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STUDY OF REUSE OF GREYWATER

Mr. Mithun Sawant[*1], Mr. Onkar Somnath Matere[*2], Mr. Mainak Chakraborty[*3], Mr. Sai Talwadekar[*4], Mr. Saad Nalgire[*5]

[*1]Assistant Professor, Civil Engineering Department, Dr. D. Y. Patil Institute of engineering, Management & Research, Akurdi-Pune, Maharashtra, India

[*2,3,4,5]UG Student, Civil Engineering Department, Dr. D. Y. Patil Institute of engineering, Management & Research, Akurdi-Pune, Maharashtra, India.

ABSTRACT

India has been poor in treatment and re-use of household and commercial wastewater. About 80% of the household water is drained out into sewages. Around 60% of water is used for bathing, washing clothes and washing utensils in household of urban cites like Mumbai and Delhi. Which means if we account for the loss even after that 50% of the water is generated as greywater. This greywater is directly drained out without reusing. Hence what if we use this greywater for flushing in toilets. Around 35%-40% water is required for the toilet flushing[1]. So, if managed properly we can use that 50% greywater to replace upto 40% of the requirement of toilet flushing. In this way we will save at least 40% of water from a single household. According to BIS, minimum of 135 L/head needs to be provided for the urban household. Hence for average if we consider 4 people family per household, we can save up to 200 L/ house/day[2].

KEYWORDS: Greywater, Greywater Treatment.

I. INTRODUCTION

Greywater is defined as waste water except for black water(mostly toliet)[3]. The basic sources of greywater in households are bathrooms, wash basins and kitchen basin. The basic source of greywater in the commercial building are wash basins.

Sources of greywater are wash basin, kitchen sink, bathroom, washing machine. It contains fewer pathogens than domestic wastewater, it is generally safer to handle and easier to treat and reuse onsite for toilet flushing, landscaping or crop irrigation.

With the increasing population the demand of water is also increasing therefore it has become necessary to find an alternative water resource. Reuse of greywater makes sure of using water for non-potable uses. It has been seen that in past few decades reuse of greywater has increased eventually and has become a local and national efforts to increase potable water supply, and reduce pollutants in the environment. The treatment of greywater is based on its different characteristics and site conditions. The treatment system of greywater depends on the quantity of the water to be treated, purpose of reuse and its quality. There are many techniques of greywater treatment each with different outcomes. In this study, we have reviewed different treatment technologies and its characteristics with the aim of designing a treatment process for residential and commercial purpose [4]. Wash basins, kitchen sinks, bathroom, washing machine.

II. LITERATURE REVIEW

2.1 Dr.HansaJeswani (Use Of Sullage For Non-Potable Purpose 2015): The grey water treatment has coagulation as well as sedimentation, adsorption, filtration and ion exchange method will be used so as to contaminate to non-potable standards. The cost of the process is low as no biological treatment is done. Also the process uses activated charcoal as an adsorbent agent so as to remove the discoloration, volatile organic matter and odor. The turbidity of the sample was found out to be very high due to sufficient dilution was not done. As per the concerns of residential buildings large amount of detergents and soaps were present in the kitchen and bathroom effluent. The portion of settled solids in the kitchen effluent was quite high.

2.2 Prof.A.B.Shelar, Ms.ShradhaM.Kalburgi, Ms.NehaD.Kesare (Treatment of grey water using Low Cost Technology 2019): The paper has information on treatment various technologies which has low cost for greywater treatment and has very important objective of providing safe and clean water. The paper shows different waste water treatment method such as Root-zone wastewater treatment(covers all the biological types of microbes, treats ground-water), Filtration through winnowing sieve(removes impurities like dry leaves, stalks and course particles), Horizontal flow course media filter (coarse gravel or crushed stone as filter media and is very fitted to turbid water), Stabilizing tank method (baffle walls are made in which water is passed through the holes in walls & filtered water will be passed out through the outlet pipe). According to the paper the results of stabilizing tank are effective and low cost from above all methods.

