

STABILIZATION OF SOIL USING INCINERATED HOSPITAL WASTE AND LIME

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ABSTRACT: It is essential that all hospital waste materials get segregated at the point of generation, appropriately treated and disposed of safely. Incineration of hospital waste is recommended practice in India. An attempt is made to in this study to investigate the feasibility of using IHW with lime to stabilize the Soil. Samples were prepared by mixing Soil with different percentage of Incinerated Hospital Waste and lime. It was found that 9% IHW with 3% of Lime is optimum percentage for stabilizing the soil.

Keywords: stabilization of Incinerated Hospital Waste, Scanning electron microscope, California Bearing ratio.

1. INTRODUCTION

Hospital waste, mostly contain needles, tubes, blades, bottles and other plastic type of wastes. These waste produced the Spread of infection and disease with create the Environmental pollution. The incineration of hospital wastes not only releases toxic acid gases (CO, CO₂, NO₂, SO₂, etc.), dioxides into the environment but also leaves a solid material called ash as residue which includes, bottom ash and fly ash which increases the levels of heavy metals, inorganic salts and organic compounds in the environment. Most of the ash produced is bottom ash that is the residues inside the burner after incineration. Fly ash settles on post burner equipment such as scrubbers. The incinerated hospital waste ash when melted at 1200°C, the ash is converted in to molten state and the molten ash is turned in to slag by cooling at room temperature. Metals are not destroyed during incineration, and often released into the environment along with ash.

2. EXPERIMENTAL MATERIAL USED

2.1 Incinerated Hospital Waste (IHW)

Incinerated hospital waste was collected from medical waste plant in Khalilabad, of District Santkabir Nagar of Uttar Pradesh. There is an incinerator plant of SNG waste management

having dual chamber direct combustion incinerator. The sample was directly collected from incinerator ash outlet in cement bags and brings to the soil mechanics laboratory of *M.M.M. University of Technology, Gorakhpur*. The properties of the Incinerated Hospital waste is given in Table 2.1-

Table 2.1 -Engineering properties of IHW

S. No	Properties	Typical value
1	Maximum dry Density, MDD(g/cc)	1.48
2	OMC, %	24 %
3	pH Value	9.0
4	Atterberg Limit	Non- plastic
5	Sand size content, %	50.00
6	Silt size content, %	50.00
7	Permeability, K, cm/sec	6.7×10^{-5}
8	CBR values	8.9

2.2 SOIL

In this experimental work, Soil was collected from Village Nirhae of District Gorakhpur of U.P. The soil samples were collected from a depth of about 0.3 to 0.4 m below the ground surface. The engineering properties of soil are given in the Table 2.2. Classification indicating that it is a clayey soil of Medium Plasticity.

S. No.	Properties	Typical value
1	I.S. Classification	CL
2	Sand size content	40%
3	Silt size content	32%
4	Clay size content	28%
5	Plastic Limit	15
6	Liquid Limit	34
7	Plastic Index	19
8	Optimum Moisture Content %	18.5
9	Maximum Dry Density, g/cc	1.40
10	Specific gravity, G	2.92
11	CBR values	1.78

2.3 LIME

These materials are formed from the reaction of calcium and aluminosilicates in the waste. As with all additives, additional stabilization can be accomplished through the use of other ingredients in other smaller quantity. Lime may also be added to raise the pH of acidic waste with other reagent that provides the main stabilization reactions such as fly ash. Lime based stabilization is typically used.

3. Result and Discussion

3.1 Stabilization of Soil using IHW and Lime

Incinerated hospital waste was mixed with 3% of lime and soil and experimental data is given in Table 3.1, the variation of moisture content and dry density is shown in Fig 3.1.

Soil mixed with different percentage of Incinerated hospital waste and using the same percentage of lime. It is given below-

- i. SOIL (94%) + IHW (3%) + LIME (3%)
- ii. SOIL (91%) + IHW (6%) + LIME (3%)
- iii. SOIL (88%) + IHW (9%) + LIME (3%)
- iv. SOIL (85%) + IHW (12%) + LIME (3%)

Table 3.1 Variation of OMC, MDD, CBR with 12% IHW+ Lime

SN.	SOIL	IHW	LIME	OMC %	MDD (g/cc)	CBR (5mm)
1	94 %	3%	3 %	23.6%	1.46	3.23
2	91%	6%	3%	24.0%	1.43	6.51
3	88%	9%	3%	24.5%	1.41	9.84
4	85%	12%	3%	25.0%	1.40	7.29

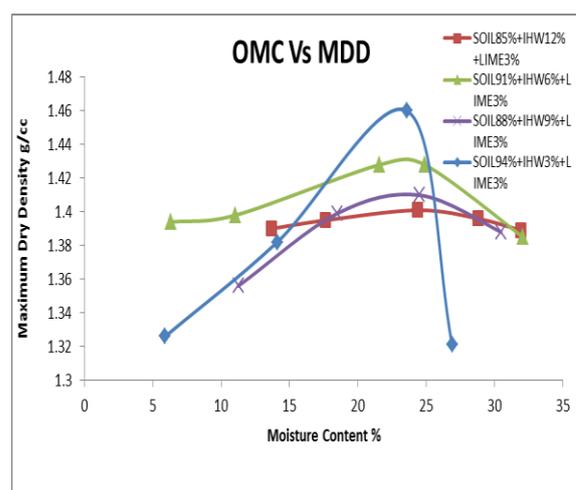


Figure3.1; Variation of moisture content with maximum dry density.

