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Quantification and Characterization of Grey Water- A Case Study of Shraddha Nagar, Pusad

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Abstract: ***Water is the resource that has no alternative. Water is the key element of complex interdependent natural system. Water scarcity has emerged as one of the most pressing problem in the twenty first century. Water scarcity is increasing day- by-day with the increase in population and decrease in rainfall. There is a need to critically look at alternative sources to ensure water availability. Rapid industrialization and urbanization has caused India to face water crisis since it has only four percent of the world's water resources. International water Management Institute (IWMI) predicts that by 2025, one in three Indians will suffer from water scarcity problems. In order to resolve the crisis, India has to look for alternative water resources which may include rain water harvesting, grey water, sewage reuse and desalination. Contamination of surface and groundwater is rampant in rural urban India with wastewater entering fresh water bodies or seeping in to groundwater. An integrated approach is needed to manage the water and wastewater treatment so that water supply is kept clean and wastewater is recycled for beneficial use in agriculture and industry.***

Shraddha nagar is the well-developed area of Pusad city. In this study an attempt has been made to analyze grey water from kitchen and bathroom considering source of supply as a tap water and bore well water in spring, winter & summer seasons. To carry out the research work a laboratory scale Integrated Model was prepared consisting of screening, sedimentation, filter-I, Filter-II, aeration and disinfection units which is economical and good alternative to treat grey water in residential rural area. Shraddha nagar, Pusad has been considered for the study.

The results of study reveal that the total 6210 liter per day grey water was generated from a sample of 16 houses in Shraddha nagar Pusad. The performance of the model for treatment of kitchen and bathroom grey water showed in terms of deduction competency of water pollutants as follows:

Bathroom: TSS (60%), TDS (71.43%), COD (73.13%), BOD (75.71%), Total hardness (24.44%).Turbidity (73.33%)

Kitchen: TSS (81.74%), TDS (70.0%), COD (81.0%), BOD (81.47%), Total hardness (27.08%).Turbidity (70.58%)

Hence, it was found that the media is effective in the treatment of grey water. This eco-friendly technology could be a good alternative to treat grey water in residential rural area.

Keywords: Grey Water, Water scarcity, screening, sedimentation, filtration, aeration and disinfection, TDS, BOD, Turbidity

I. INTRODUCTION

A. Background of Study

Waste water generally is made of black water and grey water. Grey water also known as sullage, is non-industrial waste water generated from domestic processes such as washing dishes, laundry and bathing. Grey water comprises 50-80% of residential waste water. Grey water is distinct from black water in the amount and composition of its chemical and biological contaminants (from faces or toxic chemicals)

Grey water gets its name from its cloudy appearance and from its status as being neither fresh (while water from ground water) nor heavily polluted (black water). Essentially, any water, other than toilet wastes, draining from a household is grey water. Although this used water may contain grease, food particles, hair and any number of other impurities, it may still be suitable for reuse. Reusing grey water serves two purposes: it reduces the amount of fresh water needed to supply a household, and reduces the amount of waste water entering sewer or septic systems.

Grey water is domestic waste water that is collected from dwelling units, commercial building and institutions of the community. It may include process waste water of industry (food, laundries etc.) as well as ground infiltration and miscellaneous waste liquids. It is primarily spent water from building water supply to which have been added to the waste effluent of bathrooms, kitchens and laundry.

Domestic waste water is the spent water from the kitchen, bathrooms and laundry. Many of the minerals and organic matter in the

water serve as food for saprophytic micro-organism and hence the waste water is unstable bio-degradable reduction of relative dependence on potable water usage is becoming a necessary facet of good water management. Many new or modified treatment processes are being investigated is an attempt to solve the serious water supply and waste water disposal problems of the growing population and its industries. Even with the application of the water reducing scheme, a large amount of the water reducing scheme, a large amount of water is still required and eventually, reuse of water may have to be practice. Therefore, several possible re-use of water schemes such as distillation and membrane techniques for complete reuse and biological oxidation, filtration and disinfection schemes for partial reuse have been considered.

B. Importance of Grey Water Recycling

Recycling of grey water will protect aquatic ecosystems by decreasing the diversion of freshwater, reducing the quantity of nutrients and other toxic contaminants entering waterways. It will reduce the need for water control structures. There are some other benefits of using grey water grey water. It reduces the total waste water treatment cost as it lessens the organic and Hydraulic load of wastewater treatment plant. Reclaiming nutrients in Grey water improve the soil quality. Grey Water application in excess of plant name is also a good way to recharge ground water. Highly treated grey water can be used for aquifer for recovery and storage.

Some of the benefits of Grey water recycling are

1) Reduction consumption of fresh water.
2) Conservation of aquatic ecosystem.
3) Reduce load on municipal water supply and local ground water table.

