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A STUDY ON SOIL STABILIZATION BY USING MUNICIPAL SOLID WASTE INCINERATION ASH

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ABSTRACT

Soil stabilization is the alteration of soil to enhance their physical properties. The process of soil stabilization helps to achieve the required properties in a soil needed for the construction work. Weak soil generally swells and shrinks depending upon the presence of moisture content. Stabilization can increase the shear strength of a soil and control shrinkage properties of a soil and thus improving the load bearing capacity of a soil. In this project red soil is collected. Generally, red soils are low expansive soil having average strength and low bearing capacity. The weak soil mixed with different percentage of MSWA with different percentage of 2.5%, 5%, 10%, 12.5% and 15%. Liquid limit test, Plastic limit test, Standard proctor test were conducted on soil stabilization. Finally, the index properties and Compaction values of soil to be improved.

Keywords: MSWA (municipal solid waste ash), Liquid limit test, Plastic limit test, Standard proctor test and California Bearing Ratio.

1. INTRODUCTION

1.1 General

In India, highways play an important role in transporting goods and passengers for short and long distances. Highways cater 65% freight and 80% passenger traffic. In India National highways (NH) covers 1,00,087 km and other types of highways (state highways, major district roads, other district roads and village roads) covers 53,82,495 km. Sand is heavily used both in flexible and rigid pavements, created an increase in the demand of sand. The rate of construction had gathered some steam at the end of January, 2017 in India. It should be at 18.23 km/day compared with an average of 16.6 km/day in the financial year of 2015-16. As per National Highway Development Programme (NHDP), it is estimated to lay 30km road per day now. Presently, 71,772 km network of National Highways comprises only 1.7% of the total length of roads, but carries over 40% of the total traffic around the country both in length and breadth. Considering the target growth rate of about 9%, it is estimated that the total target National Highway network of about 85,000 km may be considered as reasonable for the 12th Five Year Plan (2012 – 2017), for the region development which are not connected by National Highway. Out of 1,00,087 km of National Highways about 24% length is of 4-lane and above standard, 52% length is of 2-lane standard and 24% length of single and intermediate standard. A total of 6604 km of National Highways has been constructed under National Highway Development Programme (NHDP) out of 15,000 km planned. Road infrastructure itself needs about 150 million tons of sand every year.

1.2 MSWA

Municipal Solid Waste (MSW) generation in India is of critical concern, especially in big cities. Hyderabad city, alone, produced approximately 4200 tons per day and per year 11550000 tons in 2018. The incineration of municipal solid waste, an effective method of

volume reduction, is presently receiving wide spread attention as a final disposal method of MSW in Hyderabad. Likewise, MSW incineration process creates two general types of ash; fly ash and bottom ash. MSW ash can be used in concrete; it will not only be able to reduce the consumption of cement raw materials, but also to solve the MSW ash disposal problems simultaneously found that MSW ash has an irregular grain surface and very high specific surface area. Other properties such as high loss on ignition, highly variable in characteristics and low reactivity were also contributing problems in the reuse of MSW ash as a pozzolan. Studied the properties of concrete containing MSW incineration ash and reported that different burning conditions affected the reactivity of MSW fly ash. In addition, samples from different compositions resulted in different chemical and physical properties of the final MSW ash cement studied the use of MSW as cement replacing material. The results show that the setting time of paste was delayed significantly. Compressive strength of the concrete replaced with MSW was also greatly reduced when compared with the control concrete.

Classified the combustible MSWs into three major types; paper, leaves, and food. After preparation, leaves, paper and food were separately burned in a ferro-cement incinerator. Finally, all types of combustible MSW ashes were ground in a grinding machine fixed at 45 minutes. The weight ratio of each combustible MSW ash to total raw material was fixed at 0.05 for all of the experiments. They found that chemical composition and setting property of these cement, as well as the compressive strength of concrete, were rather close to the control cement. From the previous research, the use of MSW ash as a pozzolan or cement replacing material gave undesirable properties of the cementanous materials. Another research used MSW ash as a part of raw materials by classifying the combustible MSW in to paper, leaves and food. The results showed that the general properties were similar to Ordinary Portland Cement (OPC). However, in practice it is difficult to classify MSW.

1.3 Red soil

Red soil is a type of soil that developed in a warm temp moist climate infer deciduous forest, improvement of some properties of soil for improved constructability but does not provide the design with a having thin organic and in- organic mineral layers overlying a yellowish-brown leached layer resting on alluvium red layer. Red soil generally derived from crystalline rock. They are usually poor growing soils , low in nutrias and humus and difficult to cultivate because of its low water holding capacity. In India covering a area of 3.5 lakhs sq.km and 10.6% of india's area.

