Development of Fixed Aerated Bed for Domestic Wastewater Treatment by Using Natural Fibrous Material

Neha Ghole[1], M.K.Ranjekar [2]

[1] M.Tech student, Civil & Environmental Technology in the Department of Civil Engineering, Department of Technology, Savitribai Phule Pune University, Pune

[2] Professor, Department of Civil Engineering, Department of Technology, Savitribai Phule Pune University, Pune

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Abstract - The critical situation of domestic wastewater treatment within the rural areas of Pune city. The event of on-site systems using low cost and maintainable materials which will be applied in small and remote areas. Although this is often a very important theme, few real scale systems are studied. This study investigated a full-scale on-site domestic wastewater treatment system composed of an anaerobic filter full of Agava Sisalana fibers. Sisal may be a natural fibrous low-cost biomaterial that's frequently found within the surrounding environment and has no toxic effects.The impact of Agava Sisalana fiber on domestic waste material was studied through the analysis of the event of its physical, chemical parameters. The varied detention period's proportion was disbursed by indoor check simulation. The results clearly demonstrated that natural fibrous material may improve the removal potency of varied parameters effectively. To improve its performance and applicability, sisal was modified with polypyrrole/polyaniline via in-situ chemical oxidative polymerization technique for pollutants remove from wastewater.

Modified Sisal/polypyrrole/polyaniline was over 5.69 times effective than raw sisal for pollutants adsorption. Within the case of synthetic wastewater, the removal efficiency reached 70 %. Hence, the low- cost sisal/polypyrrole/polyaniline composite was a promising alternative for domestic wastewater removal.

The experiment was conducted in rural area located within the city of Pune and also the system was built to serve a small community. The standard of the effluent generated allows its reuse in agriculture activities used fibers are rich in nutrient values and might be used organic fertilizer. The result also reveal that feasibility of using Agava sisalana in anaerobic filters providing a replacement and more maintainable landing place for this material which is currently treated as solid waste. The mixture was shown to be a feasible technology for small communities.

Key Words: Natural fibrous material, Agave Sisalana, Removal potency, Improvement, Polypyrrole /Polyaniline, Adsorption, water recycle

1. INTRODUCTION

Lack of cleanliness is considered a hazard to environmental quality and social well-being worldwide .Although most regions have improved their sanitation services over the past years, isolated communities, rural areas and denseness regions located faraway from urban centers still lack proper sanitation facilities. Water on earth moves frequently through the water cycle of evaporation, transpiration, condensation, precipitation and runoff, typically reaching the ocean. It's one among the foremost essential issue that's needed for every living being. Waste matter is liquid waste discharged by domestic residence, business properties, industries, agriculture, which regularly contains some contaminants that result from admixture of waste water from totally different sources. Waste matter obtained from numerous sources got to be treated terribly effectively so as to form a sanitary setting. In addition to the present, illness inflicting microorganism can breed up within the stagnant water and also the health of the general public are going to be at danger. The principal aim of waste matter treatment is typically to allow human and industrial effluents to be disposed of while not danger to human health or unacceptable harm to natural setting. so within the interest of the community of the city or town it's most essential to assemble, treat and eliminate all the waste matter of {the city/town} in such some way that it shouldn't; cause damage to the orders residing within the town. The extent and also the type of treatment needed, but depends on the character and quality of every waste matter and sources of disposal on the market. The sewage after treatment could also be disposed either into a water body such as lakes, streams, rivers, estuary and ocean or into a land. It's going to use for several purposes like 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 become is becoming increasingly popular, especially in geographies where potable water in brief supply.Reduction of strength of domestic waste matter exploitation bed material agave fiber as a filter media is one such kind of treatment technique adopted. The utilization of fastened films for waste matter treatment method has been more and more thought of due to inherent benefits over suspended growth systems. This work supposed to check the applying of the comparative study between the fiber i.e. agave as a tough and fast bed for treating domestic waste matter and to understand the comparative removal potency of COD, BOD, TDS, Chlorides with standard gravel bed in little volume reactor. Sisal fiber (Agave Sisalana) is obtained from the leaves of this plant. The lustrous strands, usually creamy white, average from 80 to 100 and 20 cm long and 0.2 to 0.4 mm in diameter. Sisal fiber is fairly coarse and inflexible. It's valued for cordage use because of its strength, durability, ability to stretched, affinity certain dyestuffs, and resistance to deterioration in water. This method of treatment adopted victimization Agave Sisalana fiber as a filter media follows the principle of trickling bed filter inside that waste matter is formed to trickle over a filter media containing seeding agent due to biological action, the inorganic compounds present in waste matter gets rotten leading to the reduction of strength of waste matter. Up to now, more than thousand researchers have introduced various kind of treatment method for removal of pollutants from wastewater like adsorption, filtration, biological processes and combination of these techniques, Generally speaking each method has its intrinsic advantages and drawbacks. Adsorption is defined as the movement of the pollutant molecules from the majority solution to a solid surface, mostly called adsorbent .Simple operation, high removal efficiency, less sludge production, high efficiency are the important high points of the adsorption process.

