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Soil Stabilization Using Rice Husk Ash For Clayey Soil Of Patna

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ABSTRACT

Soil stabilization has become a very important issue in the field of civil engineering works, happening in and around the Patna City, due to the need of modification of local soil. It seems that properties of local soil such as plasticity, texture, volumetric stability, hydraulic conductivity and workability may not be suitable for the strength and stability requirements of various types of upcoming diverse structures required to be constructed under the ambit of smart city project, patna in coming future. Modification can produce improvement in strength as well as stability requirements.Research regarding the effectiveness of using agricultural/industrial wastes are rapidly increasing in the other parts of the world. Rice Husk Ash seems to be very suitable as a stabilizer for the soils in case of Patna City due to suitability in terms of cost, availability and environmental factors. Soil sample taken for the study of the clayey soil with high plasticity requires to be strengthened due to high expansion property. The performance of the soil mixed with the RHA was investigated with respect to compaction test, Unconfined Compressive Strength (UCS) test & California Bearing Ratio (CBR) tests. The results obtained indicates a decrease in the MDD and increase in OMC and a superficial improvement in CBR and UCS values with increases in RHA content. The peak UCS values were recorded at between 7-10 % RHA which indicated that a small amount of RHA can lead to considerable improvement in the strength and stability characteristics of soil.

Keyword: Stabilization,Rice Husk Ash(RHA),Plasticity ,Volumetric Stability,Maximun Dry Density(MDD), Optimum Moisture content(OMC),CBR,UCS

INTRODUCTION

There are various types of soil stabilizer like blast furnace slag or the fly ash compared to which rice husk ash is a very cheap waste material which shows great improvement in soil behaviour. If we get desired stability from this stabilized soil, then we have no requirement of extra (heavy) reinforcement in foundation to sustain a particular structure. I think Rice Husk Ash is a very good and cheap material in terms of availability and economic. We are second highest producer of rice after china, and thus huge production of rice husk which is a type of waste material. I had decided to utilise this waste as soil stabilizing material. This is a type of physical stabilisation method. Rice Husk Ash has highest composition of silica (85-90%) which induce binding property to the soil. This is burn at700-800 Celsius to induce better binding property by silica. In this project I will enhance engineering property of expansive clayey soil by using Rice Husk Ash. I had taken clayey soil of Patna city, this city comes under SMART CITY PROJECT, so obviously there will be various type of construction work. In this project I had improved Maximum Dry Density value, Reduces Optimum Moisture content,Liquid Limit & Plastic Limit. Increases CBR value,Shrinkage Limit & UCS value.Some of Equipment like cassagrande apparatus, Modified compaction test tool,Mercury and 1000ml&250ml flask has been used.

To achieve the aim of our project, work has been planned as per the following objectives:-

(i) To determine the geotechnical properties of clayey soil and rice husk ash individually.
(ii) To investigate the performance of the soil-RHA mix with respect to compaction characteristics, Unconfined Compressive Strength (UCS) and California Bearing Ratio (CBR) for the various proportions.
(iii)To study the effect of RHA on engineering properties of Clayey Soil.

Material:

Properties of clayey soil:

Specific gravity	2.62
Liquid Limit	43.24%
Plastic Limit	24%
Shrinkage Limit	15.62%
Maximum Dry Density	19.65KN/m3
Optimum Moisture Content	17.65%
California Bearing Ratio(%)	5.36
Unconfined Compressive strength(kN/m2)	115.84

Properties of Rice Husk Ash:

Physical Property:

Liquid Limit	Non Plastic
Plastic Limit	Non Plastic
Specific Gravity	2.04
Maximum Dry Density	8.16KN/m2
Optimum Moisture Content	38.65%
California Bearing Ratio	12.75%

