PUNE RESEARCH DISCOVERY ISSN 2455-9202
AN INTERNATIONAL JOURNAL OF ADVANCED STUDIES VOL 9, ISSUE 3

STUDIES ON NATURAL FIBROUS MATERIALS AS FIXED AERATED BEDS FOR DOMESTIC WASTEWATER TREATMENT

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ABSTRACT

In order, to explore the applicability of natural fibre agave sisalana used in fixed aerated beds, the effect of natural fibre on domestic wastewater was studied through the analysis of the improvement of its physical, chemical parameters. The different detention periods proportion was carried out by indoor test simulation. The results clearly demonstrated that natural fibrous material could improve the removal efficiency of different parameters effectively. Researchers have found some positive result with this material. Further research is needed to make this satisfactory replacement of sand filters which will lead to a sustainable increase in removal efficiency of parameters using natural fibrous material.

***Keywords**: Natural fibrous material, Agave sisalana, Removal efficiency, Improvement*

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1 INTRODUCTION

There is need to effectively treat wastewater generated at various sources to create a hygienic environment. The sewage after treatment may be disposed either into a water body such as lakes, streams, rivers, estuary and ocean or into a land. Wastewater reuse is becoming increasingly popular, especially in areas affected by water scarcity. The strength of domestic wastewater can be reduce by using natural fibrous material as bed material. In this treatment method agava sisalana fibre is used as a filter media. The utilization of fixed films for wastewater treatment process has been increasingly considered due to inherent advantages over suspended growth systems. The present work intended to study the application of the comparative study between the fibre i.e Agave Sisalana as a fixed bed for treating domestic wastewater and to know the comparative removal efficiency of COD, BOD, Nitrate, TDS, Chlorides with

conventional gravel bed in small volume reactor.

II. MATERIALS AND METHODS

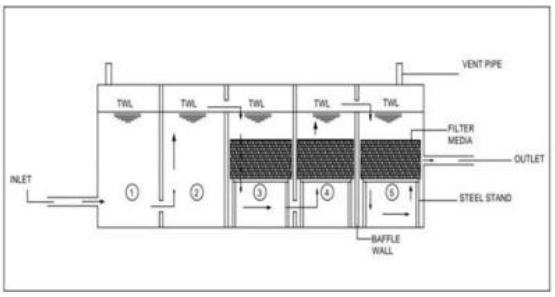
A. Materials Agave Sisalana, is a botanical name of sisal fibre, it is a species of Agave native to Southern Mexico but widely cultivated in many other countries. The sisal fibre is used for rope and twine, and other uses, including paper, cloth, footwear, hats, bags, carpets. Sisal plants Agave Sisalana, consists of a rosette of sword- shaped leaves about 1.5-2 meters (4.9 - 6.6ft) tall. It has a life span of 7-10 year and produces 200-250 commercially usable leaves. Around 1000 fibres are present in single leaf.

Agava sisalana

Areca husk

B. Methodology This method of treatment adopted using Agave Sisalana fibre as a filter media follows the principle of trickling bed filter in which wastewater is made to trickle over a filter media containing seeding agent due to biological action, the inorganic compounds present in wastewater gets decomposed resulting in the reduction of strength of wastewater. The method includes a plastic water tank used as a model, having dimensions of 90 cm x 38 cm x 40 cm. Five compartments are provided in water tank for batch operation process. In which first two compartments are kept as empty and in last three compartments fibre bags are to be provided. These fibre bags are held on stainless steel stands having desired height up to 10 cm & 8 cm resp.A bison panels are to be used to make compartments in tank. Holes are made in panels for smooth movement of water in zigzag pattern. To remove settled particles a sludge outlet is provide at bottom of first compartment. Accessories such as mesh, outlet, vent pipes and taps are used. Initially the model is charged with distilled water and then the sample of wastewater to be treated is fed in tank. A known volume of sample (20L) is fed through inlet pipe at a continuous rate. A wastewater is fed in tank at a rate of 5L per each day for 4 days detention period to maintain constant level of 20L in each compartment. Wastewater is fed into tank get filtrated or treated when it passes through the fibre bags provided in

compartments. After, this the parameters such as pH, COD, BOD, Chlorides and TDS are analyzed for the sample coming the outlet by implementing the standard methods for the Examination of Water and Wastewater, (APHA, AWWA, 20th Edition).