2.MATERIALS

2.1 AGAVE SISALANA AS A FILTER MEDIA

Agave Sisalana, is species of trichophyte native to Southern North Yankee country but wide cultivated and neutral in many different countries. It yields a stiff fiber used in making varied product. The term sisal is additionally refer either to the plants common name or the fiber, relying on the context. It's usually noted as "sisal hemp", as a results of for many years hemp was an important offer for the fiber, and different fiber sources were named once it. The sisal fiber is traditionally used for rope and twine, and has many different uses, at the side of paper, cloth, footwear, hats, bags, carpets, and dartboards. Sisal plants xenophile, consists of a rosette of sword- shaped leaves concerning one.5-2 meters (4.9-6.6ft) tall. Young leaves may have few minute teeth on their margins, but lose them as they mature. The sisal plant options a 7-10 year life-span and typically produces 200-250 commercially usable leaves. Each leaf contains a mean of around one thousand fibers. The fibers account for fewer than concerning multidimensional of the plant by weight. Sisal is taken into consideration a plant of tropics and zone, since production edges from temperatures more than 5 degrees stargazer and sunshine. Fiber is extracted by a technique spoken as surgical operation, where leaves are crushed and crushed by rotating wheel set with bunt knives, thus only fibers keep. The assembly is typically on large scale, the leaves transported to a central surgical operation plant, where water is utilized to wash away the waste parts of the leaf. The fiber is then dried, brushed and baled for export. Correct drying is important as fiber quality swear totally on condition content. Artificial drying has been found to finish in usually higher grades of fiber than sun drying, but is not forever attainable at intervals the developing countries where sisal is formed. Fiber is later cleaned by brushing. Dry fibers are machine combed and sorted into varied grades, totally on the premise of the premise of the previous in- field separation of leaves into size groups. traditionally, sisal has been the leading material for agriculture twine (binder twine and baler twine) thanks to its strength, durability, ability to stretch, affinity sure enough dyestuffs, and resistance to deterioration in salt water. Sisal has been used as Associate in nursing environmentally friendly strengthening agent to modify mineral and fiber surround composite materials in varied uses at the side of the automobile business. As extraction of fibers uses only a tiny low share of the plant, some tries to boost economic viability have targeted on utilizing the things for production biogas, for stock feed, or the extraction of pharmaceutical materials.

Fig-1. Agava Sisalana plants **Fig-2. Agava Sisala fibers**

2.2 MODIFICATION OF AGAVA SISALANA FIBRES WITH POLYPYRROLE/POLYANILINE

Polypyrrole (ppy) and polyaniline (PA) are of two widely used conducting polymers in environmental studies because of their facial synthesis ,porous structure , regeneration , non –toxicity , insolubility in water , environmental and mechanical stability and low cost. Unfortunately, conducting polymers may suffer from serious disadvantages, including aggregate formation, low process ability, low adsorption capacity, difficulties in porosity control, and low surface area in which could hinder the efficiency of the process . Accordingly, various physical and chemical techniques are considered to solve these issues. Hence, it is of great importance to prepare conducting polymers composites to introduce better material with higher applicability. Sisal, or called as Agave sisalana, could be a low-cost hard fiber bio-sorbent that is originated from Mexico. Brazil is the largest producer of sisal fiber in the world (approximately 60 %). Sisal fibers are utilized in the automotive industry, ropes, strings, sea cables, carpets, brooms, up- holster, and handicraft and annually large amount of these fibers are discarded as waste. Apart from availability and inexpensiveness, sisal fibers own effective groups (such as cellulose, lignin, and hemi- cellulose), which are suitable in terms of adsorption processes. It was also employed for volatile organic compounds and CO2 adsorption. Raw sisal, like many other unmodified materials, may have some limitations for the adsorption of pollutants. Modification and composite preparation are called the simplest way of upgrading material, especially those which re-abundant, like sisal.Within the present study aim at coating low-cost sisal fiber with ppy/pA for unwanted pollutant removal from wastewater. Facile synthesis, non-toxicity, easy separation of the spent sorbents, high performance (removal efficiency and adsorption capacity), inexpensiveness, and enjoying the advantages of ppy and pA simultaneously are the significant points of sisal/ppy/pA.

Fig-3. Modified sisal/Polypyrrole/Polyaniline fibers

3. PROBLEM STATEMENT

Central Pollution control board (CPCB) studies depict that there are 920 waste treatment plants (STPs) in Asian country, of that solely 615 are operational. Thus, the {present} treatment capability is simply 21 percent of present waste generation. The remaining untreated waste is that the main reason behind pollution of rivers and lakes. The large range of STPs created below Central Funding Schemes just like the Ganga Action arrange And Yamuna Action arrange Of National watercourse Action arrange aren't totally operated. There's a necessity to arrange methods and provides thrust to policies giving equal weightage to car cerebration of provided water likewise as development of waste matter treatment facilities, recycling, recovery, recharging and absence. The future of urban facility for potable uses can rely majorly on economical waste matter treatment systems, because the treated waste matter of upstream urban centers are the supply of water for downstream cities. Hence provide alternative method to treat domestic wastewater, which is cost effective, more efficient and user-friendly.

4. METHODOLOGY

4.1 Model Designing:-

For present study, Agave Sisalana fibers and Modified sisal/polypyrrole/polyaniline are used as a filter media for wastewater treatment

A plastic water tank is used as a model, having dimension of 38 Inch x 28 Inch x 40 Inch. Made a two parts of plastic water tank, one part for Agava Sisalna and second part for Modified sisal/polypyrrole/polyaniline, having dimension of 38 Inch x 14 Inch x 40 Inch.5 compartments of size is provided in each parts of water tank for batch operation process.. In which first two compartments are kept as empty and in last three compartments fiber bags are to be provided. These fiber bags are held on stainless steel stands having desired height up to 10cm & 8 cm respectively. A bison panels are to be used to make compartments in tank. Holes are made in panels for smooth movement of water in zig- zag pattern.

