DOMESTIC WASTEWATER TREATMENT BY AQUATIC PLANTS

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Abstract: The roots of Water hyacinths (WH) and some other aquatic plants naturally absorb pollutants as well as some organic compounds which are carcinogenic and have concentrations of approximately 10,000 times that is present as in generically found water. WH can be cultivated for waste water treatment and it can be used to aid the process of water purification either for industrial waste water or sewer water, in addition to available techniques. The root structures of Floating aquatic plants provide a suitable environment for aerobic bacteria to remove various impurities present in water. This study attempts to evaluate the effect of WH in Domestic Waste water (Grey Water). Further, the reading for various parameters like Turbidity, pH, Chemical oxygen demand (COD), Biochemical Oxygen Demand (BOD), Dissolved Oxygen (DO), TSS, TDS, Conductivity, Chlorides, Nitrate, Phosphate, Total Acidity, Total Alkalinity, Total Hardness has been periodically taken every 24 hrs for 5 days. The effect of Water Hyacinth has resulted in significant decrease in turbidity and due to which the removal of flocs and reduction in organic matters in water have been observed. The primary purpose of this study is to make use of the water hyacinth plant for the purification of Domestic Wastewater.

***Index Terms* - : Water Hyacinth plant, Domestic Wastewater, Aquatic plants, Water Purification**

I. INTRODUCTION

WASTEWATER GENERALLY IS MADE OF BLACK WATER AND GREY WATER. GREY WATER ALSO KNOWN AS SULLAGE, IS NON-INDUSTRIAL WASTEWATER OR DOMESTIC WASTEWATER GENERATED FROM DOMESTIC PROCESSES SUCH AS WASHING DISHES, LAUNDRY AND BATHING. GREY WATER COMPRISES 50-80% OF RESIDENTIAL WASTEWATER. GREY WATER IS DISTINCT FROM BLACK WATER IN THE AMOUNT AND COMPOSITION OF ITS CHEMICAL AND BIOLOGICAL CONTAMINANTS (FROM TOXIC CHEMICALS). GREY WATER GETS ITS NAME FROM CLOUDY APPEARANCE AND FROM STATUS AS BEING NOT FRESH (WHITE WATER FROM GROUND WATER OR PORTABLE 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, CHEMICALS AND ANY NUMBER OF OTHER IMPURITIES, IT MAY STILL BE SUITABLE FOR REUSE. REUSING GREY WATER SERVES TWO PURPOSES: IT REDUCES THE AMOUNT OF FRESHWATER NEEDED TO SUPPLY A HOUSEHOLD, AND REDUCES THE AMOUNT OF WASTE WATER ENTERING SEWER OR SEPTIC SYSTEMS. GREY WATER IS A DOMESTIC WASTE WATER THAT IS COLLECTED FROM HOUSES, COMMERCIAL BUILDING AND INSTITUTIONS OF THE COMMUNITY. IT MAY INCLUDE PROCESS WASTEWATER OF INDUSTRY (FOOD, LAUNDRIES) AS WELL AS GROUND INFILTRATION. IT IS PRIMARILY SPENT WATER FROM BUILDING WATER SUPPLY TO WHICH HAVE BEEN ADDED TO THE WASTE EFFLUENT OF BATHROOMS, KITCHENS AND LAUNDRY (CROOK, 1991).

Domestic wastewater is the used water from the kitchen, bathrooms and laundry. Many of the minerals and organic matters in the water serve as food for saprophytic micro-organisms and hence the wastewater is unstable bio-degrable.

Reduction of relative dependence on portable water usage is becoming a necessary facet of good water management. Many new and modified treatment processes are being investigated in an attempt to solve the serious water supply and waste water disposal problems of the growing population and its industries. Even with application 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 (Crook, 1991).

There are two types of constructed wetlands: subsurface flow and surface flow constructed wetlands. The planted vegetation plays an important role in contaminant removal. The filter bed, consisting mainly of sand and gravel, has an equally important role to play. Some artificial wetlands may also serve as a habitat for native and migratory wildlife, although that is not their main purpose. Subsurface flow artificial wetlands are designed to have either horizontal or vertical flow of water through the gravel and sand bed. Vertical flow system have a small space requirement than horizontal flow systems.

II. Literature Review-

***R. Sooknaah (2000*) [3]-** Presence of aquatic plants in natural wet-lands not only reduces the concentration of problematic nutrients from the wastewater, but also alters the physico-chemical environment of the water, rhizosphere and underlying sediment (Reddy & Patrick, 1984). In addition to plant assimilation of nutrients, changes in the environment of the water also help in reducing the pollutant level of the wastewater through biochemical processes brought about by micro-organisms. This paper gives a review of the biochemical and physico-chemical processes occurring in a floating aquatic plant system.Composition of C & D waste.

Piyush Gupta [2]- Phytoremediation techniques for the treatment of different types of wastewater have been used by several researchers. These techniques are reported to be cost effective compared to other methods. Various contaminants ex. TSS, DS, electrical conductivity, hardness, biochemical oxygen demand, chemical oxygen demand, dissolved oxygen, nitrogen, phosphorous, heavy metals, and other contaminants have been minimized using water hyacinth, water lettuce and vetiver grass. In

this paper, role of given plant species, origin and their occurrence, eco-logical factors and their efficiency in reduction of different water contaminants have been presented.

Praveen Solanki [1]- Treatment of wastewater will leads to the problems again, if we will not use new more efficient alternative technologies/methods to avoid drawback of old technologies. Loss of water can be reduce through application of easy, inexpensive and eco-friendly technologies for wastewater treatment. Using Floating plants to purify polluted wastewater is a process/method of ecological restoration at in-situ, as well as a complicated physical (attachment of pollutants to the root surface), chemical (degradation of matels into less toxic form) and biological process (microbial processes). Its core is utilizing aquatic plants such as Canna and Water lily and root attached microbes such as bac-teria, fungi and algea to absorb pollutants such as nitrogen and phosphorus, degrade organic matter and accumu-lates heavy metals in their biomass.

III. Material Used and Methods-

After going through the different research paper the topic is selected.

Sample Collection- 5 samples of grey water were collected at the interval of 24 hours from the house.

Laboratory Testing of Sample Influent- Chemical and physical parameters of influent sample were checked before the treatment like BOD, COD, Turbidity, pH, Hardness, Alkalinity, Acidity etc.

