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"FEASIBILITY STUDY OF GREY WATER TREATMENT AND ITS REUSE FOR DIFFERENT PURPOSES"

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Abstract: *Increasing water demand due to the exponential growth in population has led to the idea of using waste water as a source of water. Immense technological advancements have been made in the field of waste water engineering which helps in separating various types of solids from waste water. Identification of the reuse potential of different types of waste water thus facilitates in treating them at source and using them for various beneficial purposes. Grey water, a mixture of waste water from kitchen, laundry and bathroom is such a source which due to its less organic and coliform content compared to mixed sewage may be treated and reused for purposes like landscape irrigation, agriculture, toilet flushing and ground water recharge.*

Key words: **Grey water, Reuse, Treatment, Tests, Filter design, Cost**

1. INTRODUCTION

Grey water is the waste water generated in the bath room, laundry and kitchen. Grey water is therefore the component of domestic waste water, which has not Originated from the toilet or urinal. Grey water from bathrooms Water used in hand washing and bathing generates around 50-60% of total grey water and is considered to be the least contaminated type of grey water. Common chemical contaminants include soap, shampoo, hair dye, toothpaste and cleaning products. It also has some faecal contamination (and the associated bacteria and viruses) through body washing.

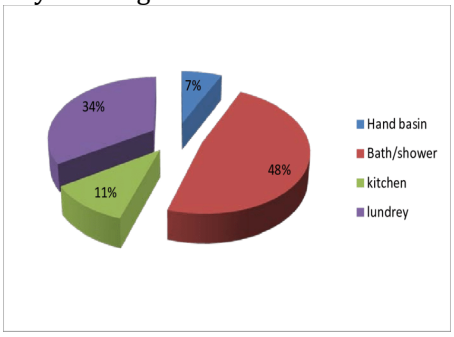

Fig.1 % of water greywater from sources

2. DIFFERENT CHARACTERISTICS F GREY WATER:

2.1. Various Physical characteristics:

2.1.1 Temperature:

Grey water temperature is often higher than that of the water supply and varies within a range of 18- 30ºC. These rather high temperatures are attributed to the use of warm water for personal hygiene and discharge of cooking water. These temperatures are not critical for biological treatment processes (aerobic and anaerobic digestion occurs within a range of 15-50ºC, with an optimal range of 25-35ºC). On the other hand, higher temperatures can cause increased bacterial growth and decreased $CaCO_3$ solubility, causing precipitation in storage tanks or piping systems.

2.1.2 Suspended solid:

Food, oil and soil particles from kitchen sinks, or hair and fibres from laundry can lead to higher solids content in grey water. These particles and colloids can cause turbidity in the water and may even result in physical pumps and filter used in treatment processes. Especially non-biodegradable fibres from clothing (polyester, nylon, and polyethylene), powdered detergents and soaps, as well as colloids are the main reasons of physical clogging. Suspended solids concentrations in grey water range from 50-300 mg/L, but can be as high as 1500mg/L. The highest concentrations of suspended solids are typically found in kitchen and laundry grey water. Suspended solids concentrations strongly depend on the amount of water used.

2.2 Various chemical characteristics:

2.2.1 pH and Alkalinity:

The pH indicates whether a liquid is acidic or basic.

For easier treatment and to avoid negative impacts on soil and plants when reused, grey water should show a pH in the range of 6.5 - 8.4. The pH value of grey water, which strongly depends on the pH value of the water supply,

2.2.2 Bio chemical oxygen demand and chemical oxygen demand:

The biological and chemical oxygen demand (BOD<COD) are parameters to measure the organic pollution in water. COD describes the amount of oxygen required to oxidize all organic matter found in grey water. BOD describes biological oxidation to bacteria within a certain time span (normally 5 days (BOD_5)). The main groups of organic substances found in waste water comprise proteins (mainly from food), carbohydrates (such as sugar or cellulose), fats and oils as well as different synthetic organic molecules surfactants that are not easily biodegradable. Discharging grey water with high BOD and Cod concentration into surface water results in oxygen deletion, which is then no longer available for aquatic life. A BOD and COD concentration on grey water strongly depends on the amount of water and products used in household. Where water consumption is relatively low, BOD and COD concentrations are high. The COD/BOD ratio is a good indicator of grey water biodegradability. A COD/BOD ratio below 2-2.5 indicates easily degradable waste water.

