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Study of Index And Engineering Properties of Soil Due to the Leachate at the Landfill Site

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Abstract-Upsurge in population and urbanization has led to the need for better solid waste management. Waste generated if not managed properly can create many problems. Ahmedabad is known as the industrial capital of Gujarat and generates about 4000 metric tonnes of waste daily. Majority of this waste is dumped at an open excavated land termed as landfill. Leachate is the liquid generated because of water percolated through decomposing waste. This generated leachate is very toxic. It percolates in soil and alters its properties in this paper change in properties of soil due to leachate is discussed. Experiments were performed on the soil collected from the Pirana landfill site located at Daskoi in Ahmedabad. The study has revealed that the soil is loose and Leachate is affecting the soil properties both Index as well as Engineering. The Soil requires improvement for future construction.

Index Terms-Leachate, Index properties, engineering properties, Pirana landfill site.

1. INTRODUCTION

Gujarat is known as one of the most industrialized Indian states, having a population of more than 60 million. According to a Times of India report, 42.6% of the state's total population is living in urban areas. Due to the high rate of urbanization and increasing population, the amount of generated municipal solid waste is increased and thus it needs to be managed. [1]. Study shows that landfills play an important role in managing solid waste as it reduces exposure to the environment [2] It is necessary that proper land is provided for sustainable and suitable landfilling formulating future requirements.

An excavated land where a large amount of waste is buried is termed as landfill. Landfilling the produced waste is one of the traditional and economic methods used in India. According to Gujarat Pollution Control Board, the state has 10 hazardous waste disposal sites from which Pirana landfill in Ahmedabad is the seventh-largest open landfill in India in terms of land area and amount of solid waste disposed of.

Leachate is created by liquid percolating through waste, with the role of biochemical process and chemical composition of the waste. As the liquid moves through the waste, it meets pathogenic micro-organisms and educe solutes and suspended solids from the waste, thus becoming contaminated. Increased levels of leachate occur with increased precipitation, such as during the wetter seasons.

This leachate percolates in the soil and ontaminates groundwater as well as deteriorates its properties that is Index as well as Engineering properties. This imposes a greater risk to future construction and agriculture Furthermore, leachate has hazardous effects on human health and environment [3]

2. STUDY AREA

The Pirana landfill site is the biggest dumping site of Ahmedabad since 1982.it covers 84 hectares of land. 8 Co-ordinates were taken from Google map as shown in Figure 1.

Figure 1: Google map showing Pirana landfill site

3. SAMPLE COLLECTION

The samples were taken from 8 Co-ordinates at a distance of 400m from the center point of Pirana landfill site and at the depth of 0.5m. Sample collection from Co-ordinate 3 was not feasible.

Co-ordinate 1: The latitude of this Co-ordinate is 22.9838 and Longitude is 72.5673. This sample was

moist, blackish, and was having a foul smell. This sample was inside the landfill site.

Co-ordinate 2: The latitude of this Co-ordinate is 22.9812 and Longitude is 72.5699. This sample was brown in color and silty.

Co-ordinate 3: The latitude of this Co-ordinate is 22.9793 and Longitude is 72.5700. This sample was not feasible to collect.

Co-ordinate 4: The latitude of this Co-ordinate is 22.9779 and Longitude is 72.5690. This sample was also black in color and foul in odor as it was located at the boundary of the landfill site.

Co-ordinate 5: The latitude of this Co-ordinate is 22.9769 and Longitude is 72.5650. This sample was having solid waste in it as it was located inside Pirana Landfill site.

Co-ordinate 6: The latitude of this Co-ordinate is 22.9792 and Longitude is 72.5626. The soil was brownish and dry.

Co-ordinate 7: The latitude of this Co-ordinate is 22.9814 and Longitude is 72.5624. This sample was brown and seems to be fertile as it was located inside a farm.

Co-ordinate 8: The latitude of this Co-ordinate is 22.9833 and Longitude is 72.5640. This sample was dry and brownish in color.

4. SAMPLE ANALYSIS

The following test was carried out on the collected samples according to Indian Standards:

4.1. Index Properties.

4.1.1Moisture content (IS: 2720 PART 2)

Soil generally possess a finite amount of water which is termed as Water content or Moisture content of the soil.

4.1.2 Sieve Analysis (IS: 2720 PART 4-1975)

Sieve analysis is a practice used to assist the particle size distribution of granular material by allowing the material to pass through a series of sieves of progressively smaller mesh size and weighing the amount of material that is retained by each sieve as a fraction of the whole mass.

4.1.3 Liquid limit (IS: 2720 PART 5-1970)

Water content at which any further increase in water will cause a plastic soil to behave as a liquid.

4.1.4 Plastic limit (IS: 2720 PART 5-1970)

Water content at which soil starts to crumble when rolled intoa thread is termed as the plastic limit.

4.1.5 Specific Gravity (IS:2720 PART 4)

Specific gravity is defined as the ratio of the unit weight (or Density) of soil solids only to unit weight (or Density) of water.

4.1.6 Free Swell Index (IS: 2720 PART 40)

Swell index is also known as free swell index. When the volume of soil increases without application of external forces or water pressure it is called The Free Swell Index.

