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THE EFFICIENCY OF SUGARCANE BAGASSE FOR DRAINAGE WATER TREATMENT

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Abstract

Sugarcane bagasse was investigated for its capability as a low-cost adsorbent for treating sewage and agricultural drainage waters via improving their physico-chemical and microbiological characteristics. Water samples were collected from sewage water drain, represented by Saft El-Henna drain and from agricultural drainage water represented by Khazbak drain. Both drains located in Al-Sharkeya governorate. Polluted waters were treated with different concentrations of sugarcane bagasse (0, 2, 4, 6, 8 or 10 g/l) for different contacting periods (1, 24, 72 or 144 hours). Water temperature, pH, total alkalinity, total hardness, NO_2, NO_3, NH_3, total nitrogen, orthophosphates and total phosphorous as well as total bacterial, total fungal and total yeast count in both treated and non treated waters were determined. Obtained results indicated that the concentrations of NO_2, No_3, NH_3, total nitrogen, orthophosphates and total phosphorous in the two investigated polluted water had been reduced significantly. It's observed also that total bacterial count in the two investigated polluted water reduced significantly after 1 hour of application, leading to the conclusion that the investigated sugarcane bagasse could be considering effective adsorbent for improving the tested parameters and increasing the quality of the tested drainage waters.

INTRODUCTION

With a growing population and intensified industrial and agricultural activities in Egypt, large amounts of untreated urban municipal, industrial wastewater and rural domestic wastes are discharged into agricultural drains (Stahl *et al.* 2009). The agricultural drainage water containing pesticides and fertilizers and effluents of industrial activities and runoffs in addition to sewage effluents, supply the water bodies and sediment with huge quantities of inorganic anions and heavy metals (ECDG, 2002).

The lack of freshwater forced us to reuse the wastewater. A large share of wastewater is still not treated and a part of it is still used in an uncontrolled manner, including for the production of uncooked food crops, which their consumption poses health risks (Abdel-Shafy and Raouf, 2002).

The World Health Organization estimates that globally, approximately 1.1 billion people consume unsafe water with approximately 88% of diarrheal diseases and 1.7 million deaths worldwide being attributable to unsafe water, sanitation and hygiene (WHO, 2008).

An agricultural country generates considerable amount of agricultural waste material such as bagasse, which is a natural highly fibrous lignocellulosic byproduct of sugarcane (Krishnani, *et al*. 2006).

In recent years, the searches for utilization of the agricultural wastes as rich sources for low cost materials in wastewater treatment have been widely intensified (Kumar, 2006).

The adsorption process has been demonstrated, to be relevant when compared to other techniques, for waste water treatment, since it has very low initial cost, easy operation, flexibility and simplicity. For this process to be efficient, in addition to its low cost, it is necessary to choose an adsorbent with high adsorptive capacity, high selectivity, stability and availability (Crini, 2006).

In Egypt, disposal of municipal solid waste accumulations, and utilization of these wastes as renewable sources of various products became important point as the produced agricultural wastes was about 23 million annually on dry basis (EEAA, 2001). Most of these residues produced from rice (5.5 million ton), sugarcane (5.17 million ton), maize (4.71 million ton), and cotton (1.24 million ton) (EL-Hissewy and Tantawi, 2004).

The present work aims to investigate the efficiency of sugarcane bagasse as low coast materials for treating drainage waters and improving their quality to be suitable for different purposes especially for aquaculture.

MATERIALS AND METHODS

Location:

Sewage water samples were collected from different sites from Saft El-Henna drain which located on the road between abu-Hammad and Zagazig cities, while agricultural drainage water samples were collected from Khazbak drain which located in El-Gafareia village. Both drains located in Al-Sharkeya governorate.

Adsorbent preparation:

Byproducts (Sugarcane bagasse) remained after cane juice extracted were gathered from local market, washed by distilled water, cut to small pieces dried in an oven at 60°C until constant weight. For preservation, it was kept in plastic–stopper bottle and to minimize contact with humidity all these bottles were preserved in desiccators until use.

Experimental design:

Different weights of sugarcane bagasse (2, 4, 6, 8 or 10 g) were added separately to 1 liter of sewage and agricultural drainage waters. This mixture kept in contact for 1, 24, 72 and 144 for sewage water, while with respect to agricultural drainage water the longest contacting period was 72 hours only, where at this period pH value reduced until reached only 6.21, which considered unsuitable for different water purposes usage, so there was no need to continue analyzing water beyond this period. Different mixing periods were investigated for their effect on the alteration occurred on the different investigated parameters. At the end of each period, the treated waste water filtered and the different tested items were determined in treated and in non-treated polluted waters.

Analytical methods:

Water physico-chemical parameters:

Temperature and dissolved oxygen (DO) were measured by using Yellow Spring Instrument (YSI model 57) oxygen meter. pH values were measured by using a pH meter (model Corning 345). Total alkalinity and total hardness were determined by titration as CaCO3 according to APHA (1985). Nitrite-nitrogen (NO_2-N) was measured by diazodyzing method using spectrophotometer (model, WPA Linton Cambridge UK) as described in APHA (1985). Nitrate-nitrogen (NO_3-N) was measured by phenol disulphonic acid method using spectrophotometer (model, WPA Linton Cambridge UK) as described in APHA (1985). Total ammonia concentrations were determined by nesslerization method (APHA, 1985), and then unionized ammonia (NH_3) values were calculated through a coefficient related to water pH and temperature values measured at the time of sampling, according to Boyd (1990). Filterable orthophosphate (PO_4) and total phosphorous were measured by ascorbic acid method by using spectrophotometer (WPA Linton Cambridge UK) according to APHA (1985).

Microbiological examinations:

For microbiological examination, the suitable number of each bacteria was reached, three different tenfold dilution prepared from each sample are used for the enumeration of each bacteria. For total viable count, poured plate method according to APHA (1989) was used, while for enumeration of mold and yeast, on oxytetracycline glucose yeast extract agar (Oxoid CM 545) medium as described by Oxoid Manual, (1982).

Statistical analysis:

Comparison of treatment means using one-way analysis of variance (ANOVA) followed by Duncan's Multiple Range Test (DMRT) was performed to compare the different treatment means at 5% level of significance. The software SPSS, version 10 (SPSS, Richmond, USA) was used as described by Dytham (1999).

RESULTS AND DISCUSSIONS

Physico – chemical characteristics:

Water temperature is the most important factor which influencies the chemical, biochemical, and biological characteristics of the aquatic systems. Temperature also alters the saturation values of solids and gases in water (Tripathi, *et al*., 1991). As shown in Table 1 there were no significant differences concerning water temperature values among different treatments for agricultural drainage water treated with sugarcane bagasse, while concerning sewage water, its indicated that water temperature after 144 hours of mixing with bagasse were significantly higher than all other contacting periods at all investigated adsorbent concentrations, which revealing that this increase in water temperature resulted from the increase in air temperature and that the tested bagasse didn't affected water temperature.

Table 1. Mean ± SE of waters temperature (°C) in sewage and agricultural drainage after treatment with sugarcane bagasse for different contacting periods.

Adsorbent conc. (Sugarcane bagasse g/l sewage water)	Contact period (h) 1	24	72	144	Adsorbent conc. (Sugarcane bagasse g/l agricultural drainage water)	Contact period (h) 1	24	72
0	16.00 ± 0.00 $^{B\,a}$	16.00 ± 0.00 $^{B\,a}$	16.00 ± 0.00 $^{B\,a}$	17.00 ± 0.00 $^{A\,a}$	0	16.0 ± 0.00 $^{A\,a}$	16.0 ± 0.00 $^{A\,a}$	16.0 ± 0.00 $^{A\,a}$
2	16.00 ± 0.00 $^{B\,a}$	16.00 ± 0.00 $^{B\,a}$	16.00 ± 0.00 $^{B\,a}$	17.00 ± 0.00 $^{A\,a}$	2	16.0 ± 0.00 $^{A\,a}$	16.0 ± 0.00 $^{A\,a}$	16.0 ± 0.00 $^{A\,a}$
4	16.00 ± 0.00 $^{B\,a}$	16.00 ± 0.00 $^{B\,a}$	16.00 ± 0.00 $^{B\,a}$	17.00 ± 0.00 $^{A\,a}$	4	16.0 ± 0.00 $^{A\,a}$	16.0 ± 0.00 $^{A\,a}$	16.0 ± 0.00 $^{A\,a}$
6	16.00 ± 0.00 $^{B\,a}$	16 ± 0.00 $^{B\,a}$	16.00 ± 0.00 $^{B\,a}$	17.00 ± 0.00 $^{A\,a}$	6	16.0 ± 0.00 $^{A\,a}$	16.0 ± 0.00 $^{A\,a}$	16.0 ± 0.00 $^{A\,a}$
8	16.00 ± 0.00 $^{B\,a}$	16.00 ± 0.00 $^{B\,a}$	16.00 ± 0.00 $^{B\,a}$	17.00 ± 0.00 $^{A\,a}$	8	16.0 ± 0.00 $^{A\,a}$	16.0 ± 0.00 $^{A\,a}$	16.0 ± 0.00 $^{A\,a}$
10	16.00 ± 0.00 $^{B\,a}$	16.00 ± 0.00 $^{B\,a}$	16.00 ± 0.00 $^{B\,a}$	17.00 ± 0.00 $^{A\,a}$	10	16.0 ± 0.00 $^{A\,a}$	16.0 ± 0.00 $^{A\,a}$	16.0 ± 0.00 $^{A\,a}$

Means followed by different capital letters in the same row or different small letters in the same column are statistically different at $P < 0.05$ level.

