

Original Research Article

LEAD Removal from Contaminated Water by Corn and Palm Nut Husks

Comment [MAI1]: Why capitalize

ABSTRACT:

Aims: Water remediation is a process of ridding the water supply of various types of contaminants such as lead and thereby making the water fit for human consumption. Water pollution by lead poses a serious environmental and human health risks due to its toxicity and tendency to bio-accumulate. Lead is not only toxic to aquatic organisms, but also has harmful effects to terrestrial animals, including humans through food chain transfers. The release of lead into natural environment such as agricultural irrigation water sources and farm or garden soils has resulted in a number of environmental problems. Since lead is not bio-degradable, it persists in the environment and can accumulate in the food chain and pose great danger to human health. Thus, this work focused on the remediation of lead in water using low cost and abundant bio-sorbents such as burnt husks from corn and palm nut. The results demonstrated that lead removal from water contaminated with 102 ppm of lead was 92% with corn husk and 99% with palm nut husk.

Comment [MAI2]: This should be introduction not the aim of the study

Comment [MAI3]: This should be the aim

Place and Duration of Study: Federal University of, Technology, Owerri, Nigeria, May 2014-August 2014

Comment [MAI4]: This should be part of the methodology

Methodology: Charred husks of Corn and palm nut were exposed to 102 PPM lead solution with only four 15 min hand-wrist agitation followed by un-agitation at room temperature for 48 hrs. The amount of lead adsorbed by each bio-sorbent was calculated by difference between control sample and residual lead in the supernatant from each substrate's reaction vessel. Residual lead in each reaction was analyzed using atomic absorption spectrophotometer (AAS).

Results: The order of percent lead removal is Palm nut husk (99.0%) > Charred Corn husk (92%).

Comment [MAI5]: This statement is not clear, paraphrase it

Conclusion: The result demonstrates that both substrates effectively removed greater than 90% of the lead from contaminated water under the reaction conditions.

Key words: Corn husk, palm nut husk, potash, bio-remediation, adsorption, lead

38 1. Introduction:

39

40 A heavy metal is a metal of relatively high specific gravity greater than five or high atomic
41 weight, one that is poisonous like lead, mercury, chromium and cadmium. Heavy metals
42 particularly lead may get to surface water via run-off or ground water [1-2]. The world is
43 becoming a global village, and as such heavy metal contamination in one region will inherently
44 have global consequences [3-7]. Lead has been selected in this study because of its high inherent
45 toxicity to most organisms. Contamination of soil, water and air by heavy metals especially lead
46 poses a detrimental threat to our environment, human health, aquatic and terrestrial animals and
47 plants. Lead uptake, transport, and accumulation by plants and animals as well as the potential
48 for its propagation into the food chain exacerbate its toxic health effects.
49 Lead does not undergo degradation or decompositions. It is estimated to persist in the soil for
50 5000 years [8-9]. Thus, its long persistence in the environment, it may have a subtle and
51 persistence results from a variety of human processes such as past practices of lead-related
52 industrial processes smelting, chipping of old lead points, disturbance of old paint during
53 renovation, combustion of coal [9-12]; mining activities [13], use of lead based paints and
54 automotive exhaust fumes [14,15], manufacture and use of Agricultural fertilizer, insecticides,
55 and pesticides [16].

56

57 L. Agwaramgbo et al [17] suggest that Natural disaster such as humaneness may exacerbate or
58 increase the Redistribution of lead in the environment. Research by H.W. Mielke et al [15]
59 suggests that the ingestion of lead contaminated sac water and food and inhalation of lead dust
60 are the most important and serious routes of lead exposure and entry in the human body. Lead
61 is a powerful toxic substance which has a range of pathological conditions associated with acute
62 poisoning, the most characteristic being cerebral Edema and mental retardation. Studies have
63 shown that there is a strong correlation between chronic lead exposure to children and impaired
64 cognitive skills [18], intellectual impairment [19], reduced IQ, physical and mental retardation,
65 neurotoxicity and blood anaemia [20-21]. Similarly, exposure to Adults has health consequences
66 that have been linked to damage to the neurological, reproductive, central nervous and renal
67 systems respectively. [22-24]. Recent studies suggest that neurological damage from early
68 childhood exposure to lead contributes to delinquent and criminal behavior [25-26]. Studies
69 done by P.A Meyer et al [4] suggest that the only medical treatment available for lead exposure
70 is Chelating (the process of removing metal ions from solutions, especially to counter poisoning
71 by heavy metals) which can save lives of persons with high Blood lead levels (BLLS).

72 However, Chelating drugs are not always available in developing countries and have limited
73 value in reducing the effects of chronic lead exposure. Hence there is need for more research on
74 remediation methods, because the removal of lead from water and soil will have positive and
75 beneficial implications on the ecosystem, economy, agriculture, and health.

