BAS™), as a combined IFAS hybrid stage (HYBAS™) and as final a polishing step (LagoonGuard™).



### System Description

The MBBR™ biofilm technology is based on specially designed plastic biofilm carriers or biocarriers that are suspended and in continuous movement within a tank or reactor of specified volume. The design of associated aerators, grids, sieves, spray nozzles and other integral parts to the reactor is also of great importance in making up the system as a whole, which is what AnoxKaldnes is marketing .

The industrial and municipal wastewater is led to the MBBR™ treatment reactor where biofilm, growing within the internal structures

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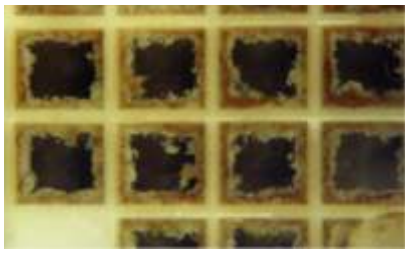
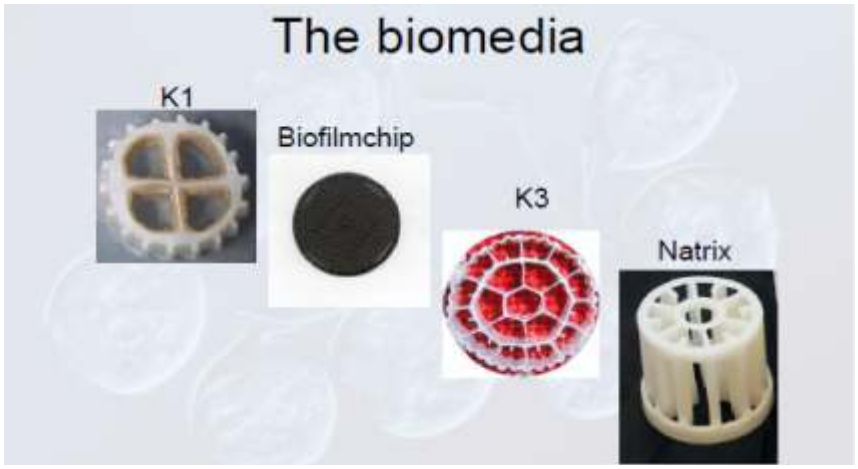
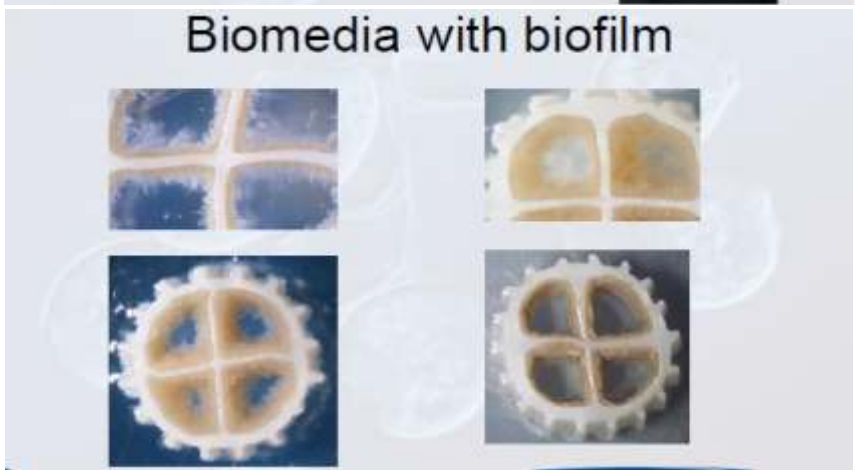
of the biocarriers, degrade the pollutants. These pollutants that need to be removed in order to treat the wastewater are food or substrate for growth of the biofilm. The biocarrier design is critical due to requirements for good mass transfer of substrate and oxygen to the microorganisms and there is a continuous R&D in the area of the MBBR™ biofilm technology . Excess biofilm sloughs off the biocarrier in a natural way .

An aeration grid located at the bottom of the reactor supplies oxygen to the biofilm along with the mixing energy required to keep the biocarriers suspended and completely mix within the reactor.

Treated water flows from reactor through a grid or a sieve, which retains the MBBR™ biocarriers in the reactor. Depending on the wastewater, the reactors may be equipped with special spray nozzles that prevent excessive foam formation.







## Bio Carriers

AnoxKaldnes has developed a complete range of MBBR biocarriers to suite different processes and wastewaters. The different models are

## Effluent Treatment Process At M/s. ITC Bhadrachalam

The main treatment process consists of the following steps.

## PRE TREATMENT STAGE

In this stage of treatment, the combined raw effluent of Pulp Mill, Power House, Chemical Recovery Plant and domestic, first subjected to stationary bar screen is in the grit chamber.

| Model | Length (mm) | Diameter (mm) | Protected surface (m2/m3) | Total Surface (m2/m3) |
|---|---|---|---|---|
| K1 | 7 | 9 | 500 | 800 |
| K3 | 12 | 25 | 500 | 600 |
| Natrix C2 | 30 | 36 | 220 | 265 |
| Natrix M2 | 50 | 64 | 200 | 230 |
| Biofilm-Chip M | 2,2 | 48 | 1200 | 1400 |
| Biofilm-Chip P | 3,0 | 45 | 900 | 990 |

