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Original Research Paper

# Effect of Hydraulic Loading Rates in the Performance of Rotating Biological Contactors for Treating Grey Water

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## ABSTRACT

The laboratory model of two-stage Rotating Biological Contactor (RBC) which was used in the present study is a modified one, with a provision to vary the speed of rotating blades. Grey wastewater was used to study the performance of the modified rotating biological contactor. The reactor had four rotating blades in each stage, having the size of 300mm × 100mm × 10mm, attached perpendicular to the shaft. The experiment was conducted for different influent COD loads and different speeds of rotating blades. Among the different speeds of rotational blades in treating grey water, the rotational speed of 3 rpm was found to yield better percent removal of COD at 95.85% as maximum, whereas against the rotational speeds of 4.5 and 6 rpm, the treatment efficiency is 92.15% and 90.90% respectively.

## INTRODUCTION

Water usage in an Indian residential building is 4% for drinking, 4% for cooking, 41% for bathing, 22% for toilet flushing, 15% for laundry and 14% for cleaning, sprinkling and other miscellaneous purpose. Wastewater segregation and treatment for reuse has become the best wastewater management option. Increasing the grey water reuse by lowering fresh water use for irrigation is an important step towards better environment and resource management (Jeppersen & Solley 1994).

Grey water is a part of used household water, which has not come into contact with toilet waste. Grey water produced can vary across each household according to the number of household occupants, ages, lifestyles, health and water use patterns. It contains waste that a household would normally wash down in drains. This content can vary between households, across different days and is dependent on daily household activities. Generally, grey water contains soap, shampoo, toothpastes, cooking oils, laundry detergents, hair and cleaning products.

A physical model of rotating biological contactor (Friedler et al. 2005) was used to study its performance for achieving desirable characteristics for reuse the treated grey water, in agriculture and landscape developments.

## MATERIALS AND METHODS

**Experimental setup:** The experimental model has been designed on the basis of empirical, as a laboratory scale RBC for an effective volume of 30 litres (in three compartments: two stages of rotating contactors and a settling tank in the third compartment). A specialty nylon wire mesh spread on both side of all the blades to impart enhanced biofilm area. The blade rotations are arranged in the opposite direction to the liquor flow, tangentially. The shafts of each stage are connected suitably to a gear motor assembly. The speed of rotating blades is 3, 4.5 and 6rpm. The schematic diagram of experimental set-up of the modified rotating biological contactor is presented in Fig. 1. The grey water analysis is presented in Table 1 (Eriksson et al. 2002).

A two-stage RBC followed by a settling tank was envisaged as the modified RBC. Real time grey water samples were daily collected from a residential building complex for conducting the experiment. The raw grey water was pumped at a pre-determined rate to the model by a peristaltic pump. The model was run for five different average influent

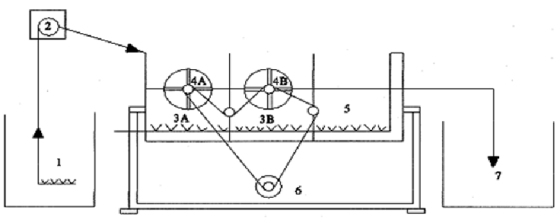


Fig. 1: Schematic diagram of experimental setup (RBC-105 L capacity.

1. Grey water Mixing - Supply Tank
2. Peristaltic Pump; Miclins / 15pp
3A,3B - Stages of RBC
4A,4B - Rotating Contactors
5.Clarifier
6.Geared Motor- pulley assembly;1HP
7.Treated Grey water

