TREATMENT OF INDUSTRIAL WASTE EFFLUENT USING TREATED BAGASSE.

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ABSTRACT: This research work is aimed at the investigation of the reduction of concentration of heavy metals from industrial Effluent water using sulphuric and acetic acid treated Bagasse. This was achieved by varying the concentration of the acids between 0.3M - 0.6M. This report discusses the treatment of Bagasse and the methodology of treating the industrial effluent water using the treated Bagasse as an adsorbent. The treated water samples were analysed using the atomic absorption spectrophotometer to determine the concentration of heavy metals present after treatment. The results obtained shows that 0.3M-0.6M sulphuric and acetic treated Bagasse were successful in the reduction of the concentration of heavy metals, with 0.4M-0.5M sulphuric and acetic acid treated Bagasse been the most effective because it has the lowest concentration of heavy metals after treatment and this implies that more active sites were opened for adsorption at this concentration. This research work has proved that treated Bagasse is an effective adsorbent in the reduction of the concentration of heavy metals in industrial effluent water.

KEYWORDS: Heavy metals, Bagasse, Adsorption, Effluents, sewage,contaminants.

1.0 INTRODUCTION

Sewage treatment, or domestic waste water treatment, is the process of removing contaminants, wastewater and household sewage, both runoff (effluents) and domestic. It includes physical, chemical and biological processes to remove physical, chemical and biological contaminants. Its objective is to produce a waste stream (or treated effluent) and a solid waste or sludge suitable for discharge or reuse back into the environment. This material is often inadvertently contaminated with many toxic organic and inorganic compounds. Sewage is created by residences, institutions, hospitals, commercial and industrial establishments. It can be treated close to where it is treated (in septic tanks, bio-filters or aerobic treatment systems), or collected and transported via a network of pipes and pump stations to a municipal treatment plant.

Sewage collection and treatment is typical subject to local, state and federal regulations and standards. Industrial sources of wastewater often require specialized treatment processes.

The sewage treatment involves 4three stages, called primary, secondary and tertiary treatment. First, the solids are separated from the wastewater stream. Then dissolved biological matters progressively converted into a solid mass by using indigenous, water-borne micro-organisms. Finally, the biological solids are neutralized then disposed of or re-used, and the treated water may be disinfected chemically or physically (for example by lagoons and micro-filtration). The final effluent can be discharged into a stream, river, bay, lagoon or wetland, or it can be used for the irrigation of a golf course, green way or park. If it is sufficiently clean, it can also be used for groundwater recharge or agricultural purposes.

Raw influence (sewage) includes household waste liquid from toilets, baths, showers, kitchens, sinks, and so forth that is disposed of via sewers. In many areas, sewage also includes liquid waste from industry and commerce. The draining of household waste into grey water and black water is becoming more common in the developed world, with grey water being permitted to be used for watering plants or recycled for flushing toilets. A lot of sewage also includes some surface water from roofs and hard-standing areas. Municipal wastewater therefore includes residential, commercial, and industrial liquid waste discharges, and may include storm water runoff.

Sewage systems capable of handling storm water are known as combined systems or combined sewers. Such systems are usually avoided since they complicate and thereby reduce the efficiency of sewage treatment plants owning to their seasonality. The variability in flow a/so leads to often large than necessary, and subsequently more expensive, treatment facilities. In addition, heavy storms that contribute more flows than the treatment plant can handle may overwhelm the sewage treatment system, causing a spill or overflow (called a combined sewer overflow, or CSO, in the United States). It is preferable to have a separate storms drain system for water in areas that are developed with sewers systems.

As rainfall runs over the surface of roofs and the ground, it may pick up various contaminants including soil particles and other sediment, heavy metals, organic compounds, animal waste, and oil and grease. Some jurisdictions require storm water to receive some level of treatment before being discharged directly into waterways. Examples of treatment processes used for storm water include sedimentation basins, wetlands, buried concrete vaults kinds of filters, and vortex separators (to remove coarse solids).

Environmental and legislative pressures have forced the pulp and paper industry to modify its pulping, bleaching and effluent treatment technologies to reduce the environmental impact of mill effluents (Bajpai et al., 1994).these pressures have a/so led to the design of many techniques aimed at improving the pulping process and reducing the lignin content of the pulp entering the bleach plant.

