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An Innovative Method for Waste Water Treatment Using Fluidized Media Bio Reactor Process.

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ABSTRACT

According to literature data there is a possibility that water scarcity could become a binding constraint on India's progress. Hence preserving the present source of water and recycling the waste water has become the need of the day. The present paper discusses the Fluidized Media Bio Reactor technology for treatment of sewage waste water and converting it into useable water. This process works on the principle of attached growth process wherein the micro-organisms grows on well-engineered plastic carriers which have a high surface area (400-500m^2/m^3). These carrier elements, having density less than that of water, are added to the aerated basins where the biological degradation occurs. The media supports the growth of bio film. The main contributing pollutant is removed by the microbes that grow on these support media. The Fluidized Media Bio Reactor technology makes it possible to handle very high conditions and treat industrial as well as municipal waste water on a relatively small footprint. The presence of the carriers reduces the use of more efficient fine bubble aeration diffusers, which would otherwise require emptying out of the aeration tank for cleaning of diffuser. Thus there is a substantial saving in land requirement for the waste water treatment plant and maintenance cost. The treated water can be used for gardening, landscape irrigation, toilet flushing etc. which otherwise would have required large amount of fresh water. Thus there is a good amount of monetary saving.

Keywords: Bio-carriers, aeration tank, fluidized media bio reactor, bio-film

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INTRODUCTION

The activated sludge process is the most common water treatment process for industrial as well as municipal waste water. It requires a high retention time of approximately 18-30 hours. Hence the space required for such a treatment process is large. The fluidized media bio reactor (FMBR) water treatment process is able to reduce the retention time to 4-5 hours and hence able to replace the out dated conventional water treatment process. This reduction in retention time is because of the high biomass concentration that is easily achieved in FMBR [1-4]. The fluidized media used in the FMBR process helps to support the growth of microbes responsible for biological degradation of pollutants. A bio-film is formed on the media during the process. This bio-film helps in providing a large surface area and hence the biological concentration increases tremendously as compared to the conventional treatment processes.

The main advantages of this process is because of its large biofilm–liquid interfacial area, high interfacial velocities and good mass transfer characteristics. The fluidized solid particles enables a very high biomass concentration and this helps in providing a superiority to FMBR over other conventional treatment processes [4].Several works are reported [5-9] on FMBR design, applicability and performance however application of FMBR in waste water treatment of industrial plant is in nascent stage. The present paper gives information on FMBR process in detail. The major objective of this work is to study the characteristics of sewage water and treated water from FMBR

EXPERIMENTAL APPARATUS AND PROCEDURE

The constructional features of fluidized media bio reactor is shown in Fig.1. It consists of a rectangular aeration tank made up of M.S. of size 11.34x11.34x3.5 m. In the aeration tank one inlet launder and one outlet launder is provided. The raw sewage comes in inlet launder and then overflows in the tank. It leaves the tank from the outlet launder. An aeration grid (diffusers) is equipped at the bottom of the reactor (Fig.2.). The aeration diffusers supplies the oxygen required to the microbes for the biological treatment as is done in conventional activated sludge treatment process. The process involves two reactors in series which are filled with bio-media in the range of 25-50% of reactor volume. The media is retained in the reactor with the help of sieves provided at the outlet of the reactor. The reactor is aerated through aeration grids.

