THE pH LEVEL AND ALKALINE PHOSPHATE ACTIVITY IN CRUDE OIL CONTAMINATED SOIL BIOREMEDIATED WITH POULTRY MANURE AND SAWDUST

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ABSTRACT: *The analysis of soil pH level and alkaline phosphate activity in crude oil treated soil following remediation with poultry manure (PM) and sawdust (SD) were studied for four weeks using standard bioremediation techniques. The result showed a statistically significant increase in soil pH level after bioremediation (P>0.05) while the alkaline phosphatase activity in the soil increased upon crude oil contamination from 1.78±014IU/g to 1.89±0.114IU/g*($P > 0.05$)*. Treatment of crude oil contaminated soil with sawdust reduced alkaline phosphatese activities to (1.65±0.132IU/g on the same day 0 (P>0.05). statistical analysis show that only the sawdust decreased alkaline phosphatase activity significantly (P<0.05 during bioremediation. The results of this study suggest that a combination of poultry manure and sawdust in bioremediation of crude oil contaminated soil is a solution to the menace of oil spillage in Niger Delta areas of Nigeria.*

Keywords: Crude Oil Contaminated Soil, Bioremediation, pH, Alkaline Phosphatase, Sawdust, Poultry Manure.
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INTRODUCTION

Crude oil has been a major contaminant of soil and water in oil producing communities the world over during exploration and transportation and its spillage has caused critical environmental and health hazards. Crude oil spills from pipelines and refineries leads to oil pollution which causes damage to the environment (Ogbo and Okhuoya, 2008). Oil pollution is a major environmental concern in many countries and this has led to a concerted effort in studying the feasibility of using oil degrading bacteria for bioremediation (Akoachere *et al.,* 2008) increasing attention has been paid to developing and implementing innovative technology for cleaning up such contaminations. Bioremediation is any process that uses microorganisms, fungi, green plants or their enzymes to return to the environment altered by contaminants to its original or close to its original condition before contamination. The addition of organic waste materials such

as poultry manure, sawdust, and dry leaves to the soil, facilitates aeration and increases the water holding capacity of the soil, thus enhancing bioremediation. Bioremediation is an economical and safe method for cleaning up of oil spills. Bioremediation of crude oil polluted soil is becoming increasingly important as most exploration and distribution of crude oil are usually environmentally non friendly (Odokuma and Dickson, 2003).

The soil is a key component of natural soil ecosystem because environmental sustainability depends largely on a sustainable soil ecosystem (Adraina *et al.,* 1998). Agricultural practices that reduce soil degradation and improve agricultural sustainability are needed for tropical and sub tropical soils. Elcio *et al.,* (2004), observed that there is correlation of soil enzyme activity with total organic carbon, carbon and nitrogen biomass. Soil enzymes (amylase, acid and alkaline phosphatases, cellulases, and arylsulfatases, among others) regulate ecosystem functioning and in particular, play a key role in nutrient cycling. They catalyses certain important reactions necessary for the live processes of microorganisms in soil and stabilization of soil structure (Makoi and Ndakidem 2008). Soil enzymatic activity which can be determined quiet promptly and precisely is a reliable indicator reflecting the current biological state of the soil (Wyszkowska *et al,* 2002) according to Achuba (2006), crude oil induced changes in the activities of starch degrading enzymes. Margesin and Schinner (2001) investigated the feasibility of bioremediation as a treatment option for a chronically diesel oil polluted soil in an alpine glacier area at an attitude of 2875m above sea level and observed that there was a significant reduction in the diesel oil after remediation thereby reducing the level of contamination. Measuring the successes of bioremediation of oil spills is based on several parameters. This includes the degradation of aromatic hydrocarbon (PAHs) in the crude oil (Igwo – Ezikpe 2006). The measurement of soil enzyme activities before, during contamination and after bioremediation is used to determine the success of bioremediation (Wyszkowska and Wyszkowski 2006).

This study, investigates the pH level and alkaline phosphatase activities of crude oil contaminated soil remediated with poultry manure and sawdust.

MATERIALS AND METHODS

Materials: Soil sample were collected from a farmland in Abraka, the sawdust (SD) was collected from a saw mill in Abraka. The poultry manure (PM), from a poultry farm in Federal Government College, Warri while the crude oil was collected from Shell Petroleum Development

Company (SPDC) Warri. Other materials and apparatus used in this study included, test tubes, test tubes rack, measuring cylinder, conical flasks, beakers, universal bottles, pH meter, spectrophotometer, laboratory coats, spatula, weighting balance, electronic digital weighting balance, micropipette, filter paper, cotton wool, masking tape and plastic bowls.

Methods: 7.3% (v/w) crude oil was added to the treated soil while the control soil had 7.3% (v/w) crude oil. 22% (v/w) of sawdust was added to one sample while 22% (v/w) of poultry manure was added to the other. The last experimental set up had the combination of sawdust and poultry manure of 7.3% and 11.1% (v/w), respectively.

For the control sample, 10g of soil was measured into a measuring cylinder and made up to 100ml with sterile deionized water. Content was mixed and the constituent solution was filtered using Whatman No. 1 filter paper and the filtrate was kept for further analysis. The measurement of enzyme activity and the pH level were done using the filtrate solution alkaline phosphatase was determined by the method of Kochmar and Moss (1976), while the pH was measured using Extech pH meter.