Preparation of Artificial Pond- We take a tub shape container in which treatment process were done.

Selection of Aquatic Plant- According to the study we selected water hyacinth because of its results, its higher growth rate and easier availability in the environment.

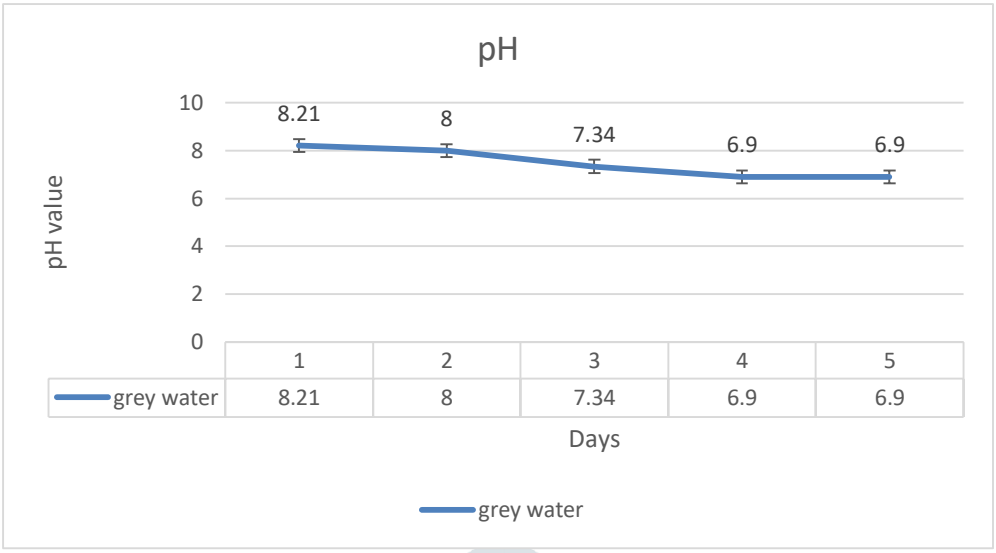
Laboratory Testing of Sample Effluent- Chemical and physical parameters of effluent grey water sample were checked after the treatment like BOD, COD, Turbidity, pH, Hardness, Alkalinity, Acidity etc.

IV. RESULT AND DISCUSSION-

The samples are collected from home for 5 days, treated with aquatic plant and analyzed as soon as possible. All the samples were analyzed for physical and chemical parameters to ascertain the quality of greywater, which is used for various purposes.

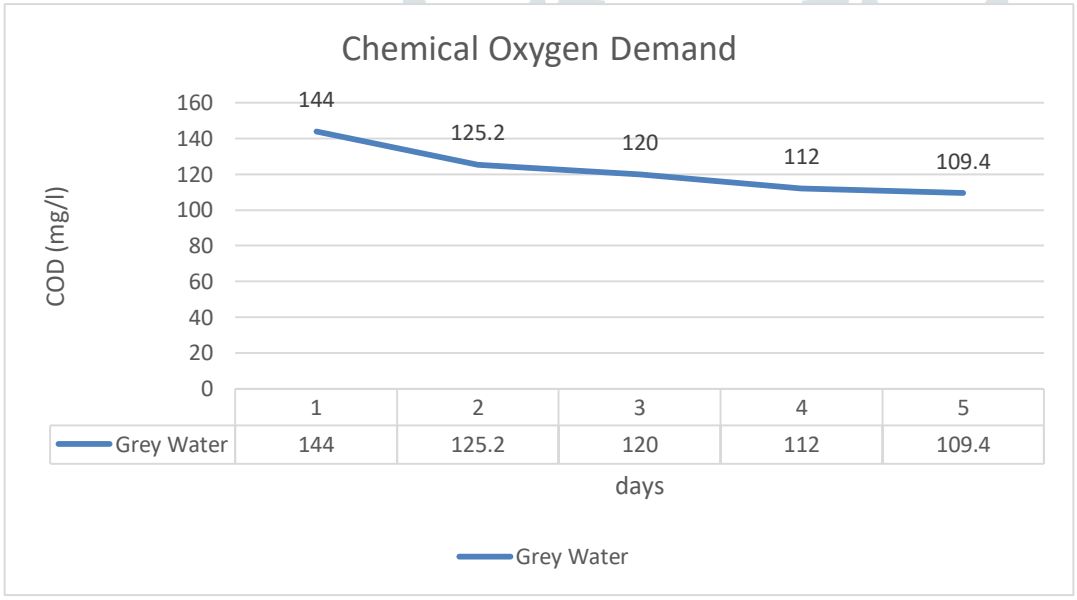
S.R. No.	Parameters	Day 1	Day 2	Day 3	Day 4	Day 5
	pH	8.21	8.0	7.34	6.90	6.90
2.	Chemical Oxygen Demand (COD), mg/l	144.0	125.2	120.0	112.0	109.4
3.	Biochemical Oxygen Demand (BOD), mg/l	26.0	24.6	18	12	11.4
4.	Dissolved Oxygen (DO), mg/l	7.8	12	12.4	13.2	13.2
5.	Total Suspended Solids, mg/l	88.0	86.0	75.2	75.0	75.0
6.	Conductivity, µS/cm	2039	2000.0	2000.0	1993.3	1990.0
7.	Turbidity, NTU	74.0	64.0	60.2	52.6	51.6
8.	Nitrate (NO_2), mg/l	4.0	3.7	2.5	2.0	2.0
9.	Phosphate(P), mg/l	1.8	1.8	1.8	1.6	1.6
10.	Total Acidity, mg/l	48.0	41.0	35.3	25.0	25.0
11.	Total Alkalinity, mg/l	175.0	153.2	130.0	124.4	115.0
12.	Total Dissolved Solids, mg/l	480.0	442.2	400.2	380.8	377.0
13.	Total Hardness, mg/l	610.0	610.0	570.82	510.4	481.6
14.	Calcium Hardness, mg/l	20.0	17.9	16.0	16.0	16.0
15.	Magnesium Hardness, mg/l	122.0	118.0	117.3	104.5	102.0

