International Journal of ChemTech Research
CODEN (USA): IJCRGG, ISSN: 0974-4290, ISSN(Online):2455-9555
Vol.10 No.8, pp 701-708, 201

Evaluation of Soil Properties on Clay Soil by using Mineral Admixtures and Human Ash

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Abstract : The clay soil is a problematic soil which cannot be directly used for the construction of structures because it has high swelling and high shrinkage. Various techniques are available to stabilize the soil to make better foundation for structures. Soil stabilization is the process of improving the engineering properties of the soil and thus making it more stable. This project deals with stabilization of clay soil by using mineral admixtures like lime with constant proportion of 1%, 3%, 5%, 7% & 9% and metakaolin with constant proportion of 2%, 4%, 6%, 8% & 10% and Waste material like human ash is added separately in various proportions like 0.5%, 1%, 1.5%, 2% & 2.5% to the soil with mineral admixtures. After the conclusion made from the laboratory test the optimum performance obtained is in **4% lime with 1.5% human ash** and **5% metakaolin with 1% of human ash.** Lime and Human ash combination can increase the maximum dry density(MDD) and Unconfined compressive(UCC) strength value of the soil.
Key Words : Clay soil, Mineral admixtures, Human ash, MDD and UCC value.

1.0 Introduction

Soil stabilization is the process of improving the engineering properties of the soil and thus making it more stable. Stabilization is used to reduce the permeability and compressibility of the soil mass in the earth. The main use of stabilization is to improve the natural soils for the construction of highways and airfields[1,2]. Improvements include increasing the weight bearing capabilities and performance of in-situ subsoil, sands, and other waste materials in order to strengthen road surfaces. Clay are the smallest particles in soil mass, and they behave as collids. The clay consists of minerals like Illite, Kaolinite and Montmorillonite[3,4]. Various techniques are available to stabilize the soil to make better foundation for structures. This project deals with stabilization of clay soil by using mineral admixtures (lime and metakaolin) mixed in constant proportion. Waste material like human ash are added separately in various proportions to the soil with mineral admixtures. The soil is taken from Kollapatti Village, Salem Dt, Tamilnadu. The clay soil has high swelling determined by Differential Free Swelling test[5,6].

1.2 Clay soil and its properties:

Table no:1 Properties of clay soil.

Test Conducted	**Result**	
Liquid limit	70.5%	
Plastic limit	40.15%	
Shrinkage limit	5.29%	
Plastic index	45.35%	
Shrinkage index	65.21%	
Standard proctor	OMC 12%	MDD 1.38kg/cm^3
UCC	1.25kg/cm^2	
CBR test	1.42g/cm^3	
Specific gravity test	2.7	

Table no:2 Properties of human ash

ELEMENT	**% BY MASS**	**ATOMIC %(CALC)**
Carbon	18%	9.5%
Oxygen	65%	25.6%
Sodium	0.1%	0.03%
Magnesium	0.05%	0.01%
Aluminium	0.72%	-
Silica	0.9%	-
Sulphur	0.2%	0.04%
Chlorine	0.2%	0.04%
Calcium	1.5%	0.24%
Iron	3g in men, 2.3g in women	-

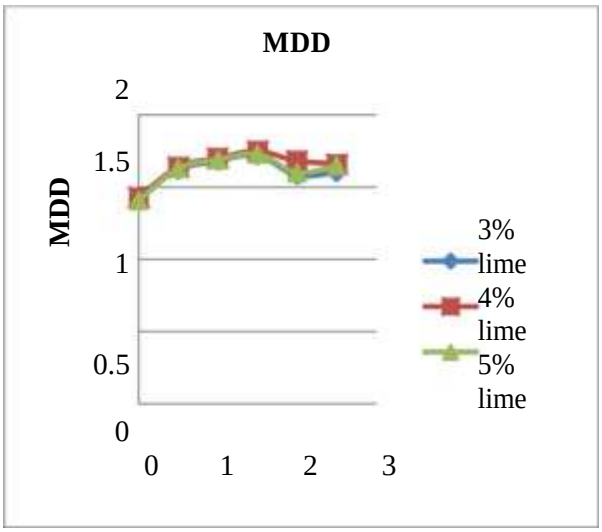
1.3 Human ash and its properties:

2.0 Experimental Test and Results:

In this project we have conducted the experiments on clay soil mixed with 3%,4%,5% lime added separately with 0.5%,1%,1.5%,2%,2.5% of human ash and 4%,5%,6% metakaolin added separately with 0.5%,1%,1.5%,2%,2.5% of human ash and the results are given below,

