ISSN 2229-5518

Experimental Study on Confiscation of Lead Pb(II) From Wastewater Using Animal Dungs

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Abstract: *Toxic mineral elements which are harmful to humans, animals, the sequester environment and construction practices occur naturally in the environment as a result of natural causes, as well as industrial and agricultural practices. Among existing toxic mineral, investigation was carried out on the removal of Pb(II) using a cheap and easy process known as "adsorption". The wastewater was collected from a Lead mining industry discharging point located at Ikwo L.G.A, Ebonyi State. The adsorbents used were Animal dungs which were dosed at different dosage in an aerobic batch reactor. Adsorption experiments were carried out at varying temperature (ranging from 27-28^oC) and pH (ranging from 7.4-8.8). The effect of contact time, temperature, and pH were studied. It showed that at adsorbent dosage of 2g, poultry dung adsorbed the highest of 1.20mg/l (80% of initial Pb^{2+} concentration) at time 4320mins, temperature 27^oC, and pH of 7.3. It equally showed that poultry dung adsorbed the highest of 1.18mg/l (78.7% of initial Pb^{2+} concentration) at time 20160 mins, adsorbent dosage of 8g, temperature 28^oC, and pH of 7.2. Finally, at adsorbent dosage of 10g, poultry dung adsorbed the highest of 1.29mg/l (86% of initial Pb^{2+} concentration) at time 4320 mins, temperature 28^oC, and pH of 8.0. This work showed however, that poultry dung is the best adsorbent for Pb(II) from contaminated water as compared to cow dung which has a highest percentage of 82.7% at 4320 mins.*

Keywords: *Adsorption, Animal dungs, Confiscation, Lead, Wastewater*

1. Introduction

Water is very essential to human life and other living things, and most have to be given adequate attention before its uses are propagated. The presence of inorganic pollutants such as metal ions in the ecosystem causes a major environmental problem [1]. Toxic metal compounds coming to the earth's surface not only contaminate earth's water (seas, lakes, ponds and reservoirs), but can also contaminate underground water in trace amounts by leaking from the soil after rain and snow. Reviewing all vitamins and minerals has shown that most substance that is useful can be a toxin or poison, as well. Metals are known primarily and almost exclusively for their potential toxicity in the body, though commercially, they may have great advantages [2].

Lead is toxic and also used in lead-acid battery, gunpowder, soldering lead applications among others. This metal found its way into the aquatic environment through wastewater discharge [3]. Because of its non-biodegradability, it tends to accumulate in aquatic organisms; feeding on such aquatic organisms as fish, crabs, or using such contaminated water can lead to metal poisoning in man. The increasing awareness of the environmental consequences arising from heavy metal contamination of the aquatic environment has led to the demand for the treatment of industrial wastewater before discharge into the aquatic environment to reduce the presence of these toxic metals in environment [4]. However, some of the methods which have been employed till date are electrolytic deposition, electro dialysis, electrochemical, evaporation, precipitation, ion exchange, reduction, reverse osmosis. However, most of these methods are associated with high instrumental and operational costs [5]. Thus, employing remediation biologically can be very cost effective and highly efficient.

Adsorption is a process that occurs when a gas or liquid solute accumulates on the surface of a solid or liquid (adsorbent), forming a molecular or atomic film (the adsorbent). It is different from absorption, in which a substance diffuses into a liquid or solid to form a solution. Adsorption process has been an area of extensive research because of the presence and accumulation of toxic carcinogenic effect on living species [6].

Animal dung as an adsorbent is an effective and versatile means and can be easily adopted in low cost to remove heavy metals from large amount of industrial wastewaters. Recent studies have shown that heavy metals can also be removed using plant materials such as palm pressed fibers and coconut husk [7], water fern: *Azolla filiculoidis* [8], peat moss [9], lignocellulosic substrate extracted from wheat bran [10], *Rhizopus nigricans* [11], cork and yohimbe bark wastes [12], and leaves of indigenous biomaterials, *Tridax procumbens* [13]. Literature has reviewed the use of cow dung for removal of chromium [14]. Also cow dung can be used as sequester over heavy metals [1].

