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EFFECTS OF CRUDE OIL ON GEOTECHNICAL CHARACTERISTICS OF SOIL

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ABSTRACT

Soil contamination by crude oil causes huge damage to the environment. But crude oil contamination does not damage the soil permanently though it has some adverse effects on the crops and other vegetation. When soil gets contaminated with crude oil, the hydrocarbons present in it will infiltrate into the soil through pore spaces and gets collected at the top of the ground level. This contamination is said to alter the geotechnical properties of soil. Therefore lab tests have been conducted on both contaminated and uncontaminated samples taken from different areas. On testing, it seems to have an increase in Atterberg limits, specific gravity and a decrease in MDD, OMC and shear strength.

Key words: Soil contamination, Crude oil , Geotechnical properties

1. INTRODUCTION

Oil contamination of soil has been common nowadays due to mechanic workshops. On contamination , it is found to have drastic changes in engineering properties of soil. This type of contamination does not support the construction of engineering structures. Crude oil contamination increases the pH of the upto8 and reduces the available phosphorous concentration in the soil. Also it affects the soil fertility and physical properties of the soil. Normally the effects of crude oil on soil depends on size, quantity and grade of oil spilled. It also decreases the porosity of the soil. This is mainly because the oil has the sticking property which tends the soil particles to stick together. Additionally crude oil forms a coat covering the soil organisms. Persistence of oil in the soil depends on the amount of oil spilled, climatic conditions etc., Therefore crude oil contamination seems to be a harmful factor in affecting the geotechnical properties of the soil.

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2. EFFECT OF SOIL CONTAMINATION BY OIL ON GEOTECHNICAL PROPERTIES OF SOIL

2.1 Angle of internal friction

Sanad et al., has studied the geotechnical properties of oil contaminated Kuwaiti sand and observed that the angle of internal friction generally decreases with oil contamination. This reduction is noticeable at all relative densities from loose sand to dense sand conditions.

Kermani et al., has studied the influence of oil contamination on clay and noticed that there was an increase in internal friction angle and decrease in cohesion. On the other hand, since cohesion is the principal factor in slope stability, trenches made in the contaminated soil will be less stable.

2.2Max dry density

Bignell at al., found that the maximum dry density for well graded sandy soils increased as oil content increased up to a particular values, then followed a decreasing trend beyond that particular oil percentage.

Rehman et al., found that the moisture content required to achieve maximum dry density decreased when oil content increased in contaminated soil. The researchers found that this variation was due to a fact that the oil has partially occupied the inter-particles spaces and the occurrence of oil has changed the soil to a state of looser material than an uncontaminated soil.

2.3 Atterberg limits

Rahman et al., found that the presence of oil has decreased the moisture content of the liquid and plastic limits of the contaminated soils. Oil would make earlier contact with clay particles therefore causing a removal of interaction between water and clay particles.

Shah et al., showed that the contaminated soils increased the liquid and plastic limits and decreased the plastic index as compared to uncontaminated CL soils.

Kermani et al., observed the plastic limits on lean clay and observed that as the oil content increases, the liquid limits increase with a light slope, and plastic index consequently decreases. Because crude oil covers clay particles and does not permit water molecules to reach the double-layer water, more water is needed for the soil to obtain plastic properties. This might be a reason for an increase in plastic limit.

2.4 Permeability

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Rahman et al., observed that the permeability of weathered basaltic soil was reduced as oil content increased. The decrease in permeability of the contaminated soils was likely associated with the clogging of some inter-particles spaces by oil.

Chang et al., observed that oil occupies some pore space, it is expected that the permeability will decrease with increasing the oil content.

Akinwumi et al., observed that when the crude oil content increased, the permeability of the contaminated soil decreased. Crude oil is entrapped in the pore spaces that forms the pathway for water within the contaminated soil and consequently, reduced the pore sizes. The decrease in the permeability of the contaminated soil is attributed to the reduction in the pore space.

2.5 Optimum moisture Content

Akinwumi et al., noticed that the OMC decreased as the crude oil content in the soil increased. Crude oil is hydrophobic and as it coats itself around individual clay particles, it disallows free water (water other than the adsorbed water) from interacting with the clay particles. This might be accountable for the reduction in the amount of water needed by the soil to reach its maximum unit

Kermani et al., observed that lean clay has an improvement incompaction characteristics can be attributed to thelubricating effects of the oil, which is due to the oil coating onthe individual clay particles and the clay groups.

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