2.1 Maximum Dry Density for 3%, 4%, 5% Lime and Various % Human Ash

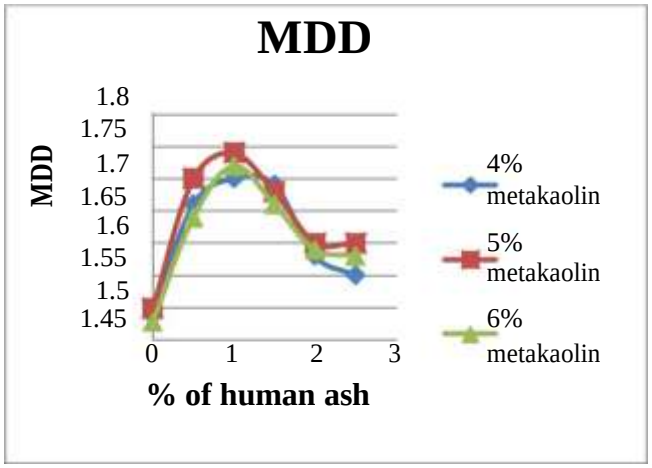
S.NO	% of human ash	MDD (3%lime with various % HA)	MDD (4%lime with various % HA)	MDD(5% lime with various % HA)
1	0	1.42	1.43	1.41
2	0.5	1.62	1.64	1.63
3	1	1.68	1.7	1.69
4	1.5	1.72	1.75	1.73
5	2	1.58	1.68	1.6
6	2.5	1.6	1.66	1.65



Graph no:1 (Maximum dry density for Clay with 3%, 4%, 5% Lime and various % Human ash)

2.2 Maximum Dry Density for 4%, 5%, 6% Metakaolin and Various % Human Ash

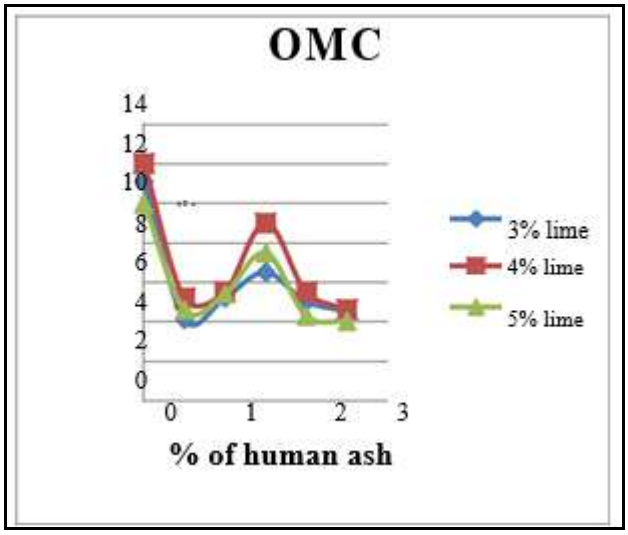
S.NO	% of human ash	MDD (4%M with various % HA)	MDD (5%M with various % HA)	MDD (6%M with various % HA)
1	0	1.488	1.498	1.477
2	0.5	1.66	1.7	1.64
3	1	1.7	1.74	1.72
4	1.5	1.69	1.68	1.66
5	2	1.58	1.6	1.59
6	2.5	1.55	1.6	1.58



Graph no: 2 (Maximum dry density for Clay with 4%, 5%, 6% Metakaolin and various % Human ash)

2.3 Optimum Moisture Content 3%, 4%, 5% Lime and Various % Human Ash

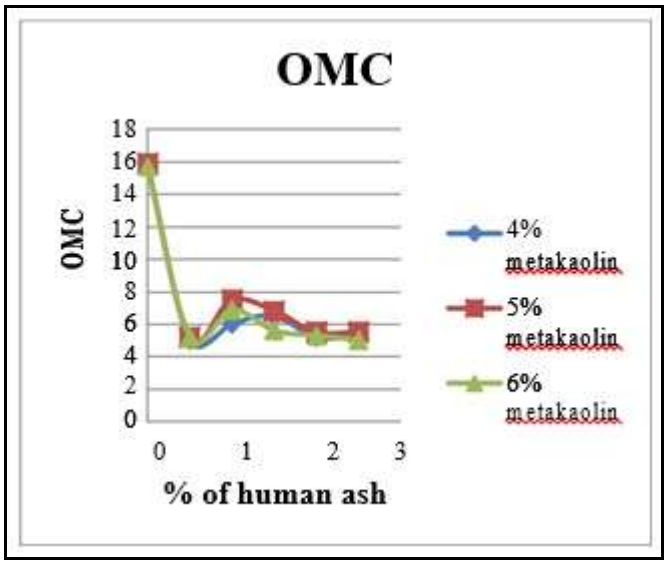
S.NO	% of human ash	OMC (3%lime with various % HA)	OMC (4%lime with various % HA)	OMC(5%lime with various % HA)
1	0	11.11	12	10
2	0.5	4.1	5.2	4.6
3	1	5.2	5.5	5.4
4	1.2	6.5	9	7.5
5	2	5	5.5	4.3
6	2.5	4.5	4.6	4



