



EFFECTS OF ACIDS AND BASES CONTAMINATION ON SOIL PROPERTIES

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Abstract— Soil which is a major and primary element for the construction is gradually leading to the degradation of its properties. With the advancement of science and technology, the growing population and the demands of the people has led to a new era of industrial advancements. The numbers of industries and factories have grown rapidly. Though the industries prove to be useful to the people in many ways providing opportunity for employment and consumers product, it also has a serious impact on the environment. Industries release a variety of pollutants into the soil thereby contaminating the soil. Such effluents consist of acids and base wastes.

For this the soil is contaminated by adding acids contaminants preferred are nitric acid, Sulphuric acid, hydrochloric acid and base contaminants preferred are sodium hydroxide, potassium hydroxide and calcium chloride. The geotechnical properties are examined by adding acids and bases at various percentages such as 5% 10% 15% 20% 25%. Further the effect of soil properties with the contaminants is studied.

Index Terms— soil Contamination, Atterberg's limits, acid contamination, engineering properties of soil.

I. INTRODUCTION

Soil forms at the upper layer of the earth like a skin covering the earth. The soil provides as the foundation of most constructed structures, most of all construction rests on soil be it buildings, roads etc.

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Soils forms at upper layer of the earth like a skin covering the earth. The soil provides as the foundation of most constructed structures, most of all construction rests on soil be it buildings, roads etc. Soil Waste interaction affects all the properties of soil. The unintended problems of soil changes lead to ground modification with the interaction of pollutants. The effect of this can cause various soil related problems and leads to engineering issues the type of soil and its pollutant depends on the nature and mineralogy of soil which needs to understand the properties of soil when contaminated with acids and bases.

Industrial advancements are necessary for the social development of the country but at the same place it is challenging the present soil mechanics concepts. The growth of population leads to the decline of the nature with increase of solid and liquid waste. The increasing technologies also lead to environmental degradation. A geotechnical is concerned mostly about the impacts of the soil which is the key element for the construction. The task of geotechnical engineer has increasing widely.

Objectives:

- Study on acids and bases contamination on soil properties.
- Performing different tests on natural and contaminated soil samples by varying the percentage of contamination.

II. MATERIALS

For this experimental investigation, Soil sample is collected from the Parvathapur, Uppal Hyderabad. After soil is collected unwanted materials are removed and sieved on 4.75mm. It is then tested for its various engineering and index properties. The results are shown in the following table 1.

III. Methodology

S.No	Properties	Result
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1	Initial moisture content	12.1%
2	Specific gravity	2.64
3	Percentage of sand	38.1%
	Percentage of silt	27.9%
	Percentage of gravel	27.8%
	Percentage of clay	31.15%
4	Differential free swell	40.6%
5	Liquid limit	55.6%
	Plastic limit	17.0%
	Shrinkage limit	13.6%
	Plasticity index	39.9%

Acid contamination

Nitric acid (HNO₃), hydrochloric acid (HCL), sulphuric acid (H₂SO₄) was taken and prepared with Normality 1. These are oven dried with soil without gravel fraction. These contaminants were added at different percentages such as 5% 10% 15% 20% 25% weight and these samples stored in dessicator for four days.

Base contamination

Sodium hydroxide (NAOH), Calcium hydroxide (CAOH) and potassium hydroxide (KOH) were prepared with normality 1. These soils are oven-dried without gravel fraction. These contaminants were added at different percentages such as 5% 10% 15% 20% 25% weight and these samples were stored in desiccator for seven days.

IV. EXPERIMENTAL PROGRAM

General

The following tests were conducted on both the natural soil and contaminated soil. The following tests include Atterberg’s limits test, pH test, Free Swell test, Specific Gravity test, particle size distribution and Standard Proctor Compaction test(CBR). For contaminated soil

the tests are performed by varying the percentages of acids and bases contamination by 5%,10% and 15%.

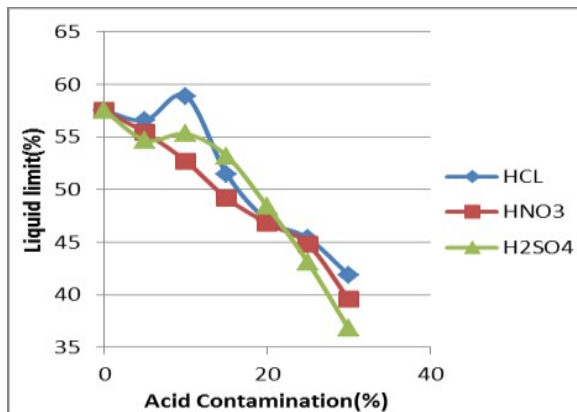
General

The following tests were conducted on both natural soil and contaminated soil. This involves Atterberg’s limits specific gravity test, and standard compaction test, unconfined compression test on natural and contaminated soil with various percentages.

