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VALUABLE RESOURCE MANAGEMENT:- CONCEPT & DESIGN OF GREY WATER TREATMENT UNIT

MISS. RATIKA V. MAHALLE , MISS RUSHALI P.WADE, PARMESHWAR KHARATE , PRASHANT BISWAS , SURESH MOTGHARE, PROF. ABHINANDAN R. GUPTA

Dept. Of Civil Engg. , C.O.E.T, Akola.

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Abstract: Grey water is waste water from baths, showers, sinks and wash basins. It may be considered as a source of water for various uses other than drinking after its proper treatment. This study examines the effects of household grey water treated with locally available peat soil. This study was performed by using a filter media (peat soil + sand + gravel + charcoal). Removal efficiency of the grey water effluent was found to be TSS-81%, BOD- 54%, COD 52% and PH of the grey water was improved from acidic (4.6) to neutral (6.9).Depending on the type of grey water and its level of treatment, it could be reused on-site for landscape water, irrigation; toilet flushing and road sprinkle etc. Grey water use is important because it restricts fresh water demand and reduces stress on treatment system and saving of approximate 70% per capita can be achieved which reflects globally for population The need, importance and status of the grey water use in the perspective of India have been discussed.

Keywords: Model, Grey Water, Filter Media, Peat Soil, Sand, Gravel, Charcoal

Corresponding Author: PROF. ABHINANDAN R. GUPTA

Co Author: MISS. RATIKA V. MAHALLE, MISS RUSHALI P.WADE, PARMESHWAR KHARATE, PRASHANT BISWAS, SURESH MOTGHARE

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INTRODUCTION

Increase in world population and urbanisation leads to the decrease in available resources . Neither the growth or population can be stopped nor can the use of essential resources be stopped. But only the method and mentality can be changed for sustainable management of such resources, so that future generations to come can be benefited from such resources. Water is one such resource whose optimum utilization is necessary now. Depletion of water resources due to high water demand and pollution, makes governments and regulating bodies worldwide to develop new ways to conserve water resources, and reclaimed water use is one of the key methods being considered. Reclaimed water is wastewater originating from commercial, industrial or residential activities that has been treated or renovated to an acceptable standard for specific uses. Before being reused, grey water is generally treated, using a variety of treatment technologies of varying sophistication, to a quality where it can be reused for other applications such as subsurface and landscape irrigation, car washing, street cleaning or toilet flushing. There are a number of technologies available to treat the grey water for specific reuse applications. The use of wastewater recycled requires a proper sustainable & manageable approach.

Aim:- To reduce water demand supply gap.

Objective:-

1. By reducing domestic water demand
2. By reusing & recycling bathroom, utensils water (gray water)

1.2 What is grey water?

Water is used for various domestic purpose like washing, drinking, flushing, cooking, bathing watering lawns etc. all this water of use is termed as wastewater which is a mixture of all water discharges within the household including bathroom sinks, bathtubs, toilets, kitchen sinks, and laundry wash-water sources. This wastewater is characteristically divided into three sub-categories related to the organic strength or level of contaminants typically contained in the water: black water; dark-grey water, and light-grey water. Black water comes from toilets and contains high concentrations of disease causing microorganisms and high levels of organic contaminants. Dark-grey water primarily originates from kitchen sinks, which can also contain disease-causing microorganisms and have high levels of organics contaminants from food waste and grease/oils. Light-grey water typically consists of drainage from bathroom sinks, tubs, showers, and often laundry. It can also contain disease causing microorganisms but they are usually in much lower numbers than the other two wastewater categories. Although light-grey water is generally also considered to have lower concentrations of organic contaminants than the other two wastewater subcategories, the level of organic contaminants can be comparable to the other two depending on the circumstances Typically, 50-80% of the household wastewater is grey water. If a composting toilet is also used, then 100% of the household wastewater is grey water.

