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CHARACTERISATION OF GREYWATER & POLLUTANT LOAD FOR RESIDENTIAL BUILDING – ECONOMIC ANALYSIS

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ABSTRACT

Water is a resource that has no substitute. Even though water covers three quarters of the planet, 97% of the Earth's water is saline water, and thus useless for drinking and other purposes. Less than 3% of water is fresh water. In the recent years, many events have occurred which point towards the decreasing fresh water resources of the world. As the needs for water increase in agriculture, industry and households with the increase in cities and populations the problem is getting worse globally. This situation necessitates that the need of conservation of water be understood and put into practice. Therefore it is essential to reduce surface and ground water use in all sectors of uses and to substitute fresh water with alternative and to use water efficiently through reuse options. Rainwater and Greywater are good alternative resources. Rainwater Harvesting is one of the most useful options of water conservation but it has some limitations such as it is only useful in the area where rainfall occurs. Greywater recycling is the viable option that can be very useful in the water arid areas. The aim of the study is to implement a grey water-recycling scheme at Household level. Since the intended use of water is for irrigation and toilet flushing, the required treatment standards are therefore less stringent as compared to that for drinking purposes. The treatment methods would never the less depend on the quality of grey water.

Keywords: Greywater, Household Level, Irrigation, Low Cost Scheme, Physicochemical Treatment Processes, Recycling, Toilet Flushing.

I. INTRODUCTION

As pressures on freshwater resources grow around the world and as new sources of supply become increasingly scarce, expensive, efforts are underway to identify new ways of meeting water needs. Special efforts are to be taken to reduce water demand by increasing the efficiency of water use and to expand the usefulness of alternative sources of water which was previously considered as unusable. Among these potential new sources of supply is "Greywater." India is facing a problem of water crisis and by 2025 it is estimated that India's population will be suffering from severe water scarcity. With increased population growth and development, there is a need to critically look at alternative approaches to ensure water availability. These alternative resources include rainwater and bulk of water used in household will emerge as grey water and contain some minerals, organic waste materials dissolved and suspended in it. The main goal of this project is to propose some efficient, cheap and sustainable grey water treatment systems for households. The treated grey water can be used for non-potable use purposes such as irrigation, toilet flushing, car washing and dust control as well as

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to recharge the aquifers. The imbalance between water demand and supply has become a significant concern of human life as demand is increasing exponentially. So implementation of alternative water supply options has become an need for urban water management. There are various kinds of grey water treatment systems around the world. A review of those processes has been done to identify the best suited processes at household and community level. Septic tank, constructed wetland and intermittent sand filter are identified as the most suitable processes for decentralized treatment due to the simple operation and maintenance facilities as well as cost effectiveness of these systems. The use of gray water is becoming more and more common, especially in areas where water resources are scarce. The use of grey water is, therefore, the last option for the water conservation. Grey water use is important because it restricts fresh water demand and reduces stress on treatment system.

Greywater is specifically wastewater from bathroom, dishwasher, and laundry water excluding toilet wastes. When properly managed, greywater can be a valuable resource for horticultural and agricultural growers as well as home gardeners can benefit from it. It can also be valuable to landscape planners, builders, developers and contractors because of the design and landscaping advantages of on-site greywater treatment.

In many utility systems around the world, greywater is combined with black water in a single domestic wastewater stream. Yet greywater can be of far higher quality than black water because of its low level of contamination and higher potential for reuse. When greywater is reused either on- site or nearby, it has the potential to reduce the demand for new water supply, reduce the energy and carbon footprint of water services, and meet a wide range of social and economic needs. In particular, the reuse of greywater can help reduce demand for more costly high-quality potable water.

By appropriately matching water quality to water need, the reuse of greywater can replace the use of potable water in non-potable applications like toilet flushing and landscaping. A greywater system, on the other hand, captures water that has been used for some purpose, but has not come into contact with high levels of contamination, e.g., sewage or food waste. This water can be reused in a variety of ways. For instance, water that has been used once in a shower, clothes washing machine, or bathroom sink can be diverted outdoors for irrigation. In this case, the demand for potable water for outdoor irrigation is reduced and the streams of wastewater produced both by the shower, washing machine, and sink are reduced. When the systems are designed and implemented properly, possible public health concerns with using different water qualities can be addressed. Attention to public health impacts of water reuse is also important in scaling up greywater solutions in areas where regulations around water reuse are not well enforced.

In many places throughout the world, lower income communities live without access to a household water connection. In these communities, women and children often have to walk long distances or wait in line in order to access water which then needs to be carried home. In these households, the water that is brought to the home is highly valuable because of the amount of labor invested and the cost relative to household income. These households often reuse water in the home and for household gardens or horticulture. Greywater reuse offers a variety of opportunities and challenges. And greywater technologies, uses, and policies vary widely around the world.

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II. COMPOSITION OF GREYWATER

Greywater Source	Contents
Automatic clothes washer	Suspended solids i.e. dirt, organic material. Oil and grease, sodium, nitrates and phosphates (from detergent), increased salinity and pH, bleach.
Automatic Dishwasher	Organic material and suspended solids (from food), bacteria, increased salinity and pH, fat, oil and grease, detergent.
Bathtub and shower	Bacteria, hair, organic material and suspended solids (skin, particles, lint), oil and grease, soap and detergent residue.
Sinks, including kitchen	Bacteria, organic matter and suspended solids (food particles), fat, oil and grease. Soap and detergent residue.