The obtained data as shown in Table 2 revealed that pH values of both sewage and agricultural drainage waters were significantly affected by bagasse and contacting period. Mixing any of the two investigated polluted waters with sugarcane bagasse reduced significantly its pH. The alteration in pH values of both sewage and agricultural drainage waters as a result of mixing with sugarcane bagasse depended on the period of mixing as well as bagasse dosage. The lowest pH value (4.52) recorded in sewage water was obtained after 144 hours of mixing with 10 g bagasse/l, while the initial pH value was 10. Applying bagasse to agricultural drainage water reduced significantly its pH value. The lowest pH value (6.21) was recorded at 10 g of bagasse for 144 hours. The decrease in pH may be due to the consumption of bicarbonate ions by nitrifying organisms (krishnani *et al*., 2006).

Table 2. Mean ± SE of pH in sewage and agricultural drainage waters after treatment with sugarcane bagasse for different contacting periods.

Adsorbent conc. (Sugarcane bagasse g/l sewage water)	Contact period (h) 1	24	72	144
0	10.00 ± 0.00 $^{B a}$	10.00 ± 0.00 $^{B a}$	10.00 ± 0.00 $^{B a}$	10.5 ± 0.00 $^{A a}$
2	9.977 ± 0.02 $^{A a}$	9.923 ± 0.01 $^{B b}$	8.787 ± 0.01 $^{C b}$	7.823 ± 0.01 $^{D b}$
4	9.92 ± 0.03 $^{A a}$	9.893 ± 0.00 $^{A c}$	8.383 ± 0.01 $^{B c}$	7.173 ± 0.02 $^{C c}$
6	9.77 ± 0.02 $^{A b}$	9.723 ± 0.01 $^{A d}$	7.183 ± 0.01 $^{B f}$	6.593 ± 0.00 $^{C e}$
8	9.66 ± 0.00 $^{A b}$	9.657 ± 0.00 $^{A e}$	7.817 ± 0.00 $^{B d}$	6.76 ± 0.02 $^{C d}$
10	9.74 ± 0.08 $^{A b}$	9.607 ± 0.00 $^{A f}$	7.72 ± 0.01 $^{B e}$	4.52 ± 0.01 $^{C f}$

Adsorbent conc. (Sugarcane bagasse g/l agricultural drainage water)	Contact period (h) 1	24	72
0	9.377 ± 0.043 $^{A a}$	9.443 ± 0.007 $^{A b}$	9.443 ± 0.007 $^{A a}$
2	9.21 ± 0.02 $^{B b}$	9.82 ± 0.01 $^{A a}$	8.963 ± 0.03 $^{C b}$
4	9.417 ± 0.01 A a	9.08 ± 0.04 B c	8.31 ± 0.05 C c
6	8.767 ± 0.033 $^{A c}$	7.3 ± 0.058 $^{B d}$	7.00 ± 0.00 $^{C e}$
8	8.6 ± 0.058 $^{A d}$	7.307 ± 0.052 $^{B d}$	7.17 ± 0.03 $^{B d}$
10	8.193 ± 0.007 $^{A e}$	6.323 ± 0.054 $^{B e}$	6.21 ± 0.01 $^{C f}$

Means followed by different capital letters in the same row or different small letters in the same Column are statistically different at $P < 0.05$ level.

Initial total alkalinity value in sewage water before treating was 930 mg/l as $CaCO_3$ (Table 3). This value started to decrease gradually after treating sewage water with sugarcane bagasse. The rate of decrease directly proportional to contacting period as well as bagasse concentration until being non - detectable when polluted water treated with 6, 8 or 10 grams for 144 hours. The decrease in total alkalinity values attributed to the consumption of bicarbonate ions by nitrifying organisms (Krishnani *et al.* 2006). According to Meade (1989) and Tucker and Robinson (1990), total alkalinity with a value higher than 100 or 150 (mg/l as $CaCO_3$) considered desirable, while a value ranged between 20 to 400 considered sufficient for most aquaculture purposes. Accordingly concerning total alkalinity, it's recommended when treating sewage or agricultural drainage waters with sugarcane bagasse to mix them for a period equal to or shorter than 72 hours, and adsorbent concentration lower than 10g/l for agricultural drainage water.

Table 3. Mean ± SE of total alkalinity (mg/l as $CaCO_3$) in sewage and agricultural drainage waters after treatment with sugarcane bagasse for different contacting periods.

Adsorbent conc. (Sugarcane bagasse g/l sewage water)	Contact period (h) 1	24	72	144
0	930.0 ± 0.00 $^{A a}$	930 ± 0.00 $^{A a}$	930.0 ± 0.00 $^{A a}$	930.0± 0.00 $^{A a}$
2	430 ± 2.89 $^{A b}$	430 ± 2.89 $^{A b}$	315 ± 2.89 $^{B b}$	56.67± 1.67 $^{C b}$
4	423.33 ± 1.67 $^{A b}$	423.33 ± 1.67 $^{A b}$	243.33 ± 3.33 $^{B c}$	56.67± 1.67 $^{C b}$
6	413.33 ± 3.33 $^{A c}$	413.33 ± 3.33 $^{A c}$	163.33 ± 1.67 $^{B d}$	ND
8	426.67 ± 1.67 $^{A b}$	426.67 ± 1.67 $^{A b}$	170.0 ± 2.887 $^{B d}$	ND
10	411.67 ± 1.67 $^{A c}$	411.67 ± 1.67 $^{A c}$	155.0 ± 2.887 $^{B e}$	ND

Adsorbent conc. (Sugarcane bagasse g/l agricultural drainage water)	Contact period (h) 1	24	72
0	785.33 ± 0.33 $^{A a}$	785.33 ± 0.33 $^{A a}$	785.33 ± 0.33 $^{A a}$
2	415.00 ± 2.89 $^{B e}$	411.67 ± 4.41 $^{B b}$	466.67 ± 4.41 $^{A b}$
4	435.0 ± 2.89 $^{A c}$	353.33 ± 3.33 $^{B c}$	333.33 ± 4.41 $^{C c}$
6	453.33 ± 3.33 $^{A b}$	325.0 ± 8.66 $^{B d}$	155.0 ± 2.887 $^{C d}$
8	445.0 ± 2.89 $^{A b}$	301.67 ± 1.67 $^{B e}$	155.0 ± 2.89 $^{C d}$
10	425 ± 2.89 $^{A d}$	283.33 ± 4.41 $^{B f}$	ND

Means followed by different capital letters in the same row or different small letters in the same column are statistically different at $P < 0.05$ level.

Table 4 revealing that initial total hardness of non-treated sewage water was 440 mg/l as $CaCO_3$. Applying bagasse for treating sewage water affected its total hardness but without consistent pattern. The investigated practice altered total hardness within a range between 406.667 and 548.667 mg/l as $CaCO_3$. Mixing agricultural drainage water with sugarcane bagasse increased its total hardness from its initial value (122 mg/l as $CaCO_3$) to different values depending on bagasse concentrations and the period of mixing, with a higher efficient and obvious rule for concentration than that of contacting period. The application of some fibrous substrates such as sugarcane bagasse acts as periphyton. Azim *et al*. (2001) observed that periphyton improved water quality in aquaculture system by increasing nitrification, which uses substantial amounts of oxygen and hydrogen carbonates, reducing hardness and buffering capacity. Rath (1993) who mentioned that pond water with hardness of 50 ppm are above satisfactory for growth of fish. Soft waters increased heavy metals toxicity where there are insufficient calcium and magnesium ions to compete with toxic metal ions for adsorption sites on the gills. Similarly, ammonia toxicity is increased in waters low in calcium (South African water quality guidelines, 1996).

Table 4. Mean ± SE of total hardness (mg/l as $CaCO_3$) in sewage and agricultural drainage waters after treatment with sugarcane bagasse for different contacting periods.

Adsorbent conc. (Sugarcane bagasse g/l sewage water)	Contact period (h) 1	24	72	144	Adsorbent conc. (Sugarcane bagasse g/l agricultural drainage water)	Contact period (h) 1	24	72
0	440.0± 0.00$^{A\ ab}$	440.0 ± 0.0$^{A\ ab}$	440.0± 0.00$^{A\ e}$	440.0 ± 0.0$^{A\ bc}$	**0**	122.0± 2.00$^{A\ d}$	122.0± 2.00$^{A\ e}$	122.0± 2.00$^{A\ f}$
2	438.6± 1.3$^{B\ abc}$	438.6± 1.3$^{B\ abc}$	548.6± 2.40$^{A\ a}$	423.3± 3.33$^{C\ d}$	**2**	250.0± 1.16$^{A\ b}$	221.3± 1.33$^{B\ d}$	213.3± 3.53$^{C\ e}$
4	444 ± 2.31$^{B\ a}$	444 ± 2.31$^{B\ a}$	500 ± 5.77$^{A\ b}$	406.6± 6.67$^{C\ e}$	**4**	231.3± 2.4$^{B\ c}$	250 ± 1.16$^{A\ c}$	229.3± 2.91$^{B\ d}$
6	437.3± 3.7$^{B\ abc}$	437.3± 3.7$^{B\ abc}$	480 ± 2.31$^{A\ c}$	430 ± 5.77$^{B\ cd}$	**6**	260.0± 2.31$^{B\ a}$	270.0 ± 1.16$^{A\ b}$	256 ± 3.06$^{B\ c}$
8	432.6 ± 1.76$^{C\ c}$	432.6 ± 1.76$^{C\ c}$	457.3 ± 1.33$^{A\ d}$	446.6 ± 3.33$^{B\ ab}$	**8**	250.0± 1.16$^{B\ b}$	252.6± 3.71$^{B\ c}$	296.6± 3.33$^{A\ b}$
10	434.0± 2.00$^{C\ bc}$	434.0± 2.00$^{C\ bc}$	510.0± 5.77$^{A\ b}$	456.6± 3.33$^{B\ a}$	**10**	252.0± 2.00$^{C\ b}$	310 ± 5.77$^{B\ a}$	344.6± 2.90$^{A\ a}$

Means followed by different capital letters in the same row or different small letters in the same column are statistically different at $P < 0.05$ level.

