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# Reduce, Reuse and Recycle of Greywater

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***Abstract*— Water is becoming a rare resource in the world. In India alone the International Water Management Institute (IWMI) predicts that by 2025, one person in three will live in conditions of absolute water scarcity (IWMI, 2003). Although India occupies only 3.29 million km$^2$ geographical areas, which forms 2.4% of the world's land area, it supports over 15% of world's population. Where will India get its water from in the coming years? The water challenge is already grave and could get graver.**

**To solve water problem there is need to find new resources of water but we cannot generate new resources but we can utilize waste as resource. So greywater can be utilized as a resource. This study is based on 3R- Reduce, Reuse and Recycle of Greywater.**

***Keywords*— *Greywater, 3R- Reduce, Reuse and Recycle, waste water***

## I. INTRODUCTION

The concept of Reduce, Reuse and Recycle are three tools for sustainable development. Sustainable development is "development that meets need of present without compromising the ability of Future generation to meet their own needs." It is essential to find new sources but we cannot generate new sources, optimization of the resources can be one of the remedial measures.

## II. CONSUMPTION OF WATER FOR DOMESTIC AND PUBLIC USE

Major consumer of potable water is domestic sector. It is clear
From following tables

TABLE I. PER CAPITA DEMAND OF VARIOUS TOWNS AS PER POPULATION

| Sr. No. | Population of the Town | Per capita Demand |
|---|---|---|
| 1. | Up to 20,000 | 110 liters/day/capita |
| 2. | 20,000 – 50,000 | 110 – 150 liters/day/capita |
| 3. | 50,000 – 2,00,000 | 150 – 180 liters/day/capita |
| 4. | 2,00,000 – 5,00,000 | 180 – 210 liters/day/capita |
| 5. | 5,00,000– 10,00,000 | 210 – 240 liters/day/capita |
| 6. | Above 10,00,000 | 240 – 270 liters/day/capita |

TABLE II. PUBLIC DEMAND

| Sr. No. | Purpose | Water requirements |
|---|---|---|
| 1. | Public parks | 1.4 liters/m²/day |
| 2. | Street washing | 1.0-1.5 liters/m²/day |
| 3. | Sewer cleaning | 4.5 liters/head/day |

TABLE III. CONSUMPTION OF WATER AS PER INDIAN STANDARD OF LIVING FOR DOMESTIC

| Use | Consumption in liters/day/person |
|---|---|
| Drinking | 5 |
| Cooking | 5 |
| Bathing | 55 |
| Washing of clothes | 20 |
| Washing of Utensils | 10 |
| Washing and cleaning of houses and residences | 10 |
| Flushing of Latrines etc. | 30 |
| TOTAL | 135 |

Water requirement calculation

If there is a family of 6 members then per year demand of water

= Number of members*per capita demand/day *365 days

= 6*135*365

= 295650 liters/year

## III. WASTE WATER

Domestic waste water is waste water from various units of house. Domestic wastewater is the water that has been used by a community and which contains all the materials added to the water during its use. It is thus composed of *human body wastes* (feces and urine) together with the water used for flushing toilets, and *sullage*, which is the wastewater resulting from personal washing, laundry, food preparation and the cleaning of kitchen utensils

TABLE IV. BLACK WATER AND GREY WATER

| BLACKWATER | LITRES/PERSON/DAY |
|---|---|
| Toilet | 30 |
| GREYWATER | LITRES/PERSON/DAY |
| Cooking | 5 |
| Bathing | 55 |
| Washing Cloths | 20 |
| Washing Utensils | 10 |
| Washing and cleaning of houses | 10 |
| Approximately Total Greywater | 100 |
| Approximately Total Wastewater | 130 |
| If we consider a family of 6 members then Approximately total waste water generated by family per day= (6*130)= | 780 |

- Near about 90% of per capita demand water is wasting i.e. 130 lit/person/day
- Out of which 95 lit/day(per person) can be effectively reuse
- If we cosider family of 6 members
- Then family can reuse water 570 lit/day

Domesic Waste water can be divided as-

### *A. Black Water*

Blackwater is water that has been mixed with waste from the toilet. Black water requires biological or chemical treatment and disinfection before re-use and after all these treatment there is no guarantee of safe reuse of water. It cannot treat completely and hence it is not safe and economical to reuse.