C. Sampling The sample was collected from Aaditya Garden city society, Warje, Pune. Sampling was conducted for every 24hrs for a period of 12 days between 4 pm to 5 pm. Grab samples were collected in plastic cans rinse with distilled water.

III. EXPERIMENTAL SECTIONS

Various test were carried out on wastewater Test conducted namely as: 1) pH, 2) BOD, 3) COD, 4) TDS, 5) chlorides, 6) sulphates. Tests were conducted in standard laboratory as well as few tests were conducted in college laboratory with IS specification and collaborated equipment's. Standard laboratory name: Lotus Water Testing and Analytical laboratory, Sinhgad road, Pune. To evaluate the removal efficiency of parameters of wastewater filtered from fibrous material, the basic tests pH, Chloride, Total dissolved solids at a various detention periods such as for 36 hours, 72 hours, 96 hours were carried out.

IV. RESULTS AND DISCUSSION

In this present study Agave sisalana fibre are used for different detention periods. The study shows higher removal efficiency for 36 hours detention period in comparison to 72 hours and 96 hours detention period.

PARAMETER	INITIAL	1st Day	Removal efficiency	2nd Day	Removal efficiency	3rd Day	Removal efficiency
BOD %	180	95	47.22	50	72.22	32	82.22
COD %	260	170	34.61	135	48.07	109	58.07
TDS %	240	198	17.5	156	35.0	137	42.91
Chlorides %	27	20	25.32	15	44.44	11	59.25
Sulphate %	1	0.52	48.0	0.13	88.0	0.10	90.0
pH	7.5	7.6	-	7.5	-	7.5	-

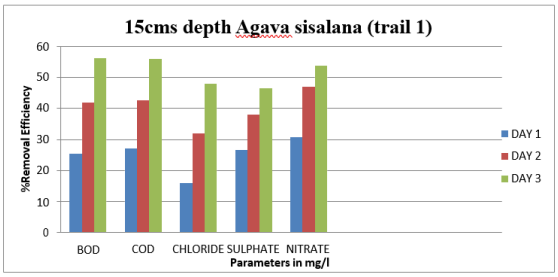


FIG 4. 2Efficiency of removal with a 15-cm Agava sisalana filter bed.

PARAMETER	INITIAL	1st Day	Removal Efficiency	2nd Day	Removal Efficiency	3rd Day	Removal Efficiency
BOD %	140	61	56.42	40	71.42	34	75.71
COD %	374	225	39.83	178	52.40	135	63.90
TDS %	238	210	11.76	168	29.41	143	39.9
Chlorides %	30	22	18.51	18	33.33	12	55.55
Sulphate %	1.4	1.1	21.42	0.9	35.71	0.68	51.42
pH	7.6	7.69	-	7.5	-	7.5	-

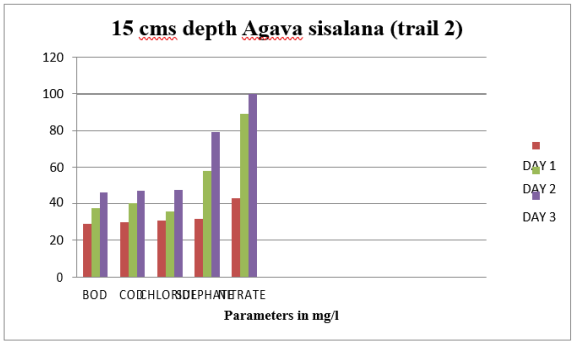
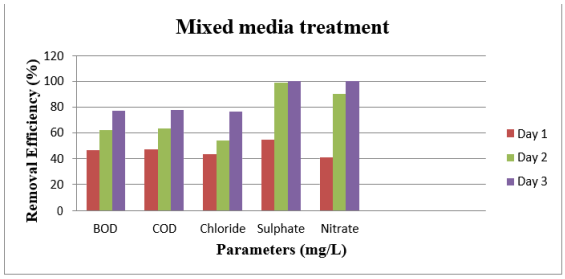
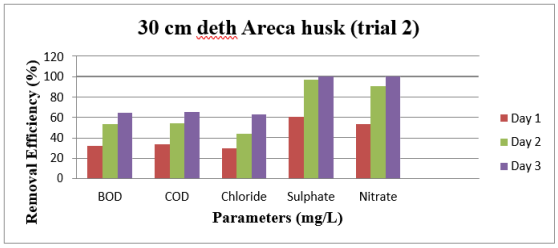