76

77 Processes that can assist in the reduction of the environmental impact of heavy metals on
78 aquatic and terrestrial systems are emerging. Such processes include but not limited to capping,
79 washing, in-situ and ex-situstabilization[27-28], electrochemical remediation (electro-
80 deposition, electro-kinetic extraction) [29], biological treat such as phytoextraction, and
81 phytoremediation [30], and chemical treatment (chemical precipitation and chelation) [31-32].
82 Although the technologies mentioned above have proven to be good remediation processes for
83 lead contaminant in water, however, they however have their own inherent drawbacks or

Comment [MAI6]: Delete

Comment [MAI7]: Ititalize

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Comment [MAI9]: ?

Comment [MAI10]: Provide evidence that lead was incriminated in either water or soil in the study area

Comment [MAI11]: Unscientific and replace with authoritative statement

84 limitations which include exorbitant cost, general acceptance, applicability at high metal
 85 concentration, contaminant type, and poor removal efficiency. Further, recent research has
 86 provided safe and cheap technologies for the removal of lead from contaminated water via
 87 precipitation [30, 32]. L. Agwaramgbo et al [32-35] reported the use of biomaterials such as
 88 coffee, tea, mustard green caffeine, spinach, charcoal, fish bone and edible plant extracts as
 89 adsorbents in the remediation of lead contaminated water. In recent years, emerging research
 90 has also provided a number of Agricultural materials which can be used as sorbents for the
 91 removal of lead in contaminated water and they include modified cellulosic material, residual
 92 lignin, wood, apple residue, olive, maize tassels, polymerized orange skin, banana husk, pine
 93 bark, sawdust, coals and modified coconut fibers [1, 36-40].

94
 95 Although new methods for removing lead from contaminated water are beginning to emerge,
 96 yet many of them have their shortcomings; they either introduce chemical to the water or affect
 97 the pH of the reaction medium. Therefore the work reported here, investigates the use of corn
 98 and palm nut husks which are cheap and abundant agricultural materials in the development of
 99 lead remediation technology.

Comment [MAI12]: What are the shortcomings or lacuna attached to each of the material listed, that trigger you to go for Corn and Palm nut husk

Comment [MAI13]: Unscientific statement, paraphrase it

Comment [MAI14]: In addition they contained activated carbon that confer them ability to absorb lead in solution

102 2. MATERIALS & METHODS FOR LEAD ADSORPTION

104 The lead nitrate from Guanghua chemical in China was used without further purification. Corn
 105 and palm nut husks were obtained from local Owerri market.

Comment [MAI15]: Provide the name of the manufacturer and his address

107 2.1. Preparation of Lead Nitrate Solution 102 ppm

109 Using an analytical balance, 0.102 g of lead Nitrate from Guanghua chemical in China was
 110 dissolved in enough distilled water (added incrementally with vigorous agitation for complete
 111 dissolution of the lead nitrate) to give a liter of solution. The flask was wrapped with aluminum
 112 foil to avoid much exposure to light at room temperature until it was used.

Comment [MAI16]: Citation needed

114 2.2. Preparation of Burnt Corn Cob Husk

116 The corn grains were manually removed from the husks. The corn husk was dried in the sun
 117 for one week and then burnt in an open system. The Burnt corn husk was crushed into fine
 118 powder and sieved with a 2-mm mesh sieve for homogeneity.

Comment [MAI17]: Why burning

119 2.3. Preparation of Burnt Palm nut Husk

120 The potash used in this work was obtained from palm nut husk. The palm nuts were removed
 121 from the husk and the husk was completely dried and burnt in an open system. The burnt husk
 122 (Potash) was crushed into fine powder and sieved with a 2 mm mesh sieve for homogeneity.

124 3. TREATMENT OF LEAD CONTAMINATED WATER WITH CHARRED CORN 125 COB AND PALM NUT HUSKS:

127 3.1.1 Treatment of Lead Solution with Charred Corn Cob Husk Substrate:

128 Into each of the respective triplicate reaction plastic bottles containing the 5g of charred corn
129 cob husk labeled CCH-1, CCH-2 and CCH-3 substrate was added 50 ml of 102ppm of lead
130 nitrate solution prepared above. The bottles and their contents were hand wrist shaken for four
131 15minutes interval and the reaction vessels were allowed to stand un-agitated for 48 hr at room
132 temperature.

Comment [MAI18]: Citation needed

134 3.1.2 Treatment of Lead Solution with Charred Palm Nut Husk Substrates:

135 Into each of the respective triplicate reaction plastic bottles containing the 5g of charred palm
136 nut husk labeled PNH-1, PNH-2 and PNH-3 was added 50 ml of 102ppm of lead nitrate
137 solution prepared above. The bottles and their contents were hand wrist shaken for four
138 15minutes interval and the reaction vessels were allowed to stand un-agitated for 48 hr at room
139 temperature.

