REMOVAL OF SELECTED HEAVY ELEMENTS IN POLLUTED WATER BY USING DIFFERENT MEDIA

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Abstract

Many different media are used and operated by batch system to study the effect of using to reduce the heavy metals (lead, chrome and copper) ions from polluted water .The media used in this study are cone powder of corn, pinnulace corn and granular activated carbon. Many tests are conducted in these experiments to reduce these ions through various dosage of media with fixed the other conditions (mixing time, pH, volume of solution and speed of mixing). The concentration of the metals in solution where measured before and after the treatment by atomic absorption spectrophotometer. The removal efficiency of the three ions (Pb, Cr and Cu) are (93.0, 78.0 and 71.2)%, respectively with pinnulace corn, (87.4, 61.4 and 64.8)% respectively with powder of corn and (98.3, 96.5 and 96.8)% respectively with granular activated carbon (GAC), with higher dosage for each media.

These results show the ability of cone powder of corn and pinnulace corn to reduce the heavy metals from industrial waste water.

Key words: Heavy Elements , lead, chrome, copper, batch system.

إزالة عناصر ثقيلة مختارة في مياه ملوثة باستخدام أوساط متعددة

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المستخلص:

تم استخدام أوساط مختلفة لدراسة تاثيرها في تقليل تراكيز ايونات العناصر الثقيلة في المياه بتقنية نظام الخلط. تم اختيـار ثلاثة ايونات في هذه الدراسة هي **الرصاص, الكروم والنحاس**. استخدمت ثلاث أوساط مختلفة لأجراء الاختبارات هـي (**مـسحوق عرنوص الذرة وشعر الذرة وحبيبات الكربون المنشط**). أجريت عدة اختبارات في هذه الدراسة لتقليل تراكيز الايونات الملوثة للميـاه بإضافة كميات مختلفة من هذه الأوساط إلى المياه الملوثة, مع تثبيت بقية ظروف التجربة كزمن الخلط, الدالة الحامضية, حجم المحلول و سرعة الخلط. قيست تراكيز الايونات في المحلول قبل وبعد المعالجة باستخدام جهاز قياس امتصاص الأطياف الذرية. بينت الدراسة أن كفاءة الإزالة للعناصر الثلاثة (الرصاص, الكروم والنحاس) هي(93.0، 78.0، 71.2)% على التوالي مع شـعر الـذرة، (87.4،

61.4، 64.8)% على التوالي مع مسحوق الذرة، في حين كانت النتائج المستحصلة مع حبيبات الكربون المنشط هـي (98.3، 96.5، 96.8)% على التوالي.

بينت النتائج المستحصلة من هذه الدراسة إمكانية استخدام مخلفات الذرة (عرنوص وشعر الـذرة) لتقليـل تراكيـز بعـض العناصر الثقيلة من مياه المخلفات الصناعية.

Nomenclature:

Pb:	Lead
Cr:	Chrome
Cu:	Copper
GAC:	Granular activated carbon
WHO:	World Health Organization
EU:	Europe Units Standards

Introduction:

The greater environmental awareness in both the public and regulatory sphere in recent year has necessitated greater treatment of industrial effluent (Townsend, 2001). In the field of environmental pollution, there are few subjects that, during the latest years, have developed as rapidly as the study of toxic metals (Bhattacharya, 1984).

According to the World Health Organization (WHO), the metals of most immediate concern are aluminum, chromium, manganese, iron, cobalt, nickel, copper, zinc, cadmium, mercury and lead (Baig, 2005).

'Heavy metal' is a general collective term applying to the group of metals and metalloids with an atomic density greater than 6g/cm^3. Although it is only a loosely defined term, it is widely recognized and usually applied to the elements such as Cd, Cr, Cu, Hg, Ni, Pb and Zn which are commonly associated with pollution and toxicity problem. An alternative (and theoretically more acceptable) name for this group of elements is 'trace metal' but it is not as widely used (Alloway, 1997). The presence of heavy metal ions in the environment has been a matter of major concern due to their toxicity to human life. Unlike organic pollutants, the majority of which are susceptible to biological degradation, heavy metal ions will not degrade into harmless end-products (Qadeer, 2005).

