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A Study on Recycling of Centralized Kitchen Wastewater for Urban Irrigation

Rajkumar Pandurang More[1], Dr. Sunil Bhimrao Thakare[2]

[1]Civil Environmental Engineering Department, ABMSP's APCOER Parvati, Pune, MH, India

[2]Principal and Professor, Civil Environmental Engineering Department, ABMSP's APCOER Parvati, Pune, MH, India

Abstract: ***The demand of water for irrigation of urban gardens is increasing day by day. On other side of urbanization to satisfy the basic food need of crowded population various service providing sectors are developing rapidly. Around 60% of total water used in kitchen was converted in in the form of wastewater. The biodegradable organic constituents present are around 80% in kitchen wastewater. As demand of water for urban irrigation increasing day by day along with problems due to direct disposal of kitchen wastewater, the objective of this study is to recycle the SBR treated centralized kitchen wastewater for Urban Irrigation.***

Keywords: Centralized Kitchen, Wastewater, SBR, Food, Urban Development, Irrigation

1. Introduction

The green development to control the changes in climatic conditions is necessary as per present situation. To manage the rise in temperature in urban areas plantation is required to cover the open surfaces. In urban areas various concepts like Roof Gardens, Backyard Gardens, Allotment Gardens, Community Gardens, and Road side Gardens etc are coming on front side in the sustainable urban development. At the same time today there is need to think about demand water required for urban irrigation. Conservation of fresh water resources become essential as day by day there is rise in water demand for different urban uses along with depletion of water resources due to climatic change.

Excreta Matters report by Centre for Science and Environment, the growth in population in cities due to migration of people exerts pressure on city planners and utility services provisions. Also the need of water is satisfied by taking water from peri-urban and rural areas through formal and informal channels [11]. Hanjraand Qureshi discussed about deficiencies in infrastructural development. Also stated lack of space in development for public services as the constraint is of economic growth. This may create challenges related to feeding the cities; where the food supplies were brought from distant rural places. [14]. Ghunmi et al. investigated the factors affecting the biodegradability of the grey water under anaerobic and aerobic treatment conditions [13]. Jayyousi studied grey water reuse in arid regions a step towards sustainable water management. The study also discussed about effective use of gray water in groundwater recharge, landscaping, and plant growth. The study concluded that the aim of current environmental policies should be control pollution with promote maximum recycling and reuse of GW within households and communities [05]. Huelgas et al. carried out a comparative study among a) kitchen-sink wastewater only, and b) a mixture of kitchen-sink wastewater and washing-machine wastewater treatment by using a submerged membrane bioreactor. The problem of foaming observed due to the mixture of kitchen-sink wastewater and washing-machine wastewater. The study concludes that the washing-machine wastewater has some components, which are not easily biodegradable[15]. Gabarró et al. investigated the use of sequencing batch reactor (SBR) technology to treat grey water generated at a sports centre. The treated gray water was used for irrigation. The results of the SBR treatment show the system was not fully accomplished for denitrification but ammonium was totally oxidized and low concentrations of nitrates were achieved. The SBR effluent have good appearance, without odour and that is used to irrigate a grid system containing natural and artificial grass sections. The study concludes that the wastewater treated through SBR technology propose a capable treatment for grey water to be reused for irrigation [12]. Patterson studied effect of chemical properties, biochemical oxygen demand and suspended solids on reuse of wastewater. As per the study the technical improvements in wastewater treatment are not the answer for quality of reuse of wastewater. The significant beneficial effects upon land application due to improvement in effluent quality will promote the application of gray water for land application [27]. Hussain et al. studied yield of wheat grain using SBR Treated Waste Water for irrigation. The results of this study are the Higher Wheat Grain Yields with Higher Protein Content Ingredients and without change in total fiber content. The study concludes that the treated Waste Water is a potential source of irrigation water with rich source of fertilizer [16].

Direct use of kitchen wastewater for small scale agriculture may badly affect over porosity of soil and may affect on soil fertility. Kitchen wastewater treated by SBR is extensively used in agriculture because it is a rich source of nutrients and provides all the moisture necessary for crop growth. Most crops give higher than potential yields with recycled kitchen wastewater irrigation; reduce the need for chemical fertilizers, resulting in net cost savings to farmers.

2. Methodology

2.1 Research Approach

The study includes treatment of wastewater from Centralized Kitchen, analyse the suitability of treated effluent to be used for irrigation purpose and evaluate variation in parametric

values of soil to determine the quality of soil due to application of treated kitchen wastewater for irrigation.
Figure No. 1 is the flow chart of the normal sequence steps of the research approach which is followed in this research work.

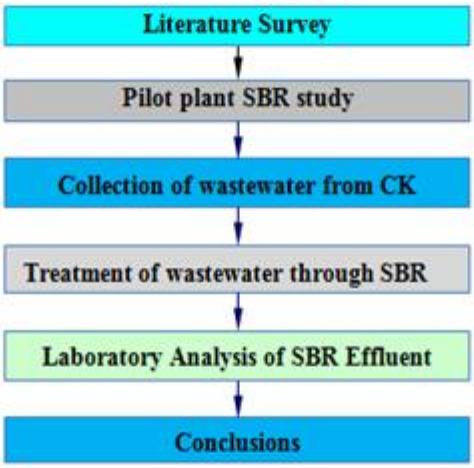

Figure 1: A Flow diagram of Research Approach

2.2 Collection of Kitchen Wastewater samples

The wastewater samples were collected from Centralised Kitchen located at Akurdi as per composite sample method mentioned by USEPA (United States Environmental Protection Agency).) (see Figure 2).

