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BIOSORPTION OF SOME HEAVY METALS FROM CRUDE OIL POLLUTED SOIL USING BANANA PEELS AND GINGER WASTE AS BIOSORBENT.

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ABSTRACT

In this study biosorption of some selected heavy metals from crude oil polluted soil was carried out using banana peels and ginger waste as biosorbent. The heavy metals analyzed are zinc, chromium, cadmium, lead and nickel. The polluted soil sample was collected from Ubeji community and the absorbent were gotten from fruit vendors and Igbudu market. The crude oil polluted soil collected from Ubeji community was digested using wet acid digestion method and analysed using the atomic absorption spectrophotometer (AAS) to determine the concentration of the various heavy metals and the result gotten were as follows 16.55 mg/kg ,<0.10 mg/kg, <0.50 mg/kg, 17.00mg/kg, <0.10 for zinc, chromium, cadmium, lead and nickel respectively, the concentration of the heavy metals were later analysed after treatment by the biosorbent (banana peel and ginger waste), the concentration gotten for the first week after treatment are 13.05mg/kg, <0.10mg/kg, 0.50mg/kg, 14.00mg/kg, <0.10mg/kg for zinc, chromium, cadmium, lead and nickel respectively for banana peel (50g) and 12.97mg/kg, <0.10mg/kg, 0.50mg/kg, 14.90mg/kg, <0.10mg/kg for zinc, chromium, cadmium, lead and nickel respectively for ginger waste (50g), Also for 100g of adsorbent the concentration gotten for the first week after treatment are 10.05mg/kg, <0.10mg/kg, 0.50mg/kg, 12.30mg/kg, <0.10mg/kg for zinc, chromium, cadmium, lead and nickel respectively for banana peel (100g) and 10.65mg/kg, <0.10mg/kg, 0.50mg/kg, 15.05mg/kg, <0.10mg/kg for zinc, chromium, cadmium, lead and nickel respectively for ginger waste (100g). Significant differences were noted for the subsequent weeks. Comparing the result of concentration of the heavy metals before treatment and after treatment for 50g and 100g of the absorbent, it clearly shows that banana peels and ginger waste where effective in reducing the concentration of zinc, chromium, cadmium, lead and nickel in the crude oil polluted soil sample and also 100g of biomass was found to be more efficient than 50g of the biomass, as such the biosorbent can be used for the bioremediation of heavy metals in crude oil polluted soil.

INTRODUCTION

Crude oil is a naturally-occurring resource which contains hydrocarbon deposits and other organic materials (Tamuno and Felix, 2006). There is an estimated consumption of 90 million barrels of oil daily worldwide. The use of crude oil and its fractions has a negative impact on the environment, damaging ecosystems through spills and releasing a range of pollutants in the environment (Guerrio, Pokhilko, Fernandez, Haliday, Millar, &Hillston, 2012).

In Nigeria, oil spill has become a common occurrence. An estimated 9 million to 13 million barrels have been spilled since oil drilling started in Nigeria in 1958 (Kadafa, 2012). The Niger Delta region which covers about 70,000km^2 of wetlands is a home to more than 20 million people and 40 ethnic groups (Agochi, 2014; Ugbomeh and Atubi, 2010). There is the slow poisoning and destruction of vegetation and agricultural land by oil spills. Idoniboye (2000) reported that oil spills presented far more hazardous effects on soil and soil organisms than air because whatever plants take in goes into the food chain and water cycle. Over the years, different methods have been applied in cleaning up crude oil polluted soils and of all these methods, bio-related clean up types appeared as the most desirable approach due to its low cost and ability to hinder the accumulation of contaminants (Esin and Ayten, 2011).

Bio-sorption is a property of certain types of inactive dead microbial biomass to bind and concentrate contaminants from even very dilute aqueous solutions. It has advantage over the other conventional treatment methods, as it is low cost, highly efficient, minimal chemical and biological sludge; no need of additional nutrients and has the possibility to regenerate sorbents and possible metal recovery and most times waste materials are used.