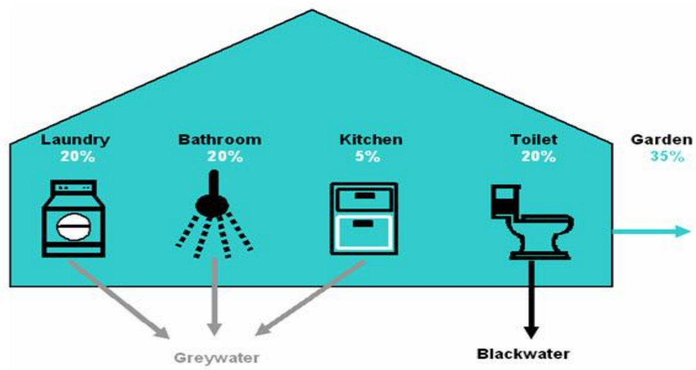

Fig 1: Major grey water sources

2. Average Domestic Water Consumption in India

As per IS 1172 Per Capita Water Demand is 135 litres.

3. Necessity of Grey water Recycling

Use	Consumption in Litres/day/person
Drinking	5
Cooking	5
Bathing	55
Washing of clothes	20
Washing of utensils	10
Washing & cleaning of Houses	10
Flushing of Latrines	30

The main purpose of grey water recycling is to substitute the precious drinking water in applications which do not require drinking water quality. Non-potable reuse applications include industrial, irrigation, toilet flushing and laundry washing dependent on the technologies utilised in the treatment process. With grey water recycling, it is possible to reduce the amounts of fresh water consumption as well as wastewater production, in addition to reducing the water bills. If grey water is regarded as an additional water source, an increased supply for irrigation water can be ensured which will in turn lead to an increase in agricultural productivity. Unlike rainwater harvesting, grey water recycling is not dependent on season or variability of rainfall and as such is a continuous and a reliable water resource. This results in smaller storage facilities than those needed for rainwater harvesting. Grey water has a relatively low nutrient and pathogenic content and therefore, it can be easily treated to high-quality water using simple technologies such as sand/gravel filters and constructed wetlands (planted soil filters).

There are four reasons why grey water may need to be recycled:

1. To remove substances which may be harmful to plants.
2. To remove substances which may be harmful to human health.
3. To remove substances which may be harmful to the wider environment.
4. To remove substances which may be clog the grey water system.

4. Methodology

With the proper inlet provision of waste water such that avoid direct scoring action, water is passed in treatment unit. Unit consist of various layers on the basis of void ratio. Various layers are used are as follows.

Layer 1:- plant enrooted in the soil. Purpose:- to hold the soil & decompose organic impurity if any

Layer 2: - fine sand is acting as dense filtration media followed by

Layer 3:- made up of coarse gravels or pebbles.

Layer 4:- is of char-coal, to absorb impurity & turbidity,

Layer 5:- is the drainage layer, so as to drain treated water up to outlet unit. Out late unit is a chamber with the provision of stock head so as to balance fluctuation of water filtration rate.

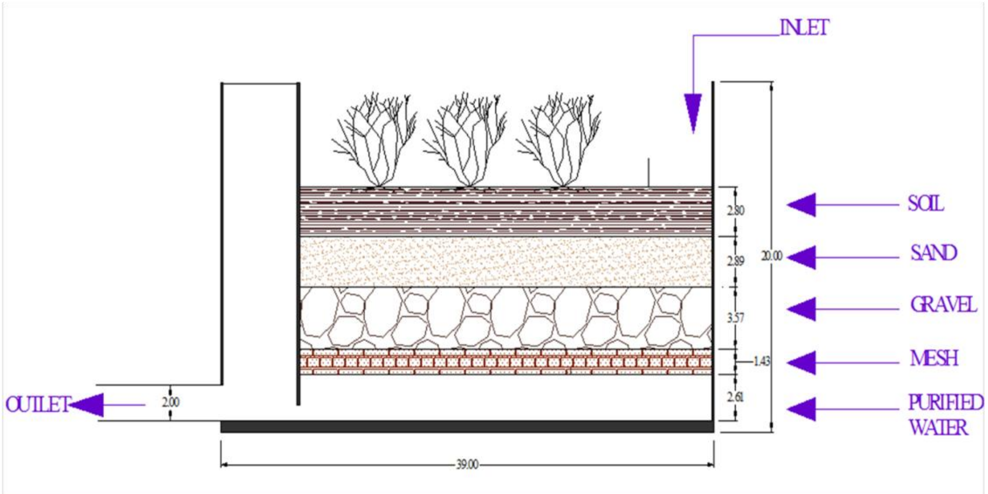

Fig 2. Grey water treatment process

Photo:- Working Model

5. Test Conducted

5.1 Physical test:- It includes following tests:

5.1.1 Temperature:

The temperature of water is measure by means of ordinary thermometers. From the temperature density, viscosity, vapour pressure & surface tension of water can be determined. The saturation value of solids and gases that can be dissolved in water and rates of chemical and biological activity are also determined on the basis of temperature. The most desirable temperature for public supply is between 10˚C to 15.6˚C .Temperature above 26˚C are undesirable above 35˚C are unfit for public supply, because is not palatable.

