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Bioabsorbent of Chromium, Cadmium and Lead from Industrial waste water by Waste plant

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Abstract:

This study was designed to absorb low-cost to treat polluted water such as banana peel and to be used as a biological treatment to remove the "chromium, cadmium and lead" elements from industrial wastewater in the General Company for Battery Industry and the General Company for Electrical Industries in Waziriyah , more grinding to peels appears more uniformly and flattened and a significant change in particle size, the disappearance of fibers due to further reduction in volume Particles by cracking to make sure that the particles the banana was regular and uniform .The best Contact time would get the ate of adsorption decreases over time due to the saturation phase . The best acid pH level was detected in 6, 89.9% chromium and banana peel . The study showed the highest efficiency of adsorption of bananas for heavy elements as these are considered inexpensive household waste on the biological removal of environmental pollutants.

Keywords: Bioabsorbent, wastewater, waste plants, heavy metals

1 INTRODUCTION

Wastewater with heavy metal is considered a big problem, therefore more chemical techniques were applied to treat and remove it such as chemical precipitation, reverse osmosis, activated carbon adsorption, ion exchange, but some of these techniques have higher costs and difficulties associated with applications. However, the biological techniques are considered safe, and much cheaper and almost free of any unpredicted influences such as different plant wastes such as agricultural wastes and fruit peels (Khan *et al.,* 2004; Husson, 2011; Boamponsem *et al.,* 2012; Shartooh *et al.,* 2012; Mohammed E.M,A , *et.al* .2018). In global, Fruits are considered remarkable much-increasing in production and the output has been growing annually about 3% percent on the world. Products from a different state to another, in 2010, almost 640 million tons of fruits were gathered throughout the world. In China the production about 81,285 Million Tons. India produces about 6,892 million Tons among which banana (32.6%), citrus (12.4%) mango (22.1%), and pawpaw (6.6%) (IHD Indian Horticulture Database, 2013). In the absence of efficient methods of chemical-physical or high-cost treatment of industrial waste, it would be necessary to find other methods using plant wastes materials which are available in large quantities from many operations and almost costless, may be successful alternative sorbent material (Deans and Dixon, 1992), such as tree bark, , fruit peels, growing plants and peanut skin (tobacco and tomato root tissues) have been used to reduce different heavy metals ions from contaminated water. Banana and Orange peels may have significant adsorption capacity for removal of heavy metal ions from industrial wastewater (Ben-Ali *et al* 2017)

So, this study was designed to understand concept of adsorption, the important goals designed a low cost adsorbent for wastewater treatment such as Banana Peels to remove Cr, Cd, Pb elements in wastewater by detecting an adsorption substance , Environment-friendly and identifying the localization of Cd, Cr and Pb by assessing the impacts of several environmental factors such as; pH, contact time of capacity of these adsorption materials.

2 MATERALS AND METHODS

2.1 Study Area and Sample Collection

During March in 2017, we have been sampling from two basic stations were chosen in the city of Baghdad. Industrial Wastewater was brought 1-General Company for Battery Industry 2- The Public company for Electrical Industries in Waziriyah area on the city of Baghdad for determining some heavy metal concentration Cd, Cr, Pb using Atomic Absorption Spectrophotometer (AAS). Water samples were collected from the industrial ponds about 5ml and five replicate water of each pond, The water samples were immediately filtered through 0.45µ Millipore filters, The filtrates were according to standard methods, Heavy metal ions to measure before and after addition of adsorbents powder.

2-2 Experimental and Preparation of Samples Collection and Milling

The banana was purchased to use peels plant waste was separated simply from banana 15k.g of it from local markets in the city of Baghdad the peel was washed with distilled water to remove adhering external dirt and then dried 3 days under the sun and the color of banana change was observed from yellow to brownish black. Dried peels were crushed and milling into powder by home mill then dried in a hot air oven at 110C for 3h the moisture content was lost from powder and kept in an air tied bottle for experimental uses, were used sieves four particle size (1000 - 500 - 212 - 180) µ to get four different particle size and then grinded again in Planetary ball mill for 30 h 1:15 ball ratio to get fine particle size (filippoui and Sutherland .2013) and also storied the powder in plastic containers for experiment used. All samples were stored in a dry place to use for biosorption tests experiments 1 kg of powder was obtained of dried crusts from 15 kg of bananas fruits.