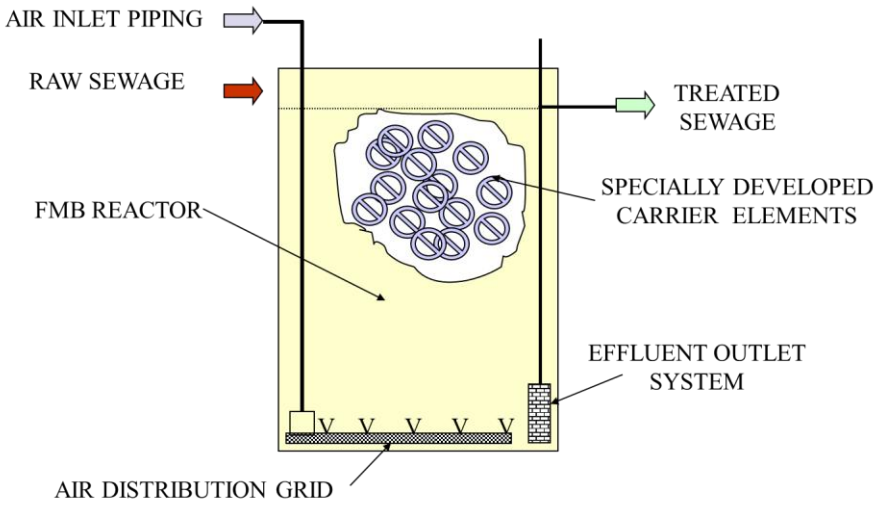

Fig 1: Fluidized media bio reactor

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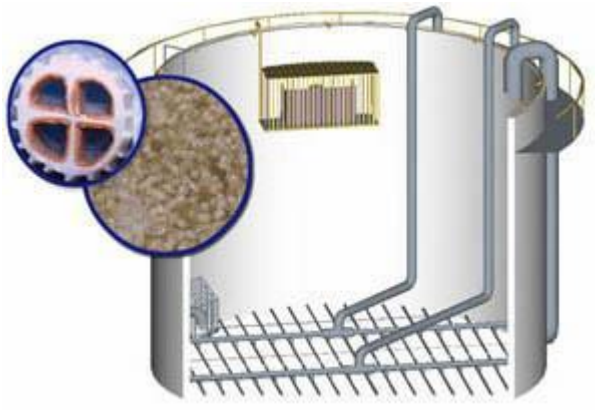

Fig 2: Aeration grids for FMBR

The fluidized media bio reactor is an attached growth process. The system uses specially designed bio-media, which can be easily fluidized (Fig.3.). The core of the process is the bio-media. The biological media is cylindrical in shape, is made up of plastic (poly-ethylene) material with a density (0.96 g/cm3) slightly lower than water and which has a very long life. An effective area of about 400-500 m^2 per cubic meter volume is provided by these media. The micro-organisms responsible for the reduction of BOD /COD of the sewage water with the help of the oxygen supplied grow on this plastic media.

