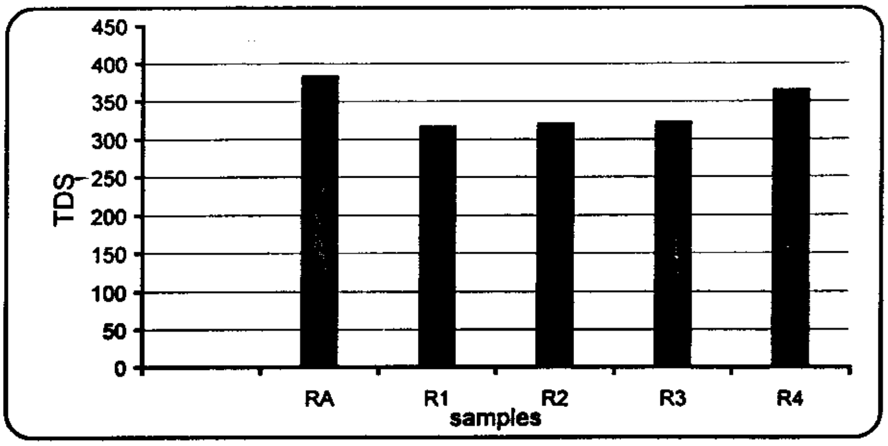

Figure (4): TDS values for rice straw before and after treatment

3.2.1.4 Total organic carbon (TOC)

Total organic carbon in water is a useful indication of the degree of its pollution in surfaces water, total organic carbon concentration is generally less than 10 mg/L, but for municipal wastewater it ranges from (10-100) mg/L and for industrial wastes depending on the level of wastewater treatment [49]. The data of TOC measurements are shown in Table II and represented graphically in Figure (5). Inspection of these results clearly shows that the use of rice straw as sorbent greatly enhances the values of TOC. So, the values of TOC increase from 1.78 mg/L in case of the untreated sample (R_A) to 47.19 mg/L on reaching 0.4gm rice straw as sorbent.

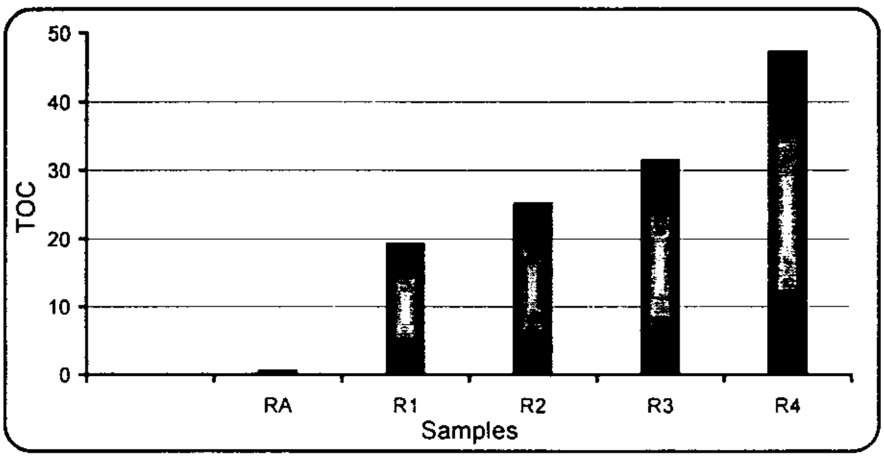

Figure (5): TOC values for rice straw before and after treatment

3.2.1.5 Trace metal

Trace metals ions such as (Al^{3+}, Ba^{2+}, Cd^{2+}, Co^{2+}, Cr^{3+}, Cu^{2+}, Fe^{3+}, Mn^{2+}, Ni^{2+}, Pb^{2+}, Sr^{3+}, Zn^{2+}) concentrations are shown in Table II. The removal of the above-mentioned metal ions with different weights of rice straw as sorbent is shown graphically in Figures (6) and (7). From which it is clearly found that Pb^{2+} is greatly removed (96.61% at 0.4 gm rice straw). Other metal ions are removed by different extents ranging from 36.60% for Cr^{3+} down to 3.10% for Sr^{3+}. The trend of metal ion removal was found to be: $Pb^{2+} > Cr^{3+} > Cu^{2+} > Co^{2+} > Zn^{2+} > Ba^{2+} > Al^{3+} > Cd^{2+} > Ni^{2+} > Fe^{3+} > Sr^{3+} >$ with removal percent from 96.81% > 36.6% > 23.6%, 21.6% > 21.8% > 20.21% > 12.2% >11.48% > 3.1% respectively.