The cooking process generates large amounts of concentrated wastewater especially that from sulphite and sulphate processes. One solution to this problem is the use of organic solvents. Although the effectiveness of such solvents has been known for a long-time, they have only recently started to be used for this purpose at pilot-and small-scale industrial plants (jimmez et al.,m 1997; Beg et al., 2001). Organosolv processes have been applied with varied success to hardwood and softwood and a/so, to a lesser extent, to non-wood materials. Agricultural fibres constitute an alternative to wood as a raw material for making pulp on account of their high growth rate and adaptability to various soil types. In Brazil where sugarcane is an abundantly grown crop, bagasse is available for paper making, besides other non-wood materials such as wheat straw and various other agricultural residues. The interest in agricultural fibres promoted research in this area regarding their potential as raw material for cooking (seisto et al., 1997 usta et al., 1999).

In recent years scientific studies have been directed towards the development of environmentally clean and non-toxic bleaching agents are associated with corrosion of storage tanks, formation of toxic and/or mutagenic organic chlorinated compounds and increased chloride and AOX levels im bleach plant effluents (viikari et al., 1994). In response of environmental concerns and stringent emission standards, a new improvement in this field is the inclusion of an enzyme stage in the bleaching process. A significant decrease in the quantity of chlorine containing reagents has been achieved in this way. Pulp bleaching has been made easier in subsequesnt stages and pulp brightness has been improved. Such techniques using xylan specific enzyme (xylanase) have found their industrial application in a number of plants in scxandinavia biomass (Nguyen and Saddler 1991). Several strategies have been used to increase the efficiency and reduce the costs of there components of the process. A successful strategy is to enhance the enzyme productivity by fungi and to reuse the enzymes several times in the process (Greeg and Saddler 1996).

2.0 METHODOLOGY

2.1 TABLE OF MATERIALS, THEIR SOURCES AND PURPOSES

Materials required for the project were obtained from different locations/ sources for different purposes as outlined in table 1

2.1.1 LIST OF APPARATUS

STOP WATCH: This is used to measure time required for the effluent water to pass through the treated bagasse.

ATOMIC ABSORPTION SPECTROPHOTOMETER (AAS):

It is an instrument used to quantify the concentration of heavy metals in a given sample type.

ELECTRONIC WEIGHING BALANCE: This is an electronic device used in measuring the quantity of the Bagasse i.e. the mass of Bagasse that is to be treated.

DRYING OVEN: This is used to dry the treated Bagasse.

MINI-CONTACTOR: This is the device in which the treatment of the effluent is to be carried out. It is locally fabricated.

2.2 PREPARATION OF THE REAGENT CONCENTRATION.

The reagent used in this research work are sulphuric acid and Acetic acid. Different concentrations ranging from 0.3m-0.6m was used to treat the Bagasse (adsorbent).

A shock solution of 1m for each of the acids and dilution were carried out to get the desired concentration.

To prepare 1m solution of sulphuric acid, add about 54.3ml of the acid 945.7ml of diluted water.

To prepare 1m solution of Acetic acid 57ml of the concentrated to about 600ml of distilled water and dilute to the litre. Using the dilution formula $C_1V_1= C_2V_2$, the desired concentration and volume will be obtained, where C1 and C2 are the concentration of the original and the diluted solutions, V1 and V2 are the volumes of the original and the diluted solutions. The dilutions of the acids are discussed in the appendix.

2.2.1 PRECAUTIONS

- Ensure that a laboratory coat and hand gloves are worn to avoid damage to the skin when there is a splash.
- Ensure that all glassware's to be used are rinsed with de-ionized water and with the content it is to contain order to avoid contamination.
- The treated Bagasse was rinsed with de-ionized water to avoid any further ion contamination.

2.3 PROCEDURE FOR THE TREATMENT OF BAGASSE

The Bagasse is from the sugarcane mill. It was dried and grounded to a powder form. A known amount of the Bagasse is weighed on a weighing balance depending on the size of the comportment for the adsorbent in the mini-contactor. For the purpose of this project 210g of Bagasse was weighed in a beaker. The weighed Bagasse was poured into a beaker with known concentration of acid solution. This is left for about six hours, the essence of doing this is to activate the surface area of the pores of the Bagasse for the entrapment of heavy metals.

After six hours, the Bagasse was rinsed with de-ionised water to wash off the acid from the Bagasse. Rinsing was done several times until there were no traces of acid in the rinse water. The Bagasse was then poured on a sieve to drain the water. The treated Bagasse was dried in an oven at temperature range of $100^{O}C – 120^{O}C$ for 8hours.