Chemical constituents	Percentage composition (%)			
	Sample 1	Sample 2	Sample 3	Average
SiO_2	81.04	86.51	78.87	82.14
Al_2O_3	1.80	0.61	1.61	1.34
Fe_2O_3	1.01	0.60	2.20	1.27
CaO	1.60	0.71	1.33	1.21
MgO	2.25	1.53	2.11	1.96
SO_3	0.45	0.02	0.03	0.17
Na_2O	0.16	0.05	0.21	0.14
K_2O	2.35	1.89	2.03	2.09
P_2O_5	5.26	4.20	9.87	6.44
Total $SiO_2 + Al_2O_3 + Fe_2O_3$	83.85	87.72	82.68	84.75

METHODOLOGY

The laboratory tests were carried out first on the natural soil which include liquid limit, plastic limit, plasticity index, specific gravity, compaction CBR and UCS. Specimens for Unconfined compressive strength (UCS) tests are prepared at the Optimum moisture contents (OMC) and Maximum dry densities (MDD). Further a series of laboratory tests were conducted on Clayey Soil mixed with Rice Husk Ash in various percentages i.e. 10% 20%, 30%,40% and 80% by weight of dry soil. For the above different proportions, tests are carried out to observe the changes in the properties of soil i.e. maximum dry density, optimum moisture content, unconfined compressive strength of soil,and California bearing ratio.

RESULT AND CONCLUSION:

Table-1 Variation of Liquid limit with RHA

Percentage of rice husk ash(%)	Liquid Limit(%)
0	43.24
5	42.82
10	40.3
20	37.48
30	33.32
40	29.52
80	22.28

