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Domestic Grey Water Treatment by Natural Coagulants Combined With Layered Filter Media

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Abstract - *The global increase in water demand, water shortage due to low rainfall, economic and environmental issues leads the researchers to show interest in wastewater recycling. This project deals with the treatment of Grey Water, which is all wastewater generated in households, public or commercial properties without any sort of fecal contamination using natural coagulants and filter media. The main objective of the present study is to investigate the effect of natural coagulants (selected seeds) on the treatment of domestic grey water and to study the factors affecting the removal efficiency in terms of Turbidity and COD removal. Effect of settling time and pH variation on the removal efficiency was also studied. The grey water sample was collected from a college canteen of Ilahia College of engineering and Technology and the natural coagulants used were freely available seasonal seeds like Beninpasa Hispiba (Witermelon) seeds and Neem Leaf. The initial characteristic of the grey water sample was assessed by using the parameters like pH, Turbidity and COD.*

Key Words: Grey water, Natural Coagulant, Turbidity, COD, pH, settling time.

1. INTRODUCTION

1.1 General

Water is one of the most important and abundant compounds of the ecosystem as all living organisms need water for their growth and survival. Safe and readily available water is important for public health, whether it is used for drinking, domestic use, food production or recreational purposes. 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 km^2 geographical areas which forms 2.4% of the world 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. Conventional groundwater and surface water sources are becoming increasingly vulnerable to anthropogenic, industrial and natural pollution. Groundwater sources are being over extracted, resulting in leaching of fluorides and nitrates. Surface water bodies are becoming susceptible to unregulated industrial discharge resulting in increased eutrophication and algal blooms. To resolve the problem, there is a need to look for alternative water resources. These include rainwater harvesting, wastewater reuse and desalination. Concerns over desalination include mineral decomposition of potable water and limited inland availability. Additionally, limitations of rainwater harvesting include the quantity and quality that may be available, given the increased threats of global warming and air pollution. In 2010, the UN General Assembly explicitly recognized the human right to water and sanitation. Everyone has the right to sufficient, continuous, safe, acceptable, physically accessible and affordable water for personal and domestic use. Fig. 1 depicts the water distribution in India and the World.

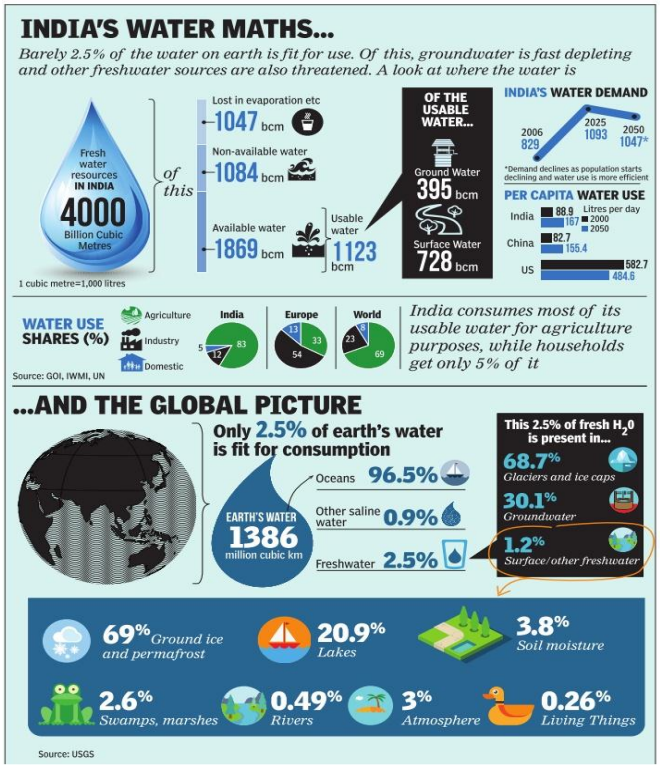

Fig 1: Water Distribution (Times of India, May 2017)