The interest of this research however, is to compare the adsorption ability of the two adsorbent at different contact

ISSN 2229-5518

times and evaluate the sorption characteristics of the best adsorbent with respect to Pb^{2+}. The investigation was limited to the use of poultry and cow dungs as organic adsorbents to adsorb lead ions from aqueous solutions, and evaluate the sorption characteristics of the best adsorbent with respect to Pb^{2+}.

II. MATERIALS AND METHODS

2.1 Materials

2.1.1 Lead water solution

The industrial wastewater used for this study was collected from the discharge point of a lead mining industry located in Ikwo LGA, Ebonyi State of Nigeria. It is situated in the eastern ea part of Nigeria with Lat (DMS) 6°4′28 and Long (DMS) 8°6′2E 2E

2.1.2 Animal dung

Dry samples of animal dungs used (poultry and cow) were collected from Livestock farm in Michael Okpara University of Agriculture, Umudike.

2.1.3 pH of Solution

The pH was measured on the lead solution combined with the adsorbent at each contact time. Buffer pH_4 was used in the standardization of the pH meter before use. The solution was hand stirred before measurement with a pH meter (Fisher Scientific Accumet Basic AB15).

2.1.4 Temperature of Solution

The temperature was measured on the lead solution combined with the adsorbent at each contact time by means of a Thermometer (Chemical Thermometer, Mercury filled 30 cm. long). The solution was hand stirred before measurement.

2.2 Methods

The experiment was carried out in aerobic batch reactor for an accurate measurement of adsorption characteristics. The adsorbents were weighed at different mass variations, 2g, 4g, 6g, 8g, and 10g respectively using a weighing balance. The measured adsorbents were poured into labeled bowel containing lead solution of 1000ml each. Each of the bowel was labeled A_1, A_2; B_1, B_2; C_1, C_2; D_1, D_2; and E_1, E_2 to accommodate for the 2 different adsorbents. (No. 1= cow dung, No. 2= poultry dung).

The mixture was allowed to equilibrate at different contact time via: 0, 30, 60, 120, 240, 480, 1440, 4320, 10080, and 20160 minutes.

The temperature and pH was determined for each mixture and at each contact time before filtering. The amount of lead adsorbed was determined by determining the difference in the concentration of the initial collected Lead "Pb(II)" solution (1.6mg/l) and the filtered solution after the experiment. Determination of lead concentration was done using Atomic Absorption Spectrometer (AAS).

III. Results and Discussion

3.1. Results

Table 3.1 Effect of Temperature on Contact Time

Time Interval (mins)		A_1	A_3	B_1	B_3	C_1	C_3	D_1	D_3	E_1	E_3
	DOSAGE AT 0g	2g		4g		6g		8g		10g	
0	28	27	27	27	27	27	27	27	27	27	27
60	27	27	27	27	28	27	27	28	27	27	27
120	28	28	28	28	28	28	28	28	28	28	28
240	27	27	27	27	27	27	28	27	27	27	27
480	27	28	27	27	27	27	28	27	27	27	27
1440	28	28	28	27	28	28	27	27	27	27	27
4320	28	27	27	27	28	28	28	28	27	28	28
10080	28	28	28	28	27	27	28	28	27	28	28
20160	27	27	28	27	28	27	28	28	28	28	27

Table 3.2 Effect of pH on Contact Time

Time Interval (mins)		A_1	A_3	B_1	B_3	C_1	C_3	D_1	D_3	E_1	E_3
	Dosage at 0g	2g		4g		6g		8g		10g	
0	7.9	7.8	7.8	7.8	7.8	7.9	7.8	8.0	7.8	8.1	7.8
30	7.8	7.9	7.8	7.9	7.8	8.0	7.8	8.1	7.8	8.1	7.8
60	7.6	8.5	7.5	8.0	7.7	8.0	7.8	8.1	7.6	8.1	7.7
120	7.9	7.9	7.5	7.9	7.6	7.8	7.6	7.8	7.6	7.8	7.5
240	7.6	7.8	7.7	7.8	7.7	7.4	7.7	8.0	7.5	8.1	7.8
480	7.5	7.9	7.6	7.6	7.6	7.6	7.7	7.8	7.5	8.3	7.9
1440	7.6	8.2	7.6	7.7	7.6	7.4	7.5	7.7	7.3	8.1	7.9
4320	7.5	8.3	7.3	7.6	7.7	7.4	7.6	7.6	7.4	8.4	8.0
10080	7.4	8.5	7.5	7.4	7.5	7.3	7.4	7.7	7.3	8.4	8.1
20160	7.5	8.8	7.7	7.3	7.5	7.4	7.3	7.5	7.2	8.5	8.2