Lowering of overall energy uses and most importantly saves your money. In this project an attempt has been made for Shraddha Nagar, Pusad

C. Problems

There has not being any record of illness caused by grey water to man grey water sky rockets in value during drought emergency and anywhere that other water sources are not available especially for irrigation but due the particles found in grey water as well as its chemical and biological properties it may be suggested that grey water could contain some properties which could cause dilapidation to plant growth and, or the soil. It was suggested that grey water from kitchen sink and dish washer should not be reused as these can contain heavy loads of organic materials, fats and caustic additives in high concentrations that are not readily broken down by soil organism. Soaps and detergents are components in grey water which could adversely affect plants the most. Relating to these facts, we decided to test for its properties (physical, chemical and biological) and then purify it to meet up to the standard for its reuse.

D. Scope and Objective of the Study

Treatment and reuse of grey water is a sustainable approach and can be cost effective in the long term. With the above backdrop, the study has pursued the following key objectives.

1) To develop and design simple and low cost Integrated Grey water treatment system.
2) To evaluate the characteristics of influent grey water
3) To evaluate the characteristics of effluent grey water at various stages of treatment

II. ABOUT THE STUDY AREA AND ACQUISITION OF DATA

A questionnaire in the form of social survey was carried out in the “Shraddha nagar, Pusad” to identify the quantity of grey water generation. In order to carry out the analysis of grey water in the laboratory for its characterization, two random samples were taken from different location where dual plumbing system exist i.e. Those houses which have separate drainage for grey water and black water. The survey include the following type of questions

A. Name of owner and House Number
B. Number of Family Members
C. Type of Water Supply
D. Weather dual Plumbing System is available or not
E. Depth of Bore Well (If present)
F. Month in which Bore Well gets dry.

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G. Terrace area.
H. Whether rain water harvesting system is installed or not.
I. Existing disposal.
J. Public acceptance towards the reuse of grey water.

TABLE I
FORMAT FOR SURVEY WORKS CARRIED OUT IN SHRADDHA NAGAR, PUSAD

S.N.	Name of owner	Family member	Existing water supply			In which month Well/Bore well dry	Depth of Well/ Bore well (Foot)	Existing Drainage System		Rain water harvesting
			Well	Bore Well	WS			Separate	Combined	
1	SNHN1	6		✓	✓	April	100	✓		✓
2	SNHN2	4		✓	✓	April	100	✓		
3	SNHN3	4		✓	✓	May	150	✓		
4	SNHN4	4		✓		May	100		✓	✓
5	SNHN5	5		✓	✓	May	150		✓	✓
6	SNHN6	4		✓	✓	April	100	✓		
7	SNHN7	2		✓	✓	May	100	✓		✓
8	SNHN8	5		✓	✓	April	215	✓		✓
9	SNHN9	4		✓	✓	Feb	135		✓	
10	SNHN10	5		✓	✓	May	150	✓		
11	SNHN11	4		✓	✓	May	250	✓		✓
12	SNHN12	4		✓	✓	April	100	✓		✓
13	SNHN13	2		✓	✓	May	100	✓		✓
14	SNHN14	6		✓	✓	May	200	✓		
15	SNHN15	5		✓	✓	April	90		✓	

K. Sample Collection

The two random samples were collected from bathroom in the Shraddha Nagar, Pusad. The selection of houses was conducted in preliminary study was based on the number of people per households, ages, gender and washing applications. These household were supplied with 20 litres plastic buckets for Grey water collection

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III. ANALYSIS OF GREY WATER

A. Dimensions and Capacity of Laboratory Scale Model

The laboratory scale integrated grey water treatment model is designed for 54 lit/hr. Capacity restiricted to five components such as storage tank with 54 litres capacity, sedimentation tank has 22.5 liters capacity, filter I (Gravel + sand) has 22.5 litres, filter II (coconut shell coal + charcoal) unit of 40 litres capacity and disinfection tank of 22.5 litre a capacity. The dimensions and capacity of component of laboratory scale model is given in table II

TABLE III
DIMENSIONS AND CAPACITY OF COMPONENTS OF LABORATORY MODEL

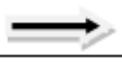
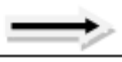
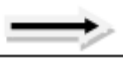
Sr. No.	Component	Dimensions	Capacity
1	Storage Tank	30 x 30 x 60cm	54 litre
2	Sedimentation Tank	25 x 20 x 45cm	22.5 litre
3	Filter-I (Gravel + Sand)	25 x 20 x 45cm	22.5 litre
4	Filter-II (Coconut shell coal + Charcoal)	25 x 20 x 45cm	22.5 litre
5	Disinfection Tank	25 x 20 x 45cm	22.5 litre