Table 1: Material Used

S/N	MATERIAL	SOURCE	PURPOSE
1.	Effluent water	Toplex paint Industries	Water sample required for the treatment
2.	Bagasse	Local mills	It serves as adsorbent for the treatment of effluent water
3.	Diluted Sulphuric Acid	Chemical village	It is a strong acid; it is very corrosive and causes severe burns. It has great affinity for water.
4.	Diluted Acetic Acid	Chemical village	It Is A Weak Acid, It Is called Glacial acetic acid and very corrosive.
5.	Treated Bagasse	Laboratory	It serves as adsorbent
6.	De-ioned water	De-ionising machine	It is used for preparation of acid solution and rinsing of the treated bagasse
7.	Polystyrene fabric	Local market	It is used in packaging of the treated bagasse.
8.	Sample bottles	Local Market	It is used to collect the effluent to be taken for analysis.

2.4 OBSERVATION

After the dilution of sulphuric acid, followed by the treated Bagasse, the color changed to dark-brown compare to that of the Acetic acid, which turns to light brown.

2.5 PACKAGING OF THE TREATED BAGASE

The treated Bagasse was brought out of the oven after it is been allowed to cool before been bagged in a special polymeric material with different sizes 0.6m bag, 0.5m bag, 0.4m bag,0.3m bag and untreated Bagasse bag which serves as the control experiment.

2.6 THE CONSTRUCTION OF A MINI CONTACTOR

The reactors are the device designed for carrying out the treatment of the waste water effluent. It was used in the treatment of the waste water effluent in a batch experiment on a small scale. The mini-contractor consists of two tank; the storage tank is where the waste water effluent to be treated is been stored and it is connected through a pipe to the treatment tank, in the treatment tank there is a compartment, the packaged treated Bagasse can fit into. It a/so has a pipe where the water is collected into a container.

Table 2: Initial concentrations of heavy metals untreated Bagasse (Control Experiment)

Heavy Metals present	Zinc	Manganese	Copper	Iron	Lead
Concen tration (mg/l)	2.460	3.780	0.110	3.610	0.310

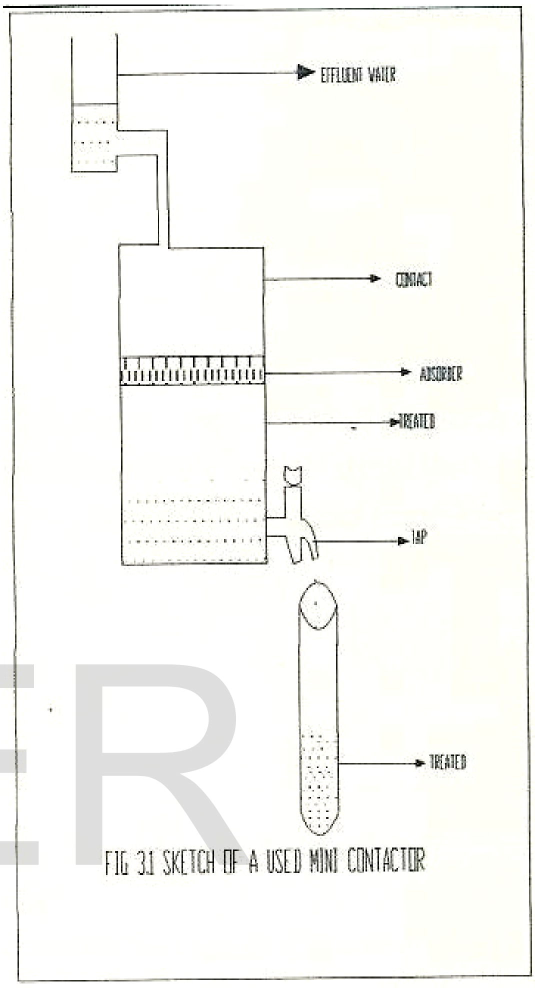

Figure 1: Sketch of a Mini Contactor

2.7 THE TREATMENT OF THE WASTE WATER EFFLUENT

The treatment of the waste water effluent was bcarried out in the mini contactor. The waste water from the storage tank flows through a pipe on to the surface of the bagged treated Bagasse (the adsorbent) in the treatment tank. A contact time of 20 minutes was allowed for the waste water to pass through the adsorbent.