1. POTENTIAL OF HYDROGEN (PH)-



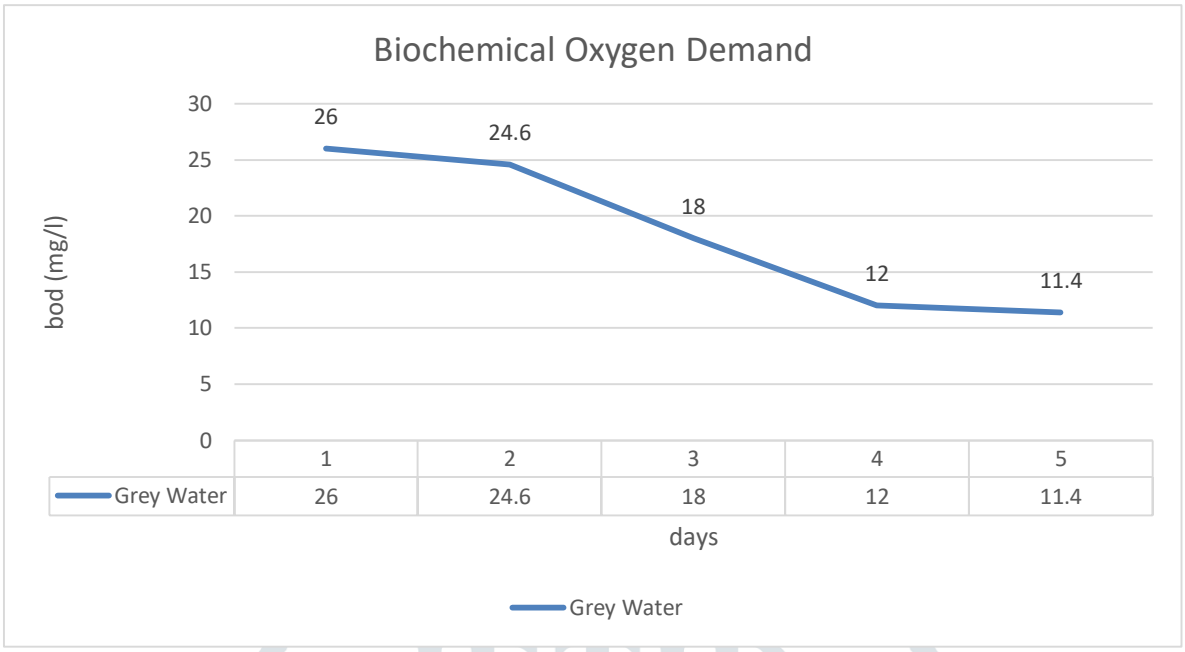
From the results of the analysis it has been observed that the pH value of Grey water(Before treatment) was 8.21, and after treatment with water hyacinth for 5 days, the pH value decreases to 8.0, 7.34, 6.90 and 6.90. The graph show that the pH value will not much change after 5th day.

2. Chemical Oxygen Demand (COD)-



The initial or 1st day of COD value was 144 mg/l before treatment and after treatment with water hyacinth 2nd, 3rd, 4th, and 5th day values are 125.2 mg/l, 120.0 mg/l, 112.0 mg/l and 109.4 mg/l.

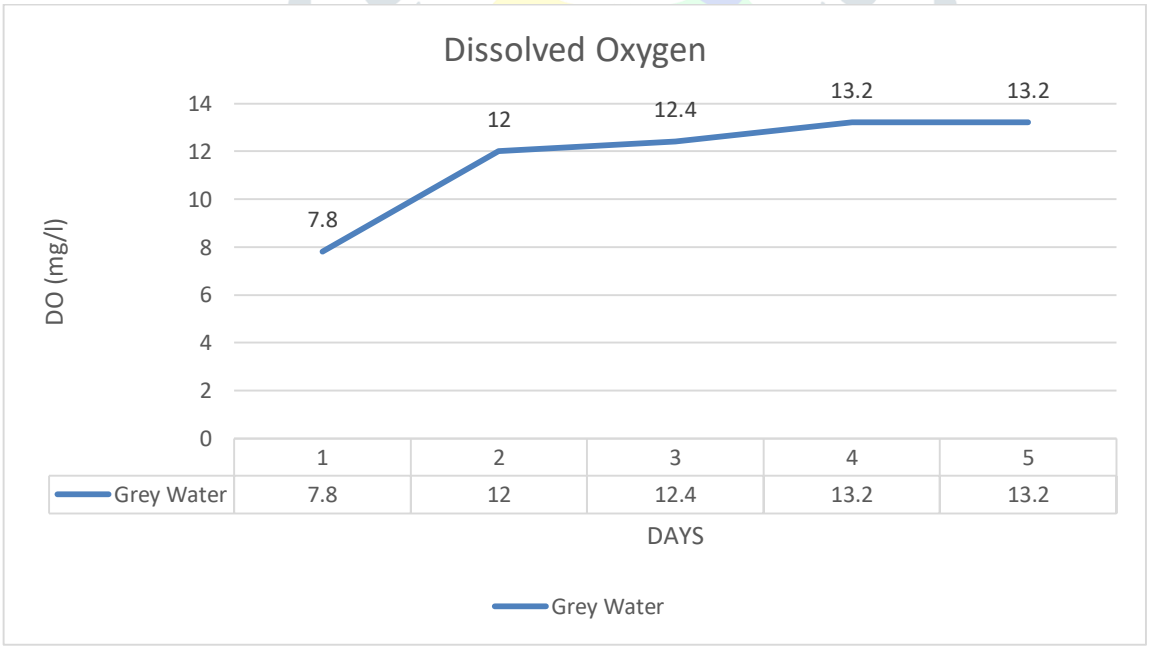
3. Biochemical Oxygen Demand (BOD)-



Biochemical Oxygen Demand (BOD, also called Biological Oxygen Demand) is the amount of dissolved oxygen needed (i.e. demanded) by aerobic biological organisms to break down organic material present in a given water sample at certain temperature over a specific time period. The BOD value is most commonly expressed in milligrams of oxygen consumed per liter of sample during 5 days of incubation at 20 °C and is often used as a surrogate of the degree of organic pollution of water.

The initial or 1st day of BOD value was 26.0 mg/l before treatment and after treatment with water hyacinth 2nd, 3rd, 4th, and 5th day values are 24.6 mg/l, 18 mg/l, 12 mg/l and 11.4 mg/l.

