Experimental Analysis of Grey Water Treatment Using Nano Metal Oxides

Kundan Kamthe, MIT ADT University, Pune, India. **kundankamthe0078@gmail.com**
Samson Khade, MIT ADT University, Pune, India. **Samsonkhade30@gmail.com**
Prof. Asha Oak , MIT ADT University, Pune, India. **ashaoak68@gmail.com**

Abstract - Water, the essential need of all living beings has became an important matter of concern in this era as the source of water is depleting throughout the world. The rapid growth of population has increased the demands more and more water in all sectors: domestic, agricultural and industrial. Increased demand in water supply with improved living standard, unplanned urbanization, ground water extraction, surface water pollution, water intensive agriculture, industrialization has contributed depletion of future fresh water supply globally. In India also, the crisis of water has became big issue as millions of people do not have access to sufficient, safe fresh water for drinking and sanitation purposes. Therefore, conservation of water is an important matter of concern. One of the promising steps for conservation of water is its treatment and reuse of gray water. By reusing gray water for non-potable purposes such as toilet flushing, floor washing, car washing, garden irrigation etc. It can be possible to reduce the demand of fresh water to some significant extent; otherwise a lot of water will get lost after a single use.

I. INTRODUCTION

As pressures on freshwater resources grow around the world and as new sources of supply become increasingly scarce, expensive, or politically controversial, efforts are underway to identify new ways for meeting various water needs by increasing the efficiency of water use and to expand the usefulness of alternative sources of water which previously considered unusable, among these potential new sources of supply is "grey water".

Wastewater recycling is been and continues to be practiced all over the world for a various reasons including; to increase water availability, water shortages and drought, and support environmental and public health protection. The increase in water demand is due mainly to the steady rise in the world's population which also generates an increase in wastewater production. Consequently wastewater, if recycled, becomes a significant source of water that could potentially cover for the lack of freshwater observed elsewhere and the time require for treatment of waste is more. The area require for treatment of waste water is more so treatment of waste water become irrelevant to use.

India is facing a water crisis and by 2025 it is estimated that India's population will be suffering from severe water scarcity. Although India occupies only 3.29 million km2 geographical areas which forms 2.4% of the worlds land area, it supports over 15% of world's population with only 4% of the world's water resources. With increased population growth and development, there is a need to critically look at alternative approaches to ensure water availability. These alternative resources include rainwater and bulk of water used in household which will be emerging as grey water and contain some minerals, organic waste materials dissolved and suspended in it. When this is allowed to flow out this will join the sewage and bacteriologic ally contaminated, resulting in a sewage stream. It is possible to intercept this grey water, at the household level, treat it so that it can be recycled for garden washing and flushing purposes.A study by International Water Management Institute (IWMI) forecasted that there will be severe water scarcity in India by 2025.

Different states of India including Uttar Pradesh, Madhya Pradesh, Bihar, Jharkhand, Haryana, Karnataka, Gujarat, Maharashtra, Rajasthan, Andhra Pradesh, Telangana, and Odisha are facing serious problem in managing water to the consumers. Over 300 districts in 13different states of India are facing shortage of drinking water as per report on 10thMay, 2016 in Live mint. In Uttar Pradesh and Madhya Pradesh, the most number of districts, 50 and 46 respectively were affected due to crisis of water. As per news in January, 2017 in Times of India, 30 towns from Andhra Pradesh and Telangana face water crisis as the demand of drinking water rises. By 2030, minimum 21 cities in India will be moving towards zero ground water level as per the report by World Bank on 9thJune, 2018 in Business World. Many big cities like Chennai, Hyderabad, Coimbatore, Vijayawada, Smile and Kochi are moving towards severe water shortage. There are acute water crisis in some major cities of India like Delhi and Bangalore. As per British Broadcasting Corporation (BBC) news on 11th February, 2018, Bangalore is likely to run out of drinking water. Alarming bells are ringing in front of us to wake up for the rise in fresh water demand. We are now in the middle of cross road where further unsustainable and impractical uses of fresh water will not be acceptable. In the

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present context of water scarcity, it's a crucial time to think about it and the steps to combat the situation for us as well as for our future generation. So, treatment and reuse of gray water for various non- potable purposes is gaining a significant momentum of discussion for conservation and management of sustainable water.

II. PROBLEM STATEMENT

Addition of grey water with waste water the treatment loading will increase as well energy requirement increases

There were a number of problems related to the reuse of untreated greywater. The risk of spreading of diseases, due to the exposure to microorganisms in the water, will be a crucial point if the water is to be reused for e.g. toilet flushing or irrigation. Both inhaling (aerosols) and hand to mouth contact can be dangerous. Growth within the system is another source for microorganisms and some chemicals

The greywater that is going to be reused should be of satisfactory physical quality Suspended solids can cause clogging of the distribution system.