Nitrogenous compounds:

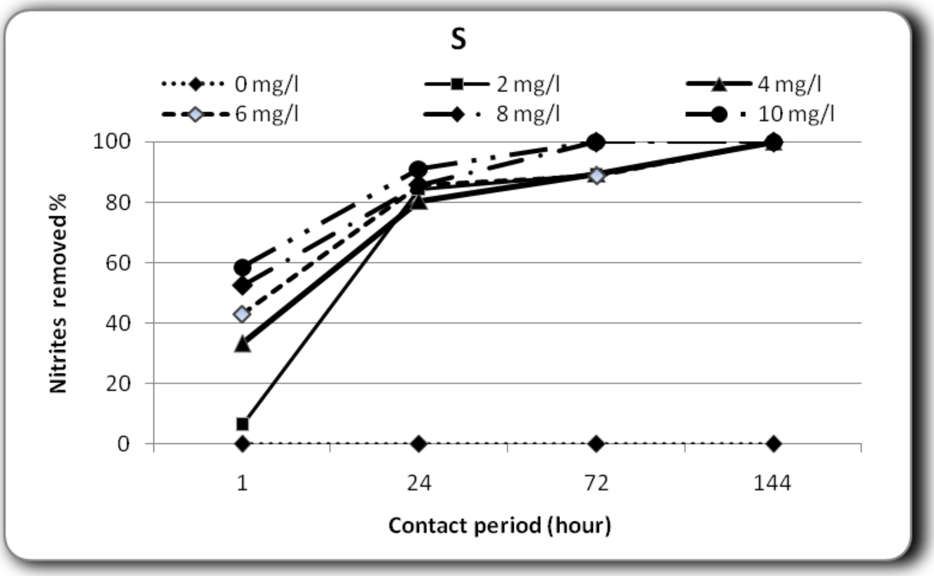
The presence of nitrogen in a wastewater discharge can be undesirable for several reasons: as free ammonia it is toxic to fish and many other aquatic organisms; as ammonium ion or ammonia it is an oxygen-consuming compound which will deplete the dissolved oxygen in receiving water; in all forms, nitrogen can be available as a nutrient to aquatic plants and consequently contribute to eutrophication; as the nitrate ion it is a potential public health hazard in water consumed by infants. Depending upon local circumstances, removal of all forms of nitrogen or just ammonium may be required (Sedlak, 1991).

Table 5. Mean ± SE of nitrites-nitrogen (mg/l) in sewage and agricultural drainage waters after treatment with sugarcane bagasse for different contacting periods.

Adsorbent conc. (Sugarcane bagasse g/l sewage water)	Contact period (h)				Adsorbent conc. (Sugarcane bagasse g/l agricultural drainage water)	Contact period (h)		
	1	**24**	**72**	**144**		**1**	**24**	**72**
0	0.21 ± $0.00^{A\,a}$	0.19 ± $0.00^{B\,a}$	0.19 ± $0.00^{B\,a}$	0.19 ± $0.00^{B\,a}$	**0**	0.062 ± $0.006^{A\,a}$	0.04 ± $0.003^{B\,a}$	0.0397± $0.003^{B\,a}$
2	0.197 ± $0.003^{A\,b}$	0.03 ± $0.006^{B\,bc}$	0.02 ± $0.007^{B\,b}$	ND	**2**	0.055 ± $0.006^{A\,b}$	0.007 ± $0.001^{B\,b}$	0.00 ± $0.00^{B\,b}$
4	0.14 ± $0.006^{A\,c}$	0.037 ± $0.003^{B\,b}$	0.02 ± $0.007^{C\,b}$	ND	**4**	0.0615± $0.009^{A\,a}$	0.007 ± $0.001^{B\,b}$	ND
6	0.12 ± $0.00^{A\,d}$	0.027 ± $0.007^{B\,bc}$	0.021 ± $0.007^{B\,b}$	ND	**6**	0.025± $0.002^{A\,c}$	0.006± 0.00^{Bbc}	ND
8	0.10 ± $0.00^{A\,e}$	0.027 ± $0.003^{B\,bc}$	ND	ND	**8**	0.023 ± $0.001^{A\,c}$	0.004 ± 0.00^{Bbc}	ND
10	0.087 ± $0.007^{A\,f}$	0.017 ± $0.003^{B\,c}$	ND	ND	**10**	0.016 ± $0.001^{A\,d}$	0.003 ± $0.00^{A\,c}$	ND

Means followed by different capital letters in the same row or different small letters in the same column are statistically different at $P < 0.05$ level.

Initial sewage water nitrite concentration was 0.21 mg/l (Table 5). This value was reduced gradually as a result of adding sugarcane bagasse until reached 0.087 mg/l at 10 g/l of bagasse and kept in contact for 1 hour. In non-treated sewage water, nitrite concentration after 24, 72 and 144 h was 0.19 mg/l. This value reduced significantly as a result of the investigated practice. Figure 1 revealing that bagasse removal efficiency reached 100 % after applying 2 g/l and keeping in contact with sewage water for 144 h, or at least 8 g/l for 72 h. Initial nitrite concentrations of agricultural drainage water after 1, 24 and 144 hours were 0.062, 0.04 and 0.0397 mg/l, respectively. After being treated with different concentrations of sugarcane bagasse, its nitrite concentrations reduced rapidly with a rate directly proportional to contact period and adsorbent concentration. Figure 1 showing that 72 hours of mixing with any of the investigated bagasse removed all detected nitrite with the used methodology, while after 24 hours of mixing between the polluted water and 2, 4, 6, 8 and 10 g/l of bagasse, nitrite removal efficiencies were 82.5, 82.5, 85, 90 and 92.5 %, respectively. Figure 1 revealing that bagasse is more efficient toward nitrite removal from agricultural drainage water than from sewage water due to that its initial concentrations in sewage water were higher than those in agricultural drainage water. Corresponding finding was mentioned by Krishnani *et al.* (2006). Obtained nitrite values in both investigated drainage waters after being treated with sugarcane bagasse could be considered quite safe for aquaculture according to South African water quality guidelines (1996) which recommended 0 – 0.05 mg/l as a target range for NO_2 – N. Obtained results consistent with that previously obtained by Krishnani *et al*. (2006) who found that nitrite removal is effective using raw bagasse.



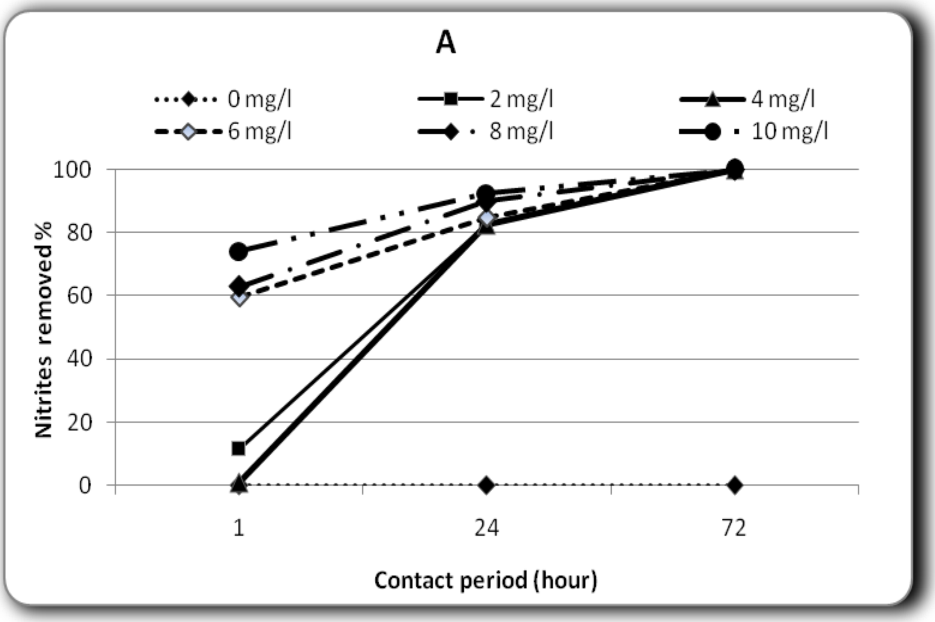
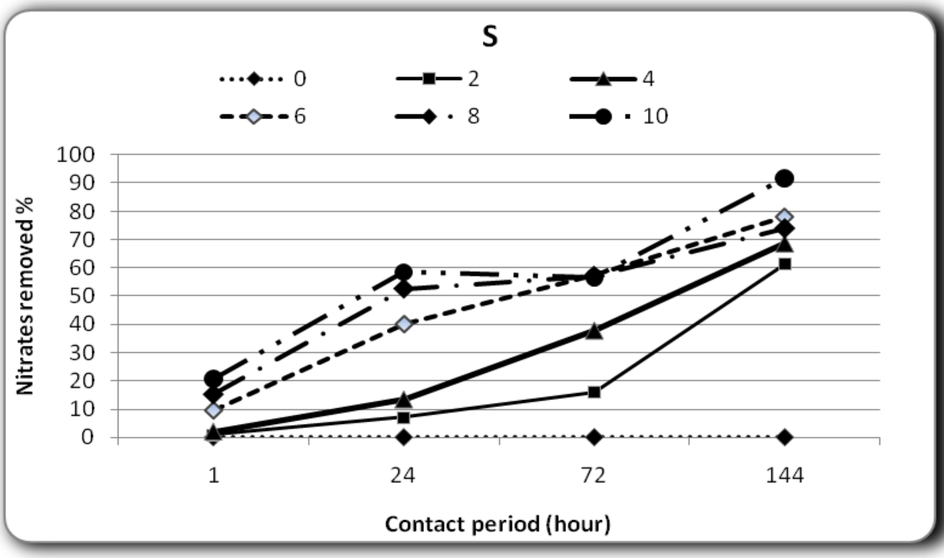


Figure 1. Nitrites-nitrogen % removed from sewage water [chart S] and agricultural drainage water [chart A] after being treated with sugarcane bagasse for different contact periods.