2.2.3 Nutrients:

Grey water normally contains low levels of nutrients compared to toilet waste water. Especially the high phosphorous contents sometimes observed in grey water can lead to problems such as algae growth in receiving water. Levels of nitrogen in grey water are relatively low. Kitchen wastewater is the main source of nitrogen in domestic grey water, the lowest nitrogen levels are generally observed in bathroom and laundry grey water. Nitrogen in grey water originates from ammonia and ammonia- containing cleansing products as well as from proteins in meats, vegetables, protein containing shampoos, and other household products in some special cases, even the water supply can be an important source of ammonium nitrogen.

2.2.4 Oil and Grease:

Grey water may contain significant amounts of fat such as oil and grease (O&G) originating mainly from kitchen sinks and dishwashers (e.g. cooking grease, vegetable oil, food grease etc.).

2.2.5 Surfactants and other household chemicals:

Surfactants are the main component of household cleaning products. Surfactants, also called surface- active agents, are organic chemicals altering the properties of water. By lowering the surface tension of water, they allow the cleaning solution to wet a surface (e.g. clothes, dishes etc) more rapidly. They also emulsify oily stains and keep them dispersed and suspended so that they do not settle back on the surface. The most common surfactants used in household cleansing chemicals are LAS (Linear Alkyl Benzene Sulphonate), AES (Alcohol Ether Sulphate) and AE (Alcohol Ethoxylate). Laundry and automatic dishwashing detergents are the main sources of surfactants in grey water; other sources include personal cleansing products and household cleaners. The amount of surfactants present in grey water is strongly dependent on type and amount of detergent used.

2.3 Microbial Characteristics of Grey water

Grey water may pose a health risk due to its contamination with pathogens. However, pathogens, such as viruses, bacteria, protozoa and intestinal parasites, are assumed to be present in partly high concentrations. These pathogens originate from excreta of infected persons. They can end up in grey water through hand washing after toilet use, washing of babies and children after defecation, diaper changes or Diaper washing. Some pathogens may also enter the grey water system through washing of vegetables and raw meat; however, pathogens of fecal origin pose the main health risks.

3. AIM AND OBJECTIVE:

3.1. Aim

- The aim of this study is to check the feasibility of Grey Water Treatment and its reuse for different purposes for T.P No – 7 (Anjana), South East Zone, Surat city.

3.2. Objective

- To study the existing problem.
- To study the properties and characteristics of grey water.
- To carry out different test on selected sample to check theusability.
- To design the filter required for the treatment process.
- To provide cost and estimate.
- Forecasting quantity of water for selected zone/T.P./village.

4. STUDY ARAE DEDAIL:

4.1 Quantity of grey water produced in study area:

Table 1. Quantity of grey water of Surat

Population	71, 85,000
People used freshwater in lpcd	135x71, 85,000 = 969975000 lit
Quantity of greywater per year	969975000 x 64%x 365 = 226586160 cu.m/yr

Table 2 Quantity of grey water in selected area of TP 07[Anajna]

Population	105089
People used freshwater I lpcd	135*105089 =14187015 lit
Quantity of greywater in lpcd	14187015 x 64% = 3314083 cu.m/yr

