# Grey Water Treatment by using Aloe Vera Plant

Arunima Martin
Department of Civil Engineering,
Jain Institute of Technology, Davanagere.

Anjinappa K T
Department of Civil Engineering
Jain Institute of Technology, Davanagere.

G N Sampathkumara
Department of Civil Engineering,
Jain Institute of Technology, Davanagere.

Chaithra H A
Department of Civil Engineering
Jain Institute of Technology, Davanagere.

Veena G T
Department of Civil Engineering
Jain Institute of Technology, Davanagere.

***Abstract*- The paper briefs an experimental investigation of the usage Aloe Vera plant for treating the grey water produced from Government Boys hostel, Bada cross, Davanagere. Aloe veras are smaller or short stemmed succulent plant which grows up to 60-100 cm of length, spreading through offsets. Researchers proved that Aloe vera plants have phenomenal capability to withstand adverse environmental circumstances. About 200 inmates are there in the hostel considered, as a result of which enormous quantity of grey water is produced everyday in hostel kitchen grey water outlet. A small scale experimental set up is done for treating the grey water generated from the grey water outlet and also the ability of using Aloe Vera plants for treatment is studied. The water quality parameters of grey water and treated grey water were tested and efficiency of Aloe vera plant for treatment is evaluated. The parameters like pH, alkalinity, acidity and BOD is analyzed for the grey water and treated grey water. It was seen that the Aloe Vera plants have the capability to remove about 80% of BOD and nearly all tested parameters are within permissible limits as per IS: 2292-1992 and 10550-2012.**

***Keywords —Greywater, Aloe vera plant, Water Quality Parameters, Biochemical Oxygen Demand(BOD).***

## I. INTRODUCTION

There are several approaches for treating the grey water; more than 50% of the inhabitants in world suffer from fresh water abundance. The paucity of water nowadays affects the agricultural production and can be turned away by using treated grey water for domestic uses and agriculture so that freshwater can be used for drinking and in emergency as a bound.

Aloe Veras are smaller or short stemmed succulent plants growing up to 60-100 cm of length, spreading through offsets which has huge biomass production and also exceptional morphological features. It also resists severe ecological condition, permits extreme levels of nutrients and have been adequately used for treating grey water. The Aloe Vera plant is also been recognized for its unique characteristics which makes it suitable for environmental protection purposes.

Grey water is specifically the wash water. That is sinks, kitchen, dish, bath and laundry water excluding toilet wastes and free garbage-grinder residues. If properly managed, grey water could become a valuable resource which agricultural and horticultural growers as well as home gardeners can get benefit from. It can also be valuable to builders, landscape planners, developers and contractors because of the design and landscaping advantages of on-site grey water management/treatment.

Grey water reuse has been an old tradition in the areas which have been threatened by water and are still being washed out. For the treatment of grey water we have selected Aloe Vera plants because Aloe Vera plant offers sustainable solution for the removal of various pollutants from water. Due to its chemical composition Aloe Vera has been explored as coagulant/flocculent and bio absorbent for water treatment. From the literature it is been observed that the Aloe vera plants have phenomenal capacity to withstand adverse ecological conditions and it consumes huge amount of water amidst its growth. The major intention of the paper is to know the potency of adopting aloe vera plant in treating the grey water produced from the hostel grey water outlet.

## II.OBJECTIVES

1. To analyze the characteristics of grey water of Bada cross Government boy's hostel.
2. To study the efficiency of grey water treatment by using Aloe Vera plants.
3. To compare the parameters that are analyzed in laboratory to BIS irrigation water standards.

## III. MATERIALS AND METHODOLOGY

The grey water required for the experiment was collected from the government boys hostel, Bada cross Davangere, Karnataka, India. About 200 inmates are there in the hostel, as a result of which enormous quantity of grey water is produced everyday in hostel kitchen grey water outlet.

