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Study of Rotating Biological Contactors (RBCs) for Wastewater Treatment Process

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Abstract- *There is many domestic wastewater treatment processes in use today. Rotating biological contactors (RBCs) constitute a very unique and superior alternative for biodegradable matter. Ph, BOD and COD removal requires very less area, low energy consumption, short start-up, low operating and maintenance cost and high treatment efficiency. The present study of RBCs model and results focused on parameters that affect performance of the unit like Detention time, rotational speed, influent and effluent waste water characteristics. biofilm formation on the media and change in the effluent characteristics were studied for different parameters. Present study was under taken to analyze the feasibility treatment of waste water by using combinations within the RBC unit fitted with various operating conditions. In all, 10 combinations of discs were studied to judge the performance of treatment through RBC units. The unit was divided in to two identical stages and discs were arranged parallel to each other. Discs were immersed 40% in the water. The Rotating Biological Contactor (RBC) system was fed with waste water from various localities. Comparing the result obtained for reduction in BOD and COD.*

Keywords *- RBC, COD, BOD, influent and effluent*

I. INTRODUCTION

A rotating biological contactor (RBC) is growth bioreactor that offers an alternative technology to the conventional activated sludge process. Firstly RBC system was installed in the 1900 century was consisting of a cylinder with wooden slats (Mathure and Patwardhan 2005). Current mainstream technologies for treatment of domestic wastewater, such as activated sludge and tertiary nutrient removal are too costly to provide a satisfactory solution. RBC system represents an excellent option for sewage treatment. RBC is an attached growth bioreactor that offers an alternative technology to the conventional activated sludge process. Because it allows a sufficiently long biomass detention time, it is a compact unit, its energy cost is very less, it is very easy to operate, it has high process stability. It also has high specific removal rate. Research carried out in the RBC system was particularly for improving the performance of rotating biological contactor. The effect of rotational speed of the discs and different media on the performance of rotating biological contactor was studied. In this paper the details of experimental model and results obtained on experimental investigations of treatment process are presented. The results of this modeling give an idea about the efficiency and performance of RBC under various operating conditions.

Excess biomass shears off at a steady rate a the media rotates. These solids are carried through the RBC system for removal in a conventional clarifier. Benefits include improving efficiency, consistent process results and stable operation with minimum supervision of the observer, economical, minimum head loss through the system, low energy consumption and minimum maintenance. The Rotating Biological Contactor (RBC) is one of the most efficient fixed film wastewater treatment technology having typical applications for municipal wastewater treatment method.

II. LITERATURE REVIEW

This paper deals with the identification of filamentous microorganisms present in the biofilms formed over the RBC surface Biofilms were obtained from three municipal wastewater treatment plants with an RBC system. Here an experimental study on the treatment of municipal waste water at a temperature of 12-24°C in an RBC system is done. This RBC system is divided in to two similar stages connected in series to optimize the performance of RBC system, this system of stages was operated at different organic loading rates and hydraulic detention time. The overall efficiency for removal of COD significantly decreases with decrease in total HRT from 10 to 24 hrs and increase in OLR from 11 to 47g/m^2/d. Thus the effluent soluble COD quality remains unaffected. Maximum value of the COD were removed in 1st stage of this system and nitrification took place in 2nd stage [1].

Rotating biological contactors (RBC) constitute a very unique and superior alternative for biodegradable matter and removal of nitrogen on the basis of their operation and simplicity of design, with short start-up, consuming less area, less energy consumption, low operating cost, less maintenance cost and more treatment efficiency. This paper review on RBC focuses on the parameters that affect performance like rotational speed, organic and hydraulic loading , detention time, biofilm support media, influent and effluent wastewater, staging, temperature [2].