Fig-4 Model of plastic water tank for experimental analysis

4.2 Synthesis of sisal/ppy/pA nanocomposite

Sisal was initially washed several times with water to get rid of any impurities and dirt on its surface and then dried at 40 °C overnight. The synthesis procedure was conducted via in situ chemical oxidative polymerization technique. In the initial step, 0.3 M HCl (3 mL) was added to 100 mL deionized water. 2 mL aniline and 2 mL pyrrole were added to the 40 mL HCl solution and agitated for about 50 min. In another 40 mL HCl solution, 1.5 g sisal was added and similarly agitated. In the final 20 mL of HCl, 6 g FeCl3 was dissolved and mixed for 30 min. Iron (III) chloride is added to the solution as the oxidant to conduct the polymerization process. In the second step, the aniline/pyrrole solution are poured into a sisal solution, and that they are allowed to interact and blend one another for an hour. Finally, to finish the polymerization process, the oxidant solution was added to the aniline/pyrrole/sisal solution and agitated for 24 h. To reach an improved polymerization, these solutions were kept in an ice bath In the end, the synthesized material was taken out from the solution, which had black to green color. The prepared material was washed several times with water and methanol, and then dried at the oven for 24 h. Fig shows a schematic of the synthesized procedure. The produced material was so-called sisal/polypyrrole/polyaniline (sisal/ppy/Pa).

Step 1-4 mL aniline and 4 mL pyrrole are added to the 80 mL HCl solution and agitated for about 50 min

Step 2-In another 80 mL HCl solution, 5 g sisal was added and similarly agitated

Step 3-In the final 40 mL of HCl, 12 g FeCl3 was dissolved and mixed for 30 min. Iron (III) chloride is added to the solution as the oxidant to conduct the polymerization process

Step 4- In this step aniline/pyrrole solution are poured into a sisal solution, and they are allowed to interact and blend one another for an hour.

Step 5- To finish the polymerization process, the oxidant solution was added to the aniline/pyrrole/sisal solution and agitated for 24 h.

Step 6- In the end, the synthesized material was taken out from the solution, which had blue to green color. The prepared material was washed several times with water and methanol, and then dried at the oven for 24 h.

Fig. 5 Modified sisal/Polypyrrole/Polyaniline

4.3 Collection of samples:-

As per the standard laid down by the CPHEEO (Central Public Health Environmental & Engineering Organization) the fresh water consumption per day per person should between 135 to 150 liters per day. In any rural area, a three bed house with a minimum population of people of 5 people would have a daily estimated wastewater production of 750 liters per day (5 x 150) the sample was collected from a rural area. 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.

4.4 Experimental procedure

Initially the model is charged with water so the sample of wastewater to be treated is fed in tank. A known volume of sample (20L) is fed through inlet pipe at continuous rate day's detention period. A wastewater is fed in tank at a rate of 5L per every day for 4 to take care of constant level of 20L in each compartment. Both the compartment of fibers get fed simultaneously. Wastewater is fed into tank get filtrated or treated when it passes through the fiber bags provided in compartments. After, this the parameters like pH, COD, BOD, Chloride and TDS are analyzed for the sample coming the outlet by implementing the quality methods for the Examination of Water and Wastewater, (APHA, AWWA, 20th Edition).

4.4 Lab tests

Two different fibrous packing materials used for the present study, Agave sisalana and modified sial/ polypyrrole / polyaniline. Fibrous are package in net plastic packets having thickness 2mm. Dude to this net packing , fibers placed in straight manner and they get maximum place for adsorption. Samples were analyzed for the following parameters BOD, COD, Chloride, Sulphate, and PH.

Fig.6 Modified Sisal/Polypyrrole/Polyaniline and Agave Sisalana fibers

4.5 Lab tests to be conducted:-

- BOD
- COD
- TDS
- pH
- Chlorides
- Sulphate

5. RESULT AND DISSCUSSION

5.1 Removal efficiency of using Agava Sisalana filter bed for different detention period

The performance of Agava Sisalana bed is checked at 36h, 72h, and 96h detention period. All results are represent in Table 5.11, Table 5.1.2 & 5.1.3 respectively. It is seen that detention period increases, removal efficiency is also increases. At36h, removal of BOD IS 52.27 % and at 96h removal of BOD is 55.65%. At 96h, the values of BOD, COD, TDS, Chloride and Sulphate as 102, 140, 135, 12 & 0.56 respectively. All values at permissible limit.

PARAMETRS	INITIAL	1st Day	Removal Efficiency (%)	2nd Day	Removal Efficiency (%)	3rd Day	Removal Efficiency (%)
BOD(mg/l)	220	180	18.18	130	40.90	105	52.27
COD(mg/l)	300	210	30	170	43.33	110	63.33
TDS(mg/l)	230	190	17.39	180	21.73	140	39.13
Chlorides(mg/l)	28	22	21.42	15	46.42	11	60.71
Sulphate(mg/l)	1.2	0.51	57.5	0.13	89.16	0.10	91.66
pH	7.5	7.6	-	7.5	-	7.5	-

Table 5.1.1- Removal efficiency of Agava Sisalana filter bed for 36 h detention period

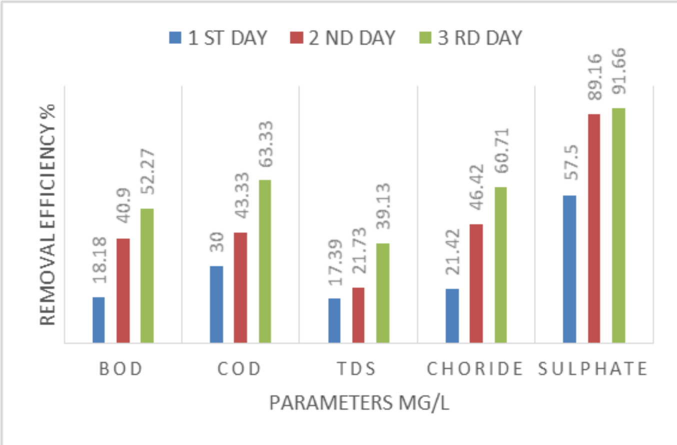

Chart 5.1.1- Removal efficiency using Agava Sisalana filter bed for 36 h detention period