Table 3.3Effect of Contact Time on adsorption

Time Interval (mins)		A_1	A_3	B_1	B_3	C_1	C_3	D_1	D_3	E_1	E_3
	Dosage at 0g	2g		4g		6g		8g		10g	
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.20	0.25	0.18	0.09	0.34	0.18	0.21	0.26	0.36	0.55
60	0.02	0.12	0.29	0.19	0.05	0.29	0.22	0.32	0.46	0.46	0.99
120	0.06	0.15	0.48	0.37	0.03	0.24	0.25	0.43	0.58	0.53	1.01
240	0.06	0.38	0.67	0.64	0.37	0.31	0.40	0.64	0.75	0.87	1.19
480	0.06	0.41	1.01	0.77	0.61	0.66	0.45	0.75	0.82	0.96	1.15
1440	0.06	0.45	1.04	0.86	0.77	0.82	0.60	0.90	0.94	1.10	1.15
4320	0.06	0.56	1.20	1.16	0.93	0.99	0.68	1.03	1.12	1.24	1.29
10080	0.06	0.48	1.15	1.06	0.88	0.93	0.66	0.96	1.11	1.18	1.19
20160	0.06	0.49	1.18	1.12	0.92	0.98	0.82	1.17	1.18	1.18	1.19

Table 3.4Effect of Contact Time on percentage adsorbed

Time Interval (mins)	0%	A_1	A_3	B_1	B_3	C_1	C_3	D_1	D_3	E_1	E_3
	dosage at 0g	2g		4g		6g		8g		10g	
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	13.3	16.7	12.0	6.0	22.7	12.0	14.0	17.3	24.0	36.0
60	1.3	8.0	19.3	12.7	3.3	19.3	14.7	21.3	30.7	30.7	66.0
120	4.0	10.0	32.0	24.7	2.0	16.0	16.7	28.7	38.7	35.3	67.3
240	4.0	25.3	44.7	42.7	24.7	20.7	26.7	42.7	50.0	58.0	79.3
480	4.0	27.3	67.3	51.33	40.7	44.0	30.0	50.0	54.66	64.0	76.7
1440	4.0	30.0	69.3	57.3	51.3	54.7	40.0	60.0	62.7	73.3	76.7
4320	4.0	37.3	80.0	77.3	62.0	66.0	45.3	68.7	74.7	82.7	86.0
10080	4.0	32.0	76.7	70.7	58.7	62.0	44.0	64.0	74.0	78.7	79.3
20160	4.0	32.7	78.7	74.7	61.3	65.3	54.7	78.0	78.7	78.7	79.3