1.2 Objectives of the study

- To investigate the effect of natural coagulants on the treatment of domestic grey water
- To study the water qualities before and after the application of coagulants

- To study the effect of coagulated water after filtration

1.3 Scope of the study

Scope of the study is limited to the following,

- Development of natural coagulants
- Finding the optimum dosage
- Water quality testing before and after treatment

2. EFFECT OF WINTER MELON SEED ON THE TREATMENT OF GREY WATER

2.1 Effect of winter melon seed coagulant dosage variation on treatment of grey water

To investigate the effect of coagulant dosage on the removal efficiency of grey water. The winter melon seed concentration has been varied from 2000mg/L to 10000mg/L. The initial concentration of the grey water was maintained pH 5.43, turbidity 435NTU, COD as 1664mg/L. It can be observed from the figure the increase in coagulant dosage increases the removal efficiency of turbidity. The optimum removal was observed at 2000mg/L of coagulant dosage.

The winter melon seed contains proteins and fibers and it will act as positively charged polymer coagulant when added to raw water the proteins bind to the predominantly negatively charged particles that make raw water turbid under proper agitation these bound particulates then grow in size to form the flocs which may be left to settle by gravity or be removed by filtration.

Table 1: Effect of variation on turbidity at different dosage of winter melon seed

SI No.	Coagulant dosage(mg/L)	Turbidity (NTU)
1	0	435
2	2000	186
3	4000	215
4	6000	261
5	8000	371
6	10000	385

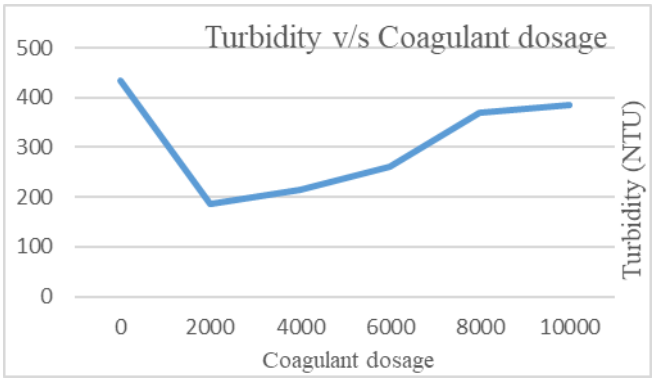

Chart 1: Effect of variation on turbidity at different dosage of winter melon seed

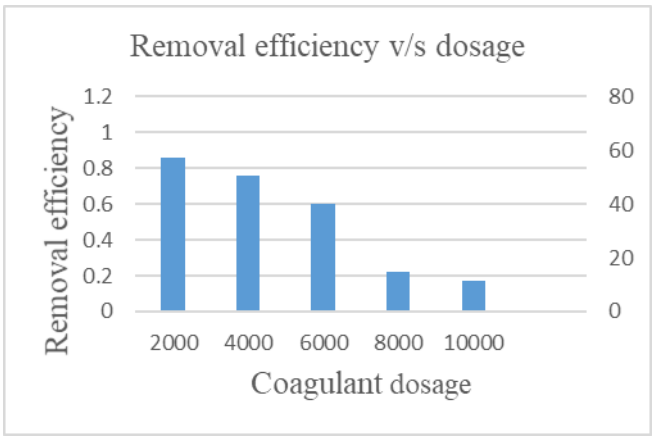

Chart 2: Effect of removal efficiency at different dosages

2.2 Effect of pH variation on the treatment of grey water using winter melon seeds as natural coagulant

pH is an important factor which affect the coagulation process. The effect of pH variation on dosage is given in table (2) for different values of pH, removal efficiency of turbidity increases. As the pH decreases the removal efficiency of turbidity increases. Here the pH decreased from its initial process to final process.