PRAMETERS	INITIAL	1st Day	Removal Efficiency (%)	2nd Day	Removal Efficiency (%)	3rd Day	Removal Efficiency (%)
BOD(mg/l)	120	60	50	40	66.66	32	73.33
COD(mg/l)	340	220	35.29	170	50	130	61.76
TDS(mg/l)	210	205	2.38	158	24.76	140	33.33
Chlorides(mg/l)	28	20	28.57	17	39.28	12	57.14
Sulphate(mg/l)	1.3	1.1	15.38	0.8	38.46	0.68	47.69
pH	7.6	7.69	-	7.5	-	7.5	-

Table 5.1.2- Removal efficiency of Agava Sisalana filter bed for 72 h detention period

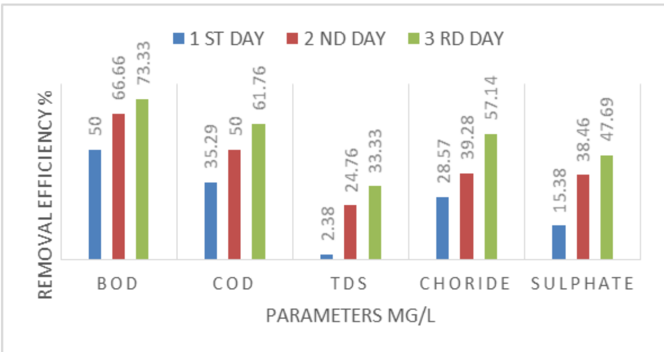

Chart 5.1.2-Removal efficiency of Agava Sisalana filter bed for 72h detention period

PRAMETERS	INITIAL	1st Day	Removal Efficiency (%)	2nd Day	Removal Efficiency (%)	3rd Day	Removal Efficiency (%)
BOD(mg/l)	230	165	28.26	132	42.60	102	55.65
COD(mg/l)	310	205	33.87	163	47.41	140	54.83
TDS(mg/l)	225	190	15.55	165	26.66	135	40
Chlorides(mg/l)	27	20	25.92	15	44.44	12	55.55
Sulphate(mg/l)	1.5	1.3	13.33	0.9	40	0.56	53.33
pH	7.5	7.56	-	7.5	-	7.5	-

Table.5.1.3- Removal efficiency using Agava Sisalana filter bed for 96 h detention periods.

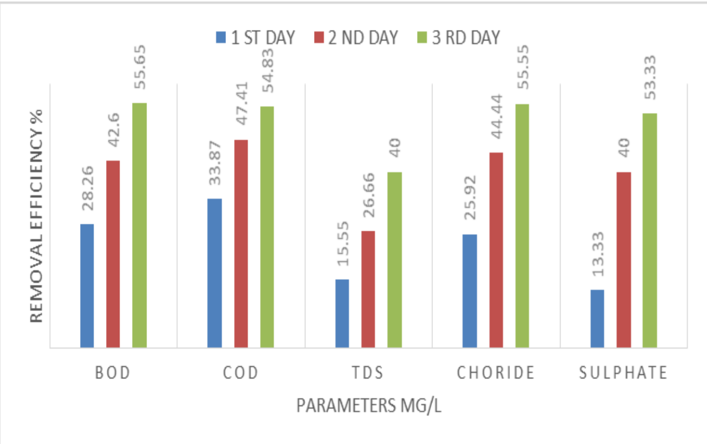

Chart.5.1.3-Removal efficiency using Agava Sisalana filter bed for 96 h detention periods

4.2 Removal efficiency of modified sial/ polypyrrole / polyaniline bed for different detention period

The performance of Modified sisal/polypyrrole/polyaniline bed is checked at 36h, 72h, and 96h detention period. All results are represent in Table 4.21, Table 4.2.2 & 4.2.3 respectively. It is seen that detention period increases, removal efficiency is also increases. At36h, removal of BOD IS 61.90 % and at 96h removal of BOD is 65.21%. At 96h, the values of BOD, COD, TDS, Chloride and Sulphate as 80, 120, 110, 10 & 0.58 respectively. All values are at permissible limit. (Ref 3.6.2, 3.6.3)

PARAMETRS	INITIAL	1st Day	Removal Efficiency (%)	2nd Day	Removal Efficiency (%)	3rd Day	Removal Efficiency (%)
BOD(mg/l)	210	170	18.18	120	42.85	80	61.90
COD(mg/l)	300	180	40	150	50	85	71.66
TDS(mg/l)	230	140	39.13	170	26.08	120	47.82
Chlorides(mg/l)	28	19	32.14	13	53.57	10	64.28
Sulphate(mg/l)	1.2	0.50	58.33	0.12	90	0.10	91.66
pH	7.4	7.6	-	7.4	-	7.5	-

Table.4.2.1-Removal efficiency of modified sial/ polypyrrole / polyaniline filter bed for 36 h detention period

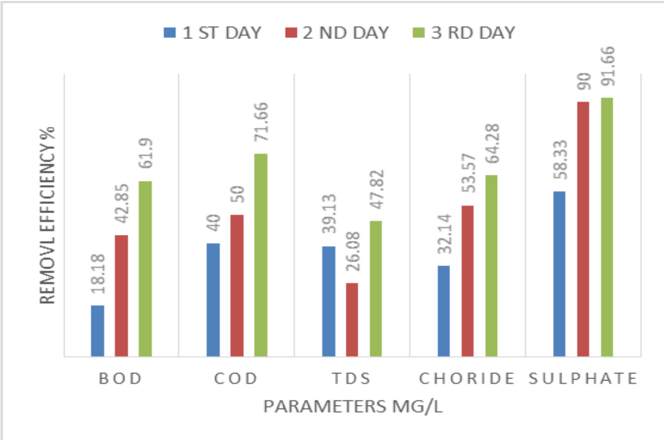

Chart.4.2.1-Removal efficiency of modified sial/ polypyrrole / polyaniline filter bed for 36 h detention period

