ASESSMENT OF SOIL AT DIFFERENT LOCATIONS FROM DUMPING YARD IN CITY

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Abstract - *Discharging of untreated municipal solid wastes (MSWs) onto land is very widespread in developing countries. The compounds contained in MSW cause a harmful effect to human, environment and also geotechnical properties of soil. Hence, an assessment of the extent of their local impact is of great interest to figure out the pollution they cause. Therefore, this study aimed at evaluating the effects of discharge of solid wastes on soil properties under dump yard and also at different locations away from site.*

In this experimental study, an effort has been made to analyze the effect of contamination on soil properties at different locations i.e., 0m, 50m, 100m & 150m away from dump yard at Sita kund, Golaghat, Sultanpur, U.P. Standard compaction tests, Specific Gravity tests, Unconfined Confined Strength (UCS) tests and California Bearing Ratio (CBR) tests are performed on selected soil samples. After analyzing tests results it is found that maximum dry density (MDD), Specific gravity, UCS and CBR increases as we move from dump yard site as contamination level is reducing as we move away from dump yard site.
Therefore, maximum values of MDD, Specific gravity, UCS and CBR are found at 150m from selected samples.

Key Words: **Municipal Solid Waste (MSW), Standard compaction tests, Unconfined Confined Strength (UCS), California Bearing Ratio (CBR), Silty Sand, dumping yard, etc.**

1. INTRODUCTION

Growth in urbanization and industrialization in India has led to increasing generation of municipal solid waste (MSW). The amount of MSW is expected to increase significantly in the future due to rapid population explosion and economical potential of cities (CPCB, 2000; Sharma and Shah, 2005; Hazra and Goel, 2009). The waste generation in India is higher than 42 million tons annually and the rate of solid waste generation varies from 0.2 kg/d to 0.8 kg/ d (Sharholy et al., 2008; Ogwueleka, 2009; Rana et al., 2015). It is reported from the literature study that the increase in MSW generation in India is around 5% annually (Sharholy et al., 2008; Kumar et al., 2009). It was estimated that the MSW generation is 127,486 tonnes per day (TPD) in India in 2011 (Rana et al., 2017). Out of the total waste generated in India, 89,334 TPD of MSW was collected and 15,881 TPD was recycled (TERI, 2015). At present, about 960 million tonnes of solid waste is being generated annually as byproducts during municipal, industrial, mining, agricultural and other processes in India. Out of this, 350 million tonnes is organic waste from agricultural sources, 290 million tonnes is inorganic waste of industrial and mining sectors, and 4.5 million tonnes is hazardous in nature (Pappu et al., 2007). Metro cities in India generate approximately 30,000 tonnes of solid waste every day, and Class 1 cities generate about 50,000 tonnes every day (Sujatha et al., 2013). The waste disposal sites and landfills that are neither properly designed nor constructed become point sources for pollution of aquifers and soils. MSW disposal is at a critical stage of development in India. There is a dire need to develop facilities for the disposal of drastically increased amount of MSW. More than 90% of the waste in India is believed to be dumped in an unsatisfactory manner. It is reported from the literature study that an area of approximately 1400 km2 was occupied by waste dumps in 1997 and it is expected to increase substantially in the near future (Goswami and Sarma, 2008; Sharholy et al., 2008). In this context, it is suggested to construct properlyengineered waste disposal facilities to improve public health and prevent environmental resources including surface water, groundwater, air and soil from being polluted (Nanda et al., 2011; Musa, 2012). This paper presents the assessment of geotechnical properties of soils within range of dumpsite (i.e., 0m, 50, 100m, 150m) and their comparison with each other to evaluate the impact of pollution potential of open dumping on soil in the region of Sultanpur City, Uttar Pradesh, India. Further, type of soil that is found at site is Silty Sand.

The geochemical analysis of the soil samples from respective study regions is done with CBR and UCS. The study also aims at encouraging authorities/researchers to work towards the improvement of the present scenario of open dumping of waste through some recommendations.

Anchal Sharma, 2017, described that properties of soil like MDD, specific gravity and UCS of soil is reduced due to contamination of soil. It is recommended that construction of engineered landfill is necessary. So that lechate cannot penetrate into the ground and not to affect the strength parameters of soil and in future any construction is possible over it.