Fixed film systems operate with little operator intervention and monitoring and generally use simple, low maintenance equipment is shown in this paper. For the activated sludge , the operator should constantly be aware of conditions so that could lead to inadequate BOD removal, requires continuous monitoring of the wastewater, amount of dissolved oxygen in the aeration basin and the type

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of microorganisms in basin. Also the rate at which biological solids settle and how they compact. For this operator should adjust the amount of biological solids in the system to address system changes, the rate of return of biological solids, the amount of oxygen provided, from the clarifier to the aeration basin. All this requires operator attention and time. Activated sludge plants sometimes experiences period of poor performance due to poor settling of solids. During this operator must take steps to respond that more intensely monitoring plant conditions. Activated sludge systems use high speed rotating equipment and aeration tanks that require frequent maintenance [3].

In this paper study was carried out to evaluate the effectiveness of supplemental aeration for improving the performance of RBC treatment system. First and second stages were overloaded resulting in very low dissolved oxygen conditions. In four-stage RBC reactor contains two parallel stages, one stage was provided with supplementary air in all stages and the other sage without supplementary air used as a control. At the end of each stage after 24-hour composite samples were collected at the influent of the RBC system. For each stage temperature, dissolved oxygen and pH levels were measured.

Samples were analyzed for COD, nitrogen, total and suspended solids. Also sample was analyzed for BOD5 and oxygen rate once a week. The thickness of biomass on the discs and growth conditions was noted. The results of experiment indicate that RBC units with supplemental aeration demonstrated performance and ability to adapt to different organic rates of loading. [4].

III. METHODOLOGY

RBC model was divided into two identical stages, so as to compare the performance of plane discs. RBC is a fixed film, biological wastewater treatment technology. It contains series of parallel rotating discs mounted perpendicular on a shaft which is slowly rotated in a tank through which the wastewater is passed. The shaft is mounted immersed in the wastewater tank. The laboratory RBC model was developed with PVC sheet material. PVC pipe of 200 mm dia. was cut longitudinally of 1000 mm length .Both the ends were sealed. Additional sheet was fitted at the centre which divides RBC unit in two compartments. Horizontal shaft was mounted longitudinally at the centre with provision of ball bearings at centre and at both ends. Acrylic sheets 2 mm thick and 150 mm in diameter were fixed centrally to the shaft spaced 90 mm centre to centre. Rotating acrylic disc are 40% immersed in to the waste water. The driving mechanism is mounted at the end with pulley and gear arrangement with the provision of speed control through regulator. The surface of the rotating acrylic sheet was roughened to provide opportunity for the micro-organism for attachment. The reactor was operated as batch reactor with varying detention time and varying rotational speed. The performance of RBC reactor was observed for nearly 4 months under various operating conditions for ph, BOD and COD parameters. To judge the efficiency of RBC for various strength / categories of waste water, the same units were fed with low strength, and high strength of waste water. To judge the performance of reactor for change in detention time and rotational speed following trials were examined. The RBC model was divided into two compartments each consisted of 5 acrylic disc and these two compartments were tested simultaneously for different operating conditions with same detention period. The performance of the units was analyzed for parameters like BOD and COD. To study the efficiency of proposed units, the study was carried out for various combinations. The RBC unit fitted with plain acrylic disc of size 150 mm in diameter with rotating shaft were exercised for varying detention time such as 8 hrs, 12 hrs, 16 hrs, 24 hrs, 28 hrs and 36 hrs. The RBC unit fitted with plain acrylic disc of size 20 cm in diameter with rotating shaft were exercised for varying rotational speed such as 2 rpm, 3 rpm, 5 rpm, 7 rpm and 10 rpm.