PARAMETRS	INITIAL	1st Day	Removal Efficiency (%)	2nd Day	Removal Efficiency (%)	3rd Day	Removal Efficiency (%)
BOD(mg/l)	120	50	58.33	30	75	30	75
COD(mg/l)	340	210	38.23	160	52.94	110	67.64
TDS(mg/l)	210	200	4.76	150	28.57	132	37.14
Chlorides(mg/l)	28	18	35.71	16	42.85	10	64.28
Sulphate(mg/l)	1.3	1.1	15.38	0.7	46.15	0.67	48.46
pH	7.5	7.6	-	7.5	-	7.5	-

Table-4.2.2 Removal efficiency of using modified sial/ polypyrrole / polyaniline filter bed for 72 h detention period

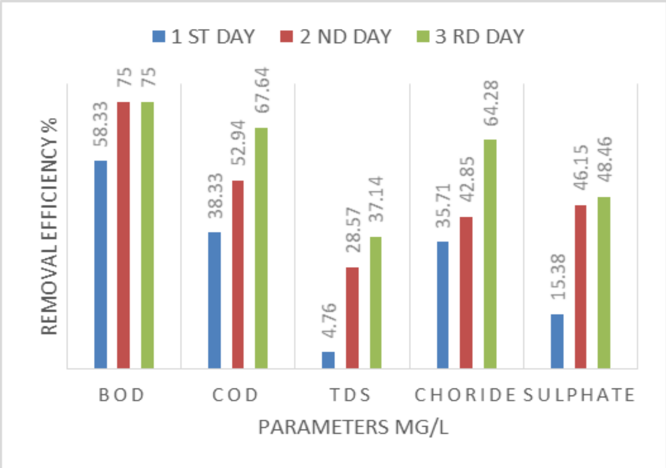

Chart 4.2.2-Removal efficiency using modified sial/ polypyrrole / polyaniline filter bed for 72 h detention period

PARAMETRS	INITIAL	1st Day	Removal Efficiency (%)	2nd Day	Removal Efficiency (%)	3rd Day	Removal Efficiency (%)
BOD(mg/l)	230	160	30.43	130	43.47	80	65.21
COD(mg/l)	310	200	35.48	160	48.38	120	61.29
TDS(mg/l)	225	180	20	150	33.33	110	51.11
Chlorides(mg/l)	27	18	33.33	13	51.85	10	62.96
Sulphate(mg/l)	1.5	1.2	20	0.8	46.66	0.58	61.33
pH	7.4	7.54	-	7.5	-	7.5	-

Table.4.2.3- Removal efficiency using modified sial/ polypyrrole / polyaniline filter bed for 96 h detention period

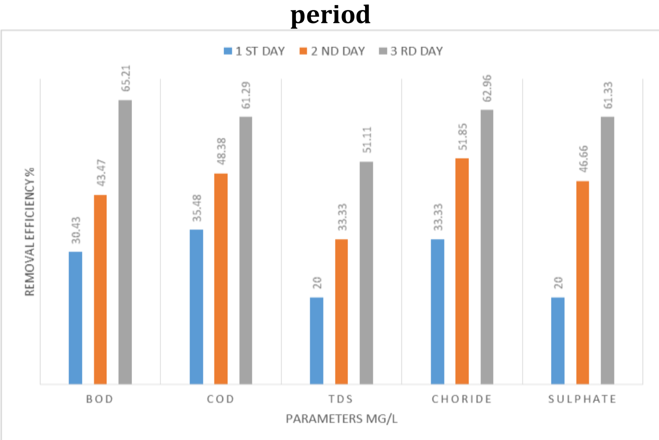

Chart.4.2.3-Removal efficiency using modified sial/ polypyrrole / polyaniline filter bed for 96 h detention period

4.3 Comparison of Agava Sisalana and Modified sisal/polypyrrol

A) Comparison of BOD, COD, TDS, Chloride & Sulphate Removal efficiency

Modified sisal shows more removal efficiency than Agava sisalana. Agava sisalana have own negative surface and could effectively adsorb positive compounds via electrostatic attraction. The main issue is raised once the intended compound own a negative surface, and not much sorption is happened due to repulsive forces. To solve this obstacle, a novel composite based on sisal and modification with polypyrrole and poly- aniline was synthesized.