141 3.2. Sample Preparation and Analysis

142 After 48 hrs, the mixture from each reaction bottle was filtered using Whatman filter paper (No.
143 1). The resulting supernatant from each reaction bottle was transferred into another labeled
144 clean sample bottle and sent out to Federal University of Technology Uyo, Nigeria for lead
145 analysis using SOLAR UNICAM 969 Atomic Absorption Spectrophotometer (AAS).

Comment [MAI19]: Why font style is different from other

146 4. RESULTS:

147 Table 1 and Figure 1 show the residual lead remaining after the lead solution was separately
148 treated with each of the two adsorbents (burnt palm nut husk often referred to as potash) and
149 burnt corn cob husk). Table 2 and Figure 2 below show the percent lead removed by each
150 adsorbent. Thus, the data on Tables 1 and 2 suggest that both potash and burnt corn husk
151 effectively removed lead from contaminated aqueous solution. However, potash removed
152 slightly more lead than corn husk.

Comment [MAI20]: Use one table or figure, but you cannot use both

154 Figure 3 compares the residual lead levels after treatment with each of the adsorbent
155 substrates with the exposure limit stipulated by the Federal Protection Agency of Nigeria
156 (FEPAN)

157 Table 1: Residual Lead Concentration after Treatment in PPM:

Substrate	CTR	PNH	CCH
Reaction 1	102	1.7	0.11
Reaction 2	102	1.5	12.7
Reaction 3	103	0.8	11.7
Av. Residual [Pb]	102.3	1.3	8.2
STD. Dev	0.47	0.39	5.7
SQRT	1.7	1.7	1.7
STD Err	0.27	0.22	3.30

158 CTR = Control; PNH = Palm Nut Husk; CCH = Corn Cob Husk

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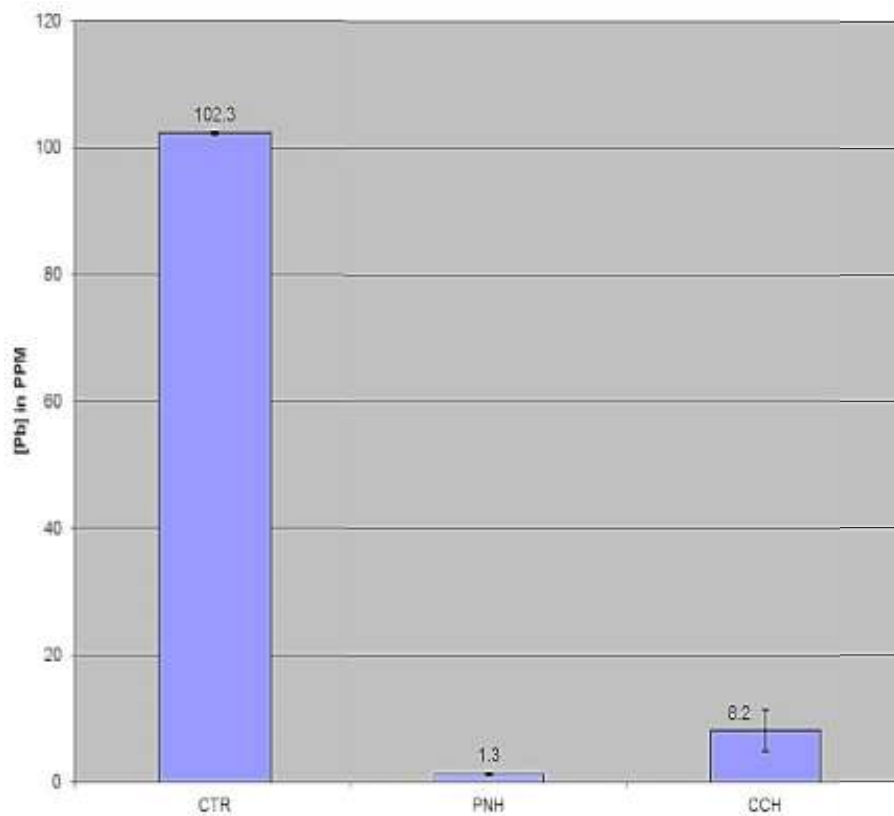
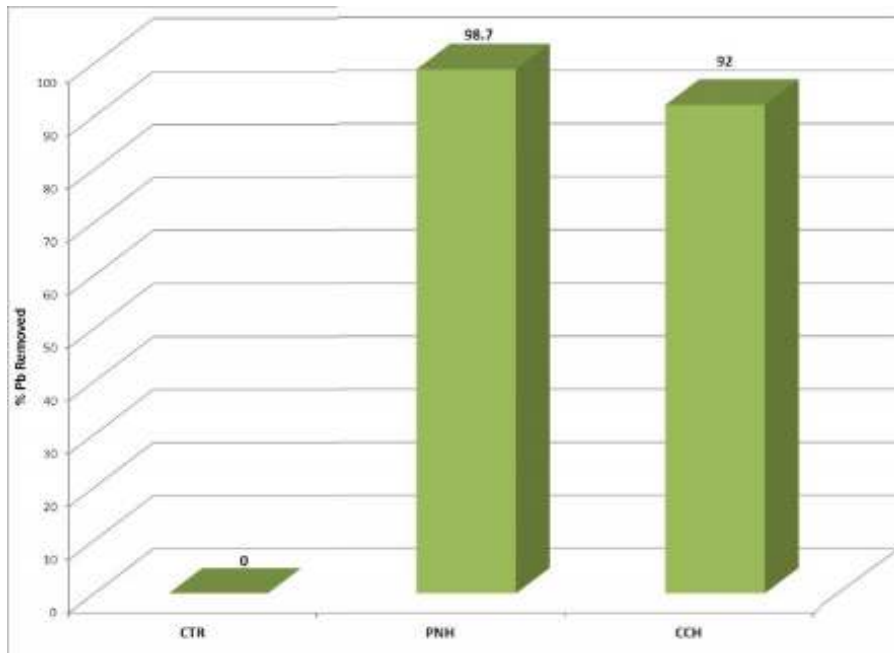


