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Effect of Alkaline water quality on subgrade layer of Pavement

Dipal Mehta[1], Mrs.Vrundani Vaidya[2],

[1]*P.G.Student of Master of Transportation HGCE-Vehlal, Ahmedabad , Gujarat, Inida*
[2]*Head of Civil Engineering Department HGCE-Vehlal,Ahmedabad, Gujarat, India*

Abstract -. *The analyses indicated that there was a significant difference in pavement behavior with respect to changes in material characteristics. Industrialization and urbanization play a key role in economy of a country. Industrialization and urbanization of the country though lead to a rapid growth of industries is prone to produce certain spillovers like contamination of land and water streams through improper treatment practices. Contamination of land is a serious issue as it modifies index and engineering properties of soils. Modification of soil properties from industrial wastes results in foundation failures, structural damage in light industrial buildings .Safe disposal of wastes is one of the important factors that has become the present paramount. On the other hand in many situations, soils in its natural state do not present adequate geotechnical properties to be used as foundation layers and road service layers*

Key Words:
Geotechnical Properties of Soil[1], Subrade layer[2], CBR Value[3], Density of soil [4], Index Properties of Soil[5] etc.

1. INTRODUCTION

Due to increase in population and industrialization, there is increase in construction activities in the cities and industrial area leaving very little locations of good soils for new projects. There are some open plots of land which are filled by liquid and solid wastes coming from municipal and industrial areas. The fill material, decayed organic soils and soils having continuous contact with sanitary fill environment loose their desired geotechnical properties. The specific gravity of polluted soil is decreased due to decay of lighter weight particles present in the soil. Organic matters have broken down to the smaller size particles of the soil and thus increasing clay size particles. This has resulted in increased plasticity of polluted soil. Liquid limit of polluted soil increases due to more number of smaller size particles present in the soil. Dry density of polluted soil is decreased due to decay of lighter weight organic matters present in the soil. Shear strength parameters of polluted soil also decreased. Angle of internal friction depends on void ratio and shape of particles, decay of organic matters and other pollutants to make the soil particles more granular. It reduces the angle of internal friction but increases the cohesion of the soil. Taking into consideration all these factors, before starting a new civil engineering construction projects on polluted soil, study of changes in properties of soil due to disposal of waste is very essential

1.1 Observation

Due to massive increase in population and industrialization there are increased road construction activities in the cities and in industrial area, leaving very little locations of good soils to construct on. Lands in the periphery of town which are open to environment are filled by liquid and solid wastes coming from municipal and industrial areas. This is happening due to limited dumping space for the pollutants or lack of proper environmental planning. Various decomposed organic materials and most of the time industrial pollutants also come into contact of surrounding soil mass due to unlined drainage systems. These wastes may find their way to shallow depth of soil and react with the same. The fill material, decayed organic soils and soils having continuous contact with sanitary fill environment lose their desired geotechnical properties. Soil in contact with pollutants becomes plastic, compressible and show comparatively lower shear strength and hence have low bearing capacity values. Organic soils due to decay of organic materials show unpredictable settlement. To utilise effectively even the poorest type of soil for supporting the structures to be constructed over it, efforts of geotechnical engineers are directed to develop technically viable and economically feasible solutions. As already discussed in the present study soil samples for each industry were collected from two locations one from polluted area and another in the vicinity but unpolluted area. When the soil is to be used for supporting the foundation standard Proctor test and shear strength parameters are important. Similarly for classification of fine grained soil Atterberg's limit are important When soil is to be used for supporting the road soaked C.B.R. value of soil is important. Hence, with these considerations the different geotechnical tests such as specific gravity, liquid limit, plastic limit, maximum dry density, optimum moisture content, shear strength parameters *i.e.* cohesion and angle of internal friction were determined for all cases. For cases *i.e.* **Agricultural chemical industries** in addition to this soaked C.B.R. values were determined.

1.2 Objective

Soil-water interaction can affect almost the properties of soils. Though the effects of pollutants on soils are complex, they may be better understood if the various factors are isolated and considered independently. These factors are primarily due to ion exchange or mature of pore fluid. The effects may different for different types of soils. The effect on clayey soils by different pollutants are considered on

1. Index properties
2. Density parameter
3. Permeability
4. CBR Value
5. Free Swell Index

2. Data Collection

The soil used for this investigation is obtained from near Naroda GIDC by doing trial pit up to 0.60 to 1.0m depth. The dried and pulverized material passing through I.S.4.75 mm sieve is taken for the study. The properties of the soil are given in Table.1. The soil is classified as "CI" as per I.S. Classification (IS 1498:1970) indicating that it is clay with intermediate plasticity. It is expansive in nature as the Differential Free Swell Index (DFSI) is about 50%

Table -1: Properties of Natural Soil

Sr.no.	Property	Value
1	Grain Size Analysis	
a	Gravel(%)	2
b	Sand(%)	28
c	Silt+Clay (%)	70
2	Atterberg Limit	
a	Liquid limit (%)	45
b	Plastic limit (%)	25
c	Plasticity Index (%)	20
3	Free Swell Index (%)	52
4	Compaction Characteristic	
a	Maximum Dry Density in gm/cc	1.82
b	Optimum Moisture Content (%)	12.8
5	Swelling Pressure kg/sq.cm	0.08
6	Specific Gravity	2.65
7	CBR Value at 2.5mm Penetration (%)	4.9

Agricultural chemical effluent is a colored liquid and soluble in water. The chemical properties of the effluent are shown in Table no.2

Table -2: Properties of Agricultural Chemical

Sr.no.	Property	Value
1	Color	Yellow
2	pH	9.83mg/lit.
3	Suspended Solids	150 mg/lit.
4	Chlorides	380 mg/lit.
5	Sulphates	98.2mg/lit.
6	Total Hardness	450 mg/lit.
7	TDS	1850 mg/lit
8	Calcium	150 mg/lit.
9	Magnesium	62 mg/lit.

3. Data Analysis

The soil sample tested for all geotechnical properties after mixing with distilled water and agricultural chemical effluent. The all properties were tested as per procedure mentioned in relevant part of Indian standard. The various part of IS: 2720 Part-4, 5, 8, 16, 40 was followed for the testing. The samples were tested with distilled water and agricultural chemical were compared. The summarized result of both with distilled and agricultural chemical affluent is as follow

Table -3: Summary of Properties of Soil with Agricultural Chemical and distilled water

Sr.no.	Description	Result of Soil sample with Distilled water	Result of Soil sample with Agricultural chemical effluent
1	Liquid limit(%)	45	70
2	Plastic Limit(%)	23	35
3	Plasticity Index(%)	22	35
4	Free Swell Index(%)	50	65
5	Maximum Dry Density in gm/cc	1.83	1.78
6	Optimum Moisture Content (%)	13.1	16.5
7	CBR Value at 2.5mm Penetration	5.1	3.9
8	Permeability at MDD in cm/sec	$3.4x10^{-5}$	$2.5x10^{-4}$

4. CONCLUSIONS

The index property of soil is found higher with alkaline water than the distilled water.
The free swell index of soil is found higher with alkaline water than the distilled water.
The proctor density is found lesser with alkaline water than the distilled water and optimum moisture content is found higher with alkaline water than the distilled water.
The CBR value of soil is found lesser with alkaline water than the distilled water.
The permeability of soil is increase with alkaline water than the distilled water.

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