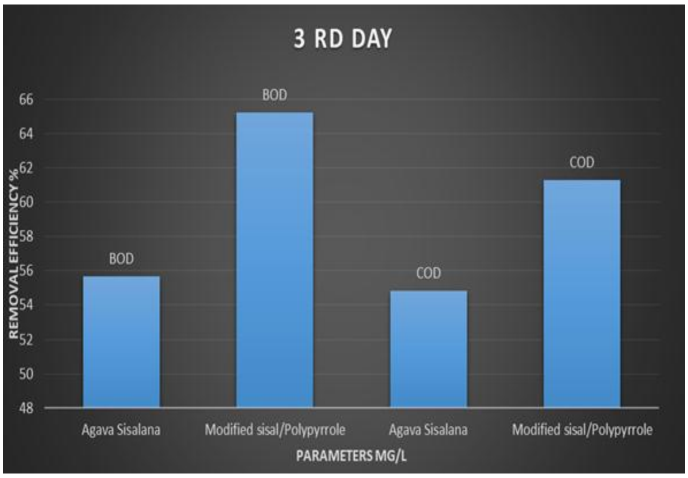

Chart 4.3.1 Comparison of BOD , COD removal efficiency

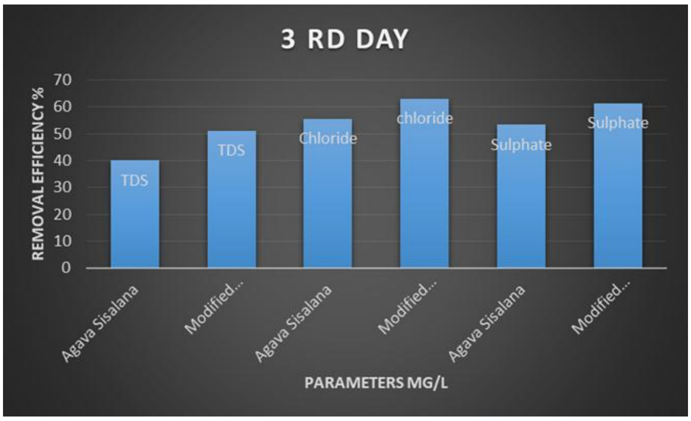

Chart 4.3.2- Comparison of TDS , Chloride & Sulphate removal efficiency

4.4 The effects of operational parameters

4.4.1 Effect of detention period

Detention period or contact time is one in every of the main parameters in adsorption process for removal contaminants from wastewater .Fig (a) shows the pollutants removal efficiency and Agava sisalana adsorption capacity at the time ranging from 0 to 96 hours . In sight of removal efficiency, it is observed that the elimination process could be divided into three different parts. In the starting from 0-36 hours the curve got a high slope with rapid increase in pollutant removal, until 36 hours, 28.26 % pollutants was adsorbed. In the second stage (36-72 hours) the slope of the removal curve drastically reduced in the way that the removal efficiency slightly increase from 28.26 % to 42.60 %. Adsorption rate in this period was not significant. Within the conclusion (72 to 96 hours), it is substantially clear that removal efficiency slightly increase from 42.60 to 55.65% .It is almost constant. In similar way, by using modified sisal/polypyrrole/polyaniline removal efficiency shows in fig (b). Within the initial stage (0-36hours) the curve got high slope with rapid increase in pollutant removal, until 36 hours, 30.43% pollutant was adsorbed. Within the second stage (36-72 hours) the slope of the removal curve drastically reduced in the way that the removal efficiency slightly increase from 30.43 % to 43.47%. Adsorption rate within this period was not significant. In the final stage (72 to 96 hours), it is greatly clear that removal efficiency slightly increase from 43.47to 65.21%. It is slightly increasing. Such behavior could be attributed to the actual fact that initial stage of the adsorption process, there are many vacant sites on Agava sisalana and modified sisal that are vulnerable to adsorb the pollutant from wastewater. Therefore, for the optimum contact period was set at 96 hours.

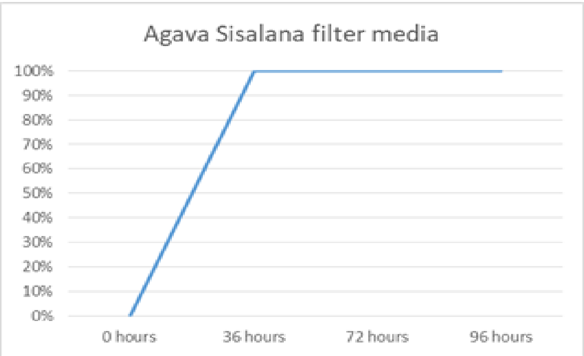

Fig (a) The effect of contact time

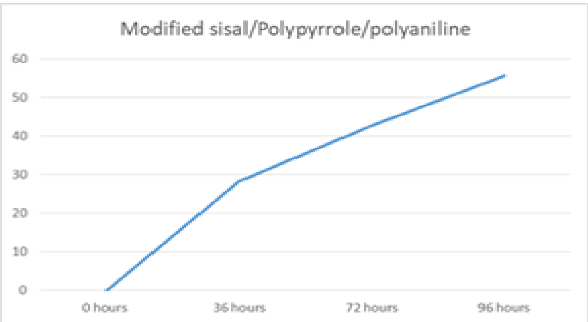

Fig (b) The effect of contact time

4.4.2 Effect of adsorbent dosage

The adsorption rate of pollutant are investigated by changing the dosage of under optimum detention period. The importance of adsorbent dosage is especially associated with the ultimate cost of treatment and removal efficient. The effect of pollutant removal efficiency and adsorption capacity under various adsorbent dosages is shown in Fig. (a) It shows that by increasing the adsorbent dosage from 50 mg to 150 mg, pollutant removal efficiency enhanced from 43.47% to 65.21%. Higher pollutants elimination are observed at higher sisal/ppy/pA dosage. Logically, it is fair to suggest that after the adsorbent dosage increases, more active sites become available for pollutant removal. Considering the adsorption capacity (Fig. b), different results were observed. Numerically, the adsorption capacity of 10 mg/g was achieved at an adsorbent dosage of 50 mg; however, at sisal/ppy/pA dosage of 150 mg the adsorption capacity was found to be 5 mg/g. Intending these figures the greater adsorption capacity are achieved at lower adsorbent dosage. In fact, when there is the limited number of vacant sites on the adsorbent (at low adsorbent dosage), competitive behavior is occurred between pollutants molecules to occupy these available sites, resulting in a greater adsorption capacity at lower adsorbent dosage. In order to optimize the rest of parameters, it is intended to decide on the adsorbent dosage of 50 mg dosage.