Another problem is the risk of Sulphide production, which is produced when oxygen is depleted and gives bad odour.

In grey water if there is bacteria such as gram positive and gram negative present it will remove by nano metal oxides.

Objectives:

- To analyze grey water properties.
- To design and develop working model for treatment of grey water.
- To check efficiency of developed model with and without nano metal oxides.

III. LITERATURE REVIEW

Gupta , Shreyas and Kuruvilla (2016)

The assessment has taken into consideration of different membranes related to nanotechnology for the waste water treatment such as nanostructure catalytic membrane along with membrane filtration technology, biomimetic membranes and ceramic membranes. Biomimetic membranes have greater value and importance. The biomimetic membrane does not vastly contribute towards process of purification of water but it also plays in part in reduction of cost of electricity up to 80% and it can also used in process of desalination which can further result reduction of electrical cost. Biomimetic membranes are considered as more important when compared to other membranes such as nanostructured catalytic membrane and ceramic membrane.

Sulekha (2016) Nanotechnology provides possibility of proficient removal of pollutants in water purification area. Diverse types of nano particles have proven effective in detention, removal of various contaminants. Four classes of nano scale materials that are functional materials for water purification.

Dendrimers Metal containing nano particles Zeolites

Carbonaceous nano material Various nano technology applications for sustainable water supplies are water filtration, water treatment, desalination and using such techniques as sensors, nanoparticles and catalyst. The only limitation to use nanotechnology is nanoparticles might be difficult to separate from treated solution which may result to loss of nano particles. This problem could be reduced by immobilization of nanoparticles on appropriate substrate. **Melhem and Smith (2012)** The performance of an integrated process consisting of an electronic coagulation (EC) unit and a submerged membrane bioreactor technology for grey water treatment. Grey water submerged membrane bioreactor. Electro coagulation performance slightly exceed that of SMBR for COD, turbidity and colour. Both processes produced effluent free of suspended solid and feacal. Coliform were nearly (100%) removal in both processes. Physical impurities both processes show excellent removal efficiency for colour and turbidity. Turbidity removal 97% in EC SMBR to 95%. Colour was reduced 94%-unit EC SMBR and to 91% in SMBR organic matter the treatment by EC SMBR process reduced the COD average of 89% compared with 86% by SMBR. **Gulgundi and Nagappa (2011)** Nanoparticles of magnesium oxides (MgO) were synthesized by using solution combustion technique using Magnesium Nitrate as oxidizer and sugar as fuel. The highly efficient, modular & multi-functional process enable by nano technology. The major application of Nano materials was critically review based on their function in unit process. Three categories of the technology show most promise of full-scale application, namely, nano adsorbent, nano technology enabled membrane & nano photo catalyst, nanometal oxides are excellent adsorbent. To improve treatment efficiency & reduce the time taken for satisfactory removal of organic & inorganic matter by using less quantity of chemical used. Porous nanocrystalline MgO was prepared by solution combustion synthetic process. Grab samples of soaps & detergent s manufacturing unit (courtesy of M/S Karnataka soaps and detergent limited Bangalore) was collected of inlet & outlet. In each experiment 100ml of inlet sample was taken in 250 ml beaker, a known quantity of MgO (0.05-0.3gm) an adsorbent was added & find optimum dose, their efficiency. The maximum level of BOD removal occurs in the presence of 0.3 mg of MgO (91% removal) & chloride removal occurs 6.3% in the presence of 0.2mg of MgO, COD removal are 93.7%. In conclusion a novel combustion synthetic method has been used successfully to prepare nano scale MgO powder. From synthetic of nano scale MgO to the recovery & reuse it is cost effective, eco-friendly in treatment.

MS, babu and premalatha (2016) The technologies are started as to treatment of waste water are nano absorbents,

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nano membranes and nano catalyst. All these techniques have commercial products, although they have not been applied in large scale application of water treatment. A promising separation process includes membrane filtration which allows continuous operation with small footprint and chemical use. Ceramic membranes are more advantageous than the polymeric membranes. Current techniques are resulting in significant loss of treatment efficiency. Research is needed to develop simple, low cost method to immobilize nano materials without significantly impact its performance.

IV. METHODOLOGY

- The first step of project to recognize the problem that society facing everyday.
- Second step is literature review in that various method of treatment is studied and reviewed. Various data is collected from research papers.
- Third step to finalize the project objectives.
- Fourth step to visit various treatment plant nearby.
- Fifth step sample collection from household.
- Sixth step is sample analysis is sample analysis. Various test should be done on collected sample.
- Seventh step design and development of model.
- Eighth step is analysis of grey water with or without nano metal oxide.
- Ninth step is result and discussion.

4.1 Procedure

Sample Collection: We collected daily sample of grey water from household chamber between 7-10 A.M. All type of grey water available in that chamber such as bathroom, washing machine and wash basin.These samples are taken daily. Various tests are carried out.