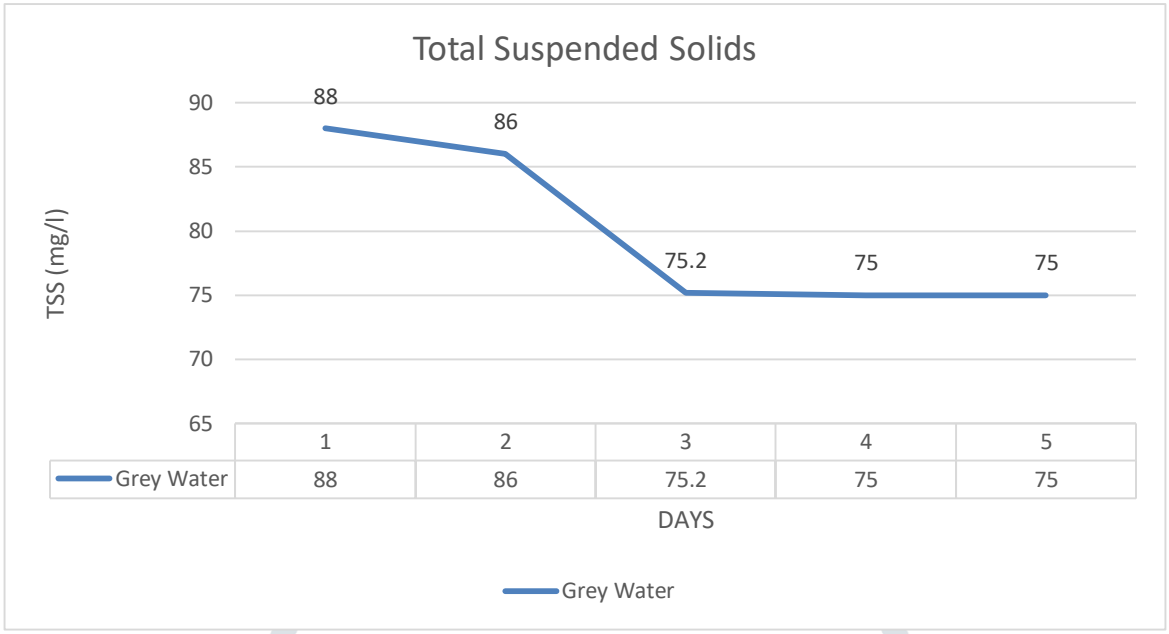
4. Dissolved Oxygen (DO)-



Dissolved Oxygen is the amount of gaseous oxygen (O2) dissolved in the water. Oxygen enters the water by direct absorption from the atmosphere, by rapid movement, or as a waste product of plant photosynthesis. Water temperature and the volume of moving water can affect dissolved oxygen levels.

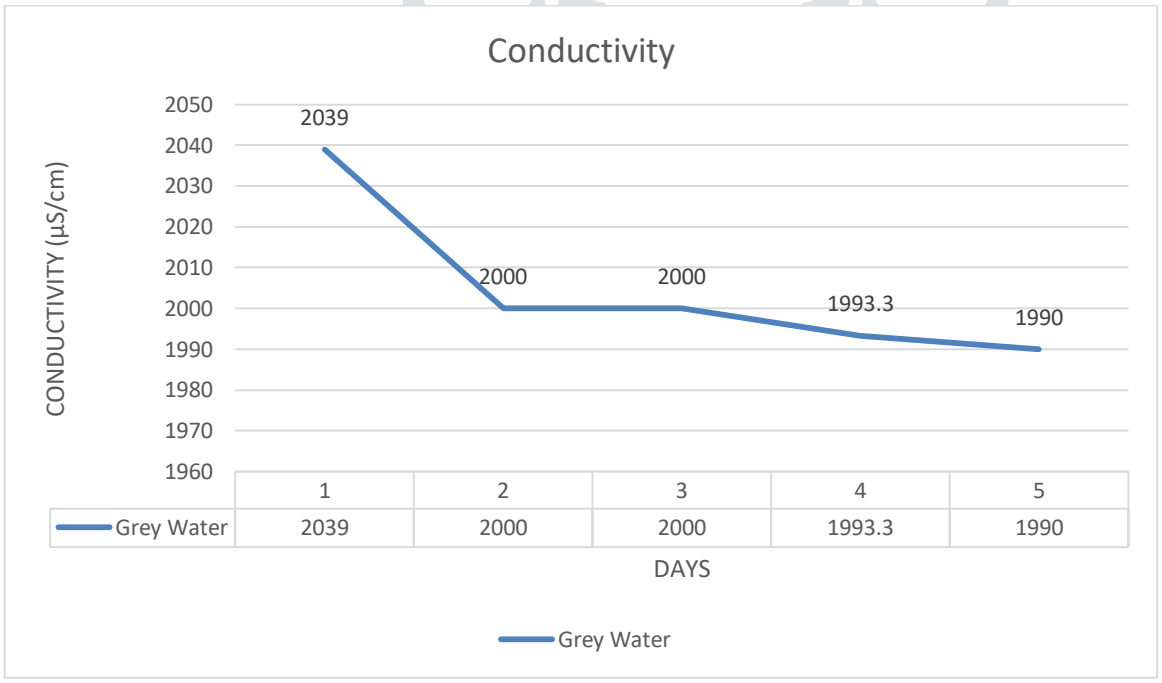
The initial or 1st day of DO value was 7.8 mg/l before treatment and after treatment with water hyacinth 2nd, 3rd, 4th, and 5th day values are 12.0 mg/l, 12.4 mg/l, 13.2 mg/l and 13.2 mg/l.