STATISTICAL ANLYSIS

The results were expressed as mean $\pm SD$. The one way analysis of variance (ANOVA) was used for the evaluation of statistical significance.

RESULTS

Upon contamination of soil with crude oil contaminated soil (COTS) increased then compared with control soil (NC) (Table 1). Bioremediation with sawdust and poultry manure decreased the pH when compared with crude oil treated soil and normal (control) soil. Thereafter, the pH 7.15 ± 0.143 after twenty eight (28) days of treatment of the four (4) crude oil contaminated soil ($p < 0.05$) (Table 1).

The result from Table 2 shows that upon crude oil contamination, alkaline phosphatase activity in the soil increased. However, with bioremediation, the alkaline phosphatase activity decreased significantly ($p < 0.05$) on day 14, when the treatment of sawdust and poultry manure were combined, when compared with crude oil treated soil.

Table 1: The pH Levels of Crude Oil Contaminated Soil Treated with Poultry Manure and Sawdust

Samples	Day 0 ($mean \pm sd$)	Day 14 ($mean \pm sd$)	Day 28 ($mean \pm sd$)

Normal Control Soil	$6.64 \pm 0.123b$	$6.40 \pm 122b$	$6.37 \pm 0.123b$
Crude Oil Treated Soil (COTS)	$7.76 \pm 0.142a$	$6.75 \pm 0.134b$	$6.70 \pm 0.144b$
COTS + Sawdust (SD)	$6.37 \pm 0.122b$	$6.59 \pm 0.125b$	$7.07 \pm 0.142a$
COTS + Poultry Manure (PM)	$6.56 \pm 0.125b$	$6.84 \pm 0.128b$	$6.94 \pm 0.132b$
COTS + PM + SD	$6.45 \pm 0.122b$	$6.90 \pm 0.127b$	$7.15 \pm 0.143a$

Table 2: Alkaline Phosphatase Activities of Crude Oil Contaminated Soil Treated with Poultry Manure and Sawdust

Samples	Day 0 $(mean \pm sd)$	Day 14 $(mean \pm sd)$	Day 28 $(mean \pm sd)$
Normal Control Soil	$1.78 \pm .143a$	$1.71 \pm 0.143a$	$1.71 \pm 0.132a$
Crude Oil Treated Soil (COTS)	$1.89 \pm 0.144a$	$1.88 \pm 0.132a$	$1.98 \pm 0.135a$
COTS + Sawdust (SD)	$1.54 \pm 0.133b$	$1.54 \pm 0.133b$	$1.54 \pm 0.135b$
COTS + Poultry Manure (PM)	$1.65 \pm 0.133a$	$1.75 \pm 0.133a$	$1.81 \pm 0.144a$
COTS + PM + SD	$1.42 \pm 0.125b$	$1.54 \pm 0.125b$	$1.64 \pm 0.142a$

DISCUSSION

Crude oil spills from pipelines and refineries cause damage to the environment. The contamination changes the physicochemical and biological properties of the soil, as the oil is toxic to some microorganisms and plants (Ogbo and Okhuoya, 2008). Pollution of the natural environment has been observed to have adverse effects on the soil. In other to ameliorate these effects on the soil, the concept of bioremediation was initiated. Akonye and Onwudiwe (2004) reported that, the addition of organic materials such as sawdust as well as dry grass helped in the remediation process of the soil. Adedodun and Ataga (2007) also reported that, for efficient bioremediation, soil amendments or additives such as sawdust, peat, waste cotton manure, fertilizers could be added to increase activities of microorganisms. Wyszkowska *et al,* (2002) stated that, the activity of alkaline phosphatase was dependent on the experimental series and degree of soil contamination with diesel oil. The results from this investigation show that upon contamination of the soil there was an increase in the pH level($p < 0.05$). This finding is in agreement with Adenipekun (2008), who observed that contamination of soil with crude oil increased pH level. The result also shows that when the soil was remediated with poultry manure and sawdust the contaminated soil regained its original status; the level of alkaline phosphatase activity in the soil increased phosphates activity (Table 2). This increase in phosphates activity may be due to the ability of the sawdust present in poultry manure to absorb the oil films thereby reducing acid radicals released into the soil; thus, reducing the toxicity effect of the contaminant. This result may be adduced to the fact that increase in phosphorus activity is due to the addition of poultry manure (PM), which mobilizes microorganism that secretes phosphates,

to hydrolyse phosphorus. These findings are in agreement with Wyszdowska and Wyszdowski (2006), who stated that diesel oil stimulate the activity of dehydrogenises ureases, alkaline phosphatase as well as nitrification, but inhibited the activity of acid phosphatase.

CONCLUSION

This present research has shown that pH level of soil increased upon oil contamination. This is expected since crude oil is alkaline in nature. However, crude oil contamination of soil over a long time may lead to a drop in pH due to the release of hydrogen ions in the soil which will thus lead to soil toxicity. Such environment if bioremediated with poultry manure will return such soil close or back to its original status before contamination took place. Alkaline phosphatase activity was increased upon oil contamination. Treatment of such soil with sawdust helped in reducing the alkaline phosphatase activity. The results of this study clearly showed that a combination of poultry manure and sawdust can be used as a good bioremediation material on a crude oil contaminated soil.

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