It is apparent that the presence of a toxic metal may not present a hazard if a threshold exists below which there are no observable effects. It should be noted that certain heavy metals, including aluminum, copper, cadmium, iron, lead, manganese and nickel are essential or beneficial or harmful in trace quantities (Kirk, 1984).

The removal of heavy metal ions from industrial effluents is drawing an increased interest. It is well known that the presence of toxic metal in the environment is a potential health hazard. Industrial effluents that contain high metal concentration are those of the metal plating, mining and tanneries industries, etc. For the heavy metals removal from wastewater, several methods such as, precipitation, reverse osmosis, ion exchange, flotation, cementation, and adsorption have been used (Kazemian, 2005).

Treatment process for metal removal must be selected to remove the existing form of metal or the metal must be converted to a suitable form which is compatible with the removal process (Kasim, 1990). To remove the heavy metal ions by the adsorption, the heavy metal ions must be found in the soluble form to adsorb on the adsorbent surface.

Much interest has been exhibited lately in the use of adsorption technique for the removal of heavy metal ions from industrial effluent. Adsorption of heavy metals is an attractive option due to the proven efficiency of this process in the treatment of industrial effluents and removal of a large number of different contaminants. Such treatments can use either a prepared sorption media, with its recovery and reuse, or low cost adsorption media, anticipating a single use of the material followed by destruction or retention.

Although many areas of adsorption and different adsorbents have been thoroughly researched, there have been few projects that deal with the adsorption of heavy metals (Townsend, 2001). **Table (1)** shown standards concentrations of (Pb, Cr and Cu) in water according to WHO and Europe Units Standards (EU) (Internet, 2001).

Experimental Work:

Synthetic polluted water samples containing define concentration of $Pb^{+2,}$ Cr^{+2}, Cu^{+2} ions are prepared by dilution from stock solution of (1000 mg/l) for each one, with distilled water. Different media where used in this study (con powder of corn, pinnulace of corn and granule activated carbon) to remove the pollutants from waste water, could be applied in main mechanism, namely batch system. This system includes an addition of certain amount of adsorbent material in proportion to certain volume of water. This solution has been mixed for a period time (contact time) to decreased to a desirable leveled (Al-Salihi, 1996), **Figure (1)**. Activated animal carbon (supplied by BDH chemicals Ltd, Poole England) is used as an adsorbent in the present work. Activated carbon is sieved to size range of (0.65-0.8) mm in diameter (passing 0.8mm standard sieve and retained on 0.65mm sieve) and is washed with distilled water before being used to remove fines and dried in oven at 105 ^{o}C for 24 hours.

The concentrations are measured by Atomic Absorption Spectrophotometer: (Shimadzu/Japan, AA-6200, atomic absorption flame emission spectrophotometer).

This process is done by mixing (0.06, 0.16, 0.26 and 0.4) gm of each media (con powder of corn, pinnulace of corn and granule activated carbon) with 50 ml of synthetic wastewater (prepared in the laboratory) and contains (lead, chrome and copper) ions with the concentrations (1.75, 1.14 and 0.94) ppm, respectively. The solutions were mixed for 7 minutes for each run by magnetic stirrers. The pH for influent concentrations are fixed (pH=3.45) with all the tests. The solutions are filtered through (42 Whatman) filter paper to separate the media from solution and the concentration of (Pb, Cr and Cu) ions remaining in the effluents solution is measured by using atomic absorption spectrophotometer technique.

