ANALYSIS OF SOIL CONTAMINATED WITH MUNICIPAL SOLID WASTE LEACHATE

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ABSTRACT

The leachate composition and concentration of The Municipal Solid Waste (MSW) changes with time and region as a result of depletion of various components and changes in the chemical environment. This paper presents the result of field study and experimental study on contaminated soil due to Municipal solid waste landfill leachate. Soil surrounding an unlined municipal solid waste landfill is exposed to various pollutions due to the contact with leachate. The study is conducted on soil surrounding a stabilized unlined MSW landfill site in the Cochin area of 15 years age and on non polluted soil treated with chemicals. Atterberg Limits, Vane Shear Strength and Permeability of soil are examined. The influence of chemicals on soil properties is proved by getting an increased shear strength and permeability while reduced atterberg limits for chemically influencedsoil.

Keywords: *Municipal Solid Wastes, leachate, Atterberg limits, Vane Shear Strength, Permeability.*

INTRODUCTION

Soil pollution has been increased due to high amount of the waste products as a result of urbanization. Although As per the Municipal Solid Wastes (Management and Handling) Rules 2000, it obligatory for all urban local bodies to upgrade their waste collection, transportation, and processing/disposal systems, only a few urban local bodies have made any substantial progress in this regard. The existing waste dumping sites are full beyond capacity and under unsanitary conditions irrational disposal of waste leading to pollution. Soil pollution results in modification of the physical, chemical and biological properties of soil restrictingorpreventingitsuseinthevariousapplicationswhereitnormallyplaysapart .Though the present landfill engineering emphasis on pollution reducing technology by using suitable liner material, open dumping on without any liners is extensively practiced in India. Leachate is produced due to the biochemical changes in organic substances and it is composed of large amount of organic and inorganic compounds. The MSW landfill leachate composition characterizes it as conventional contaminants, non- conventional contaminants and hazardous chemicals. Conventional contaminants include total dissolved solids, hardness, alkalinity, chloride, sulfate, iron, manganese, and hydrogen sulfide. In addition, this group includes a variety of non-differentiated organics measured as chemical oxygen demand, biochemical oxygen demand, and total organic carbon. Non-conventional contaminants are largely organic chemicals that have not been defined, and whose potential hazards to public healthandgroundwaterqualityarenotknown.Itisestimatedthatfrom90to95%ofthe

organic materials in municipal landfill leachate are of unknown composition. US EPA prescribes, until a chemical is leached in concentrations at least 100-times the drinking water standard, a material is not classified as a hazardous waste. This paper presents the results of a Field test and laboratory testing program carried out to determine the percolation on soil.

