

Strength Characteristics of Diesel Oil Contaminated Marine Clay

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Abstract - Oil Pollution is the resultant contamination of environment due to the presence of oil in excessive quantity. Oil contamination is a genuine danger to our environment and biological community and should be controlled with urgency. The oil contamination influences the geotechnical properties of soil. So it's a need to study the effect of diesel oil on geotechnical properties of soils. In this study, the variation of geotechnical properties like Atterberg limits, compaction characteristics, and unconfined compressive strength with the addition of diesel oil in marine clay was considered. The results showed that increase in the amount of diesel oil decreases the Atterberg limits, compaction characteristics and unconfined compressive strength. Increasing diesel oil content will lead to decrease in strength and settlement.

Key Words : Oil pollution, geotechnical properties, Atterberg limits, compaction characteristics, unconfined compressive strength, diesel oil.

1. INTRODUCTION

Every kind of pollution is harmful to nature. Oil does not break up in water and hence oil normally floats on the surface of water. Oil Pollution is the resultant contamination of environment due to the presence of oil in unreasonable amount. Oil pollution is most common in expansive water bodies like oceans and seas. Oil spills include any spill of raw petroleum or oil refined items e.g., gasoline, diesel fuels, jet fuels, kerosene, hydraulic oils, lubricating oils that can contaminate the surface of the land, air, and water environments. Oil spills occur due to the release of a liquid petroleum hydrocarbon into the environment particularly the marine ecosystem. Marine water is particularly influenced by this type of contamination. Oil contamination is basically a man-made contamination and is a result of human reckless exercises. Ships and tankers conveying crude oil over the oceans may cause deadly oil spills in marine water due to different causes, leakage being the most widely recognized one. The amount of oil spills matter when it comes to the significance of oil and water pollution. During marine accidents, the oil spills amount is enormous. Oil contamination is a serious risk to our environment and ecosystem and should be controlled with urgency.

2. MATERIALS

In this study the soil was artificially contaminated with diesel oil and variations in geotechnical properties was studied.

2.1 Soil

The study was conducted on Marine clay, collected from near Bolgatty, Cochin and it was high plastic clay. The geotechnical properties of marine clay are given in table 1.



Fig- 1: Marine Clay

Table -1: Properties of Marine Clay

Properties	values
Specific gravity	2.5
Permeability(m/s)	1.7x10 ⁻⁹
Liquid Limit (%)	73.4
Plastic Limit (%)	32.6
Shrinkage Limit (%)	40.8
Unconfined compressive strength (kN/m ²)	62.68
Optimum moisture content (%)	32.6
Maximum dry density(g/cc)	1.53
Clay (%)	50
Silt (%)	38
Sand (%)	12
pH	7.7
IS classification	CH
Natural moisture content (%)	55.2

2.2 Diesel oil

The diesel oil was taken from a petrol pump in Trivandrum. Diesel oil used has light brown color.



Fig -2: Diesel oil (Google Images)

Table -2: Properties of diesel oil

Specific gravity	Viscosity	API gravity	Pour point (°C)
0.86	20.52	32.75	-18

3. METHODOLOGY

The study was conducted to determine the effects of diesel oil on Marine clay, high plastic clay. For this the contaminants are mixed in various proportions and the variations in geotechnical properties like liquid limit, plastic limit, compaction characteristics and unconfined compressive strength are analyzed. The contaminants are mixed in 4%, 8%, 12% and 16% by weight of the dry soil samples.

Table - 3: Variation of Geotechnical Properties

Diesel oil (%)	LL (%)	PL (%)	MDD (g/cc)	OMC (%)	UCS (kN/m ²)
0	73.4	35.8	4.48	38.39	62.68
4	69.5	32.5	3.86	36.34	54.64
8	62.55	29.64	3.56	35.25	50.52
12	59.11	20.9	3.08	34.81	46.49
16	55.67	16.8	2.63	30.89	40.46

