



International Conference on Sustainable Materials Processing and Manufacturing, SMPM 2017,
23-25 January 2017, Kruger National Park

Bioremediation of Crude Oil Contaminated Soil Using Agricultural Wastes

F.V Adams*, A. Niyomugabo, O.P. Sylvester

Department of Petroleum Chemistry, American University of Nigeria, Yola, 640001, Nigeria

Abstract

Identification of total petroleum hydrocarbons and trace of heavy metals, namely; zinc (Zn), cadmium (Cd), and cobalt (Co) in crude oil contaminated soil and effect of rice husk and chicken manure in bioremediation of contaminated soil were studied. Five soil samples each weighing 0.5 kg was collected. Each sample was mixed with 50ml of crude oil (at 100ml/kg). Four samples were treated by adding 20 g of chicken manure (CM), 20 g rice husk (RH), 3:1 of 20 g chicken manure/rice husk (CR_3:1) and 3:1 of 20 g rice husk/chicken manure (RC_3:1). respectively while the fifth sample was left untreated (SO). Total petroleum hydrocarbon and trace of heavy metals were determined before treatment and after 6 weeks of treatment using Gas Chromatograph-Mass Spectrometer and Atomic Absorption Spectrometer, respectively. Infrared Spectrometer was used to monitor a weekly change in functional group absorbance of petroleum hydrocarbons. The results indicated that rice husk ultimately removed more petroleum hydrocarbons compared to chicken manure and their combinations. It was also found that the combination of rice husk and chicken manure (RC_3:1) reduced 75.8% of Co concentration, CR_3:1 reduced 89.6% of Zn concentration while CM reduced 65.5% of Cd concentration.

© 2017 Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Peer-review under responsibility of the organizing committee of SMPM 2017

Keywords: Agricultural waste, bioremediation, heavy metals, hydrocarbons, pollution, soil

1. Introduction

Bioremediation is the treatment of contaminated environment by using biological mechanisms. The treatment of contaminated soil is a key point in restoring affected human being, fauna and flora in the ecosystem. Environmental

* Corresponding author. Tel.: +234 802 802 4519
E-mail address: feyikayo@gmail.com

pollution has been discovered to be a major challenge to the development of the society [1]. One of the major environmental pollution is caused by oil spillage due to the exploration and exploitation of crude oil. Crude oil and its hydrocarbon by-products could also be discharged into the environment as a result of accidents that occur during shipping, offshore/onshore exploration /production, and transportation of oil in pipelines [2]. These contaminants affect the chemical composition and physical matrix of soils culminating to the loss of soil fertility, change in ecosystem and displacement of communities [2,3].

Bioremediation deals with biological treatment and recovery of contaminated sites during cleanup process. It helps in degradation, alteration, removal and de-pollution of chemicals from nature by mean of microorganisms, plants or fungi [4]. During biodegradation, organic matters are broken down into small molecule under microorganism activities [5]. Bio-stimulation deals with the modification of the environment by introducing special nutrients, such as nitrogen and phosphorus, oxygen and other electron acceptors to increase rate of contaminant degradations under indigenous bacteria [6]. Applying fertilizers such as NPK in contaminated media have shown improvement in degradation rate of contaminants in the soil [7]. Benefits of chicken manures in soil remedies include a good soil alteration, adding organic matter, increase of the water holding capacity and advantageous biota [8]. The use of rice husks for the removal of dyes, heavy metals and some other chemicals has been studied. Their application to absorb lead, copper, cadmium [9,10] and mercury [11] has also been reported. This work focuses on the use of agricultural waste for the treatment of crude oil contaminated soils.

2. Materials and Methods

2.1. Materials

Sieve cups of 1 mm size were used to control the soil texture, five plastic plates were used as simulation environment, electronic weighing balance was used in checking weight of soil samples, and pH paper was used to measure the acidity level of soil. Bonny light crude oil was used to create oil spillage simulation on soil while 180 ml of acetone was used as solvent to extract oil from soil during mechanical shaking extraction method. Other apparatus and equipment used were conical flasks and beakers, GC-MS, IR Spectroscopy and AA Spectroscope.

2.2 Soil preparation

Approximately 500 g of soil was weigh into different bowls, contaminated with about 50 ml of crude oil in ratio 10:1 w/v. The plates were labeled as RH (rice husk), CM (chicken manure), RC_3:1(rice husk and chicken manure in ratio of 3:1), CR_3:1(chicken manure and rice husks in ratio of 3:1), SO (soil_crude oil mixture). The pH and humidity was controlled with the former kept at 6.5 – 8.5 so as to maintain a favorable condition for the growth of microorganisms using calcium hydroxide solution.

2.3 Extraction using mechanical shaking method

Mechanical shaking is considered as effective and rapid soil solvent extraction method. During mechanical shaking, 3g of each soil sample was put in conical flask and mixed with 20 ml of acetone and covered with aluminium foil paper to prevent loss of solvent. The mixtures were shaken for 30 min, and then filtered using paper filters. The filtrates were analyzed using IR Spectrometer, GC/MS and AA Spectroscope to check total petroleum hydrocarbon decrease over time, initial and final hydrocarbon content and trace of heavy metals, respectively.

2.4 Sample digestion in nitric acid for heavy metals analysis

Digestion of extracts was a major part of heavy metals analysis due to the fact that heavy metals form complex compounds which prevent availability of the metals in their free form. The digestion of sample destroys the carbon-based matters, removes intrusive ions and release free metal compounds in solution [12]. Sample digestion was done by putting 1ml of each extract into 20ml of 1M HNO₃, and heated to evaporate to 10ml. 100ml of distilled water was then added and solution stirred. The solution was cool at room temperature and kept for trace of heavy metals assessment. Standard solutions of 1ppm, 3ppm and 5 ppm of Co, Cd and Zn, respectively, were prepared from their stock solution for AA Spectrometer calibration. Percentage removal was calculated using equation 1.

Download English Version:

<https://daneshyari.com/en/article/5129194>

Download Persian Version:

<https://daneshyari.com/article/5129194>

[Daneshyari.com](https://daneshyari.com)