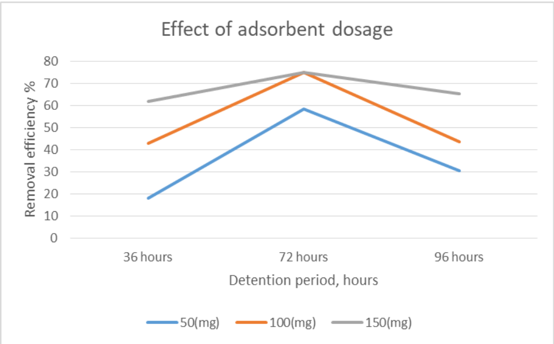

Fig (a) Effect of adsorbent dosage

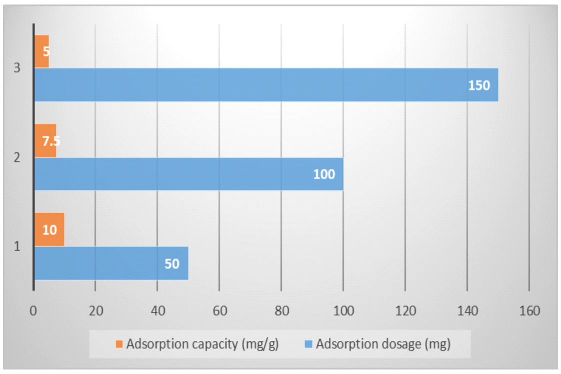

Fig. (b)) Effect of adsorbent dosage

4.4.3 Effect of pollutants concentration

In terms of adsorption applicability in a real environment, it is important to determine the effect of different pollutants concentrations. Accordingly, chart-4.4.3 represents the effect of contaminants concentration on the removal efficiency. The experiments are conducted at contact time 96 hours and adsorbent dosage 150 mg. Based on the obtained results, the highest removal efficiency of 65.21 % are observed at contaminants concentration of 5 ppm. However, the lowest removal of 30.43%, are seen at a contaminants concentration of 100 ppm. It can be explained that the quantity of obtainable active sites on sisal/ppy/pA are constant and once contaminants concentration increases (dude to season-wise variation seen in contaminant concentration) the number of pollutant molecules increase. However, these required sites do not seem to be available, leading to lower removal efficiency at higher contaminants concentration. In contrast, at pollutants 5 ppm, the contaminants molecules could simply occupy the sites and be removed. Approximately, all pollutants are removed.

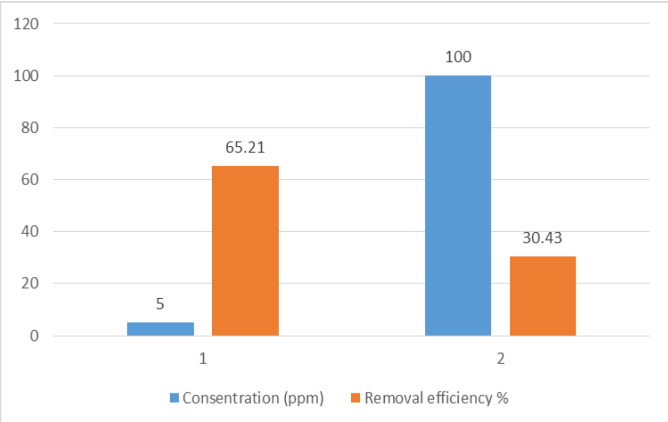

Chart-.4.4.3 Effect of pollutants concentration

4.4.4 Effect of temperature

Based on numerous investigations, the temperature of the working solution directly effects on the interaction between adsorbate and adsorbent. Within the present study, the effect of temperature ranging from 25 to 45 °C was studied. These results are shown in Chart-4.4.4 accordingly, by increasing the temperature starting from 25 °C to 45 °C, the removal efficiency increased from 30.43 % to 65.21 %, revealing an endothermic nature of sisal/ppy/pA for RO5 adsorption. This behavior is mainly because of the interaction between adsorbate and adsorbent, which could be said that at high temperature sisal/ppy/pA sites exhibit greater affinity and adsorption energy toward pollutant molecules. Since do not seem to be many differences within the removal efficiencies and the cost of temperature adjusting within the industrial scale.

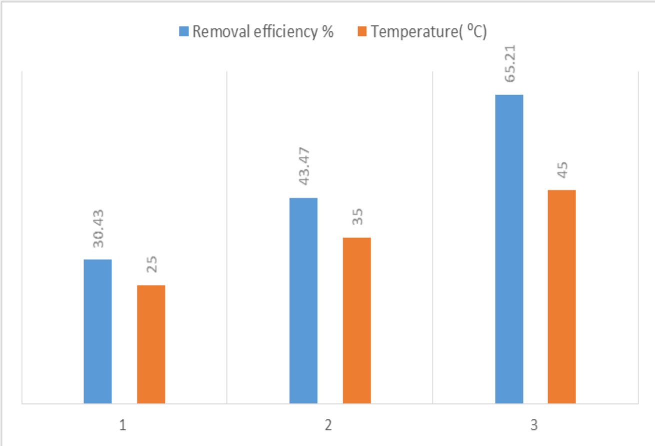

Chart 4.4.4- Effect of temperature

4.4.5 Reusability of modified sisal/ppy/pA

In view of total treatment cost in adsorption processes, adsorbent plays an important role and scientists attempt to employ biomaterials found in the environment. In the present study, the reusability of bio-sorbent sisal/ppy/pA was tested under optimum conditions, and also the results are presented in Fig.4.4.5 The spent adsorbent is firstly washed with distilled water, and then dried at ambient temperature. After that, it had been washed several times with 0.1 M NaOH solution (100 mL). Next, it absolutely was again washed with ethanol and distilled water, and then dried at 60 °C. It was found that one the adsorbent was used for four times; the removal efficiency was still more than 80 % for pollutant adsorption. Thus, the results revealed that sisal/ppy/pA may be successfully utilized for the removal of pollutant from wastewater.