Crude oil pollution seems inevitable in areas where crude exploration/refining are carried out. This spill not only cause ecological damage, but destroys the livelihood of inhabitants of the area and also their health. Besides the devastating effects it has on the environment, it also incures huge cost of cleaning up the environment. As the current techniques for cleanup are capital intensive. This necessitated the search for cheaper means of clean ups. Not only that these clean up techniques are expensive, they are also environmentally friendly. These agricultural by product are widely available and are of little or no economic value and some of them in fact present a disposal problem. Moreover, dead cells are cheaper, effective in reducing heavy metals to very low levels and requires less care and maintenance

Also, the dead biomas could be easily regenerated and reused (Wankasi et al 2005, Hors fall et al 2006). The reason for the use bio sorption over conventional treatment methods is that it is cost effective, has high efficiency, minimization of chemicals and other biological sludge and the possibility of metals recovery.

The aim of the study is to examine the bio-sorption of heavy metals from oil polluted soil ,Nigeria using Banana and Ginger peels *in* order to evaluate the concentration of these heavy metals in soil from the study area and to determine the concentration of these heavy metals in soil after treatment (applying remediation).

This study covers the use of agricultural waste (dead biomes like banana and ginger wastes) as adsorbent for the treatment of some heavy metal (zinc, chromium, cadmium, lead, nickel,) contaminant in crude oil polluted soil collected from Ubeji community, Warri south local government area of Delta State.

MATERIAL AND METHODS

The Banana peels were collected from the fruit vendors and the garlic waste was gotten from food vendors and also purchased from the market. The Banana peels and the ginger were sorted and dried for 10days. After the moisture contents have been removed, the complex was dried in the oven at 120 degree for 2 hours and was grinded. then sieved through a 2mm mesh size of a micro sieve.

The crude oil polluted soil sample was collected at Ubeji community Delta State. Ubeji community is situated at geographical position of coordinates 5.572326 and 5.702848. The soil was collected with agar to about 15cm in depth and the sample was poured into a polythene bag. The soil samples were collected randomly at different parts of the community and mixed together. Control soil was collected about 500m away from spill site. The soil samples were air dried for 24 hours, and sieved to pass through 2mm mesh and stored at room temperature prior to chemical analysis. The experimental pots were set up using 50g and 100g of the biomass to 200g 0f soil and were labeled accordingly.

After 7 days, 20 g of the crude oil polluted soil was prepared for digestion and was taken to the Atomic absorption spectrophotometer (AAS) machine for analyses of the various heavy metals (cadmium, zinc, lead, chromium nickel)

RESULT AND DISCUSSION

Table1 showing the result of adsorption rate of the adsorbents on zinc

Adsorbent	Untreated soil sample conc (mg/kg)	Week 1 Treated soil sample conc (mg/kg)	Week 2 Treated soil sample conc (mg/kg)	Week 3 Treated soil sample conc (mg/kg)	Week 4 Treated soil sample conc (mg/kg)	Week 5 Treated soil sample conc (mg/kg)
BANANA PEEL (50g)	16.55	13.05	10.37	9.55	8.00	7.25
GINGER WASTE (50g)	16.55	12.97	11.01	9.76	8.89	8.10