Table 2: Effect of variation on pH at different time and different dosage

SI No.	Coagulant Dosage (mg/L)	pH		
		30minunts	60minutes	90 minutes
1	0	5.43	5.10	4.90
2	2000	5.50	5.22	5.02
3	4000	5.69	5.50	5.19
4	6000	5.92	5.69	5.53
5	8000	6.10	5.86	5.61
6	10000	6.20	5.99	5.54

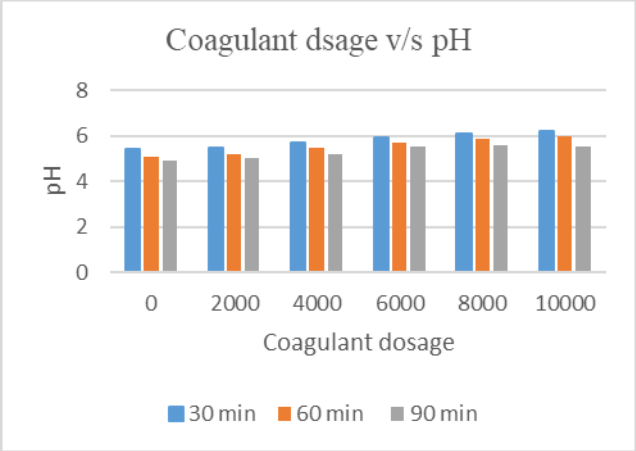

Chart 3: Effect of variation on pH at different time and different dosage

2.3 Effect on settling time variation on the treatment of grey water using winter melon seed as natural coagulant

To study the effect of floc settling with respect to the time, the sedimentation or settling time refers to time given to settle down suspended particles. Table (3) shows the effect of settling time on the removal of turbidity from grey water. Different concentrations of winter melon seeds were taken and their turbidity removal was studied for different settling time. The maximum removal of turbidity can be seen for optimum dosage of 2000mg/L and settling time of 90 minutes. This phenomenon can be explained as for maximum settling. Maximum solid particles would settle which leads to maximum removal of turbidity. Chart (4) shows the different turbidity obtained by varying settling time.

Table 3: Effect of settling time variation on turbidity removal at different dosage of winter melon seed coagulant.

SI No.	Coagulant Dosage (mg/L)	Turbidity (NTU)		
		30minunts	60minutes	90 minutes
1	0	435	390	350
2	2000	186	171	168
3	4000	215	197	186
4	6000	261	263	254
5	8000	371	320	307
6	10000	385	350	327

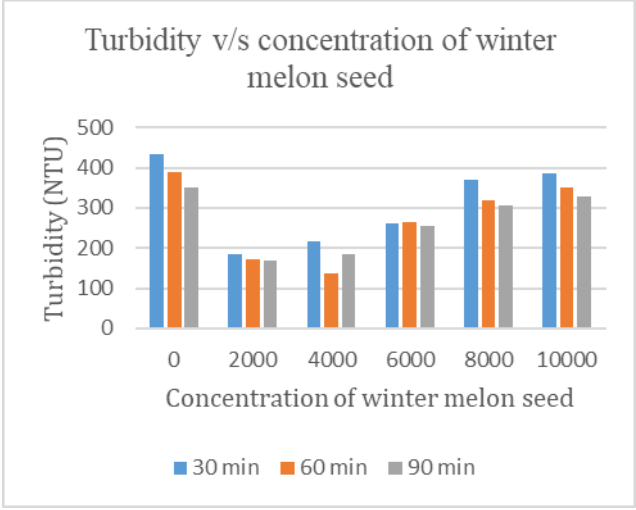

Chart.4: Effect of settling time variation on turbidity removal at different dosage of winter melon seed coagulant

2.4: Effect of COD removal on the treatment of grey water using winter melon seed as natural coagulant

The removal of COD by adding natural coagulant and after filtration for optimum dosage as shown in Table (4).The addition of coagulants would increases the formation of sludge. By using winter melon seeds as natural coagulant 45.19% of COD is removed.