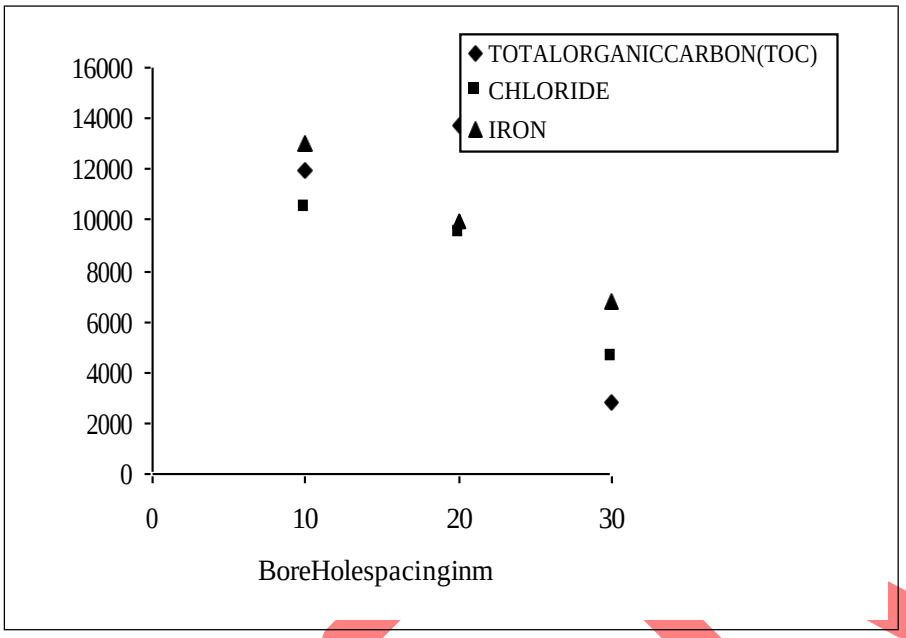
FIELD INVESTIGATION

The selected MSW landfill site lies between latitude 90° 42' to 10° 18' 00" northand longitude 76° 12' 00" to 76° 46' 00. The soil consists mainly of recent sediments (Alluvium, Teri's, Brown sand which had a sticky nature etc). The region is concentrated with several chemicals and fertilizers factories, as well as IT companies. Because of the amount of Chemical wastes that has been discarded from Chemical factories, this region is regarded as polluted. This site is spread over an area of about 4 x 10^4 m^2 and situated near National Highway 47. Its base is not lined and has not been designed systematically before being used for disposal /dumping of waste and is functioning as a disposal area for 15 years. Three boreholes A, B and C at 10 meter lateral spacing were prepared to collect the polluted soil and water samples Fig 1. Chemical analysis was carried out as per the standard methods published by American Public Health Association. Engineering properties were tested in accordance with the IS codes. (IS 2720 Part3, 5,30)

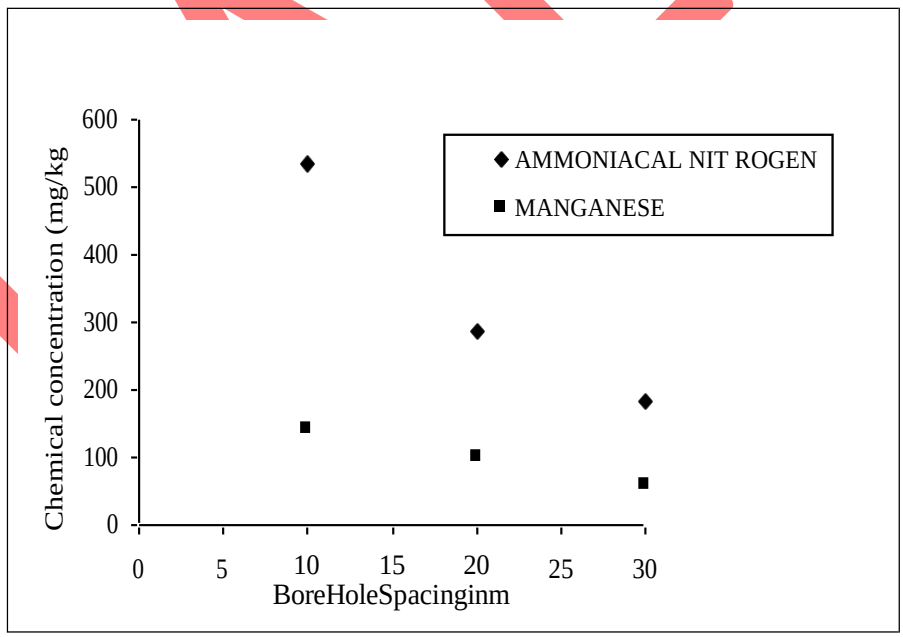
Fig1. MSW landfill site.

RESULT AND DISCUSSION

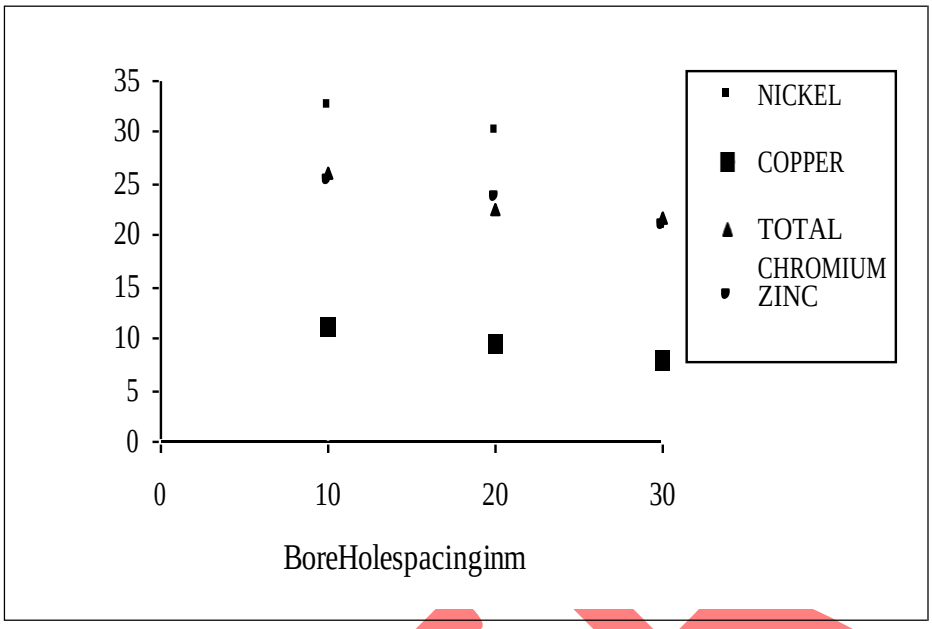
The result obtained from the tests on soil samples are summarized in fig 2, 3, 4.


