International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 05, May-2022

Effect of Leachate on Geotechnical Characteristics of Soil in Lucknow the Capital of Uttar Pradesh

Mannu Singh[1], Kamal Nabh Tripathi[2]
[1]M. Tech Scholar, Environmental Engineering, Babu Banarasi Das University Lucknow
[2]Assistant Professor, Dept of Civil Engineering, Babu Banarasi Das University Lucknow

***Abstract*- The gradual decomposition of solid waste includes various bye-products and soluble materials like nutrients, pesticides, chemicals are leaching into the soil and causing soil pollution as well as ground water pollution. The leaching liquid known as Leachate percolates into the layers of soil and affects the Various Geo-technical properties. The study confines to identify the effects of the leachate on soil properties. Recent estimates indicate that approximately 100,000 metric tons of MSW is generated daily in India and more than 90% of the solid waste collected is disposed of by landfilling only. The study indicated that the dumpsite soils from four study regions show decreasing trends in the values of maximum dry density (MDD), specific gravity, cohesion and CBR, and increasing permeability as compared to the natural soil. The results show that the geotechnical properties of the soils at the location have been severely hampered due to contamination induced by open dumping of waste. In general, the soil properties have been found to deteriorate because of being contaminated by industrial effluents. Usage of geo-membrane at the dumping yard site improves the soil quality.**

Keywords: Solid waste, Leachate, Landfill, Soil, Decomposition, Waste management.

1. INTRODUCTION

As per the Census of 2011, Lucknow city has a total population of about 4.5 million including 0.6 million floating population which generates about 1500 metric tons of municipal solid waste every day. In general, leachate may comprise very high concentrations of dissolved organic matter and inorganic macro components. Once landfill stabilized, several parameters would change dramatically over period of stabilization. It is estimated that the emission greenhouse gaseous will increase by 50% in year 2020. This is the fact that low income groups generate less waste per capita than middle and high income groups. The specific waste generation rate in low income areas is low at 172.89 g
per capita per day. Middle income areas show a specific waste generation rate of 162.67 g per capita per day and high income residential areas range with 221.21g per capita per day. As leachate percolates into the soil, it migrate contaminants into the soil and affects soil stability and strength. . The rate of leachate production, its volume, and its properties depend on various factors, e.g., the composition of waste material, its particle size, and degree of waste compaction, waste moisture and temperature, the amount of rainfall, and the quantity and quality of biochemical that occur in the degradation stages of the MSW. The study includes the geotechnical investigation of dump soil characteristics and its comparison with the uncontaminated soil samples.

2 .PROBLEM STATEMENT

- Main objective of the research is to study the impact of leachate on soil characteristics which is generated by municipal solid waste dump practices in Lucknow region.
- Leachate testing which are frequently used to assess the potential risk of waste to release organic and inorganic contaminants into environment.
- Suggest some strategies that could help in prevention of soil quality.

3. RESARCH METHODOLOGY

The soil samples were collected within the dumping ground.
All the samples were collected at the same day. The 5 samples were taken from dumpsite near the IIM Road Lucknow at 100 meters distance from each other and labeled as sample 1, 2, 3, 4, 5. Sample collections were carried out in the months of November. The samples will be analyzed for parameters such as moisture content, specific gravity pH, liquid limit, plastic limit, permeability, CBR, Electrical conductivity.

4. STUDY AND FINDINGS

Description	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Moisture content (%)	25.714	24.642	25.806	26.315	27.868
Specific gravity	2.59	2.63	2.62	2.73	2.69
pH	7.35	7.65	7.80	7.75	8.10
Liquid Limit	35.38	32.8	30.5	28.59	37.6
Plastic limit	21.37	20.65	21.17	24.11	20.0
Plasticity index	14.01	12.15	9.33	4.48	17.6
Permeability (cm/sec)	3.033 * 10^-3	2.96* 10^-3	2.91* 10^-3	3.61* 10^-3	3.068 * 10^-3
CBR %	5.109	5.839	6.93	5.4744	6.56
Electrical conductivity	90.66	92.06	94.78	97.45	98.62

