Treatment Of Grey Water Generated from Hostels by Cost Effective Adsorbents - A Case Study

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Abstract- ***Grey water recycle is a genuine measure for redeeming water on the local level and decreasing the load on wastewater treatment plant. Filtration with cost effective adsorbent media is used in this research to recycle grey water which can be efficiently used for irrigation. Fly ash available in surplus at thermal power plants nearby the study area was utilized as an adsorbent. The parameters such as Total Suspended Solids (TSS), TDS, COD, BOD, DO, Na, Total N, Total P and chlorides in the effluents before treatment are surpassing the tolerance limits. The characteristics of the treated effluent revealed that for many parameters there were more than 85% deductions from the original value of the grey water and for some parameters the reduction was very low.***

Indexed Terms- Grey water, Filtration, Adsorbents, Fly ash

I. INTRODUCTION

Water insufficiency one of the most significant challenges to human well-being and environmental integrity. As the world's population grows and prosperity spreads demand for water also increases and multiply without the possibility for an increase in supply, 800 million people live under a threshold of water stress and if continuous will rise to three billion in 2025 particularly in Asia and Africa alone. (United Nations 2012; Food and Agriculture Organization of the United Nations 2012). India has made regular enhancements over the past eras interns of availability and characteristics of municipal drinking water systems; its huge population has stressed water resources with rural areas partially abandoned. Around 60-90 liters per day is the current average per capita water use in the conventional Indian conditions, where the water supply is largely intermittent and the water used for washing and cleaning activities make up 50-60% of the per capita water use. To ease the water stress, particularly in developing countries, grey water reuse is becoming more and more significant, having universal appreciation as a substitute for water source mostly for irrigation, toilet flushing and others. Reclamation of grey water is an effective measure for redeeming water in the local level and decreasing load on wastewater treatment plant. Grey water reuse may lead to considerable monetary benefits wherever water is scarce and expensive, (Morel 2005; Morel and Diener 2006). The recycling of grey water can considerably decrease the water resource depletion. The treatment technique and the characteristics of the treated grey water will have to be adapted to the reuse purpose (Dalahmeh et al. 2012). Various treatment approaches have been carried out by many researchers to recycle the grey water for variety of purpose (Oteng-Peprah 2018), filtration with cost effective adsorbent media is used in this research to recycle grey water which can be used for irrigating the fodder crops and thereby reducing the load to the treatment plant.

II. STUDY AREA

Annamalai University a unitary university covers an area of 950 acres (3.8km2) in Chidambaram Tamil Nadu, India, located at 11°23′27.04″N latitude and 79°42′53.13″E longitude. The university plays a key role in providing access to higher education to thousands of youths cutting across the social spectrum, especially from economically and socially underprivileged classes. Approximately 30000 students are been educated yearly in which nearly 9000 students reside in hostels. Annamalai University has 14 hostels which produce approximately 9 lakhs litres of waste water per day. Moreover, to meet the gardening and the fodder farm it uses roughly 1lakh litre of water daily. Fig. 1 shows the layout map of Annamalai University.