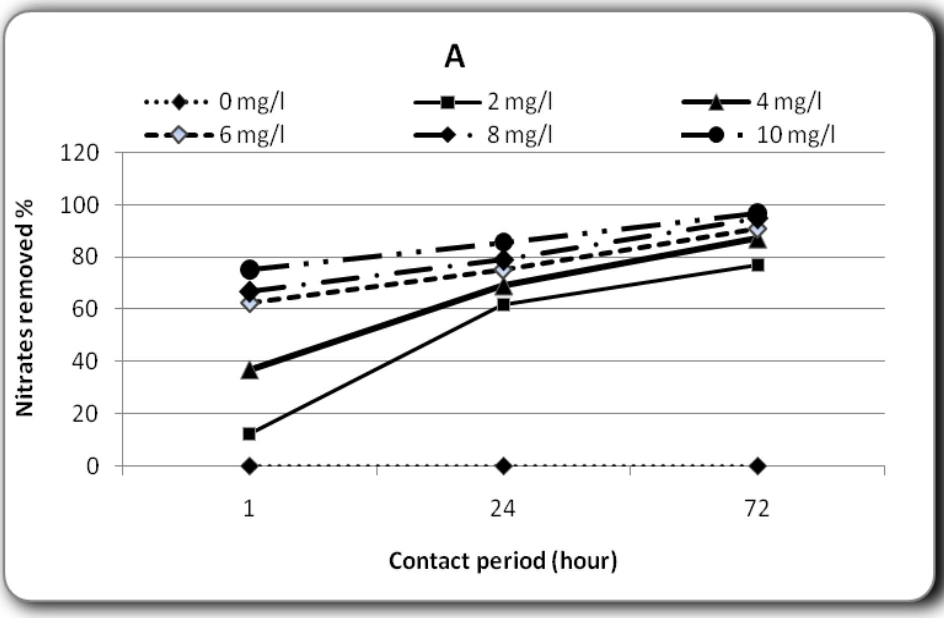


Figure 2. Nitrates-nitrogen % removed from sewage water [chart S] and agricultural drainage water [chart A] after being treated with sugarcane bagasse for different contact periods.

Table 6. Mean ± SE of nitrates-nitrogen (mg/l) in sewage and agricultural drainage waters after treatment with sugarcane bagasse for different contacting periods.

Adsorbent conc. (Sugarcane bagasse g/l sewage water)	Contact period (h) 1	24	72	144
0	2.36 3 ± 0.009$^{A a}$	2.287 ± 0.007$^{B a}$	2.287 ± 0.007$^{B a}$	2.353 ± 0.003$^{B a}$
2	2.34 ± 0.01$^{A a}$	2.123 ± 0.003$^{B b}$	1.92 ± 0.031$^{C b}$	0.907 ± 0.012$^{D b}$
4	2.313 ± 0.003$^{A b}$	1.977 ± 0.003$^{B c}$	1.42 ± 0.035$^{C c}$	0.733 ± 0.029$^{D c}$
6	2.133 ± 0.012$^{A c}$	1.37 ± 0.012$^{B d}$	0.97 ± 0.01$^{C d}$	0.513 ± 0.009$^{D e}$
8	2.003 ± 0.007$^{A d}$	1.083± 0.007$^{B e}$	0.983 ± 0.009$^{C d}$	0.613 ± 0.013$^{D d}$
10	1.877 ± 0.003$^{A e}$	0.95 ± 0.03$^{B f}$	0.991 ± 0.007$^{B d}$	0.193 ± 0.012$^{C f}$

Adsorbent conc. (Sugarcane bagasse g/l agricultural drainage water)	Contact period (h) 1	24	72
0	0.353 ± 0.009$^{A a}$	0.333 ± 0.019$^{A a}$	0.333 ± 0.019$^{A a}$
2	0.31 ± 0.012$^{A b}$	0.127 ± 0.003$^{B b}$	0.077 ± 0.003$^{C b}$
4	0.223 ± 0.007$^{A c}$	0.103 ± 0.007$^{B bc}$	0.043 ± 0.003$^{C c}$
6	0.133 ± 0.009$^{A d}$	0.083 ± 0.003$^{B cd}$	0.03 ± 0.00$^{C cd}$
8	0.117 ± 0.009$^{A d}$	0.07 ± 0.00$^{B de}$	0.017 ± 0.003$^{C d}$
10	0.087 ± 0.003$^{A e}$	0.047 ± 0.003$^{B e}$	0.01 ± 0.0003$^{C d}$

Means followed by different capital letters in the same row or different small letters in the same column are statistically different at $P < 0.05$ level.Table 6 showing that the recorded initial nitrates values of the investigated sewage water at 1, 24, 72 and 144 hours were 2.363, 2.287, 2.287 and 2.353 mg/l, respectively. These values reduced significantly after applying sugarcane bagasse. Rate of nitrates reduction in sewage water directly proportional to adsorbents dosage as well as period of contact. The highest sewage water nitrate removal efficiency after being in contact with sugarcane bagasse, as shown in Figure 2, was 91 % at 10 g/l for 144 h. Initial nitrates-nitrogen concentrations, recorded in agricultural drainage water at 1, 24 and 72 hours, were 0.353, 0.333 and 0.333 mg/l, respectively. The applied sugarcane bagasse reduced these values with a rate directly proportional to mixing period and adsorbent concentration. Figure 2 showing that the highest removal efficiency (97%) obtained as a result of mixing with 10 g bagasse /l for 72 hours. Figure 2 revealing that bagasse is more efficient toward NO_3 removal from agricultural drainage water than sewage water, which could be attributed to the increased initial concentration in sewage water as mentioned by Farasati *et al.* (2011). Obtained data for nitrate nitrogen revealed that its values in treated or even non treated sewage water were below the maximum level mentioned by OATA (2008) which recommended that nitrate levels in freshwater systems do not exceed those in the tap water supply by more than 50 mg/l. Obtained date also were within the target NO3 – N range recommended by the South African water quality guidelines (1996) which stated to be below 300 mg/l.

The un-ionized ammonia concentration in non-treated sewage water was 23.07 mg/l (Table 7). The investigated bagasse significantly reduced the concentrations of un-ionized ammonia in sewage water with a rate directly proportional to adsorbent dosage and contacting period. Figure 3 showing that mixing 6, 8 or 10 g of bagasse / l of sewage water for 144 hours has removed all its detected un-ionized ammonia, and the removal efficiency reached 100%. Table 7 revealing that NH_3–N concentration in non – treated agricultural drainage water was 1.66 mg/l. The investigated practice efficiently reduced this concentration with a rate directly proportional to contacting period and adsorbent concentrations, until being non – detectable after 24 hours of mixing with 10 g bagasse/l. Figure 3 indicates that bagasse removal efficiencies toward NH_3 – N after 24 hours of contacting period after applying 2, 4, 6, 8 and 10 g/l were 60.24, 51.39, 98.98, 98.98 and 100 %, respectively, while these values after 72 hours were 87.35, 93.37, 99.58, 99.34 and 100 %, respectively. Cai *et al*. (2001) reported that when the concentration of non-ionic ammonia reaches 0.02 mg/l, it can cause chronic stress on fishes. When the concentration reaches 0.05 mg/l, it can cause acute stress on fishes, and fishes will die when the concentration reaches 0.4 mg/l. Consequently, sewage water treated with bagasse could be reliable and quite safe for aquaculture, while that treated with rice straw in spite of being significantly reduced its content of un-ionized ammonia but still being un suitable for aquaculture.

Table 7. Mean ± SE of un-ionized ammonia (mg/l) in sewage and agricultural drainage waters after treatment with sugarcane bagasse for different contacting periods.

Adsorbent conc. (Sugarcane bagasse g/l sewage water)	Contact period (h) 1	24	72	144
0	23.07± 0.01 $^{A a}$	23.07± 0.01 $^{A a}$	23.07± 0.01 $^{A a}$	23.07± 0.01 $^{A a}$
2	15.52± 0.923 $^{A b}$	15.52± 0.923 $^{A b}$	2.36± 0.001 $^{B b}$	0.118± 0.0003$^{C b}$
4	15.42 ± 0.22 $^{A b}$	15.45 ± 0.236 $^{A b}$	2.001 ± 0.024 $^{B c}$	0.0095 ± 0.0002 $^{C c}$
6	14.093 ± 0.207 $^{A c}$	14.093 ± 0.207 $^{A c}$	0.03 ± 0.00 $^{B e}$	ND
8	14.6 ± 0.00 $^{A bc}$	14.6 ± 0.00 $^{A bc}$	0.267 ± 0.004 $^{B d}$	ND
10	14.06 ± 0.00 $^{B c}$	14.273 ± 0.079 $^{A bc}$	0.24 ± 0.00 $^{C d}$	ND

Adsorbent conc. (Sugarcane bagasse g/l agricultural drainage water)	Contact period (h) 1	24	72
0	1.66 ± 0.00 $^{A a}$	1.66 ± 0.00$^{A b}$	1.66 ± 0.00 $^{A a}$
2	0.883± 0.046$^{B c}$	0.66 ± 0.059$^{A a}$	0.21 ± 0.006$^{C b}$
4	1.05± 0.074 $^{A b}$	0.807± 0.094 $^{B c}$	0.11 ± 0.014 $^{C c}$
6	0.99± 0.054 $^{A a}$	0.017± 0.002 $^{B d}$	0.007± 0.0003$^{B d}$
8	0.28± 0.05 $^{A d}$	0.017± 0.002 $^{B d}$	0.011± 0.0006$^{B d}$
10	0.117± 0.003$^{A e}$	ND	ND

Means followed by different capital letters in the same row or different small letters in the same column are statistically different at $P < 0.05$ level.