FIGURE 4.1: COLLECTION OF SAMPLES

TABLE 4.2: CHEMICAL AND PHYSICAL QUALITY OF GREY WATER TESTED

Sr. No	Parameter	Unit	Raw Grey Water tested							
1.	pH		8.40	8.59	8.77	8.21	8.50	8.44	8.50	8.63
2.	Turbidity	NTU	142	160	155	159	129	132	147	157
3.	BOD3	mg/l	120	132	127	128	122	130	132	124
4.	COD	mg/l	450	425	432	435	462	455	465	429
5.	Suspended solids	mg/l	42	59	48	51	55	53	46	54
6.	Dissolved solids	mg/l	58	60	62	55	59	62	54	59

FIGURE 4.2: DISSOLVED SOLIDS TEST

FIGURE 4.3: COLLECTED SAMPLES

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FIGURE 4.4: PH TEST

FIGURE 4.5: BOD INCUBATOR

FIGURE 4.6: DO PRESENT

FIGURE 4.7: COD DIGESTOR

FIGURE 4.8: TURBIDITY TEST

V. EXPERIMENTATION

5.1 Development of model

A house of 4 adults is assumed for design of model. Around 60 liters of grey water is generated form one person. Therefore around 240-250 liters of water can be generated from one house. So, we have assumed the model size should be around 17-18 liters. Model is small and can be move easily. The size of our model is around 50cmX20cmX25cm. Storage tank of around 100 liters also provided for storage of extra grey water so we can use that water for pressure. In model 9 compartments are provided for various purposes such as aeration, sedimentation, coagulation as well as filtration**.**

FIGURE 5.1: TOP VIEW OF MODEL

FIGURE 5.2: ELEVATION OF MODEL

5.2 Material used in compartments

1st Compartment- In first compartment grey water is stored. Suspended materials such as hair, sand particles and cloths material get trapped in first compartment.

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2nd Compartment- In this compartment silica sand is used of very thin size. The bed height is about 6 cm so very fine material get trapped and this sand easily washable. Small plastic screener also provided in bottom therefore nil sand get out of that compartment due to gravity.

3rd Compartment- various stone aggregate is placed in this compartment so after forming thin shape jelly various particles get trapped.

4th Compartment- In this broken brick metal is used for filtration purpose.

5th Compartment- In the charcoal is used as bed material around 5 cm thickness is given to charcoal material. Due to charcoal, odour of water change as well as various impurities get trapped such as volatile organic compound.

6th Compartment- Sand filter is used as bed in this compartment. Floating matters, suspended particles and sinkable particles get trapped.

7th Compartment- Alum stones as well as stone aggregates are used in this compartment so various tiny suspended particles get trapped in it. Alum act as a coagulant.

8th Compartment- In this compartment 2 plastic mesh is provided so no other particles should come in 8th compartment.

9th Compartment- In this compartment water is stored for future use. Outlet is provided for collection of treated Gray water.