2. LITERATURE REVIEW

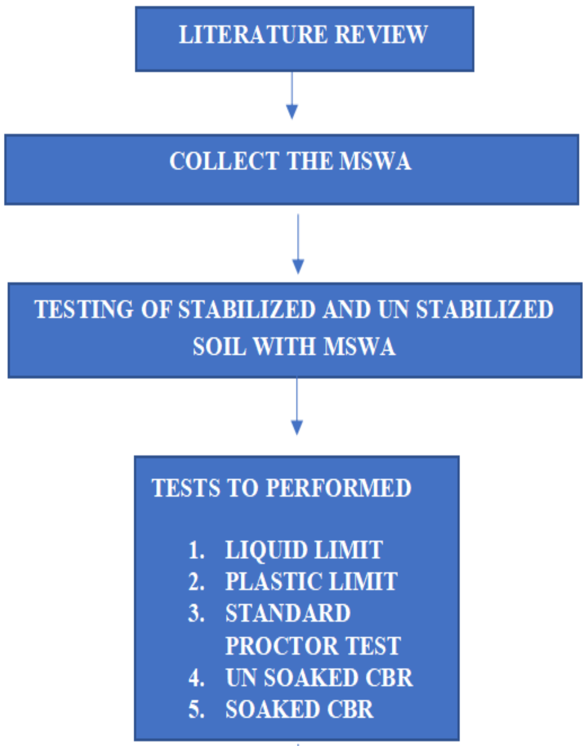
Bhavya (2015) reported the improvement in the strength of a cohesive soil collected from area in the vicinity of Renigunta Airport, India by addition of Municipal Solid Waste (MSW) incinerator ash as a soil stabilizing agent. Grain size distribution, specific gravity, Atterberg limits, maximum dry unit weight, optimum moisture content (OMC), UCS, CBR, free swell index (FSI) tests were performed on the soil sample. They used 0 to 50% of ash to stabilize the soil. The optimum bottom ash content was found at 25% considering the unconfined compressive strength of treated soil. The UCS value increased to 53.4 kPa and CBR value increased to 9.38 by addition of 25% ash. Taha (2006) presented the use of incinerator ash in stabilizing desert sands for possible use in geotechnical engineering applications. The incinerator ash was added in percentages of 2, 4, 8, 10, and 12%, by dry weight of sand. Laboratory tests such as compaction, unconfined compression, shear box and hydraulic conductivity were performed to measure the engineering characteristics of the stabilized material. The results showed substantial improvements in unconfined compressive strength and shear strength parameters (c and u). Thus, incinerator ash can be used to improve the shear strength characteristics of desert sands. The permeability of the sand–incinerator ash mixture was relatively low. Shi and Kan (2009) carried out study to investigate the feasibility of application of municipal solid waste incinerator fly ash as an auxiliary cementitious material. The water demand for normal consistency, setting time, volume stability, flexural, and compressive strength of municipal solid waste incinerator fly ash cement compound matrices were tested. The results show that the MSWI fly ash has some cementitious activity, but the reactivity is relatively lower and its addition to cement may lead to retardation of cement hydration.

3. OBJECTIVE AND METHODOLOGY

3.1 Objective of the study

1. To analyze the characteristics of Red soil for different concentrations of 0%, 5%, 10%, 15%, 20%, 25% and 30% MSWA mixed with it.
2. To study the effect of solid wastes namely MSWA in red soil on the variation of index properties and compaction characteristics.
3. To study the outcome of MSWA in soil stabilization, in the way to decrease the waste disposal problem, environmental pollution.

3.2 Methodology



4.EXPERIMENTAL INVESTIGATIONS

4.1 General

The detailed experimental programme of the present study was undertaken to investigate the changed behaviour of the available red soil when mixed with easily available local stabilizing admixtures like MSWA in different proportions individually or in combinations. This will enable to examine not only suitability of these composite materials in the construction of sub-grade for flexible pavement, but also to decide the optimum mixing proportion for cost effective construction.

Initially the geotechnical property like Atterberg limit of the soil and stabilized soil had been determined. The necessary experiment on made to determine the compaction characteristics i.e. optimum moisture content (OMC) and maximum dry density (MDD) by conducting Standard Proctor Compaction tests of those soils. The different tests were conducted in order to determine the different characteristics and properties of the soil..

5. RESULTS AND DISCUSSIONS

5.1.1 Atterberg Limit (Casagrande Method)

Table. 1: Atterberg Limits of Soil – MSWAMixes.