TOTALORGANICCARBON(TOC)
CHLORIDE
IRON
16000
14000
12000
10000
8000
6000
4000
2000
0
0
10
20
30
BoreHolespacinginm

(a)


AMMONIACAL NIT ROGEN
MANGANESE
Chemical concentration (mg/kg
600
500
400
300
200
100
0
0
5
10
15
20
25
30
BoreHoleSpacinginm

(b)



(c)

Fig2 (a,b,c). Chemical Concentration Vs Bore Hole spacing

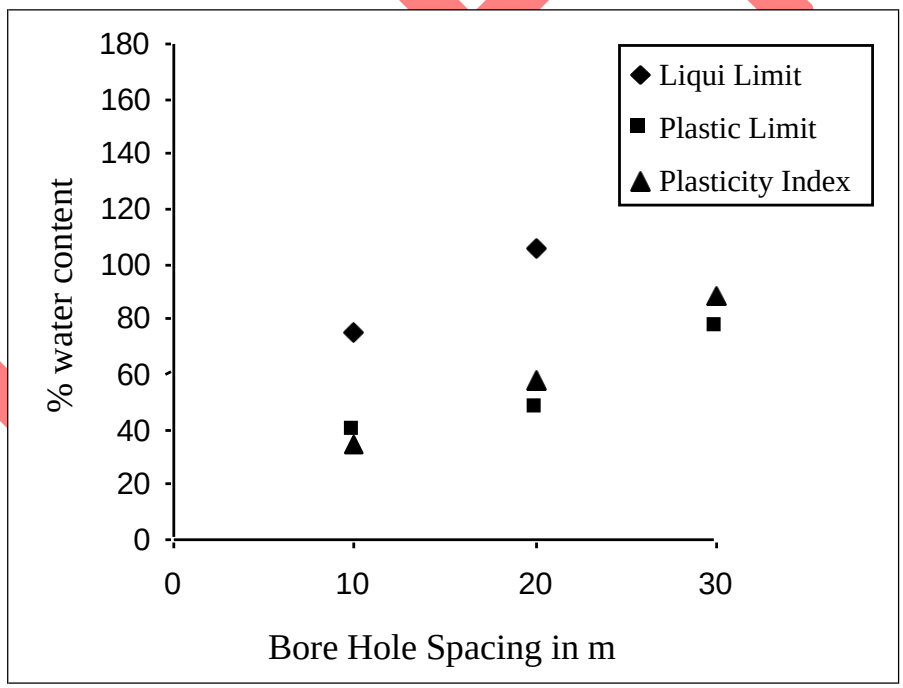


Fig 3 Variation in Atterberg limits

Fig .4.Variation in Shear Strength

Tests conducted on soil samples collected from three boreholes at different lateral spacing reveals that most of the chemical concentration is getting decreased as the distance from the landfill increases. Concentration of TOC analyzed in the soil varies from 24000 to 2827 mg/kg. It characterizes the municipal solid waste as an organic waste. Shear Strength and Atterberg limits also show some increase in the result as the distance increases. This may be due the influence of chemicals on the soil.

LABORATORY INVESTIGATION

The influence of chemicals on the geotechnical properties is proved by analyzing non polluted soil treated with chemicals for 100 days. Properties of soil before treating with chemical are tabulated in Table1.

Table 1 Properties of non polluted soil.

Specific Gravity	2.66
Liquid Limit,%	25
Plastic Limit,%	20
Shrinkage Limit,%	16.4
Vane Shear Strength, kg/cm^2	0.0181
Permeability, k(cm/s)	$2.5x10^{-5}$

