BIO-DERIVED MATERIALS AND THEIR APPLICATION IN WATER PURIFICATION

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ABSTRACT

The scarcity of clean and safe drinking water is one of the major problems faced by human nowadays. The study is focused on the filtration of domestic waste water. This filtration is done by preparing here different bed using different layers of powdered cactus, pine bark, sand and coarse aggregate. The use of pine bark enhances the purification by preventing microbial action and reduces turbidity. But the application of the pine bark increases the concentration of acidity. In order to reduce the acidity, coarse aggregate is used as another layer. Finally a sandy layer is provided as a supporting layer for powdered cactus. The thickness was fixed by column study method. As per the column study, we fixed different layers for different filter bed (f1 f2 f3) consist of F1: 3cm pine bark and 3cmcactus powder F2: 3cm pine bark and F3: 5cm pine bark and 5cm cactus powder. The percentage reduction for Turbidity, Alkalinity, Hardness, Chloride, Acidity, BOD for F3 were obtain 56%, 13%, 43%, 85%, 58%, 84% respectively.

INTRODUCTION

The growth of the global population, the increasing need of water for agriculture and the increasing urbanization put great pressure on the existing resources of freshwater and the finding of news sources of freshwater become necessary. An alternative source of water can be to reuse wastewater. Grey water is all wastewater from a household, with the exception of toilet water, which is called black water. Water from dishwashing, from kitchen sinks and from laundry machines constitute grey water and it account for 80% of the household wastewater. Grey water can be reused in areas that do not require portable water such as irrigation and toilet flushing. The reuse of grey water reduces

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the pressure on freshwater resources and thereby preserves the environment and decrease the cost of water. Grey water in this scenario is a resource of water rather than wastewater. Unfortunately, grey water by its origins contains chemicals, bacteria and viruses. The reuse of raw grey water without a pre-treatment can have negative impacts on the soil, can pollute the groundwater, the surface water or/and contribute to the transmission of diseases

The high cost and the insufficiency of centralized wastewater treatment plants mainly in low- income countries justify the choice of the onsite filtration system with local and inexpensive filter materials (Praveen D Dathan). In this study, pine bark, powdered cactus, coarse aggregate and sand were used as filter media in column filters. Some physical and chemical parameters of grey water that can have a negative environment impact were measured before and after filtration with different materials and with different layer thickness.

The filtration efficiency depends on both the flow rate of different filter material. Pine bark, cactus, coarse aggregate and sand were found to be better in reducing some of the chemical and biological parameters. The bark filters have an acidifying effect on the filtrated grey water. This study has contributed to the finding of methods to improve the quality of grey water for reuse. The study confirmed the possibility to improve the quality of grey water by filtration and showed that degree of the reduction depends on the filter material used and the characteristics of the microorganisms. Water purification using natural materials such as pine bark, cactus, sand and coarse aggregate can be affordable for all class people and it have some advantages over the most preferable water purifiers.

STATEMENT OF PROBLEM

Wastewater is liquid waste discharged by domestic residences, commercial properties, industry, agriculture, which often contains some contaminants that result from the mixing of wastewater from different sources. Wastewater obtained from various sources need to be treated very effectively in order to create a hygienic environment. If proper arrangements for collection, treatment and disposal of all the waste produce from city or town are not made, they will go on accumulating and create a foul condition that the safety of the structures such that building, roads will be damaged due to accumulation of wastewater in the foundations. In addition to this, disease

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causing bacteria will breed up in the stagnant water and the health of the public will be in danger. The principal aim of wastewater treatment is generally to allow human and industrial effluents to be disposed of without danger to human health or unacceptable damage to the natural environment. Therefore, in the interest of the community of the town or city it is most essential to collect, treat and dispose of all the wastewater of the city in such a way that it may not cause harm to the people residing in the town. The extent and the type of treatment required, however depends on the character and quality of both sewage and sources of disposal available (Gulhane M.L.,). The sewage after treatment may be disposed either into a water body such as lakes, streams, river, estuary and ocean or into land. It may be used for several purposes such as conservation, industrial use or reclaimed sewage effluent in cooling systems, boiler feed, process water, reuse in agriculture, horticulture, sericulture, watering of lawns. Wastewater reuse is becoming increasingly popular, especially in geographies where potable water is in short supply

