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Original Research Paper

Studies on the Chemical Parameters of Grey Water Treated by Modified Rotating Biological Contactor (RBC)

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Key Words:
Wastewater
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ABSTRACT

In this paper, fundamental concepts of grey water reclamation and reuse are developed that include categories of water reuse and technological innovations for the safe use of reclaimed grey water. In general, grey water contains lower levels of organic matter and nutrients compared to ordinary wastewater; since urine, faeces and toilet are not included. The pilot plant combines biological treatment (RBC) with physico-chemical treatment (filter media that is stone, coal). The treated effluent from RBC was allowed to pass through three columns of filter connected in series. The experiments were run for two different filter media namely, granite stone and coal separately. The experiment was conducted for different influent substrate concentrations 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 reduction of pH, hardness, total dissolved solids, total Kjeldahl nitrogen, dissolved phosphates, total phosphorus, sodium, and boron than the rotational speeds of 4.5 and 6 rpm.

INTRODUCTION

In arid region, water conservation and reuse are issues that receive a great deal of public attention. Grey water is used household water which has not come into contact with toilet waste. Water usage in an Indian residential building is 41% for bathing, 22% for toilet flushing, 15% for laundry, 14% for cleaning, sprinkling and other miscellaneous purposes, 4% for kitchen, and 4% for drinking. Reuse of grey water can also reduce the load on septic tanks and leach fields. As an alternative, which can be applied in the rural areas, is the treatment of grey water by Rotating Biological Contactor (Friedler et al. 2005) and its reuse for irrigation, and this is the interest of this study.

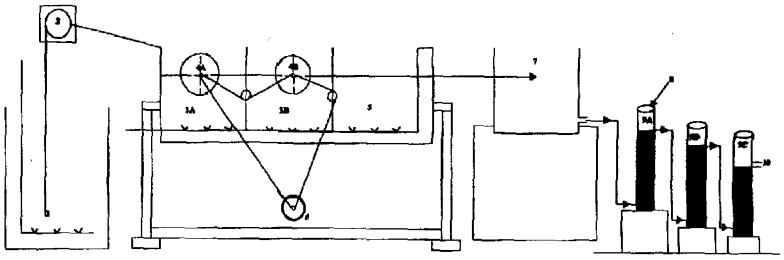
MATERIALS AND METHODS

Experimental set-up: A two-stage RBC model followed by settling facility having 140 litres effective capacity was used in the study.

The reactor had four blades each of size 350 mm × 100 mm attached to a shaft at an angle of 90°. The effluent from the RBC was allowed to pass through three columns of filter media. The experiments were conducted for two different filter media; in the first case with all the three columns packed with granite stones and in the second case with all the three columns filled with coal. The grey water used in this study was daily collected from a group of residential buildings nearby

Table 1: Chemical composition of the grey water.

Parameter	Average Concentration
pH value	8-10
Hardness	above 300 mg/L
Total Dissolved Solids (TDS)	3000 mg/L
Total Kjeldahl Nitrogen (TKN)	1-40 mg/L
Dissolved Phosphates	0.1-2 mg/L
Total Phosphorus	0.062-42 mg/L
Sodium	49-480 mg/L
Boron	1.4-1.7 mg/L



1) Grey water mixing- supply tank
2) Peristaltic pump; Miclins/15pp
3.A,B) Stages of RBC
4.A,B) Rotating blades
5) Clarifier
6) Geared motor- pulley assembly;1HP
7) Effluent collection tank
8) Filter- circular column of size(1000mm x300mm)
9.A,B,C) Containing filter media of Granite, coal of size 18mm,12mm & 8mm
10) Treated grey water

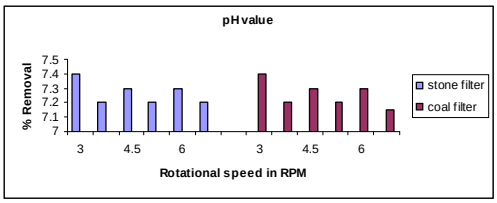
Fig. 1: Schematic diagram of experimental set-up (RBC of 140-L capacity).

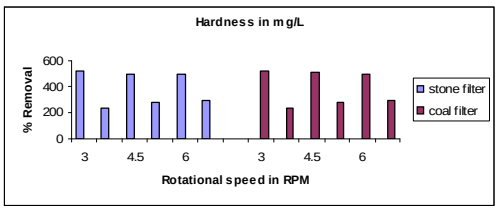
Table 2: Chemical analysis of untreated and treated grey water by using stone filter media.

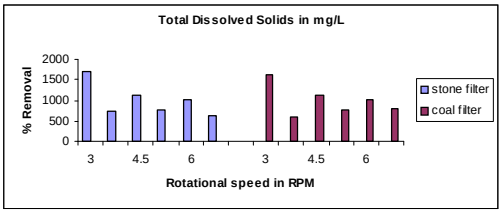
S.No.	Parameters	Unit	3 rpm		4.5 rpm		6 rpm	
			In	Out	In	Out	In	Out
1.	pH		7.4	7.2	7.3	7.2	7.3	7.2
2.	Hardness	mg/L	523.4	279	500	300	496.4	237.1
3.	Total Dissolved Solids (TDS)	mg/L	1709	752.2	1121	780.2	1017.4	617.2
4.	Total Kjeldahl Nitrogen (TKN)	mg/L	14.5	6.4	20	7.4	21	8
5.	Dissolved Phosphates	mg/L	0.97	0.5	0.9	0.4	0.9	0.5
6.	Total Phosphorus	mg/L	17	3.4	18	4	18.9	5
7.	Sodium	mg/L	210.3	50.3	190	52	205	50
8.	Boron	mg/L	1.82	0.4	1.8	0.53	1.7	0.6

Table 3: Chemical analysis of untreated and treated grey water by using coal filter media.