Table 8 showed that total nitrogen concentrations in non treated sewage water at 1, 24, 72 and 144 hours of the study were 11.30, 11.00, 11.00 and 11.1 mg/l, respectively. The bagasse reduced significantly total nitrogen values in sewage water with a high potentiality. The lowest total nitrogen concentration remained in sewage water after being treated with 10 g/l sugarcane bagasse for 144 hours was 1.243 mg/l. Figure 4 reveals that the highest removal efficiencies of total nitrogen from sewage water after mixing with 10 g bagasse/l for 144 hours was 88.8 %. Initial TN concentrations in agricultural drainage water after 1, 24, and 72 hours were 7.217, 7.237 and 7.237 mg/l, respectively. Mixing agricultural waste water with bagasse reduced total nitrogen to different values depending on adsorbent concentrations and contacting period until reached 1.05 mg/l after 72 hours of mixing with 10 g bagasse/l. The highest removal efficiency was 85.81 % after polluted water being mixed with 6 g bagasse/l for 72 hours (Figure 4).

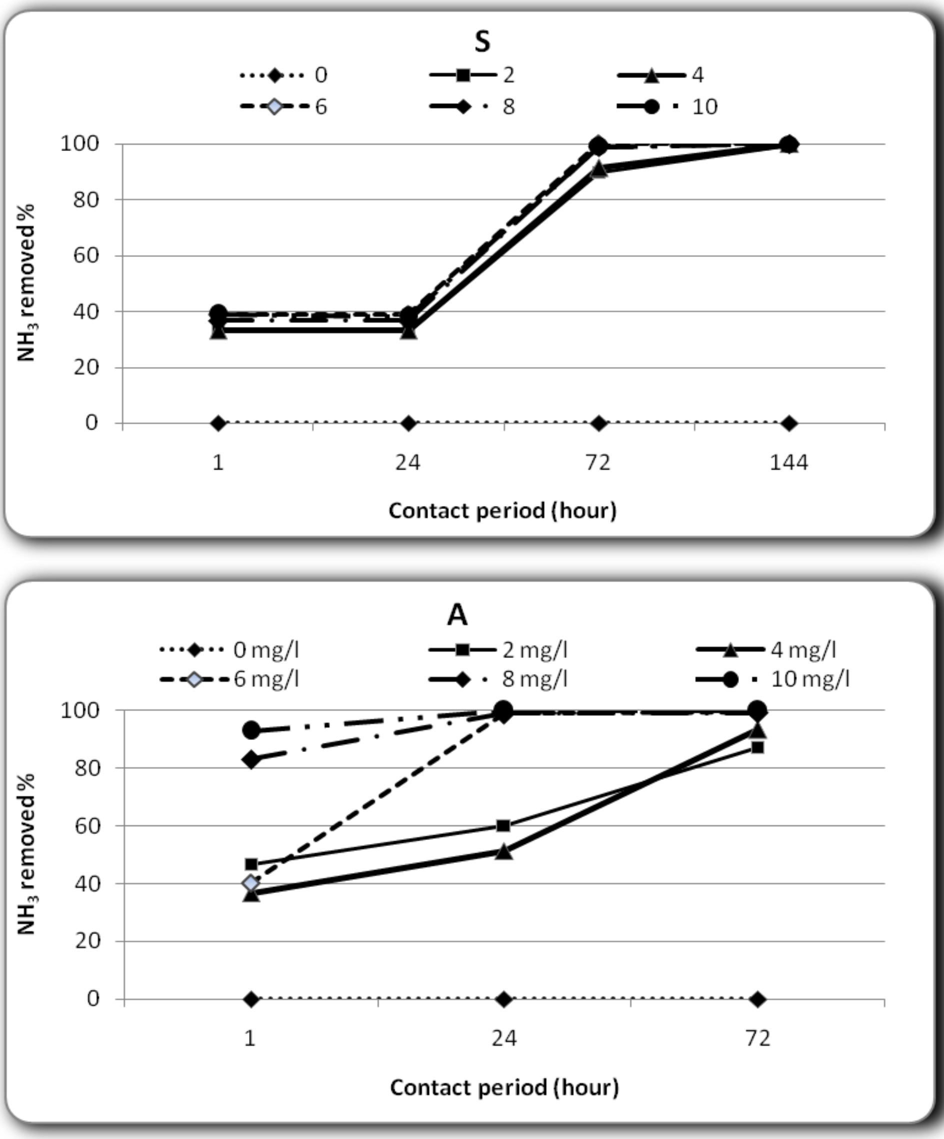
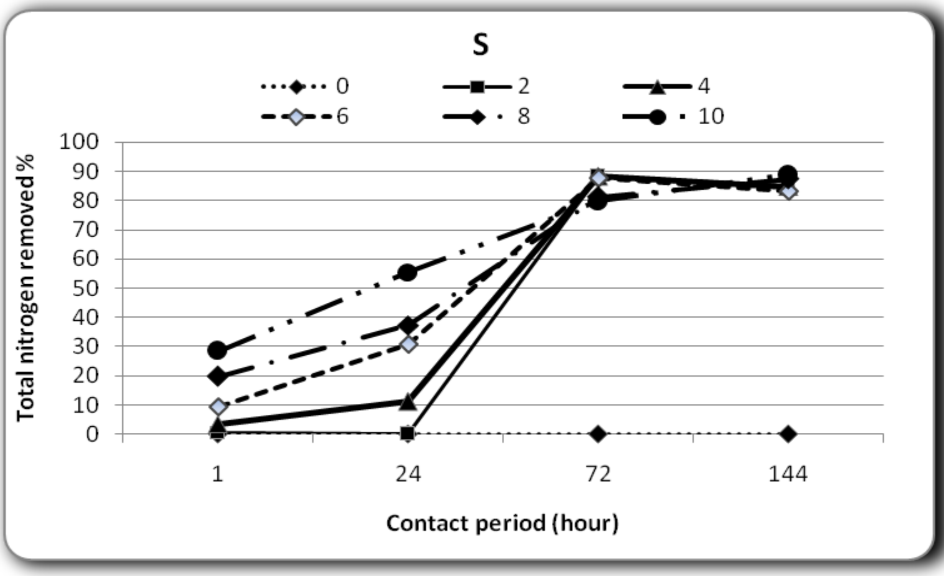


Figure 3. Un-ionized ammonia % removed from sewage water [chart S] and agricultural drainage water [chart A] after being treated with sugarcane bagasse for different contact periods for different contact periods.



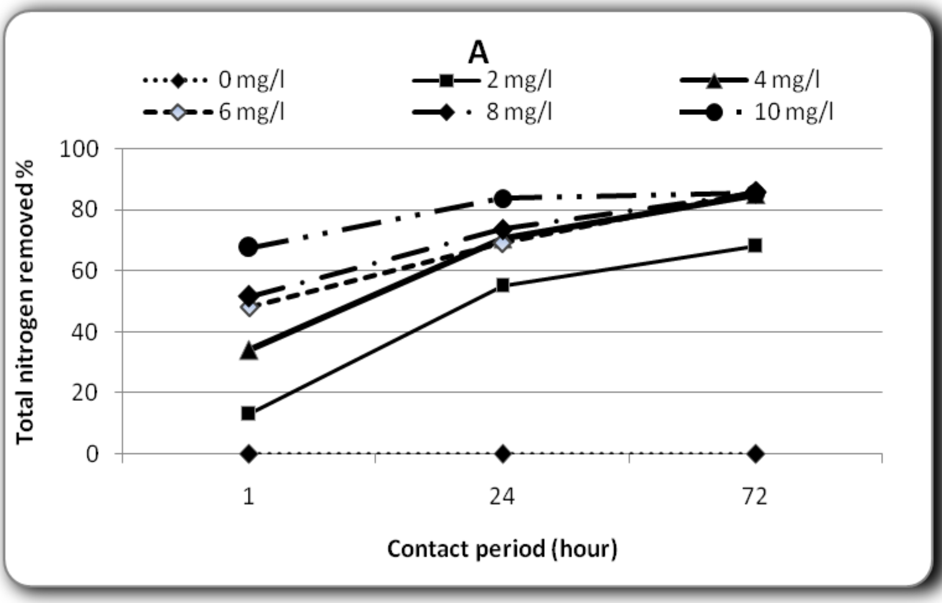


Figure 4. Total nitrogen % removed from sewage water [chart S] and agricultural drainage water [chart A] after being treated with sugarcane bagasse for different contact periods.

Table 8. Mean ± SE of total nitrogen (mg/l) in sewage and agricultural drainage waters after treatment with sugarcane bagasse for different contacting periods.