Table 4: Effect of variation on treatment on cod at optimum dosage of winter melon seed

Parameters	COD(mg/L)
Grey water	1664
Coagulated grey water	512

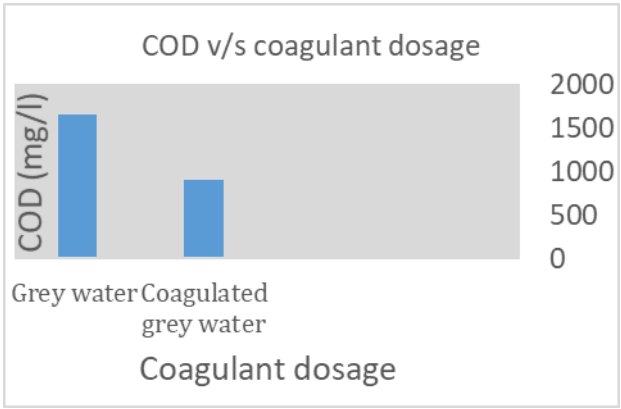

Chart 5: Effect of variation on treatment on cod at optimum dosage of winter melon seed

3. EFFECT OF NEAM LEAF ON TREATMENT OF GREY WATER

3.1 Effect of neem leaf coagulant dosage variation on treatment of grey water

To investigate the effect of coagulant dosage on the removal efficiency of grey water. The neem leaf concentration has been varied from 200mg/L to 1000 mg/L. The initial concentration of grey water was maintained pH 5.65 turbidity 446 NTU COD as 1472mg/L. It can be observed from chart (6) that the increase in coagulant dosage increases the removal efficiency of turbidity. The optimum removal was observed at 400 mg/L of coagulant dosage and removal efficiency is found to be 45.96%. The neem leaf contains proteins, fibers, carbohydrates. Proteins and carbohydrates are act as positively charged polymer coagulant when added to raw water the proteins bind to the predominantly negatively charged particulates that make raw water turbid under proper agitation these bound particulates then grow in size to form the flocs which may be left to settle by gravity or be removed by filtration. In the initial stage turbidity is found to be 446 NTU. After coagulation using neem leaf as coagulant the turbidity is reduced to 241 NTU and it is considered as the optimum coagulant dosage and removal efficiency is in the range of 45.96%.

Table 5: Effect of variation on turbidity at different dosage of neem leaf

SI No.	Coagulant dosage (mg/L)	Turbidity (NTU)
1	0	446
2	200	314
3	400	241
4	600	273
5	800	348
6	1000	386

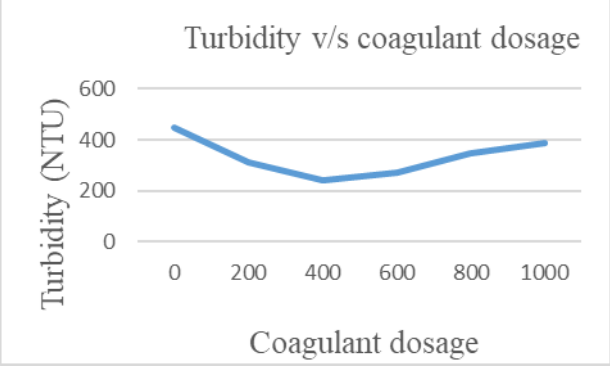

Chart 6: Effect of variation on turbidity at different dosage of neem leaf

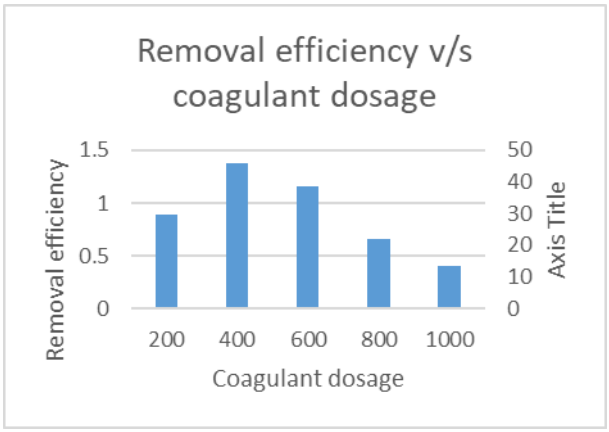

Chart.7: Effect of removal efficiency at different dosages

3.2 Effect of pH variation on the treatment of grey water using neem leaf as natural coagulant

pH is an important factor which affect the coagulation process. The effect of pH variation on dosage is given in table (6). For different values of pH removal efficiency of turbidity increases. Here the pH increases from its initial process to final process.