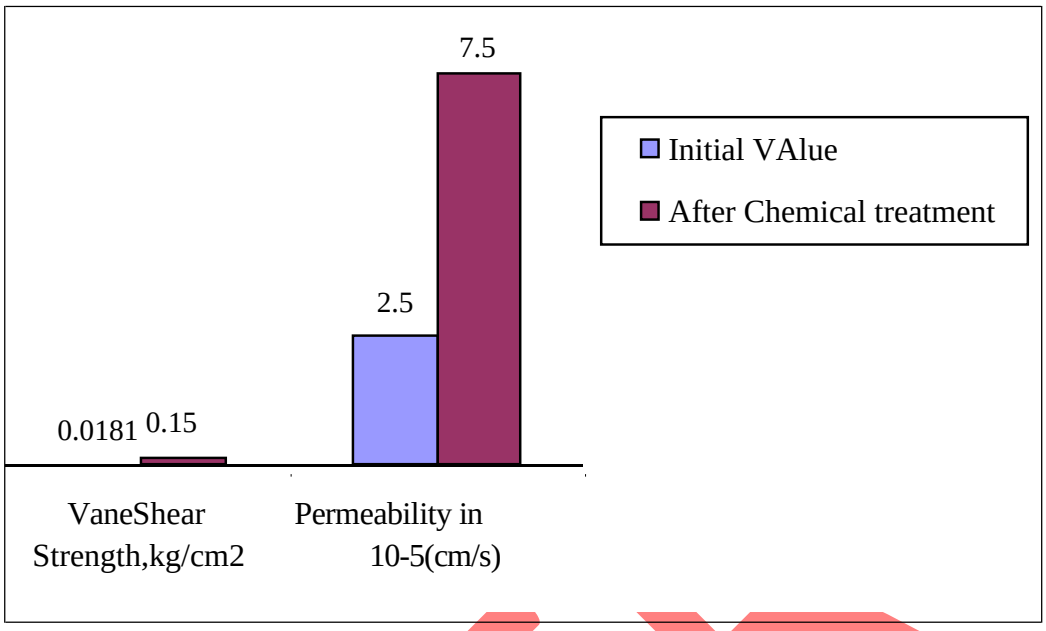
The concentration of the chemicals to be added to the soil for treatment was similar to that obtained from the first borehole in the field study as in Table 2. Soil properties were analyzed after 150 days of curing.

Table 2. Chemicals added to the soil.

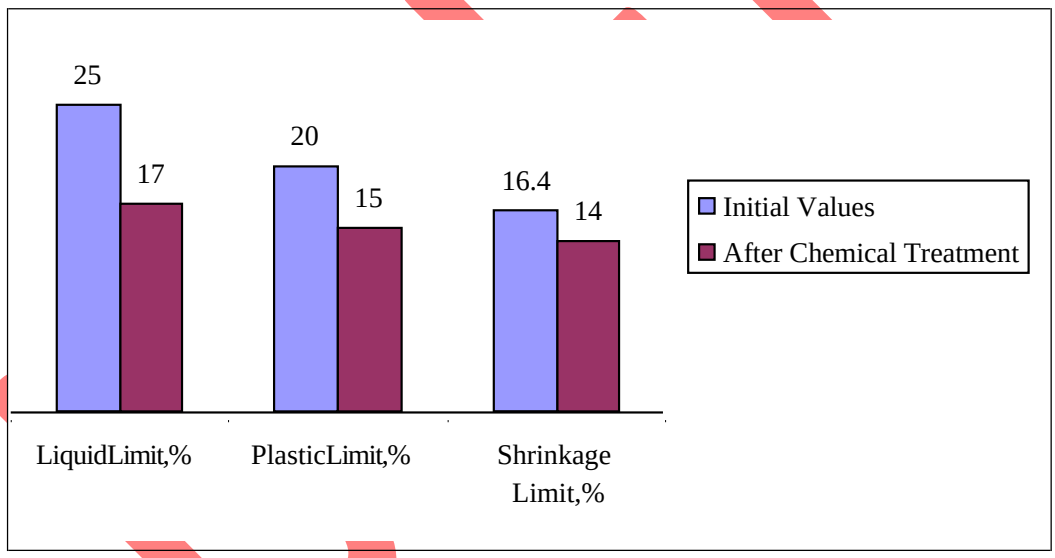
Parameters	Concentration(mg/kg)
Chloride	6500
Ammonia (as N)	300
Fe	11300
Mn	119
Zn	38
Chromium	30
Copper	11
Nickel	28
Total Organic carbon (TOC)	11160

RESULT AND DISCUSSION

Effects of chemicals on the characteristics such as consistency limits, shear strength and hydraulic conductivity soils are summarized in Figs. 5 (a, b)



(a)



(b)

Fig 5. Effect of Chemical on Soil.

The results shows reduction in atterberg limits as and increase in shear strength as well as hydraulic conductivity of the soil. Thus the trend shown field test is proved in the laboratory test also.

CONCLUSION

This paper presents the result of analysis of the effect of Municipal solid waste leachate on soil. From the experiments and the field study it is evident that the soil properties are getting changed due to the influence of chemicals in the waste leachate.

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