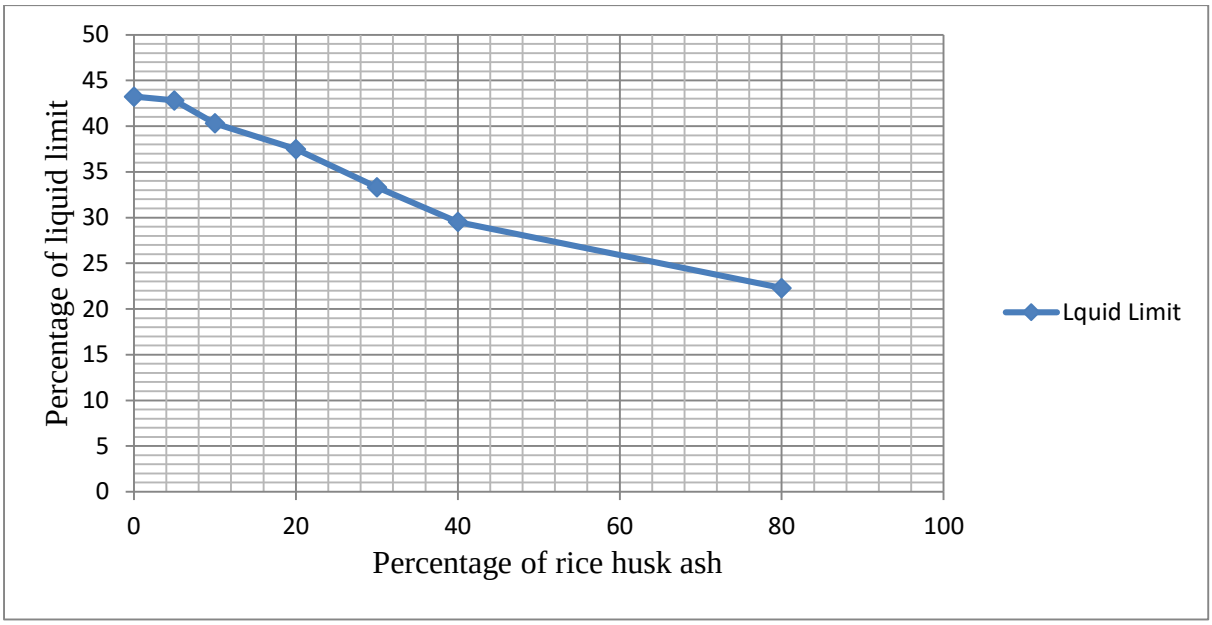


Table-2 Variation of plastic limit with RHA

percentage of RHA	plastic limit (%)
0	24
10	18.25
20	15.78
30	10
40	8.5

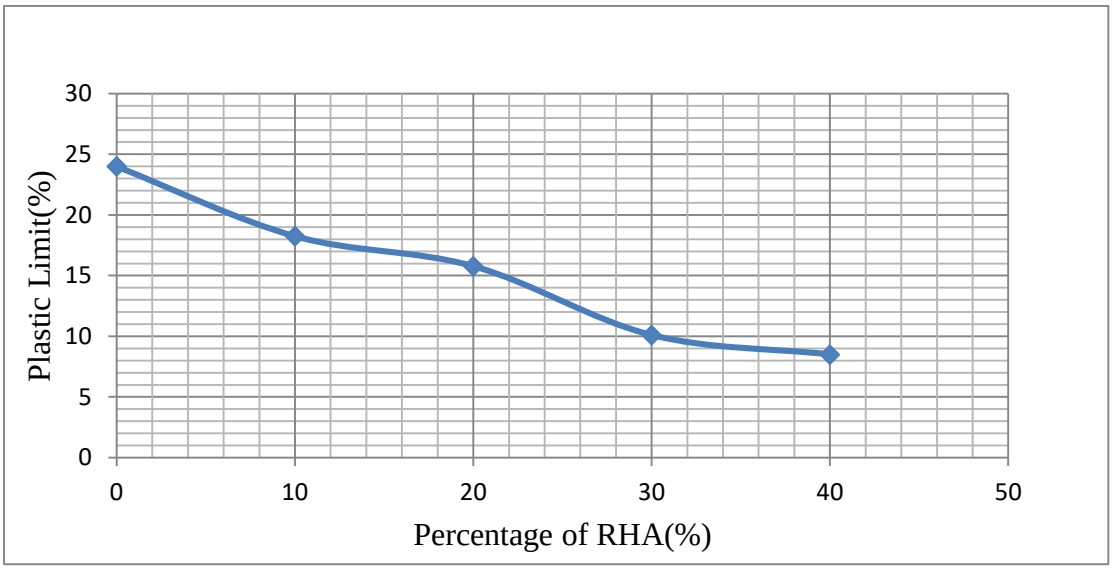


Table- 3 Variation of shrinkage limit with RHA

percentage of rice husk ash	shrinkage limit
0	15.62
5	14.25
10	15.98
20	16.42
30	17.52
40	19.56
50	21.89
80	23.24

