

Effects of Gasoline Contamination on Geotechnical Properties of Silty Soils

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ABSTRACT

The environment is faced with various pollutions. Pollution with oil and oil derivatives such as gasoline and diesel is one of the most dangerous environmental aspects. Organic chemical materials are the basis of many industries such as fuel refining, petrochemical complexes, pesticides and detergents. Inappropriate use of organic chemical materials can cause irreparable damage to the environment that has caused increasing concern in different countries. In addition to the harmful environmental effects such as groundwater and seawater pollution, it causes changes in the geotechnical properties of the soil, which manifests itself in cohesive soils with changes in the texture and overall structure of the soil. In this research, the laboratory investigation of the geotechnical properties of silty soil contaminated with different percentages of gasoline (5, 10, 15%) by performing the Atterberg limit tests (the liquid limit and the plastic limit), uniaxial compression strength, direct shear and compaction tests were carried out. The obtained results show that 27% decrease in the liquid limit and 48% decrease in the plastic limit with an increase in the amount of soil pollution with gasoline. Also decreasing trend is observed in the shear strength parameters of silty soil polluted with different percentages of gasoline. The results of both direct shear and uniaxial compression strength tests demonstrate decreasing in the shear strength of polluted soil with the same trend.

KEYWORDS

Oil pollution, gasoline, geotechnical parameters, silty soils.

1. Introduction

The study of the effect of soil contamination on base oil has been carried out by various researchers since 1992. In these researches, soil with different weight

percentages (ratio of oil weight to dry soil weight) mixed with oil after a period of one week to one month has been tested. Different types of granular and clay soils, pollution and oils with different characteristics (including viscosity and specific gravity) and different parameters have been tested. In 2007 Khamechian et al. [1] conducted experimental research to investigate the effects of base oil pollution on clay and sandy soils. The samples for this joint experiment were taken from 14 sampling stations through the beaches at depths of 0-10, 10-20 and 20-30 cm. Sieve analysis was done on soil samples. In 2018 Safahian et al. [2] performed experimental tests on illite clay that was polluted with different amounts of gasoline (0-20% by dry soil weight). Ashraf Nazir in 2011 [3] by investigating the effects of motor oil on the geotechnical properties of consolidated clay concluded that oil pollution causes a significant reduction in the unconfined compression stress of the soil, which has a reduction of about 38% compared to the natural value of the soil. Also, it showed a significant decrease in both liquid and plastic limits, which continues with the increase of the oil contamination period up to about 3 months, and after that, they remain constant.

2. Methodology

In this research a vast laboratory tests are conducted on the ML soil (silty soil with low plasticity). Different plastic limit tests, limit tests, direct shear tests, uniaxial compression tests and also compaction tests are performed on the base soil and the polluted soil with gasoline. The obtained experimental results are compared with the base soil obtained results. In this research 5, 10 and also 15 percent gasoline contents are added to the base ML soil in order to comparison the effect of the gasoline and also its content effect on the geotechnical soil parameters. The considered geotechnical soil parameters in this experimental research are LL (Liquid limit), PL (plastic limit), unconfined compression strength and direct shear test results that demonstrate the internal soil friction angle and also the cohesion.

3. Discussion and Results

By increasing the amount of pollutant up to 15%, 27% decrease in the liquid limit of the soil and 48% decrease in the plastic limit is observed. In the other word, obtained results show that increasing the gasoline,

decreases the LL and PL of the base soil. The obtained experimental results show that gasoline decreases the cohesion and the internal soil friction angle of the base soil. This matter is related to the lubrication effect of the gasoline in the middle of the soil particles. This lubrication effect decreases the shear strength of the ML soil mixture with gasoline. This reduction in the shear strength of the ML soil is related to the reduction of its internal soil friction angle and cohesion parameters. It is obvious that gasoline content in the ML soil decreases the uniaxial strength of the polluted ML soil with the gasoline. The gasoline between the soil particles decreases the compression strength of the soil due to its lubrication effect. In figure 1, an example of uniaxial compression strength of the ML soil polluted with gasoline is presented.



Figure 1. An example of a uniaxial compression strength test

4. Conclusion

The obtained results in this experimental laboratory research show that increasing gasoline to the ML soil decreases the shear strength of the polluted ML soil. Gasoline also decreases the uniaxial compression strength of the polluted ML soil. This material also decreases the LL and PL of the ML soil that is mixed with gasoline. The main reason for decrease in strength parameters of the soil is related to the lubrication effect of the gasoline that is mixed with the ML soil.

5. References

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