### *B. Grey Water*

Greywater is all water from sinks, shower, bath; laundry machine etc. water is all from domestic-basically anything but not toilet water. Water recycling of greywater uses various household system and methods and the water is used to flush toilets, irrigation cleaning and cloth washing. As pressures on freshwater resources grow around the world and as new sources of supply become increasingly scarce, expensive, or politically controversial, efforts are underway to identify new ways of meeting water needs. Of special note are efforts to reduce water demand by increasing the efficiency of water use and to expand the usefulness of alternative sources of water previously considered unusable. Among these potential new sources of supply is "greywater". Greywater, defined slightly differently in different parts of the world, generally refers to the wastewater generated from household uses like bathing and washing clothes. This wastewater is distinguished from more heavily contaminated "black water" from toilets. In many utility systems around the world, greywater is combined with black water in a single domestic waste water 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 onsite 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.

## IV. REUSING GREYWATER FOR INDOOR

Appropriately treated greywater can be re-used indoors for toilet flushing and clothes washing. Toilets and clothes washers are two of the biggest users of water in an average household.

- Reusing treated greywater for toilet flushing can save approximately 50L of potable water in an average household every day.
- Reusing treated greywater in your clothes washer can save approximately 90L of potable water in an average household every day.
- In order to re-use greywater indoors for Toilet flushing and clothes washing will need firstly:
- Separate greywater and blackwater waste streams.
- Install a greywater treatment and disinfection system so it provides a suitable level of treatment and meets local regulations.

## V. TYPES OF GREY WATER

Grey water comes from various sources. "It is the household waste water that has not come in contact of toilet waste and it includes the wastewater from bathtubs, showers, clothes washers and laundry tubs". There are two types of grey water.

1. Light grey water,
2. Dark grey water

automatic dishwashers etc. Clothes Washer contains bacteria, bleach, foam, high pH, hot water, nitrates, oil and grease, salinity, soaps, sodium and suspended solids. Bathtub and Showers contains bacteria, hair, hot water, odour, oil and grease, soaps, and suspended solids. Sink contains bacteria, food particles, hot water, odor, oil and grease, organic matter, soaps, high pH and sodium from dishwasher, and suspended solids.

Various Test which are performed on greywater their Results and Standard Parameters of Drinking Water are as follows

TABLE V: TEST RESULTS AND STANDARD PARAMETERS OF DRINKING WATER

| SR. NO. | PARAMETER | RESULTS | DESIRED LIMIT |
|---|---|---|---|
| 1 | pH | 10.96 | 6.5 to 8.5 |
| 2 | Total Hardness | 485.60 | 300 |
| 3 | Chlorides | 95.8 mg(cl) | 250 |
| 4 | Alkalinity | 1794mg/l | 200 |
| 5 | BOD (domestic) | 333.33 mg/l | 300 |
| 6 | COD | 143.5 mg/l | 161 – 435 |

TABLE VI: STANDARD PARAMETERS REMARK OF DRINKING WATER

| Sr. No. | Impurities | Process used for Removal |
|---|---|---|
| 1. | Floating matters as leaves, dead animals, etc. | Screening |
| 2. | Suspended impurities as silt, clay, sand etc. | Plain Sedimentations |
| 3. | Fine suspended matter | Sedimentation with Coagulation |
| 4. | Micro organisms and colloidal matters | Filtration |
| 5. | Dissolved gasses, tastes and odours | Aeration and chemical treatment |
| 6. | Hardness | Water softening |
| 7. | Pathogenic Bacteria | Disinfection |

