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Some Studies on Yellow Soils using Lime and Saw Dust Ash as Stabilizing Agents

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ABSTRACT: The main aim of this paper is to study about stabilization of soil by using lime and sawdust ash, the soil is clayey in nature. Firstly the lime (5%, 10%, 15%) and saw dust ash (2%, 4%, 6%, 8%) where added separately to the soil and after that a combination of lime and sawdust was added in it to check the variations in different characteristics of soil like compaction characteristics, unconfined compressive strength, and CBR value. The compaction characteristics can be determined by adding different percentage of sawdust ash and lime. The decrease in MDD was noticed when there will be an increase in sawdust ash percentage. When lime is kept constant at 10% as optimum value, then at that time MDD get decreases with the increase in saw dust ash and the reason behind this is that lime is lighter in weight and also addition of lime causes more voids spaces and as a result MDD decreases and ultimately OMC increases. The soaked CBR value gets improved from 2.85% to 4.37% with the increase in lime to 10%. Similarly for saw dust ash with its addition up to 6% the CBR Value increases from 4.59 to 6.79 beyond which it decreases. With the addition of lime the UCS value increased from 178.5KN/m^2 to 322.4 KN/m^2 up to 10% lime beyond which it decreases. Similarly for saw dust ash with its addition up to 6% the value of UCS increases up to 580.3 KN/m^2 beyond which it decreases with the addition of saw dust ash.

Keywords: ***Soil Stabilization, Lime, Saw Dust Ash, Compaction Characteristics, CBR and UCS.***

I. INTRODUCTION

As we know that the soil is a peculiar material. The existing soil at a particular location may not be suitable for the construction due to poor bearing capacity and higher compressibility or even sometimes excessive swelling in case of expansive soils. The improvement of soil at a site is indispensable due to rising cost of the land, and there is huge demand for high rise buildings. There is a need to concentrate on improving properties of soils using cost-effective practices like treating with industrial wastes like pond ash ,rice husk ash etc. having cementitious value [1]. In this study, materials like Saw Dust Ash (SDA) and Lime are used to improve geotechnical properties of a soil. Some waste materials like pond ash, rice husk ash can are used to make a soil stable. Addition of such materials has a great impact on both physical as well as chemical properties of the soil [2]. By adding such admixtures some of the properties like liquidity index, plasticity index, compaction characteristics, unconfined compressive strength, CBR value etc can be modified depending upon the properties of soil and the improving method used. As we know large amount of sawdust ash and lime is being produced all over the world, the disposal of sawdust ash in open areas causes many environmental problems so it should not be dumped openly as it is not eco-friendly. The proper utilization of ash in geotechnical applications gives a good solution [3-5]. The main aim of this paper was to study about stabilization of clayey soil by using lime and sawdust ash. In this study the soil which is used was taken from the local area of Rajouri J&K. The soil was clayey in nature. Firstly the lime was added in soil at a proportion of 5%, 10%, and 15% and after that a combination of lime and sawdust (keeping lime as 10% i.e. optimum value and saw dust ash as 2%, 4%, 6% and 8%) was added in it to check the variations in different tests like Standard Proctor Test, UCS, and CBR test. After that curing of samples was done. For UCS curing was done for 3 days but for CBR curing was done for 7 days. From the experimental study it was concluded that sawdust ash act as a good stabilizing agent for both base and sub base course. Moreover, its improvement can also be improved by combining it with other materials to provide a better result for future. Okunade 2008, carried research on the effects of wood ash and sawdust admixtures on the engineering properties of a burnt laterite-clay bricks. The admixtures were added in various combinations of proportions by volume (from 0 to 10%). He observed that the major contribution of the saw dust admixture is the reduction in dry density of finished burnt brick product. Henry & Ogunribido 2009, carried