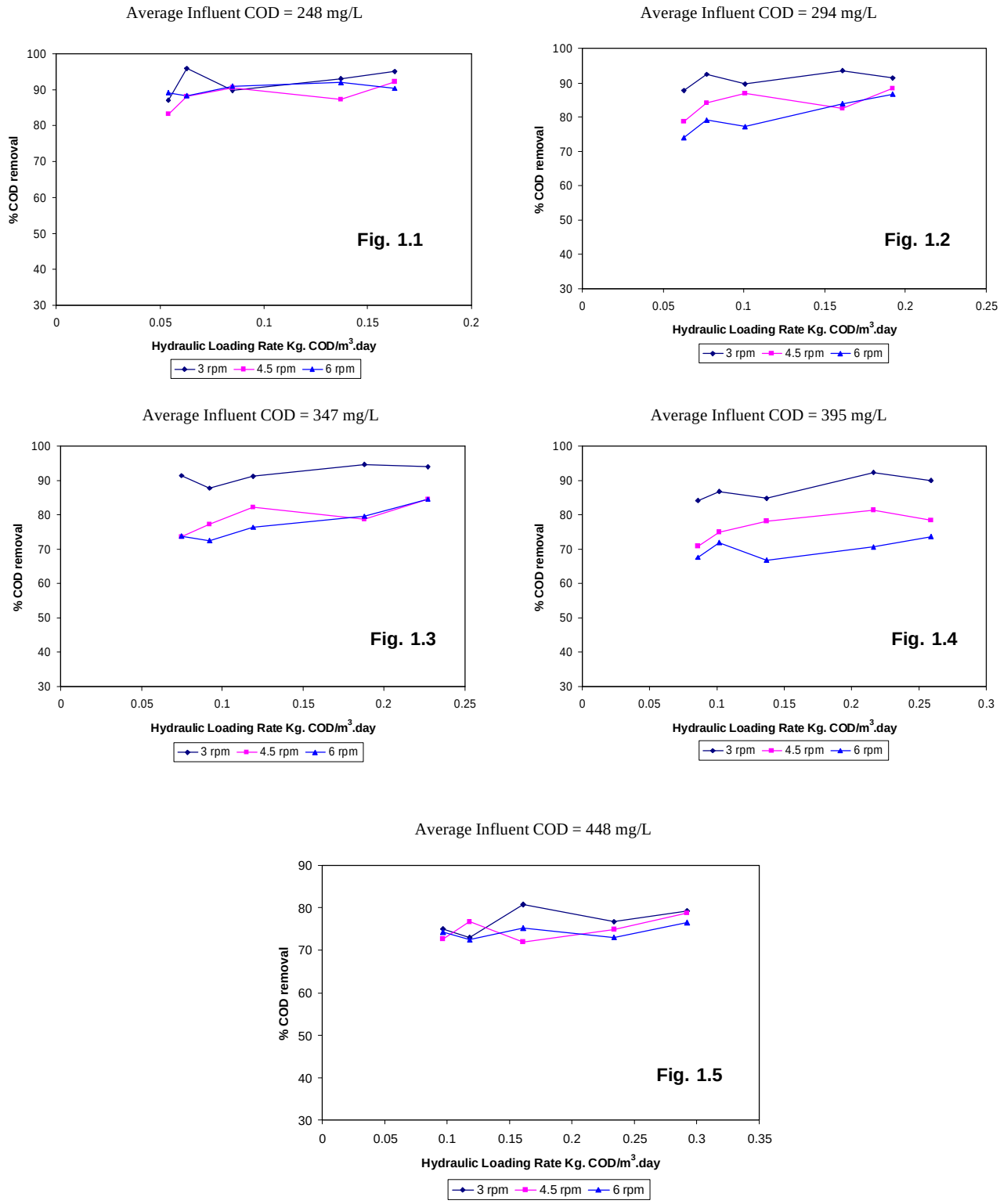


Fig. 1.1, 1.2, 1.3, 1.4 and 1.5: Percent COD removal efficiency vs. HLR for varying rotational speeds of blades.

Table 1: Grey water analysis.

| Parameter | Concentration |
|---|---|
| Total Suspended Solids (TSS) | 100 mg/L |
| Chemical Oxygen Demand (COD) | 250 mg/L |
| Biochemical Oxygen Demand (BOD) | 100 mg/L |
| TKN | 20 mg/L |
| Sodium | 50 mg/L |
| Total Phosphorus | 0.5 mg/L |

substrate concentrations measured as COD (248, 294, 347, 395 and 448 mg/L). Each stream was fed into the model for five different hydraulic flow rates (13.2, 10.5, 7.01, 5.3, 4.4 L/h). Each combination of these two was conducted on three different speeds of the rotating blades (3, 4.5 and 6 rpm). In total, the experiment was conducted for 75 combinations of these three operating variables. An increase in the rotational speed shows decrease in removal percentage of COD. The samples were analysed for various chemical parameter such as COD as per procedures given by APHA (1995) and Trivedy & Goel (1986).

## RESULTS AND DISCUSSION

The rotational speed of blades greatly affects the performance of rotating biological contactors (Nehru Kumar 2005). In the present study also, the rotational speed of blades was found to affect the performance of the model. An increase in the rotational speed decreases the percentage of COD removal efficiency of the model plant. The results of model performance studies are presented in Fig. 1.1, 1.2, 1.3, 1.4 and 1.5. Among the three rotational speeds of discs, the blade rotational speed of 3 rpm was found to give best results. The maximum COD removal was observed as 95.85% against OLR of 0.291 kgCOD/$m^3$/day for the rotational speed of 3 rpm. The present study shows that with proper management, grey water can be used for irrigation/gardening without any risk.

## CONCLUSION

The optimum rotational speed of the blades is understood to be the lowest possible. Though, 3 rpm of the blade rotational speed was found to be optimum from the results of the experiment, it could be still lower in the full fledged, field level RBC plants, for better removal of COD from the waste streams.

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