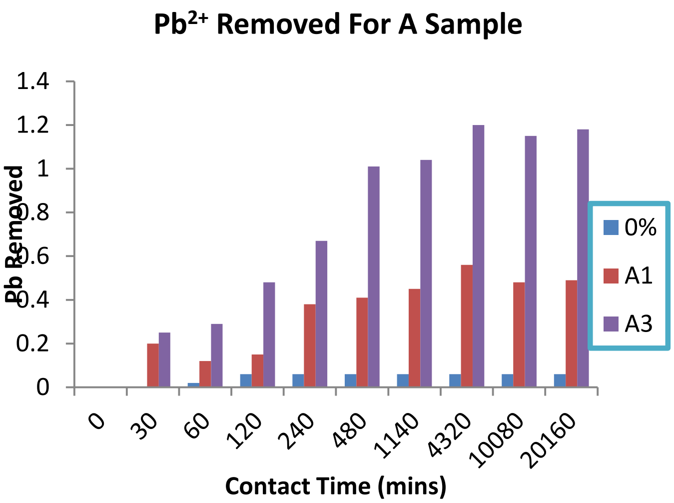

Fig. 3.1 A graph of Pb^{2+} adsorbed against contact time at 2g

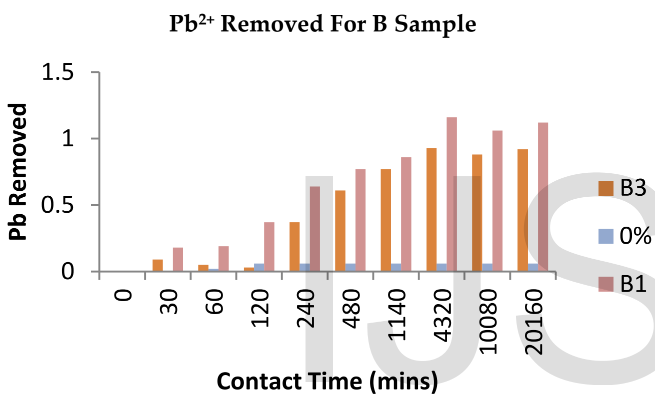

Fig. 3.2: A graph of Pb^{2+} adsorbed against contact time at 4g

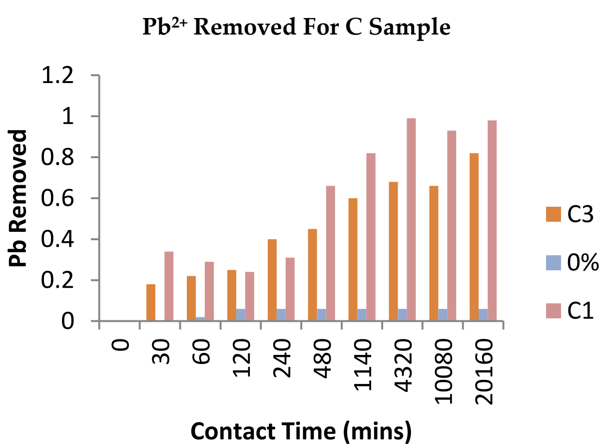

Fig. 3.3: A graph of Pb^{2+} adsorbed against contact time at 6g

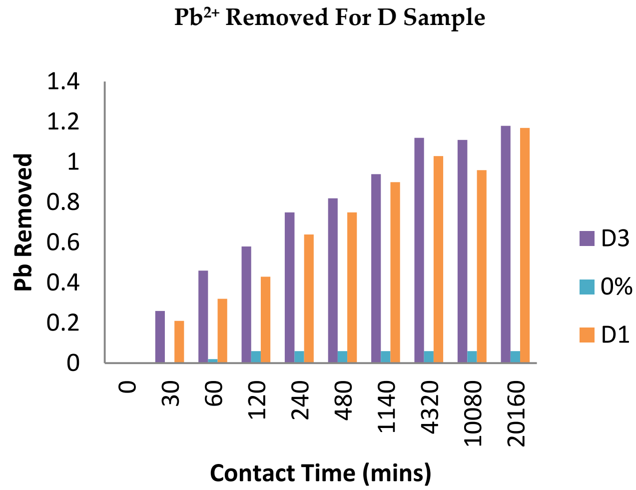

Fig. 3.4: A graph of Pb^{2+} adsorbed against contact time at 8g

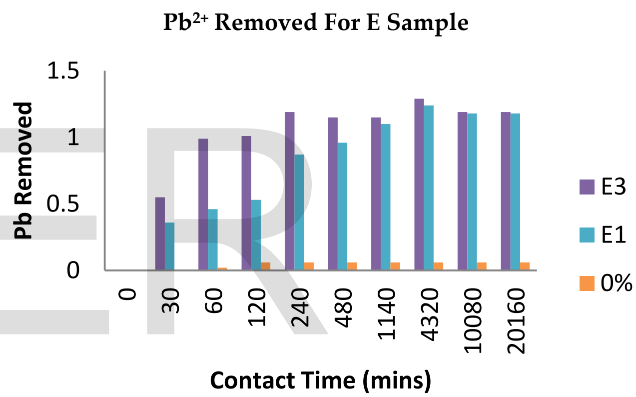

Fig. 3.5: A graph of Pb^{2+} adsorbed against contact time at 10g

3.2 Discussion

Fig 3.1: The above presented graphs reveal the adsorption of the two adsorbents on the lead solution at adsorbent quantity of 2g each and at different contact time. It shows that at 2g, cow dung absorbed its highest of 0.56 mg/l at time 4320mins and least at 30mins of 0.2mg/l and poultry dung absorbed its highest of 1.20mg/l at time 4320mins and least at 30mins of 0.04mg/l making it the best adsorbent.

Generally, at time 0mins, there was no adsorption. Poultry (A_3) dung reveals to be the best adsorbent at adsorbent quantity of 2g and at different contact time than the cow dung.

Fig 3.2 reveals the adsorption of the adsorbents on the lead solution at adsorbent quantity of 4g each and at different contact time. It shows that at 4g, poultry dung absorbed its highest of 0.93mg/l at time 4320mins and least at 30mins of 0.09mg/l. It finally shows that at 4g, cow dung absorbed its highest of 1.16mg/l at time 4320mins and least at 30mins of 0.18mg/l making it the best adsorbent than poultry dung.

Fig 3.3: shows the effect of 6g of the adsorbent at different contact time. At 6g, poultry dung absorbed its highest of 0.82mg/l at time 20160mins and least at 30mins of 0.18mg/l and cow dung absorbed its highest of 0.99mg/l at time 4320mins and least at 120mins of 0.24mg/l making it the best adsorbent.

Fig 3.4: reveals the effect of the adsorbent at 8g each and at different contact time. It shows that at 8g, cow dung absorbed its highest of 1.17mg/l at time 20160mins and least at 30mins of 0.21mg/l. It finally shows that at 8g, poultry dung absorbed its highest of 1.18mg/l at time 20160mins and least at 30mins of 0.26mg/l making it the best adsorbent.

