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Review Article

Review Paper on Study of Rotating Biological Contactor for Wastewater Treatment Process

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Abstract

There are many wastewater treatment technologies in use today. Rotating biological contactors (RBCs) serves as a superior alternative for biodegradable material, BOD removal rate and COD removal, less area requirement, less energy consumption, with very short start-up, with low cost of operating, less maintenance cost and treatment efficiency. Presently this review of RBC focus on parameters that affect performance like rotational speed, detention time, influent and effluent wastewater characteristics. Here it is proposed to study the performance RBC for various parameters and operating conditions. RBC consists of parallel circular discs attached perpendicular to a horizontal shaft which passes through their centers. The entire assembly is placed into tank with the shaft slightly above the surface of liquid so that the disc approximately 40% immersed. Microorganism grows on surface of disc and rotation of the shaft brings them into contact with liquid allowing the digestion of organic matter.

Keywords: *RBC, COD, BOD, influent and effluent.*

1. 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 with less footprint requirement, 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.

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Excess biomass shears off at a steady rate as 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, food and beverage wastewater treatment, landfill treatment, refinery and petrochemical wastewater treatment, paper and pulp effluent wastewater treatment method.

2. 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 (Tawfik *et al*, 2006).

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 (S. Cortez *et al*, 2008).

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 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 (Galvaânz *et al*, 2000).

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 samples 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. (Rao Y. Surampalli *et al*, 1996).

3. Proposed Work

RBC model is 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. A simplified Rotating Biological Contactor is shown in figure 1.

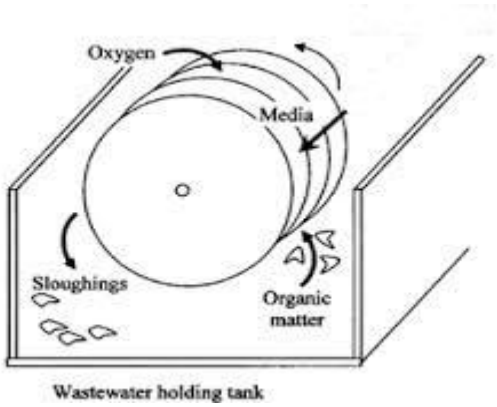

Fig.1 Simplified figure of Rotating Biological Contactor

RBC model is 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. A simplified Rotating Biological Contactor is shown in figure 1. During the treatment process, microbes that remove the organic material in the wastewater (by using the organic material as a food source) attach themselves to the disc surfaces. They grow in a thin biofilm, whose thickness is controlled by the shearing force of the discs being rotated through the water. By rotating the disc wastewater comes in contact with the atmospheric air and thus the purification or addition of oxygen in the wastewater takes place. Which is further required for the biodegradation of organic matter present in the water. which is termed as the biofilm. This leads to form a thin layer of microorganisms on the rotating discs which are immersed in to the wastewater. The settled solids are then pumped out from the bottom of clarifier. Tese settled solids on further processing leads to the formation of last residue, which is most commonly used as a fertilizer to improve the fertility of soil in farms.

Conclusions

Rotating biological contactors have been widely used in different treatment applications. However, due to the complex flow patterns where aeration, nutrient and oxygen mass transfer, biofilm growth and detachment, and the participation of suspended biomass must be considered, with the help of model and with some limitations have been proposed to describe the performance of this type of biological reactor. RBC design is not fully mastered yet and further studies on,

biochemical kinetics and biofilm properties should be carried out.

References

Tawfik, H. Temmink, G. Zeeman And B. Klapwijk (11 March 2006), Sewage Treatment In A Rotating Biological Contactor (RBC) System, *National Research Center, Water Pollution Control Dept,* 275–289.

S. Cortez, P. Teixeira, R. Oliveira And M. Mota (2008), Rotating Biological Contactors: A Review On Main FactorsAffecting Performance, Rev *Environ Sci Biotechnol*, 155–172.

Galvaân, P. Urbina, F. De Castro (2000) ,Characterization Of Filamentous Microorganisms In Rotating Biological Contactor Biofilms Of Wastewater Treatment Plants, *Bioprocess Engineering Springer-Verlag*, 257-260.

Rao Y. Surampalli and E. Robert Baumann (1996) ,Role Of Supplemental Aeration In mproving Overloaded First-Stage RBC Performance, *Kluwer Academic Publishers*, , 1 – 15.

Mercedes Martín-Cereceda, Susana Serrano And Almudena Guinea (18 February 2000), Biofilm Communities And Operational Monitoring Of A Rotating Biological Contactor System,

Costley S C, Wallis F M. (2000), Effect of flow rate on heavy metal accumulation by rotating biological contactor, RBC biofilms J. Ind Microbiol Biotechnol, 244–250.

Chung, J.C., Strom, P.F (1991), Microbiological study of ten New Jersey rotating biological contactor wastewater treatment plants*, Research Journal WPCF*, 35-43.