Adsorbent conc. (Sugarcane bagasse g/l sewage water)	Contact period (h) 1	24	72	144
0	11.300 ± 0.12 $^{A\ a}$	11.00 ± 0.00 $^{B\ a}$	11.00 ± 0.00 $^{B\ a}$	11.1 ± 0.00 $^{B\ a}$
2	11.233 ± 0.145 $^{A\ ab}$	11.00 ± 0.306 $^{A\ a}$	1.29 ± 0.061 $^{B\ d}$	1.67 ± 0.015 $^{B\ c}$
4	10.913±0.03 $^{A\ b}$	9.78 ± 0.01 $^{B\ b}$	1.293 ± 0.018 $^{D\ d}$	1.687 ± 0.003 $^{E\ c}$
6	10.257 ± 0.212 $^{A\ c}$	7.623 ± 0.152 $^{B\ c}$	1.36 ± 0.03 $^{D\ d}$	1.88 ± 0.012 $^{E\ b}$
8	9.057 ± 0.087 $^{A\ d}$	6.9 ± 0.042 $^{B\ d}$	2.06 ± 0.012 $^{C\ c}$	1.385 ± 0.005 $^{D\ d}$
10	8.077 ± 0.075 $^{A\ e}$	4.893 ± 0.023 $^{B\ e}$	2.21 ± 0.012 $^{C\ b}$	1.243 ± 0.032 $^{D\ e}$

Adsorbent conc. (Sugarcane bagasse g/l agricultural drainage water)	Contact period (h) 1	24	72
0	7.217 ± 0.018 $^{A\ a}$	7.237 ± 0.009 $^{A\ a}$	7.237 ± 0.009 $^{A\ a}$
2	6.273 ± 0.003 $^{A\ b}$	3.25 ± 0.012 $^{B\ b}$	2.31 ± 0.017 $^{C\ b}$
4	4.75 ± 0.00 $^{A\ c}$	2.123 ± 0.007 $^{B\ d}$	1.08 ± 0.006 $^{C\ c}$
6	3.747 ± 0.027 $^{A\ d}$	2.24 ± 0.044 $^{B\ c}$	1.027 ± 0.003 $^{C\ d}$
8	3.483 ± 0.007 $^{A\ e}$	1.903 ± 0.012 $^{B\ e}$	1.037 ± 0.009 $^{C\ d}$
10	2.337 ± 0.013 $^{A\ f}$	1.173 ± 0.009 $^{B\ f}$	1.05 ± 0.017 $^{C\ cd}$

Means followed by different capital letters in the same row or different small letters in the same column are statistically different at $P < 0.05$ level.

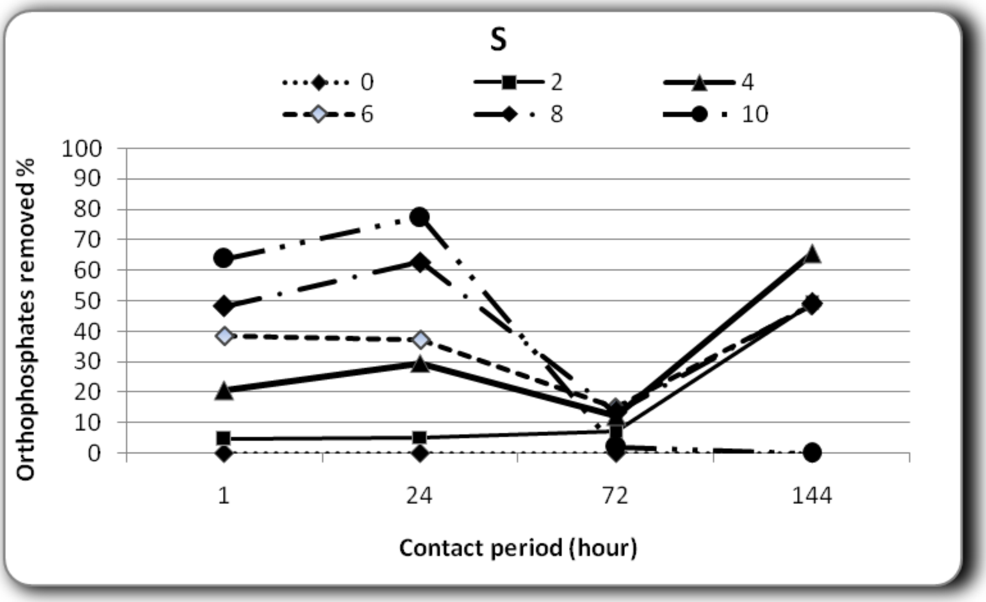
Table 9 shows that orthophosphates concentrations in sewage water before being treated were 0.6, 0.583, 0.800 and 0.59 mg/l at 1, 24, 72 and 144 hours, respectively. The initial value that recorded after 1 hour reduced until reached 0.217 mg/l at 10 g bagasse/l. This concentration of bagasse reduced sewage water orthophosphate concentration to 0.132 mg/l. Keeping different bagasse concentrations for longer periods showing less efficiency toward orthophosphates removal, where its concentrations as a result of applying 10 g bagasse/l for 72 and 144 hours were 0.783 and 0.59 mg/l, respectively. Figure 5 shows that the highest removal efficiency was 77.36 % at 10 g bagasse/l for 24 hours, and then removal efficiency decreased again, meaning that some orthophosphates released to the water again. Initial orthophosphates concentrations in agricultural drainage water at 1, 24 and 72 hours were 0.093, 0.1and 0.1 mg/l, respectively. These values reduced sharply as a result of applying sugarcane bagasse. Table 9 revealing that the rate in which orthophosphates concentrations decrease was directly proportional to bagasse concentrations and contacting periods. As illustrate in Figure 5, the highest orthophosphates removal efficiency was 98 %, at 10 g bagasse/l for 72 hours. South African water quality guidelines (1996) detected values up to 0.1 mg OP as a target range which ensures the protection of all aquatic organisms.

Table 9. Mean ± SE of orthophosphates (mg/l) in sewage and agricultural drainage waters after treatment with sugarcane bagasse for different contacting periods.

Adsorbent conc. (Sugarcane bagasse g/l sewage water)	**Contact period (h)** 1	24	72	144
0	0.6 ± 0.015 $^{A a}$	0.583 ± 0.003 $^{A a}$	0.800 ± 0.003 $^{A d}$	0.59 ± 0.00 $^{A a}$
2	0.573 ± 0.007 $^{B b}$	0.553 ± 0.017 $^{B b}$	0.743 ± 0.018 $^{A b}$	0.3 ± 0.00 $^{C b}$
4	0.477 ± 0.007 $^{B c}$	0.41 ± 0.006 $^{C c}$	0.703 ± 0.007 $^{A c}$	0.203 ± 0.003 $^{D c}$
6	0.37 ± 0.007 $^{B d}$	0.367 ± 0.003 $^{B d}$	0.68 ± 0.006 $^{A c}$	0.303 ± 0.003 $^{C b}$
8	0.31 ± 0.006 $^{B e}$	0.217 ± 0.007 $^{C e}$	0.693 ± 0.009 $^{A c}$	0.3 ± 0.00 $^{B b}$
10	0.217 ± 0.007 $^{C f}$	0.132 ± 0.01 $^{D f}$	0.783 ± 0.009 $^{A a}$	0.59 ± 0.007 $^{B a}$

Adsorbent conc. (Sugarcane bagasse g/l agricultural drainage water)	**Contact period (h)** 1	24	72
0	0.093 ± 0.007 $^{A a}$	0.1 ± 0.0 $^{A a}$	0.1 ± 0.00 $^{A a}$
2	0.027 ± 0.003 $^{A b}$	0.02± 0.00 $^{B b}$	0.01 ± 0.00 $^{C b}$
4	0.02 ± 0.00 $^{A c}$	0.013 ± 0.003 $^{B c}$	0.01 ± 0.00 $^{B b}$
6	0.017 ± 0.003 $^{A c}$	0.01 ± 0.0 $^{AB cd}$	0.008 ± 0.0003 $^{B c}$
8	0.013 ± 0.003 $^{A d}$	0.008 ± 0.001 $^{A d}$	0.006 ± 0.0007 $^{A d}$
10	0.013 ± 0.003 $^{A d}$	0.007 ± 0.001 $^{AB d}$	0.002 ± 0.0007 $^{B e}$

Means followed by different capital letters in the same row or different small letters in the same column are statistically different at $P < 0.05$ level.



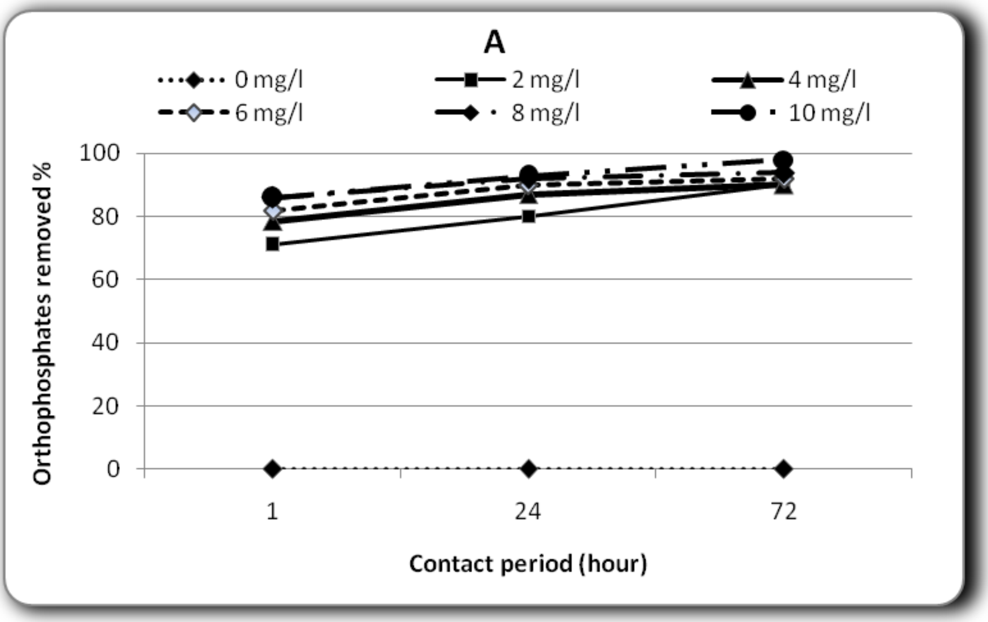


Figure 5. Ortho phosphates % removed from sewage water [chart S] and agricultural drainage water [chart A] after being treated with sugarcane bagasse for different contact periods.