### A. *Materials used*

**Grey water:** Grey water is the used water from bathroom, showers, sinks, tubs, washing machines, etc. which is not in contact with black toilets and urinals. It may contain waste food, traces of dirt, grease, hair, and other household cleaning products[fig 1].


Fig 1: Raw Grey water

**Aloe Vera**: Aloe Veras are short stemmed plant growing up to a height of 60-100 cm (24-39 inches) which are spread through offsets. The leaves are thick and fleshy, green or greyish green in colour.. Aloe Vera is chosen as most preferred plant species because it is capable of absorbing phosphates, nitrates, cholera and dysentery causing bacteria[fig 2].

Fig 2: Aloe Vera plant

**Big Container:** The containers must be used for growing Aloe Vera plants and to store water which is having a capacity of about 75 liters[fig 3].

Fig 3: Container

**PVC Pipes:** PVC (polyvinyl chloride) pipes will be used to make connections for containers to flow water[fig 4].


Fig 4: Pipes for connection

**B. *Observations***

**Filter bed:** In the container a filter bed of coarse aggregate, fine aggregate and soil are placed and above the soil Aloe Vera plants are grown.

**Raw grey water:** Grey water is the water collected from Bada cross Government Boy's hostel and is tested for various water quality parameters in the Jain college laboratory.

**Treated water:** The water collected from the container after keeping it in contact with the Aloe Vera plants for a detention period of 5 days. This treated water is tested in laboratory.

**Course aggregate** : In the filter bed, 40mm down size coarse aggregates have laid as first layer up to a height of 4.5 cm.

**Course aggregate:** In the filter bed, 20mm down size coarse aggregates are laying as second layer up to a height of 4.5cm.

**Sand (1mm & 0.6 micron**): In the filter bed 1mm & 0.6 micron size sand particles are laid as the third layer up to a height of 4.5cm.

**Red soil:** Red soil was laid as the upper layer of the filter bed to facilitate the growth of Aloe Vera plants. Aloe Vera plants are grown for a period of 3 months.

**C. *Experimental Setup***

A small scale experimental set up is made to evaluate the potency of Aloe Vera plant for grey water treatment. The experimental set up is as shown in fig 5, fig 6 below.

Fig 5: Experimental set up of the container

Experimental setup consists of 1 drum of 75 liters capacity and has filled with course aggregate, fine aggregate, red soil. The Aloe Vera plant has planted in to it and has connected in series with different pipe fittings. These containers are connected using PVC pipes having controlling valves and different pipe fittings. The containers are 60 cm in height and are connected to one another with hose having diameter 1 inch. The drum has an outlet and an inlet at a depth of 50 cm from top. Through the roots of the Aloe Vera plant after a detention period of 5 days, the grey water have to be collected from the outlet. The treated water thus obtained from outlet and raw grey water is to be tested for various parameters of water like:

i) pH
ii) Alkalinity
iii) Acidity
iv) BOD.

Fig 6: Experimental setup with Aloe Vera plants grown and in contact with grey water

## IV. RESULT AND DISCUSSION

The raw grey water and treated grey water are analyzed for different parameters i.e. pH, alkalinity, acidity, and BOD. Here the Table 1 depicts comparison of tested parameters of raw grey water and treated grey water.

