A Review of Low-Cost Greywater Treatment for Urban Residential Reuse

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Abstract

Greywater, which is wastewater generated from baths, sinks, laundry but not toilets, makes up about 50–80% of a typical household's total wastewater. Because of this, it has the neat potential as a low-cost source for non-potable reuse, which is yet largely underutilized. This paper reviews on low-cost, decentralized greywater treatment systems that can fit into dense urban residential areas. Most of these systems rely on gravity-fed filters using locally available materials like sand, and existing literature shows that these simple systems can reliably reduce turbidity and Chemical Oxygen Demand (COD). The paper also looks at where treated greywater can actually be used. For gardening and small-scale irrigation, treated greywater often performs about as well as tap water, while untreated greywater can gradually increase soil salinity and alkalinity. The review also includes findings from experiments showing that using treated wastewater for concrete mixing is feasible, and has no meaningful drop in compressive strength when compared to fresh water. Even though the technical results are promising, public perception still poses a major challenge. People tend to be unwilling to use the water indoors compared to outdoor reuses due to its unappealing appearances. Finally, the review points out that wider implementation is slowed down by the absence of clear and consistent regulations and/or guidelines for household-level greywater reuse.

Keywords

Grey water; Reuse; Low-cost; Decentralized; Small-scale treatment; Non-potable use

Introduction

According to the United Nations (2018), “55% of the world’s population lives in urban areas, a proportion that is expected to increase to 68% by 2050,” and “close to 90% of this increase [will take place] in Asia and Africa,” which includes Bangladesh. This increase in population is resulting in high demand of freshwater resources and also increasing load on municipal systems. In nearly all cases, households rely heavily on treated municipal water for tasks that do not require drinking-quality water, such as cleaning, gardening, and flushing. However, majority portion of total domestic wastewater, particularly greywater from showers, sinks, and laundry, flows directly into drains without being reused even though this greywater represents 50-80% of total household wastewater. This imbalance between how much water we use and how much reusable water we throw away has created a huge potential and need for solution as cities look for sustainable ways to manage their water.

The objective of this paper is to review low-cost, decentralized greywater treatment options that are practical for urban residential use, especially in settings where space, infrastructure, and financial resources are limited. Low-cost systems, such as gravity-fed sand/gravel filters, are particularly appealing because they can be built with materials available locally, require little to no maintenance, works without electricity, and are installable on household and small community levels.

This research area is particularly relevant now because urban fresh water crisis is already a concern that is affecting everyday life of many, which is increasing household expenses, and putting pressure on old water supply networks. Greywater reuse can help ease this pressure by cutting down the demand for fresh water and also reducing the amount of wastewater that cities need to handle. Treated greywater can support several practical use cases, such as garden irrigation, toilet flushing, cleaning outdoor spaces, and even concrete curing or mixing in construction.

Despite these clear advantages, greywater reuse is mostly underutilized. Public acceptance remains mixed, largely due to concerns about appearance, odor, and hygiene. In addition, the lack of

clear regulations and guidelines for small-scale greywater reuse, creating uncertainty about safety requirements and system design. As a result, households and small communities are hesitate or not informed enough to adopt these solutions, even when the technology is simple and affordable.