SOIL STABILIZATION USING BURNT MUNICIPAL SOLID WASTE

[1]Vipin Madadh, [2]Mr.Aman Bathla, [3]Dr.Gurcharan Singh

[1]Student, [2]Assistant Professor, [3]Head of Department
Department of Civil Engineering,
Geeta Engineering College,
Panipat, Haryana,India

***Abstract*: Soil stabilization using burnt municipal solid waste ash is done with varied test being carried out on different proportions of soil and additive which in our case is bottom ash and not fly ash. Many researchers attempt to stabilize the different type of soil with use of cementious materials or waste or as a combination; here we discuss some of works based on use of waste Ash which used in combination with cementious material or used separately. Ash and inert material collected after complete combustion are analyzed for their physical and engineering properties. MSW burnt in furnace and the ash collected at the bottom of the furnace is highly puzzolonic in nature and this material is often termed as Municipal incinerated bottom ash (MIBA). Many researchers in the recent past carried engineering studies on MIBA for its use as highway construction material using soil stabilizing techniques.**

***Keywords*: Soil waste, Plastic limit, Liquid Limit, CBR Test, Shrinkage Test.**

1.1 INTRODUCTION

Soil-improvement techniques involve changing soil characteristics by a physical action, such as vibration, or by the inclusion or mixing in the soil of a stronger material. The aim of this process is as follows:

- increase the load-bearing capacity and/or the shear strength
- reduce both absolute and differential settlements or in certain cases, accelerate them,
- To mitigate or remove the risk of liquefaction in the event of an earthquake or major vibrations.

Quite often, engineers may encounter situations where the selected site is not found suitable to take the load of the proposed structure. In such cases, various methods of ground improvement can be used to improve the ground conditions. The main objective of the ground improvement is to improve the characteristics of the soil at the site. Ground improvement is a rapidly developing field because good sites for construction are becoming limited day to day. The geotechnical engineer has the challenge of construction of foundation at the sites which are previously considered unsuitable and unacceptable. The presence of plant roots is a natural means of incorporating randomly oriented fiber inclusion in the soils. These plant fibers improve the strength of the soils and the stability of the natural slopes. There are several examples of reinforcing the soil like Great Wall of China (Branches of trees as soil reinforcement), etc.

The geotechnical engineers design foundations and other structures on the soil after investigation of the type of soil, its characteristics and its extent. If the soil is good at shallow depth below the ground surface, shallow foundation such as footing and rafts are generally most economical However if the soil just below the ground surface is not good but a strong stratum exist at a great depth, deep foundation such as piles, wells and caissons are required. Deep foundations are quite expensive and are cost effective only where the structure to be supported is quite heavy and huge. Sometimes the soil conditions are very poor even at greater depth and are not practical to construct. even deep foundation. In such cases various methods of soil improvement (stabilisation) and reinforcement techniques are adopted. The objective is to improve the characteristics at site and make soil capable of carrying load and to increase the shear strength, decrease the compressibility of the soil. Synthetic materials like geotextiles, geomembranes, geogrids, geocomposits etc have successfully been used in recent times for reinforcing the soil to improve their stability. Soil improvement incorporates various methods employed for modifying the properties of the soil to improve its engineering performance. Soil improvement techniques are used for a variety of engineering works like the construction of roads and air field pavements. The main objective is to increase the strength or stability of soil and to reduce the construction cost by making the best use of locally available materials.

1.2 Burnt Municipal Solid Waste(BMSW)

Solid Waste (SW) is the material that arises from various human and economic activities. It is being produced since the beginning of civilization. In the past they were conveniently disposed off on to open lands due to low population density and abundant availability. Ever increasing population growth, urbanization and industrialization is causing in generation of large quantities of solid waste. Increased waste generation and non-availability of lands for safe disposal is of serious concern to the Municipal

Administration. Despite spending 40-50 percent of Municipal service budget on solid waste disposal, most of the Indian Municipalities are unable to provide satisfactory solid waste management services. Often the solid waste disposal sites are away from urban limits and there is a need to find eco-friendly disposal solutions for MSW disposal and re use. There is a basic difference in composition of Municipal Solid Waste (MSW) generated in developing countries and developed countries. India, being a developing country cannot adopt waste disposal methods followed in developed countries. The conventional methods available for solid waste disposal are land filling, incineration, and composting and bio-gas generation. Composting and bio-gas generation methods are attempted but could not go commercially on large scale due to practical difficulties in implementation. Also the other issues involved in biogas and composting are operational, maintenance and marketing related. The incineration method of disposal is not adoptable due to huge capital investment. On land disposal method leads to pollution of ground water due to percolation of leachate and moreover it is becoming impracticable to continue with open land dumping due to scarcity of dumping sites. This necessitates adoption of suitable cost effective incineration method for safe disposal of MSW. In this method, waste collected from the dumping yards is set for natural burning for 24 hours on open yard to ensure complete burning of organic matter and all combustible matter like plastics, rubber paper, thermo coal etc,. which converts the solid waste into waste ash which known as Burnt Municipal Solid Waste.

1.3 Different Types of Stabilization

MECHANICAL METHOD OF STABILIZATION

In this procedure, soils of different gradations are mixed together to obtain the desired property in the soil. This may be done at the site or at some other place from where it can be transported easily. The final mixture is then compacted by the usual methods to get the required density. It shows load carrying capacity of stabilizes and unstabilized soil diagrammatically.

Denser soil after stabilization makes load distribution effective and improves soil bearing capacity. It enables load to be effective within soil mass which enhances load carrying capacity of soil.