MATERIALS

I) Pine Bark

Pine bark the reduction of turbidity is done. The bark originated from undefined mixture of pine bark is air dried and it sieved through 4.75, 2.36 and 1mm screens. The bark retained on 2.36- and 1-mm screens was mixed in 3:2 ratio by weight. As the first layer from top, the pine bark was filled in the filter pipe at a thickness of 5cm. Pine bark chips as shown in Fig 3.1

II

Powdered cactus was used as the second layer. Cactus were sliced, dried and grinded into a fine powder and sieved to a size of 600µm. It was filled in the filter pipe at a thickness of 3cm. Cactus powder is helps in thereduction BOD5 and turbidity. Cactus powder as shown in fig 3.2.

Figure 3.2: Cactus Powder

III) Sand

Sand is bottom most layer act as

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supporting layer to other three layers which is passing through 4.75mm IS sieve, 2.36mm IS sieve and which retains on

1mm IS sieve is taken. Sand as shown in fig 3.3

Figure 3.3 – SAND

IV) Coarse aggregate

Coarse aggregate is the top layer of the filter media the size of the coarse aggregate various from to 4.75 to 5mm. Laterite Soil is used as coarse aggregate, which helps in the reduction of acidity fig 3.4 shows laterite soil.

Figure 3.4 – LATERITE SOIL

V) Reducer with a sieve net

A reducer which is attached with a sieve net is placed at the end of bottom most filter layer in the pipe. The size of the reducer varies from 1.5 inches to 1.25 inches. 1 mm size of sieve net is provided at end of arrangement to retain the sandy layer.

VI) Domestic waste water

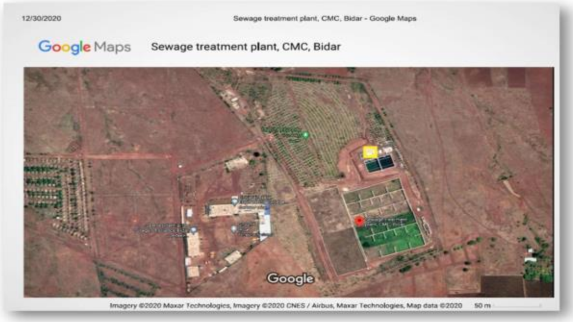

Figure 3.5 –Google Map location of Domestic waste water treatment plant

The sample which we have collected for test is from Gornalli “Sewage treatment plant, CMC, Bidar” the STP is situated in Bidar where taken to environmental laboratory GNDCB and were analyzed for various physico-chemical parameters as per the standard methods.

METHODOLOGY

The water samples will be collected from sewage treatment plant. The various Physico- chemical parameters such as pH, Chloride, Hardness, Dissolved Oxygen, BOD_5, Acidity, Alkalinity and Turbidity were analyzed. In the current research work, pine bark, powdered cactus, coarse aggregate and sand were used as filter media in column filters.

Preparation of filter apparatus:

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The waste water filter is constructed in 4 layers. These layers are filled with 4 different materials. The materials are coarse aggregate, grinded pine bark, powdered cactus and sand. The materials are added in order to remove various biological, chemical and physical characteristics of waste water.

The filter is constructed using a 50mm PVC pipe. The top most layer is filled with the coarse aggregate (Laterite). The application of coarse aggregate is moreeffective in removing acidity (Tesfaye Betela BekaloS (2017)). Pine bark is used as the second layer. By the addition of pine bark, the reduction of turbidity is achieved. The third layer is filled with powdered cactus. COD, BOD_5 and turbidity can be reduced by the application of cactus. The bottom most layer is filled with sand, which act as a supporting layer for the top layers. The bottom most portion of the pipe is attached to a reducer with a sieve net. The flow rate is found out for three filter bed F1, F2 and F3. Study in three different filter media