Organic compounds naturally occurring in rice straw are effective agents for chelating heavy metals and the solubility of metal chelates depends on both binding strength and the mobility of the chelates that formed [50]. The composition of rice straw such as carbohydrates, protein, phenolic compound and the cell wall contains a framework of insoluble mineral complex of calcium; phosphorus; magnesium and silicon could make a complexation with other compound or form a covalent bond. Sposito [51] defined the tendency of the metals to form covalent bonds on the basis of the ionic radius and the ionization potential quantified by the Misono softness parameter. This parameter measures the ability of the metal cations to form strong complexes according to their ability to form covalent bonds, in the following order: $Pb^{2+} > Cd^{2+} > Cu^{2+} > Co^{2+} > Ni^{2+} > Zn^{2+}$.

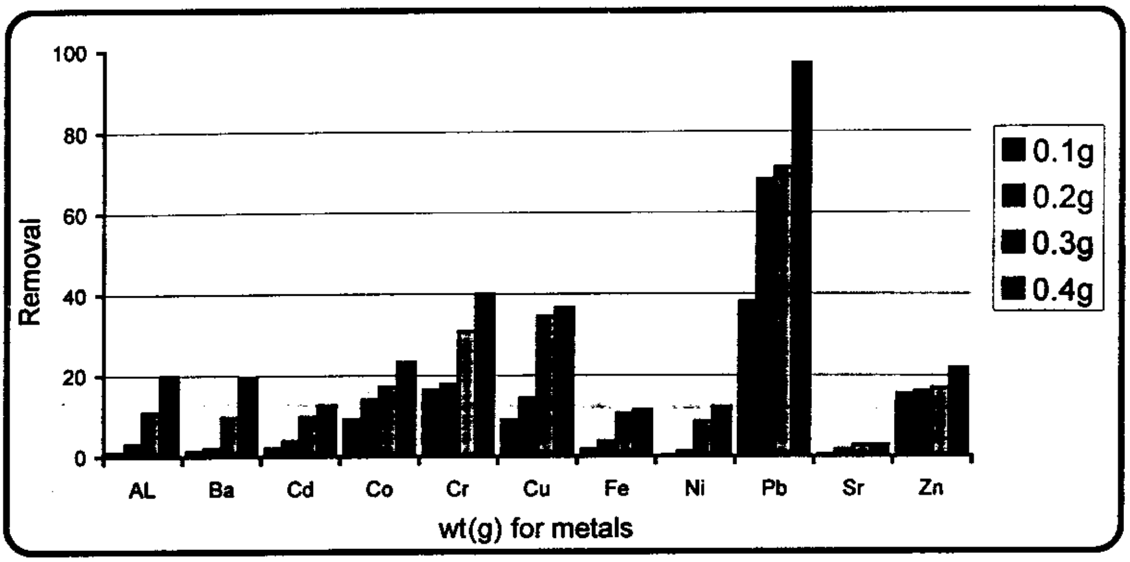

Figure (6): Removal percent values for rice straw before and after treatment

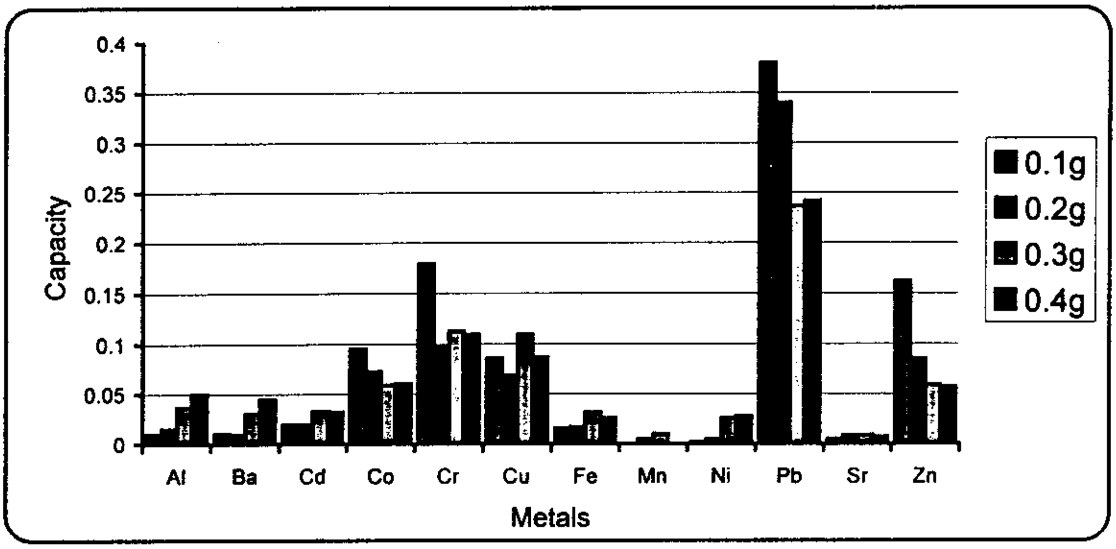

Figure (7): Capacity values for rice straw before and after treatment

Table II

Data for rice straw

Physio -Chemical,Organic parameters

Sample	Code	pH	EC ms/cm	TDS mg/L	TOC mg/L
1	R_A	2.90	0.564	383	1.78
2	R_1	3.10	0.468	316	19.25
3	R_2	3.30	0.477	320	31.57
4	R_3	4.09	0.482	322	35.23
5	R_4	5.20	0.543	364	47.19

Trace Metals

Metals		AL			Ba			Cd			Co		
Initial Conc.		1.01			0.932			1.02			1.03		
wt. gm	sample	final con.	Removed%	Capcity mg/g	final con.	Removed%	Capcity mg/g	final con.	Removed%	Capcity mg/g	final con.	Removed%	Capcity mg/g
0.1	R_1	1	0.990099	0.01	0.921	1.180258	0.011	1	1.960784	0.02	0.935	9.223301	0.095
0.2	R_2	0.98	2.9703	0.015	0.913	2.03863	0.0095	0.98	3.92157	0.02	0.885	14.0777	0.0725
