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IMPACT OF MUNICIPAL SOLID WASTE DISPOSAL ON GEOTECHNICAL PROPERTIES OF SOIL

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ABSTRACT: In most of Indian cities, MSW used to dump nearby on low laying lands. This investigation aims to characterizing MSW and assessing geotechnical properties of contaminated soils at dumping sites in Chickballapur city of Karnataka. Representative solid wastes from selected wards of the city were collected and analyzed. Substantial release of leachate form the dump yards occurred during past few years and the soil at the dump site experience extensive contamination. The test results of contaminated and uncontaminated soil show increase in Optimum Moisture Content and decrease in Maximum Dry Density. The unconfined compressive strength decreased considerably for soil samples obtained at 0.0 m, 0.5 m and 1.0 m depths below waste dump. At depths greater than 1.5m compaction characteristics and UCC strength closely matches with the uncontaminated soil. Little variation in pH value, which makes soil slightly alkaline, was observed. From the study, it is inferred that, this investigation is very significant, as the foundation normally at these depths may be affected by this contamination.

INTRODUCTION

Municipal Solid Waste (MSW), a complex refuse composed of various materials with different properties. Some of the components are stable while others degrade as a result of biological and chemical process. Leachate resulted from this, is most hazardous pollutant for the soil underlying and subsequently ground water. Leaching of nutrients and heavy metals into the soil which leads to soil and groundwater contamination. MSW management is mainly focused on major cities in India. Safe and scientific practice of MSW disposal for any developing city is need of the hour.

The increasing level of solid waste is, now a day, a serious problem in the urban areas of the world. A high rate of growth of population and increasing per-capita income have resulted in the generation of enormous solid waste posing a serious threat to quality of soil and water. This is more so in the case of developing countries where large quantities of solid waste are dumped haphazardly, thereby, putting pressure on scarce land and water resources and at the same time affecting the geotechnical properties of soil [2].

STUDY AREA

The study area, one of the municipal solid wastes dumping site located near Chickballapur town of Karnataka, the birth place of Bharatharathna Sir. M. Visvesvaraya. The dumping site selected for this preliminary investigation, located between Nimmakalakunte and Ankanagondi village is about 7 years old, in which the solid waste dumping in this yard was in practice for a period of one to one and half of year later there was no further dumping in this site since seven years. The present practice of SWM is unscientific, disposing wastes on open space without considering the future environmental consequences

MATERIALS AND METHODOLOGY

In this investigation the main focus was to determine the extent of leachate effect on soil below the landfill with respect to- pH, Optimum Moisture Content, Maximum Dry Density and Unconfined Compressive Strength properties. To attain the study objectives, the following steps were followed:

a) Characterizing MSW.
b) Assessing geotechnical properties of contaminated soils at various depths.

Representative solid wastes from selected wards of the Chickballapur city were collected and analyzed. Disturbed soil sample was collected immediately below waste dumps sites which are seven to eight years old. The soil samples also collected from excavated pits right below the solid waste dump at different depths and were used for characterization. The representative uncontaminated soil samples are also collected adjacent to dumping site for comparisons.

RESULTS AND DISCUSSION

The extent of effect of MSW leachate on soil at dumping sites is presented in this paper. This investigation aims to characterizing MSW and assessing geotechnical properties of contaminated soils at dumping sites in Chickballapur city of Karnataka.

Characterizing MSW:

The solid wastes generated for a period of one week from dwelling houses of selected wards were collected and brought to laboratory. The solid wastes are segregated for characterization. The MSW consist of materials compostable waste (66 %), paper, cardboard (26%), plastic, glass (6%), leather, cloth, textile (1%) and inert material (1%).

Geotechnical Properties of Contaminated Soils at Various Depths:

Compaction characteristics:

The compaction characteristics of soil at deferent depths were studied in the laboratory using standard proctor test as per IS:2720 (Part-VII) - 1980. The Optimum Moisture Content and Maximum Dry Density values were established for uncontaminated soil. Soil samples obtained immediately below the solid waste dump, at depths of 0.5m, 1.0m and 1.5m beneath the soil surface were tested in the laboratory. The test results of Optimum Moisture Content and Maximum Dry Density for contaminated soil show increase in Optimum Moisture Content (26% -63%) and decrease in Maximum Dry Density (18%-13%) compare to uncontaminated soil[4,5]. The test results are represented in Table.1. This may be due to particle flocculation as a result of soil contaminated with MSW at varying concentration.