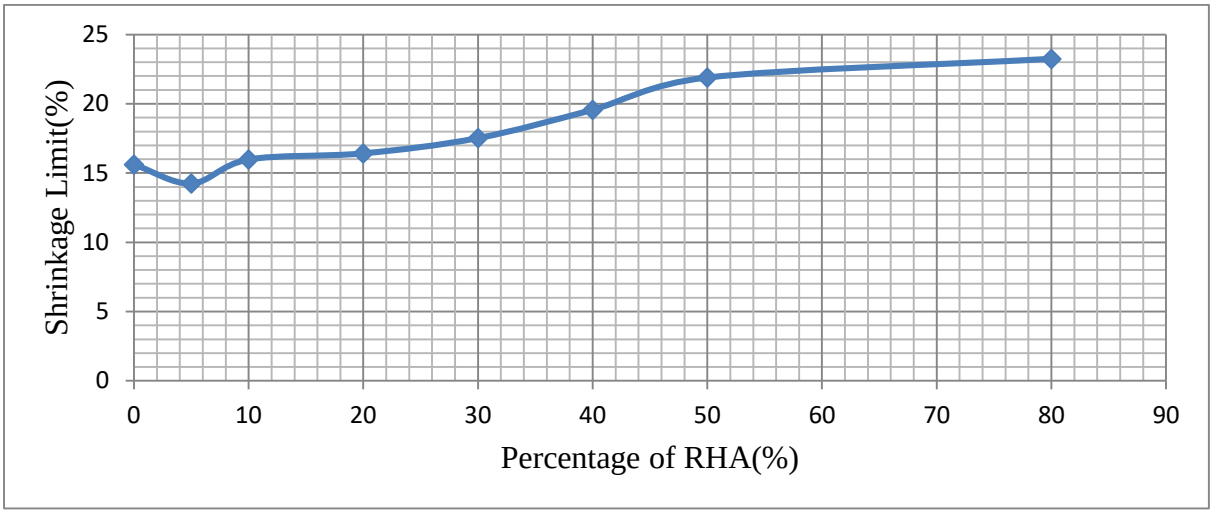


Table-4 Variation OMC with RHA

percentage of RHA	OMC (%)
0	17.65
10	17.28
20	16.13
30	15.75
50	14.1
80	13.85

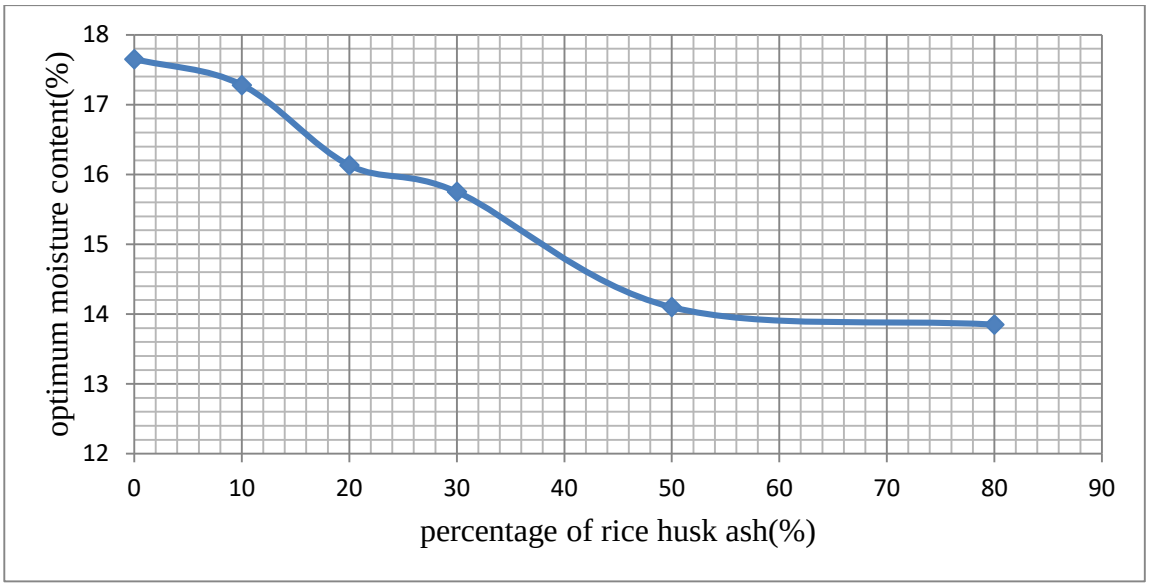


Table- 5 Variation of dry density with RHA

percentage of rice husk ash	maximum dry density (kN/m^3)
0	19.65
10	21.12
20	21.53
30	21.89
50	22.54
80	23.26