TABLE IIIII
FILTER MEDIA IN FILTER-I AND FILTER-II

Sr. No.	Component	Filter media	Thickness
1	Filter-I (Gravel + Sand)	Sand	8cm
		Gravel(20mm)	10cm
		Gravel(40mm)	10cm
2	Filter-II (Coconut shell coal + Charcoal)	Charcoal layer (alternate two layer)	7.5cm
		Coconut shell coal (alternate two layer)	7.5cm

B. Different Stages of Treatment of Grey Water

TABLE IV
DIFFERENT STAGES OF TREATMENT OF GREY WATER

Stage –I	Stage-II	Stage-III	Stage-IV	Stage-V
Before primary treatment	After primary treatment	After Secondary treatment	After tertiary treatment	Storage tank
Collection to sedimentation	Sedimentation to filter –I	Filter-I to Filter-II	Filter –II to Disinfection	Disinfection to outlet
Raw grey water **Influent**				Filtered grey water **Effluents**

C. Laboratory Analysis

The samples were collected from raw water and from each stage for the analysis. These samples are analyzed by standard method for water and waste water analysis at Environmental Laboratory of Babasaheb Naik College of Engineering, Pusad.
The following parameters were determined of raw and treated water sample for the performance study of laboratory scale integrated model. The table V shows the various parameters for Kitchen & Bathroom grey water.

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TABLE V
QUANTITY AND DATE OF COLLECTION OF GREY WATER

Sr. No.	Sample	Source	Quantity	Date Of Collection
01	Sample 1	Bathroom	100 litres	16/03/2017
02	Sample 2	Kitchen	100 litres	24/03/2017

TABLE VI
CHEMICAL ANALYSIS OF SAMPLE NO 1 (BATHROOM SAMPLE)

Sr. No	Parameters	Units	Raw water Influent	Sedimentation	Filter-I	Filter-II
			Stage -I	Stage –II	Stage -III	Stage –IV
1	pH	--	7.7	7.5	7.3	7.1
2	COD	mg/l	335	212	170	90
3	BOD	mg/l	280	185	123	68
4	TSS	mg/l	270	200	130	108
5	TDS	mg/l	210	178	112	60
6	Total hardness	mg/l	45	39	35	34
7	Turbidity	NTU	150	120	90	40
8	Color		Dark grey	Light grey	Light grey	Light black

TABLE VII
CHEMICAL ANALYSIS OF SAMPLE NO 2 (KITCHEN SAMPLE)

Sr. No	Parameters	Units	Raw water Influent	Sedimentation	Filter-I	Filter-II
			Stage –I	Stage –II	Stage -III	Stage –IV
1	pH	--	7.8	7.6	7.4	7.2
2	COD	mg/l	380	255	200	72
3	BOD	mg/l	340	215	180	63
4	TSS	mg/l	230	145	102	42
5	TDS	mg/l	160	90	55	48
6	Total hardness	mg/l	48	42	36	35
7	Turbidity	NTU	170	130	102	50
8	Color		Dark grey	Light grey	Light grey	Light black

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IV. RESULTS AND DISCUSSION

TABLE VIII

CHARACTERIZATION AND AVERAGE PERCENTAGE REMOVAL OF BATHROOM GREY WATER FROM A RESIDENTIAL AREA OF SHRADDHA NAGAR, PUSAD

Sr. No.	Parameter	Raw Water	Filtered Water			Reduction % Competency		
			Stage 1	Stage 2	Stage 3	Stage 1	Stage 2	Stage 3
1	pH	7.7	7.5	7.3	7.1	Nil	Nil	Nil
2	TSS	270	200	130	108	25.92	51.85	60
3	TDS	210	178	112	60	15.24	46.67	71.43
4	Total Hardness	45	39	35	34	13.33	22.22	24.44
5	COD	335	212	170	90	36.72	49.25	73.13
6	BOD	280	185	123	68	33.93	56.07	75.71
7	Turbidity	150	120	90	40	20	40	73.33

TABLE IX

CHARACTERIZATION AND AVERAGE PERCENTAGE REMOVAL OF KITCHEN GREY WATER FROM A RESIDENTIAL AREA OF SHRADDHA NAGAR, PUSAD

Sr. No.	Parameter	Raw Water	Filtered Water			Reduction % Competency		
			Stage 1	Stage 2	Stage 3	Stage 1	Stage 2	Stage 3
1	pH	7.8	7.6	7.4	7.2	Nil	Nil	Nil
2	TSS	230	145	102	42	36.96	55.65	81.74
3	TDS	160	90	55	48	43.75	65.63	70
4	Total Hardness	48	42	36	35	12.5	25	27.08
5	COD	380	255	200	72	52.89	47.37	81
6	BOD	340	215	180	63	36.76	47.06	81.47
7	Turbidity	170	130	102	50	23.53	40	70.58

V. CONCLUSIONS

The following are the major conclusions of major study

A. The present study demonstrates the reuse and treatment of residential bathroom Greywater for the purpose of landscaping, gardening and toilet flushing.