Table 6: Effect of variation on pH at different dosage of neem leaf

SI No.	Dosage (mg/L)	pH		
		30minunts	60minutes	90 minutes
1	0	5.65	5.70	5.81
2	200	5.71	5.76	5.84
3	400	6	6.73	6.86
4	600	6.04	6.23	6.74
5	800	6.2	6.57	6.93
6	1000	6.13	5.42	6.85

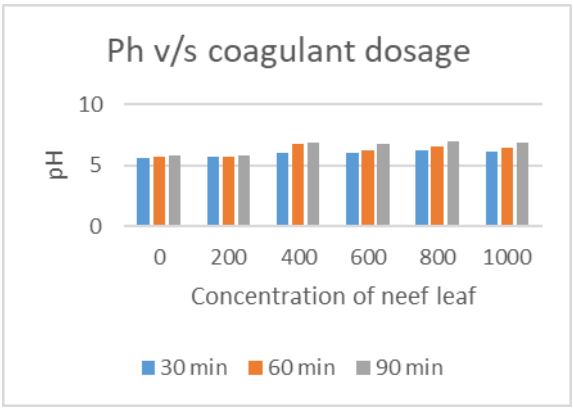

Chart 8: Effect of variation on pH at different dosage of neem leaf

3.3 Effect of settling time variation on the treatment of grey water using neem leaf as natural coagulant

To study the effect of floc settling with respect to the time. The settling time refers to time given to settle down suspended particles. Table (7) shows the effect of settling time on the removal of turbidity from grey water. Different concentrations of Neem leaf were taken and their turbidity removal was studied for different settling time. The maximum removal of turbidity can be seen for optimum dosage of 400 mg/L and settling time of 90 minutes. This can be explained as for maximum settling time maximum solid particles would settle. Which leads to maximum removal of turbidity. Chart (9) shows the different turbidity obtained by varying settling time.

Table 7: Effect of settling time variation on turbidity removal at different dosage of neem leaf coagulant

SI No.	Dosage (mg/L)	Turbidity (NTU)		
		30minunts	60minutes	90 minutes
1	0	446	401	363
2	200	314	297	285
3	400	241	224	210
4	600	273	255	243
5	800	348	329	314
6	1000	386	361	358

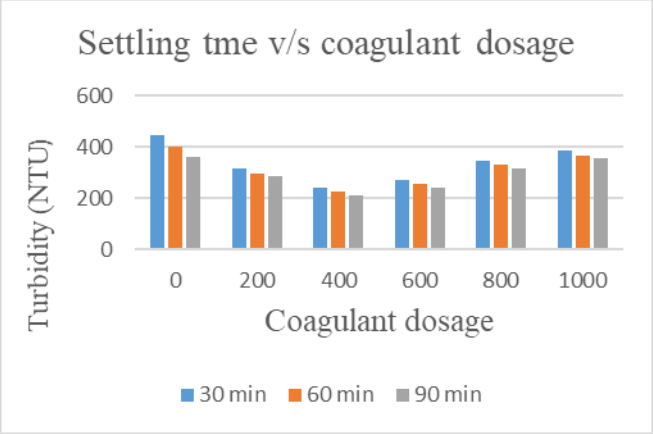

Chart 9: Effect of settling time variation on turbidity removal at different dosage of neem leaf coagulant

3.4 Effect of COD removal on the treatment of grey water using neem leaf as natural coagulant

The removal of COD by adding natural coagulant and after filtration for optimum dosage as shown in Table (8). The addition of coagulants would increases the formation of sludge. By using neem leaf as natural coagulant 41.30% COD is removed.

