

Effect of Pollutants on Permeability Characteristics of Soil

T Sai Krishna¹, Dr. M Chittaranjan², S Akhil Tej³

¹Assistant Professor, Dept. of Civil Engineering, Annamacharya Institute of Technology & Sciences- Tirupati, Andhra Pradesh, India

²Associate Professor & Head, Dept. of Civil Engineering, Sri Venkateswara College of Engineering- Tirupati, Andhra Pradesh, India

³Assistant Professor & Dept. of Civil Engineering, G. Pullaiah College of Engineering and Technology, Andhra Pradesh, India

Abstract - In the present investigation two types of soils were collected near renigunta region to study the effect of pollutants on permeability characteristics of the soils a limited effort is made to evaluate the influence of inorganic chemical pollutants predominantly present in the effluents from tannery, textile and pharmaceutical industries on the permeability of soils. The inorganic chemicals considered are sodium chloride, sodium carbonate, and calcium carbonate. The percentage concentrations of inorganic salts, which are added range from 0% - 6%

Key Words: NaCl, CaCO₃, NaCO₃, Permeability

1. INTRODUCTION

Soils being an effective medium of disposal, both solid and liquid wastes are increasingly getting mixed up with soils leading to a change in soil environment. Soil behaviour is therefore, subject to modification to varying extents in the presence of pollutants which find their way into soils through the disposal of large quantities of wastes into the land. For obvious reasons clayey soils are abundantly used in current civil engineering practice under different environmental conditions. Owing to these facts a greater importance needs to be attached in order to understand the modification of soil mechanical properties due to chemical contamination.

In the light of the above, a limited effort is made to evaluate the influence of inorganic chemical pollutants predominantly present in the effluents from tannery, textile and pharmaceutical industries on the permeability of soils. The inorganic chemicals considered are sodium chloride, sodium carbonate, and calcium carbonate. The percentage concentrations of inorganic salts, which are added range from 0% - 6%

Effluents coming out from industries like Tanning, sugar cane, and pharmaceutical industries generally consist of so many chemicals. Among them chemicals like Sodium chloride (NaCl), Sodium carbonate (NaCO₃), and Calcium carbonate (CaCO₃) are more predominant.

The data thus obtained from the study is thought to be useful towards development of a better understanding of permeability studies and establishment of quantitative guidelines for soil behaviour in a given environment.

An account has been made to understand the effect of inorganic chemicals such as NaCl, NaCO₃, CaCO₃ on Permeability characteristics of soils. Further, soil in combination with Fly ash is also considered indenting inorganic chemicals to understand the Permeability properties when Fly ash is used in combination with Soils.

2. EXPERIMENTAL INVESTIGATION.

The experimental investigation done on two soil samples were tabulated below in table1

Table-1 Properties of soil samples

PARICULARS	SAMPLE-I	SAMPLE-II
Gravel (%)	0	0.9
Sand (%)	18.5	63
Silt+clay (%)	81.5	63.1
Liquid limit (%)	34	42
Plastic limit (%)	14	16
Plasticity index (%)	20	26
Free swell index (%)	30	50
Degree of swelling	LOW	MEDIUM
Soil classification according to IS 1498	CL	CI
Optimum moisture content (%)	13	13
Maximum dry density (kN/m ³)	18.3	18.1

3. RESULTS AND DISCUSSIONS

In this chapter it is aimed to observe the variation of permeability by addition of various pollutants such as sodium chloride (NaCl), sodium carbonate (NaCO₃) and Calcium Carbonate (CaCO₃) to the soil samples used with the different percentages as follows 0%, 2%, 4% and 6%

Table-2 Effect of Pollutants on Soil Sample-I

Sample-I			
POLLUTANT %	NaCl	CaCO ₃	NaCO ₃
0	4.81E-06	4.80E-06	4.82E-06
2	3.41E-05	5.05E-05	4.99E-05
4	4.06E-05	5.44E-05	5.46E-05
6	4.47E-05	5.66E-05	5.82E-05

