EFFECT OF LIME ON GEOTECHNICAL PROPERTIES OF INCINERATED HOSPITAL WASTE

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ABSTRACT: It is now mandatory to incinerate the Hospital Waste (IHW) leading to development of huge quantity of Incinerated hospital waste (IHW), thanks to the large population. Disposal of IHW is of concern due to fact that land is a very precious commodity now and so, it is difficult to constants landfills for its disposal. A viable solution to the disposal problem would be to improve its property so that I may be used in fills/embankments. In this study, an attempt is made to improve the geotechnical properties of the IHW using different percentage of Lime. CBR values encourage the use of IHW with 9% of lime as optimum percentage. Due to toxic element present in the Incinerated hospital waste, it may be used in civil engineering projects only after removal/solidification of toxic element.

Keywords: IHW, LIME, Density, CBR value and Scanning electron microscope

1. INTRODUCTION

Hospital Waste generated by health care activities includes a broad range of materials, from used needles and syringes to soiled dressings, body parts, diagnostic samples, blood, chemicals, pharmaceuticals, medical devices and radioactive materials. Poor management of Hospital Waste potentially exposes health care workers, waste handlers, patients and the community at large to infection, toxic effects and injuries, and risks polluting the environment. In India, thanks to population rise, we may expect huge generation of incinerator hospital waste. It will produce million tons of IHW as a waste biomedical product and the environmentally acceptable disposal of this material has become an increasing concern. Incineration of Hospital waste produces around 65-70% of IHW (Lambardi et al, 1998). Proper effective disposal of IHW is a big task and efforts are underway to improve the use of IHW in several ways. Over the last few years, environmental and economical issues have stimulated interest in development of alternative materials that can fulfil design specification. Government of India made it mandatory for the hospital/Nursing homes to incinerate their waste and incinerated ash must be transfer to sanitary landfills. But due to high cost of land, it is not possible to develop new landfills. This study is an attempt to enhance the properties of Incinerated hospital waste, so that it may be used in the construction of embankments/filling.

Leachate tests were also carried out to study the percentage of toxic elements present in Incinerated Hospital waste.

2. EXPERIMENTAL MATERIAL USED

2.1 Incinerated Hospital Waste (IHW)

In this study, Incinerated hospital waste samples were collected from medical waste plant in Khalilabad, of District Santkabir Nagar of Uttar Pradesh (Figure 1) and tested in soil engineering laboratory of

M.M.M. University of Technology, Gorakhpur.

Figure1; Filtered IHW for engineering properties testing

The engineering and chemical properties of IHW are given in Table 1 and 2 respectively.

Table 1 Engineering properties of Incinerated Hospital Waste

S. No.	Properties	Typical value
1	Maximum Dry Density(MDD), g/cc	1.48
2	Optimum Moisture content(OMC), %	24 %
3	pH	9.0
4	Atterberg limit	Non- plastic
5	Sand size content	45.0%
6	Silt size content	55.0%
7	CBR values	8.0
8	Permeability, K, cm/sec	$6.7x10^{-6}$

Table2 Chemical properties of IHW (Source; Kaushik, 2011)

S. No.	Chemical Element	% by weight
1	Calcium	61.0
2	chlorine	11.2
3	Silicon	2.2
4	Sulphur	0.9
5	Sodium	2.1
6	Potassium	0.8
7	Magnesium	0.4
8	Iron	0.4
9	Zinc	0.3
10	Aluminium	0.2

2.2 LIME

It is very widely used in the improvement of engineering properties of sludge and fine grained soil in water logged areas (Uppal, 1960). Incinerated hospital waste (IHW) was mixed in various percentages of lime and cued for 28 days to study the improvement in engineering properties of IHW. Incinerated hospital waste and lime were mixed in various percentages as given below-

1. IHW (97%) + lime 3%
2. IHW (94%) + lime 6%
3. IHW (91%) + lime 9%
4. IHW (88%) + lime 12%

Table 3 Variation of MDD and CBR of IHW with addition of LIME

S.N.	IHW	LIME	OMC %	MDD (g/cc)	CBR (5mm)
1	100%	0%	24	1.48	8.98
2	97%	3%	23	1.42	12.66
3	94%	6%	22	1.41	15.61
4	91%	9%	21	1.38	26.42
5	88%	12%	12	1.30	36.20

3. RESULT AND DISCUSSION

The variation of different engineering particle of IHW mixed with lime is given in Table 3.The variation of Maximum Dry Density, Optimum Moisture Content and CBR with shown in fig2, 3 and 4 respectively.