2.3 Michael Oteng-Peprah (Greywater Characteristics, Treatment Systems, Reuse Strategies and User Perception 2018): The paper consists of greywater quality in various developing countries, pollutants in greywater, some treatment methods, natural materials, some strategies and public and social opinion on greywater reuse. The paper shows that generation of greywater are mainly affected by daily lifestyle, types of use of water and climate. Types of Pollutants found in greywater are mainly due to type of detergent used and household activities. Other treatment methods which were studied were not able to treat greywater to that effectiveness which was required as they were made to remove particular group of pollutants. The study revealed that some naturally occurring materials such as Moringa oleifera, sawdust, can be used to remove particular pollutants in greywater. The study further showed the user perceptions towards greywater treatment and reuse were only effective on non-potable purposes, mostly due to contamination or lack of trust and effectiveness in the level of treatment offered by the treatment method.

III. SIGNIFICANCE

The problem of water consumption and sanitation facilities in metro region in India is a big issue. An approximation is made that by the year 2050, 50% of India's population will be living in cities and will face major water crisis. At present, 16.30 crores people do not have access to safe drinking-water and 21 crores people do not have proper sanitation in India. In cities, 96% out of total have proper water supply and 54% to improved sanitation. Whereas in villages, which have almost 72% of India's population, only 84% have proper water supply and 21% have proper sanitation source [5]. In addition, there are improper wastewater treatment facilities to treat the wastewater. Due to all these reasons it has become a need to reuse treated wastewater in order to meet the present and future demands of water supply in cities as well as villages.

It is possible to decrease the use of fresh-water and wastewater production and reduce the water bills by reusing the greywater. Non-potable reuse of greywater consists of commercial, industrial, irrigation and toilet flushing. Different treatment process is carried for reuse of greywater. If grey water is considered as a water source other than fresh water and demand of required water supply for irrigation water could be fulfilled which will than later lead to an increase production of agricultural crops. As rainwater harvesting, grey water reuse is independent of season or variability of rainfall and as such can be considered as a dependent water source.

Dealing with the past as well as present events it is necessary to save water and take proper actions that will lead towards sustainable water management. A proper healthy environment is the most important requirement of the 21st century challenging human settlements, development and management. Therefore, flexible and innovative solutions are required to deal with these changes in water demand for present as well as future generation

Table-1: Greywater categories for household

Light greywater(sources)	**Dark greywater(sources)**
1. Bathroom 2. Wash basin	1.Kitchen sink 2. Laundry

(Source- Christova – Boal et al., 1996; Ghunmi, 2009)[4]

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IV. QUANTITY AND SOURCES OF GREYWATER

The use of water is dependent on various factors like quality of life, economic background, availability of water, population, function of the building. Greywater counts for 80% of the water drained out of the house as a waste water [6]. Depending on the countries and its income, volume of generation of greywater varies. For high income countries, the generation of greywater ranges from 100-120 liters per day and for small income countries it varies from 20-30 liters per day [7]. The major source of greywater is bathroom i.e. 47%. Kitchen accounts for 27% and washing clothes accounts for 26% of total greywater [8]

V. PHYSIOCHEMICAL CHARACTERISTICS OF GREYWATER OF VARIOUS COUNTRIES

Table-2: Greywater characteristics

PARAMETERS	INDIA	USA	UK
pH	7.3-8.1	6.4	6.6-7.6
Turbidity (NTU)	-	31.1	26.5-164
TSS (mg/L)	100-283	17	37-153
TDS (mg/L)	573	171	-
BOD_5 (mg/L)	100-188	86	39-155
COD (mg/L)	250-375	-	96-587
E. Coli (CFU)	-	$5.4 * 10^5$	$3.9*10^5$

(Source - Michael Oteng-Peprah, 2018) [11]