4.1 Review of people of study area about grey water treatment:

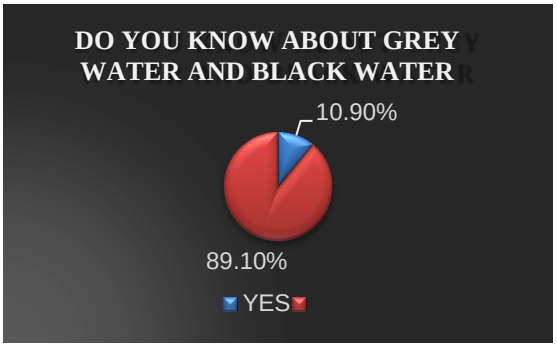

Chart-1:Review of people bysurvey

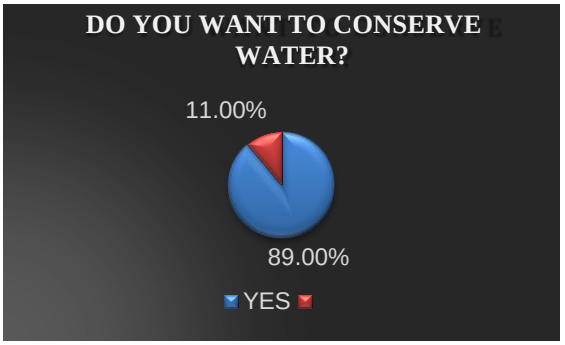

Chart-2: Review of people by survey

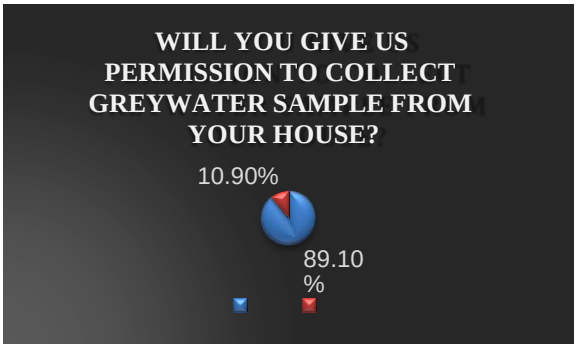

Chart-3: Review of people by survey

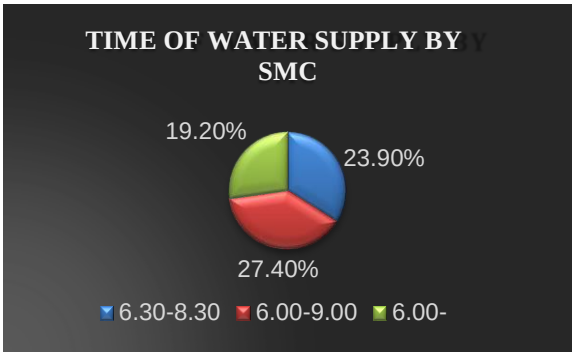

Chart-4: Reviewofpeoplebysurvey

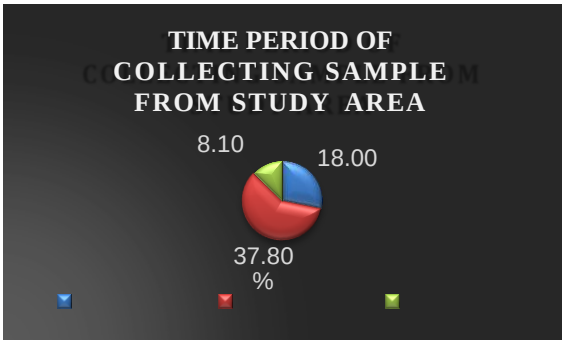

Chart-5: Review of people by survey

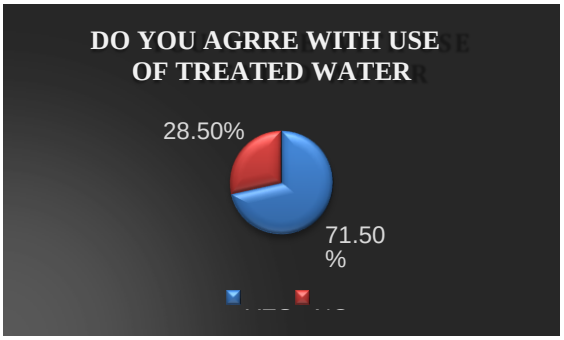

Chart-6: Review of people by survey

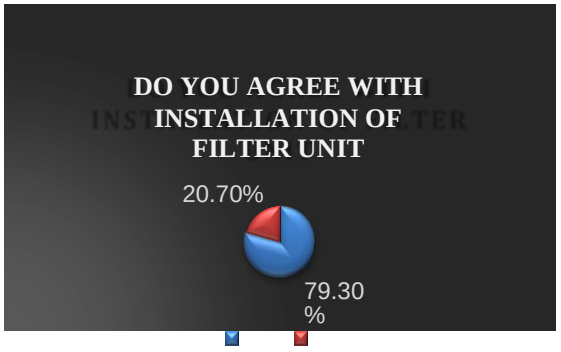

Chart-7: Review of people by survey

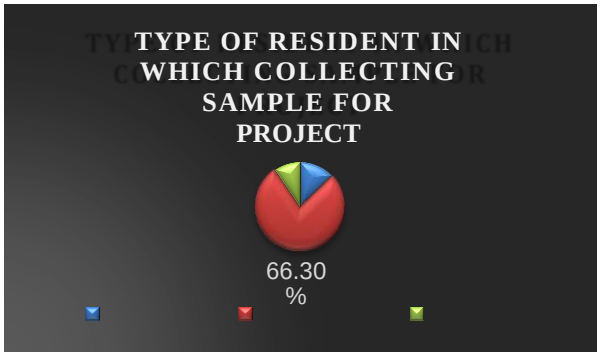

Chart-8: Review of people by survey

4.2 Different test performed on grey water before filtration and after filtration:

- Color
- Odour
- Turbidity test
- Dissolved oxygen test
- Total dissolved solids
- COD
- BOD
- pH value test