5. Total Suspended Solids (TSS)-



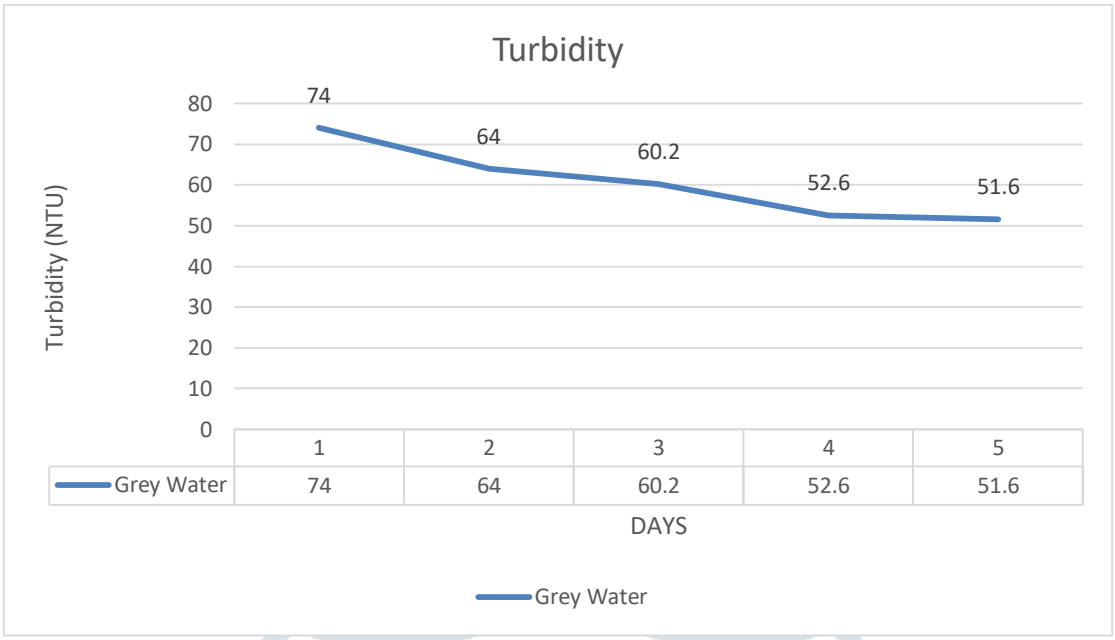
The initial or 1st day of TSS value was 88 mg/l before treatment and after treatment with water hyacinth 2nd, 3rd, 4th, and 5th day values are 86 mg/l, 75.2 mg/l, 75 mg/l and 75 mg/l.

6. Conductivity-



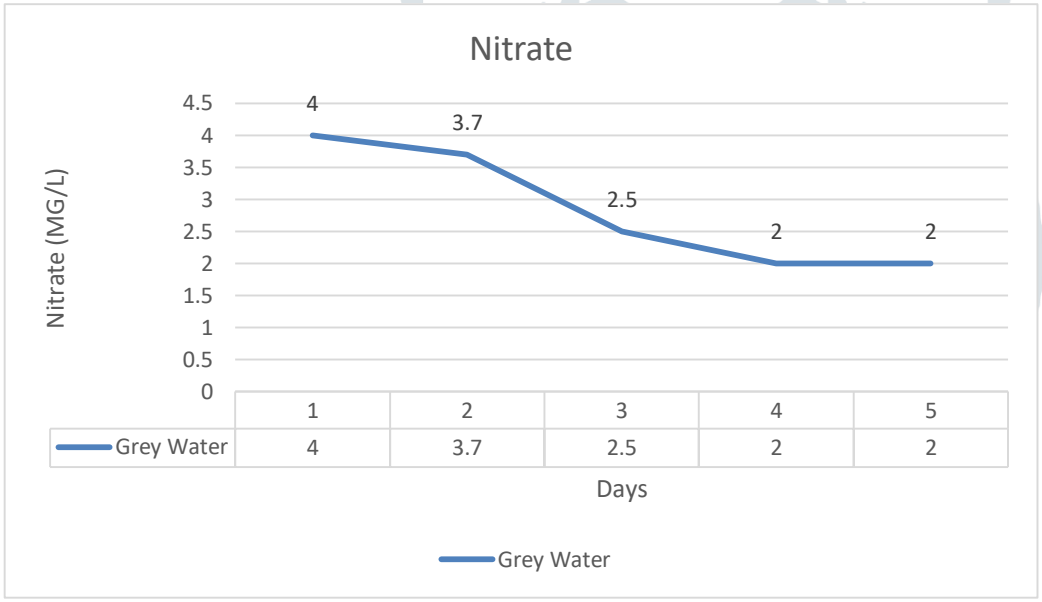
The initial or 1st day of Conductivity was 2039 µS/cm before treatment and after treatment with water hyacinth 2nd, 3rd, 4th, and 5th day values are 2000 µS/cm, 2000 µS/cm, 1993.3 µS/cm and 1990.0 µS/cm.

7. Turbidity-



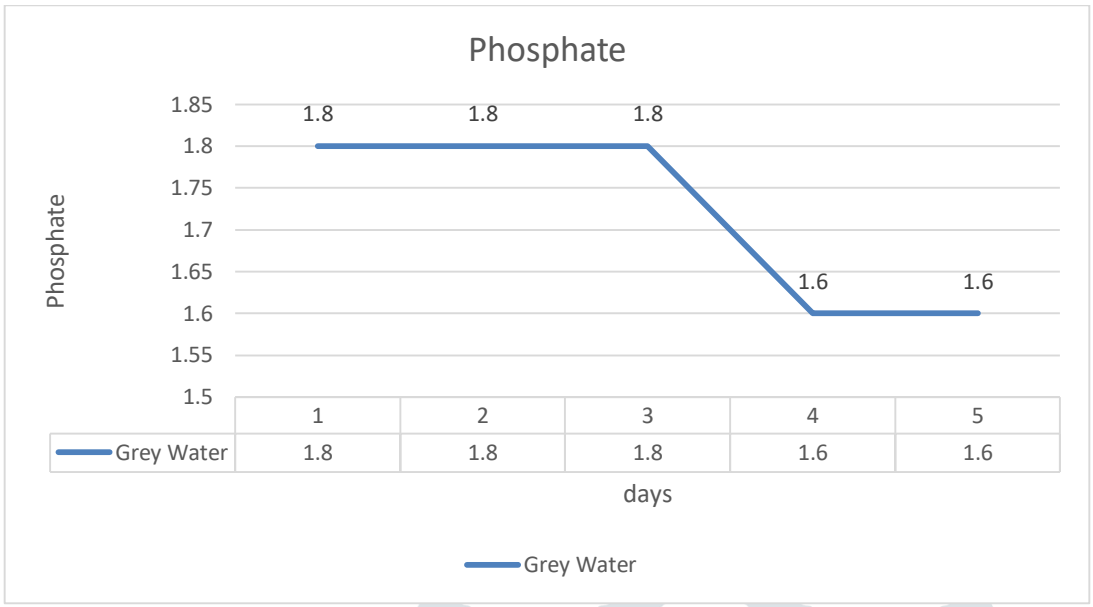
The initial or 1st day of Turbidity was 74.0 NTU before treatment and after treatment with water hyacinth 2nd, 3rd, 4th, and 5th day values are 64.0 NTU, 60.2 NTU, 52.6 NTU and 51.6 NTU.