5.1.2 Turbidity:

It is due to presence of suspended and colloidal matter in the water. The character and amount of turbidity depends on the types of soil over which the water has moved .Ground water is generally less turbid than the surface water.

Units:-

Turbidity was previously determined by Jackson's candles turbidity units(JTU).This units is not replaced by more appropriate unit called 'Nephelometric Turbidity Unit' or (NTU).Turbidity is measured of the resistance of water to passage of light through it. Turbidity is expressed in parts per million (PPM). The turbidity produced by one milligram of silica in one litres of distilled water is unit of turbidity. In other word turbidity produced by one parts of finely divided silica in million parts of distilled water as a standard unit. Turbidity of water is determined by various methods.

1. By turbidity rod or tape
2. By Jackson's turbidity meter
3. By Baylis turbidity meter
4. Helige turbidity Meter
5. Hach Laboratory turbidity meter

5.2 Chemical Test: It includes following tests:

5.2.1 PH Value:-

Depending upon the nature of dissolved salts and minerals, the water found in neutral, acidic or alkaline. The acidity or alkalinity is usual measured in p.p.m. of dissolved salts and express in terms of equivalent weight of calcium carbonates. When acids alkalis are dissolved in water they dissociates into electrically charged ions of hydrogen & hydroxyl resp. Hydrogen ions are charged with positive whereas hydroxyl ions charged with negative charge. For pure water PH is 7.

Table:- PH Scale

0 to nearly 7	Exact 7	Slightly above 7 to14
Acidic range	Pure Water	Alkaline range

Determination of PH value:

The PH value of water is determined by Chorimetric method or Electrometric method some indicator is added in the sample of water and colour so formed has comp aired with standard colour disc.

5.2.2 Total Solids:-

These includes the solids in suspensions, colloidal and dissolved form. The quality of suspended solids is determined by filtering the the samples of water through a fine fillers drawing and weighing. The quantity of dissolved and colloidal solids is determined by evaporating the filtered water (obtained from suspended solid test) and weighing the residue. The total solids in the water sample can directly determined by evaporating water and weighing the residue. If the residue of total solids is muffler-furnace the organic solids will decompose whereas only organic solids will remains. By weighing we can determine the inorganic solids and deducting it from total solids, we calculate organic solids.

5.2.3. Hardness:

It is the property of water that prevents the lathering of soap. It is caused due to the presence of carbonates and sulphates of calcium & magnesium in the water. Hardness is usually expressed in mg/litres or ppm of calcium carbonates in water. Hardness is generally determined versenate method. In this method, the water is treated against EDTA salts solutions using Erio-chrome black T as indicator solution. While titrating the colour from wine red to blue. In the past hardness was determined by soap test, in which the standards of solutions was added in the water & it was vigorously shake to see the information of lather for 5mins. The hardness of water was calculated on the basis of soap solution added and lather factor.

6. OBSERVATIONS

Summary of grey water quality before and after treatment with natural filter media.

SR.NO	Standard Test	Acceptable Value	Before Treatment Observed Value	After Treatment Observed Value
1.	**Physical Test**			
	Temperature	10˚C to 15.6˚C	36˚ C to 38˚C	30˚C to 32˚C
	Turbidity	5.0 to 10 (NTU)	32.0 (NTU)	14.0 (NTU)
2.	**Chemical Test**			
	PH	6.5 to 8.0	5.2 to 6.0	6.6 to 6.8
	Total Solids	Upto 500 ppm	2000 ppm to 2400 ppm	750 ppm to 850ppm
	Hardness	75 to 115 ppm	160 ppm to 200 ppm	110 ppm to 130ppm

Parameters	Grey water Concentration (mg/l)					
	1st Day		7th Day		14th Day	
	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
BOD	75mg/l	61mg/l	72mg/l	48mg/l	67mg/l	37mg/l
COD	149mg/l	122mg/l	143mg/l	98mg/l	128mg/l	73mg/l