4.2 Engineering Properties:

4.2.1 Standard Procter Test (IS: 2720 PART 7-1983)

The Procter Compaction Test is a laboratory method of determining the optimal moisture content at which a given soil type will become most dense and achieve its maximum dry density.

4.2.2 Permeability (IS: 2720 PART 17)

Permeability is defined as the property of soil which allows the seepage of Water/fluid through the voids present in it.

4.2.3 Direct Shear Test (IS: 2720 PART 13)

Direct Shear Test is a laboratory or field test used to measure the Shear Parameter that is Cohesion (c) and the angle of internal friction (ϕ).

5. RESULT AND DISCUSSION

. (1)etters like x are to appear as x

5.1 Index Properties

5.1.1 Moisture content:

From the result of this test, we can conclude that the moisture content of soil collected from Co-ordinates which lies inside piranha are high.

Sr.no	Co-ordinate No.	Water Content (%)
1	CO-1	45.5
2	CO-2	15.38
3	CO- 4	20
4	CO- 5	23.07
5	CO-6	6.67
6	CO-7	18.91
7	CO- 8	8.33

5.1.2 Sieve analysis:

The Sieve Analysis shows that most of the samples are loose fill sand.

Sr no	Co-ordinate No.	Gravel (%)	Sand (%)	Silt + Clay (%)
1	CO-1	29.3	65.1	5
2	CO-2	34.6	56.6	7.9
3	CO- 4	16.1	76.8	6.5
4	CO- 5	16.9	74.7	8.2
5	CO-6	18.1	72.6	7.5

6	CO-7	25.5	64.8	9
7	CO- 8	30.5	62.2	6.7

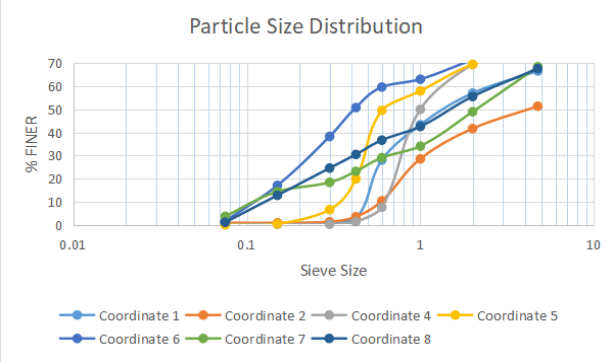

Figure 2 Particle size distribution curve

5.1.3 Liquid Limit:
The Liquid limit of sample varies from 21.41 to 41.85.

Sr no	Co-ordinate No.	LL
1	CO-1	41.85
2	CO-2	23.79
3	CO-4	34.96
4	CO-5	36.53
5	CO-6	21.41
6	CO-7	35.83
7	CO-8	20.82

5.1.4 Plastic limit:
The plasticity Index and plastic limit are shown in the table.

Sr no	Co-ordinate No.	PL	PI
1	CO-1	28.57	13.28
2	CO-2	15.21	8.58
3	CO- 4	23.17	11.79
4	CO- 5	26.63	9.89
5	CO-6	16.11	5.29
6	CO-7	21.12	14.71
7	CO- 8	14.71	6.10

5.1.5 Specific gravity:
Knowledge of specific gravity helps in the determination of soil properties like the degree of saturation, void ratio, etc. The result shows Specific Gravity which ranges from 1.799 to 2.63.

Sr no	Co-ordinate No.	SG (%)
1	CO-1	2.02
2	CO-2	2.248
3	CO- 4	1.799
4	CO- 5	1.803
5	CO-6	2.63
6	CO-7	2.365
7	CO- 8	2.353

5.1.6 Free Swell Index:
The Swell index was highest in Co-ordinate 2 and 6. The lowest value was 6.25 at Co-ordinate 7.

Sr no	Co-ordinate No.	Free swell (%)
1	CO-1	7.14
2	CO-2	7.69
3	CO-4	7.14
4	CO-5	7.14
5	CO-6	7.69
6	CO-7	6.25
7	CO-8	7.14

5.2 Engineering Properties

5.2.1 Standard Procter Test:
From the result of this test, we can say that the majority of the soil sample is having low Dry-density.

Sr no	Co-ordinate No.	OMC (%)	MDD (gm/cc)
1	CO-1	28.2	1.32
2	CO-2	12.3	1.90
3	CO-4	17.3	1.12
4	CO-5	16	1.336
5	CO-6	11.2	1.886
6	CO-7	20	0.95
7	CO-8	10.5	1.402

5.2.2 Permeability:
Permeability test was conducted only on 3 Co-ordinates. Results of these 3 samples suggest that the Coefficient of Permeability is low.

Sr no	Co-ordinate No.	Permeability (k) (cm/s)
1	CO-1	7.85*10-5
2	CO-4	9.045*10-5
3	CO-6	1.85*10-5

5.2.3 Direct Shear Test:

The values of angle of the internal friction do not vary from one Co-ordinate to another Co-ordinate and value of cohesion is also the same for all Tested Co-ordinate.