3. Experimental Work

A. Development of Pilot plant SBR model

The SBR model was developed with the glass and Silicon adhesive material. The reactor unit tanks were formed with 4 no's of rectangular glass pieces for sides and one piece for bottom. The dimensions of SBR model were as per Table No. 1.

Figure 2: Collection of Centralized kitchen wastewater sample

Table 1: The Dimensions of SBR model

Sr. No.	*Particulars of Tank*	*Capacity in liters*	*Dimensions in mm*		
			Length	*Width*	*Depth*
1	Holding	20	300	250	300
2	Reactor	20	300	250	300
3	Collection	20	300	250	300

The capacity of tank is 20 liters'. To remove the supernatant from tank a tap is provided such a way that sludge retained in the tank is upto 6 litres.

2.3 Treatment of Centralized kitchen wastewater

A centralized kitchen wastewater sample was treated as per Flow sheet shown in Figure 3. The kitchen wastewater samples collected from selected centralized kitchens were treated through pilot plant SBR model. The treated effluent from model was collected as supernatant from SBR.

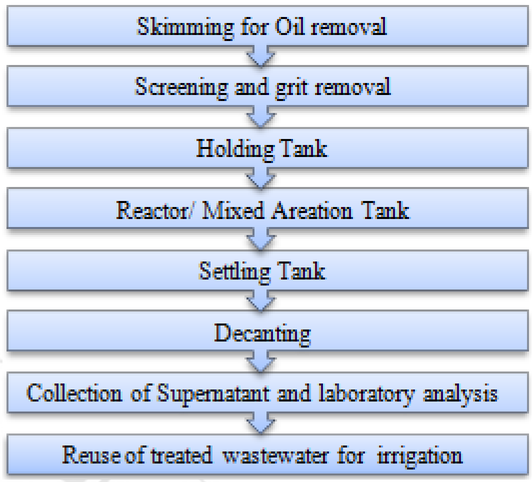

Figure 3: A flow diagram for treatment centralized kitchen wastewater

4. Results and Discussions

4.1 Laboratory analysis of SBR effluent

The laboratory analysis of centralized kitchen wastewater effluent from SBR model was done periodically. The parameters pH, EC, Chlorides, Nitrate and BOD of treated and untreated wastewater samples analyzed at the interval of three days. (see Figure 4).

Figure 5: Determination of pH of treated kitchen wastewater

The averages results of parametric values of laboratory analysis of treated centralized kitchen wastewater and untreated are shown in Table No. 2.

Table 2: The average parametric values of treated centralized kitchen wastewater through SBR for the F/M ration = 0.20

No.	*Parameters*	*Influent*	*Effluent*	*% Reduction*
1	BOD mg/l	819.58	18.37	97.76
2	Chlorides mg/l	851.44	69.78	91.80
3	Nitrate mg/l	94.95	4.94	94.78
4	EC dS/m	3.02	0.83	72.04
5	pH	6.91	6.47	NA

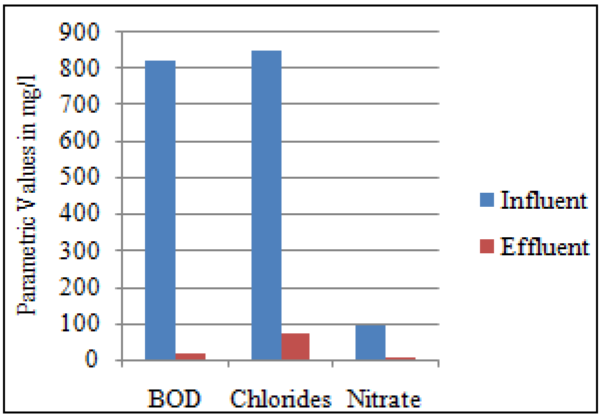

Figure 5: The average variation in parametric values of kitchen wastewater treated by SBR technique

From Table 2 and Figure 5 the following points are observed

- The average % reduction in parametric values of kitchen wastewater is : BOD - 97.76 %; Chlorides - 91.80 %; Nitrate - 94.78 % and EC - 72.04 % by SBR treatment.
- The average parametric values of kitchen wastewater treated by SBR was observed: BOD - 18.37 mg/l, Chlorides - 69.78 mg/l, Nitrate – 4.94 mg/l, EC – 0.83 and pH – 6.47; which are within the permissible limits as per the standards for waste water used for irrigation.

5. Conclusions

The work carried out under this research project was the developed SBR model to treat centralized kitchen wastewater.

The following are the conclusions of this study

1) The quality of wastewater generated from centralized kitchen is worst as it contains higher parametric values of BOD, Chlorides, Nitrates, EC and pH.
2) SBR treatment in combination of tertiary treatment units like activated carbon filter and pressure sand filter are effective in treatment of kitchen wastewater upto desired parametric values of effluent to be applied for irrigation.
3) The fresh water utilized for irrigation has replaced by recycled kitchen wastewater, which conserves natural water resources.

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Author Profile

Rajkumar Pandurang More obtained BE Civil and pursuing M.E. degree from the Civil Environmental Engineering Department, ABMSP’s APCOER Parvati, affiliated to Savitribai Phule Pune University, Pune, MH, INDIA. His area of specialization is Environmental Engineering. He has Published 03 research papers in International Journals & 03 papers in national conferences. He has more than 26 year’s industrial and institutional experience.

Dr. S. B. Thakare obtained PG and doctoral degrees from Sant Gadgebaba Amravati University. His area of specialization is Environmental Engineering. He has Published 20 research papers in International Journals & 15 papers in international conferences. He has awarded as best lecture award by Indian water works association in – 42nd Annual Convention of Jodhpur on 29th Jan. 2010.