Fig 3.5: reveals the adsorption of the two adsorbents on the lead solution at adsorbent quantities of 10g each and at different contact time. It shows that at 10g, cow dung absorbed its highest of 1.24mg/l at time 4320mins and least at 30mins of 0.36mg/l and finally shows that at same gram, poultry dung absorbed its highest of 1.29mg/l at time 4320mins and least at 30mins of 0.55mg/l making it the best adsorbent.

IV. Conclusion

From the studies and graph analysis above, it showed that at adsorbent dosage of 4g, cow dung absorbed the highest of 1.16mg/l **(77.3%)** at time 4320mins, temperature 28^{o}C, and pH of 7.7. It equally showed that, cow dung absorbed the highest of 0.99mg/l **(66%)** at time 4320mins, adsorbent dosage of 6g, temperature 28^{o}C, and pH of 7.4.

More so, result showed that at adsorbent dosage of 2g, poultry dung fascinated the highest of 1.20mg/l **(80%)** at time 4320mins, temperature 27^{o}C, and pH of 7.3. It equally shows that, poultry dung adsorbed the highest of 1.18mg/l **(78.7%)** at time 20160mins, adsorbent dosage of 8g, temperature 28^{o}C, and pH of 7.2. Finally, at adsorbent dosage of 10g, poultry dung absorbed the highest of 1.29mg/l **(86%)** at time 4320mins, temperature 28^{o}C, and pH of 8.0.

From the two adsorbents, poultry dung which absorbed **86%** of lead ion at 20160mins proves to be the best adsorbent in the absorption of Pb^{2+} than the cow dung which absorbed **82.7%** at 4320mins for 10g adsorbent.

Economically, the adsorbents are affordable and readily available; therefore it will be beneficial to the environmentalist in the treatment of lead contaminated wastewater before a discharge into the aquatic environment and usage for irrigation or construction purposes. Prior to this, animal dungs has been prefer a lot in agricultural sector as manure and also has being use for manufacturing of gases in different ways which benefit man earnestly.

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