0.3	R_3	0.9	10.891	0.0367	0.841	9.7639	0.0303	0.92	9.8039	0.0333	0.852	17.282	0.0593
0.4	R_4	0.81	19.802	0.05	0.751	19.421	0.0453	0.891	12.647	0.0323	0.789	23.398	0.0603

Metals		Cr			Cu			Fe			Mn		
Initial Conc.		1.09			0.948			0.897			1.05		
wt. gm	sample	final con.	Removed%	Capcity mg/g	final con.	Removed%	Capcity mg/g	final con.	Removed%	Capcity mg/g	final con.	Removed%	Capcity mg/g
0.1	R_1	0.911	16.42202	0.179	0.862	9.07173	0.086	0.881	1.783724	0.016	1.05	0	0
0.2	R_2	0.896	17.7982	0.097	0.811	14.4515	0.0685	0.863	3.79041	0.017	1.04	0.95238	0.005
0.3	R_3	0.753	30.917	0.1123	0.62	34.599	0.1093	0.801	10.702	0.032	1.02	2.8571	0.01
0.4	R_4	0.653	40.092	0.1093	0.601	36.603	0.0868	0.794	11.483	0.0258	1.05	0	0

Metals		Ni			Pb			Sr			Zn		
Initial Conc.		0.913			1			0.978			1.05		
wt. gm	sample	final con.	Removed%	Capcity mg/g	final con.	Removed%	Capcity mg/g	final con.	Removed%	Capcity mg/g	final con.	Removed%	Capcity mg/g
0.1	R_1	0.911	0.219058	0.002	0.62	38	0.38	0.973	0.511247	0.005	0.888	15.42857	0.162
0.2	R_2	0.903	1.09529	0.005	0.319	68.1	0.3405	0.961	1.73824	0.0085	0.88	16.1905	0.085
0.3	R_3	0.834	8.6528	0.0263	0.29	71	0.2367	0.951	2.7607	0.009	0.873	16.857	0.059
0.4	R_4	0.801	12.267	0.028	0.032	96.8	0.242	0.95	2.863	0.007	0.821	21.81	0.0573

3.2.2 Treatment by guava seed

A great quantity of guava waste is predicted as waste of canning industry in Egypt. The aim for this research is to develop inexpensive and effective metal ion adsorbents from plentiful sources of natural wastes (by products), such as guava seed. The chemical composition of guava seeds contained 11.1% lipids, 12.8 % protein, 30.6 % carbohydrates, 42.7% crude fiber and 2.8% ash [52].