Essienubong, 2019, described that dumpsites may contain hazardous and toxic substances which can affect soil and water in ground. He also showed that permeability of soil gets reduced due to waste contamination in soil, so it will reduce the consolidation process, if it has been used for construction of roads or buildings in future.

Keshav K Deshmukh, 2017, Described that organic carbon is found in dump yard soil and permeability of soil is also reduced as compared to normal soil. As we know that for early consolidation permeability should be high, so construction in such type of soil is not easy.

2. METHODOLOGY AND EXPERIMENTAL DATA

An experimental program has been done using soil samples collected from different locations near dump yard. Total 4 samples are taken from sites. These are given in Table – 1

Table -1: Description of Samples

Sr. No.	Description of Sample	Sample Name
1.	Sample taken from dump yard	Sample 1
2.	Sample taken at 50m from dump yard	Sample 2
3.	Sample taken at 100m from dump yard	Sample 3
4.	Sample taken at 150m from dump yard	Sample 4

Experiments like Specific gravity, atterberg's limits, particle size distribution analysis, UCS & CBR were performed during the project work. The method adopted for performing these experiments are as per Indian Standards

Particle Size Distribution of soil

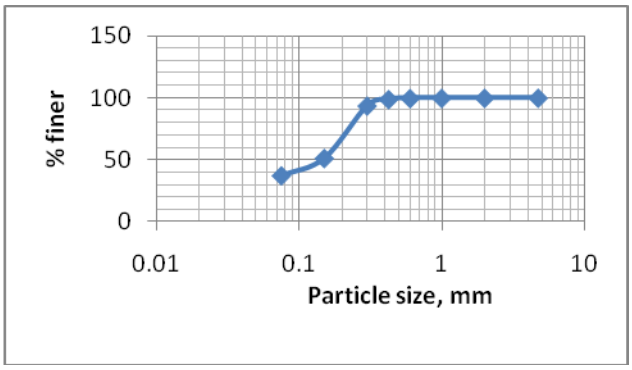

Fig- 1: Particle Size Distribution Curve

The above chart shows the PSD analysis of soil found at site and from this curve following data is obatained
From fig. 1,
D10 = 0.097114585 mm, Cu = D60 / D10 =2.35
D30 = 0.157194699 mm
Cc = (D30)2 / (D60 * D10) = 1.11
D60 = 0.228195014 mm
D50= 0.204528242 mm
Since, Cu< 6 & 1 < Cc< 3
So, it is sand fraction
Liquid limit & plastic limit of soil sample are 27% & 24% respectively. So, plasticity index is 3%.
According to 'A' line, Plasticity Index, IP = 0.73(27-20) = 5.11%

Classification of soil

More than 50% of soil retained on 0.075mm, so, it is coarse grained soil.
More than half of coarse fraction is smaller than 4.75mm IS sieve, so it is sand fraction (S).
Fines are greater than 12% and atterberg limits below A-line
From above data, it is concluded that soil is Silty Sands (SM).

3. RESULTS AND DISCUSSION

Soil samples obtained from different locations near dump yard (i.e., 0m, 50m, 100m and 150m) have been analyzed in a combined way for the outcome properties such as OMC, MDD, Specific gravity, UCS and CBR. The experimental results obtained and analysis of them is presented in coming discussions.

3.1 Maximum Dry Density (MDD)

Table 2 shows the maximum dry density of different soil samples taken from sites (i.e., 0m, 50m, 100m and 150m from dump yard)

Table- 2: MDD of SB different soil samples

Sample name	Sample 1	Sample 2	Sample 3	Sample 4
MDD(kg/m^3)	1741.63	1772.92	1783.18	1789.49

Figure 2 depicts the comparison of MDD of soil samples

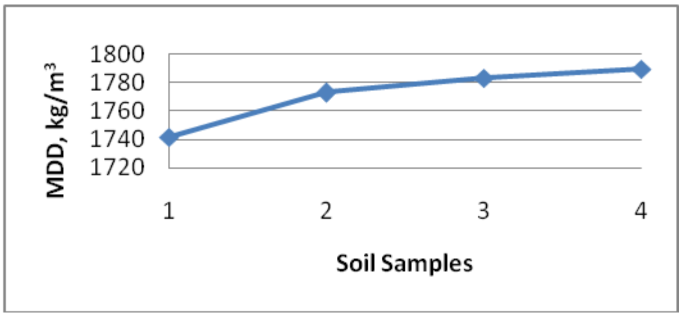

Fig- 2: Comparison of MDD of soil samples

From figure 2, it is observed that MDD is increasing as we move away from dump yard site because contamination is decreasing as we move away from dump yard site.
Therefore, from selected sites maximum MDD is found at 150 m away from dump yard site i.e. 1789.49 kg/m^3.