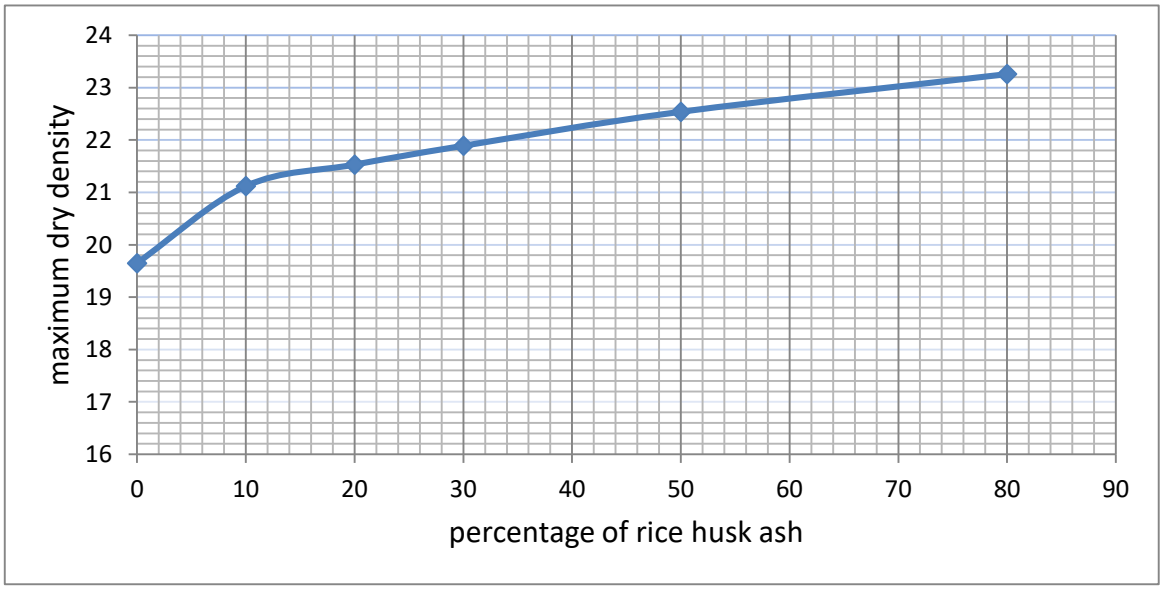


Table- 6 UCS vs. % RHA

percentage of rice husk ash(%)	UCS(KN/m^2)
0	115.84
4	132.88
8	170.25
10	140.75
15	100.6

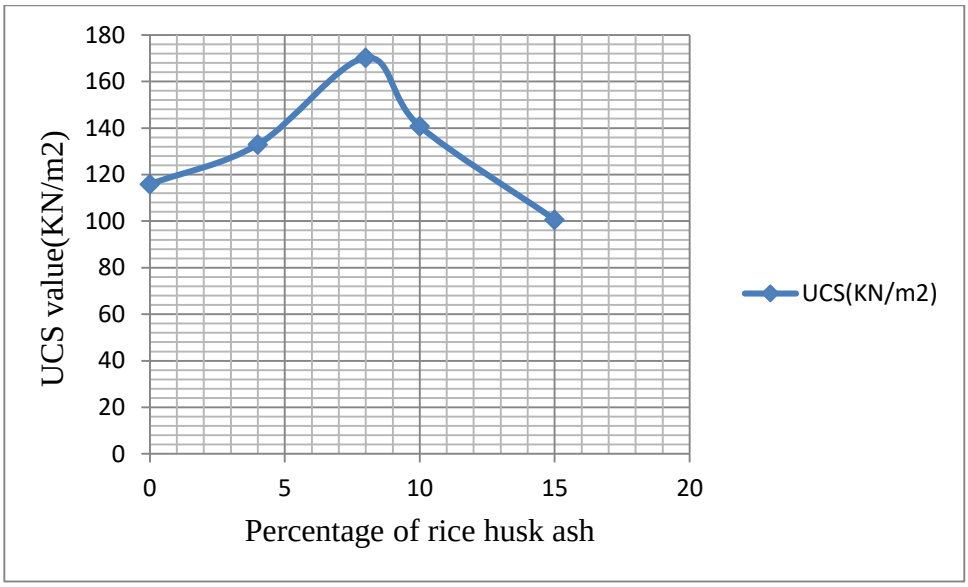


Table- 7 Variation of CBR with RHA

percentage of rice husk ash	unsoaked CBR value
0	5.36
5	7.23
7.5	9.84
10	8.63
15	5.48
20	2.65