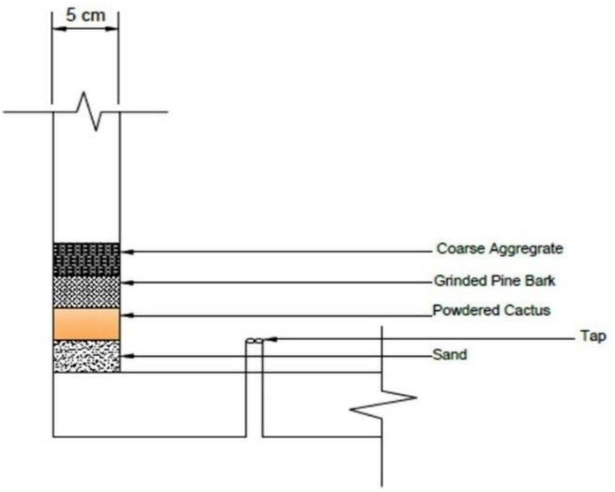


Figure 3.7: Schematic Diagram of Filter Unit

which gives better result were taken in to consideration.

Three different layers of filtration

Filtration 1 = 3cm thickness of pine bark and 3cm of cactus powder Filtration 2 = 3cm thickness of pine bark and 5cm of cactus powder

Filtration 3 = 5cm thickness of pine bark and 5cm of cactus powder

PHYSICO-CHEMICAL PARAMETERS

The physico-chemical parameters is shown in table 1.1

Table 1.1: Physico-chemical parameters of domestic waste water

Parameters	Units	Raw waste water
Turbidity	NTU	9
Alkalinity	mg/l	172
Hardness	mg/l	612
Chloride	mg/l	85
DO	mg/l	0.6
Acidity	mg/l	95
BOD_5	mg/l	425
pH	-	7.5

RESULT AND DISCUSSION

Result obtained from the various filter unit F, F2 and F3 are as shown in table 1.2

Table 1.2: Effluent characteristic of treated domestic waste water

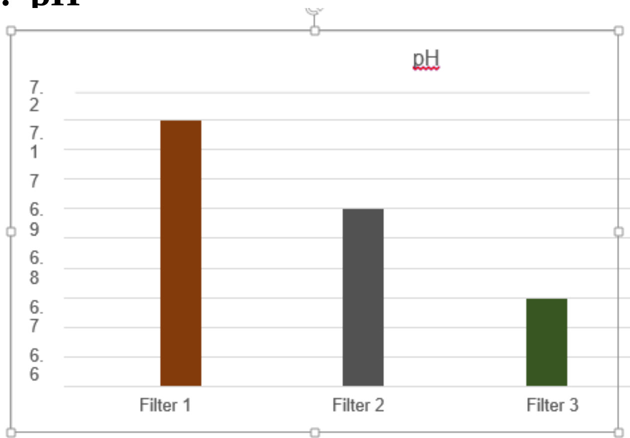
Parameters	Units	Raw waste water	F1	F2	F3
Turbidity	NTU	9	7	6	**4**
Alkalinity	mg/l	172	160	158	**150**
Hardness	mg/l	612	515	390	**350**
Chloride	mg/l	85	67	46	**38**
D, O	mg/l	0.6	2.4	3.9	**5.4**
Acidity	mg/l	95	67	52	**40**
BOD5	mg/l	425	225	150	**68**
pH	**-**	**7.5**	**7.1**	**6.8**	**6.5**

Treatment efficiency for the various filter units i.e., F1,F2 and F3 as shown in table 1.3

Parameters	Units	Raw water	F1	Efficiency (%)	F2	Efficiency (%)	F3	Efficiency (%)
Turbidity	NTU	9	7	22	6	33	4	**56**
Alkalinity	mg/l	172	160	7	158	8	150	**13**
Hardness	mg/l	612	515	16	390	36	350	**43**
Chloride	mg/l	85	67	21	46	46	38	**55**
Acidity	mg/l	95	67	29	52	45	40	**58**
BOD_5	**mg/l**	**425**	**225**	**47**	**150**	**65**	**68**	**84**

Table 1.3: Percentage removal of various parameters

1. pH



Graph1.1: Variation of pH with different filters

PH– The variation of pH value various with different filter bed F1, F2 and F3 found 7.1,6.8 and 6.5 respectively.