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research on geotechnical properties of saw dust ash stabilized south-western Nigeria lateritic soils. This research was carried out to evaluate the effects of saw dust ash on the geotechnical properties of soil. The results show that saw dust ash has improved geotechnical properties of soil samples. Tiwari and Mahiyar 2014 tried 48 samples test samples to study the physical properties of soil such as hygroscopic water content grain size allotment, specific gravity, Atterberg's limits, Direct shear test, Swelling pressure, MDD-OMC, CBR, Permeability test values in first phase. In second phase, a variety of test exploration were done on black cotton soil using different percentages of Fly Ash (FA), Coconut Coir Fiber (CCF) and Crushed Glass (CG). It was found that there was significant increase in strength of soil. Singh and Vasaikar, 2016 found that foundation design on black cotton soil (expansive soil) is difficult task to achieve because the structure built on this type of soil break without any signal. They modified the BC soil by lime to stabilize it and added 4 % and 6 % of lime and results were positive.[6-12] The focus of the study was mainly to determine the index properties of clayey soil, to compare the Unconfined Compressive strength, CBR and compaction characteristics between clayey soils treated with Lime alone then treated with mixture of both saw dust ash and Lime. Main objectives of the present study include

1. To determine the compaction characteristics by adding different proportions of lime and sawdust ash.

2. To determine the effect on California bearing ratio of clayey soil by adding different proportions of lime and sawdust ash.

3. To determine the effect on unconfined compressive strength of the clayey soil by adding different proportions of lime and sawdust ash.

II. MATERIALS AND EXPERIMENTAL METHODOLOGY

Sufficient quantity of yellow soil was collected from local area of district Rajouri (J&K) at a depth of 1-1.5m. The soil is pulverized with wooden hammer and then dried in air. The characteristics of this soil are summarized in table 1. Lime used was quick lime (CaO) which is in the form of white powder (Robinson et. al 2012). To protect it from moisture it was packed in a polythene bags and can be used further in study. Its oxide composition and physical properties are as under. The Saw dust was collected from local Saw mill in Industrial area Kheora Rajouri (J&K). The saw dust collected was obtained from sawing of deodar and kail wood. Saw dust is actually by-products of sawmills generated by sawing timber. It is the loose particles or wood chippings obtained by sawing wood into useable sizes. After collection, clean saw dust not having much bark and so not much organic content was air dried and burnt at the room temperature. The SDA was then sieved through 600 micron sieves to remove the lumps, gravels, unburnt particles and other materials which are deleterious to soil. The saw dust passing through 600 microns sieve was used for the laboratory work. After that it was burnt using conventional method of burning and was packed in a polythene bags to protect it from moisture and then it was used further in study. The main chemical components of saw dust are carbon 60.8 %, hydrogen 5.19 %, oxygen 33.83 % and nitrogen 0.90 %. The specific gravity of Saw dust ash is 2.03 and loss in ignition is 4.27 %. The chemical composition of saw dust is SiO2-86 %, Al2 O3-2.6 %, CaO -3.6 %, Fe2O3-1.8 %, MgO-0.27 %, MnO-0.07 %, K2O-0.11 %, SO2-0.45 % and P2O5-0.43 % (Wajid et. al 2016). Different tests were conducted on virgin soil and soil containing lime and sawdust as admixture. These tests which were performed as per Indian Standard Specifications include Standard proctor test, California bearing ratio test and unconfined compressive strength tests. For Compaction characteristics of soil the virgin soil was mixed with lime 5%,10%,15% and after keeping lime as 10% constant which is optimum lime the ash content was varied as 2%,4%,6%,8% and 10%. Similarly for Unconfined Compressive Strength samples were kept for 3 days curing which were prepared by mixing soil with 5%,10%,15% lime and ash 2%,4%,6%,8%,10% (keeping lime as 10% constant i.e. optimum value) and for California Bearing Resistance tests the samples were kept for 7 days curing which were prepared by mixing soil with 5%,10%,15% lime and ash 2%,4%,6%,8%,10% (keeping lime as 10% constant i.e. optimum value).