The experiments were carried out with (0.1, 0.2, 0.3, 0.4) gm of guava seed with 0.65 mm mesh size are represented as (G_1, G_2, G_3, G_4) with 100 ml aliquot standard concentration 1 mg/L "synthetic wastewater" denoted as G_A. the experimental results are outlined as follows:

3.2.2.1 pH

The effect of using different weights of guava seeds on the pH of the treated solutions is given in Figure (8) and listed in Table III. The pH of the solutions was found to be slightly altered by changing weight of sorbent.

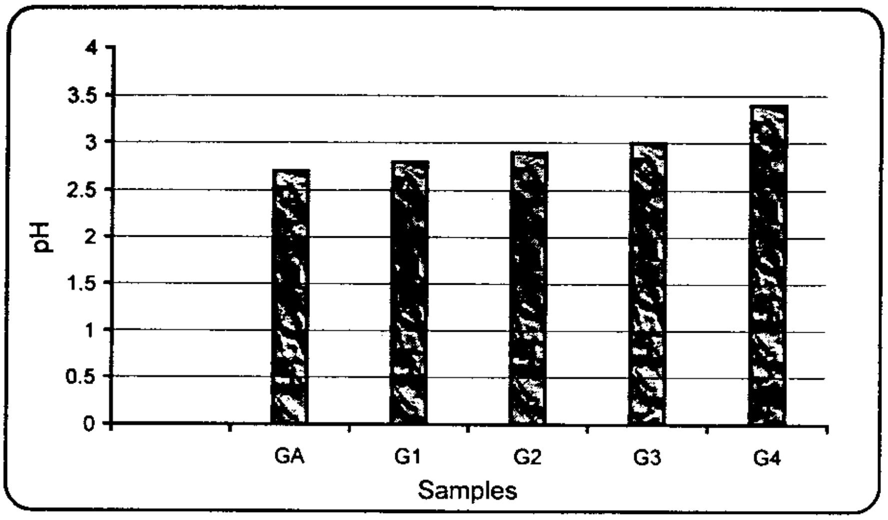

Figure (8): pH values for guava seeds before and after treatment

3.2.2.2 Electrical conductivity (EC)

Electrical conductivity measurements are shown in Table III and Figure (9), which indicate a decreased in EC values by the increase in the weight of sorbent material. This reflects an increasing percentage of metal ions removal from G_1 to G_4.

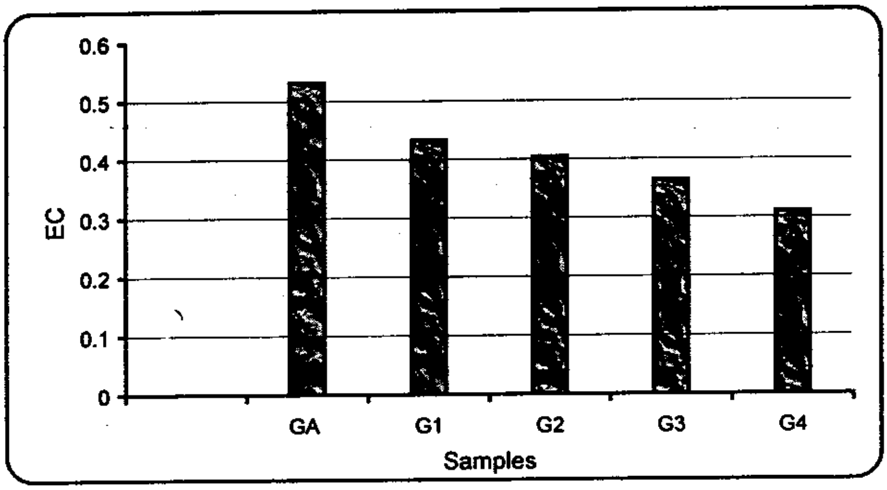

Figure (9): EC values for guava seeds before and after treatment

3.2.2.3 Total dissolved solid (TDS)

From the results obtained in the Table III and Figure (10), it is shown that a decrease in the TDS values is obtained by increasing the weight of guava seeds used as sorbent. This indicates a consequent decrease in the concentration of ionic substances present in water sample.