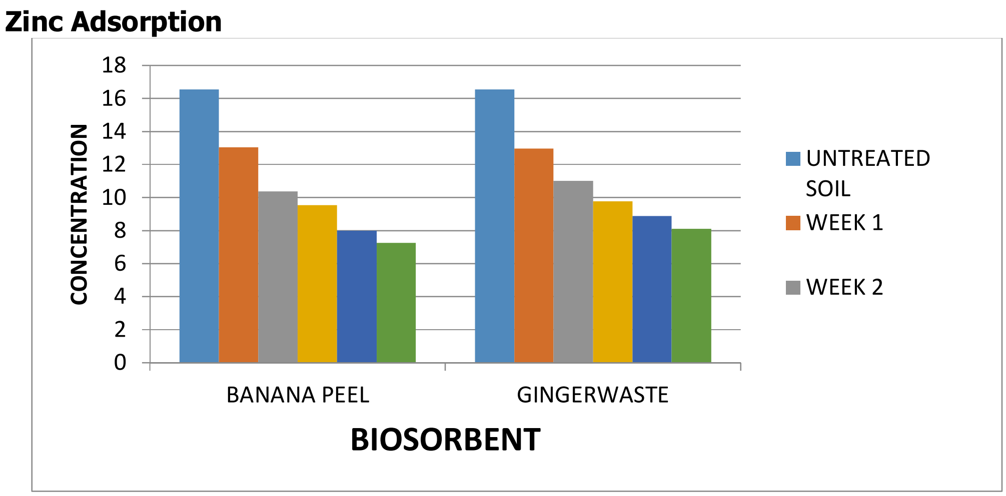


Figure 1 Zinc Adsorption

Table 1 above illustrate the reduction of zinc concentration from 16.55 to 13.05 for week one, 10.37 for week two, 9.55 for week three, 8.00 for week four and 7.25 for week five by banana peel (50g) while ginger waste (50g) reduced the concentration from 16.55 to 12.97 for week one, 11.01 for week two, 9.76 for week three, 8.89 for week four and 8.10 for week 5.

Table 2 showing the result of adsorption rate of the adsorbents on chromium

Adsorbent	Untreated soil sample conc (mg/kg)	Week 1 Treated soil sample conc (mg/kg)	Week 2 Treated soil sample conc (mg/kg)	Week 3 Treated soil sample conc (mg/kg)	Week 4 Treated soil sample conc (mg/kg)	Week 5 Treated soil sample conc (mg/kg)
BANANA PEEL (50g)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
GINGER WASTE (50g)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10

Table 2 shows the result of chromium concentration which was constant at <0.10 (indicating that there is no significant level of chromium concentration in the soil sample) for the five weeks for both banana peel (50g) and ginger waste (50g).

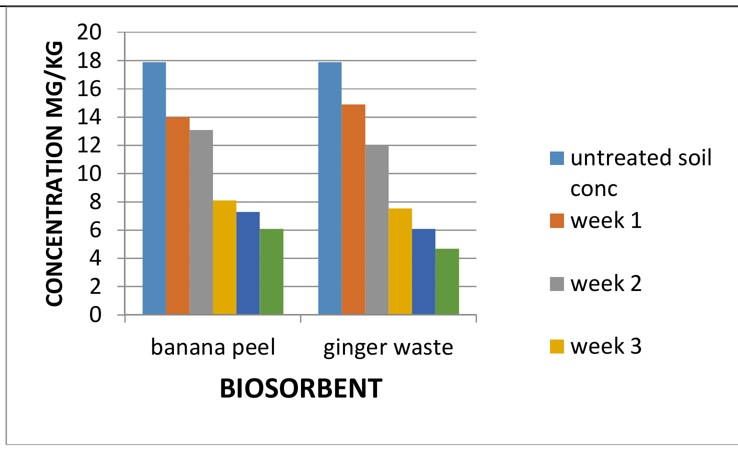
Table 3 showing the result of adsorption rate of the adsorbents on cadmium

Adsorbent	Untreated soil sample conc (mg/kg)	Week 1 Treated soil sample conc (mg/kg)	Week 2 Treated soil sample conc (mg/kg)	Week 3 Treated soil sample conc (mg/kg)	Week 4 Treated soil sample conc (mg/kg)	Week 5 Treated soil sample conc (mg/kg)
BANANA PEEL (50g)	<0.50	<0.10	<0.10	<0.10	<0.10	<0.10
GINGER WASTE (50g)	<0.50	<0.10	<0.10	<0.10	<0.10	<0.10

Table 3 shows the result of cadmium concentration which was constant at <0.10 (indicating that there is no significant level of cadmium concentration in the soil sample) for the five weeks for both banana peel (50g) and ginger waste (50g).