8. Nitrate-



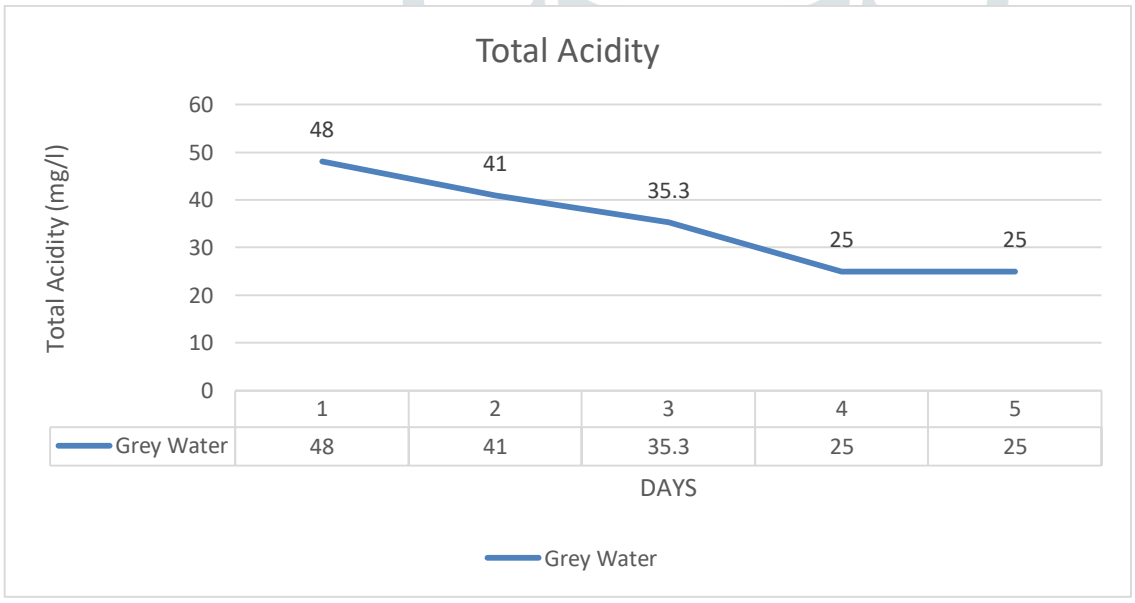
It is clear from the graph that the nitrate in the greywater is more before the treatment as its value on 1st day or its initial value was 4.0 mg/l but after the treatment by Water Hyacinth, the value of nitrate in water goes low as its value on 2nd, 3rd, 4th, and 5th day are 3.7 mg/l, 2.5 mg/l, 2.0 mg/l, 2.0 mg/l.

9. Phosphate-



It is clear from the graph that the phosphate concentration is higher in greywater before the treatment with Water Hyacinth as its value was 1.8 mg/l. And the value of phosphate after the treatment with Water Hyacinth is 2nd, 3rd, 4th, and 5th day values are 1.8 mg/l, 1.8 mg/l, 1.6 mg/l, 1.6 mg/l.

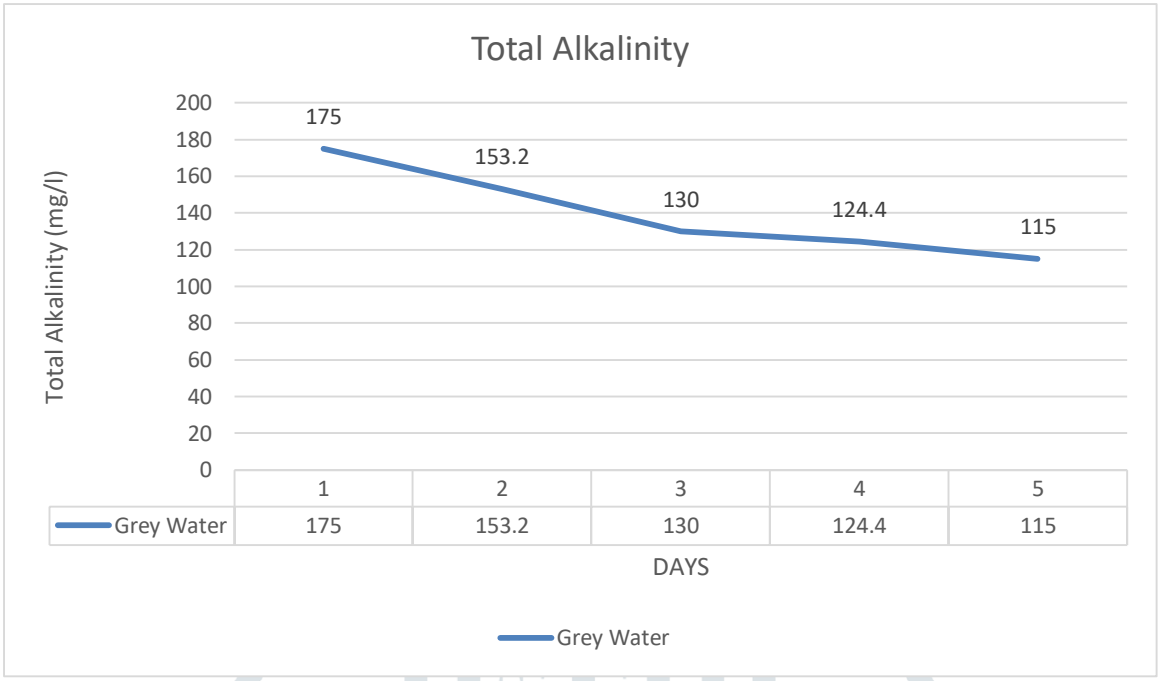
10. Total Acidity-



Acidity is the sum of all titrable *acid* present in the water sample. Strong mineral acids, weak acids such as carbonic acid, acetic acid present in the water sample contributes to acidity of the water. Usually dissolved carbon dioxide (CO2) is the major acidic component present in the unpolluted surface waters.

