Behavior of Oil Contaminated CL Soil

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Abstract: In this study, the geotechnical behavior of used engine oil-contaminated soils, simulating oil spills was investigated. The testing program included Atterberg limit, compaction using (Harvard Miniature), unconfined compressive strength and total soil suction. Soil samples were artificially contaminated up to 7% used engine oil of the dry weight of soil, Also total suction in contaminated and uncontaminated soil samples by the filter paper and chilled-mirror hygrometer technique were measured. The results showed that the used engine oil contamination decreased the liquid limit and plastic limit of the CL soil. Also oil-contaminated soils indicated a lower maximum dry density and optimum water content compared to uncontaminated soil. The unconfined compressive strength; (q_u) was affected by the increase in oil content in contaminated soils. Soil suction decreased with increasing amount of oil.

1.Introduction

There are several potential sources of oil leakage to surrounding ecosystem through damaged pipeline, tanker accidents, discharges from coastal facilities, offshore petroleum production and natural seepage. Improper management of used engine oil and illegal dumping of other hydrocarbon components could also contaminate the soil. *(Rahman, Z., 2010).*Oil spillage or leakage will contaminate the soil and water system. Oil contamination of the soil could alter the physical properties of oil-contaminated soil.

Soil Suction: The theory of soil suction and the methods used measure it are well documented. The measurement of suction can be obtained by direct and indirect measurement in which the filter paper serves as a sensor. The basic principle of the method is that a filter paper, after an equilibrium period, exchanges moisture with the soil at a specific soil suction .This occurs because the relative humidity inside the soil specimen is controlled by the soil-water content and suction, in the chilled-mirror hygrometer technique, the dew point of the vapor space in the soil pores is measured using a mirror that can detect the condensation of water vapor at its first appearance. An internal infrared thermometer was utilized to measure temperature.

2.Objectives

The objective of this study was to investigate the effect of used engine oil on the geotechnical properties of a CL soil.

3.Materials and Methods:

ASTM methods were used to characterize the soil. Harvard Miniature method was used to compact the soil. Soil was contaminated by adding up to 7% (based on total soil weight) of oil.

4.Analysis and Discussion:

The soil selected for this study had a liquid limit (LL) and plastic limit (PL) of 39 and 22.5% respectively. It was classified as CL soil with 25% clay and 28% silt. The specific gravity = 2.7.Addition of oil reduce the liquid limit and plastic limit of CL soil .Addition of 7% oil reduced the LL by 59% and PL by 78% and O.M.C by 64% (Fig.1). The unconfined compressive strength (q_u) of CL soil was 98 psi and was reduced to 14 psi at oil content of 7% (Fig.3).The uncontaminated soil suction was 5.2pF, it decreased by 58% at oil content of 7% (Fig.4).