TABLEVII: TREATMENT PROCESSES

| SR. NO. | PARAMETER | REMARK |
|---|---|---|
| 1 | pH | May be relaxed up to 9.2 in the absence |
| 2 | Total Hardness | May be extended up to 600 |
| 3 | Chlorides | 250 May be extended up to 1000 |
| 4 | Alkalinity | Beyond this limit taste become unpleasant 600 |
| 5 | BOD (domestic) | - |
| 6 | COD | - |

## VI. REUSING GREY WATER FOR OUTDOORS

Reusing wastewater outdoors can reduce your household's potable water use by 30 to 50% Greywater can be re-used in gardens even without treatment. Sub-surface drip irrigation Systems spread water evenly around the garden, and are safer for spreading untreated Greywater. Avoid watering vegetables with re-use water if they will be eaten raw. There is a chance that some pathogenic organisms may still be present even after treatment.

*Precaution*

- In order to maintain the health of garden, the level of re-use of wastewater in the garden needs to be balanced with the amount of water, solids and nutrients that the plants and soil in your garden can absorb. If excess wastewater is applied:
- Excess nutrients may run-off or leach through the soil to enter waterways, contributing to algal blooms and other water quality problems.
- Soils and plants may become water logged and inhibit plant growth.
- Soils can become physically clogged with organic and suspended material or damaged by salts in the wastewater.
- Salinity may increase in problem areas when greywater contributes to raising water tables.

## VII. LIFE CYCLE COSTS

The costs that have been used throughout this document have excluded the costs for maintaining and operating the systems. This is because although some documented information exists on the real costs of operating a system, the case studies show that the costs are not predictable. This may be a result of few case studies being available meaning that patterns cannot be clearly seen. However these costs will need to be taken into account at the design stage and should include estimations of:

*Site preparation costs (i.e. excavation if necessary)*

- Purchase of components
- Collection and distribution pipe work
- Installation and commissioning
- Consumables such as disinfectants and cleaning chemicals
- Electrical operating cost
- Unplanned maintenance costs
- Cost of maintenance and inspection (incl. any regular water quality checks performed by laboratory)

## VIII. OTHER ENVIRONMENTAL IMPACTS

*Environmentally beneficial materials*

- The majority of the materials that are used in greywater and rainwater systems are made of plastic. Although certain metals such as copper would be more environmentally beneficial, it would appear that these materials are not recommended for water reuse systems. This is because the water is likely to be more corrosive than standard mains water and will tend to corrode metal parts and pipe work.
- Below ground clay pipes could be used, although as the majority of the surface and foul water drainage is in place there will be little need for such items at Eastside.

**Impact on wildlife**

It is unlikely that the use of rainwater or greywater would have any impact on wildlife. If surface water lakes or ponds were used on site to balance water flows or

store water, this would provide a useful and valuable habitat for birds or other wildlife, and result in a positive impact, particularly if designed sensitively.

## IX . ADVANTAGES OF REUSING AND RECYCLING GRYWATER

- This technology reduces the demands on potable sources of freshwater.
- Recharges groundwater
  Uses nutrients in the gray water to support Plant growth through irrigation
- Lowers water bills.
- Use less water resources.
- Irrigate gardens during drought water restrictions.
- Cut down the amount of pollution going into our waterways.
- Pollution of seawater, rivers, and groundwater may be reduced. The technology may diminish the volume of wastewater discharged, resulting in a beneficial impact on the aquatic environment

## IX. LIMITATIONS

- If it stored for long time, it can spread disease.
- Improper handling of waste water may causes health problems
- Conventional thinking of people
- It may damage soil from salt build-up.

## X. CONCLUSION

- With the urge of development and increase in population the consumption of resources is also increasing, however it is not possible to stop the growth but measures can be used to reduce the consumption of resources.
- One such measure is to reduce, reuse and recycle of waste water. Thus by making proper use and recycling the optimization of resources can be achieved.
- Reuse, reduce and recycle serves dual purpose - it doesn't just make the waste reusable, but also helps to prevent water pollution and waterborne diseases which result in millions of death every year.
- Saving of liters of potable water per day if greywater is reuse.

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