It is shown in Figure 3.1, that addition of IHW leads to decrease in maximum dry density and increase in optimum moisture content. This is due to fact that Incinerated hospital waste is a light weight material as compared to soil. Mixing of IHW with soil leads to an increase in surface area and hence an increase in optimum moisture content.

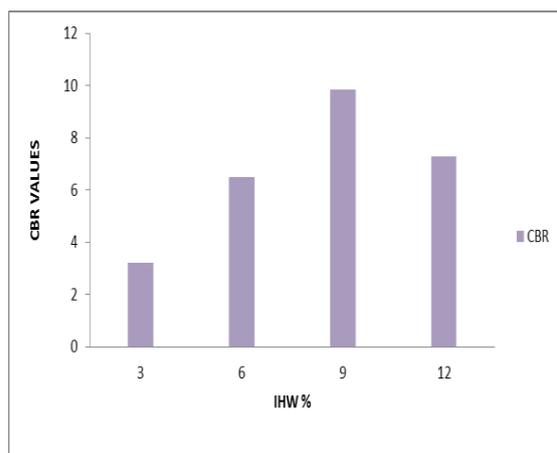


Figure3.2; Variation of CBR values and % IHW

Variation of CBR with Incinerated hospital waste is shown in Figure 3.2. It is evident from Figure 3.2 that maximum CBR was achieved at 9% of IHW and 3% of lime. This is due to fact that the addition of Incinerated hospital waste and lime causes the aggregation of soil leading to an increase in California Bearing Ratio (CBR).

4. Study of Scanning Electron Microscopy Imageries

The Scanning Electron Microscope (SEM) analysis was carried out to study the morphology of the selected samples. These SEM tests were carried out IIT-BHU, Varanasi of U.P. The microscopic picture was taken at different magnification an aim to understand the stabilization of sample.

4.1 Soil + IHW and Lime

Figure 4.1 and 4.2 shows the Scanning Electron Microscopic view at 1000X and 4000X respectively Soil with 9% Incinerated hospital waste and 3 % lime. It is clearly seen from the picture that mixing of Soil with 9% IHW and 3% lime leads to the aggregation of soil particle.

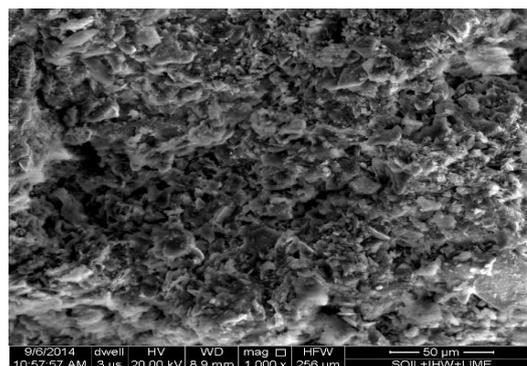


Figure4.1; SEM Image of Soil+9%IHW+3%Lime at 1000X magnification

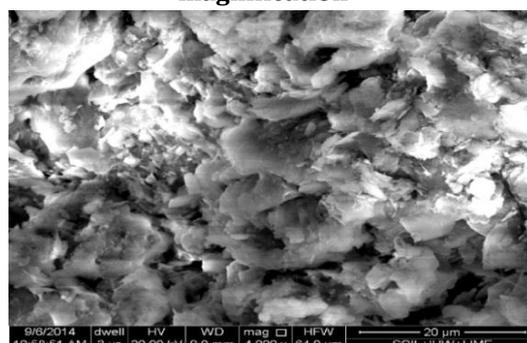


Figure4.2; SEM Image of Soil+9%IHW+3%Lime at 4000X magnification

5. Conclusion

Based on this study, the following Conclusions are drawn-

- i. Incinerated hospital waste (IHW) and of lime is quite effective in the stabilization of Soil.
- ii. Maximum CBR value of 9.8 was obtained where soil was treated with 9% Incinerated hospital waste and 3% of lime.
- iii. A SEM pictures shows that addition 9% of IHW and 3% of lime with soil leads to the aggregation of soil grain which leads to increase in CBR.

Thus, Incinerated hospital waste and lime may be used for stabilization of soil subjected to leachate studies confirm the encapsulation of toxic element metals present in the mixture.

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