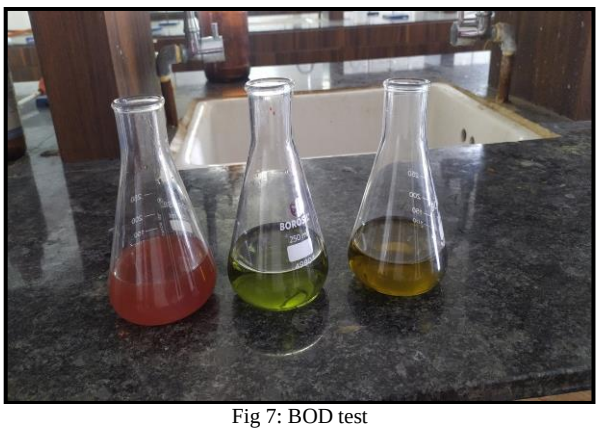

Fig 7: BOD test

TABLE 1: Comparison of Raw Grey Water with Treated Grey Water

| Sl No | Parameters | Raw Grey Water | Treated Grey Water |
|---|---|---|---|
| 1 | pH | 5.65 | 6.05 |
| 2 | Alkalinity (mg/l) | 111 | 110 |
| 3 | Acidity (mg/l) | 70 | 48 |
| 4 | Hardness (mg/l) | 84 | 46 |
| 5 | BOD (mg/l) | 157 | 72 |

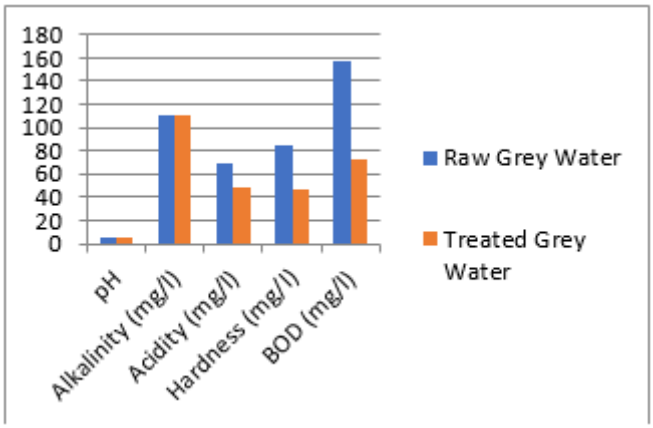


Fig 8: Graphical representation of Raw Grey Water and Treated Grey Water

TABLE 2 - Comparision of Treated Grey Water with BIS Values

| Sl No | Parameters | Treated Grey water | BIS Irrigation water standards as per IS 10500 2012 | BIS Drinking water standards as per IS 10500 2012 |
|---|---|---|---|---|
| 1 | pH | 6.05 | 6.0-7.5 | 6.5-8.5 |
| 2 | Alkalinity (mg/l) | 110 | 75-150 | 200 |
| 3 | Acidity (mg/l) | 128 | 150 | 100 |
| 4 | Hardness (mg/l) | 46 | - | 300 |
| 5 | BOD (mg/l) | 48 | 150 | 5 |

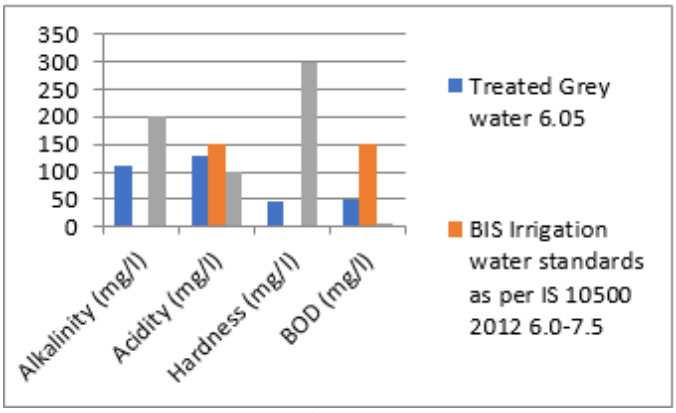


Fig 9: Graphical Representation of BIS Standards and Treated Grey Water

## V. CONCLUSION

The treatment of grey water generated from grey water outlet using Aloe Vera plants have been conducted. The different water quality parameters was analyzed for the raw grey water and treated water, correlated with the standard permissible limits. The results depicted shows that the water quality

parameters tested haven't exceeded limits. The Aloe Vera plant thus has the capability to remove about 80% to 85 % of BOD. The data thus presented in this paper shows that the Aloe Vera plants are the most efficient, cost effective, easily adaptable method for the treatment of grey water.