Table.1 Compaction characteristics of soil samples

Test	Un contaminated soil	Contaminated soil below natural ground level			
		0.0m	0.50m	1.00m	1.50m
OMC %	15.0	19.0	24.5	20.5	16.0
ODD kN/m^3	19.9	16.18	17.16	17.88	20.0

Unconfined Compressive Strength:

The Unconfined Compressive Strength tests were conducted on soil samples obtained at defined depths as mentioned in the Table.2 and the results are compared with Unconfined Compressive Strength value of uncontaminated soil. The Unconfined Compressive Strength decreased considerably (61% - 50%) for soil samples obtained at 0.0 m, 0.5 m and 1.0 m depths below waste dump. At depths greater than 1.5m compaction characteristics and Unconfined Compressive Strength closely matches with the uncontaminated soil. This clearly indicates the effect of MSW on strength behavior of soil

Table.2 Unconfined Compressive Strength of soil samples

Test	Un contaminated soil	Contaminated soil below natural ground level			
		0.0m	0.50m	1.00m	1.50m
UCC kN/m^2	44.0	17.0	22.0	30.0	42.5

pH value:

The pH tests were also conducted on soil samples obtained at various depths and the results are compared with pH value of uncontaminated soil. The test results are as depicted in table.3. The test result shows soil pH value increases resulting in changing from slightly acidic to slightly alkaline in the presence of leachate at different depths. It also shows that in the reduced concentration of leachate below 1.5 m, the pH of soil almost equal to pH value of uncontaminated soil[1].

Table:3. pH value of soil samples

Test	Un contaminated soil	Contaminated soil below natural ground level			
		0.0m	0.50m	1.00m	1.50m
pHvalue	6.6	7.5	7.6	7.3	6.7

CONCLUSIONS

The objective of this investigation was to determine the possible effect of leachate on soil in the solid waste dumping site which was seven years old, in which solid waste dumping in this site was in practice for a period of one to one and half years and later there was no further dumping took place in this site. An extensive laboratory testing program was carried out to achieve these objectives. The following conclusions were drawn based on test results.

- Leachate contamination leads to alter the compaction, density and strength properties of soil.
- The influence of leachate decreases with depth and its effect reflects as concentration varies. This is attributed due to chemical reactions with the leachate and soil particles.
- Experimental results indicated that geotechnical properties of soil varies with depth upto 1.0 m and there is no much changes in its properties beyond 1.5 m depth implies, leachate influence was limited to within this depth as further dumping of MSW was stopped.
- This investigation indicates that, greater effect to higher depth in the continued dumping site could be expected, as the size of landfill and variety of solid wastes disposed increases, large amount of leachate will be generated and create environmental problems.
- Future studies may be carried out to assess the leachate effect on soil and groundwater laterally in the landfill locality.

REFERENCES

1. Allam M.M,Sivapullaiah,P.V, Sankara Gullapalli;2008 "Geotechnical Behaviour of Soil Containing Mixed Layered Illite-Smectite Contaminated with Caustic Alkali, Electronic Theses and Dissertations of Indian Institute of Science.
2. Edward J Martin, James H Johnson. Jr, (1987), Hazardous Waste Management Engineering, published by Van Nostrand Reihold Company Inc. New York.
3. IS: 2720 (Part-VII) – 1980.
4. Sitraram Nayak, B.M. Sunil and S. Shrihari. (2007), Hydraulic and Compaction Characterstics of leachate-Contaminated Lateritic Soil, Jr. Engineering Geology, 94, Science Direct, ELSEVIER, 137-144.
5. Sunil. B.M , Shrihari. S and Sitaram Nayak. (2008), Soil –Leachate Interaction & Their Effects on Hydraulic Conductivity and Compaction Characteristics, the 12th International Conference of International Association, for computer methods & Advances in Geomechanics (IACMAG), 1-6 October, 2008, Goa, India, 2380-2386.