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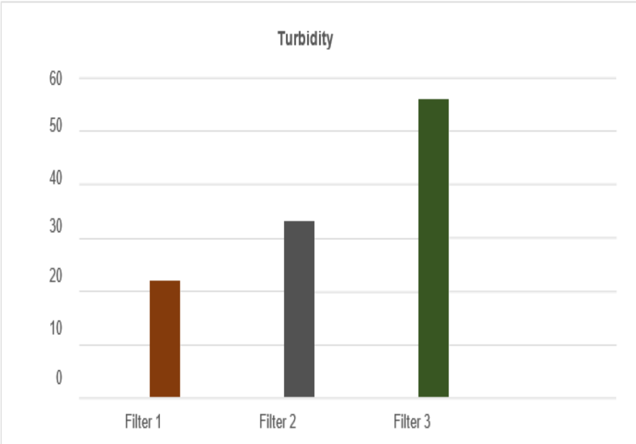
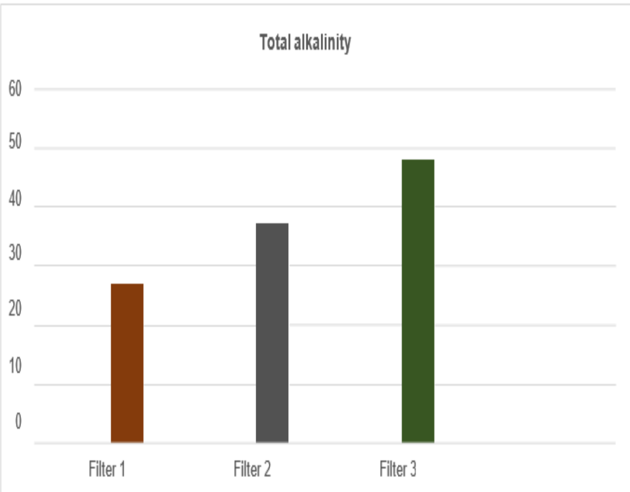
2. Turbidity



Graph1.2: Variation Turbidity with different filters

Turbidity is the measure of clarity of water. Lesser the value of turbidity more is the clarity of water. The combined efficiency of filter bed F1 F2 and F3 is obtained as 22%, 33%, and 56%. Pine bark and coarse aggregate (Laterite soil) materials are capable of reducing turbidity. The better removal efficiency in turbidity is found F3.

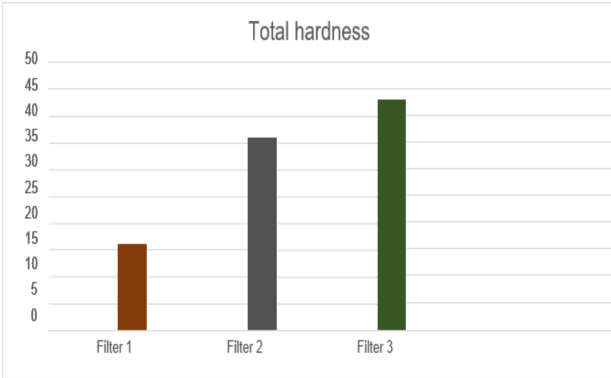
3. Total alkalinity



Graph1.3: Variation of Total alkalinity with different filters

Alkalinity varies in different filter bed F1, F2, and F3 was found 27% 37% and 48%. The most effective filter bed in removal of Alkalinity is F3.

4. Total hardness



Graph1.4: Variation of Total hardness with different filters

Hardness, Calcium and magnesium dissolved in water are the two most common minerals that make water "hard”. The hardness was reduced when passed through fine powdered cactus.Variation of hardness in different bed F1 F2 and F3 found 16%, 36%, and 43% respectively. The most effective filter bed was F3.