2-3 Solutions

2.3.1 Heavy Metals Standard Solutions:

Heavy metals standard solutions were prepared depending on the atomic and molecular weight of the element (Harley and Prescott, 1996) and they were:

2.3.1.1 Chromium Standard Solution:

An adsorbate standard solution of 1000 mg/l of chromium was prepared by dissolving 5.66 g of K2Cr2O7 in 1000 ml of de-ionized distilled water (DDW). This solution was passed through 0.45µm membrane filter and served as stock solution for further uses.

2.3.1.2 Cadmium Standard Solution :

An adsorbate standard solution of 1000 mg/l of Cadmium was prepared by dissolving 6.8457g of 3Cd2So4.8H2O in1000 ml of DDW. This solution was passed through 0.45µm membrane filter and served as stock solution for further uses.

2.3.1.3 Lead Standard Solution:

An adsorbate standard solution of 1000 mg/l of Lead was prepared by dissolving 1.3422g of PbCl2 in 1000 ml of DDW. This solution was passed through 0.45µm membrane filter and served as stock solution for further uses.

2.3.2 Preparation of Different Concentration:

Preparation the concentration of Cd and Pb, Cr were done by diluting the stock solution with distilled water to serial dilutions using the equation: C1V1 = C2V2 (APHA, 1998).

2.4: The Experiments Batch:
Experiments batch were carried out in duplicate under same conditions after agitation, the powder was removed by filtration using filter paper. The concentration of Cd, Pb, Cr in the filtrates as well as in the control samples were determined by using Flame Atomic Absorption Spectroscopy (FAAS) spectrometer. Calculated using the equation:
Uptake % = Co −Ce/ Co x 100% (Shartooh .2012)
Co =Initial concentration of elements (mg/L)
Ce = Concentration of elements at equilibrium state (mg/L)

2.5: Factors Affecting Biosorption of Heavy Metals:
The main investigated parameters that may influence metal sorption were; pH, temperature, contacting time, Biosorbent weight, heavy metal initial concentration, particle size of waste fruit peels and flow rate the standard method for cited reference (Chen, et .al 2011).
2.5.1 PH Effect
An experiment was carried out at a range of solution pH between 2, 4, 5, 6 for Cd, Cr and pb, because pH above 6 will precipitates metal ions (Asku et al., 1991; Pavasant et al., 2006). The acidic and alkaline pH of the solution was maintained by adding the required amount of Nitric acid and NaOH solutions (Arivoli et al., 2009).
2.5.2 Contacting Time :
The effect of period of contact time between the adsorbent and adsorbate on the removal of the metal ions was determined by keeping pH according to (Arivoli et al., 2009), by different periods (1min., 15min., 30min., 1hr., 2hr) and flow rate was 10ml per0.5 min.

2-3 Statistical method
The statistical analysis was performed according to the AOAC Protocol (Thompson,2006) was assessed using different measures of statistical and coefficient of determination correlation coefficient, mean prediction error concentration of component standard method. The coefficient of determination, r^2, was calculated where N is the total number of paired observations. A value of $r^2 = 1$ indicates 100% precision between the methods.

3- RESULTS AND DISCUSSION

3-5-1: Determination of Cr, Cd, and Pb Concentrations in Water and Peels Sample
It was conducted initial examination of samples of industrial waste water The average value of elements concentrations It was between 0.1 and 0.05 ppm in all water sites, these results correspond to (Hassoon ,2015) in canal University of Baghdad the reported that concentrations of Chrome, Lead and Cadmium were 0.05ppm,0.1ppm, 0.003ppm ,Respectively, therefore we prepared saline solutions Batch to obtain the highest percentage of element concentrations for the adsorption experiment. Determination of Cr, Cd, and Pb concentrations in peels Banana it, results showed Nil concentrations of Cd, Pb , Cr Respectively. Adsorption for Cd, Cr and Pb Ions in the Single Solution Using Banana Powder in Batch Concentration for each metal was 100 ppm , Concentration (Cr, Cd, Pb) Batch (62.3, 50.13, 44.2) and Adsorption (37.7,49.87, 41.15). respectively.