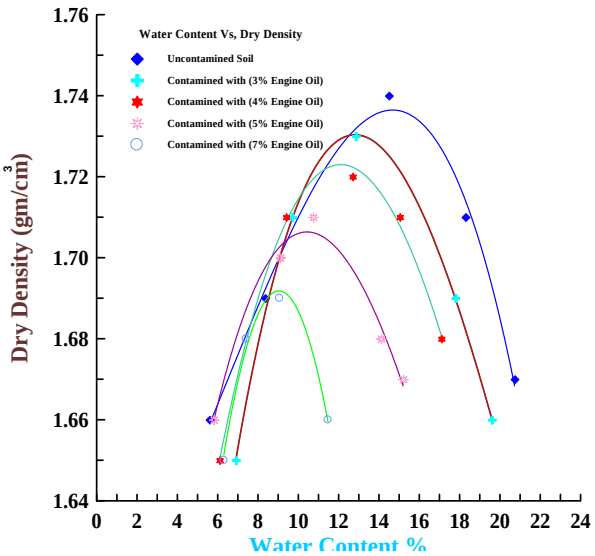

Fig.1 Compaction Curves for Uncontaminated and Contaminated Soil

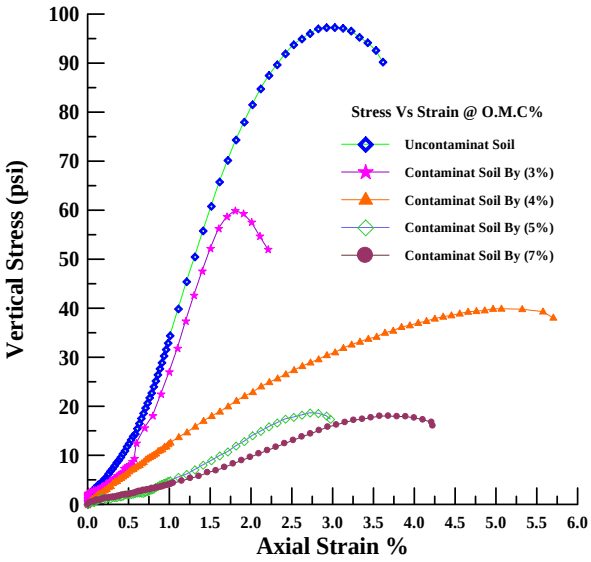

Fig.2 Stress – Strain Curves for Uncontaminated and Contaminated Soil

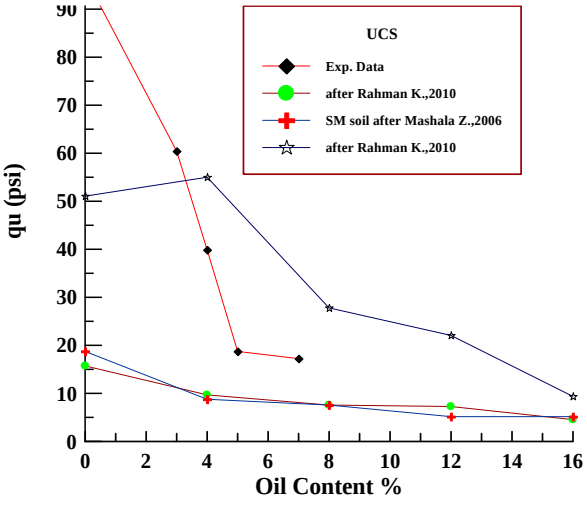

Fig. 3 Influence of Used Engine Oil on Unaixial Compressive Strength q_u

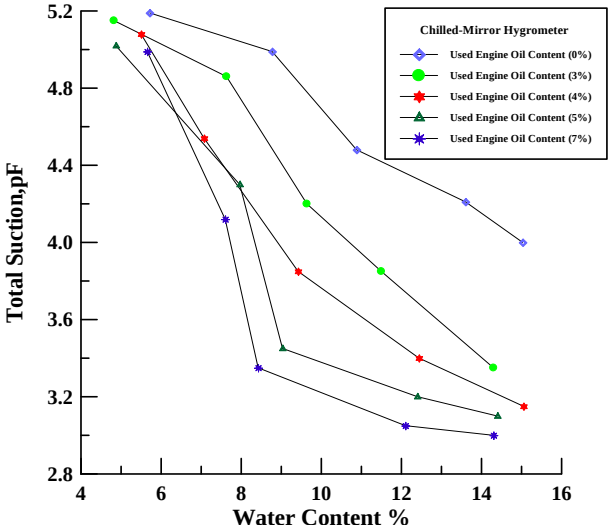

Fig. 4 Soil Water Characteristic Curve by Chilled-Mirror Hygrometer Method

5.Conclusion:

Maximum dry density and optimum moisture content decreased with increasing of oil contents. The unconfined compressive strength decreased with an increased oil content. The soil suction also decreased with increased oil content. Addition of 7% oil reduced the LL by 59% and PL by 78%.

6.References

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