Chapter 20
Application of Soil Washing Treatment Method for the Remediation of Petroleum Polluted Soil

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ABSTRACT

The increasing contamination of soil by petroleum products has been a great source of concern to our society because of its negative consequences on the environment. Thus, several remediation technologies and trials have been propounded for a crude oil-polluted environment. This chapter reviews the dynamics of pollutants in the soil and the various treatment technologies for petroleum-polluted soils viz physico-chemical, thermal, and biological treatment methods. Authors experimented on soil washing using detergent for the remediation of petroleum contaminated soils considering different concentrations. The percentage removal of aliphatic and Polycyclic Aromatic Hydrocarbons (PAHs) was determined using Gas Chromatography Mass Spectrometry (GC-MS). The highest percentage removal efficiencies of 97.55% and 61.41% for aliphatic and Polycyclic Aromatic Hydrocarbons were obtained at detergent concentration of 20w/v% respectively.

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INTRODUCTION

Soil which is the essential basis of agricultural resources, food security, global economy and environmental quality is now continuously being polluted by heavy metals, organic pollutant and petroleum products due to urbanization and industrialisation (Kokyo *et al.*, 2014). Thus environmental pollution, according to Dike *et al*., (2013), has become a significant global issue and the accumulation of these contaminants over time poses severe threat to both plants and animals. Accidental and deliberate spillage of crude oil and other petroleum products into the environment is a significant source of environmental contamination due the resultant air, water and soil pollution around the affected areas (Trindade *et al*., 2005). This situation became worse in Nigeria with the incessant vandalism of oil pipelines by militants and oil bunkering. On terrestrial ecosystem, crude oil contamination affects soil chemical properties such as electrical conductivity, mineral and organic matter content; cation exchange capacity and pH (Tanee and Jude, 2017).

Remediation of petroleum polluted site is defined as the management of the contaminated area to prevent imminent danger to human health or the environment and restoring all or portion of the area to a beneficial goal (Dike *et al*., 2013). The different remediation methods are isolation and containment, mechanical separation, pyro-metallurgical separation, permeable treatment wall, soil flushing, molecular and phase separation, chemical destruction, soil washing, vapor extraction, electro kinetics and biodegradation. Although, some besides being more expensive and difficult to apply, have been reported to cause more harm to the environment than the pollutant. So the need for research into the use of simple, economical, environmentally friendly and efficient technology for the remediation of crude oil contaminated site has become imperative (Tanee and Jude, 2017).

Chemical remediation involves the use of substances such as detergent/ degreasers. Detergent contains some active ingredients such as surfactant, sodium, chlorine and bleach which emulsify and weaken the hydrocarbon chains and thus, provide a good surface area for biodegradation (Couto *et al*., 2010). This chapter therefore reviews the various petroleum contaminated soil remediation techniques and presents a case study on the determination of the effectiveness detergent for the remediation of petroleum contaminated soils.

DYNAMICS OF POLLUTANTS IN THE SOIL

Presently, the geosphere is seen as fragile and prone to damages emanating from anthropogenic activities (Raphael *et al.*, 2013). Manahan (2001) defined pollution as an increase in the quantity of a particular element above the levels in which they naturally occur, resulting from external source related to human actions. Xenobiotic behaviour in the soil is of great difficulty to predict, because its composition is completely complex and heterogeneous. Hence, the understanding of the physico-chemical properties of the contaminant compounds and the environment is fundamental to predict its dynamics.

Contaminant spread in the soil in vaporised, residual or absorbed phases, free phase and dissolved phase. The distribution of such phases will depend on their physico-chemical properties and also on the soil type. Hence, the movement of the contaminants and their toxic nature are linked to the soil's capacity in maintaining them while retained in their solid phase, making them not available to be absorbed by plants, eroded or leached (McBride, 1994). Soil particles (m^2/g) have available surface area due to some of the factors that influence binding between the contaminant and the soil. Also, the adsorption