FIGURE 5.3: WORKING MODEL

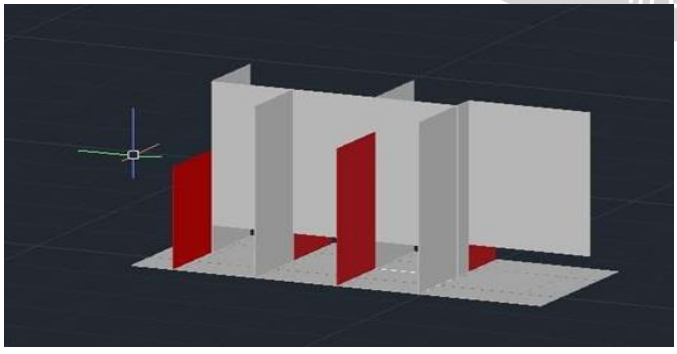

FIGURE 5.4: 3D OF MODEL SIDE VIEW

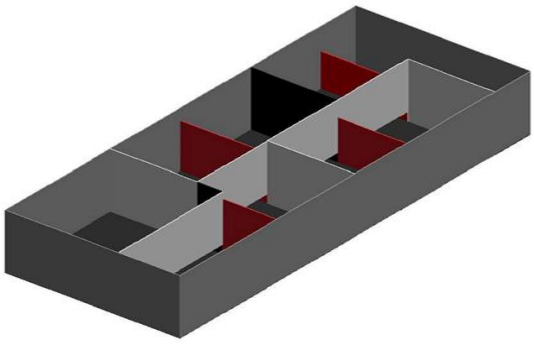

FIGURE 5.5: 3D OF MODEL TOP VIEW

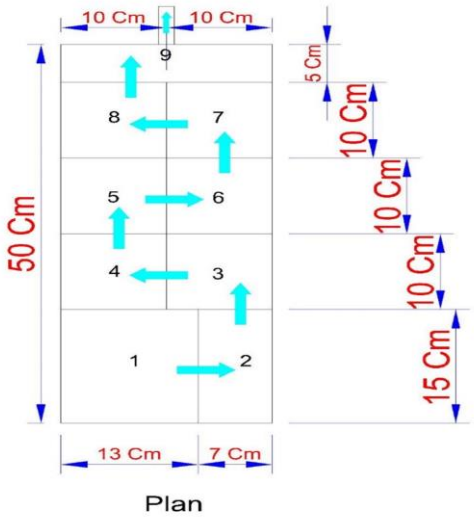

FIGURE 5.6: DIMENSIONS OF MODEL

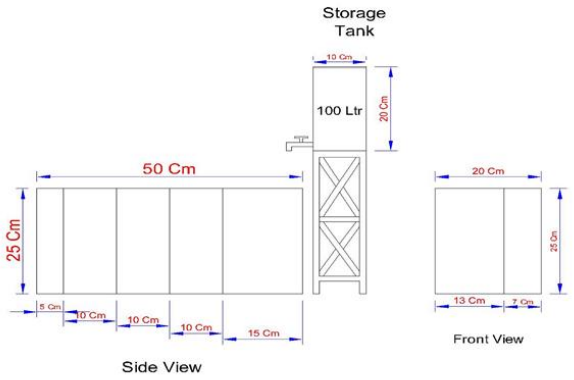

FIGURE 5.7: FRONT VIEW OF MODEL

5.3 Preparation of nano metal oxide

In this, chemicals and reagents of AR grade and distilled water were used in the preparation of solutions. Porous nanocrystalline MgO was prepared by Solution Combustion Synthesis process. Aqueous solution of Magnesium Nitrate as oxidizer and sugar as fuel (corresponding to equivalent stoichiometric ratio (Øc) of oxidizer to fuel (O/F) = 0.21) was taken in a beaker. The excess water was allowed to evaporate by heating on a hot plate until a gelatinous mass was left out and then introduced into a muffle furnace maintained at 450 ± 10 °C. Initially, the gelatinous mass

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underwent dehydration. Later, flameless ignition (smoldering) appeared at one end and propagated throughout the mass within a couple of minutes. Voluminous and porous nanocrystalline, pale white MgO was obtained. The theoretical equation assuming complete combustion of redox mixture used for the synthesis of MgO maybe written as:

24Mg(NO3)2 (aq) + 5C12H22O11(aq) → 24MgO(s) + 24N2 (g) + 60 CO2 (g) + 55H2O (g)

FIGURE 5.8: EVAPORATION OF EXCESS WATER FROM SOLUTION

FIGURE 5.9: MGO NANO METAL OXIDE AFTER HEATING IN MUFFLE FURNACE AT 450 °C

5.4 Calculation and results

Two days testing was done for grey water about 50 liters of water filtered. Grey water is discharged from storage tank to first compartment at flow rate of 0.45-0.50 liter per minute and at outlet we get varying flow rate around 0.20-0.25 liter per minute. Various tests are carried out such as pH, TDS, TSS, BOD, COD and turbidity. Sample are tested at inlet and outlet with or without nano metal oxide. 2 days reading taken in following tabular form.

TABLE 5.1: TESTING OF GREY WATER AT INLET AND OUTLET WITH OR WITHOUT NANO MEAL OXIDE

Sr.	Parameters	11 March 2021			12 March 2021		
		R	F	N	R	F	N
1	PH	8.40	7.87	7.87	8.77	7.90	7.90
2	COD (mg/lit)	473	130	128	460	125	120
3	BOD (mg/lit)	120	24.6	23	100	21.2	20.1
4	TDS (mg/lit)	58	13.2	13.4	60	14	14.3
5	TSS (mg/lit)	41.2	9.1	9	45	12.4	12.5
6	Turbidity (NTU)	157	41	39	150	35.6	36

R= Raw grey water F= filtered grey water
N= filtered grey water with nano metal oxide

VI. CONCLUSION

With the help of the analysis that has been concluded above that this model can be used for filtration of grey water. Nano metal oxide not give support as they give in waste water treatment. So nano metal oxide cannot be used for filtration. The various filter media require periodic maintenance so they can run with full efficiency. In first two days of test model can reduced COD up to 70-75% and BOD up to 70%. More test required to conclude the efficiency of this model for public use. Gray water has capacity that can be used for non-conventional use such as toilet flushing, floor cleaning and gardening.

The present study demonstrates the reuse and treatment of residential bathroom, wash basin, cloth washing. Based on finding of this study, this treatment can be considered as viable alternative to conventional treatment plant in small houses and in rural areas. The benefits found are nil energy demand, less maintenance cost, highly effective and can be used for ground recharge.

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