The treated water from adsorbent drained into the bottom of the treatment tank where it is collected through a tap into a beaker. The treated water stored in sample bottles and analysis was carried out on the water sample in anatomic absorption spectrophotometer (AAS) to check the concentration of heavy metals that are present in the water samples. This helps to present at different concentration of the reduction of concentration of heavy metals in the waste water.

3.0 RESULT AND DISCUSSION

3.1 RESULT

The following heavy metals ions were present in the effluent water of the paint industry and that of the untreated Bagasse (control experiment) is shown in table 2 above

Table 3: Concentrations of sulphuric acid using treated Bagasse

Sulphuric Acid concentration (Mg/l)	*HEAVY METALS*				
	Zinc	Manganese	copper	iron	Lead
0.3	2.352	3.020	0.104	2.782	0.230
0.4	2.022	2.522	0.100	2.421	0.201
0.5	2.101	2.643	0.101	2.201	0.227
0.6	2.023	2.524	0.101	2.436	0.216

Figure 2 shows sulphuric acid concentration using treated Bagasse.

	ZINC	MANGANESE	COPPER	IRON	LEAD
0.3	2.111	2.062	0.11	2.34	0.226
0.4	2.086	2.063	0.106	2.258	0.241
0.5	2.001	2.003	0.102	2.116	0.236
0.6	2.099	2.061	0.107	2.257	0.271

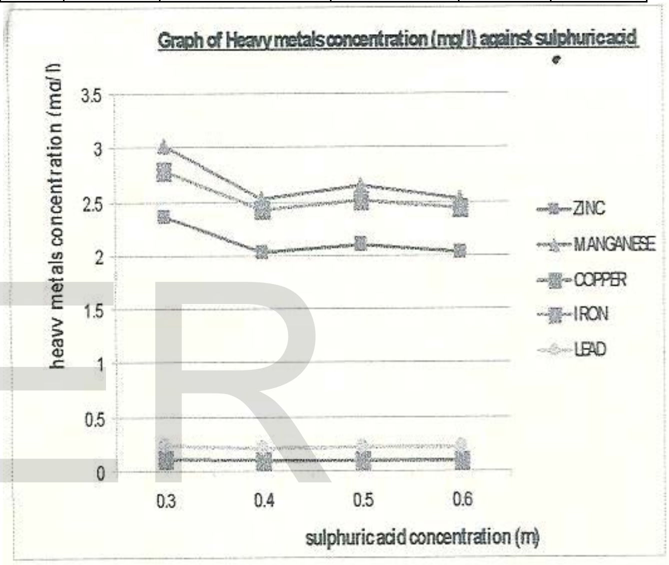

Figure 2: Heavy metal concentrations against sulphuric acid concentrations

Table 4: Concentrations of acetic acid using treated Bagasse

Figure 3 shows the concentration of acetic acid using treated Bagasse. Graph of heavy metals concentration against acetic acid concentration

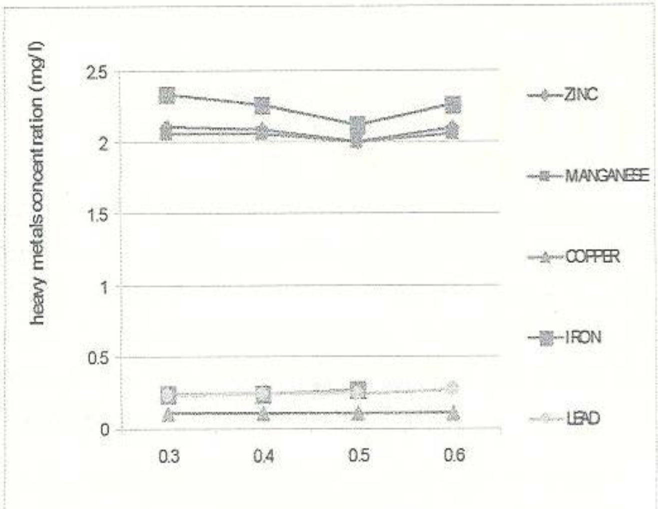

Figure 3: Heavy metal concentrations against acetic acid concentrations

3.2 DISCUSSION OF RESULTS

The result obtained in table 2 shows the heavy metals ions present in the effluent water from paint industry and their various conclusions.

The result also shows the untreated bagasse (control experiment). The adsorption of heavy metals was low because the pores were not as open as the treated bagasse.