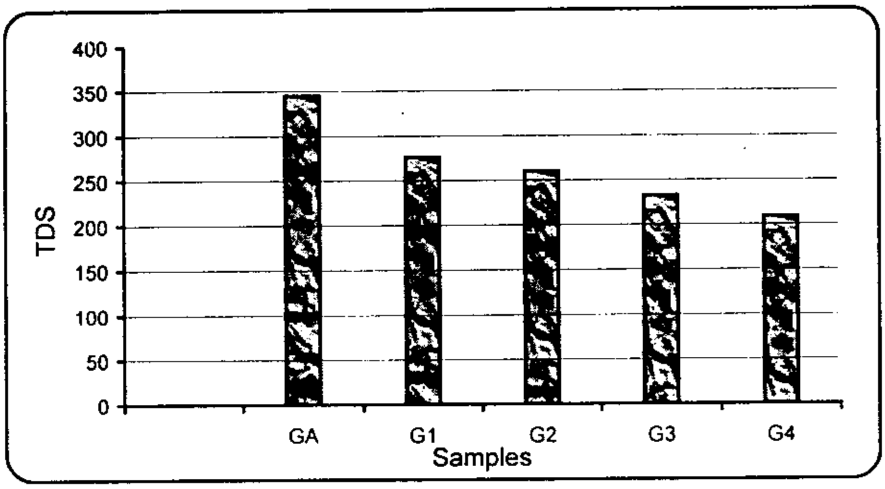

Figure (10): TDS values for guava seeds before and after treatment

3.2.2.4 Total organic carbon (TOC)

Measurements for TOC are shown in Table III and Figure (11). The value for G_A equals 1.054 mg/L and the values of (G_1, G_2, G_3, and G4) equal (6.009, 7.11, 7.82, 8.109) mg/L. From the results shown, as weight of guava seed increases the amount of organic carbon increases.

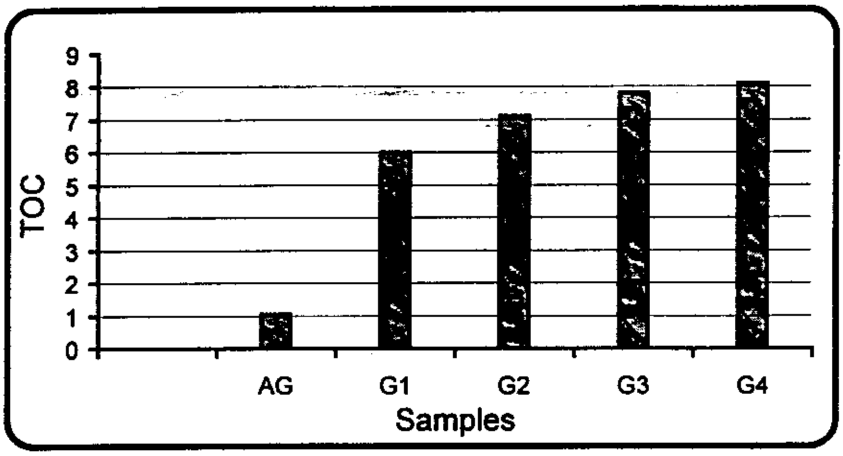

Figure (11): TOC values for guava seeds before and after treatment

3.2.2.5 Trace metals

The effect of weight of guava seeds as sorbent for trace metals removal (Al^{3+}, Ba^{2+}, Cd^{2+}, Co^{2+}, Cr^{3+}, Cu^{2+}, Fe^{3+}, Mn^{2+}, Ni^{2+}, Pb^{2+}, Sr^{3+}, Zn^{2+}) is shown graphically in Figures (12 and13) and listed in Table III. Inspection of the experimental data obtained shows that this type of sorbent greatly affects the removal of Fe^{3+}, Al^{3+}, Pb^{2+} and Cr^{3+} whose removal percentages are (99.5, 96.57, 94.11 and 93.31)% respectively. On the other hand Cu^{2+} is found to be less removed by guava seeds but still in acceptable values; 49.7%, while other cations are removed by less extent; (14.23, 13.55, 10.7, 10.28, 8.8 and 3.6)% for (Ni^{2+}, Cd^{2+}, Co^{2+}, Ba^{2+}, Mn^{2+} and Sr^{3+}) respectively. The total capacity in mg/g of guava seeds were also calculated and given in Figure (13).