S.No.	Parameters	Unit	3 rpm		4.5 rpm		6 rpm	
			In	Out	In	Out	In	Out
1.	pH		7.4	7.2	7.3	7.2	7.3	7.15
2.	Hardness	mg/L	523	234	511	276	499	292.4
3.	Total Dissolved Solids (TDS)	mg/L	1627	607.4	1126	779.3	1023.4	782
4.	Total Kjeldahl Nitrogen (TKN)	mg/L	16	7	20	8	20.5	9.3
5.	Dissolved Phosphates	mg/L	1.07	0.54	1.1	0.54	1.2	0.6
6.	Total Phosphorus	mg/L	17.8	4.3	19	4.8	19.32	6
7.	Sodium	mg/L	210.2	50.1	190.5	51.5	208	52
8.	Boron	mg/L	2.02	0.37	1.9	0.63	1.83	0.7







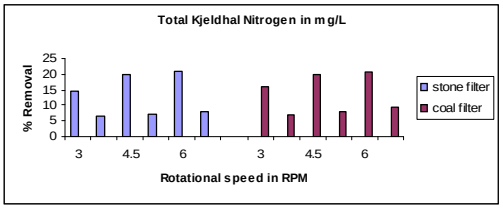
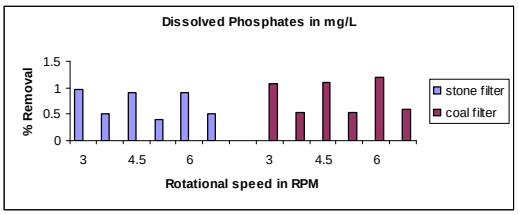
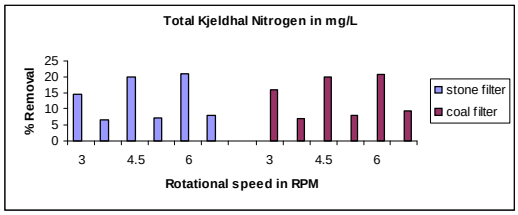
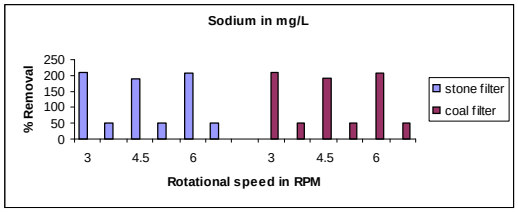


Fig. 2: Chemical quality of grey water (influent and effluent) in the treatment process.







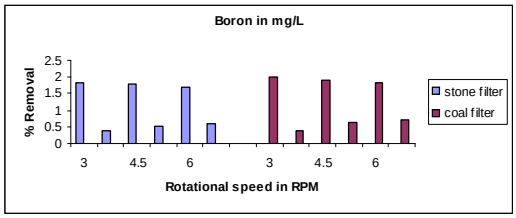


Fig. 3: Chemical quality of grey water (influent and effluent) in the treatment process.

Annamalai University. The raw grey water was pumped at a predetermined rate to the model by a peristaltic pump. The schematic diagram of experimental set-up of the modified RBC is presented in Fig. 1. The average composition of the grey water is presented in Table 1 (Eriksson et al. 2002).

Methodology: The model was run for a flow rate of 0.100m^3/day at three different speeds of the rotating blades (3, 4.5 and 6 rpm) and allowed to pass through three columns of filter filled with stones in one case and with coal in the other case. The samples were analysed for various chemical parameters such as pH, hardness, total dissolved solids, total Kjeldahl nitrogen, dissolved phosphates, total phosphorus, sodium, and boron as per procedures given by APHA (1995) and Trivedy & Goel (1986).

RESULTS AND DISCUSSION

Water consumption rates, population density, and habits of population have an impact on the characteristics of wastewater (black or grey). Due to low water, consumption wastewater is concentrated and strength in some locations is comparable to that of industrial wastewater. The speed of rotation

of blades has a great bearing on the efficiency of treatment (Nehru Kumar 2005). An increase in the rotational speed shows decrease in removal percentage of chemical parameters. The results of chemical analysis are given in Tables 2 and 3 and shown in Figs. 2 and 3. The results are well within the quality requirements of irrigation water (Table 4). The laboratory model produced effluent of improved quality and was very efficient in chemical parameters at a rotational speed of 3 rpm with coal as filter media. Among the three rotational speeds of blades namely 3, 4.5, and 6 rpm, the blade rotational speed of 3 rpm was found to give better results.

Table 4: Standards for irrigation water.

Parameters	Permissible limits
pH	6.5-8.5
Hardness	>300 mg/L
TDS	1000-3000 mg/L
TKN	Nil
DP	Nil
TP	< 12
Sodium	60
Boron	2

Source: Tolerance limits for trade effluents.

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