VI. METHODS

6.1 Coagulant Aided Sedimentation:

This treatment reduces the turbidity and suspended solids through coagulant aided sedimentation using optimum dose of alum (Al2(SO4)3•18H2O). The optimum dosage of alum is calculated through jar test. The jar test is performed as follows:

Varying doses of alum are added in 6 jars containing one liter of sullage. Rapid mixing at 110 rpm is performed for a minute followed by slow mixing for 15 min at revolution for 35-40rpm followed by settling for a period of one hour. Final turbidity is measured for each dose at the end of the jar test by carefully taking the supernatant from the jars.[10]

6.2 Charcoal Aided Adsorption:

Activated charcoal primarily adsorbs the dissolved solids which are organic in nature (i.e. phenols, chlorinated hydrocarbons, surfactants and other color and odor producing substances) and thus causes reduction in COD.

For the most efficient use the charcoal must be finly powdered so as to increase the surface area of the charcoal, this will give more surface for the contamination to adsorb on it.[10]

6.3 Horizontal Flow Course Media Filter:

Horizontal flow course media filter technique uses coarse gravel or crushed stones as filter media and is very fitted to turbid waters with turbidities larger than fifty NTU. Through the horizontal passage of water into the filter a series of filtration and sedimentation of suspended solids is performed. Also to get rid of pathogens slow sand filters can be used, but in restricted manner.[11]

6.4 Rotating Biological Contactor:

It is a biological treatment process in which biological medium remove pollutants in wastewater before disposed treated water to the water bodies(river, lake or ocean). Rotating Biological Contractor consists of closely spaced parallel discs mounted on rotating shaft above surface of waste water on the surface of the disc microorganisms grow and biological degradation of wastewater pollutants takes place.[11]

6.5 Sand Filters (SF):

Sand filters are effective process to treat water but are labour intensive and expensive as the sand is to be cleaned and replaced as time passes. The sand particles I have pores between them due to their grain size and the contaminant particles larger than the pores get trapped in between sand particles. As a result a filter cake is formed. As the process continuous the pore space becomes smaller and smaller each time resulting in in particle removal increase. Even though the contaminant particle removal increases, as a result of smaller pores the the filtration rate decreases.[11]

6.6 Ion Exchange:

Ion exchange is a method of treatment of water in which a specific unwanted contaminant can be replaced by another substance(which is is not of harmful or undesirable nature) resulting in removal of contaminant. For the process to work both the contaminant and replacing substance must be dissolved in the water. Both the substances should also carry the same charge i.e. positive(+) or negative(-). "Water softening" is one of the application of ion exchange method.

The most common application of ion exchange method is in in the process of purification of water, separation of specific chemicals and decontamination of water based(aqueous) and other ion containing solutions with solid polymeric or mineralic ion exchangers.[10]

VII. CONCLUSION

In household level the major source of greywater is bathroom. The other sources are kitchen, wash basin, laundry i.e. washing clothes. Whereas in the commercial and institutional buildings such as offices, educational complexes the major source of greywater is wash basin. Pantry and private washrooms are other greywater sources in the commercial buildings but its negligible in comparison with the wash basin.

A typical greywater reuse includes collection, treatment, storage and pumping of the treated greywater. As discussed above there are various methods to treat the greywater. Each method has its own advantages and disadvantages. If the greywater includes the water from kitchen sink and laundry, the complex compounds increases and it requires heavy treatment. But if the greywater includes water from wash basin only, a simpler treatment like sand-gravel filtration can be used. Hence it is efficient to re-use greywater from the commercial, institutional buildings in comparison with the greywater generated from household.

Depending on the characteristics of greywater suitable method is used. If required combination of various method can be complexed and used. Ion exchange would be required only if the hardness is required to be reduced to the expected level of less than 10 mg/L as $CaCO_3$ if the sullage is reused for boiler water or cooling water make up for some industry.

The reuse of greywater has many applications. The main two application of the greywater are Toilet Flushing and gardening. Hence with the proper design of reuse system we can save huge amount of water and decrease the water demand.

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