IV. RESULT AND DISCUSSION

The study was carried out to obtain optimum detention time and rotational speed for various type of waste water from different areas. The RBC unit fitted with plain acrylic disc of size 150 mm in diameter with rotating shaft were exercised for varying detention time such as 8 hrs, 12 hrs, 16 hrs, 24 hrs, 28 hrs and 36 hrs. The RBC unit fitted with plain acrylic disc of size 20 cm in diameter with rotating shaft were exercised for varying rotational speed such as 2 rpm, 3 rpm, 5 rpm, 7 rpm and 10 rpm. The results are shown in figure no. 1

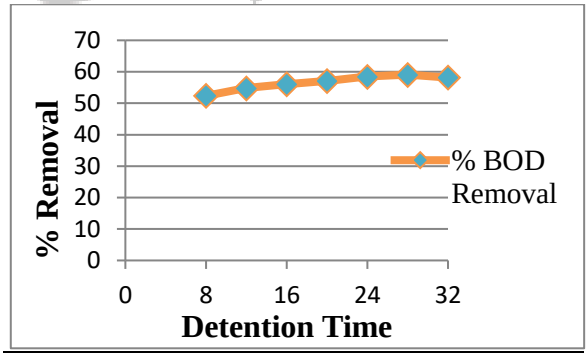

Figure. 1.

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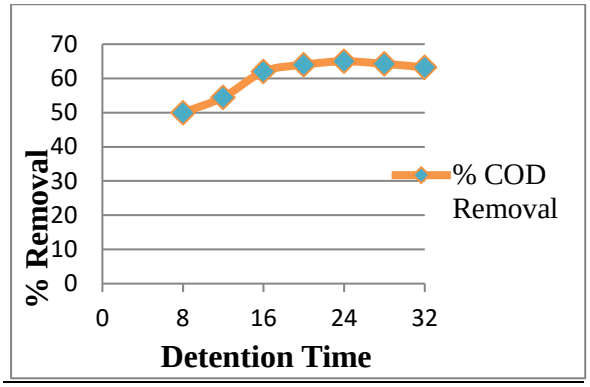

Figure.2.

From the results obtained from above readings optimum detention time for BOD and COD removal was found to be 24 hrs.
Now for rotational speed consider figures.3. and figure.4.

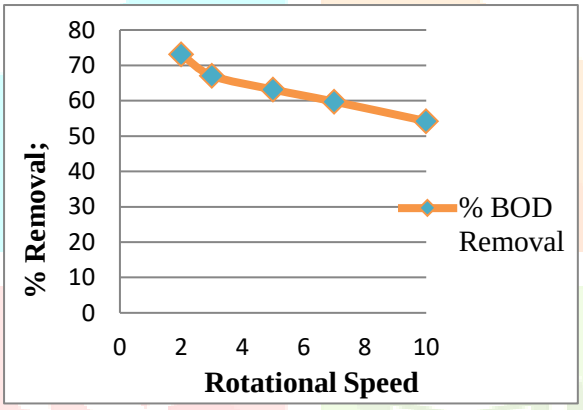

Figure.3.

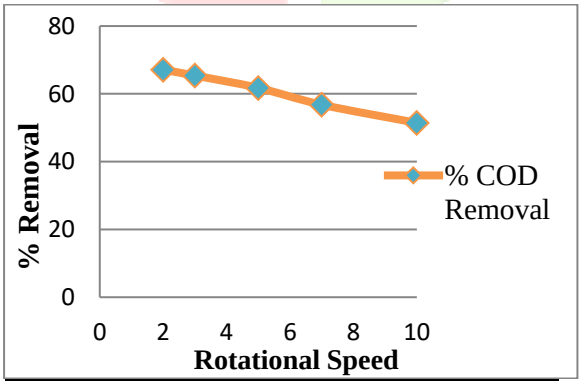

Figure.4.

So the optimum rotational speed was found to be 2rpm.

For the next trials are performed for optimum detention time of 24 hrs and rotational speed of 2rpm.

V. CONCLUSION

- Higher BOD and COD removal rate was found for the acrylic discs having sleeves at an angle of 135^0 as 80% and 83% respectively.
- Medium BOD and COD removal rate was found for the acrylic discs having sleeves at an angle of 90^0 as 74% and 77% respectively.
- Low BOD and COD removal rate was found for perforated acrylic discs as 62% and 66% respectively.

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