It is clear from the graph that the Acidity of water is higher in greywater before the treatment with Water Hyacinth as its value was 48.0 mg/l. And the value of Acidity after the treatment with Water Hyacinth is 2nd, 3rd, 4th, and 5th day values are 41.0 mg/l, 35.3 mg/l, 25.0 mg/l, 25.0 mg/l.

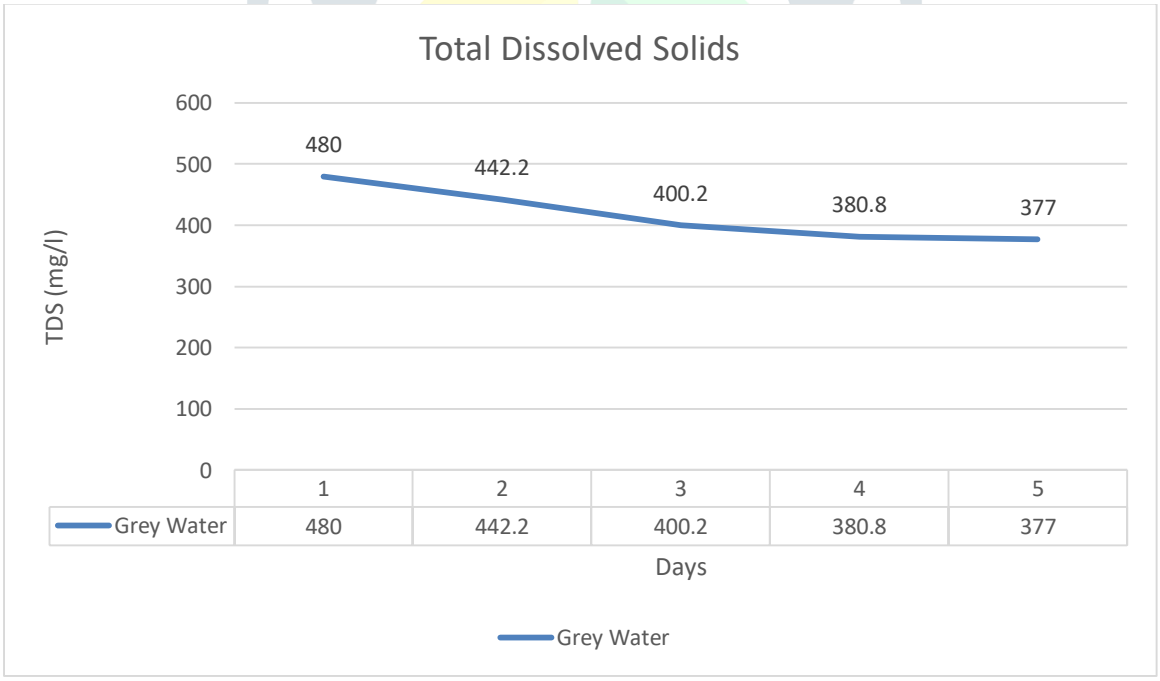
11. Total Alkalinity-



Alkalinity is the capacity of water to resist changes in pH that would make the water more acidic. (It should not be confused with basicity which is an absolute measurement on the pH scale.) Alkalinity is the strength of a buffer solution composed of weak acidsand their conjugate bases. It is measured by titrating the solution with a monoprotic acid such as HCl until its pH changes abruptly, or it reaches a known endpoint where that happens.

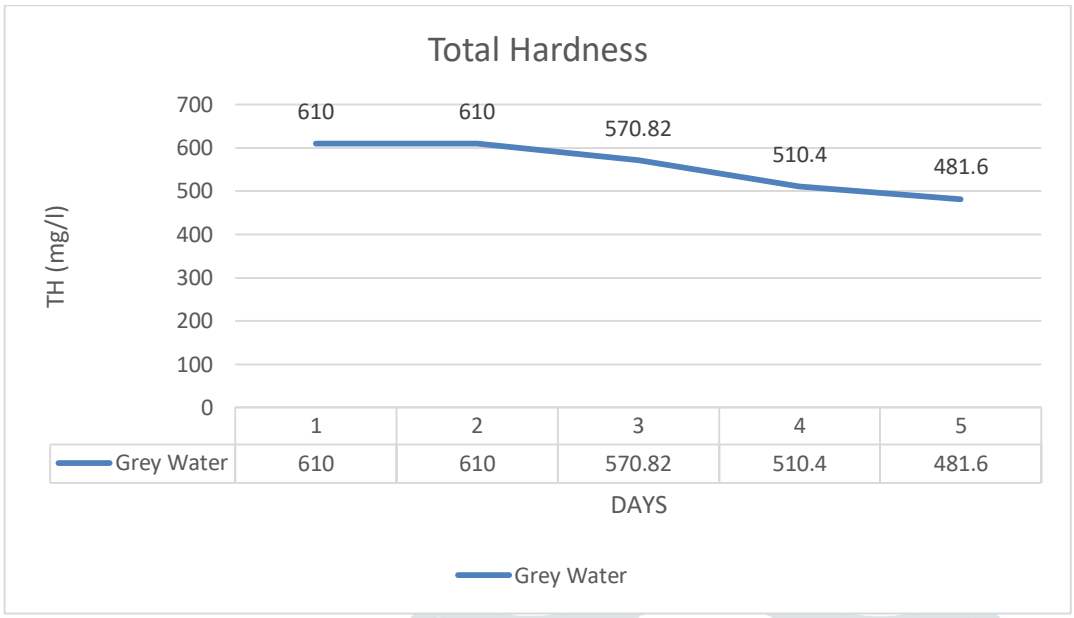
The initial or 1st day of TSS value was 175 mg/l before treatment and after treatment with water hyacinth 2nd, 3rd, 4th, and 5th day values are 153.2 mg/l, 130.0 mg/l, 124.4 mg/l and 115.0 mg/l.