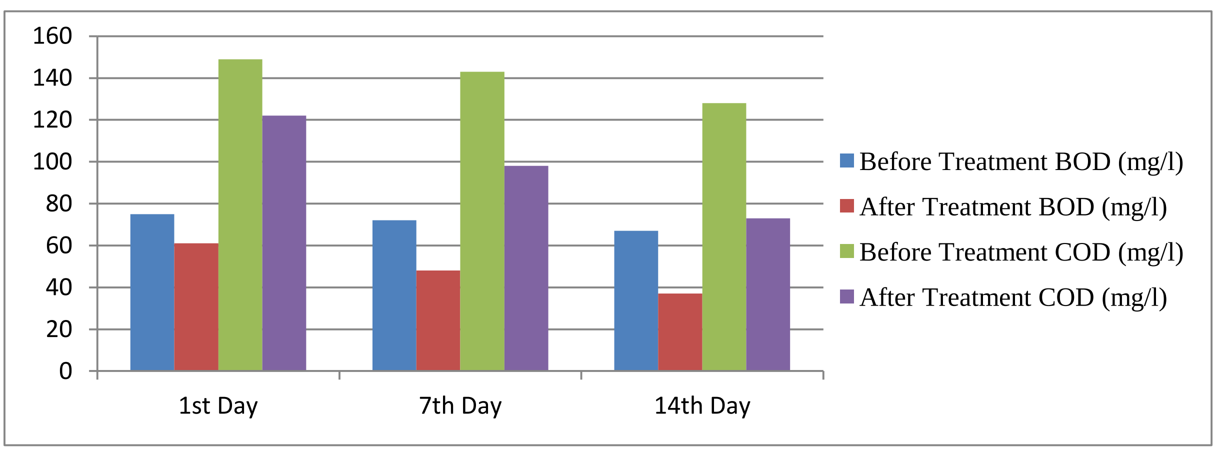

Fig 3. BOD and COD Concentration Before & After Treatment

7. Advantages of grey water recycling

- The obvious key advantage of domestic grey water use is that it replaces or conserves potable water use, and can reduce the cost of potable water supply.
- Appropriately applied, grey water may contain nutrients (e.g. phosphorus and nitrogen from detergents), benefiting plant growth and resulting in more vigorous vegetation.
- Offers potential cost reductions for regional sewage treatment facilities. Removing grey water from residential wastewater drainage to sewer decreases the flow through the sewer and to the treatment plant and enables the existing infrastructure to service more connections.
- Grey water reuse applications require limited or no treatment, and where the grey water otherwise would have to be pumped to a centralized treatment plant and treated.
- Grey water could supply most, if not all, of the irrigation needs of a domestic dwelling landscaped with vegetation in a semiarid region.
- In addition to applications for outside irrigation, grey water can also be used for toilet flushing and, if treated to an advanced secondary or tertiary level, can also be used for a wide range of domestic water uses including bathing, showering, and laundry
- Grey water treatment reduces the volume of wastewater that must be diverted to more costly sewage and septic treatments
- Grey water is rich in phosphorous, potassium, and nitrogen, making it a good nutrient or fertilizer source for irrigation
- Grey water diversion is particularly well-suited for small-scale or decentralized wastewater systems and can be implemented in either a rural or urban setting

8. Disadvantages of Grey Water Recycling

- Less energy and chemicals are used due to the reduced amount of both freshwater and wastewater that needs pumping and treatment. Grey water may contain sodium and chloride, or other chemicals that can be harmful to some sensitive plant species. Additionally, grey water is alkaline (high pH) and shouldn’t be used to irrigate acid-loving plants such as rhododendrons or azaleas

- Resulting diminished sewer flows from domestic grey water could potentially result in insufficient sewer flows in some circumstances to carry waste to the sewer plant (e.g. pipes with low slopes), or may result in a high strength sewage that combined with lower flow may lead to odour and corrosion problems in the centralized sewerage systems

- Concern regarding the public health implications of grey water reuse and the need for research to determine the risks of grey water reuse

- Cost of treatment and diversion/transfer pipe & pumps.