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 05, May-2022

Fig 1) Soil Sample Collection

Fig 2) Site Location near IIM Road, Lucknow

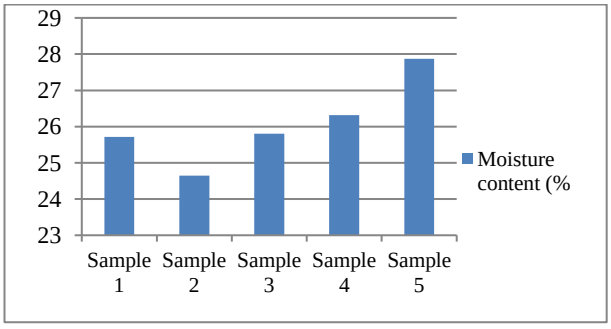

Fig 3. Effect of contamination Moisture content

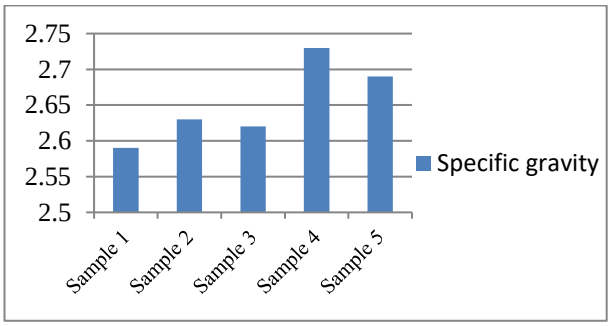

Fig. 4. Effect of contamination on Specific gravity

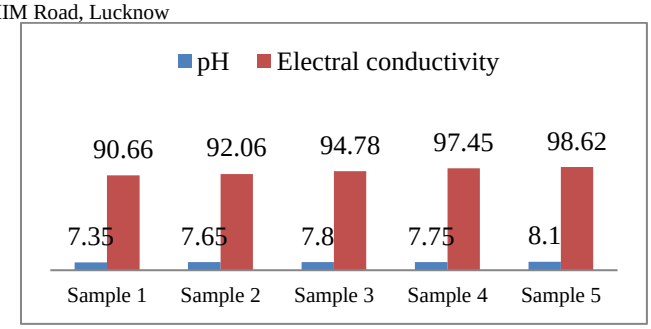

Fig. 5. Effect of contamination on soil pH and electrical conductivity

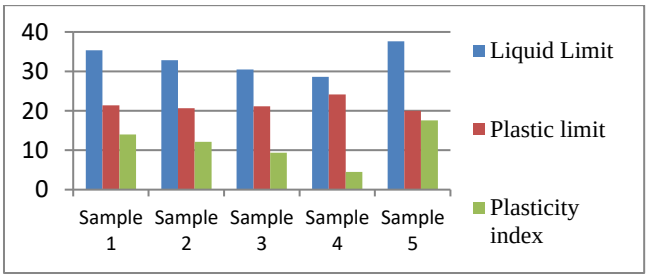

Fig. 6. Effect of contamination on Plastic limit and liquid limit

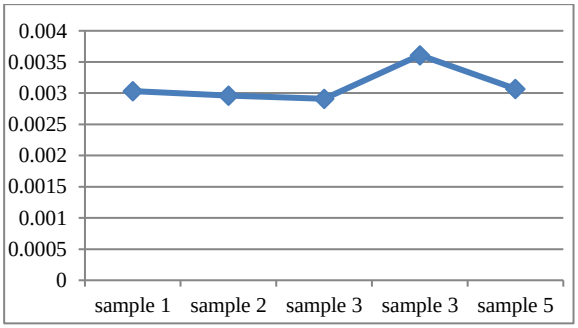

Fig. 7. Effect of contamination on Permeability of Soil

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 05, May-2022

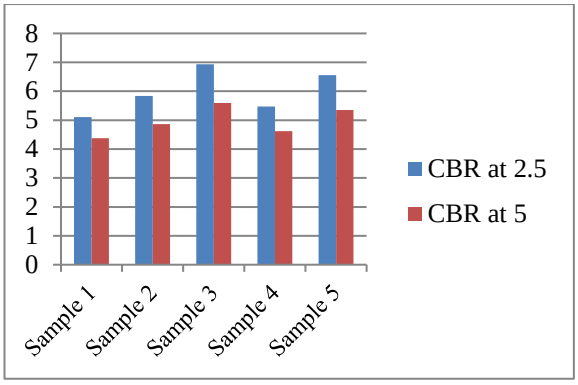

Fig. 8. Effect of contamination on CBR of soil

5. RESULT AND DISCUSSION

Description	Contaminated soil	Uncontaminated soil
Moisture content	26.075%	15.6
Specific gravity	2.625	2.51
pH	7.73	7.42
Liquid Limit	34.7083%	41.00%
Plastic Limit	21.46%	23.00%
Permeability cm/ sec	6.16×10^{-3}	3.00×10^{-3} to 6×10^{-3}
CBR	5.982	16

Table 2. Comparison between contaminated and uncontaminated soil

Leachates even in small concentrations have major long-term drawbacks on strength and compressibility of soil. Leachate is a water-based fluid that consists of groups of contaminants of dissolved organic matter (alcohol, acids, short chain sugar etc.), inorganic micro components (cations and anions including sulphate, chloride, iron, aluminum, zinc and ammonia), heavy metals (Pb, Ni, Cu and Hg). This wastewater can contaminate soils and groundwater not only in the proximity of the landfill but also at some distance, causing environmental and human health problems