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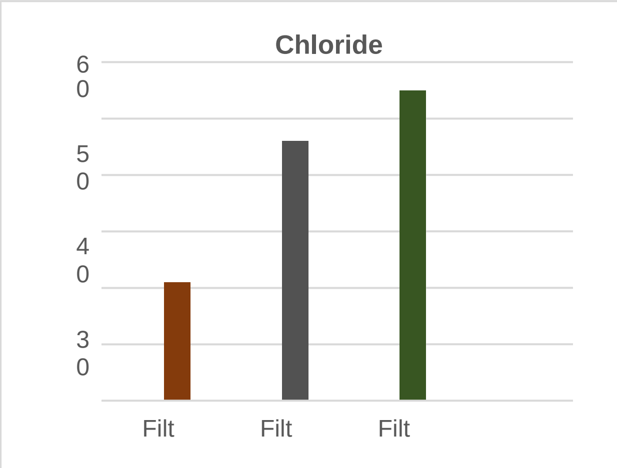
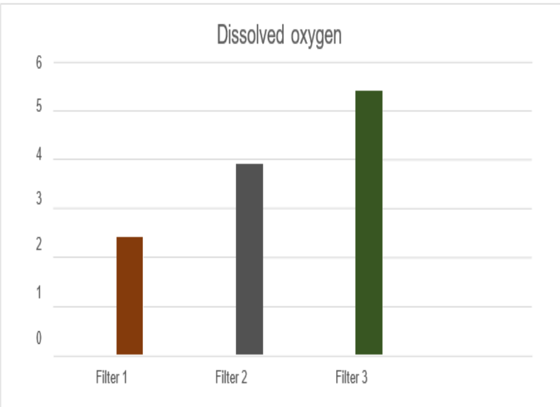
5. Chloride



Graph1.5: Variation of Chloride with different filters

Chloride increases with different filter bed F1 F2 and F3 was found to be 21%, 46%, and 55% respectively. The most effective case was found to be F3.

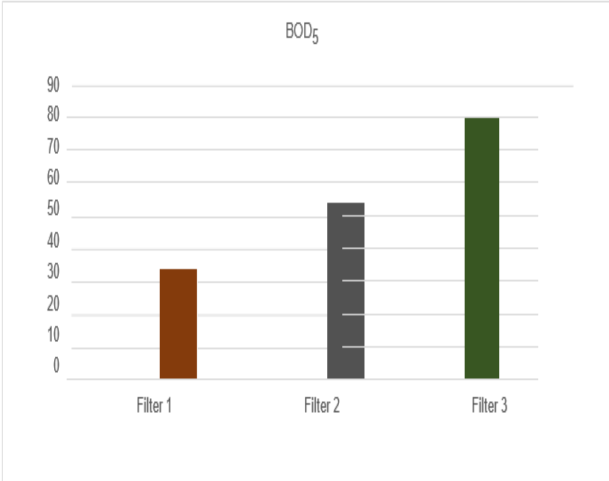
6. Dissolved oxygen



Graph1.6: Variation of Dissolved oxygen with different filters

Dissolved oxygen increases with different filter bed F1 F2 and F3 was found to be 2.4mg/l, 3.9mg/l, and 5.4mg/l respectively. The most effective case was found to be F3.

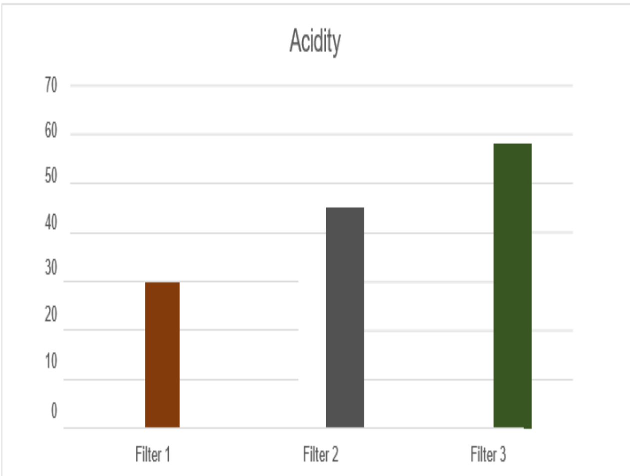
7. Biochemical oxygen demand



Graph1.7: Variation of BOD_5 with different filters

BOD_5 varies with different filter bed F1 F2 and F3 was found to be 34% 54% and 79% respectively. The most effective case removal of BOD5 was found to be F3.

8. Acidity



Graph1.8: Variation of Acidity with different filters

Acidity varies with different filter bed F1 F2 and F3 found to be 29% 45% and 58%respectively. The most effective filter bed was F3.

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Conclusion

The removal efficiency of Turbidity, Alkalinity, Hardness, BOD_5Chloride and Acidity using F3 was found to be 56%, 48% 43% 79%55% and 58% respectively was found to be higher than other than two Filter media F1 & F2. From the above study it can be concluded that as depth of filter media increases the treatment efficiency increases.

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