Table 8: Effect of variation of COD at optimum dosage of neem leaf

Parameters	COD(mg/L)
Grey water	1472
Coagulated grey water	864

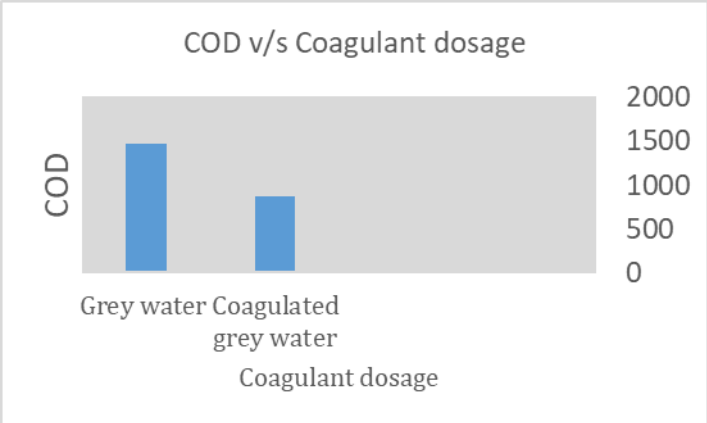

Chart10: Effect of variation of COD at optimum dosage of neem leaf

4. EFFECT OF FILTER MEDIA ON THE TREATMENT OF GREYWATER

4.1 Effect of combination of winter melon seed coagulant and filter media on the treatment of grey water

To investigate the effect of layered filter media on the removal efficiency of grey water, optimum dosage of winter melon seed 2000 mg/L was taken and coagulation, flocculation, sedimentation treatment was done. The treated water was then passed over filtration media and turbidity, pH, and COD values were observed. Table (9) shows the values of grey water after various treatment stages. Removal efficiency in terms of turbidity increases from 57.24%-97.70%. Removal efficiency of COD increases from 43.85%-69.22%. PH in the range of 5.50-7.35.

Table 9: Effect of combination of winter melon seed and filter media on the treatment efficiency of grey water.

Parameters	Initial greywater characteristics	Treatment with winter melon seed	Treated water and filtration
Turbidity (NTU)	435	186	10
COD(mg/L)	1664	912	512
pH	5.43	5.50	7.35

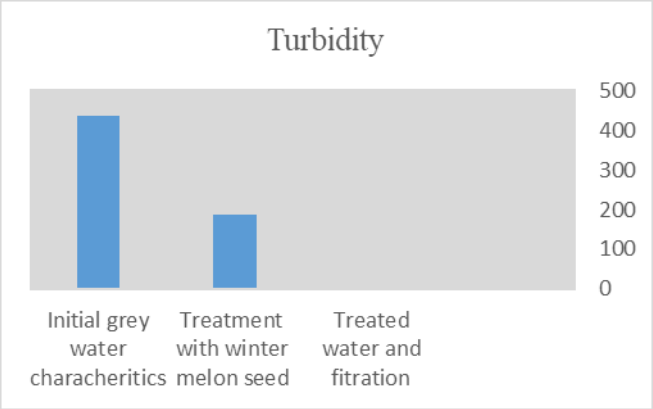

Chart 11: Effect of combination of winter melon seed coagulant and filter media on the treatment efficiency of grey water in terms of turbidity.

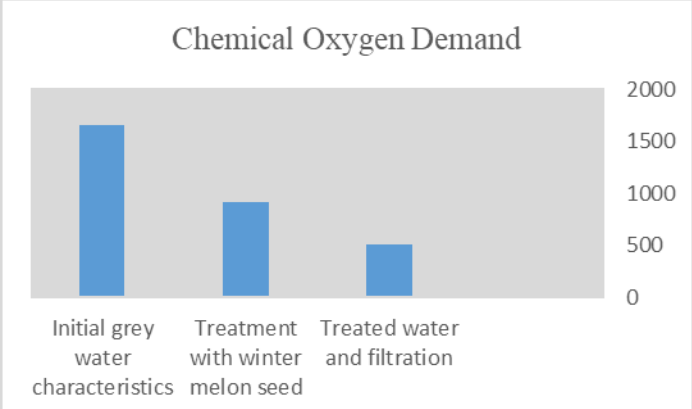

Chart 12: Effect of combination of winter melon seed coagulant and filter media on the treatment efficiency of grey water in terms of chemical oxygen demand.