Table 4 showing the result of adsorption rate of the adsorbents on lead

Adsorbent	Untreated soil sample conc (mg/kg)	Week 1 Treated soil sample conc (mg/kg)	Week 2 Treated soil sample conc (mg/kg)	Week 3 Treated soil sample conc mg/kg	Week 4 Treated soil sample conc (mg/kg)	Week 5 Treated soil sample conc (mg/kg)
BANANA PEEL (50g)	17.90	14.00	13.10	8.10	7.30	6.09
GINGER WASTE (50g)	17.90	14.90	12.00	7.55	6.10	4.70



Lead Adsorption

Figure 2 Lead Adsorption

Table 4 illustrate the reduction of lead concentration from 17.90 to 14.00 for week one, 13.10 for week two, 8.10 for week three, 7.30 for week four and 6.09 for week five by banana peel (5g) while ginger waste (50g) reduced the concentration from 17.90 to 14.90 for week one, 12.00 for week two, 7.55 for week three, 6.10 for week four and 4.70 for week 5.

Table 5 showing the result of adsorption rate of the adsorbents on nickel

Adsorbent	Untreated soil sample conc	Week 1	Week 2	Week 3	Week 4	Week 5

	(mg/kg)	Treated soil sample conc (mg/kg)	Treated soil sample conc (mg/kg)	Treated soil sample conc (mg/kg)	Treated soil sample conc (mg/kg)	Treated soil sample conc (mg/kg)
BANANA PEEL (50g)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
GINGER WASTE (50g)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10

Table 5 shows the result of nickel concentration which was constant at <0.10 (indicating that there is no significant level of cadmium concentration in the soil sample) for the five weeks for both banana peel (50g) and ginger waste (50g).

Table 6 showing the result of adsorption rate of the adsorbents on zinc

Adsorbent	Untreated soil sample conc (mg/kg)	Week 1 Treated soil sample conc (mg/kg)	Week 2 Treated soil sample conc (mg/kg)	Week 3 Treated soil sample conc mg/kg	Week 4 Treated soil sample conc (mg/kg)	Week 5 Treated soil sample conc (mg/kg)
BANANA PEEL (100g)	16.55	10.05	9.02	5.0	1.10	<0.10
GINGER WASTE (100g)	16.55	10.65	7.50	2.75	<0.10	<0.10

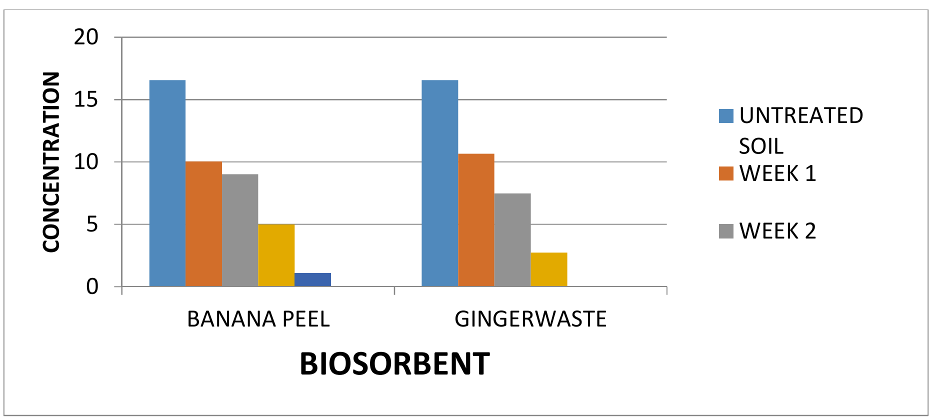


Figure 3 Zinc Adsorption

Table 6 illustrate the reduction of zinc concentration from 16.55 to 10.05 for week one, 9.02 for week two, 5.00 for week three, 1.10 for week four and <0.10 for week five by banana peel (100g) while ginger waste (100g) reduced the concentration from 16.55 to 10.65 for week one, 7.50 for week two, 2.75 for week three, <0.10 for week four and <0.10 for week 5.

