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TITLE: REUSE OF WASTEWATER FOR A HOUSEHOLD UNIT

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Abstract

India is facing a water crisis and by 2025 it is estimated that India's population will be suffering from severe water scarcity. Although India occupies only 3.29 million km^2 geographical area which forms 2.4% of the world's land area, it supports over 15% of world's population with only 4% of the world's water resources. . There are numerous challenges in reliably providing these resources amid growing population, increased urbanization and improved living standards causing increased demand for these resources. Development of new supply centralized systems comes at a high cost, whereas decentralized systems are touted as an attractive alternative. Wastewater recycling at buildings level is such an alternative that can provide water for non-potable uses. However, there are technological challenges of optimally operating such systems while ensuring efficient use of associated energy. This paper introduces some strategies aimed at ensuring safe and reliable operation of the wastewater recycling. Adoption of these systems would have a huge environmental effect in reducing demand for sewerage services, conservation of water thereby reducing demand for potable water.

Index Terms: *Centralized System, Decentralized System, Wastewater Recycling, Non-Potable*

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1. INTRODUCTION

. Wastewater derived from human activities in households such as bath, laundry, dish washing, toilets etc. is called as Domestic Wastewater. Domestic wastewater treatment and its reuse is becoming an important field of research in a global context of increasing water scarcity and inadequate sanitation. In the developing world, insufficient water supply and poor sanitation facilities cause thousands of deaths each day.

Two types of wastewater are generated in home:

A. Greywater

Greywater is wastewater from non-toilet plumbing fixtures like as showers, basins and taps.

Greywater constitutes about 60% - 70% of household water consumption, has lower concentration of organic compounds and fewer pathogens as compared to blackwater.

B. Blackwate

Blackwater is the water that has been mixed with waste from the toilet.

Blackwater is the mixture of urine, feces and flushwater along with anal cleansing water (if water is used for cleansing) and/or dry cleansing materials.

The easiest and most efficient method for reducing potable water use is to conserve water by using less of it. Water conservation is an easy and affordable mechanism to save water. However, many people want to go beyond conservation by using grey water in place of potable for subsurface irrigation, toilet flushing, fighting fires, washing cars, and other possible uses. Source separation of domestic wastewater is a strategy for simplifying and decentralizing the wastewater treatment and reuse process.

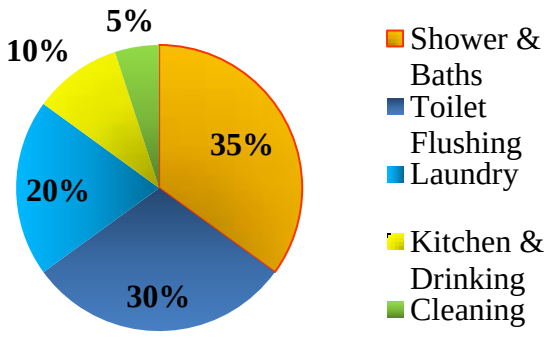

Fig-1: Household wastewater consumption

1.1. Aim of Study

- To improve the wastewater quality, making it suitable for reuse.

1.2. Objectives of Study

- **To** improve quality of wastewater by eliminating pollutants, toxicants and many such.
- **To** make wastewater reusable for other purposes.

1.3. Scope of Study

Wastewater derived from human activities in households such as bath, laundry, dish washing, garbage disposal, toilets etc. contains relatively small amounts of contaminants, but even small amount of pollutants can make a big impact on environment. A properly installed and maintained residential treatment system for treating and disposing of household wastewater will ensure that all household wastewater is properly treated to make it safe, clean and suitable for reusing and releasing back into the environment, lakes, or streams eventually minimizing the impact on ground water and surface water. This will help in recycling of the wastewater, its reuse, promoting health concern and public hygiene. Wastewater recycling will be one of the keys to solving the world water crises in the years to come.

1.4. Need of Study

The need for water is growing with increasing population. In big cities generally the wastewater outlets form the houses are directly introduced in the sewer which is connected to a huge treatment system. But this is not the case in small cities, towns, villages where the wastewater outlets are connected to sewers but the sewers carry that wastewater to some small water bodies. So innovative concepts and technologies are urgently needed to close the loop for water. Among the options, treatment of greywater and reuse is receiving crucial attention for decentralized areas as a sustainable approach. Grey water represents considerable portion of household water consumption in volume. Treating grey water to a level, complying reuse rules and regulations, can be reused for several purposes including agriculture, landscaping and toilet flush.

1.5. Advantages of Reuse

- Reduction in water bills
- Use of less water resources
- Cut down amount of pollution going into waterways.
- Decrease in demand of water.

1.6. Disadvantages of Reuse

- The extent of centralised wastewater treatment services is limited.
- Type of system – annual operating and maintenance cost vary between system.
- The length of time a person intends to live in his current house.
- Scarcity of water and the price of water in the area.