S. No	MSWA(%)	Liquid limit (%)	Plastic limit (%)	Plasticity index (%)	Group
1	0	52.3	30.8	21.6	MH
2	2.5	53.3	32.4	20.9	MH
3	5	53.5	33	20.5	MH
4	7.5	54.2	34.2	20	MH
5	10	54.7	35.1	19.6	MH
6	12.5	55.4	36.1	19.3	MH
7	15	56.1	37	19.1	MH

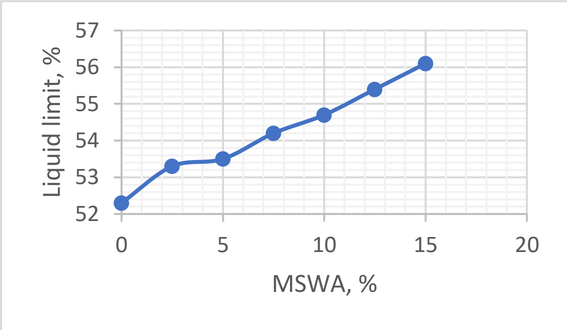


Fig. 1: Liquid limit test results.

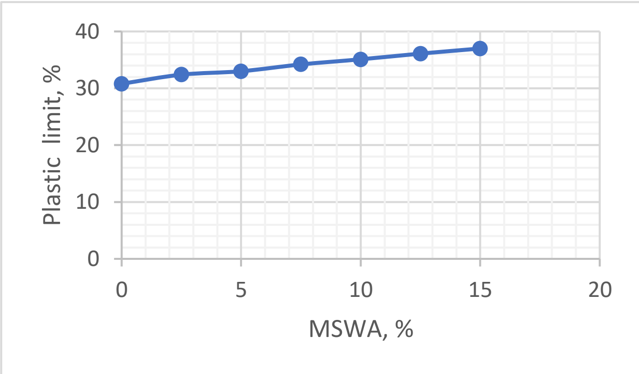


Fig. 2: Plastic limit test results.

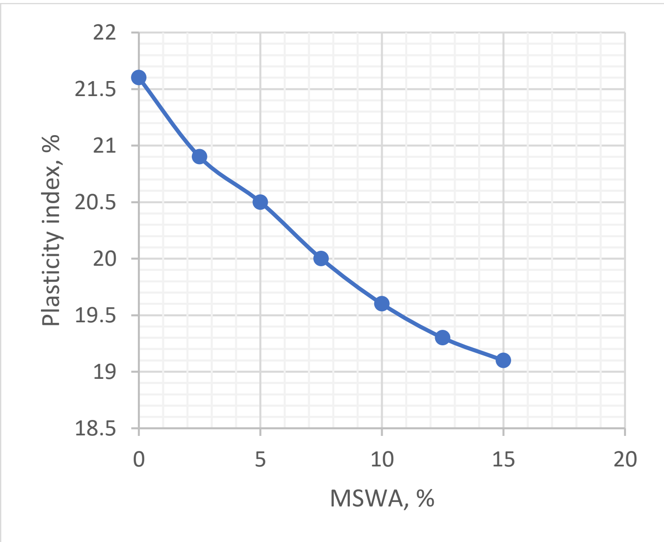


Fig. 3: Plasticity index test results.

5.1.2 Compaction test (Standard proctor method)

Table. 2: OMC and MDD of Soil-MSWAMixes

S.No	MSWA %	MDD(g/cc)	OMC (%)
1	0	1.436	26.8
2	2.5	1.420	27.3
3	5	1.398	28.6
4	7.5	1.352	29.4
5	10	1.342	30.6
6	12.5	1.280	31.5
7	15	1.242	32.2

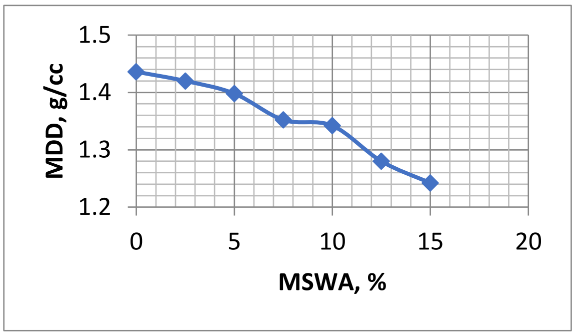


Fig. 4: OMC curve for soil + MSWA.

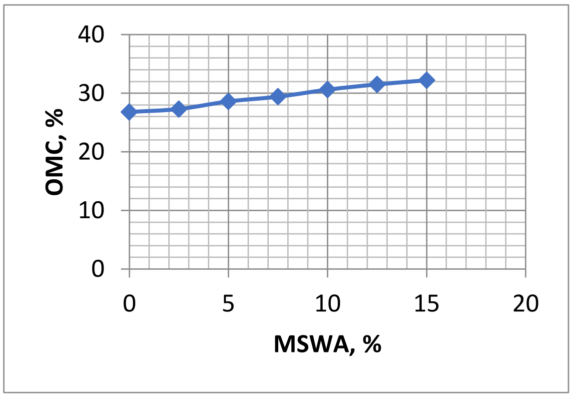


Fig. 5: MDD curve for soil + MSWA.