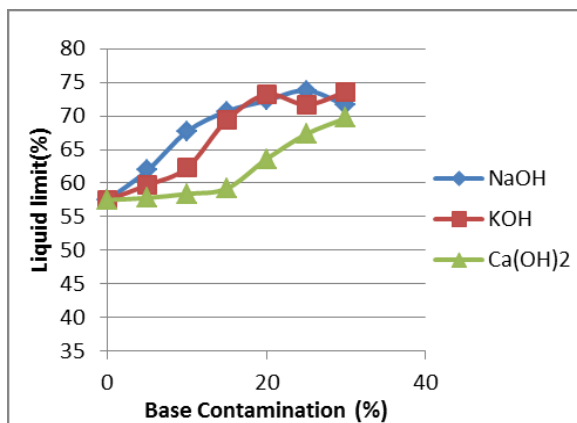
Atterberg’s limit

These test was performed as per IS :2720 (Part 5)- 1985 and IS: 2720 (Part 6)-1972 on the normal and contaminated soil sample. Different amounts of acids and bases such as 5% 10% 15% 20% 25%.

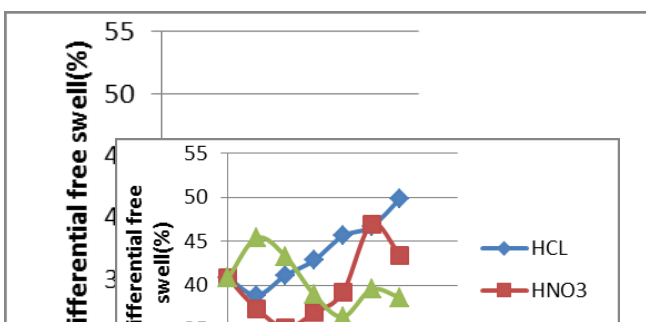
liquid limit results



Freeswell test:



Free swell test was conducted on the acid and base contaminated soil sample with different percentages such as 5% 10% 15% 20% 25%. The results are charted below

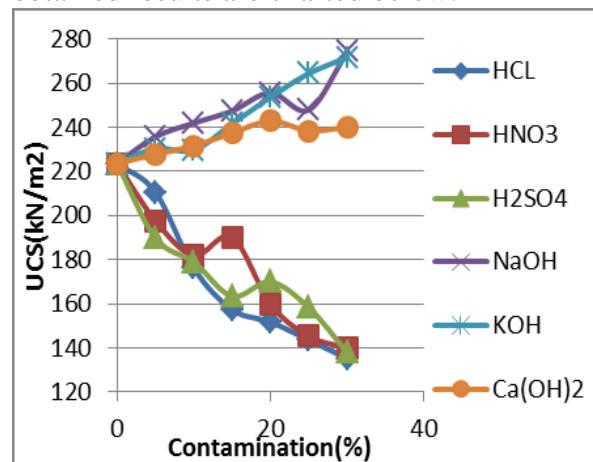


V. RESULTS AND DISCUSSIONS

Unconfined compression test

These test was performed as per IS :2720 (Part 5)- 1985 and IS: 2720 (Part 6)-1972 on the normal and contaminated clay sample with different amounts of acids and bases such as 5% 10% 15% 20% 25%. The results are noted and charted.

From this the unconfined compression strength and undrained cohesion were examined as per IS 2720 (Part 10) -1991. The obtained results are charted below.



VI. CONCLUSION

The laboratory testing was performed to study the effects of acid and base contaminated soil sample by adding it with a increment of 5% by weight to contaminate artificially. The following are the conclusions from the experiments.

Acid contamination

1. The liquid limit decreases with increase in acid content.
2. The plasticity index decreases in which soil changes from high plastic to normal plastic state.
3. Free swell values have gradually increased with increase in acid content.
4. The specific gravity decreases with the acid contamination.

- 5 The optimum moisture content and maximum dry density decreases with the increase in the contamination.
6. The values of shear strength have decrease with the increase in the acid contamination.

Base contamination

1. The liquid limit decreases with increase in base content.
2. The plasticity index increases with increase in the base content.
3. Free swell values have shown gradual decrease with increase in acid contamination.
4. The specific gravity increases with the base content.
5. The optimum moisture content decreases with increase in case content and maximum dry density decreases with the increase in the contamination.
6. The values of shear strength have increase with the increase in the contamination.

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