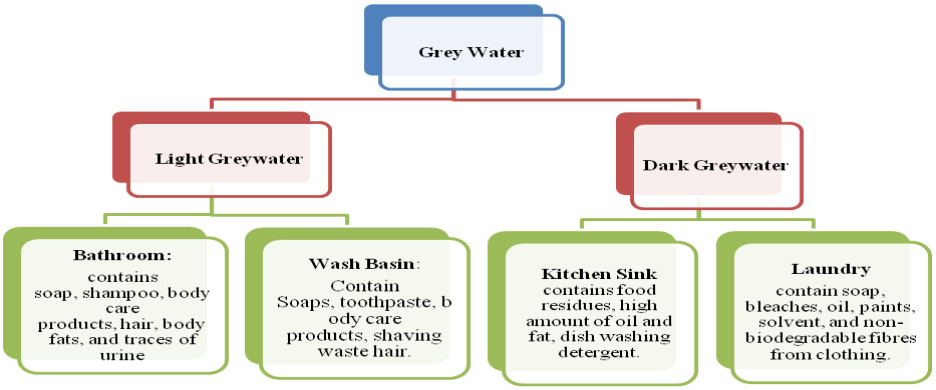

Fig. 1 Classification Of Greywater

III. QUANTITY OF GREYWATER PRODUCE

No.	Source of waste water	Quantity /day/capita
1	Bathroom	20-25 liters
2	Kitchen	10-15 liters
3	Laundry or washing machine	50-60 liters
4	Hand Wash basin	5-10 liters

Fig.2 Pollutant Load From Various Sources

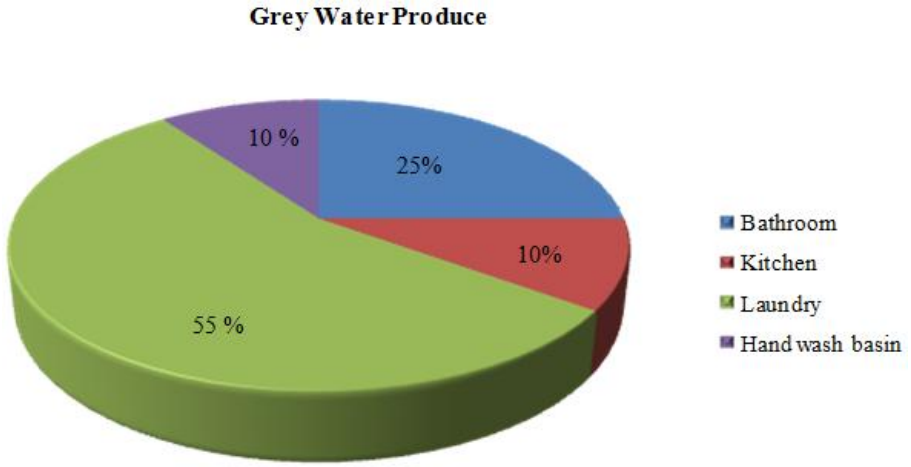

Fig. 3 Quantity of Greywaterproduce

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IV. CHARACTERISTICS OF GREY WATER

Type	Parameters	Wash Basin	Bathroom	Laundry/Washing machine	Kitchen sink
Physical	Turbidity	180.1	197.7	145	176.3
	Total Solids	156.2	180.8	290.1	360.6
	Total suspended solids	90.3	125.6	135.6	325.4
	Total dissolved solids	65.9	55.2	154.5	35.2
Chemical	pH	7.6	7.5	9.4	9.9
	BOD	45.7	43.2	59.1	87.8
	COD	225.3	250.5	378.2	424.7
Nutrient	E.coli	8	56.7		84.3

Fig. 4 Table Qualitative Characteristics Of Greywater Produce From Different Sources

V.GREYWATER TREATMENT METHODOLOGIES

Grey water treatment methodologies range from simple low-cost devices that divert grey water to direct reuse, such as in toilets or outdoor landscaping, to complex treatment processes incorporating sedimentation tanks, bioreactors, filters, pumps, and disinfection.

VI. GREYWATER TREATMENT SCHEME

Step 1Primary treatment

This includes (Screening of greywater) to remove the floating materials.

Step 2Secondary treatment - I

This includes (Gravel Filter, Sand Filter) to remove the turbidity and suspended solids.

Step 3 Secondary treatments – II

This includes (Broken Brick, Charcoal) to remove the Color and some amount of BOD.

VII. DETAILS OF GREYWATER TREATMENT SYSTEM

Water used per day	13000 to 15000 L/day
Treatment	Sedimentation and physical treatment
Uses	Floor washing, gardening
Cost on Construction	Rs. 2100
Cost on material	Rs. 9066.66
Water saving per year	1248000 L/year

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VIII.CASE STUDY

We have done a case study on 30 row houses society. Each row house has say 5 person on an average.

Average consumption of fresh water is 90 liters/day/person

Hence total freshwater required shall be 90 x 5 x 30 = 13500 liters/day.

The cost of municipal water is say 55 Rs/1000 liters.

Daily water bill = 13500 x 55/1000 = Rs 742.5/day.

Which is Rs. 271012.5/year.

There will be charges for disposal on sewage. We can avoid this if we recycle the Greywater.

If Greywater Recycling system is installed, smaller sewage treatment plant is also adequate.

IX.CONCLUSION

The present study shows that there is large variation in the generation and characteristics of greywater. Greywater is less polluted compared to the black water so it can be treated efficiently by separating it from the source of origin. Though GW is not very polluted but it should be treated to avoid infertility of soil and to avoid ground water pollution. The benefits of greywater recycling include: Reduced use of freshwater, less strain on septic tanks or treatment plants, more effective purification, reduced use of energy, Groundwater recharge, and .Saving water per day.Greywater can be reused for toilet flushing, gardening, washing floors etc.

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