Table 10 shows that the application of sugarcane bagasse reduced significantly the initial values of total phosphorous concentrations in sewage water in non treated water which were 1.9, 1.7, 1.89 and 1.867 mg/l at 1, 24, 72 and 144 hours, respectively. When sewage water treated with sugarcane bagasse its total phosphorous decreased significantly during the 1^{st} 24 hours of treatment with a rate directly proportional to either dosage or period of contact. However when the period of contact extended to 72 hours some total phosphorous released again to water where its concentration increased at 8 and 10 g/l, but its concentration still lower than the initial one. After 144 hours of contact between bagasse and sewage water, total phosphorous concentrations fluctuated without a definite trend. As shown in Figure 6 bagasse seems to be low efficient toward total phosphorous removal, where the highest total phosphorous removal efficiency was only 36.47 %. Initial total phosphorous concentration in agricultural drainage water was 0.89 mg/l, and gradually decreased with the increase of bagasse dosage and contact period. It reached 0.073 mg/l after applying 10 g bagasse/l for 72 hours. Figure 6 shows that bagasse are more efficient toward total phosphorous removal efficiency from agricultural drainage water than its efficiency toward removing total phosphorous from sewage water, where the highest removal efficiency of total phosphorous from agricultural drainage water was 98.8 %.

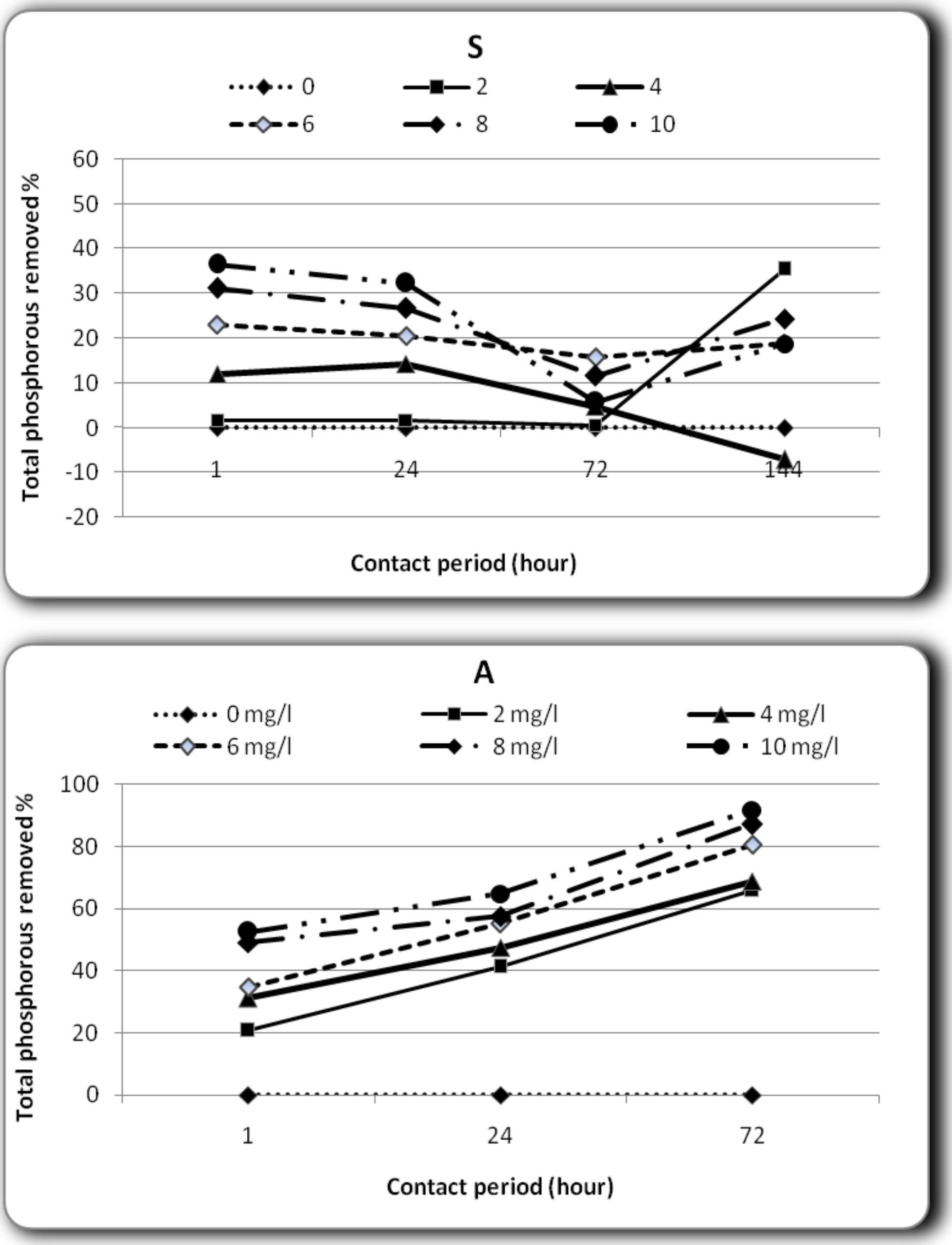


Figure 6. Total phosphorous % removed from sewage water [chart S] and agricultural drainage water [chart A] after being treated with sugarcane bagasse for different contact periods.

Total bacterial count:

Applying sugarcane bagasse to sewage water reduced its total bacterial count significantly after 1 hour with a rate directly proportional to bagasse concentrations (Table 11). After 24 hours bacterial count increased but still lower than control except in case of applying 10 grams bagasse where the bacterial counts increased above control. After being increased at 24 hours, total bacterial count decreased again with increasing time until 144 hours.

Table 11. Means ± SE of total viable bacterial count (10^6 cell/ml) in sewage water as being treated with sugarcane bagasse for different contact periods.

C. P. (H)	Sugarcane bagasse concentrations (g/l)					
	0	2	4	6	8	10
1	24.00 ± 3.464 ^{Aa}	0.045 ± 0.026 ^{Bb}	0.06 ± 0.006 ^{Cb}	0.0803 ± 0.006 ^{Bb}	0.0015 ± 0.0001 ^{Bb}	0.001 1± 0.0003 ^{Bb}
24	1.7 ± 0.557 ^{Bb}	6.033 ± 2.05 ^{Ab}	9.33 ± 0.882 ^{Ab}	4.433 ± 1.33 ^{Ab}	15 ± 2.517 ^{Ab}	48.667 ± 20.169 ^{Aa}
72	0.104 ± 0.058 ^{Bb}	0.867 ± 0.067 ^{Bb}	2.933 ± 0.233 ^{Bb}	3.933 ± 0.636 ^{Ab}	8.00 ± 4.00A ^{Bb}	29.33 ± 10.59 ^{ABa}
144	0.061 ± 0.023 ^{Bb}	0.115 ± 0.025 ^{Bb}	0.163 ± 0.055 ^{Cb}	0.693 ± 0.15 ^{Bb}	6.9 ± 2.397 ^{ABa}	3.267 ± 0.504 ^{Bb}

Means followed by different capital letters in the same column or small letters in the same row are statistically (P< 0.05) different. C.P = contact period.

Table 12 shows that total bacterial count of agricultural drainage water decreased significantly with a rate directly proportional to bagasse dosages during the 1st hour of contacting period. The measured count increased significantly at 24 hours as a result of applying 4, 6, 8 or 10 g/l of bagasse and then re decreased significantly until 72 hours. Prolonging the contacting period to 144 hours led to different effect on the measured bacterial count depending on bagasse concentration. Applying 2 g resulted in no significant alteration in bacterial count, while the addition of 6 g to the agricultural drainage water reduced its total bacterial count. Moreover, the application of 4 and 8 g of bagasse increased significantly the measured total bacterial count, but to values lower than in control. Applying 10 g of sugarcane bagasse increased the total bacterial count of the tested water to a value significantly higher than in control.

Table 12. Means ± SE of total viable bacterial count (10^6cell/ml) in agricultural drainage water as being treated with sugarcane bagasse for different contact periods.

C. P. (H)	Sugarcane bagasse concentrations (g/l)					
	0	**2**	**4**	**6**	**8**	**10**
1	6.133 ± 0.731 ^{Aa}	0.513 ± 0.038 ^{Ab}	0.077 ± 0.023 ^{Cb}	0.005 ± 0.001 ^{Cb}	0.017 ± 0.002 ^{Cb}	0.004 ± 0.001 ^{Cb}
24	3.90 ± 1.242 ^{Acd}	0.43 ± 0.156 ^{Ad}	7.17 ± 0.219 ^{Ac}	7.333 ± 0.426 ^{Ac}	14.00 ± 2.31 ^{Ab}	22.00 ± 1.155 ^{Aa}
72	0.34 ± 0.023 ^{Bc}	3.633 ± 1.55 ^{Aab}	0.24 ± 0.023 ^{BCc}	4.00 ± 0.462 ^{Ba}	1.83 ± 0.49 ^{Babc}	1.533 ± 0.26 ^{Bbc}

Means followed by different capital letters in the same column or small letters in the same row are statistically ($P < 0.05$) different. C.P = contact period.

For both types of the tested polluted water, the applying of sugarcane bagasse was most efficient after only 1 hour resulting in lowest count of total bacteria. The reincrease in total bacterial count could be explained by the fact that agricultural wastes are energy rich substrates; so, it have been employed for the cultivation of microorganisms (Ezejiofor, et al. 2014). Odeyemi and Agunbiade (2012) mentioned values for total bacterial count in fish pond and river in Ila-Orangun, Osun State, Nigeria were between 6.4 and 7.4 x 10^4 CFU/ml, respectively. Saha et al. (2012) reported that the maximum aerobic heterotrophic bacterial count of four pond water samples of Dhaka Metropolis ranged between 6.92×10^4 and 1.72×10^6 CFU/100 ml.