ResultS and Discussion:

The untreated water is mixed with deferent media (con powder of corn, pinnulaes of corn and granule activated carbon) of a certain volume containing (Pb, Cr and Cu) ions. When the impurities in water came in contact with the different media, the ions take place by the absorption and/or adsorption methods. The greater removal efficiency of the three ions after treatment is proved with higher dosage (0.40) gm for each media. The removals efficiencies for (Pb , Cr and Cu) are (93.0, 78.0 and 71.2) %, respectively, with pinnulace of corn, as shown in **Table (2)**, (87.4, 61.4 and 64.8)%, respectively, with con powder of corn as shown in **Table (3)**, and (98.3 ,96.5 and 96.8)%, respectively, with GAC as shown in **Table (4)**. The results show that the removal of lead, chromium and copper ions with pinnulace of corn is greater than con powder of corn, as result of higher surface area for pinnulace of corn and high ability to absorbents and/or adsorbents of ions.

The removal efficiencies indicated by pinnulace and powder of corn are compared with that indicated by GAC, the result shown that the removal efficiency of GAC consistent with the removal efficiency obtained by using powder and pinnulace of corn, as a fact that the GAC the best adsorption media for removal the heavy metal from wastewater. The concentration of ions is shown in **Figure (2)** for pinnulace of corn, **Figure (3)** for the powder of corn and **Figure (4)** for granule activated carbon.

Conclusions:

1- The use of plants waste (con powder and pinnulace of corn) was found to be an efficient media for removal heavy elements Pb, Cr and Cu, from polluted water with a removal efficiency reaches (93, 78 and 71.2)% respectively, with pinnulance corn, (87.4, 61.4 and 64.8)% respectively, with con powder of corn relation to (98.3, 96.5 and 96.8)%, respectively, with GAC, for (Pb, Cr and Cu) respectively with higher dosage (0.4) gm for each media.
2- Traditional methods used for the removal of heavy metals from the environment are in general expensive and potentially risk due to possibility of hazardous by production .We believe that these material are more economical and practical.
3- Result showed that this material is suitable biosorbent for Pb, Cr and Cu ions.
4- This method represents environmental friendly cost-effective possibilities.
5- These material shown its potentiality to be used for treatment of metal contaminated wastewaters.

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Table (1) WHO and EU Standards for Pb, Cr and Cu [10]

Element	***WHO /1993 (mg/l)***	***EU /1998 (mg/l)***
Pb	0.01	0.01
Cr	0.05	0.05
Cu	2	2

Table (2) The Concentration of (Pb, Cr and Cu) Before
and After Treatment by Using Pinnulace of Corn

Dosage of pinnulace of corn (gm)	**Input conc. (ppm)**			**Out put (ppm)**			**Removal efficiency (%)**		
	Pb	***Cr***	***Cu***	***Pb***	***Cr***	***Cu***	***Pb***	***Cr***	***Cu***
0	1.75	1.14	0.94	1.75	1.14	0.94	0	0	0
0.06	1.75	1.14	0.94	0.81	0.88	0.58	53.0	22.0	38.0
0.16	1.75	1.14	0.94	0.20	0.72	0.33	88.0	36.0	64.0
0.26	1.75	1.14	0.94	0.21	0.70	0.32	88.0	36.0	65.0
0.4	1.75	1.14	0.94	0.12	0.25	0.27	93.0	78.0	71.2

Table (3) The Concentration of (Pb, Cr and Cu) Before
and After Treatment by Using Con Powder

Dosage of powder of corn (gm)	**Input conc. (ppm)**			**Out put (ppm)**			**Removal efficiency (%)**		
	Pb	***Cr***	***Cu***	***Pb***	***Cr***	***Cu***	***Pb***	***Cr***	***Cu***
0	1.75	1.14	0.94	1.75	1.14	0.94	0	0	0
0.06	1.75	1.14	0.94	0.71	0.82	0.63	59.0	28.0	17.5
0.16	1.75	1.14	0.94	0.48	0.71	0.57	72.5	37.7	44.7
0.26	1.75	1.14	0.94	0.40	0.66	0.41	77.0	42.0	56.3
0.4	1.75	1.14	0.94	0.22	0.44	0.33	87.4	61.4	64.8

