SUSTAINABLE USE OF GREYWATER FOR THE LOWER FLOOR TOILET FLUSHING

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Introduction:
Drought and water shortage are the key factors for water scarcity in arid and semi-arid areas in the world. Nowadays, overexploited underground water reservoirs and seriously polluted surface water have intensified the water crisis; moreover, population growth coupled with ever-increasing urbanization has resulted in continuous growth of urban water demand. As a result, there is a growing need to manage water resources in a sustainable manner, and reclaimed water has become an increasingly important source of water. Recently, centralized wastewater treatment and reuse systems have been confronted with many problems, such as high susceptibility towards overloading during storm events, unnecessary or insufficient treatment for different reuse applications and long-distance conveying systems. Meanwhile, flexible on-site water treatment and reuse systems are considered a promising solution for India. Due to low-level contamination and continuous availability, greywater reuse has become a special focus for on-site reuse. Greywater is defined as wastewater without any input from toilets, and it includes wastewater from bathtubs, showers, washing basins, laundry and kitchen sinks.

Compared to household compositedomestic wastewater, greywater is more lightly polluted, thus it can be treated with sand filters based on input characteristic of greywater. Recently, the most commonly described and promising application for grey-water reuse has been toilet/urinal flushing, which can reduce water demand within a dwelling by up to 10–30%. Thus this project deals with the development of the onsite, portable, and miniaturized greywater treatment unit.

Objectives:
- To recycle the grey water of one floor and to reutilize it for use in the water closets of the immediate lower floor in a multistoried buildings.
- To study the purification ability by checking the parameters such as pH, hardness, alkalinity, BOD, bacterial properties, turbidity, etc. of the treated water in comparison with greywater.
To efficiently reduce the fresh water usage thereby and also reduce the load on the treatment plant
To reduce energy use and greenhouse gas production from water treatment plants

Methodology
- The greywater is recyclable and with proper treatment can be put to reuse in toilet flushing.
- The data collection and processing water use - includes greywater from flushing and face/hand washing, mopping, utensils washing etc. is done on the basis of actual consumption.
- The treatment unit is made potable and thus the units adopted in this project is such that it could be accommodated in small space provided for the entire unit.
- The equalization tank and sand filtration method is adopted here with various locally available materials such as sand of various sizes, gravel of different sizes, charcoal, coir and sponge.
- Parallel pipeline networks are made to collect the greywater and direct it to the treatment unit where it enters the equalization tank prior to sand filtration. Parallel pipeline networks are provided to check that the waste water is being sent to the treatment plant during the maintenance period of the greywater recycling system.
- Flow rate of 300ml/min is adopted for the effective operation of the system.
- The outlet and the inlet of the system are provided with check valves so as to direct it to the next floor inlet or outlet in case of overflows.
- The effluents are made to flow through gravity to the immediate lower floor toilet flush through well connected pipe network. It is to be noted that no additional or extra energy is needed as input in any stage for the operation of this treatment unit.

Results and conclusion:
- For India’s future generations to be ensured of a reliable water supply, sustainable management practices must be implemented to preserve the nation’s declining groundwater resources. The present study reviews and suggests the concept of using greywater in various possible fields and thus, making fresh water demand within control. The use of grey water in India is in the stage of infancy. In India, this greywater system may be very effective in the school/college campuses especially those with residential facilities.
- The method experimentally assures to be effective water conservatory method cutting off the fresh water usage up to 10 to 30%. It also reduces load on the treatment plant and saves the energy used for such large scale treatments.
- The experimental trials were conducted in the laboratory with different materials and varying depths and the most efficient method was adopted. The comparison of the parameters of the untreated and the treated water is as shown in the table.
- This is also a reliable and sustainable method made handy and thus can be easily adopted in any floor of the building.
- The method also is the solution for the water crisis which is one of the major crisis in present day and in future in India.
- Proper maintenance and improved public awareness can make this decentralized system more effective and convenient by reducing transportation cost and pressure on centralized
recycling systems. Therefore, a novel wastewater treatment and reuse strategy has been proposed which suggests the separate treatment of greywater. Greywater can be treated by onsite treatment processes unlike black water which can be treated as centralized system. This treatment system can be implemented at household or cluster level so that recycling system needs to be robust and simple to operate.

<table>
<thead>
<tr>
<th>TESTS</th>
<th>OBSERVATION BEFORE PASSING THROUGH FILTRATION UNIT</th>
<th>OBSERVATION AFTER PASSING THROUGH FILTRATION UNIT</th>
<th>PERMISSIBLE LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.9</td>
<td>6.7</td>
<td>6.5-8.5</td>
</tr>
<tr>
<td>Total Hardness</td>
<td>323</td>
<td>451</td>
<td>600 mg/l Max</td>
</tr>
<tr>
<td>Alkalinity</td>
<td>1068</td>
<td>616</td>
<td>600 mg/l Max</td>
</tr>
<tr>
<td>Colour</td>
<td>10</td>
<td>&lt;1.0</td>
<td>10 CFU Max</td>
</tr>
<tr>
<td>Odour</td>
<td>Disagreeable</td>
<td>Agreeable</td>
<td>Agreeable</td>
</tr>
<tr>
<td>Turbidity</td>
<td>102</td>
<td>3</td>
<td>5 NTU</td>
</tr>
<tr>
<td>BOD₅</td>
<td>72</td>
<td>30</td>
<td>2-50 mg/l</td>
</tr>
<tr>
<td>TSS</td>
<td>1200</td>
<td>700</td>
<td>1-1000 mg/l</td>
</tr>
<tr>
<td>Total Phosphorous</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
</tr>
<tr>
<td>Chloride</td>
<td>404</td>
<td>390</td>
<td>500 mg/l Max</td>
</tr>
<tr>
<td>Sulphate</td>
<td>300</td>
<td>150</td>
<td>400 mg/l Max</td>
</tr>
<tr>
<td>Microbial parameters</td>
<td>21MPN</td>
<td>14MPN</td>
<td>15 MPN</td>
</tr>
</tbody>
</table>

- From this analysis it can be concluded that seasonal fluctuation is a great problem in utilizing demand management, rain water and storm water harvesting as alternative supply options of water resources. For this reason using these alternative options is not always reliable. In contrast, grey water recycling is more reliable source in order to manage the rising demand of water. Reliability reduces water demand throughout the year and also reduces volumes of waste water to be treated are the major advantages of grey water recycling process.
- Thus the greywater is purified in site and reused for toilet flushing and in turn contributes in decreasing the water demand to a certain extent in the present water scarce scenario.

**Scope of future work**

- This treatment unit being handy can be adopted in any kind of building and can be specially designed depending on the location, water demand and disposal method and the quality of greywater generated in the building.
- This method serves the best in the multi-storey residential buildings where lots of greywater generates in site. In such locations this treat unit can effectively treat the waste water avoiding extra load on the septic plants and conserving water at the same time.
- This method can also be developed as a separate unit of treatment for kitchen wastes alone by necessary additions in the filter media depending on the quality of the kitchen waste water generated in the building.
- Based on the type of the building for which the unit is being adopted, the treatment unit can be effectively designed as per the water quality of the greywater generated there.