4.3 Sample collection

Total 5 sample of grey water collected from study area And one sample of bath, kitchen sink, cloth wash and handwash also collected from study area for treatment purpose and testing purpose.

4.4 Grey water treatment techniques:

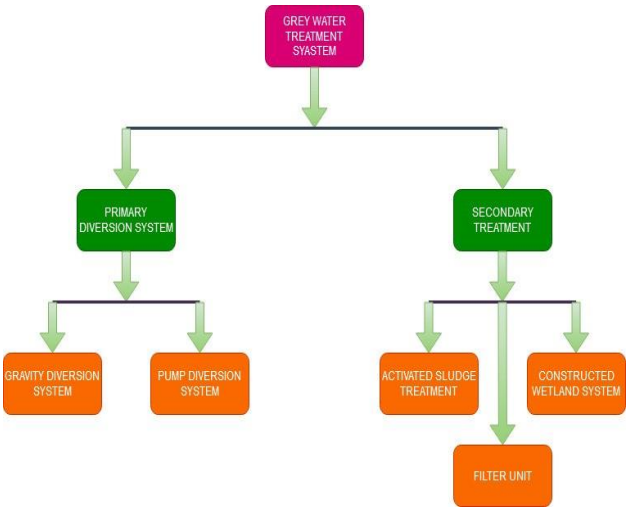

Image 1: techniques of filter

4.5 Benefits of use of filtration method:

- Efficiency to absorb contaminants goes as high as 90%
- This filtration **process** is easy to operate.
- Low maintenance.
- Effectively removes chlorine, organics, bad taste, and odour.
- Cost effective – reduced installation cost.
- Operating costs – limited to **filter** replacement.

4.6 Material used for filter:

Table 2materials

MATERIAL	SIZE OF PARTICAL	WEIGHT OF SAMPLE
AGGREGATE	4-12MM	4 KG
FINE AGGREGATE	2-4 MM	5 KG
COARSE SAND	0.5 -1 MM	3 KG
FINE SAND	< 0.5MM	2 KG
ACTIVATED CARBON	< 1MM	1 KG
COTTON CLOTH	-	-