## REFERENCES

[1] Mini Mathew, Sr. Claramma Rosary, Mathukutty Sebastian,Sandra Maria Cherian, "Effectiveness of Vetiver system for the Treatment of Wastewater from an Institutional Kitchen", Procedia Technology 24:203-209, December 2016.

[2] Simon Jaborning, "Overview and feasibility of advanced greywater treatment systems for single household", In published Taylor and francis 2013.783086, final version received 28 February 2013.

[3] Azni Idris, Wan nor Wan azmin ,Mohd. Amin. Soom, Abdullah-al-mamun, "The importance of sullage treatment in the restoration and conservation of urban streams",J. River Basin Management Vol. IAHR and INBO No.3(2015),pp.223-227.

[4] J Gabarro,L Batchelli ,Marilos Balaguer, Sebastia Puig,"A case study grey water treatment at a sports Centre for reuse irrigation", Water science technology,November 2012.

[5] Fangyue li, "Treatment of household grey water with a IF membrane filtration system"Journal of Membrane Science 446:277-285,November 2013

[6] S.Rai, R.SharmaArora, S.Sharma and A.K. Chopra. "concentration of the heavy metals in Aloe vera . Leaves collected from different geographical locations of India."Annals of Biological Research,2(6),575-579,2011

[7] M.I.Kopytko, E.P.Villamizar, and Y.P.Picon. "Application of Natural Product (Aloe Vera) In Coagulation-Flocculation Procedures, for Water Treatability Study." International Journal of Engineering Science and Innovative Technology(IJESIT),3(3),2014

[8] Ashwini Prabhakar, S.Ojha, N.DAS. "Application of Aloe vera mucilage as bioflocculant for the treated of textile wastewater:process optimization." Water sci.Technol.2020,82,2446-2459.

[9] Lee, K.E.Hanafiah, M.M.Halim, A.A.MahmuD. "Primary treatment of dye waste waterusing Aloe vera-aided aluminium and magnesium hybrid coagulants." Precedio environ. Sci.2015,13,56-61.

[10] H.S.Patil, S.A.Shinde, G.A.Raut, N.P.Nawel, A.Hakke, M.Deosarkar, "Use of Aloe vera gel as natural coagulant in treatment of drinking water." Int .J. Adv. Sci. Res. Eng. Trends 2020,5,81-89.

[11] Jonathan, M.; Srinivasalu, S.; Thangadurai, N.; Ayyamperumal, T.; Armstrong-Altrin, J.; Ram-Mohan, V. Contamination of Uppanar River and coastal waters off Cuddalore, Southeast coast of India. Environ. Geol. 2008, 53, 1391–1404.

[12] Govil, P.; Sorlie, J.; Murthy, N.; Sujatha, D.; Reddy, G.; Rudolph-Lund, K.; Krishna, A.; Mohan, K.R. Soil contamination of heavy metals in the Katedan industrial development area, Hyderabad, India. Environ. Monit. Assess. 2008, 140, 313–323.

[13] Raju, N.J.; Ram, P.; Dey, S. Groundwater quality in the lower Varuna river basin, Varanasi district, Uttar Pradesh. J. Geol. Soc.India 2009, 73, 178–192.

[14] Kurniawan, T.A.; Lo, W.; Chan, G.; Sillanpää, M.E. Biological processes for treatment of landfifill leachate. J. Environ. Monit. 2010, 12, 2032–2047.

[15] Cesaro, A.; Naddeo, V.; Belgiorno, V. Wastewater treatment by combination of advanced oxidation processes and conventional biological systems. J. Bioremediat. Biodegrad. 2013, 4, 1–8.

[16] Amuda, O.; Alade, A. Coagulation/flflocculation process in the treatment of abattoir wastewater. Desalination 2006, 196, 22–31.

[17] El-Gohary, F.; Tawfifik, A.; Mahmoud, U. Comparative study between chemical coagulation/precipitation (C/P) versus coagulation/dissolved air flflotation (C/DAF) for pre-treatment of personal care products (PCPs) wastewater. Desalination 2010, 252.