Fig 3: Unused FMBR media and biological growth on the media

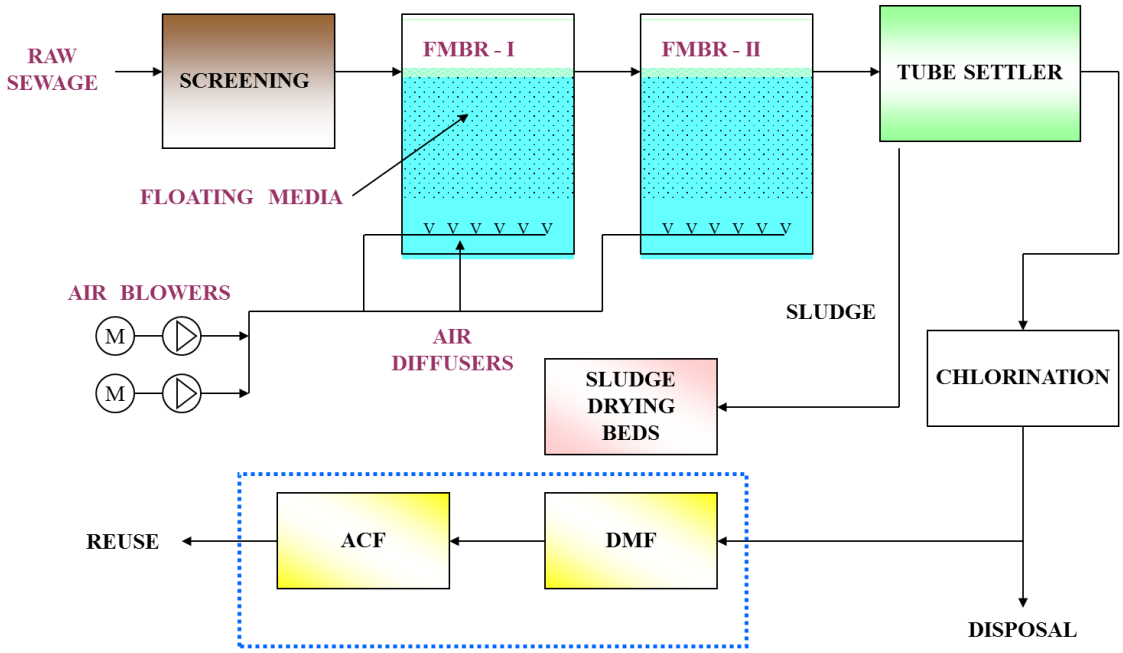

Fig 4: Block diagram showing FMBR sewage treatment process

Fig. 4. Shows the block diagram of FMBR sewage treatment process. Raw sewage at a flow rate of 100 m^3/hour is taken to the Bar Screen cum Grid Chamber. Wastes containing large floating materials are removed in the Bar Screen. The sewage is then passed to Equalization Tank where the contents are mixed thoroughly by blowing air into it. The sewage is then subjected to the biological treatment in the Aeration Tank (FMBR tank) at a superficial velocity of 0.78 m/hour. The hydraulic retention time is maintained at 4.5 hours. Micro-organisms growing on the surface of the media, helps to biologically treat the pollutants that need to be removed. Air is supplied to the micro-organisms for their survival and growth by means of Aeration System. The aerobic reaction breaks the complex organic matter into carbon dioxide, water and ammonia.

The Mixed Liquor Suspended Solids (MLSS) concentration of around 2500-4500 mg/L is maintained. The sewage is then passed to a Secondary Clarifier (Tube Settlers). Sludge that is activated is settled in this unit. The part of activated sludge is recycled back into the FMBR tank by means of Return Sludge Pumps to maintain the MLSS concentration. Excess sludge is passed to the Sludge Sump, from where it is sent to the filter press. After this sludge is disposed of in tankers or into Sludge Drying Beds.

The clarified water over flow from Secondary Clarifier is collected in Clarified Water Tank from where it is pumped through a Pressure Sand Filter. Removal of residual suspended solids takes place in this unit. The waste water is further polished in an Activated Carbon Filter. The treated water from the outlet of Activated Carbon Filter is dosed with Hypochlorite solution for disinfection purpose before reusing /disposal.

RESULTS AND DISCUSSION

Quality of water after treatment from FMBR

Characteristics of sewage water and treated water from FMBR is reported in Table 1. It is seen that BOD value of sewage water i.e. 250-300 got reduced to <20 after treatment. Similarly there is drastic reduction in concentration of COD, TSS, oil and grease in treated water. The treated water can be used for: landscape irrigation, flushing of water closets and urinals, condenser cooling water for A.C. plants, gardening purpose etc.

Table 1: Characteristics of sewage water and treated water from FMBR

Parameter	Sewage water (mg/L)	Treated water (mg/L)
pH	6-8	6.5-7.5
BOD	250-300	<20
COD	400	<200
TSS	200	<30
Oil and grease	20	<10

Comparison of FMBR process with conventional process

The biological treatment in FMBR process is similar to the activated sludge process. The main advantages of this process over the conventional activated sludge process are as follows:

Enhanced Oxygen Transfer:

The use of the plastic media increases the contact time of the oxygen with the micro-organisms and thus enhances the oxygen transfer which is necessary for the biological treatment (Fig.5.).

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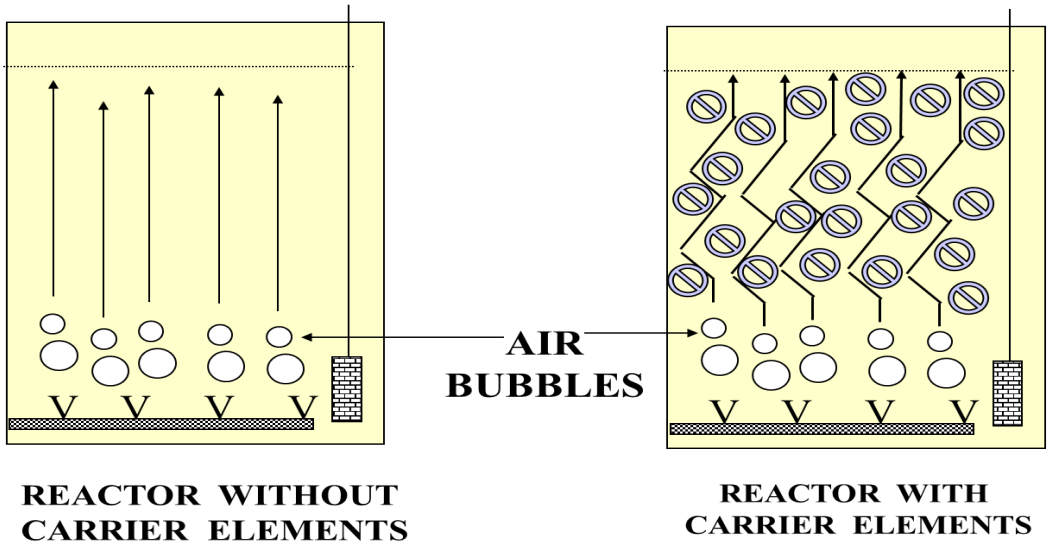