Table 3 and 4 show the result obtained from sulphuric acid treated bagasse and acetic acid treated Baggase and the following deduction were made; all the test samples showed remarkable decrease in the concentration of heavy metals after treatment. This was due to the fact that more pores of the adsorbent (treated bagasse) were opened by increasing the surface area of the pores for ion entrapment.

The experiment shows that 0.3m – 0.6m was successful in the reduction of metals and it does not damage the surface of the bagasse shows the lowest value in the concentration of heavy metals present. This implies that 0.4m sulphuric acid treated bagasse more pores were opened for the adsorption of heavy metals. 0.5m Acetic acid treated bagasse shows the lowest values in the concentration of the heavy metals present that implies that more pores were opened for the adsorption of heavy metals. From figure 1 and 2, the graphs show the concentration of heavy metals (mg/l) against the concentration of acid used in the treatment of bagasse and 0.4m – 0.5m gives the highest adsorption of heavy metals and as such shows that the concentration of acid needed to effectively treat the bagasse for adequate metallic reduction is between 0.4m-0.5m.

3.3 COMPARISON OF RESULT

The scope of this project was limited only to untreated bagasse and other agricultural products. The introduction of H_2SO_4 and acetic varying acid strength (to open the pores for more ion entrapment gives more excellent research of work.

The graph in figure 2 and 3 illustrate more about the reaction of Fe^{+}, Cu^{2+}, Pb^{2+}, Zn^{2+} and Mg^{2+} to a varying strength of H_2SO_4 and acetic acid.

4.0 CONCLUSION AND RECOMMENDATION

4.1 CONCLUSION

Using Toplex Paint as a Case Study, and based on the experiment result obtained, the effluent water from a paint industry could be treated by agricultural by-products. Agricultural by product such as treated bagasse has shown remarkable adsorption and can be successfully used in the reduction of the concentration of heavy metals ions from industrial effluent water.

There were reductions in the concentration of metals to a degree that would not be harmful to aquatic life, human and vegetation. The data's obtained could be used as a guide in the fabrication of an economically cheap treatment process using batch or stirred tank flow reactors for the removal of heavy metals.

Adsorption rate differs with variation in the concentration of acid. Adsorption is possible through other agricultural waste such as rice husk, soybean hulls, and sawdust (treated). Mini contractor is very effective for laboratory experiment. Polystyrene is the best packaging material for this experiment.

4.2 RECOMMENDATIONS

The manufacturing industries should adopt the use of agricultural waste such as sugar cane bagasse, sawdust, rice husk, coconut shell as an adsorbent in the removal of heavy meals from their effluent water. This will enable them to reduce the high manufacturing cost involved in treatment due to the high cost activated carbon.

More research should be carried out in order to have a variety of knowledge on the various acids that can be used in the treatment of these agricultural wastes. This will help to determine the best reagent and concentration that would effectively treat the agricultural waste. Also a large range of particular size of Bagasse could also be used in carrying out this experiment on industrial scale. A fixed bed (large contractor) of different sizes could be built on the outlet path of the effluent, which may be recycled for further use.

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APPENDIX

DILUTION THEORY

Due to the high concentration of sulphuric Acid and Acetic Acid. There is need to dilute the Acid to a very considerable concentration where the bagasse will not charred and the acid efficiency will still be retained. After much trial and error method, different motor ratios were adopted and used to treat 210g of dry bagasse for six hours.

1st Ratio

For sulphuric Acid to prepare 1ml

Measure 54.3ml of Acid (H_2SO_4)

Measure 945.7ml of distilled water

To get 0.6m using dilution formula or using ratio method

$C_1V_1=C_2V_2$. Assuming the volume to be 500ml

0.6m x 500ml = 1m x V_2

$$V_2 = \frac{0.6x500}{1} = 300ml$$

Therefore 200ml of H_2SO_4 were measured and 100ml of H_2O so different measured where used for different volume that is 0.5m, 0.4, 0.3m

2nd Ratio

For Acetic acid to prepare 1ml

Measure 57ml of Acetic Acid

Measure 600ml of dist5illed water

To get 0.6m

Using dilution formula or using ratio method

$C_1V_1 = C_2V_2$

Assuming the volume to be 500ml

0.6mx500ml = 1m x V_2

$$V_2 = \frac{0.6 \ x \ 500}{I} = 300ml$$

Therefore 200ml of acetic were measured and 100ml of H2O so different measure where used for different volume. That is 0.5m, 0.4m, 0.3m.