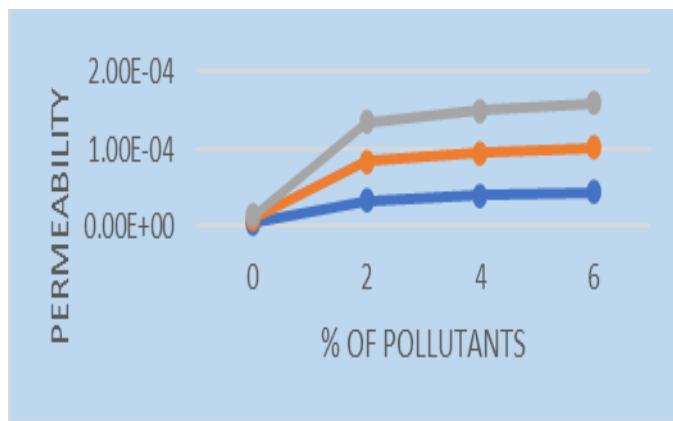


Figure-1 Comparison graph for different pollutants versus permeability of soil sample-I

Table-3 Effect of Pollutants on Soil Sample-II

Sample-II			
POLLUTANT %	NaCl	CaCO ₃	NaCO ₃
0	1.04E-04	1.04E-04	1.04E-04
2	1.06E-03	2.24E-03	2.07E-03
4	1.71E-03	2.47E-03	2.29E-03
6	2.04E-03	2.77E-03	2.51E-03

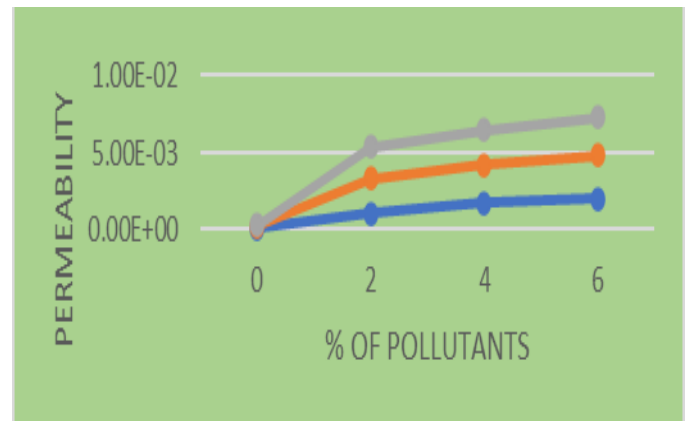


Figure-2 Comparison graph for different pollutants versus permeability of soil sample-II

4. CONCLUSIONS

- [1] As % NaCl increases permeability increases for both soil
- [2] The addition of NaCl is likely to cause flocculated structure resulting in increase in permeability which is the usual case when soil is polluted with salts.
- [3] When Naco3 is permeated through soil and soil fly ash mixture same observations are noticed as found with NaCl with minor differences in magnitude of permeability.
- [4] The effect of NaCO₃ and CaCO₃ on permeability of soil seen to agree with each other quite well.
- [5] The effect of inorganic chemicals adopted in the present study is said to be more pronounced with respect to soil sample-2 which has liquid limit value greater than sample-1. Accordingly, the base exchange capacity of sample-2 is greater. The permeating fluid is likely to affect the basic structure of the soil such that large pores are formed due to flocculation and hence increase in permeability

REFERENCES

- [1] Gordon, B.B., and Michael Forrest, "Permeability of Soils using contaminated Permeant", Permeability and ground water contaminant Transport, ASTM STP 746, 1981, pp. 101-120.
- [2] IS: 1498-1970, "classification and identification of soils for general Engineering purposes".
- [3] IS: 2720(part v), Methods of test for soils, "Determination of Liquid limit".

- [4] James K. Mitchell, Fundamentals of soil behaviour, John wiley and sons, Inc, 1976.
- [5] Katti, R.K Kulakarni, and K.R Radhakrishna, "Research on black cotton soil with and without inorganic chemicals", Indian Road congress Bulletin No.10,1962, pp 1-79.
- [6] Nelson L. Nemerow, "Liquid waste of Industry Theories, practices and treatment", Addison -wesley publishing company, Inc., 1971, pp 281.
- [7] Sridharan, and Sivapullaiah P.V, "Engineering behaviour of soils contaminated with different pollutants", 9th Bongkok Geotechnical symposium and speciality session, 1985.
- [8] Rodney W. Lentz, William D. Horst and Janardhan O. Uppot, "The Permeability of clay of acidic and caustic Permeants", Hydraulic barriers in soil and rocks, ASTM STP 874, 1985.
- [9] Rosenqvist, I.Th., "Investigation in the clay - electrolyte system", Norwegian Geotechnical Institute, publication No.9, 1955.
- [10] Sivapullaiah, P.V., Sithram, and Subbarao K.S., "Effect of organic solvents on the behaviour of soil", Asian regional symposium on geotechnical problems and practice in foundation Engineering, colombo, Sri Lanka, Feb.1986.