Table 7 showing the result of adsorption rate of the adsorbents on chromium

Adsorbent	Untreated soil sample conc (mg/kg)	Week 1 Treated soil sample conc (mg/kg)	Week 2 Treated soil sample conc (mg/kg)	Week 3 Treated soil sample conc mg/kg	Week 4 Treated soil sample conc (mg/kg)	Week 5 Treated soil sample conc (mg/kg)
BANANA PEEL (100g)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
GINGER WASTE (100g)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10

Table 7 shows the result of chromium concentration which was constant at <0.10 (indicating that there is no significant level of chromium concentration in the soil sample) for the five weeks for both banana peel (100g) and ginger waste (100g).

Table 8 showing the result of adsorption rate of the adsorbents on cadmium

Adsorbent	Untreated soil sample conc (mg/kg)	Week 1 Treated soil sample conc (mg/kg)	Week 2 Treated soil sample conc (mg/kg)	Week 3 Treated soil sample conc (mg/kg)	Week 4 Treated soil sample conc (mg/kg)	Week 5 Treated soil sample conc (mg/kg)
BANANA PEEL (100g)	<0.50	<0.10	<0.10	<0.10	<0.10	<0.10
GINGER WASTE (100g)	<0.50	<0.10	<0.10	<0.10	<0.10	<0.10

Table 8 shows the result of cadmium concentration which was constant at <0.10 (indicating that there is no significant level of cadmium concentration in the soil sample) for the five weeks for both banana peel (100g) and ginger waste (100g).

Table 9 showing the result of adsorption rate of the adsorbents on lead

Adsorbent	Untreated soil sample conc (mg/kg)	Week 1 Treated soil sample conc (mg/kg)	Week 2 Treated soil sample conc (mg/kg)	Week 3 Treated soil sample conc (mg/kg)	Week 4 Treated soil sample conc (mg/kg)	Week 5 Treated soil sample conc (mg/kg)
BANANA PEEL (100g)	17.90	12.30	<0.10	<0.10	<0.10	<0.10
GINGER WASTE (100g)	17.90	15.05	<0.10	<0.10	<0.10	<0.10

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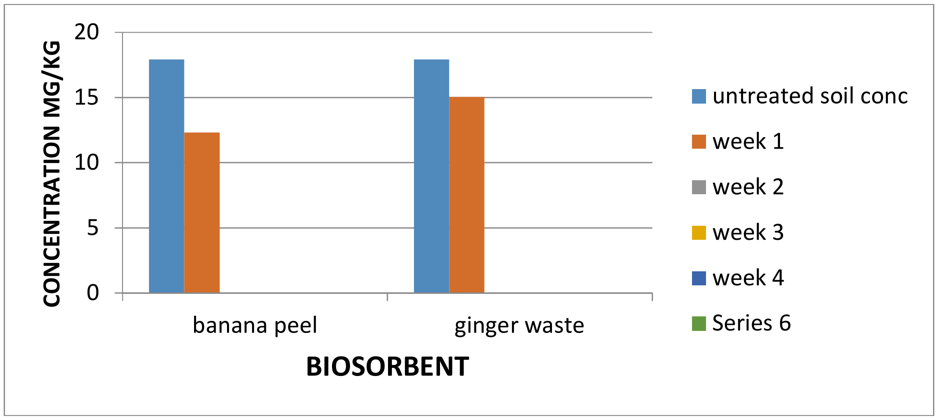

Figure 4 Lead Adsorption

Table 9 illustrate the reduction of lead concentration from 17.90 to 12.30 for week one, <0.10 for week two, <0.10 for week three, <0.10 for week four and <0.10 for week five by banana peel (100g) while ginger waste (100g) reduced the concentration from 17.90 to 15.05 for week one, <0.10 for week two, <0.10 for week three,<0.10 for week four and <0.10 for week 5.