Table 1: Characteristics of soil used in this research work

Sr. No.	Properties of soil	Value
1	Specific gravity	2.63
2	Liquid limit (%)	37
3	Plastic limit (%)	29
4	Plasticity index (%)	8
5	Classification of soil (According to ISC)	ML (Silt of Low Compressibility)
6	Maximum dry density (kN/m^3)	17.2
7	Optimum moisture content (%)	14
8	CBR (soaked)	2.85
9	Unconfined compressive strength (kN/m^2)	178.5

III. RESULTS AND DISCUSSIONS

From the experimental investigations it was observed that the maximum dry density and optimum moisture content for virgin soil is 17.2 kN/m^3 and 17%. From the experimental observations refer to Figure 1, it is clear that the maximum dry density increases with the addition of lime up to certain limit (i.e.10% lime) and then decreases thereafter whereas optimum moisture content remains constant. After keeping the lime content as optimum value

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that is 10% and varying the percentages of saw dust ash it was observed that the dry density increases from 17.2 kN/m^3 to 17.92 kN/m^3 up to 6% ash content and thereafter starts decreasing on further addition on saw dust ash, while as optimum moisture content decreases from 17.0 % to 14.0% as shown in Figure 2. This may take place due to the reason that the specific gravity of sawdust ash is lower as compared to that of soil. Moreover there was an increase in optimum moisture content when sawdust ash is added and this may be either due to more water react with the flocculent soil or may be due to more water absorption by it (O.O. Amu et al 2005). The CBR value of soil gets improved by 3.81% on addition of lime up to 10% and thereafter decreases (Figure 3). Similar on varying the percentage of saw dust ash content keeping lime as 10% constant the CBR value again increases by 4.29% at 6% ash content and there after decreases again (Figure 4). The UCS value increased from 178.5KN/m^2 to 430.4 KN/m^2, on adding lime and beyond 10% content the UCS value started decreasing (Figure 5). Similarly on adding saw dust ash keeping lime as optimum value (10%) the UCS value increased from 430.4 KN/m^2 to 580.3 KN/m^2 up to 6% saw dust ash and starts decreasing on further addition of saw dust ash (Figure 6).

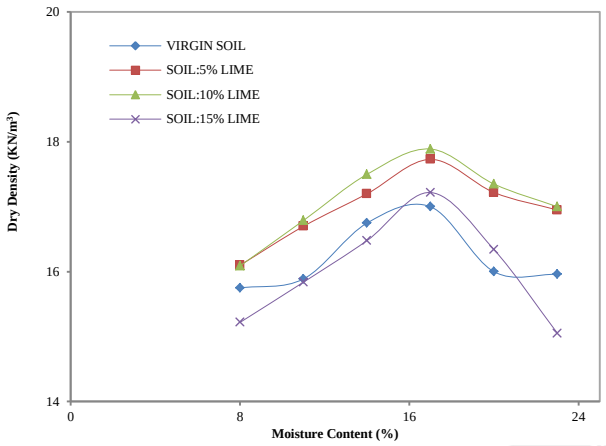

Figure 1: Variation of Dry Density with Moisture Content of soil mixed with different percentages of lime.

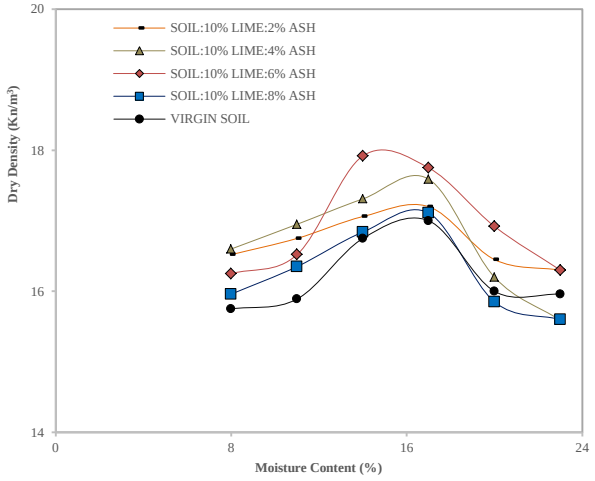

Figure 2: Variation of Dry Density with Moisture Content of soil mixed with different percentages of lime and saw dust ash.