Figure 1: Residual lead concentrations in PPM after treatment
CTR = Control; PNH = Pal Nut Husk; CCH = Corn Cob Husk

Table 2: Percent Lead Removed by Potash and Corn Husk

Adsorbent	CTR	PNH	CCH
% Pb Removed	0	98.7	92.0

CTR = Control; PNH = Pal Nut Husk; CCH = Corn Cob Husk

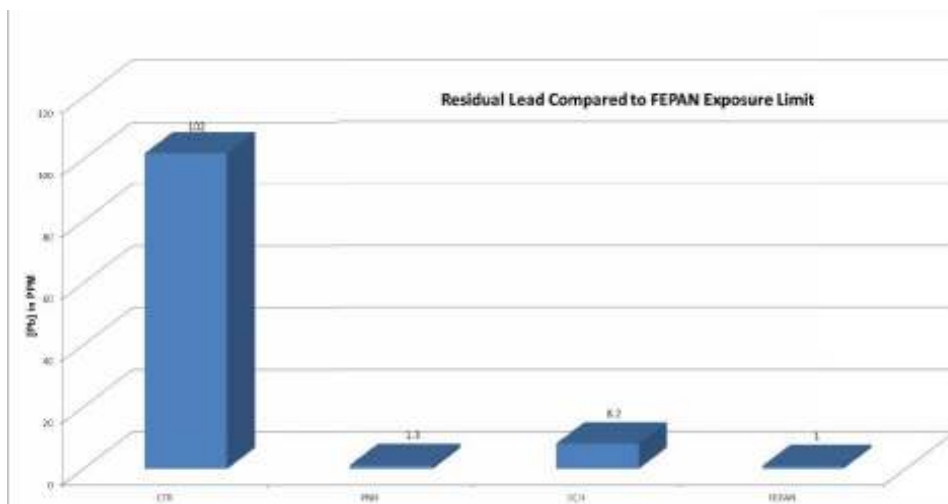


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Figure 2: Percent Lead removed by Substrate: CTR = Control; PNH = Pal Nut Husk; CCH = Corn Cob Husk



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Figure 3: Residual Lead after treatment compared to FEPAN Exposure Limit in Water
CTR= Control, PNH = Pal Nut Husk; CCH = Corn Cob Husk; FEPAN = Federal Protection Agency of Nigeria

182 5. Discussions:

183 It is believed that because the burnt palm nut husk (potash) has smaller
184 particles than burnt corn cob husk even-though both were sieved with the
185 same size sieve mesh. Thus, the burnt palm nut husk (potash) is finer, packs
186 tighter, has larger surface area, and is more able to adsorb more lead than
187 burnt corn husk which is more-coarse.
188

189 6. Conclusions:

190 The result from the project reported here clearly demonstrated that both charred husks from
191 palm nut and corn cob effectively removed lead from contaminated water with greater than
192 ninety percent (90%) of the lead being removed by each adsorbent. More importantly, the
193 technology developed in this project [Palm Nut Husk (Potash)] is able to remediate the
194 contaminated water at or near the allowable level (1 PPM) by the Federal Protection Agency of
195 Nigeria (FEPAN).
196

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Comment [MAI21]: The discussion is very scanty. Some references need to be added to strengthen the result observed by the author. The author should relate his results to what other researchers in the area have obtained. In addition the author needs to discuss all the tables of the results

Comment [MAI22]: Replace with research work

Comment [MAI23]: Paraphrase the sentence

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