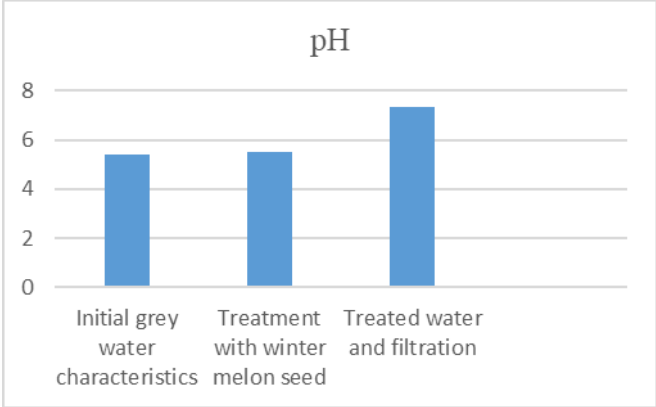

Chart 13: Effect of combination of winter melon seed coagulant and filter media on the treatment efficiency of grey water in terms of Ph.

4.2 Effect of combination of neem leaf coagulant and filter media on the treatment of grey water

To investigate the effect of layered filter media on the removal efficiency of greywater optimum dosage of neem leaf (400mg/L) was taken and coagulation, flocculation, sedimentation treatment was done. The treated water was then passed over filtration media and turbidity, pH, COD values were observed. Table (10) shows the values of grey water after various treatment stages. Removal efficiency in terms of turbidity increases from 45.65%-97.08%. COD removal increases from 41.35%-73.91% and the pH which is in the range of 6-8.1.

Table 10: Effect of combination of neem leaf and filter media on the treatment efficiency of grey water

Parameters	Initial grey water characteristics	Treatment with neem leaf	Treated water and filtration
Turbidity (NTU)	446	241	13
COD(mg/L)	1472	864	384
pH	5.65	6	8.1

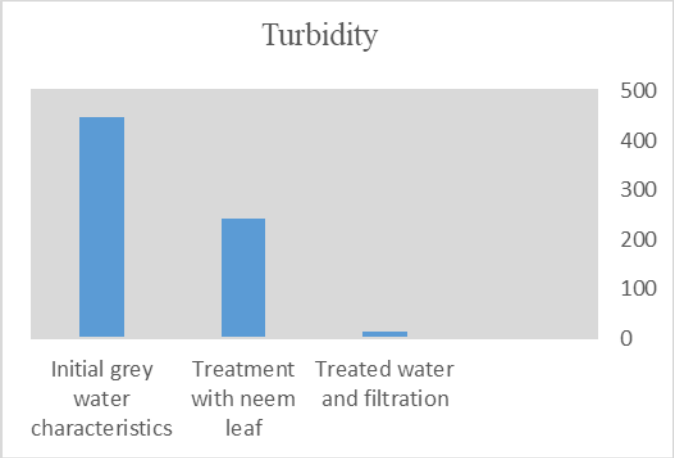

Chart 14 Effect of combination of neem leaf coagulant and filter media on the treatment efficiency of grey water in terms of turbidity