Presence of various contaminants from organic origin can modify the viscosity of fluid as exhibited by leachate. Therefore, the leachate will affect the performance of structures relied on such soils

6. CONCLUSION

The main objective of this research was to study the effects of industrial contamination on local cohesive soils. The test results showed a significant change in the geotechnical properties of contaminated soils when compared with the parent soil samples. The conclusions drawn from this research work are as follows:

- Addition of acidic and basic contaminants, vary the pH of soil. Due to the presence of more free ions in contaminated soils, electrical conductivity is also increased.
- pH of the soil ranges from 7.35 to 8.10 which show that soil is slightly alkaline in nature. The alkalinity causes corrosive action to the bark of stems and root system.
- Due to chemical reaction between contaminant and soil particles, soil becomes more plastic in nature
- Contamination makes the soil highly compressible However, a decrease in the coefficient of consolidation of contaminated soils indicate a decrease in the permeability of contaminated soil.
- In general, the soil properties have been found to deteriorate because of being contaminated by industrial effluents. Special considerations would therefore be required for constructing on such soils
- Usage of geo-membrane at the dumping yard site does not show any decrease in the soil characteristics and it will be as same as with fresh land.

7. REFERENCES

[1] STANDING COMMITTEE ON URBAN DEVELOPMENT (2018-2019) SIXTEENTH LOK SABHA MINISTRY OF HOUSING AND URBAN AFFAIRS SOLID WASTE MANAGEMENT INCLUDING HAZARDOUS WASTE, MEDICAL WASTE AND E-WASTE TWENTY FIFTH REPORT

[2] ^ "Solid waste management rules, 2016". Civilsdaily. 15 September 2017. Retrieved 26 March 2019.

[3] ^ Jump up to:[a b c] "Government notifies new solid waste management rules". www.globalwmcindia.com/. Retrieved 26 March 2019.

[4] ^ "'Solid Waste Management Rules Revised After 16 Years; Rules Now Extend to Urban and Industrial Areas': Javadekar". pib.nic.in. Retrieved 26 March 2019.

[5] "A Small Town in West Bengal Helped Kolkata Win a Global Award for Waste Management". The Better India. 19 December 2016. Retrieved 21 January 2019.

[6] ^ "A tiny town in West Bengal is turning waste into piles of wealth". Hindustan Times. 13 December 2016. Retrieved 21 January 2019.

[7] ^ "/newsite/PrintRelease.aspx?relid=145110". Press Information Bureau. 9 May 2016.

[8] ^ "Position paper on The Solid Waste Management sector in India". Ministry of Finance, Government of India. Department of Economic Affairs. November 2009.

[9] ^ Joshi, Rajkumar; Ahmed, Sirajuddin; Ng, Carla Aparecida (19 February 2016). "Status and challenges of municipal solid waste management in India: A review". Cogent Environmental Science. 2 (1). doi:10.1080/23311843.2016.1139434.

[10] "SWMRT – Solid Waste Management Round Table". Retrieved 9 August 2020.

[11] International Journal of Engineering Research and General Science Volume 4, Issue 1, January-February, 2016 ISSN 2091-2730. Impact of Leachate on Soil Properties in the Dumpsite

[12] Qi, Chengdu; Huang, Jun; Wang, Bin; Deng, Shubo; Wang, Yujue; Yu, Gang (2018). "Contaminants of emerging concern in landfill leachate in China: A review". Emerging Contaminants. 4 (1): 1–10. doi:10.1016/j.emcon.2018.06.001

[13] ASTM D4439 Standard Terminology for Geosynthetics. ASTM International

[14] ^ Devkar, Ganesh A.; Mahalingam, Ashwin; Kalidindi, Satyanarayana N. (3 March 2017). "Competencies and urban Public-Private Partnership projects in India: A case study analysis". Policy and Society. 32 (2): 125–142. doi:10.1016/j.polsoc.2013.05.001. S2CID 155072781.

[15] Sunil, B.; Nayak, S.; Shrihari, S. 2006. Effect of pH on the geotechnical properties of laterite, Engineering Geology 85(1): 197–203. https://doi.org/10.1016/j.enggeo.2005.09.039

[16] Sunil, B.; Shrihari, S.; Nayak, S. 2009. Shear strength characteristics and chemical characteristics of leachate-contaminated lateritic soil, Engineering Geology 106(1): 20–25. https://doi.org/10.1016/j.enggeo.2008.12.011