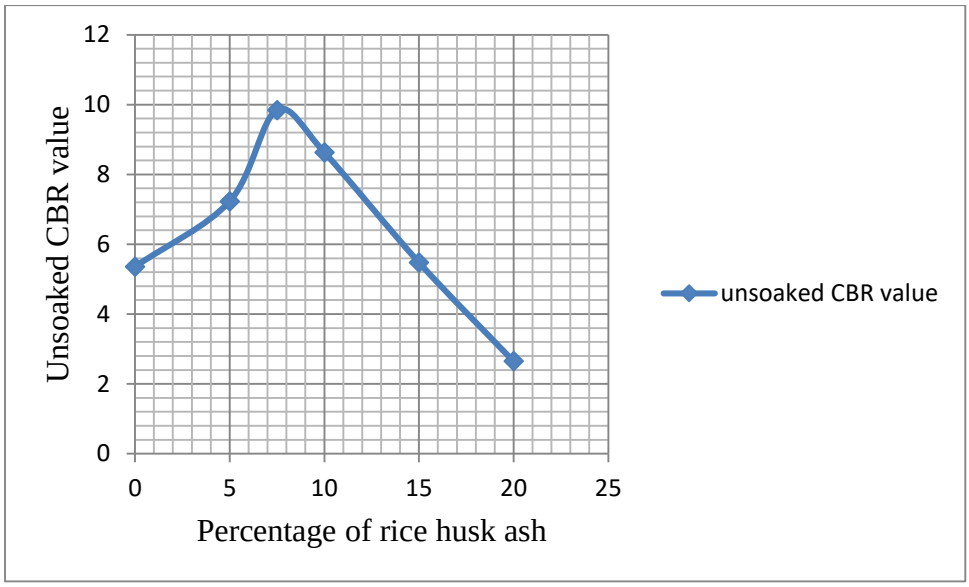


Table- 8 Particle size of RHA vs. % FINER

Size(mm)	Percentage finer
0.6	95.54 %
0.3	68.03 %
0.15	37.55 %
0.075	4.46 %

D_{10}=0.087mm
D_{30}=0.033mm
D_{60}=0.26mm
C_u=2.988
C_c=0.78

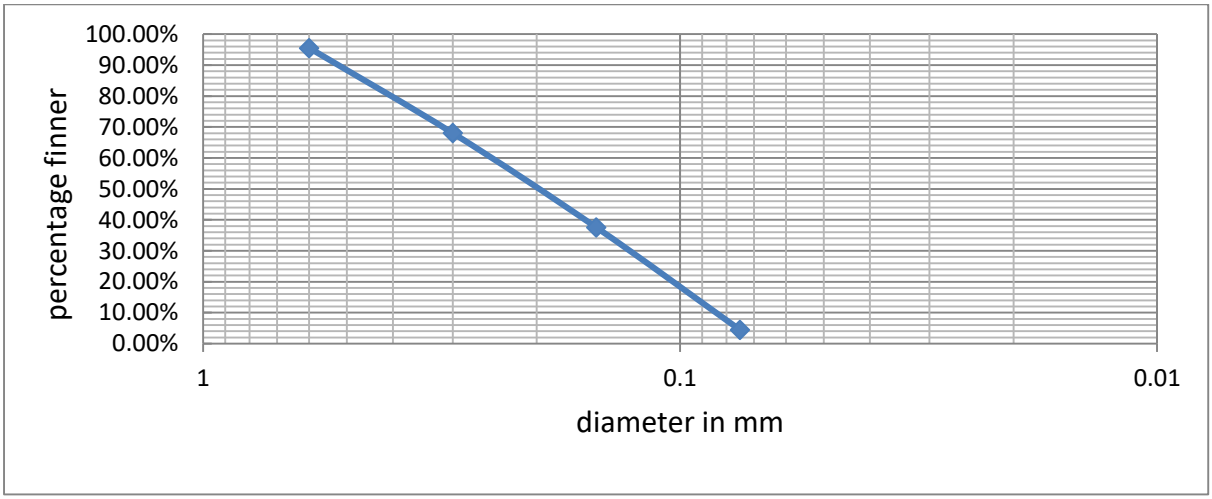
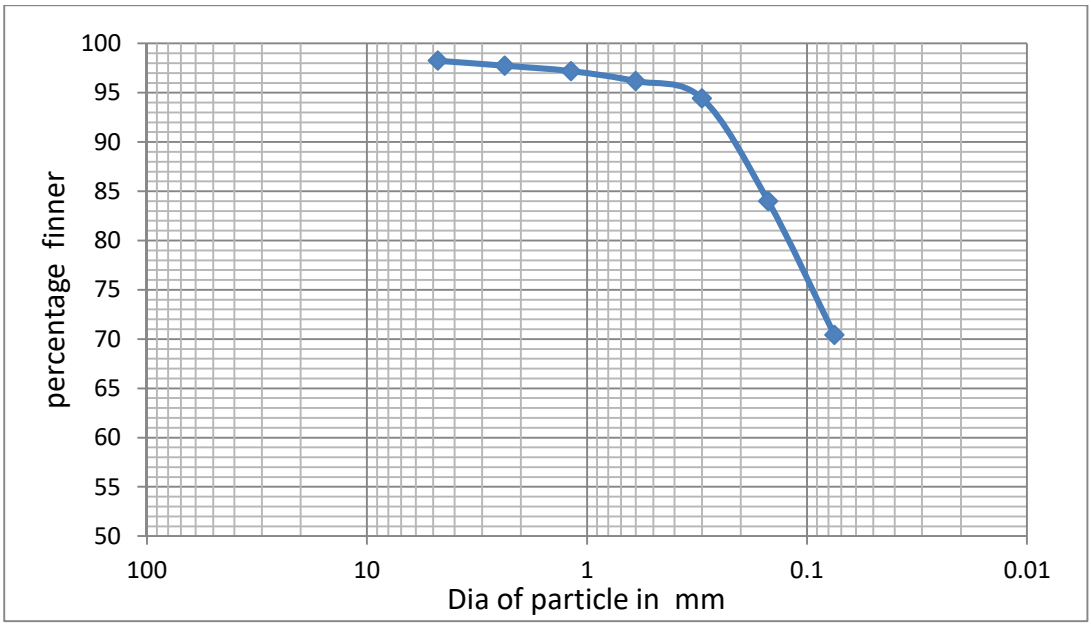


Table- 9 Particle size of SOILvs. %FINER

weight retained (gm)	percentage finner	sieve size (mm)
5.5	98.15	4.75
1.2	97.75	2.36
1.65	97.2	1.18
3.03	96.19	0.6
5.24	94.44	0.3
31.32	84	0.15
40.73	70.43	0.75



Conclusion:

1. I had used intermediate plastic clayey soil having plasticity index=19.24(%)
2. Rice husk has temperature varying property but at 600-800^{0}C maximum amorphous property is induced by silica which percentage is 86(%).
3. Since my soil was not of very poor quality, so there is not very much property variation noticed but some strength imparting property was improved.
4. As the Rice Husk ash was increasing Liquid limit and Plastic Limit was continuously decreases and shrinkage limit was increases.
5. This test has been performed at 5%,10%,20%,40% and 80% of rice husk ash for Liquid limit,Plastic limit and shrinkage limit.
6. But for strength Causing property it was performed at 2%,4%,8%,10% and 15%.And I obtained maximum property enhanced at 7-10% of rice husk ash.
7. When I mixed rice husk Ash to the soil CBR value was increased upto 80% and UCS value increased by 47%.

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