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Low Cost Treatment System in Residential Building

Ar. Niranjan Vilas Sangawar, Prof. Joshi Sanjay Dhondo

SPSMBH's College of Architecture, Kolhapur, Maharashtra, India

ABSTRACT

The dearth of fresh water is one of the chief concerns at various places in India and even the pinch can be sensed in many areas of India particularly in summer days which compels human's more responsiveness towards the preservation of fresh water. In similar line to the world many countries are already facing fresh water crisis and many in verge to move to the club of water scarcity due their negligence towards water conversation.

Wastewater is any water that has been polluted by human use. Domestic wastewater can contain physical, chemical and biological pollutants. Broadly we can classify waste water as black water and grey water. Black water can contain feces, urine, water and toilet paper from flush toilets. Black water is distinguished from grey water, which comes from kitchen sinks, bathrooms, washing machines, and other kitchen appliances apart from toilets. Grey water can be further categorized based on the source of waste like Light Grey water and dark grey water. Our study will focused on light grey water which consist waste from bathroom, wash basin, washing machine except the kitchen waste will come under dark grey water.

Various researchers and Institutes are working towards the solutions in different ways to combat the circumstance. As an architect the role we can play to make the treatment and reuse of light grey water in effective way towards preservation of water. Study will be carried out in the direction of feasible system or solution for residential building so that the light grey water can be reused for toilet flushing, garden and plant irrigation, floor washing, car washing, ground recharging etc after a suitable treatment.

KEYWORDS: *Grey water, Effluent, physico-chemical, Treatment System*

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INTRODUCTION

The construction industry is a critical constituent of India or any country economy but has a major impact on the environment. If we talk about size, building construction and building maintenance is one of the prime users of energy, material resources, and water, and also an alarming polluter. In a same line water plays a vital role and one of the basic necessities of human being. As per the various research paper summary around one-fifth of the world's population, belongs to the areas of physical scarcity of water occurs (i.e. the countries where water in scarcity form) and almost one-fourth of the world's population, faces economic water lack (i.e., the countries that lack the necessary infrastructure to obtain water from rivers and aquifers). The world population has been rising at a pace of about 1% per year, similarly other infusing factors like economic growth, changing lifestyle patterns (due to pandemic diseases like covid-19) will continue to grow, and resulting in water scarcity in various parts of the world.[1]

Wastewater is any water that has been polluted by human use. Domestic wastewater can contain physical, chemical and biological pollutants. Broadly we can classify waste water as blackwater and greywater. Black water can contain feces, urine, water and toilet paper from flush toilets. Black water is distinguished from grey water, which comes from kitchen sinks, bathrooms, washing machines, and other kitchen appliances apart from toilets. Greywater

can be further categorized based on the source of waste like light greywater and dark grey water. In the recent past, there is comparatively increased awareness among the governments and bodies dealing with water management to address the challenges related to water security. Measures to reduce water usage through increased awareness, installation of rainwater harvesting and grey water (GW) treatment systems are seen as promising solutions, especially in developing countries that are more vulnerable to water scarcity like India. Water is an essential part of human's life. In water shortages, three key methods: water conservation, desalination and recycling could be considered. Due to lower costs and possibility of wastewater treatment in waste production site, water recycling is much better than the other two methods. Greywater reuse is increasingly emerging as an integral part of water demand management.[2][3]

AIM AND OBJECTIVE

The aim and objective of this research paper is as follows

A. Aim:

"The ultimate aim of this research work is to study the low cost treatment system on the basis of data collected from literature review and case studies for a residential building"

B. Objective:

1. To design and develop low-cost treatment systems.
2. To study scope of reuse of waste water.

LITERATURE REVIEW

A literature review of scholarly articles, books, dissertations, conference proceedings and other resources which are relevant to the study of light greywater effluent, carried out to set the background on what has been explored on the topic so far. An extensive literature review provides background information on current knowledge related to the research topic.

Table No. 1: Various approaches to reuse of Grey Water Treatment System from Various Research Paper