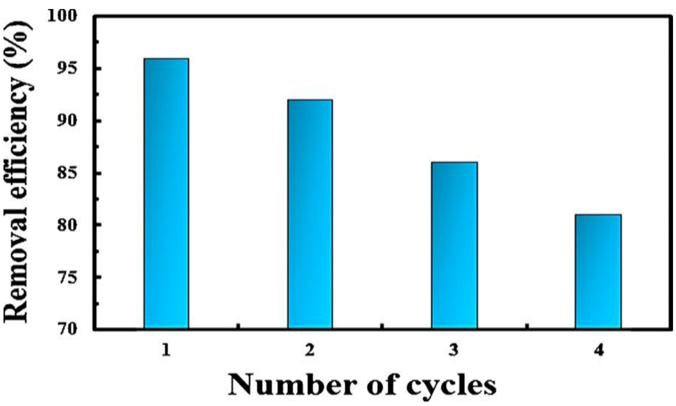

Chart 4.4.5- Reusability of modified sisal/ppy/pA

4.4.6 Effect of Ph

The fluctuation of PH during absorption process in Agava sisalana bed media is constant throughout all detention period. But in the modified bed media is get alter the surface charge of the material. By increasing the PH from 2 to 8, the removal efficiency decreases from 99% to 30.43%. Identical trends are observed for adsorption capacity.

4.4.7 Cost Analysis

Characteristics	Processing fees	Labor fees	Transportation charges	Total cost
Agava Sisalana (5kg)	30/-	50/-	50/-	130/-
Modified sisal /Polypyrrole/Polyaniline (5Kg)	100/-	50/-	50/-	200/-

Table 4.4.7- Cost analysis for Agava Sisalana & Modified sisal /Polypyrrole/Polyanilin

Extraction process of Agava Sisalana fibers is simple to implement. Fiber is extracted by a technique spoken as surgical operation, where leaves are crushed and crushed by rotating wheel set with bunt knives, thus only fibers keep. The assembly is typically on large scale, the leaves transported to a central surgical operation plant, where water is utilized to wash away the waste parts of the leaf. The fiber is then dried, brushed and baled for export. For 5kg fiber extraction process required 30 rupees per kg, labor charges are 50 /-, transportation charges are 50/- and total cost for complete procedure is 130/-, for modified sisal fibers required some experimental procedure. The experimental procedure was conducted via in place chemical oxidative polymerization technique. For this procedure 100 rupees per kg charges required. Labor charges is 50 rupees per kg and transportation charges is also 50 rupees per kg. Total cost is required for this complete procedure is 200 rupees per kg.

6. CONCLUSION

The potential of sisal/ppy/pA as a cost-effective adsorbent to adsorb pollutant is evaluated in the present study. It is first time that sisal/ppy/pA is synthesized and used for such removal of wastewater pollutants. Electrostatic attraction and physical adsorption were introduced as the chief mechanisms for pollutants removal from wastewater. In this study, it has been showed that treatment the treated of sisal fibers with Aniline/pyrrole shows a better capacity in the removal of pollutants from domestic wastewater than natural sisal fibers, with maximum adsorption capacity up to 65.21 mg/g .It has also been shown that the best results for bio-sorption of contaminants on natural and modified sisal fibers were obtained using an adsorbent dose of 5 g/l and after a detention period 96h. The adsorbed quantities of pollutants decreases with increasing temperature. Pollutants removal from wastewater is increased with increasing contact period like 36h, 72h, & 96h and a higher dosage of sisal /ppy/pA provided more place for pollutants removal, which was favorable in terms of performance. Considerable reduction in BOD, COD, TDS, nutrients such as chloride, sulphate are achieved by using Agava sisalana filter bed and Modified sisal/ppy/pA filter bed. The removal efficiency of BOD , COD, TDS and Chloride , Sulphate by using Modified sisal/ppy/pA filter bed are found to be 65.21%, 61.29%, 51.11% & 62.96%, 61.33% respectively which is higher than that of Agava Sisalana filter media is found to be 55.65%, 55.48%, 42.22%,& 55.55%, 53.33% respectively .High removal efficiency, nontoxicity, availability, and cost-effectiveness are the main pros of sisal/ppy/pA.This model is used in any season, pollutants concentration is inversely proportional to removal efficiency. When pollutants concentration is 5ppm then removal efficiency is 65.21% and when pollutants concentration is 100 ppm then removal efficiency is 30.43 % relatively less .Hence here conclude that pollutants increases, removal efficiency decreases. The cost of Agava sisalana fibers used for treatment of 150 liters of wastewater is about Rs-133,which is economical than compared to modified sisal/poypyrrole/polyaniline fibers cost about Rs-200.However the treatment efficiency of modified is found to be higher than that of Agava Sisalana . The fluctuation of PH during absorption process in Agava sisalana bed media is constant throughout all detention period. But in the modified bed media is get alter the surface charge of the material. By increasing the PH from 2 to 8, the removal efficiency decreases from 99% to 30.43%. Identical trends are observed for adsorption capacity. The treated wastewater can be used for car washing, irrigation, watering lawns, and, recharge of aquifers. This method is user-friendly and can be used as pre-treatment process for wastewater treatment. The treatment method is easily implement in any developed rural area. Instead of conventional media such as sand etc. Use of natural and modified fibrous materials as a fixed bed in wastewater treatment equally shows promising efficiency of organics and nutrients. The used fibers are rich in nutrient values and can be used organic fertilizer. The result also demonstrate that viability of using Agava sisalana in anaerobic filters for the treatment of sewage from small communities. The quality of the final effluent generated allows its recycle in agriculture activates. This system required maintenance every 6 months.This provides a new and more maintainable landing place for this material which is currently treated as solid waste.

7. Future scope of Study

Modified sisal/ppy/pA could also be utilized for variety kinds of pollutants, including pharmaceuticals and pesticides.

Agava sisal is one of the greatest biomaterials which is highly capable of being used in many composites. Further study on agava sisalana's remedial properties and attention will be paid to the sustainable management of these plants in the country in a sustainable manner. In future perspective the biomass of sisal may be used for removal of cadmium and lead ions in contaminated water

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