B. The treatment technology can be considered as a viable alternative to the conventional treatment plant in rural region.

C. The benefits of treatment system are low energy demand, less operating and maintenance cost, lower load on fresh water.

D. The treatment system is an environmental friendly, without chemical operation, cost effective and resourceful plant rural development.

E. Recycling of Greywater provides new water supplies to meet future need to protect health and safety.

F. The study helps to create awareness among people about re-use of grey water as one of the alternative source.

G. The current system investigated the performance of the plant for treatment of bathroom and kitchen Greywater shown in terms of deduction, competency of water

1) Bathroom: TSS (60%), TDS (71.43%), COD (73.13%), BOD (75.71%), Total hardness (24.44%).Turbidity (73.33%)

2) Kitchen : TSS (81.74%), TDS (70.0%), COD (81.0%), BOD (81.47%), Total hardness (27.08%).Turbidity (70.58%)

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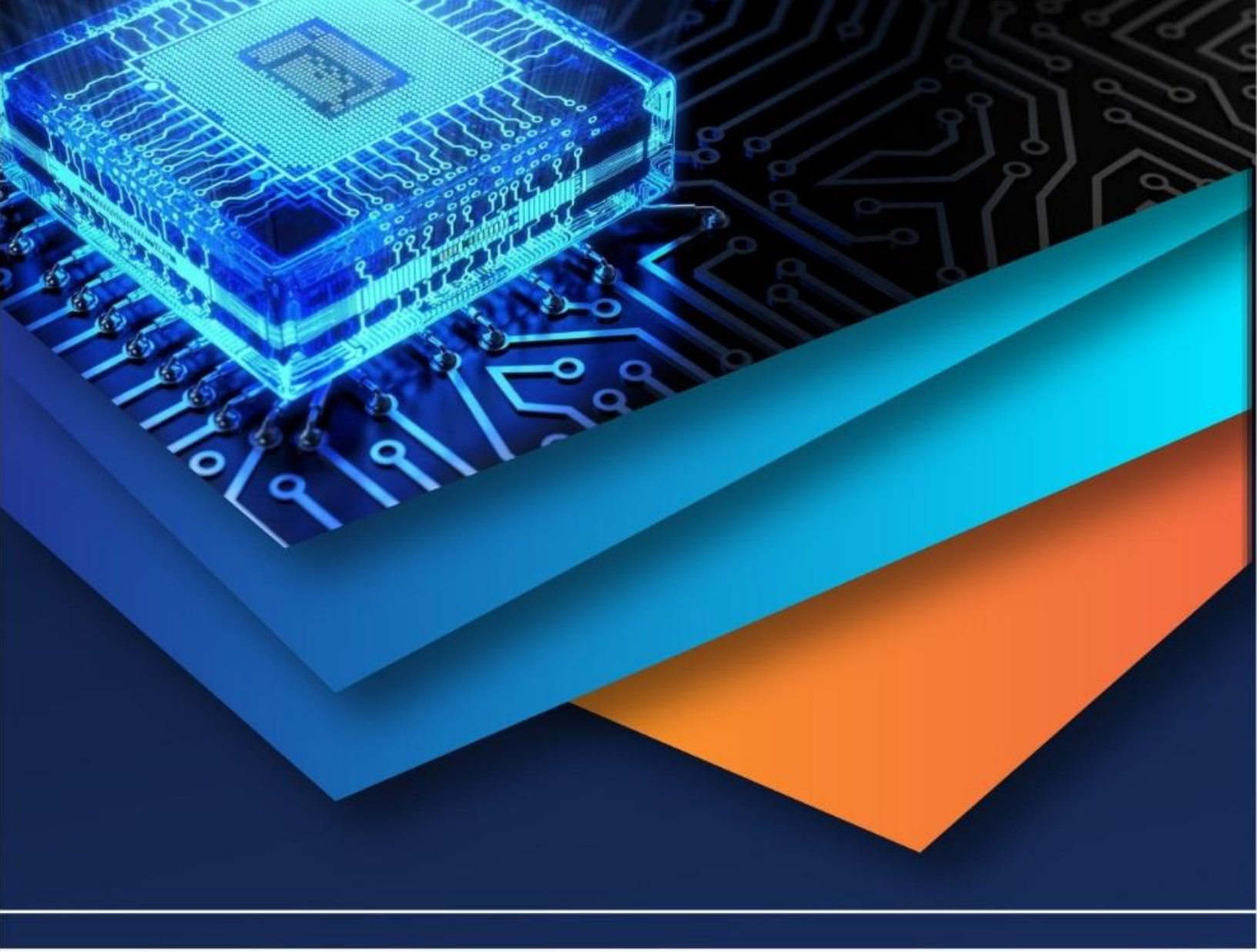

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