9. Economic aspects & Cost Analysis

The two key capital cost components for grey water systems are for treatment and dual plumbing. In general, the costs for a grey water system can be classified as follows:(1) design costs and permit fee, (2) installation costs, (3) operation and maintenance costs. The design costs depend greatly on the suitability of the site and the complexity of the system. If grey water reuse becomes a legal practice, it would be expected that a permit would be necessary to construct an appropriate system and that there would be a fee. The installation costs would include materials and labour. These would be site and system specific. In some cases the owner might prefer to do part of the work, but for some specific components of the system a licensed specialist (plumber and/or electrician) would be required. The operating costs include electricity, disposable filters, and disinfectants. For systems with pumps and other ancillary equipment it may be necessary to meet the cost of repair or replacement parts. Cost of Grey Water treatment Plant depends upon Materials (plastic , glass, or Fibres).It is possible to prepare only 65 Rs/- **Material** :- Waste Battery Box, P.V.C. Pipes

10. CONCLUSION

Above discussion shows that the reuse of wastewater will not only save the money but also it retains the natural resources and helps to develop a sustainable environment. The scarcity of fresh water is increasing day by day. For the development of urban infrastructure, it is essential to have wastewater reuse for non- potable application since it will be very difficult to provide the huge water requirement for the developmental projects through local water supply authorities. Per capita domestic demand is 135 litres, out of which 120 litres can be treated & reused. this 120 litres can provide at least 100 litres treated water available for reuse except for drinking purpose. Purification depends upon purpose of treatment, thus saving of approximate 70% per capita can be achieved which reflects globally for population of 128 billions water demand only for domestic consideration is172 billions litres and saving of 130 billions litres will be achieved.

REFERENCE

1. Radin Maya Saphira Radin Mohamed. "The Use of Natural Filter Media Added with Peat Soil for Household Grey water Treatment". GSTF International Journal of Engineering Technology (JET) Vol. No 2 , 4 April 2014.

2. Abhinandan R. Gupta. "A step towards Sustainable Water Managements-Grey water resuse".www. civil engineering portal.com

3. H.E. Muga, & J.R. Mihelcic, "Sustainability of wastewater treatment technologies," Journal of Environmental Management. 88 (3), pp. 437- 447.2008.

4. R.M.S.R. Mohamed, A.H.M. Kassim, M. Anda, S. Dallas, "A monitoring of environmental effects from household greywater reuse for garden irrigation," Environmental monitoring and assessment. 185 (10), pp. 8473-8488.2013.

5. R.M.S.R. Mohamed, C.M. Chan, H. Ghani, M.A.M. Yasin, A.H.M. Kassim, "Application of Peat Filter Media in Treating Kitchen Wastewater," International Journal of Zero Waste Generation 1 (1), pp. 11-16. 2013.

6. H. Palmquist & J. Hanæus, "Hazardous substances in separately collected grey-and blackwater from ordinary Swedish households," Science of the Total Environment. 348(1-3), pp. 151-163.2005.

7. F.E. Tang, A.H. Tan & C.L.I. Ho, "Wastewater treatment systems for small cities in Sarawak". In Conference on Sustainable Building South East Asia. Malaysia

8. S. Deboucha, H. Roslan, and A. Alwi. "Engineering Properties of Stabilized Tropical Peat Soils," Journal of Geotechnical Engineering, 13, University of Malaya, Malaysia. 2008.

9. E.C. Leong & C.Y. Chin, "Geotechnical characteristics of peaty soils in southeast asia," Nanyang Technological University, School of Civil & Structural Engineering, Singapore. 1997.

10. P.A. Brown, S.A. Gill, & J.J. Allen."Metal removal from wastewater using peat," Water Research, 34 (16), pp. 3907-3916. 2001.

11. M. Kõiv, R. Mõtlep, M. Liira, K. Kirsimäe and U. Mander, U. "The performance of peat-filled subsurface flow filters treating landfill leachate and municipal wastewater". Ecological Engineering, 35 (2), pp. 204–212. 2009.

12. J.B. Xiong, and Q. Mahmood. "Adsorptive removal of phosphate from aqueous media by peat". Desalination. 259 (1-3):59-64. 2010.

13. CM Chan, RMSR Mohamed. "Post-Filtration Compressibility Characteristics of Peat Used as Greywater Filter Media," Middle-East Journal of Scientific Research, 17 (5), pp. 647-654. 2013.

14. I. Ali, M. Asim & T.A. Khan. "Low cost adsorbents for the removal of organic pollutants from wastewater," Journal of Environmental Management. 113 (2012), pp. 170-183. 2012.