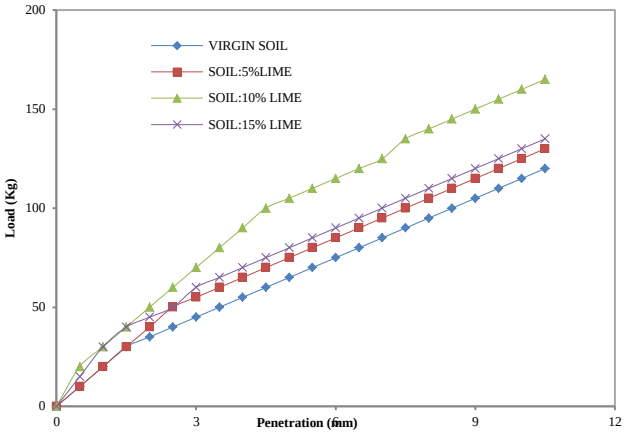

Figure 3: Variation of Load with Penetration of soil mixed with different percentages of lime.

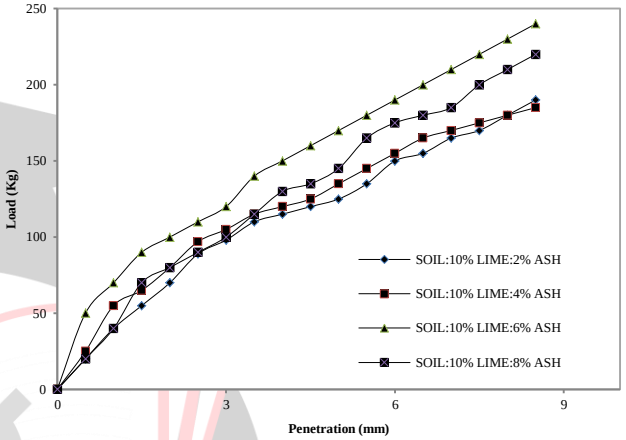

Figure 4: Variation of Load with Penetration of soil mixed with different percentages of Saw Dust Ash and 10% Lime.

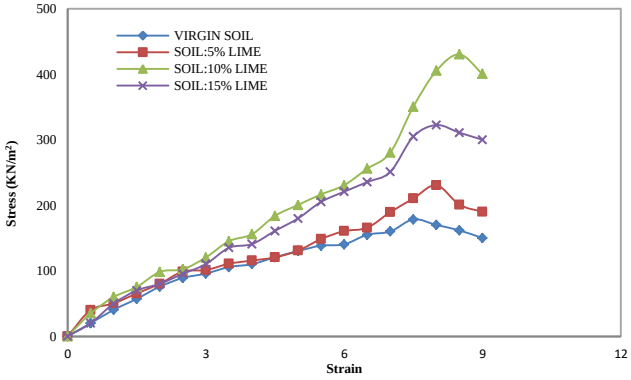

Figure 5: Stress vs Strain relationships of soil mixed with different percentages of lime.

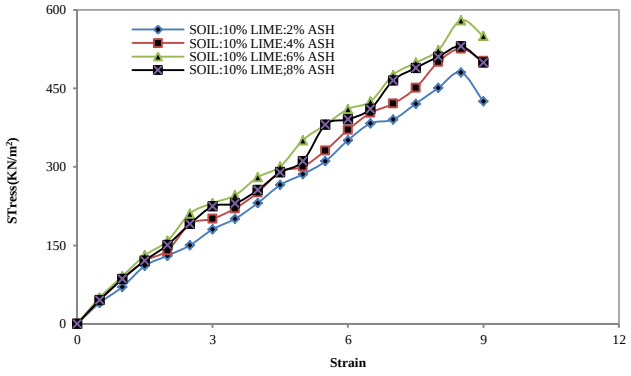

Figure 6: Stress vs Strain relationships of soil mixed with different percentages of saw dust ash and 10% lime.

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IV. CONCLUSION

From the experimental observations it may be concluded that that with the increase in the quantity of lime the OMC remains whereas MDD decreases. The optimum value of lime was found to be 10%. The CBR and UCS value were increased by the addition of lime alone and also combination of lime and saw dust ash. The best ratio was found to be 84% Soil: 10% Lime: 6% Ash. The decrease in VBR and UCS due to further addition of lime i.e. beyond 10% lime, lime and ash (10% lime and 6% ash) is due to the reason that excess amount leads to the reaction and due to this there will be the formation of voids. Moreover the strength of the sample get increased with the increase in the curing period and it is may be due to various reactions like hydration, pozzolanic reaction etc.

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