Sr no	Co-ordinate No.	Cohesion (c)	Angle of internal friction (Ø)
1	CO-1	0.08	27°
2	CO-4	0.07	26°
3	CO-6	0.04	27°

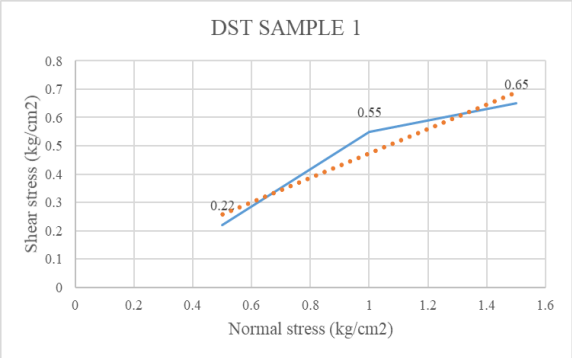

Figure 3: Graph of DST test of sample 1

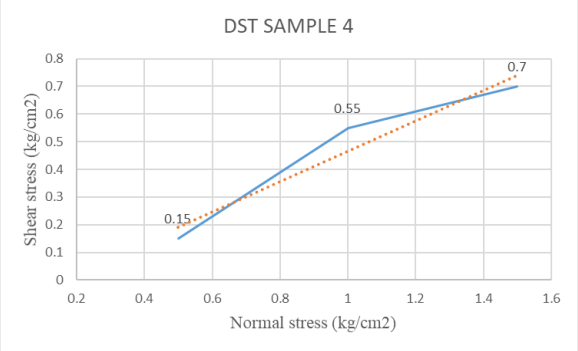

Figure 4: Graph of DST test of sample 4

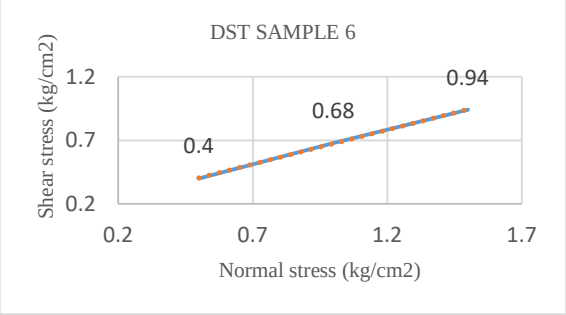

Figure 5: Graph of DST test of sample 6

Sample Label	Gravel %	Sand %	Silt + clay %	Specific gravity	FSI %	LL	PL	PI	Proctor test		Shear Parameters		Paremeablity (k) (cm/s)
									OMC %	MDD (gm/cc)	C (kg/cm²)	Ø	
1	29.3	65.1	5	2.02	7.14	41.85	28.57	13.28	28.2	1.32	0.08	27°	$7.85*10^{-5}$
2	34.6	56.6	7.9	2.248	7.69	23.79	15.21	8.58	12.3	1.90			
4	16.1	76.8	6.5	1.799	7.14	34.96	23.17	11.79	17.3	1.12	0.07	26°	$9.045*10^{-5}$
5	16.9	74.7	8.2	1.803	7.14	36.53	26.63	9.89	16	1.336			
6	18.1	72.6	7.5	2.63	7.69	21.41	16.11	5.29	11.2	1.886	0.04	27°	$1.85*10^{-5}$
7	25.5	64.8	9	2.365	6.25	35.83	21.12	14.71	20	0.95			
8	30.5	62.2	6.7	2.353	7.14	20.82	14.71	6.10	10.5	1.402			

6. CONCLUSION

In the present study, 7 samples were taken from different Co-ordinates and their Index, as well as Engineering properties of soil were analyzed. Following were the conclusions drawn from the study
Results from Standard Proctor Test analysis indicates that the majority of the soil samples possess low values of dry density which further needs to be densified by proper techniques.
In addition to this, the shear strength parameters obtained indicated fair to good values of angle of internal friction and low values of cohesion.
Results of permeability indicate that the value of the coefficient of permeability is low which is in contrast to the soil type. The probable reason for this maybe presence of organic matter due to which electric-dipole is generated that attracts water particles along the surface of the soil which obstructs the easy flow of water through the soil.

7. FUTURE SCOPE:

The properties of soil obtained such as Density, cohesion, and angle of internal friction obtained from the test can further be improved by :
Adopting suitable Ground Improvement Techniques for silty and sandy soil to modify the engineering properties of soil.
Possibility of exploring the generation of energy from Leachate can be studied

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REFERENCES

[1] Abhishek Nandan, Bikarama Prasad Yadav, Soumyadeep Baksi and Debajyoti Bose “Recent Scenario of Solid Waste Management in India” WSN 66 (2017) 56-74 EISSN 2392-2192.

[2] Ayub, S. & Khan, A.H. 2011. Journal of Chemical and Pharmaceutical Research. J. Chem, 3(1): 685-97.
[3] M. Danthurebandara, S. V. Passel, Dirk Nelen,,Yves, K. V. Acker "Environmental and socio-economic effects of landfills" Linnaeus ECO-TECH: Noveber 26-28, 2012.