3.2 Optimum Moisture Content (OMC)

Table 3 shows the Optimum Moisture Content of different soil samples taken from sites (i.e., 0m, 50m, 100m and 150m from dump yard)

Table- 3: OMC of SB different soil samples

Sample name	Sample 1	Sample 2	Sample 3	Sample 4
OMC (%)	18.22	17.99	17.65	17.51

Figure 3. depicts the comparison of OMC of soil samples

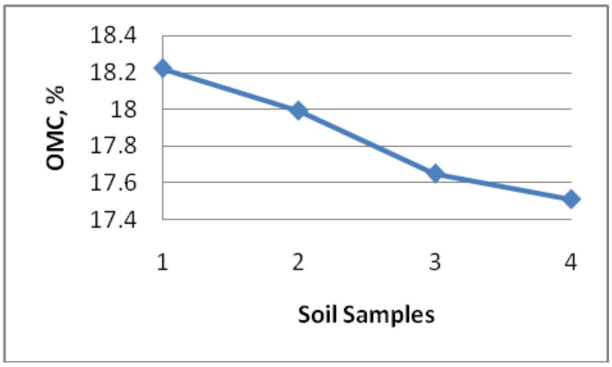

Fig- 3: Comparison of OMC of soil samples

From figure 3, it is observed that OMC is decreasing as we move away from dump yard site because contamination is decreasing as we move away from dump yard site.
Therefore, from selected sites minimum OMC is found at 150 m away from dump yard site i.e. 17.51%.

3.3 Specific Gravity

Table 4 shows the Specific Gravity of different soil samples taken from sites (i.e., 0m, 50m, 100m and 150m from dump yard)

Table- 4: Specific Gravity of SB different soil samples

Sample name	Sample 1	Sample 2	Sample 3	Sample 4
Specific Gravity	2.59	2.63	2.67	2.67

Figure 4 depicts the comparison of Specific Gravity of soil samples

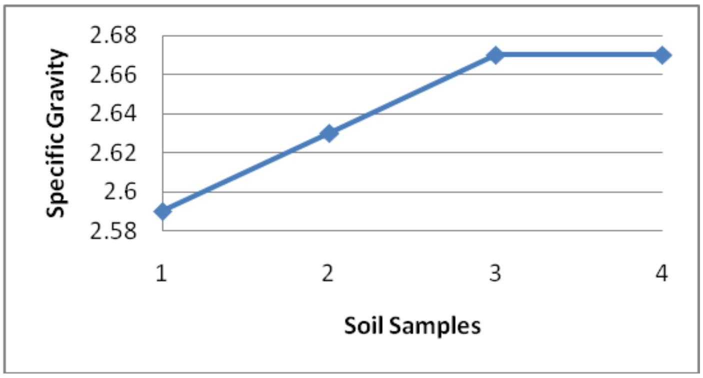

Fig- 4: Comparison of Specific Gravity of soil samples

From figure 4, it is observed that Specific Gravity is increasing as we move away from dump yard site because contamination is decreasing as we move away from dump yard site.

Therefore, from selected sites maximum Specific gravity is found at 150 m away from dump yard site i.e. 2.67.

3.4 Unconfined Compressive Strength (UCS)

Table 5 shows UCS of different soil samples taken from sites (i.e., 0m, 50m, 100m and 150m from dump yard)

Table- 5: UCS of SB different soil samples

Sample name	Sample 1	Sample 2	Sample 3	Sample 4
UCS (kPa)	230.83	244.51	249.70	258.28

Figure 5 depicts the comparison of UCS of soil samples

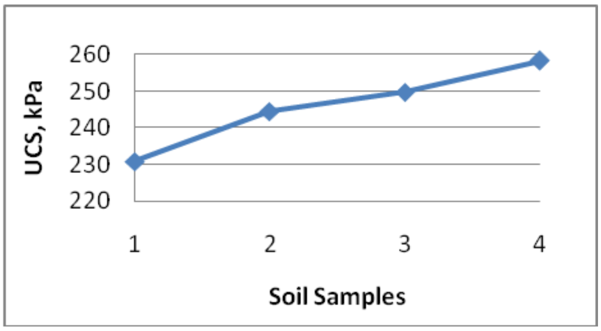

Fig- 5: Comparison of UCS of soil samples

From figure 5, it is observed that UCS is increasing as we move away from dump yard site because contamination is decreasing as we move away from dump yard site.