Table 10 showing the result of adsorption rate of the adsorbents on nickel

Adsorbent	Untreated soil sample conc (mg/kg)	Week 1 Treated soil sample conc (mg/kg)	Week 2 Treated soil sample conc (mg/kg)	Week 3 Treated soil sample conc mg/kg	Week 4 Treated soil sample conc (mg/kg)	Week 5 Treated soil sample conc (mg/kg)
BANANA PEEL (100g)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
GINGER WASTE (100g)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10

Table 10 shows the result of nickel concentration which was constant at <0.10 (indicating that there is no significant level of cadmium concentration in the soil sample) for the five weeks for both banana peel (100g) and ginger waste (100g).

Comparative Discussion of Result for 50g and 100g of Biomass

ZINC

Comparing the result gotten for 50g of biomass and 100g of biomass, it show that adsorption of heavy metals is more efficient in 100g of banana peel and ginger waste than 50g 0f banana peels and ginger waste as the concentration of zinc was reduced from 16.55 to 7.25 for banana peel(50g) and the concentration of zinc was reduced from 16.55 to 8.10 for ginger waste (50g), while the concentration of zinc was reduced from 16.55 to <0.10 using banana peel (100g) for the five week and the concentration of zinc was reduced from 16.55 to <0.10 using ginger waste(100g) in five week.

LEAD

Comparing the result of gotten for 50g of biomass and 100g of biomass, it show that adsorption of heavy metals is more efficient in 100g of banana peel and ginger waste than 50g 0f banana peels and ginger waste as the concentration of lead was reduced from 17.90 to 6.09 for banana peel (50g) and the concentration of lead was reduced from 17.90 to 4.70 for ginger waste (50g), while the concentration of lead was reduced from 17.90 to <0.10 using banana peel (100g) in two week and the concentration of zinc was reduced from 17.90 to <0.10 using ginger waste (100g) in two week.

CHROMIUM
The concentration of chromium was constant at <0.10 mg/kg(indicating that there is no significant level of chromium) for both the banana peel (50g) and ginger waste (50g) for the five week. Also for 100g of the biomass the concentration of chromium was constant at <0.10 mg/kg (indicating that there is no significant level of chromium) for both the banana peel (100g) and ginger waste (100g) for the five week.

CADMIUM
The concentration of cadmium was constant at <0.10 mg/kg (indicating that there is no significant level of chromium) for both the banana peel (50g) and ginger waste (50g) for the five week.
Also for 100g of the biomass the concentration of cadmium was constant at <0.10 mg/kg (indicating that there is no significant level of chromium) for both the banana peel (100g) and ginger waste (100g) for the five week

NICKEL
The concentration of nickel was constant at <0.10 mg/kg (indicating that there is no significant level of chromium) for both the banana peel (50g) and ginger waste (50g) for the five week.
Also for 100g of the biomass the concentration of nickel was constant at <0.10 mg/kg (indicating that there is no significant level of chromium) for both the banana peel (100g) and ginger waste (100g) for the five week

CONCLUSION
The treatment of Crude oil polluted soil using agricultural waste such as Ginger waste and Banana Peels has been studied and found feasible for both 50g and 100g of the biomass Adsorption of each heavy metal varies with the nature of the adsorbents and the 100g of biomass was seen to more efficient in adsorbing the heavy metals.
Results from this study can be used to access the suitability of this agricultural waste as adsorbents for heavy metal removal (bioremediation) or reduction of concentration as a cheap alternative to the commercially available expensive activated carbon.

RECOMMENDATION
Efficiency can certainly be improved and more research is recommended in this area, Research on other agricultural waste using the same method can help in analyzing the effectiveness of the process. Adsorption capacity on concentration of heavy metals was examined with the different agricultural waste for five weeks. Although, there are various other parameters whose effect could be investigated and results analyzed to make an even better assessment if time permit.

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