ADDITIVE METHOD OF STABILIZATION

It refers to the addition of manufactured products into the soil, which in proper quantities enhances the quality of the soil. Materials such as cement, lime, bitumen, MSW ash etc. are used as chemical additives. Sometimes different fibers are also used as reinforcements in the soil. The addition of these fibers takes place by two methods

A) ORIENTED FIBER REINFORCEMENT

The fibers are arranged in some order and all the fibers are placed in the same orientation. The fibers are laid layer by layer in this type of orientation. Continuous fibers in the form of sheets, strips or bars etc. are used systematically in this type of arrangement.

B) RANDOM FIBER REINFORCEMENT

This arrangement has discrete fibers distributed randomly in the soil mass. The mixing is done until the soil and the reinforcement form a more or less homogeneous mixture. Materials used in this type of reinforcements are generally derived from paper, nylon, metals or other materials having varied physical properties.

1.4 NEED OF STUDY

1) To use municipal waste ash as a stabilizing material and to solve the problem of waste disposal.

2) To evaluate the different characteristics of soil for different proportions of ash in replacement of 5% and10%.

3) To analysis the cost of MSWA stabilization.

4) To study the results of replacement and concentration on future use.

5) To increase the shear strength of soil.

6) To reduce the thickness of sub grade for flexible pavement

7) To reduce the cost of flexible pavement.

1.5 MUNICIPAL BURNT SOLID WASTE

Solid Waste (SW) is the materialthat arises from various human and economic activities. In this method,waste collected from the dumpingyards is set for burning for 24 hours on open yard to ensure complete burning of organic matter and all combustible matter like plastics, rubber paper, thermo coal etc,. which converts the solid waste into waste ash which known as Burnt Municipal Solid Waste.

Fig. Process of incineration of MSW

1.5 CONCLUSION

FOR VIRGIN SOIL

Fig. Test for water content

- We used Oven Drying method for water content determination whose temperature is maintained at 105-110℃

Water Content = 13.63%

Cu = 4 and Cc = 1, hence the soil is poor graded oruniformly graded soil.

- We used Casagrande Apparatus for liquidlimit determination.

Fig. Test for Sieve Analysis

- Liquid Limit of soil was found to be 21.1%

Fig. Test for Liquid Limit

- The minimum water content is determined at which soil begins to crumble when rolled intothe thread of 3mm.
- Plastic limit of soil was found to be 14.28%

Fig. Test for Plastic Limit

- Shrinkage limit was found to be 10.77%
- OMC = 15.7%

Fig. Test for CBR

- MDD = 1.777 g/cc

CBR value at 2.5mm and 5.0mm penetration are 4.9and 5.69. So,

- CBR value of soil is 5.69

SOIL WITH 4% BOTTOM ASH

- We used casagrande apparatus for liquid limit determination.
- The minimum water content is determined at whichsoil begins to crumble when rolled into the thread of 3mm.
- Plastic limit was found to be 15.38%.
- Shrinkage limit was found to be 11%.
- OMC = 16%
- MDD = 1.78g/cc
- CBR value at 2.5mm and 5.0mm penetration are 5.69 and 6.41.

SOILWITH 8% BOTTOM ASH

- Liquid limit was found to be 23.61%
- Plastic limit was found to be 16.6%
- Shrinkage limit was found to be 11.8%
- OMC = 16.2%
- MDD = 1.79g/cc

CBR Value at 2.5 mm and 5.0 mm penetration are 6.05 and 8.3.
CBR Value of soil is 8.3.

SOIL WITH 12% BOTTOM ASH

- Liquid limit was found to be 21.82%
- Plastic limit was found to be 16%
- Shrinkage limit was found to be 11.2%
- OMC = 16.12%
- MDD = 1.78g/cc

CBR Value at 2.5 mm and 5.0 mm penetration are 6.05 and 7.59.

- CBR Value of soil is 7.59.

1. On the basis of various results such as liquid limit, plastic limit, shrinkage limit,max dry density and CBR Value we conclude that optimum value of ash that is desirable to use to stabilize the soil is found to be 8%

2. As plasticity index is 6.82 and liquid limit is 21.1 Hence soil was found as low compressible silt and clay.

3. As the value of CBR is more for soil with 8% ash than virgin soil. Hence it increased the bearing capacity of soil.

REFERENCES

1. IS: 2720 (Part 5-1985, 6-1972) Methods of tests for soil - Determination of
2. Atterberg's limits, Bureau of Indian Standards, New Delhi.
3. IS: 2720 (Part 7) 1980, Methods of tests for soil - Determination of water content - dry. Density relation using light compaction, Bureau of Indian Standards, New Delhi.
4. IS: 2720 (Part 16) 1987, Methods of tests for soil - Laboratory determination of CBR, 6. Bureau of Indian Standards, New Delhi.
5. H.M. Alhassan and A.M. Tanko(2004) Characterization of solid waste incinerator bottom ash.
6. IRC (2001) Guidelines for the Design of Flexible Pavements
7. https://www.sciencedirect.com/science/article/pii/S0013795203001054
8. https://ascelibrary.org/doi/abs/10.1061/(ASCE)0899-1561(2006)18:2(283)
9. https://www.sciencedirect.com/science/article/pii/S0950061804001734
10. http://www.ipublishing.co.in/jcandsevol1no12010/EIJCSE2060.pdf
11. https://s3.amazonaws.com/academia.edu.documents/3220169/soil_lime_stabilisation.pdf
12. https://theconstructor.org/geotechnical/ground-improvement-techniques-soil-stabilization/1836/
13. https://theconstructor.org/geotechnical/soil-stabilization-methods-and-materials/9439/
14. http://www.aiktcdspace.org:8080/jspui/bitstream/123456789/2060/1/aiktcDspace2060