Graph no: 3 (Optimum moisture content for Clay with 3%, 4%, 5% Lime and various % Human ash)

2.4 Optimum Moisture Content for 4%, 5%, 6% Metakaolin and Various % Human Ash

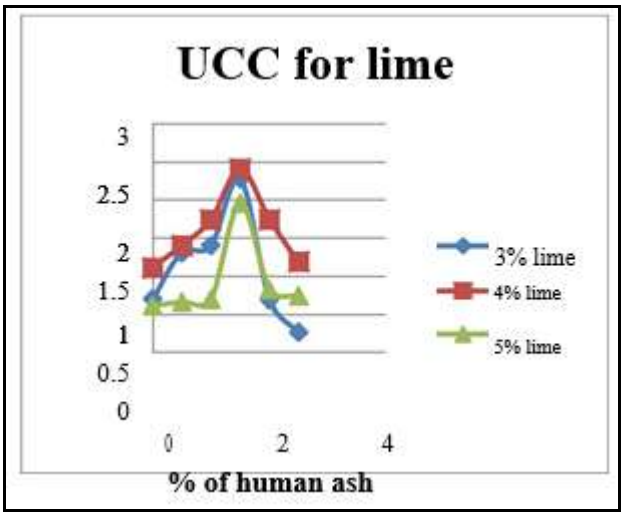
S. No	% of human ash	OMC (4%M with various % HA)	OMC (5%M with various % HA)	OMC (6%M with various % HA)
1	0	15.78	15.9	15.7
2	0.5	5	5.2	5.2
3	1	6	7.5	6.9
4	1.5	6.5	6.8	5.6
5	2	5.2	5.5	5.3
6	2.5	5.2	5.5	5



Graph no: 4 (Optimum moisture content for Clay with 4%, 5%, 6% Metakaolin and various % Human ash)

2.5 UCC for 3%, 4%, 5% Lime and Various % Human Ash

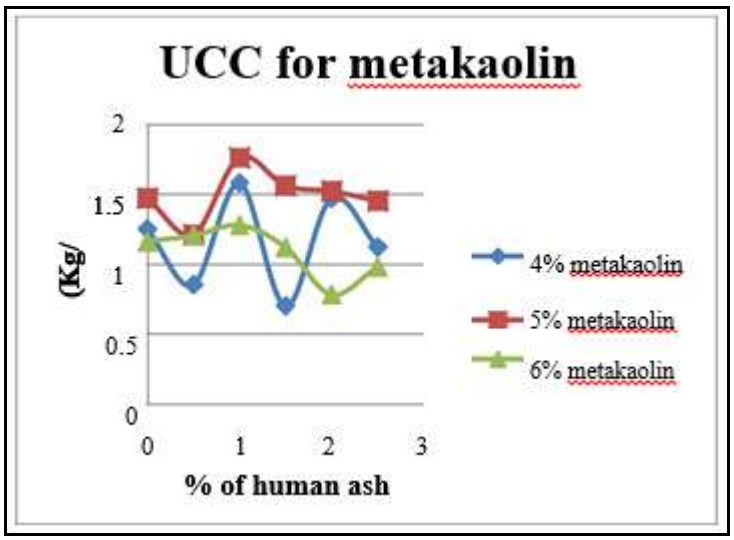
S.N0	% of human ash	Stress (3% lime with various % HA)	Stress (4% lime with various % HA)	Stress (5% lime with various % HA)
1	0	0.7	1.11	0.61
2	0.5	1.3	1.4	0.66
3	1	1.4	1.74	0.7
4	1.5	2.27	2.4	1.96
5	2	0.69	1.74	0.83
6	2.5	0.26	1.19	0.74



Graph no: 5 (Optimum moisture content for Clay with 4%, 5%, 6% Metakaolin and various % Human ash)

2.6 UCC for 4%, 5%, 6% Metakaolin and Various % Human Ash

S.NO	% of human ash	Stress (4% M with various % HA)	Stress (5% M with various % HA)	Stress (6%M with various % HA)
1	0	1.25	1.47	1.16
2	0.5	0.85	1.21	1.2
3	1	1.58	1.76	1.28
4	1.5	0.7	1.56	1.12
5	2	1.47	1.52	0.78
6	2.5	1.12	1.45	0.98



Graph no: 6 (Unconfined compressive strength for Clay with 4%, 5%, 6% Metakaolin and various % Human ash

3.0 Conclusion:

The aim of this project is to improve the index and engineeering properties of expansive clay soil [7,8].In this project we have concluded that by adding lime, metakaolin and human ash with clay soil it gives high index properties and bearing strength when compared to clay soil[9].

Maximum dry density and compressive strength of soil increased with 4% lime with 1.5% human ash. and also increased with 5% metakaolin and 1% human ash.

By comparing lime and metakaolin the best result obtained on soil with 4% lime and 1.5% human ash. It is very economical for soil stabilization.

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