3-5-2: Factors Affecting Biosorption of Heavy Metals by Powder:
1-pH:
These experiments in current study were carried out at four different means of pH values (2,4,5,6) for Cd ,Cr and Pb solutions, for powder Banana peels chosen these values of pH which conducted in the same these values of pH , have achieved high rates of removal of the same elements Cadmium, Lead and Chromium using different adsorbent materials pH results showed that increased with increase conditions for the maximum adsorption there is a significant correlation between pH concentration and adsorption ratio due to competition between H ions and metal ions this corresponds to (Dubey et al,2014. ,Jameel et al, 2012). Very important factors to affect the biosorption of metal to examine the effect of pH on the efficiency biosorption , several experiments were performed at different ranges from 2, 4, 5, 6 as shown in Table (1) increasing progressive up 2 pH to pH 6 where the maximum adsorption efficiency was obtained removal rate reached Cd ,Cr and Pb up to (98% and 99%, 97%) Respectively. The highest adsorption rate for cadmium was 98% ppm in pH 6 for banana peel .The highest adsorption of chromium was 99% mm in pH 6. The highest adsorption of the lead element was 97% mm in pH 6 . This result deals with (ALkusaibi.et.al ,2015) when used different value of pH 2,4,6,8,10 and this sudy prove the best adsorption ratio in pH value 6 ,8 and this result also agreed with (Darge, A; Mane ;S.j. 2015), that used 3,5,8 of pH value and prove 5,8 pH was best to get of high adsorption ratio and also agreed with (Ben-Ali .2017) were used the value of pH 1 ,2 ,3 ,4, 5 ,6 and the result of high asdsorption ratio in 5,6 pH

Table (1) pH values with concentrations of heavy elements

Cadmium	PH2	PH4	PH5	PH6
BP	6.4	4.99	3.98	2.23
Chromium	PH2	PH4	PH5	PH6
BP	4.6	3.1	1.99	1.1
Lead	PH2	PH4	PH5	PH6
BP	8.99	6.99	4.99	3.1
Absorption	PH 2 %	PH4 %	PH5 %	PH6 %
BP	93.6	95.01	96.02	97.77
Absorption	PH2 %	PH4 %	PH5 %	PH6 %
BP	95.4	96.9	98.01	98.9
Absorption	PH2 %	PH4 %	PH5 %	PH6 %
BP	91.01	93.01	95.01	96.9

2- Contact time (Flow rate time):
Different time it's an important factor has a positive effect on concentrations with heavy element In the current results found the contact between time adsorbent to removal of the metal ions was determined and calculated from the column range 30 min between (1min, 15 min, 1hour, 2hour) significantly enhanced by increasing the contact time up to 60 min efficiency was obtained removal rate reached Cd ,Cr and Pb Respectively up to (91% and 90%, 90%), as showed in Tables concentration elements with Different time in (2). Results agreed with several studies achieved a maximum removal of Pb and or Cd such as (Keskinkan et al .2004) in which the contact time was 20 minute for removal Pb by C.demersum (Zadeh et al.,2014) at 40 min, (Dixit et al ; Thijar et al; 2014, ;Hassoon, 2015) was contact time in their studies (30 minute) for removal Pb or Cd by C.demersum. and the result of this study agreed with (ALkusaibi, et.al .2015) which was conducted at different time 30 , 60 ,90 , 120, 150 min The process of adsorption starts from the first minute, which the powder touches with the solution and increases with time as the materials become more susceptible and available for adsorption until the powder saturation of the ions found in the solution . Also deals with (Hossain et. al. ,2012) which used different time 10 ,20 ,30 ,40 ,50 ,60 min Where the study proved that the rate of adsorption decreases over time due to the saturation phase .

Table (2) : Concentration Each Elements in Different Time

Cr	1min	15min	1hour	2hour
BP	0.61	1.1	0.61	0.61
Cd	1min	15min	1hour	2hour
BP	1.6	2.1	2.1	2.1
Pb	1min	15min	1hour	2hour
BP	0.81	0.71	3.1	3.1
Adsorption	1min %	15min %	1hour %	2hour %
BP	99.39	98.9	99.39	99.39
Adsorption	1min %	15min %	1hour%	2hour %
BP	98.4	97.9	97.9	97.9
Adsorption	1min %	15min%	1hour	2hour
BP	0.61	1.1	0.61	0.61

4 DISSCUSION AND RECOMMENDATION

The result agree with (Shartooh ,2012) which used different heavy metals of concentration 5 ,10 ,50, 100 ,250 , 500 , 1000 The absorption capacity increases with the initial concentration of the metal ions increases until the optimum concentration is reached. According to (Langmuir, 1916) we found the Maximum adsorption corresponds to a saturated monolayer of adsorbate molecules on the adsorbent in surface Banana and energy of adsorption have been constant with no transmigration of adsorbent in the plane of the surface area. The experiments of this study proved the efficiency of Banana peels on the adsorption of heavy elements , which is considered a dangerous environmental contaminant produced from wastewater ,therefore, Strongly agree with the recommendation of WHO, a minimum daily intake of 400 g of fruit and vegetables and used waste different fruits are usually processed wastes and would suggest enhancing the scientific attention towards using waste plants and the ability of banana and orange peels in the probable controlling other pollutants such as Uranium, oil, pesticides.

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