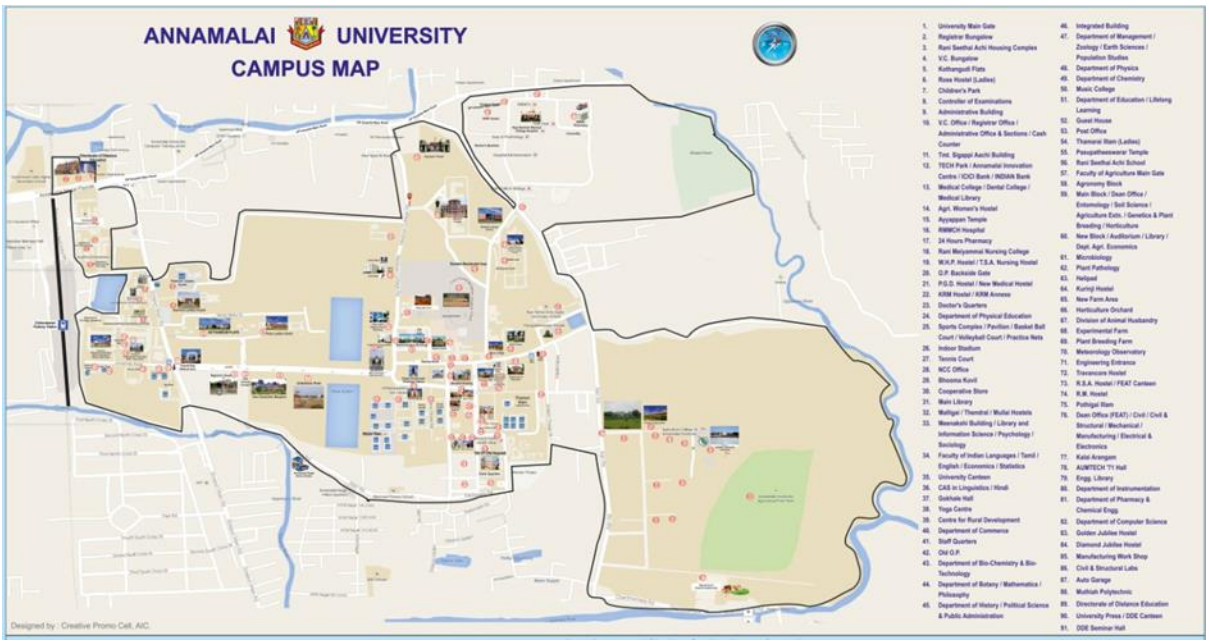

Fig.1 shows the layout map of Annamalai University

III. MATERIALS AND METHODS

A. Materials

All chemicals used were of the highest grade and commonly available. The instruments like COD apparatus, heating oven and vacuum desiccator etc. are used in this study.

B. Preparation of adsorbent

Fly ash available in surplus quantity from the thermal power plant, Neyveli Lignite Corporation (NLC) was used as an adsorbent for the study. It was sieved in 90µm sieve and washed two to three times and then dried for 24 hours and kept in vacuum desiccator. Fig. 2 shows the fly ash sample used as an adsorbent.

Fig. 2 Sample used as an adsorbent

C. Sampling

Grab samples of aqueous untreated effluent from student hostels of Annamalai University, Annamalainagar, Tamilnadu, India was collected and tested for its characteristics as per standard method (APHA, 2005). Grey water samples from the hostel were collected twice in a month and the mean of the value was taken. The sample collected consisted of oils, fats, soap, shampoo and was grey in colour. Fig. 3 shows the collected grey water sample.

Fig. 3 Collected grey water sample.

D. Experimental setup:

Grey water treatment was carried in the laboratory using a reactor made of two containers of 2L capacity placed one above the other with a filter media of 10cm

height fixed within the two containers. The bottom of the filter media was covered by filter mesh of less than .0001micron size. The filter media was filled with fly ash for treating the grey water. The attachments of these containers were completely sealed with sealant to avoid leakage (Al-Hamaiedeh and Bino 2010). The outlet pipe is fixed at the bottom of the lower container to collect the filtered water. Fig. 4 shows the experimental setup of the system to treat the grey water.

Fig. 4 Experimental setup

E. Treatment process

Fly Ash was sieved in 90µm sieve and the retained fly ash was taken up and cleaned with distilled water. The washed fly ash was dried at the room temperature for 24 hours and kept in vacuum desiccator. The processed fly ash was filled in filter media and placed within the two containers.

1500 ml volume of grey water sample was filled in the upper container and permitted to filter through the filter media and collected in the lowermost container. The filtered effluent was collected and tested for its characteristics as per standard method (APHA, 2005) at the Environmental Engineering Laboratory, Department of Civil Engineering, Annamalai University, Annamalainagar, Tamilnadu, India. The treated effluent was analysed for TS (Total Solid), BOD (Biochemical Oxygen Demand), COD (Chemical Oxygen Demand), and DO (Dissolved Oxygen) parameters were measured. Fig. 5 shows the filtration process.