4.7 Graphical representation of grey water tests before and after filtration:

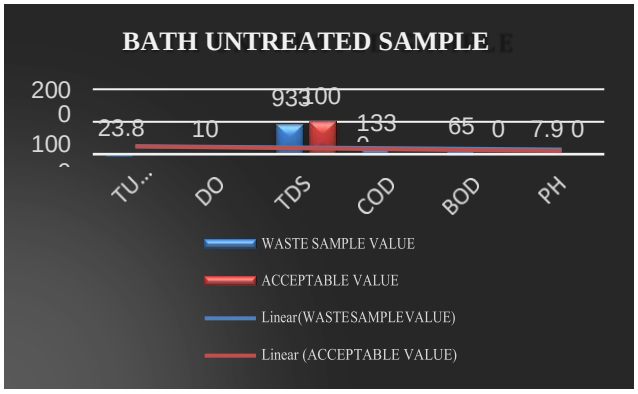

Chart-9:UntreatedSamplevalue-bath

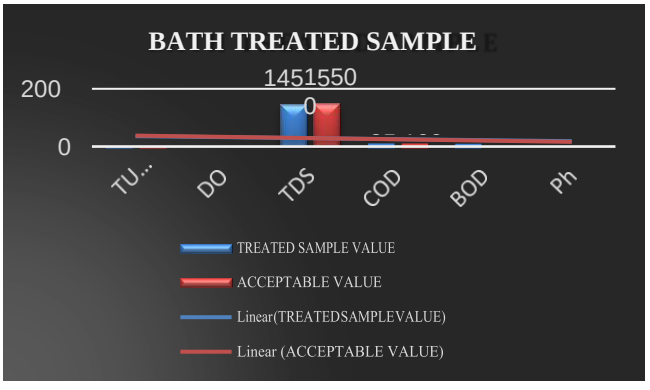

Chart-10:TreatedSamplevalue-bath

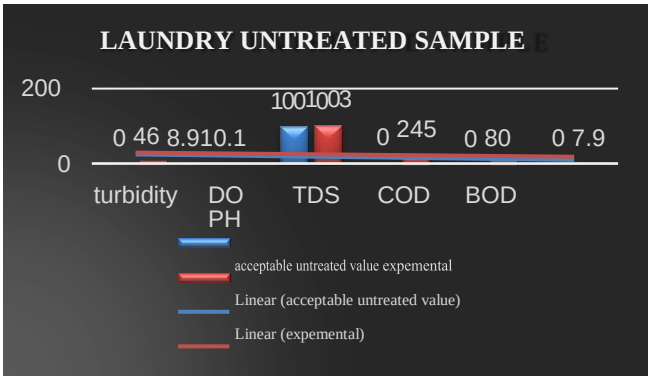

Chart-11: Untreated Sample value-laundr

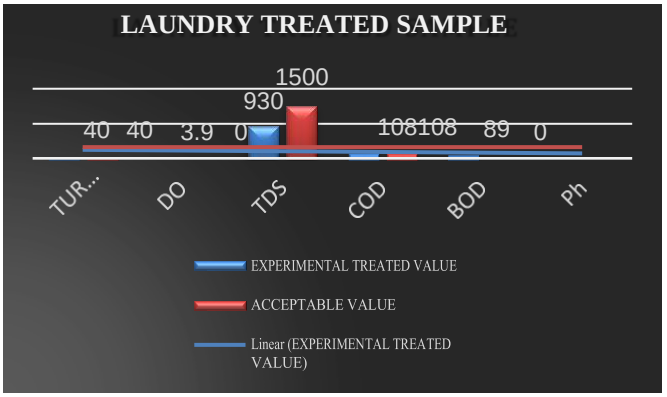

Chart-12: Treated Sample value-laundry

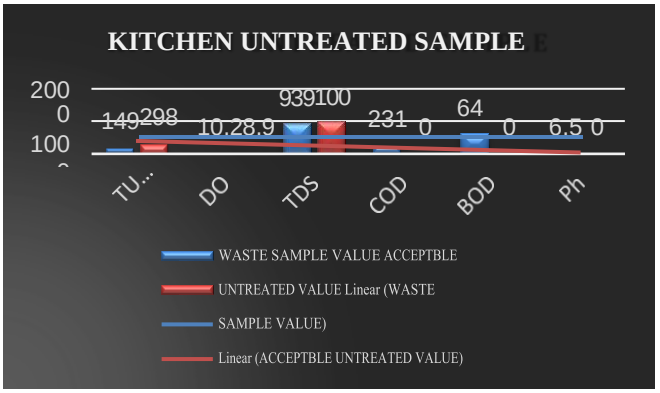

Chart-13: Untreated Sample value-kitchen

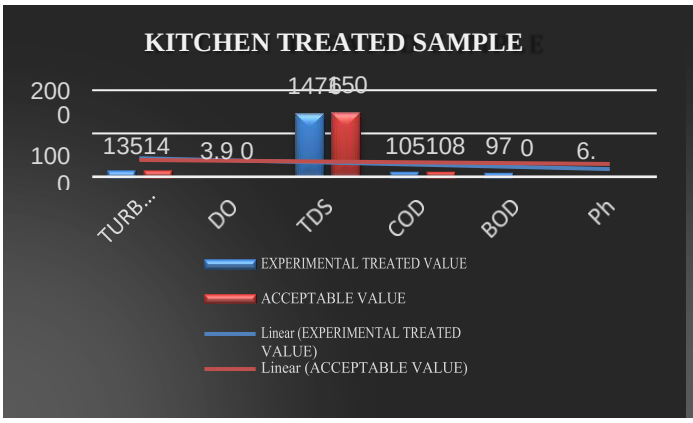

Chart-14: Treated Sample value- kithchen

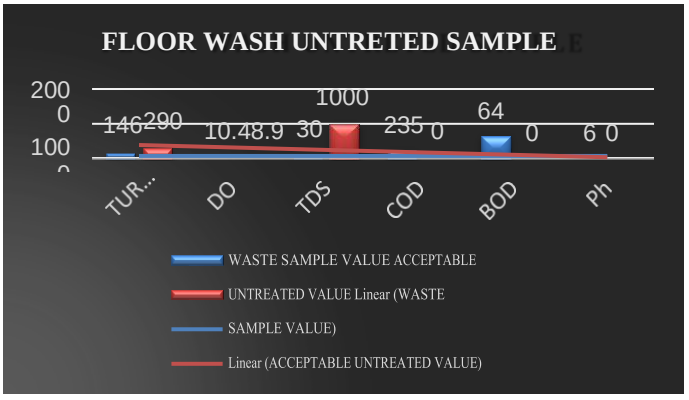

Chart-15: Untreated Sample value-floor wash

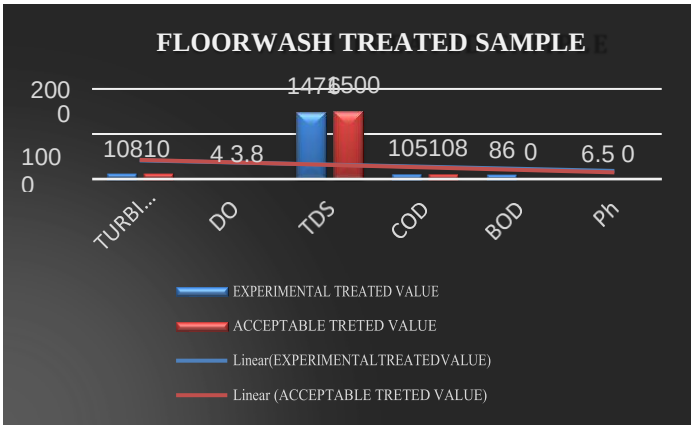

Chart-16: Treated Sample value-floor wash

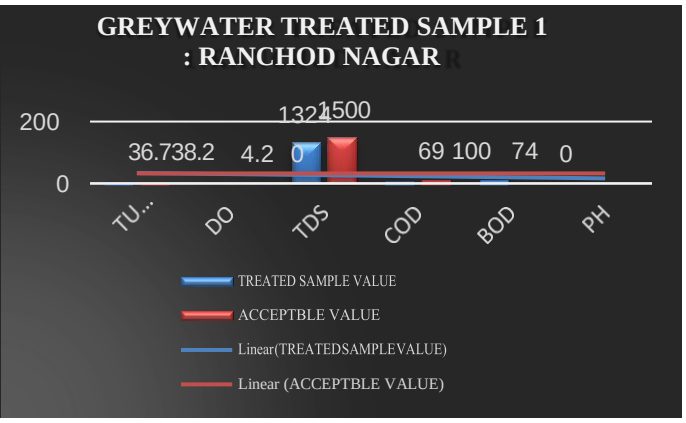

Chart-17: Untreated Sample value-Ranchod Nagar

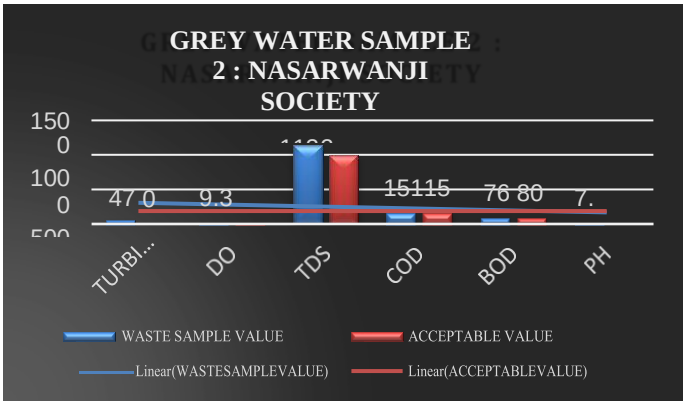

Chart-18: Untreated Sample value-Nasarwanji society