Total fungal count

Tables 13 and 14 showed that total fungal count in agricultural drainage water was much higher than that in sewage water. Sugarcane bagasse seems to have different manner toward fungal count in the investigated polluted waters. As a general trend, total fungal count in sewage water increase as a result of applying bagasse until reaching its maximum value at 8 or 10 g bagasse/l for 144 hours. The investigated practice sharply reduced total fungal count of agricultural drainage water at 24 h. This result could be attributed to the decreased pH in sewage water than in agricultural drainage water were sewage water pH at 8 and 10 g/l of bagasse applied for 144 hours were 6.76 and 4.52, respectively. Many authors mentioned that a negative correlation has frequently been observed between high pH values and species richness (Barlocher and Rosset, 1981; Wood-Eggenschwiller and Barlocher, 1983; Czeczuga and Proba, 1987). Eze and Ogbaran (2010) reported that the mean fungal count in fish pond water obtained from various locations in Ughelli-South Local Government Area of Delta State, Nigeria, ranged from 4.65 to 4.72 Log10 CFU/ml.

Table 13. Means ± SE of total fungal count (cell/ml) in sewage water as being treated with sugarcane bagasse for different contact periods.

C. P. (H)	Sugarcane bagasse concentrations (g/l)					
	0	2	4	6	8	10
1	40.00 ± 5.774 Bb	45.333 ± 2.906 Aab	60.00 ± 0.00 Ca	46.667 ± 8.819 Bab	50 ± 5.774 Bab	43.333 ± 6.667 Bab
24	30.00 ± 0.00 Bb	50.0 ± 5.774 Aa	50.0 ± 0.0 Ca	20.0 ± 0.0 Cb	50.0 ± 11.547 Ba	26.667 ±3.33 Bb
72	60.00 ± 5.774 Ac	40.0 ± 11.547 Ac	150.0 ± 17.32 Aa	130.0 ± 0.0 Aab	103.33 ± 3.33 Bb	50.00 ± 0.00 Bc
144	0.00 ± 0.00 Cc	10.00 ± 0.00 Bc	100.0 ± 5.774 Bb	16.667 ± 3.33 Cc	200.0 ± 28.868 Aa	200.0 ± 40.415 Aa

Means followed by different capital letters in the same column or small letters in the same row are statistically ($P< 0.05$) different. C.P = contact period.

Table 14. Means ± SE of total fungal count (cell/ml) in agricultural drainage Water as being treated with sugarcane bagasse for different contact periods.

C. P. (H)	**Sugarcane bagasse concentrations (g/l)**					
	0	**2**	**4**	**6**	**8**	**10**
1	763.33 ± 24.037 Aa	380 ± 15.275 Ab	670 ± 58.595 Aa	766.667 ± 3.333 Aa	443.33 ± 18.56 Ab	680 ± 73.711 Aa
24	86.667 ± 3.333 Ba	30.00 ± 0.00 Bc	30.00 ± 0.00 Bc	20.0 ± 5.774 Bcd	50.0 ± 11.547 Bb	10.0 ± 5.774 Bd
72	0.00 ± 0.00 Cb	15.0 ± 2.887 BCab	20.00 ± 0.00 Ba	13.333 ± 6.667 Cab	26.667 ± 3.333 Ba	30.00 ± 11.547 Ba

Means followed by different capital letters in the same column or small letters in the same row are statistically (P< 0.05) different. C.P = contact period.

Total yeast count:

As shown in Tables 15 and 16 mixing both types of polluted waters with sugarcane bagasse increased their total yeast count after 24 hours, and then decreased till the rest of experimental period, except in case of applying 10 g/l of bagasse to agricultural drainage water for a period of 72 hours producing its maximum value. The increase in yeast count attributed to the fact that lignocellulosic materials act as a medium for microorganism's growth. Ezejiofor, *et al.* (2014) reported that many microorganisms, including filamentous fungi, yeasts and bacteria, have been cultivated on sugarcane bagasse in fermentation processes. The lowest yeast count in sewage water after being treated with bagasse were in case of applying 6 and 10 g/l of bagasse for 144 hours, which correlated with the lowest pH values (6.59 and 4.52, respectively). It could be observed that the increased total yeast count were corresponding to the decreased bacterial count which could be attributed to the fact that the yeast may be antagonistic to bathogenic bacteria, due to adhesion of bacterial cells or by secreting protoeases which inhibit bacterial toxins (Gedek, 1999; Castagliulo *et al*., 1999).

Table 15. Means ± SE of total yeast count (cell/ml) of sewage water as being treated with sugarcane bagasse for different contact periods.

C. P. (H)	Sugarcane bagasse concentrations (g/l)					
	0	2	4	6	8	10
1	1333.33 ± 88.19 Ab	4533.3 ± 1126 Aa	840 ± 136.14 Bb	813.33 ± 258.29 Bb	816.67 ± 82.13 Ab	1166.67 ± 33.33 Bb
24	513.33 ± 52.07 Bc	2200 ± 230.9 Bab	2200 ± 208.2 Aab	2000 ± 57.8 Aab	1040 ± 780.5 Abc	2566.7 ± 417.7 Aa
72	40 ± 4.619 Cd	300 ± 28.87 Cc	410 ± 11.55 Cc	456.67 ± 3.33 Bc	876.67 ± 3.33 Ab	1600 ± 173.21 Ba
144	10.0 ± 0.00 Ccd	110 ± 5.774 Ca	60 ± 17.32 Cb	0.00 ± 0.00 Cd	40.0 ± 17.3 Abc	13.33 ± 6.67 Ccd

Means followed by different capital letters in the same column or small letters in the same row are statistically ($P < 0.05$) different. C.P = contact period.

Table 16. Means ± SE of total yeast count (cell/ml) of agricultural drainage Water as being treated with sugarcane bagasse for different contact periods.

C. P. (H)	Sugarcane bagasse concentrations (g/l)					
	0	2	4	6	8	10
1	163.33 ± 8.82 Ac	236.67 ± 3.33 Cb	273.33 ± 33.33 Cb	366.67 ± 31.8 Ba	73.33 ± 8.82 Bd	166.67 ± 8.82 Cc
24	160 ± 23.09 Ad	3900 ± 404.15 Ab	1033.3 ± 33.3 Acd	2000 ± 57.74 Ac	5400 ± 1212.4 Ab	8500 ± 288.7 Ba
72	0.00 ± 0.00 Bc	483.33 ± 20.28 Bc	400 ± 11.55 Bc	476.67 ± 47.02 Bc	6700 ± 251.66 Ab	10666.7 ± 333.3 Aa

Means followed by different capital letters in the same column or small letters in the same row are statistically ($P < 0.05$) different. C.P = contact period.

CONCLUSION

The bioadsorbent made using sugarcane bagasse is basically built by macromolecules with humic and fulvic substances, lignin, cellulose, hemicelluloses and proteins that have adsorptive sites such as carbonyl, carboxylic, amine and hydroxyl groups, able to absorb the pollutants by the ion exchange phenomena or by complexation (Dávila-Jiménez, *et al.* 2005). Sugarcane bagasse has a potential efficiency for treating sewage and agricultural drainage waters which resulted in improving their water characteristics to be adequate for different purposes, especially aquaculture purposes.

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كفاءة مصاصة قصب السكر في معالجة مياه الصرف

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الملخص العربي

في تجربة معملية اجريت بالمعمل المركزي لبحوث الأسماك بالعباسة تم اختبار كفاءة مصاصة قصب السكر في معالجة كل من مياه الصرف الصحي والصرف الزراعي لتحسين عوامل جودة المياه لتكون أكثر ملائمة للإستخدامات المختلفة وبالذات الإستزراع المائي.

تمت إضافة عدة تركيزات مختلفة من مصاصة قصب السكر 0 ، 2 ، 4 ، 6 ، 8 ، 10 جرام (لكل لتر من مياه الصرف الصحي والمجمعه من مصرف صفت الحنة أو من مياه الصرف الزراعي والمجمعة من مصرف خزبك والمصرفان موجودان بمحافظة الشرقية . تم أخذ عينات من المياه المعالجة بعد فترات مختلفة 1) ، 24 ، 72 ساعة (وبالنسية لمياه الصرف الصحي فقط تم أخذ عينات بعد 144 ساعة بينما لم يتم أخذ عينات من الصرف الزراعي للإنخفاض الشديد في درجة الأس الهيدروجيني21) و (6 بعد 72 ساعة .وقد تم قياس عدد من الخصائص الطبيعية والكيميائية للمياه) درجة الحرارة – تركيز أيون الهيدروجين – القلوية الكلية والعسر الكلي – النيتريت والنترات والأمونيا غير المتأينة – الأورثوفوسفات والفوسفور الكلي .(وتم كذلك تحديد بعض الصفات الميكروبيولوجية من خلال العد الكلي لكل من البكتيريا والفطريات والخمائر.

وقد كان من أهم النتائج المتحصل عليها إنخفاض تركيزات كل من النيتريت والنترات والأمونيا غير المتأينة والنيتروجين الكلي والأرثو فوسفات والفوسفور الكلي في مياه كل من الصرف الصحي والزراعي .كما تبين إنخفاض العدد الكلي للبكتيريا في كلا النوعين من المياه الملوثة بعد ساعة واحدة من اضافة مصاصة قصب السكر، بينما لم تنخفض اعداد الفطريات سوي بعد 24 ساعة في مياه الصرف الزراعي بينما زادت أعداد الخمائر في كل من مياه الصرف الصحي و الزراعي ويستدل من هذه النتائج علي كفاءة تطبيق مصاصة قصب السكر كأحد المخلفات الزراعية منخفضة التكلفة في تحسين صفات مياه الصرف الصحي والزراعي لتكون أكثر ملائمة للإستخدامات المختلفة ولا سيما الإستزراع المائي.