Fig 5: Aeration tanks with and without carrier elements

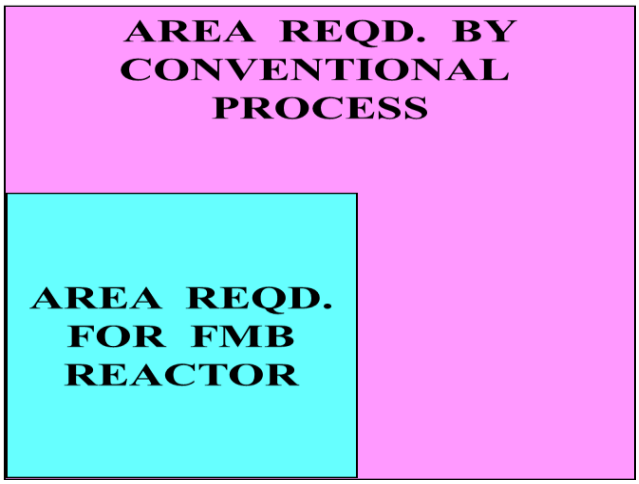

Fig 6: Land requirement for FMBR S.T.P.

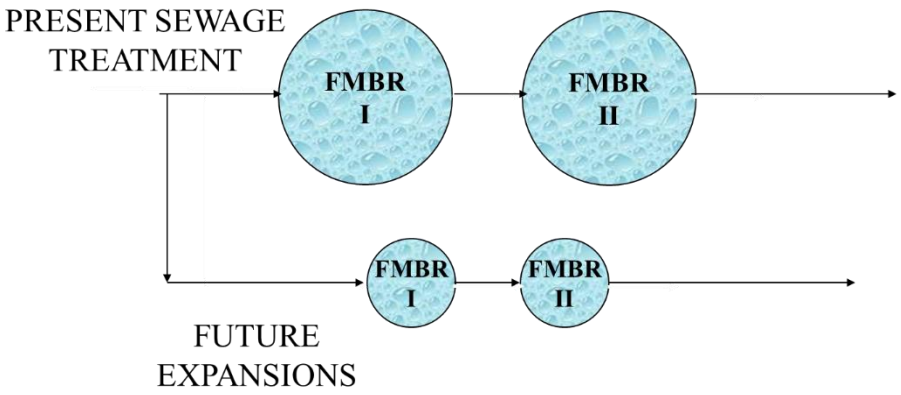

Fig 7: Augmentation of a S.T.P.

Space requirement:

As shown in Fig.6. Space requirement in FMBR process is less as compared to the conventional process.

Augmentation of plant:

Augmentation or future expansion of the present capacity of the S.T.P. is possible using FMBR process (Fig.7.).

The other advantages of this process over the conventional activated sludge process are reported in Table 2.

Table 2: Table showing advantages of FMBR process

1.	Smaller footprints	Less area for the S.T.P., hence more area is available for other amenities like parking, playground etc.
2.	Compact design	Substantial saving in civil costs compared to other systems
3.	Non-clog media	Reduces maintenance time as well as maintenance cost
4.	Excellent quality of treated water	Reduction in use of fresh water for gardening, flushing etc. Thus good amount of monetary saving
5.	No smell compared to other systems	Less smell from the plant area compared to other systems
6.	Low sludge production	Less amount of sludge generation

CONCLUSION

Preserving the present source of water and recycling the waste water has become the need of the day. FMBR is one such waste water treatment process which can help to us to meet this need. FMBR is a waste water treatment technology which acts as a better alternative to the conventional water treatment plants. Scarcity of open space in cities due to increase in population, large networking of piping, high power requirement and land cost has made the conventional systems obsolete. FMBR process serves as a great space saving and efficient treatment option. The FMBR technology makes it possible to handle very high conditions and treat industrial as well as municipal waste water on a relatively small footprint. It also could be a solution to complexes of big housing societies, hotels, colleges and institutes for metro cities where water may be treated in premises itself and recycled for non-potable purposes.

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