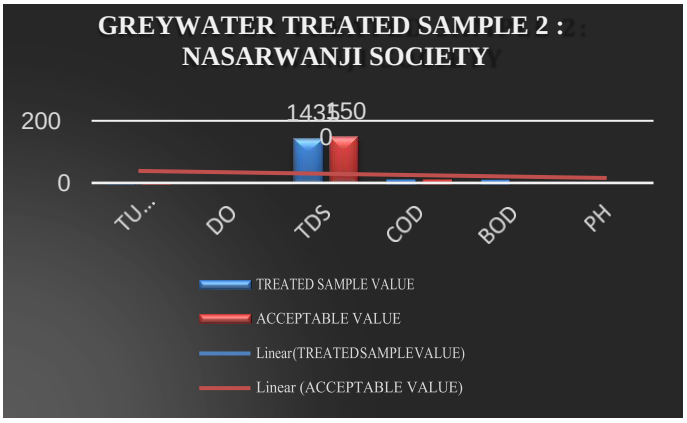

Chart-19: Treated Sample value- Nasarwanji society

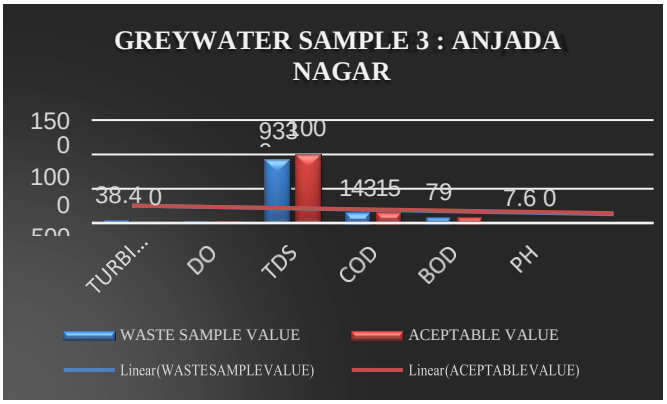

Chart-20 Untreated Sample value- Anjada nagar

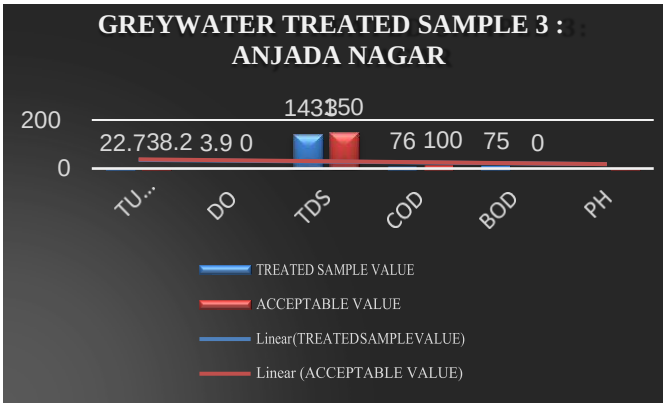

Chart-21 Treated Sample value- Anjada nagar

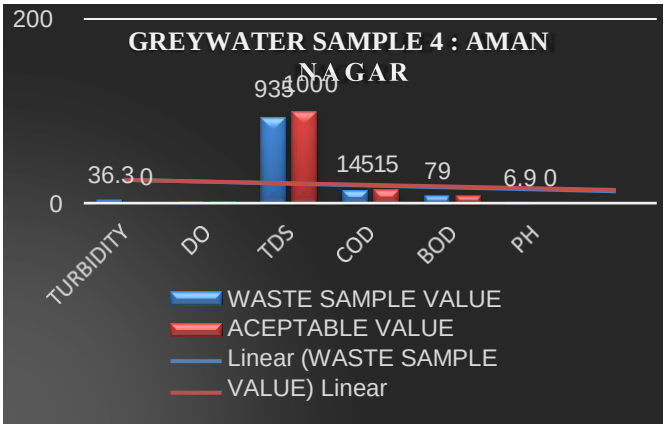

Chart-22 Untreated Sample value- Aman nagar

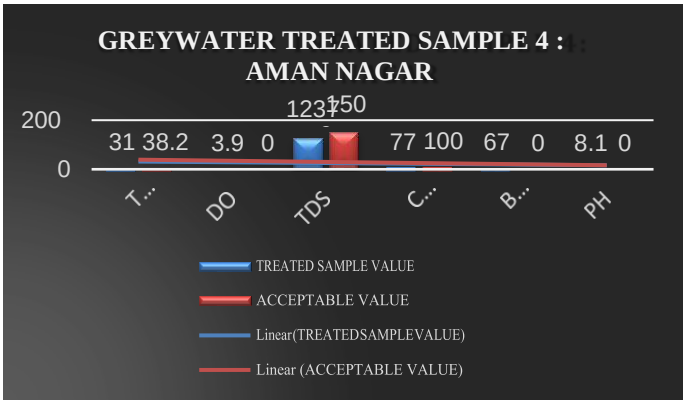

Chart-23 Treated Sample value- Aman nagar

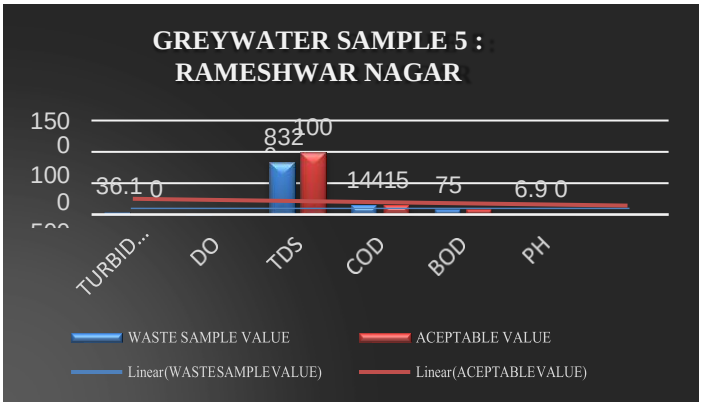

Chart-24 Untreated Sample value- Rameshwar nagar

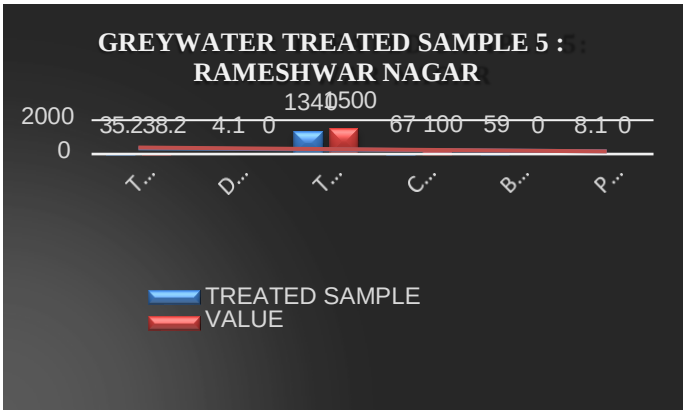

Chart-25 Treated Sample value- Rameshwar nagar

4.8 Design of filter media:

- Density = Weight of Sample / Volume of filter bottle
- Volume = Area x thickness
- Thickness= volume / area

I. Thickness of coarse aggregate:

Weight of coarse aggregate: 4kg
Density of coarse aggregate: 1450 kg/m3
Volume=4/1450=0.028