FIG 4.5: Removal effectiveness when employing a 15-cm Agava sisalana filter bed

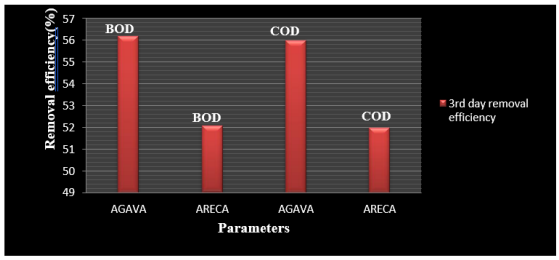
PRAMETERS	INITIAL	1st Day	Removal efficiency	2nd Day	Removal efficiency	3rd Day	Removal efficiency
BOD %	243	168	30.86	135	44.44	105	56.79
COD %	350	208	40.57	165	52.85	142	60.42



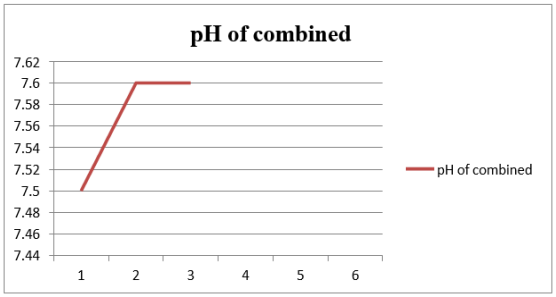
A. Comparison of Results: 1) Graph showing comparative statement regarding removal efficiency of BOD and COD for different detention periods.



2) Graph showing comparative statement regarding removal efficiency of TDS, Chloride, Sulphate for different detention periods



3) Graph showing pH values for different days



B. Discussions In comparison, Agave sisalana fibre removes pollutant to great

extent as well as it is easily available material. Use of such natural fibres as aerated beds reduces the strength of wastewater and the use of conventional sand as well. The remaining sludge from the fibres can be use as manure for gardening or agricultural purposes. And the treated water can be reuse for other purpose.

Cost Analysis:

Characteristics	processing fees	labour fees	transportation charges	total cost
Agava sisalana(4kg)	20/-	50/-	50/-	120/-
Areca husk(4kg)	-	20/-	50/-	70/-

V. CONCLUSIONS

In this study, some conventional and specific experiments were conducted to evaluate removal efficiency of parameters for various detention periods. Based on experiment result and analysis from different detention periods and proportions, following conclusions can be drawn,

1) Considerable reduction in BOD, COD, TDS, chlorides and sulphates were achieved. 2) The removal efficiency of BOD and COD by using Agave Sisalana filter media was found to be 82.22% and 58.07% respectively, for 36 hours detention period. 3) The removal efficiency of BOD and COD by using Agave Sisalana filter media was found to be 75.71% and 63.90% respectively, for 36 hours detention period. 4) The removal efficiency of BOD and COD by using Agave Sisalana filter media was found to be 56.79% and 60.42% respectively, for 36 hours detention period. 5) The operation trouble faced during the study was foul odour emission due to the early decomposition of the fibres. 6) The treated wastewater can be used for gardening and other domestic purposes like washing and cleaning purposes. 7) The spent fibres were rich in nutrient values and can be used as organic manure. 8) This method is eco –friendly and can be used as pretreatment processes for wastewater treatment.

VI. FUTURE SCOPE OF STUDY 1) Media filtration technology has potential for application to small scale systems. Multi- media filter is also a recent development in the filtration technology which involves use of conventional medias opposed to sand used in the conventional sand filters. 2) It can also be concluded from the study that the media filter may be considered as efficient pre –treatment process for wastewater treatment

3) Conflicts of Interest: The authors declare no conflicts of interest.

ACKNOWLEDGEMENT

The support provided by staff of RMD Sinhgad Institute of Technical Campus, the Head of Department and the Principal in the form of a research grant and lotus solutions laboratory by providing standard tests in their laboratory for this study is very much appreciated

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