Sr. No.	Title	Year of Publication	Characteristics of Treatment System
1.	The Design Of Wastewater Treatment System In Tall Residential Building Using Phytorid By KomalHemantMalpani	2015	➢ Decentralized biological wastewater treatment system. ➢ Suitable for Tall Building. ➢ Using a patented 'Phytorid' technology. ➢ This technology uses no electricity, requires minimal manpower and uses natural plants. ➢ Reused for landscape and gardening.
2.	Water filter-based MBR unit in laundry effluent treatment M A Islam Et. al	2017	➢ An aerobic membrane bioreactor (MBR) system with filter. ➢ Suitable for group of Buildings. ➢ Efficient to remove flux, COD.
3.	Laundry wastewater treatment using coagulation and membrane filtration By S. Šostar Turk Et. al	2017	➢ Precipitation/coagulation and the flocculation process with adsorption on granular-activated carbon (GAC) – No scope or possibility of selection of parameters. ➢ Precipitation/coagulation and the flocculation process with ultrafiltration (UF). ➢ Precipitation/coagulation and the flocculation process with reverse osmosis. - possibility of selection
4.	Design and Treatability Studies of Low Cost Grey Water Treatment with Respect to Recycle and Reuse in Rural Areas By Vijaya V. Shegokar Et al.	2018	➢ Laboratory scale grey water treatment system. ➢ Five stages of physical operations of raw grey water unit. ➢ Suitable for physico-chemical characterization of grey water.

5.	Greywater Reuse System Design and Economic Analysis for Residential Buildings in Taiwan By Yi-Kai Juan	2019	➢ Applicable for the family unit (size of 4 to 6 persons). ➢ Interior Customized Greywater System (ICGS). ➢ This system has a minimum payback period of 4 years.
6.	Domestic Waste Water Treatment Using Fly Ash Alone or in Combined Form By Dr. Pankaj Singh Et al.	2020	➢ Use of fly ash for the treatment of domestic laundry waste water. ➢ Different ratios with wood ash for the treatment of domestic laundry waste water. ➢ Dosage of 40g/L is recommended.

METHODOLOGY

This section of research paper will explorethe process of carrying out research work in systematic way as shown in Figure 1.

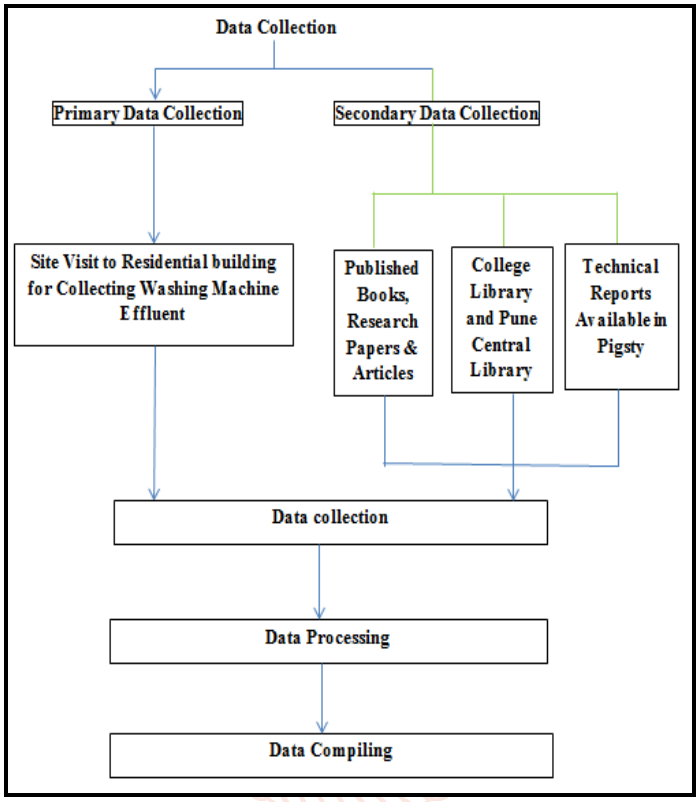

Figure 1: Methodology Process

DATA COLLECTION

To carry out the analytical assessment in smooth and effective way, the samples are collected and kept in ice till the reaching of labs before assessment.

Figure 2: Photos While Collecting Light Greywater at Source

The physicochemical composition of light greywater effluent samples was statistically analyzed in April 2021 and the results are presented in the form of acceptability or class of the parameter based on Water recycle/reuse standards based on protection of human health and the environment and suitability for the intended reuse application in below section.

Table No. 2: Washing machine Quality Classification based on Recycle/Reuse Standards

Sr. No.	Analysis Parameters	Mean Value	Acceptability
01	pH	9.1	Above the permissible limit
02	COD	1549.0	Above the permissible limit
03	BOD	180.6	Above the permissible limit
04	Oil and Grease	2.0	Doubtful
05	Turbidity	108.7	Above the permissible limit
06	Conductivity	640.0	Doubtful
07	TDS	722.9	Within Permissible limit
08	Total Hardness	621.4	Above the permissible limit
09	Calcium	4.1	Within Permissible limit
10	Magnesium	1.3	Within Permissible limit
11	Total Alkalinity	37.2	Doubtful
12	Sulphate	25.8	Within Permissible limit
13	Iron	0.8	Within Permissible limit
14	Lead	<0.003	Within Permissible limit
15	Zinc	<0.01	Within Permissible limit
16	Dissolved Oxygen	ND	Insufficient to be in permissible limit
17	Nitrate	0.2	Within Permissible limit

The table represents the parameters have exceed the permissible limit of recycle/reuse of water like pH, COD, BOD, Turbidity, TDS, Total Hardness, DO so there is a need for an appropriate treatment system to reuse the light greywater in the case study building.