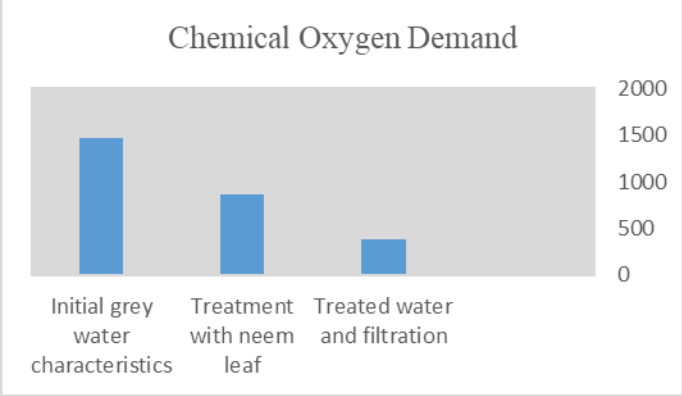

Chart 15: Effect of combination of neem leaf coagulant and filter media on the treatment efficiency of grey water in terms of chemical oxygen demand

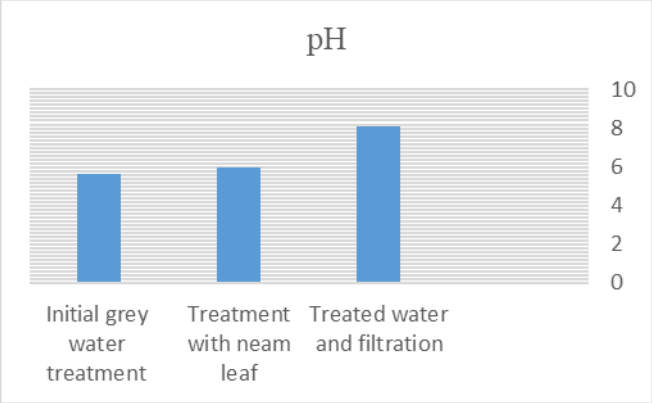

Chart 16: Effect of combination neem leaf coagulant and filter media on the treatment efficiency of grey water in terms of pH.

CONCLUSIONS

From the study, we concluded that

The optimum dosage of winter melon seeds coagulant was found to be 2000 mg/L giving 57.24% of turbidity removal and 45.19% COD removal. The studies proved that around 45.96% of the turbidity and 41.30% of the COD can be removed from the grey water using neem leaf as natural coagulant. The natural coagulants selected for the study proved to be effective in the removal of an appreciable amount of solids. Winter melon seeds and neem leaf can be used as an alternative natural coagulant for the treatment of domestic grey water. From this study it is concluded that settling time is slightly affecting the removal efficiency of turbidity and COD removal from grey water using winter melon seeds and neem leaf as natural coagulant. Physical and chemical properties can be changed by passing through filter media. By combining natural coagulant and filter media 94%-95% turbidity can be removed and about 41%-55% of COD can be removed. It will reduce the volume of sludge because it will carry less amount of water. Effective way of treating grey water.

REFERENCES

[1] M.Seenirajan, S.Sasikumar, Erlin Antony. (May 2018) "Design of Grey Water Treatment Units." International Research Journal of Engineering and Technology (IRJET).Volume: 05 Issue: 05 May-2018

[2] Michael Oteng-Peprah, Mike Agbesi Acheampong & Nanne K. deVries. (2018) "Grey water Characteristics, Treatment Systems, Reuse Strategies and User Perception."Water Air Soil Pollut (2018) 229: 255

[3] Ramaprasd and Ligy Philip(Auguest 2017) "Grey water reuse understanding the role of media on pollutant removal " Article in chemical engineering Journal 284

[4] Mohammed gulfan pathan, piyush kumbhalkar(2017)" State of art on grey water treatment "Article in IRD India.

[5] A A wurochekke, R. M. S Mohamed, H. m Amir (28 July 2016)" House hold grey water treatment methods using natural materials and the hybrid "Research article

[6] Veljik prodanovic (March 2016)"Optimisation of light weight green wall media for grey water treatment and reuse "Article in building and environment 131

[7] Mariana cardosa, Marcelo nolasco (July 2016)"Grey water treatment using a biofilm reactor "Article in Journal of cleaner production 142.

[8] Mahmoud nasar, Mohamed atria (July 2015)"Grey water treatment by electrochemical using Al electrode" Article in separation science and technology.