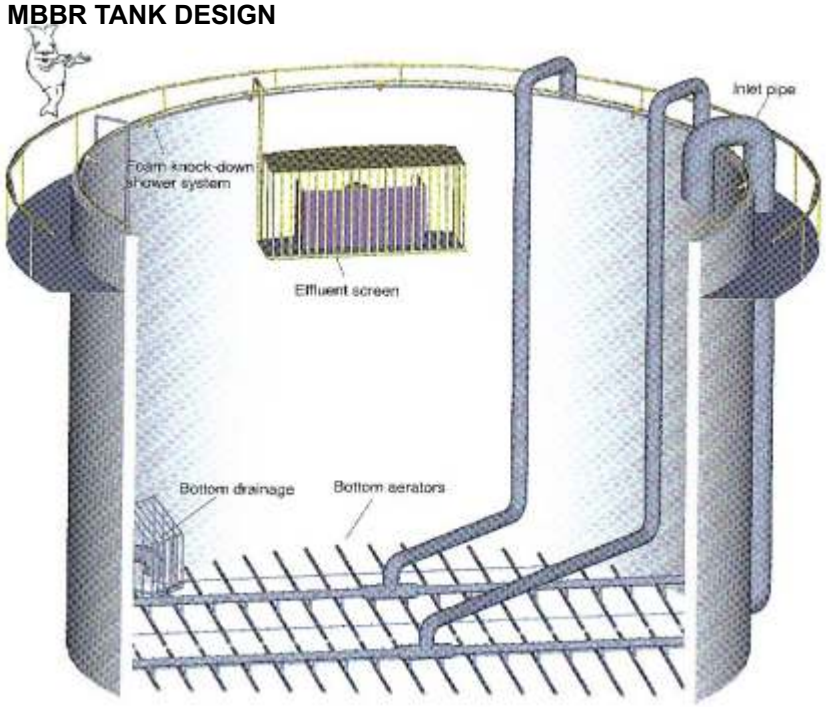
### Primary Clarification State

The screened raw effluent is pumped to primary clarifier for gravity settling of the settlrable material. Here effluent is subjected to 2 to 2½ hrs retention period.

### Secondary Biological Treatment

The clarified effluent is given secondary biological treatment in two number of aeration tanks, which are

## MBBR TANK DESIGN




kept in parallel, equipped with surface Aeration system and Moving Bed Bio-Film with diffusers aeration system for biological degradation of the waste.

Nutrient dozing is done in order to ensure that the incoming effluent is completely suitable for biological treatment. The contents of aeration tank after minimum retention of 12 hrs are transferred to secondary clarifier for the floc separation. The overflow of the secondary clarifier is finally treated effluent, which is taken to flow monitoring station via open channel where the arrangements have been made to continuously monitor the flow of the treated effluent, pH, DO and Temperature of the outgoing effluent.

### Moving Bed Bio-Film Reactor(MBBR)

The overflow from Street-1 Primary Clarifier(pulp mill+SRP+Utilities including domestic)led to Cooling Tower to control the temperature of the influents and there to MBBR tank for further reduction of pollutant loads.

### Design details of implemented MBBR Technology in M/s.ITC -

| Parameter | Unit | Design | Normal |
|---|---|---|---|
| Flow | m3/d | 44,000 | --- |
| Flow | m3/h | 1833 | --- |
| pH | -- | 6 - 8 | 6.5-7.5 |
| Temperature | C | Max 40 | 35-38 |
| TSSGF/A | mg/l | <120 | <120 |
| BOD5 | mg/l | --- | --- |
| COD | mg/l | 720 | <720 |

| S.No | Parameter | Unit | Before MBBR | After MBBR | % Reduction |
|---|---|---|---|---|---|
| 1 | Sol.COD | mg/lit | 930 (Inlet to MBBR tank) | 464 (Out let of MBBR tank) | 50.0% |
| 2 | Final Treated effluent discharge | m3/ton | 44 | 39 | 11.36% |
| 3 | COD | Kg/ton | 14.34 | 10.93 | 21.53% |
| 4 | BOD | Kg/ton | 2.03 | 1.35 | 33.5 % |
| 5 | * AOX (Final Discharge) | Kg/ton | 0.044 | 0.0066 | 85.0% |

### BCM

Number of reactors : 2
Reactor dimensions: 21.3 m x 21.2 m x 8 m (WxLxH)
Water depth : 7 m
Reactor volume : 3200 $m^3$ each
Media type : Biofilm-Chip P
Amount of media : 320 $m^3$ in each reactor
Protected area : 900 $m^2/m^3$
Void volume : 80%

### Design parameters

### Results & Discussions

Operating results, with installation of above plant, we are able to achieve the norms for the treated effluent very comfortably.

The plant is also able to take care of shocks coming from the process plant.

Given table is the typical comparison of test results of final discharge before and after implementation of MBBR.

Inlet to MBBR effluents temperature reduced to 12-14°C by installation of Cooling Tower in the year 2009-10.

AOX reduction due to implementation of ECF/Ozone bleaching at Fiberline-1&2 and MBBR Technology at ETP

### Conclusion

The new technology of MBBR with diffused aeration System has shown great potential in reducing the pollution load and has definite edge over the surface aeration system . The surface aerator act like a half submerged mixers, rotating on the surface of the tank for mixing and entraining air in to the aeration tank, whereas the MBBR Technology is a attached growth system and diffused aeration system provides complete mixing of air with effluent.

### Acknowledgement

The Authors express their sincere thanks to the management of M/s.ITC Ltd PSPD, Unit : Bhadrachalam management for granting permission to present this paper at IPPTA Workshop.

### References

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