Fig. 5 shows the filtration process

IV. RESULT AND DISCUSSION

Grey water considered as low strength, high volume wastewater with high potential for reuse and application is a wastewater without any contributions from toilet water, Composition of grey water varies, and it is mostly a replication of the lifestyle, the form and choice of compounds used for laundry, cleaning and bathing. The quality of the water supply and the form of dissemination also affect the characteristics of grey water (Gross 2008). There will be substantial disparities in the composition of grey water interns of place and time which may be due to variations in volume of water used. The composition may also be unnatural due to chemical and biological degradations of some composites during the conveyance and storage. Generally, grey water contains high concentrations of easily decomposable organic materials and some basic ingredients which are largely produced from households (Metcalf & Eddy, Inc 2003). These include nutrients such as nitrates, phosphorus and their derivatives, along with certain xenobiotic organic compounds. Table 1 shows the characteristics of grey water obtained at two different sources.

The parameters such as Total Suspended Solids (TSS), TDS, COD, BOD, DO, Na, Total N, Total P and chlorides in the effluents are exceeding the tolerance limits recommended by the Statutory Authorities,

Government of India. Based on the above results, various waste constituents may have to be removed or recovered before discharge or else they may cause interference to the surroundings such as, colour causes aesthetic problems though they may not be particularly hostile for most water uses. Excess suspended solids present in the effluent will cause deposition of solids in inert stretches of a stream and will damage the aquatic life.

Table 1 Characteristics of grey water at various sources

S.No	Parameter*	Bathroom	Kitchen
1	pH	7 - 7.5	7.5-8.9
2	TS	600	650-1132
3	TSS	54 -64	135 - 600
4	TDS	-	300 - 850
5	BOD	125 - 190	75 - 1250
6	COD	225 -350	250 -600
7	Chlorides	156	150 -220
8	Total Nitrogen	11	7
9	Total Phosphorous	2	1
10	Dissolved oxygen	9.5 -10.5	8 - 9
11	Sodium	102	65-145

*All values are in mg/L except pH

A. Treatment of grey water

Management of grey water progresses from simple to extremely complex, when necessary, approaches and expertise are not properly implemented and existing (Zuma et al. 2009). Treatment systems have been used to lessen the level of pollution in grey water Before reprocess or disposal.

The filtered effluent was collected and tested for its characteristics as per standard method (APHA, 2005) at the Environmental Engineering Laboratory, Department of Civil Engineering, Annamalai University, Annamalainagar, Tamilnadu, India. The treated effluent was analysed for TS (Total Solid), BOD (Biochemical Oxygen Demand), and COD (Chemical Oxygen Demand), DO (Dissolved Oxygen), etc and measured. Table 2 shows the results of grey water after filtration. The results revealed that for many parameters there were more than 85% deductions from the original value of the grey water after treatment and for some parameters (BOD, etc) the reduction was very low. The characteristics of the treated effluent reveal that the grey water can be reused for certain domestic purposes such as gardening, firefighting etc.

Table 2 Characteristics of grey water after filtration

S.No	Parameter*	Bathroom	Kitchen
1	pH	7 - 8.5	7.5 - 8.5
2	TS	120	350
3	TSS	12	200
4	TDS	-	200
5	BOD	110	250
6	COD	75	70
7	Chlorides	32	35
8	Total Nitrogen	8	5
9	Total Phosphorous	1	.06
10	Dissolved oxygen	9.5 -10.5	8 - 9
11	Sodium	70	45

*All values are in mg/L except pH

CONCLUSION

Based on the study the following points are been concluded,

- Various treatment methods have been carried out by many researchers, filtration with cost effective adsorbent media is used in this research to recycle grey water which can be used for irrigating the fodder crops.
- The parameters such as Total Suspended Solids (TSS), TDS, COD, BOD, DO, Na, Total N, Total P and chlorides in the effluents before treatment are exceeding the tolerance limits.
- The adsorbent selected for this study is cost effective and is found in abundance in the study area.
- The characteristics of the treated effluent revealed that for many parameters there were more than 85% deductions from the original value of the grey water and for some parameters the reduction was very low.

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