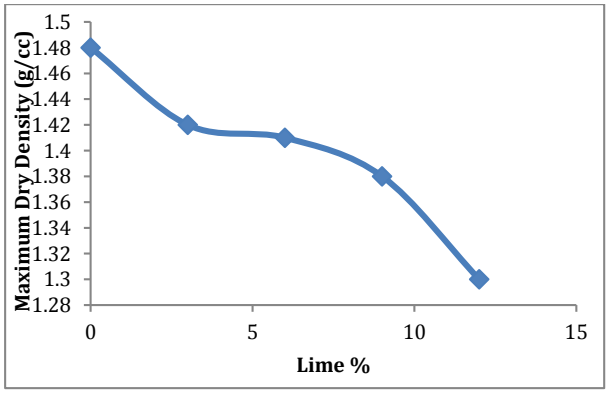

Figure 2; Variation of MDD with lime content

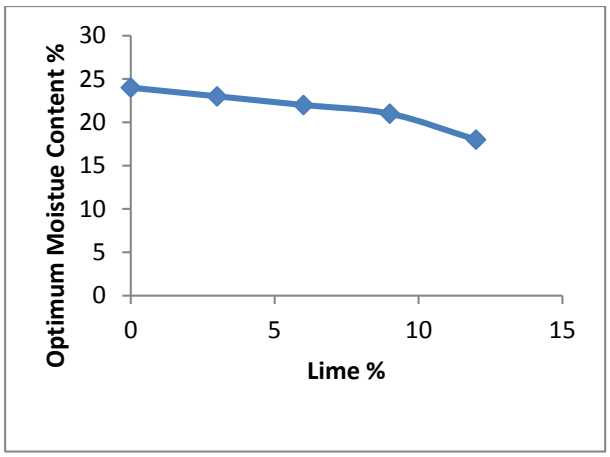

Figure 3; Variation of OMC with lime content

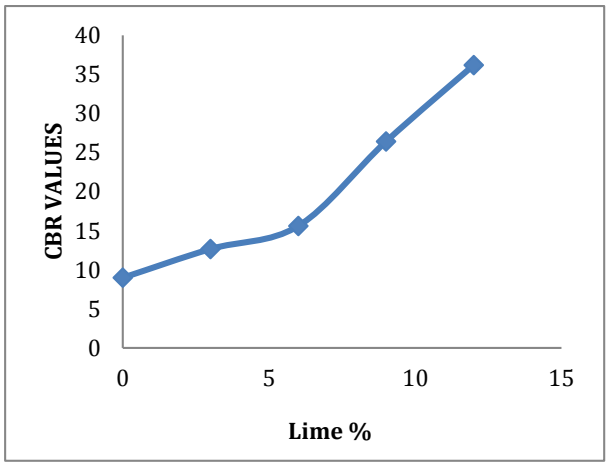

Figure 4; Variation of CBR curve different percentage of lime with IHW

It is evident from Fig 2 to 4 shown that addition of lime with IHW, result in the decrease of maximum dry density and Optimum moisture content (OMC) but California Bearing Ratio (CBR) value increases. Since CBR value of 26.42 is sufficient for its application in GSB layer and hence 9% of lime may be considered as optimum moisture content. The decrease in Maximum Dry Density (MDD) is due to fact that lime is lighter material as compared to IHW. It is also found that CBR increases with increase in lime content. It is due to fact that addition of lime leads to strength gain due to bonding of IHW particle.

4. SEM Imageries

The Scanning Electron Micrograph (SEM) analysis was carried out to study the morphology of the selected samples. These SEM tests were carried out IIT-BHU, Varanasi in Uttar Pradesh.

4.1 IHW and LIME

Figure 5 and 6 shows the Scanning Electron Microscope view at 1000X and 4000X magnification respectively of IHW mixed with 9% lime. It is clearly seen from the Imageries that there is decrease in voids leading to dense packing of constituents grains which could be the reason for its low permeability and high strength.

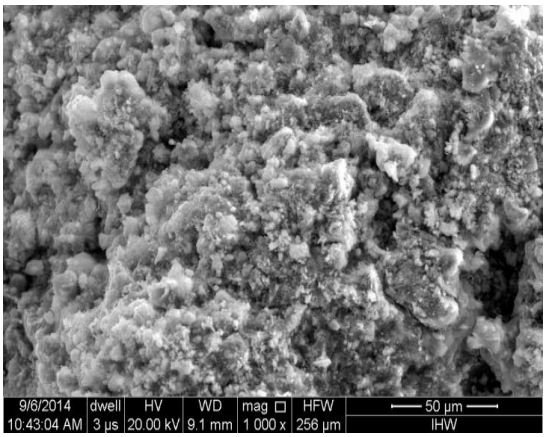

Figure 5; SEM Image of IHW+9%Lime at 1000X magnification

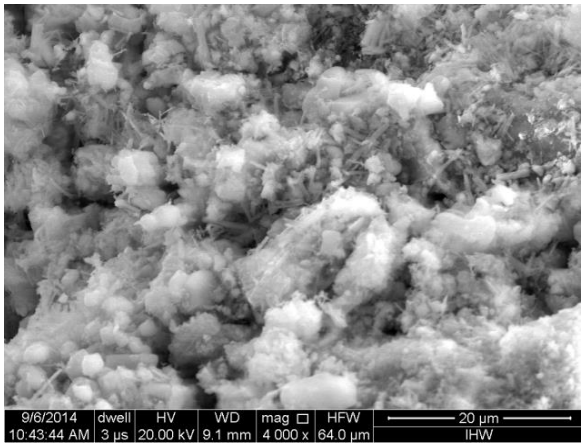

Figure 6; SEM Image of IHW+9%Lime at 4000X magnification

4.2 Leachate Studies

Leachate studies were carried with an aim to ascertain the leaching of heavy metals in IHW and 9% lime mix. High concentration of lead (Pb) and Arsenic (As) is found in leachate. Thus, IHW mixed with lime may be used in embankment/fill only after removal of toxic metals.

5. Conclusion

Based on this study, the following Conclusions are drawn-

1. It is found the 9% of lime is optimum percentage effective for the stabilized in order to improve the geotechnical properties of Incinerated hospital waste (IHW) based on CBR values.
2. It is found that when different a percentage of lime is mixed with IHW, then both the Optimum moisture content (OMC) and with addition of the maximum dry density (MDD) decreases.
3. A SEM Imageries shows that with addition of 9% lime, densest packing of IHW- Lime mixture is achieved.
4. Leachate studies show the availability of toxic metals in IHW.

It is found that Incinerated hospital waste (IHW) may be utilized in the construction of embankment/fills provided the toxic metal gets removal/stabilized.

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