Therefore, from selected sites maximum UCS is found at 150 m away from dump yard site i.e. 258.28 kPa.

3.5 California Bearing Ratio (CBR)

Table 6 shows CBR of different soil samples taken from sites (i.e., 0m, 50m, 100m and 150m from dump yard)

Table- 6: CBR of SB different soil samples

Sample name	Sample 1	Sample 2	Sample 3	Sample 4
CBR (%)	3	3.52	4.46	4.54

Figure 6 depicts the comparison of CBR of soil samples

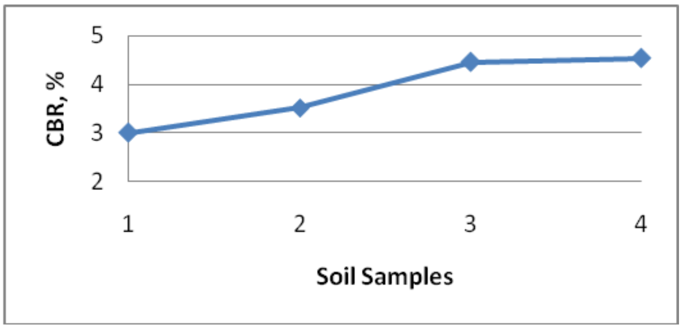

Fig- 6: Comparison of CBR of soil samples

From figure 6, it is observed that CBR is increasing as we move away from dump yard site because contamination is decreasing as we move away from dump yard site.

Therefore, from selected sites maximum CBR is found at 150 m away from dump yard site i.e. 4.54%.

Table 7 shows the percentage increment in MDD, Specific Gravity, UCS & CBR i.e. compared between Sample 1 & Sample 4.

Table- 7: Percentage increment in MDD, Specific Gravity, UCS & CBR

Sr. No.	Geotechnical property	Sample 1 (i.e., at 0m)	Sample 4 (i.e., at 150m)	Percentage increment, %
1.	MDD (kg/m³)	1741.63	1789.49	2.75
2.	Specific Gravity	2.59	2.67	3.08
3.	UCS (kPa)	230.83	258.28	11.89
4.	CBR (%)	3	4.54	51.33

4. CONCLUSIONS

Following tests: specific gravity, standard compaction tests, unconfined compressive strength test and California bearing ratio tests were carried out on several soil samples in order to investigate variation in strength characteristics of different soil samples and also comparison in these characteristics with regards to different soils sample locations.

Based on the results obtained from specific gravity, standard compaction tests, UCS and CBR tests the following conclusions are made:

- When soil samples are tested for MDD then it is found that due to higher contamination at dump yard site it has minimum MDD and it is slightly increasing as we move away from dump yard site and maximum found at 150m i.e., 1789.49kg / m^3.
- When soil samples are tested for Specific Gravity then it is found that due to higher contamination at dump yard site it has minimum Specific Gravity and it is slightly increasing as we move away from dump yard site and maximum found at 150m i.e., 2.67.
- When soil samples are tested for OMC(Optimum moisture content) then it is found that due to higher contamination at dump yard site it has minimum OMC(Optimum moisture content) and it is slightly increasing as we move away from dump yard site and maximum found at 150m i.e., 17.51%.
- When soil samples are tested for CBR then it is found that due to higher contamination at dump yard site it has minimum CBR and it is slightly increasing as we move away from dump yard site and maximum found at 150m i.e., 4.54%.

Therefore, it is concluded that maximum increment in MDD, specific gravity, UCS and CBR are 2.75%, 3.08%, 11.89% & 51.33% respectively with respect to original soil. Hence, it can be said that these above properties of soil are get reduced due to contamination if soil.

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