12. Total Dissolved Solids (TDS)-



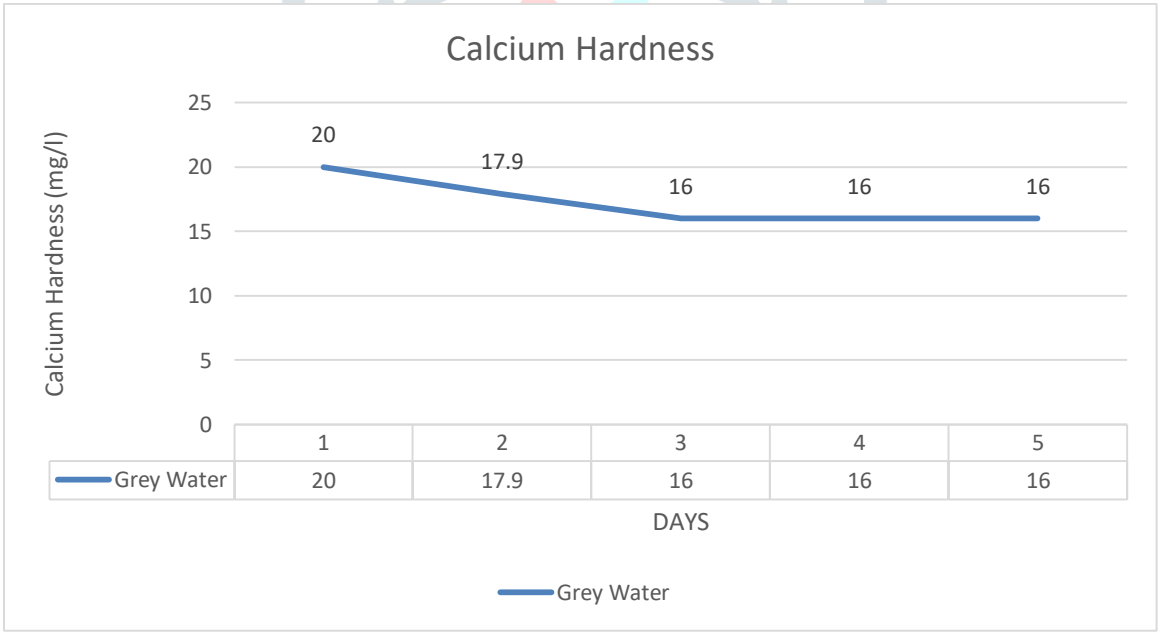
The initial or 1st day of TDS value was 480 mg/l before treatment and after treatment with water hyacinth 2nd, 3rd, 4th, and 5th day values are 442.2 mg/l, 400.2 mg/l, 380.8 mg/l and 377.0 mg/l.

13. Total Hardness-



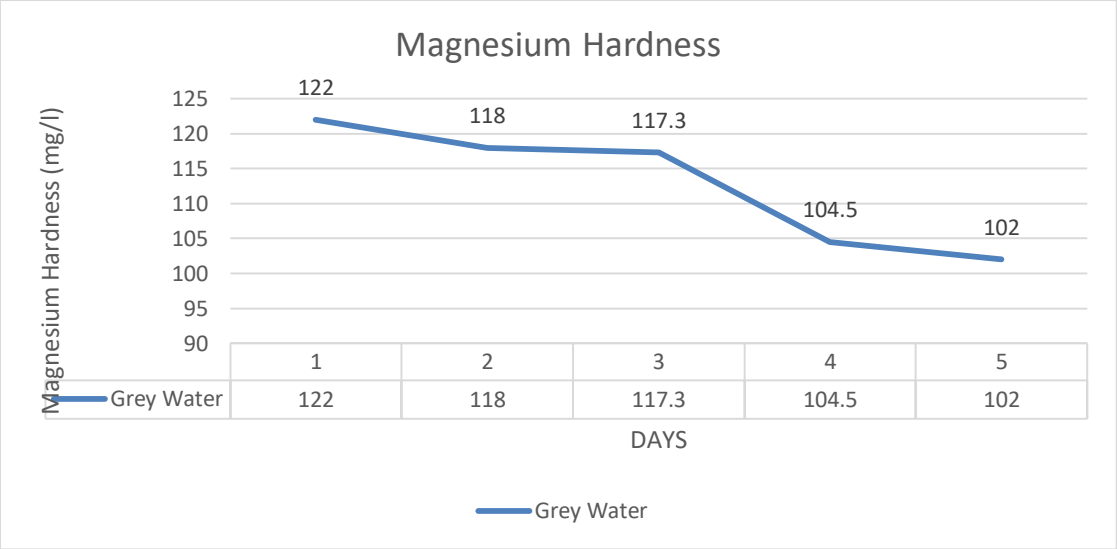
The initial or 1st day of Total Hardness value was 610 mg/l before treatment and after treatment with water hyacinth 2nd, 3rd, 4th, and 5th day values are 610 mg/l, 570.82 mg/l, 510.4 mg/l and 481.6 mg/l.

14. Calcium Hardness-



The initial or 1st day of Total Hardness value was 20 mg/l before treatment and after treatment with water hyacinth 2nd, 3rd, 4th, and 5th day values are 17.9 mg/l, 16.0 mg/l, 16 mg/l and 16 mg/l.

15. Magnesium Hardness-



The initial or 1st day of Total Hardness value was 122 mg/l before treatment and after treatment with water hyacinth 2nd, 3rd, 4th, and 5th day values are 118 mg/l, 117.3 mg/l, 104.5 mg/l and 102.0 mg/l.

V. CONCLUSION-

The efficiency of waste water treatment was expressed in terms of the variation in pH, biochemical Oxygen Demand (*BOD*), Chemical Oxygen Demand (*COD*), Total Dissolved Solids (*TDS*) and some other physical and chemical parameters of water before and after treatment. When the Aquatic plants were collectively grown, the removal of pollutants from the water was very high. This system of treatment is cost effective since cost of installation and maintenance was very low. This system could be provided very easily treating domestic waste water or grey water. In conclusion, the present investigation demonstrated the feasibility of adopting a "sustainable" and eco-friendly approach to domestic waste water treatment using aquatic plant Water Hyacinth (*Eichhornia)*. Since it was only a laboratory scale base - line study, further investigations should be carried out in future on a large scale particularly focusing on phytoremediation and resource utilization. Water hyacinth gave good result in treatment of grey water.

3. REFERENCES-

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