5.2 Discussions

Table. 3: Summary of soil with MSWAMix.

S.No	MSWA %	Property	Increment / Decrement
LIQUID LIMIT (%)			
1	0	52.4	0
2	2.5	53.3	+1.71
3	5	53.5	+2.09
4	7.5	54.2	+3.43
5	10	54.7	+4.38
6	12.5	55.4	+5.72
7	15	56.1	+7.06
PLASTIC LIMIT (%)			
1	0	30.8	0
2	2.5	32.4	+5.19
3	5	33	+7.14
4	7.5	34.2	+11.03
5	10	35.1	+13.96
6	12.5	36.1	+17.2
7	15	37	+20
PLASTICITY INDEX (%)			
1	0	21.6	0
2	2.5	20.9	-3.2
3	5	20.5	-5.09
4	7.5	20	-7.4
5	10	19.6	-9.23
6	12.5	19.3	-10.6
7	15	19.1	-11.5
MDD (g/cc)			
1	0	1.436	0
2	2.5	1.420	-1.1

3	5	1.398	-2.64
4	7.5	1.352	-5.84
5	10	1.342	-6.54
6	12.5	1.280	-10.8
7	15	1.242	-13.51
OMC (%)			
1	0	26.8	0
2	2.5	27.3	+1.8
3	5	28.6	+6.7
4	7.5	29.4	+9.7
5	10	30.6	+14.18
6	12.5	31.5	+17.53
7	15	32.2	+20.15

1. The liquid limit of the soil alone was found to be 52.4%. The liquid limit of the soil with addition of 15% MSWA was found to be increased by 7%, when compared to liquid limit of soil alone.
2. The plastic limit of the soil alone was found to be 30.8%. The plastic limit of the soil with addition of 30% MSWA was found to be increases by 20%, when compared to plastic limit of soil alone.
3. The plasticity index of the soil alone was found to be 21.6%. The plasticity index of the soil with the addition of 30% MSWA was found to be decreased by 11.5%, when compared to plasticity index of soil alone.
4. The optimum moisture content (OMC) and maximum dry density (MDD) of soil alone was found to be 26.8% and 1.436 g/cc respectively. The MDD of the soil with addition of 30% MSWA by weight of soil is found to be decreases by 13.51% and the corresponding OMC is increased by 20.15%.

6. CONCLUSIONS

On the basis of present experimental study, the following conclusions are drawn

1. The red soil was identified as Intermediate compressible inorganic silt is designed (MH) on Indian Standard classification system. MSWA was used to stabilize the soil for road construction in this study and a sufficient cementitious property was found in MSWA.
2. On addition of different percentage of MSWA in the soil (0 to 15%), the plasticity index decreases with an increase in the proportion of rice husk ash from 0% to 15%. The percentage decreases in plasticity index value of soil from 21.6 to 19.1, MSWA stabilized soil respectively.
3. The compaction characteristic of stabilized soil found to be dependent on the plastic nature of the soil. For medium plastic soil, addition of stabilizer to soil reduced the maximum dry density while increasing the optimum moisture content irrespective of stabilizer type.

REFERENCES

[1] Bhavya M, Harith M, Vinod Kumar G, Munilakshmi N, Sudharani Ch, Mallikarjuna Rao K (2015) A study on incinerator ash as a soil stabilizer

[2] Bose B (2012) geo-engineering properties of expansive soil stabilized with fly ash

[3] Dahale PP, Nagarnaik PB, Gajbhiye

AR (2012) Utilization of solid waste for soil stabilization Dinesh A, Gokilavani SR (2017) stabilization of soil by using solid waste

[4] Karthik S, Ashok kumar E, Gowtham P, Elango G, Gokul DS (2014) Soil stabilization by using fly ash Krishna MK, Chaitra BR, Kumari J (2016) Effect of municipal solid waste leachate on the quality of soil

[5] Lam CHK, Ip AWM, Barford JP, Mckay G (2010) Use of incineration msw ash a review

[6] Mir BA, Sridharan A (2013) Physical and compaction behaviour of clay soil–fly ash mixtures

[7] Show K-Y, Tay J-H, Goh ATC (2003) reuse of incinerator fly ash in soft soil stabilization Singh D, Kumar A (2017) Geo-environmental application of municipal solid waste incinerator ash stabilized with cement.