TREATMENT SYSTEM

A. Experimental Setup

The experimental setup were performed by using low cost materials and their performance were evaluated. The low cost material such as sand, gravels, granular activated carbon and nylon cloth were used in the filtration unit. The sample of water was taken before and after filtration of each filter bed at 20ml/min of water flow rate.

The samples were analyzed for the physical and chemical parameters to check the quality of light greywater collected. The filtration system consist of following four unit:

1. Influent storage Chamber
2. Filter Media I
3. Filter Media II
4. Effluent storage Unit

Figure No. 3: Designed and Prepared Light Greywater Treatment System

B. Treatment System

The samples were analyzed for the parameters which are above the permissible limit as per standards in the same laboratory where the previous examination has been carried out. The pH and turbidity of wastewater was 9.1 and 171 NTU respectively which is reduced to a level of 7.61 and 28.9 NTU and become within permissible limit. The total hardness of waste water is reduced to 262.7 mg/l from 614 mg/l. Additional parameters like COD reduced from 1520 mg/l to 78.20 mg/l with BOD from 187 mg/l to 21.4 mg/l. The values are illustrated in graphical form.

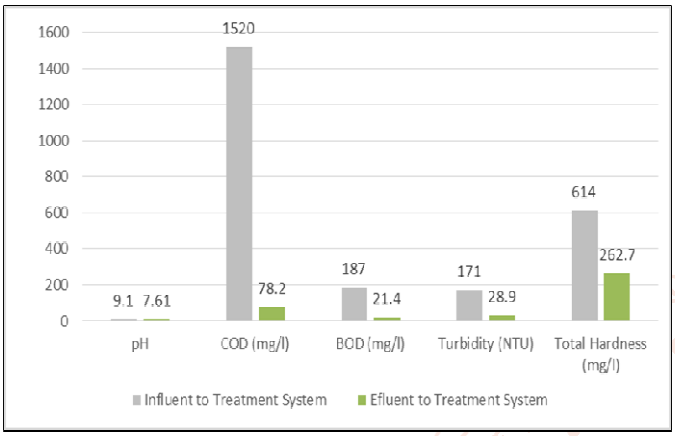

Figure No. 4: Inlet and Outlet Value Designed Filter System

Figure No. 5: Greywater Treatment System with a sample before filtration and after filtration

C. Result Analysis

Readings indicates the removal of pollutants in water treatment system. Due to sedimentation, the course size and fine solid particles are settled down by gravitational force and only clear water flew towards sand and gravel filters. The result the pH has been reduced to 16.37%, were as COD and BOD has a much higher efficiency which is about 94.86% and 88.56% respectively. The turbidity and total hardness removed about 83.10% and 57.21% respectively. In following the efficiency % has been illustrated in graphical format.

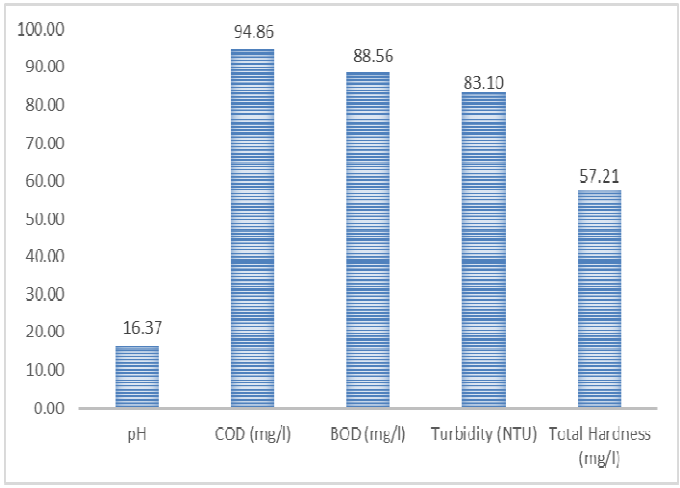

Figure No. 5: Efficiency of Designed Treatment System

CONCLUSION

The low cost grey water treatment system is a combination of natural and physical operations which could be applied easily without any maintenance. All the natural and easily available low cost materials were used for the treatment process. The results presented in this study are to establish the potential applicability of the developed low cost technological treatment system especially for the areas in which water scarcity is major constraint for particular months of calendar.

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