2. LITERATURE SURVEY

2.1. Domestic Wastewater Treatment In Developing Countries, Mara. D. Duncan

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, along with the wastewater resulting from personal washing, laundry, food preparation and the cleaning of kitchen utensils.

2.2. Sustainable energy water management for residential houses with optimal integrated grey and rain water recycling, Evan Wanjiru, Xiaohua Xia

South Africa is a semi-arid developing country facing water and energy insecurity. There are colossal challenges in reliably providing these resources amid growing population, increased urbanization and improved living standards causing increased demand for these resources. Development of new supply centralized systems comes at an exorbitant cost, whereas decentralized systems are touted as an attractive alternative. Grey water recycling and rain water harvesting at buildings level is such an alternative that can provide water for non-potable uses. However, there are technological challenges of optimally operating such systems while ensuring efficient use of associated energy. This paper introduces two control strategies; open loop optimal control and closed-loop model predictive control (MPC) strategies aimed at ensuring safe and reliable operation of the grey water recycling and rain water harvesting system while efficiently using associated energy. From the case study, the proposed system with either control strategy can save the cost of water and waste water by up to 32.3% and 29.5% respectively, while leading to 35.7% in energy cost savings and 31.5% in total operational cost savings in a month. Adoption of these systems would have a huge environmental effect in reducing demand for sewerage services, conservation of water hence reducing demand for potable water as well as increasing the energy efficiency. Furthermore, the system would increase the reliability and security of water supply. Despite the benefits, the system does not pay within its lifetime and therefore, government intervention

is required so as to make it economically attractive. High cost of implementation coupled with low potable and waste water tariffs harbour adoption of these systems. Appropriate regulations, policies, incentives and public education are necessary to support such novel technologies in ensuring resource conservation, efficiency and security are achieved.

3. METHODOLOGY

3.1. Greywater Treatment System

A greywater treatment system consists of the following process:

A. Primary treatment
- Screening
- Settling tank

B. Secondary treatment
- Gravel filter
- Sand filter
- Disinfection

3.1.1. Screen

Screen can be mesh with less than 10 mm size to remove coarse particles. The mesh is kept at the inlet of the piping system of sources such as bathroom, kitchen etc. The screens can be cleaned manually and solids disposed of along with solid waste.

3.1.2 Settling Tank

An equalization tank or settling tank is required to balance the flow to take into account maximum flow of greywater generated during morning hours due to bathroom use. Adequate aeration by providing baffles should be done to prevent odours and solids deposition in the tank. Greywater is continuously collected in the tank and flows to filter for treatment.

3.1.3 Upflow – Downflow Filter

As the name suggests, raw greywater is fed in from top of first column of filter and collected at the bottom of the same. This water is then fed in from top of second column of the filter and collected at the bottom of the same. The collected water at the bottom of the second column of the filter is then fed in from the top of third filter and collected at the bottom of the same and the same process is followed for the fourth. The filter media varies with the column and may contain gravel, coarse sand, fine sand and may contain wooden chips, charcoal etc. An optimally upflow – downflow filter contains four columns.

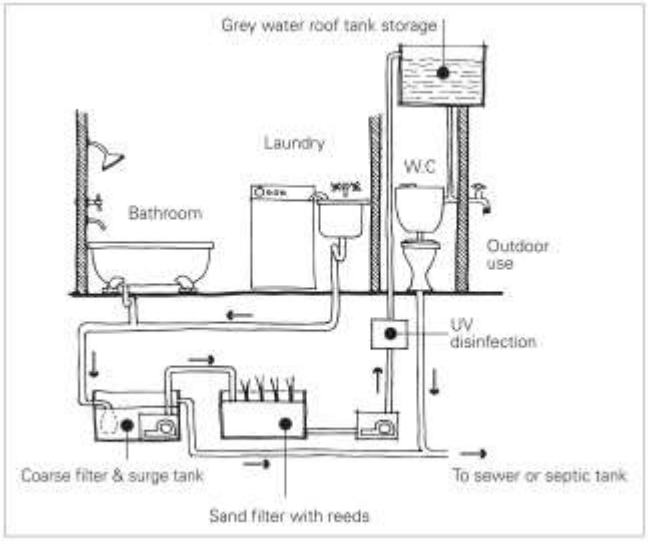

Fig-2: Schematic of greywater recycling

Table-1: Treatment unit and its functions

Units of Treatment System	Removal
1. Screen	Floating matter, suspended matter
2. Settling Tank	Settable solids
3. Upflow – Downflow filter	Colour, bacteria, suspended solids, some of BOD
4. Disinfection	Bacteria, odour

4. CONCLUSION

Water is an inseparable resource and is vital for development of country. Supply of this resource is however declining due to various factors like population increase, improved standards of living and rapid urbanization. This has led in increased demand leading to water scarcity resulting in various management strategies. The study has confirmed that by using strategy like greywater treatment system almost 60% of wastewater generated form the house (except water from toilets) can be used for various purposes like gardening, car washing, and toilet flushing etc. resulting in minimum consumption of portable water thereby preserving the water resources.

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