Table (4) The Concentration of (Pb, Cr and Cu) Before and After Treatment by Using GAC

Dosage (GAC) (gm)	**Input conc. (ppm)**			**Out put (ppm)**			**Removal efficiency (%)**		
	Pb	***Cr***	***Cu***	***Pb***	***Cr***	***Cu***	***Pb***	***Cr***	***Cu***
0	1.75	1.14	0.94	1.75	1.14	0.94	0	0	0
0.06	1.75	1.14	0.94	0.82	0.80	0.57	53.1	29.82	39.3
0.16	1.75	1.14	0.94	0.61	0.76	0.51	65.14	33.33	45.7
0.26	1.75	1.14	0.94	0.03	0.06	0.03	98.28	94.73	96.8
0.4	1.75	1.14	0.94	0.03	0.04	0.03	98.28	96.50	96.8

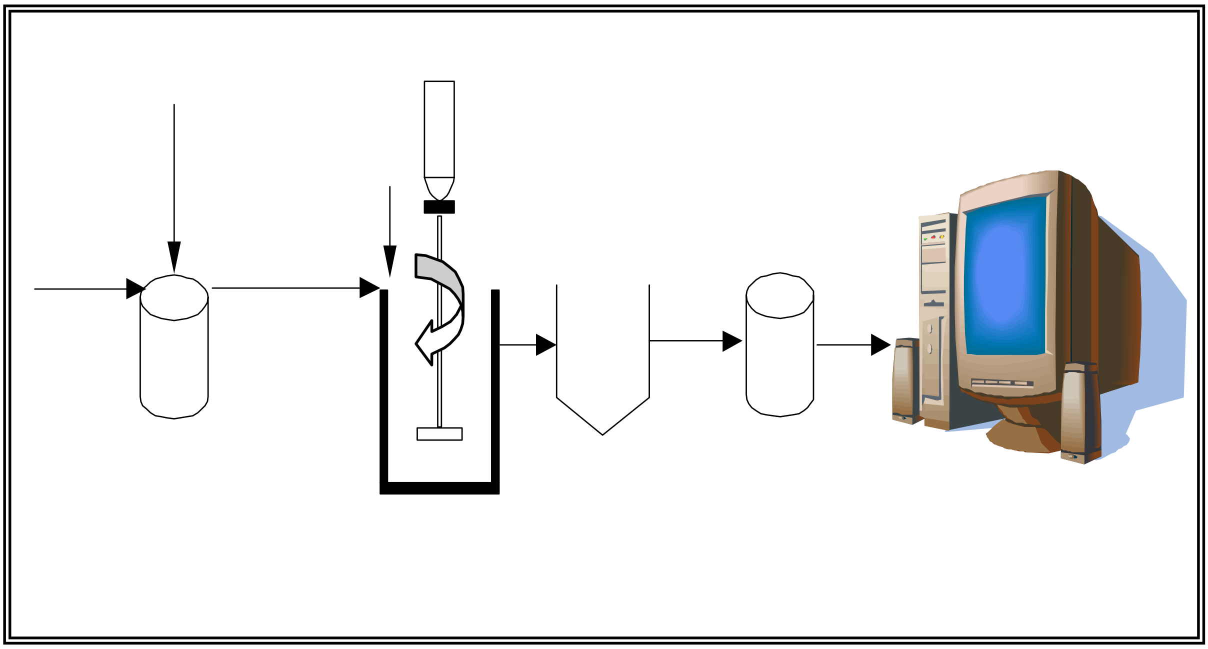

Figure (1) Schematic Diagram of Batch Reactor Process

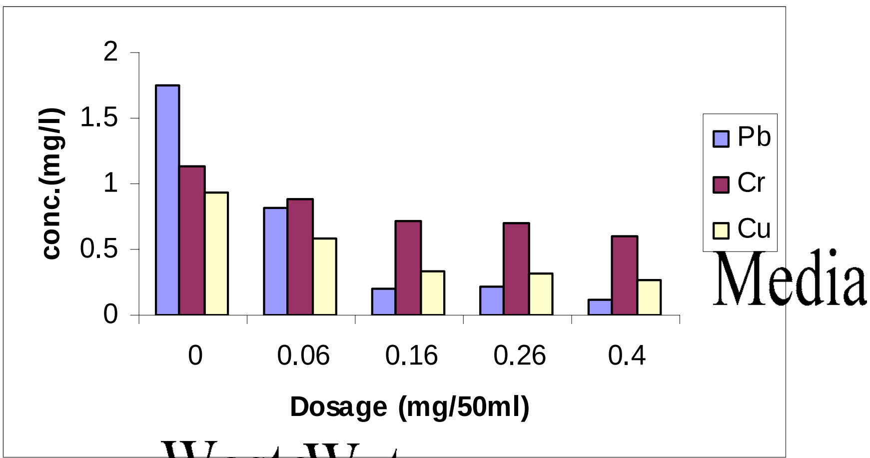

Figure (2) The Concentration of (Pb, Cr and Cu) Before and After Treatment by Using Pinnulace Corn

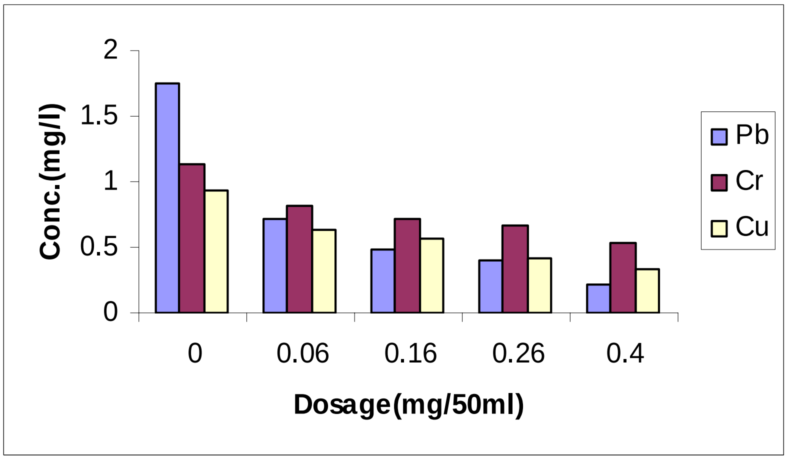

Figure (3)The Concentration of (Pb, Cr and Cu) Before and After Treatment by Using Con Powder of Corn

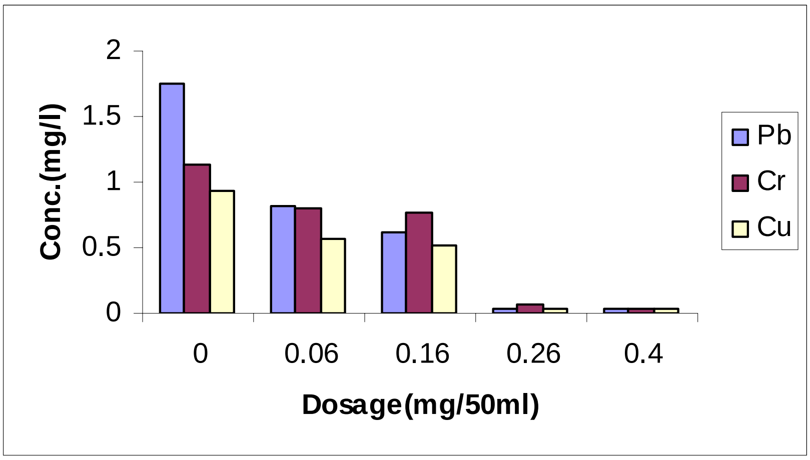

Figure (4) The Concentration of (Pb, Cr and Cu) before and After Treatment by Using GAC