Area=0.037 sq.
Thickness=0.028/0.037=0.07m=7cm

II. Thickness of fine aggregate:

Weight of fine aggregate: 5 kg
Density of coarse aggregate: 2082 kg/m3
Volume=5/2082 =0.024
Area=0.037 sq.
Thickness=0.024/0.037=0.065m=6.5 cm
say 7cm

III. Thickness of coarse sand:

Weight of coarse sand: 3 kg
Density of coarse aggregate: 2082 kg/m3
Area=0.037 sq.

Thickness=0.0014/0.037=0.037 m=3.7cm say 4 cm

IV. Thickness of fine sand:

Weight of fine sand: 2kg
Density of coarse aggregate: 1450 kg/m3
Volume=2/1450=0.0014
Area=0.037 sq.m
Thickness=0.0014/0.037=0.037m=3.7 cm say
4 cm

V. Thickness of activated carbon:

Weight of activated carbon: 1 kg Density of coarse aggregate: 34.4 kg/m3
Volume=1/34.4=0.029
Area=0.037 sq.m Thickness=0.029/0.037=0.0785 m=7.85 cm
say 10 cm

4.9 Uses of Treated water:

- Gardening
- Irrigation to food product
- Irrigation to non-food product
- Flushing of toilet
- Washing of floors
- Non-potable purposes in commercial building
- Used for landscaping and fountain
- Washing of vehicles

5. CONCLUSION

- We are conclude that by making filter, the sand acts as a good filtration medium. The sand filtration is a combination of physical, chemical and biological process as it removes turbidity, organic matter and microorganism's coarse particles help to remove suspended solids, whereas fine particles remove ions by adsorption and ion exchange mechanism. Further, the removal process is more effective with the increase in surface area. Activated carbon has removed the color of the greywater which is identified by the colorless nature of the treated greywater. It is also to be noted that if the time of contact between the flow of water and the Materials present in the column increases, the efficiency in removal also increases.

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