3.1 Variation of Atterberg Limits

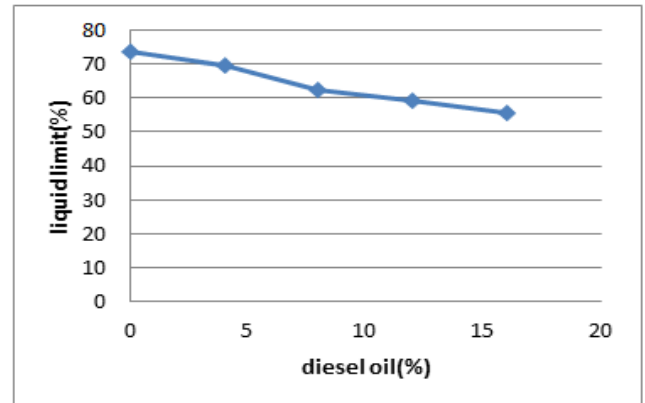


Chart -1: Variation of Liquid Limit

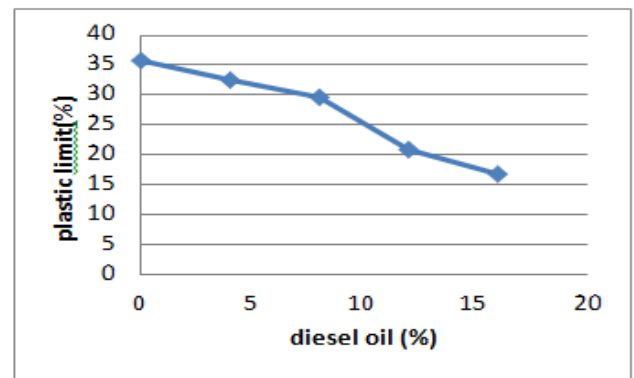


Chart -2: Variation of Plastic Limit

Chart 1 and chart 2 shows variation in liquid limit and plastic limit with diesel oil. It observed that liquid limit and plastic limit decreases with the increase in diesel oil content. It is because of the oil is mixed with soil, it surrounds the soil particles, and then the water reaction with soil particle reduces. The thickness of double-layer reduces and decrease in Atterberg limits as oil is added to a soil.

3.2 Variation of Compaction Characteristics

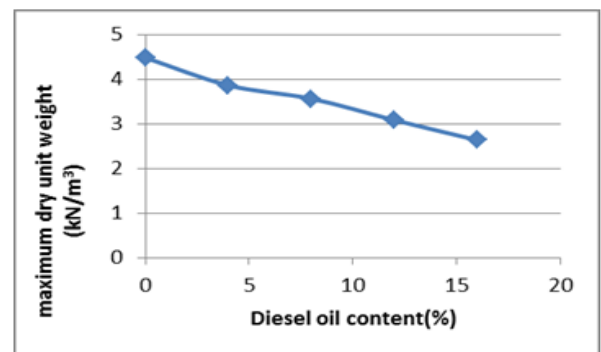


Chart - 3: Variation of Maximum Dry Density

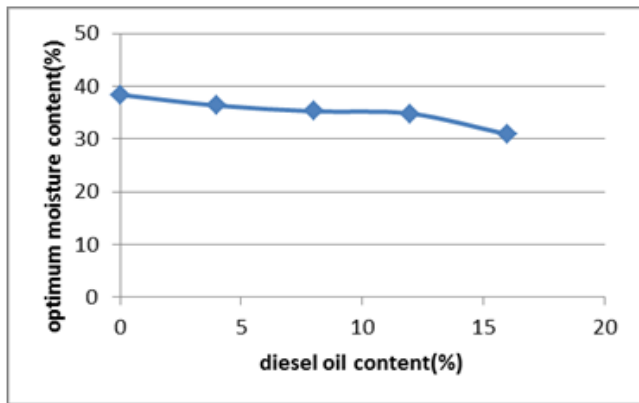


Chart - 4: Variation of Optimum Moisture Content

Chart 3 and chart 4 shows variation in MDD and OMC with diesel oil. It observed that MDD and OMC decrease with the increase in diesel oil content. It is because of the diesel oil is hydrophobic and it coats itself around individual clay particles and prevents the entry of water which interacts with clay particles.

3.3 Variation of Unconfined Compressive Strength

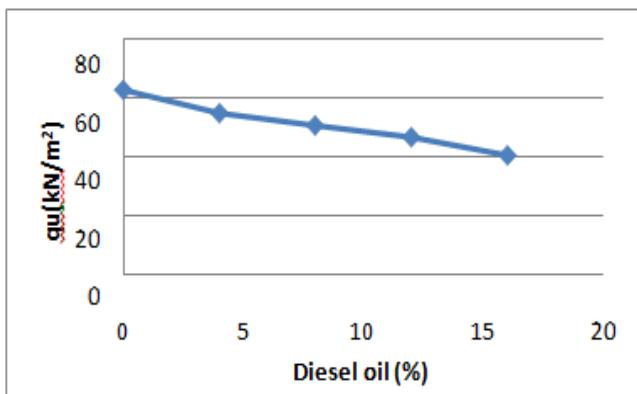


Chart -5: Variation of UCS with Diesel Oil

Chart 5 shows the variation of UCS with the addition of diesel oil. On this sample, there is an inverse correlation between q_u and oil content. UCS decreases drastically with the increase in diesel oil contamination in the soil. It leads to the weakness of soil and decreases the strength.

4. CONCLUSIONS

From the results, it was observed that diesel oil affect the geotechnical properties of high plastic clay.

- Atterberg limits decrease with increasing oil contamination in soil.

- Increasing of diesel oil content in soils causes a reduction of maximum dry density and optimum water content.
- The reduction in optimum water content is more in artificially oil-contaminated soil samples, indicating excess oil in the soil.
- Oil contamination induces a reduction in strength of the soil samples.
- UCS value decreases from 62.68 k N/m^2 to 40.46 k N/m^2 when it added with diesel oil.
- The strength of soil is decreased up to 1.5 times that of the uncontaminated soil is obtained.
- 16% of oil contamination gives the worst strength.

BIOGRAPHY



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