RESEARCH ARTICLE OPEN ACCESS

An Experimental Investigation of Soil Stabilization Using Black Cotton Soil and Kota Stone Slurry Dust

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ABSTRACT

Expansive soils are an overall issue that represents a few difficulties for civil engineers. Such soils expand when given an admittance to water and shrink when they dry out. Among the construction exercises, a very much associated street network is one of the fundamental foundation necessities, which assume an imperative part for the quick and agreeable development of between local traffic in the nation like India. The most well-known and efficient strategy for settling these soils is utilizing admixtures that forestall volume changes. In this study the impact of utilizing kota stone slurry dust (KSSD), an industrial waste in diminishing the expanding potential is analyzed. In this performance of black cotton soil (BCS) with KSSD in varied proportion has studied by conducting grain size distribution, liquid limit, plastic limit and shrinkage limit of the soil alone and of the mixtures. Experiments were done using KSSD in different proportion (3%, 6%, 9%, 12%, 15%, 18%, 21% and 24 %).

I.INTRODUCTION

Soil is the final destination of any structure on which the load of structure rests. Therefore strength of soil is most important and in general, soil strength depends upon density, moisture, and texture of the soil [1-2]. Increase in density is usually accompanied by increase in strength, whereas increases in moisture content are usually accompanied by decrease in soil strength [3]. The reason for asphalt is to give a smooth surface over which the vehicle might pass under whole climatic condition. Thusly, the performance of asphalt is impacted by qualities of sub grade. Helpful properties which the sub grade ought to have incorporated strength, waste, simplicity of compaction, permanency of solidarity, since sub grade changes significantly [4-5]. It is important to make a careful investigation of the soil in place for pavement design purposes [6]. Because of the complexity, it is not possible to set down rules which will be suitable for every cases. The problem which we continuously facing is that dealing with procedure and techniques by which otherwise unsuitable soils may be improved by stabilization [7-8]. Sub grade soils that are unsatisfactory in their natural state can be altered by admixtures, by the addition of aggregate and this made suitable for highway sub grade construction [9]. Adaptable asphalts infer their the limit of load supporting not from the bending activity of slab but rather by disseminating the load down via limited thickness of asphalt, so that pressure on the sub grade won't be surpassed [10]. Stabilization for this type of asphalt should logically impart additional strength to the sub grade soil [11]. Kota stone slurry is available in huge amount in areas near by Jhalawar and Kota district in Rajasthan. It creates soil pollution, water pollution, and air pollution leading to adverse affect on crop production and human health. The most well-known and efficient strategy for settling these soils is utilizing admixtures that forestall volume changes. Utilizing the kota stone slurry dust as an industrial waste in diminishing the expanding potential is impacted.

II.EXPERIMENTAL METHODOLOGY

The Kota stone waste and slurry makes ecological contamination issue in the surrounding of mining and industrial region. There is no innovation for proper disposal of Kota stone waste. There is enormous number of stores of Kota stone slurry made by dumping the waste surrounding the whole region. Similarly polished waste material surrounding the grinding and polishing industries has been made. The proper drainage system of area has been damaged. Pollution increases surrounding the area and causing problem for habitation. The waste received from polishing industries is, a very fine material, deposited in the agriculture fields and affect the fertility of soil. Thus it is beneficial to this waste in considered in use for enhanced the properties of sub grade soil for flexible pavements. In this investigation soil samples and stone slurry was collected form Jhalawar district. Kota soil sample and KSSD was collected form Jhalawar region. This was the first stage of the research programme i.e. methodology. Soil sample was to be selected from military area in

Jhalawar. The place was chosen because the soil at that place is clean in respect of sand particles, boulder, organic waste, and any other types of vegetation.

III.RESULTS & DISCUSSION

Various experiments were performed to determine index properties and engineering properties as required on different mix proportions of soil and Kota stone slurry dust. The investigation was done to study the feasibility of Kota stone slurry dust as stabilization material for road construction purpose. In fact a very detailed experimentation and investigation is required to find out an efficient and economical use of Kota stone slurry dust for road construction purpose. In this work, experiments were performed to find feasible use of kota stone slurry dust. All the obtained data from the experimental study were analyzed to magnitude of inherent variations in atterberg's limits, moisture content and dry density relationship of soil KSSD mixes. The effect of KSSD content on soil were analysed to arrive at the optimum values of KSSD content to get maximum benefit. The grain size analysis tests were conducted on the BCS and on KSSD.

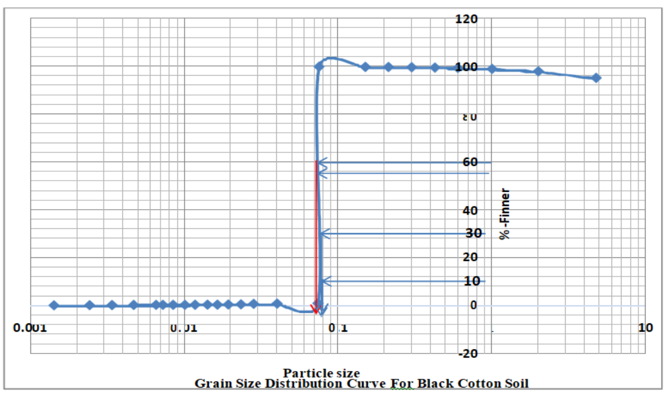

Figure 1. Grains size distribution of black cotton soil (BCS)

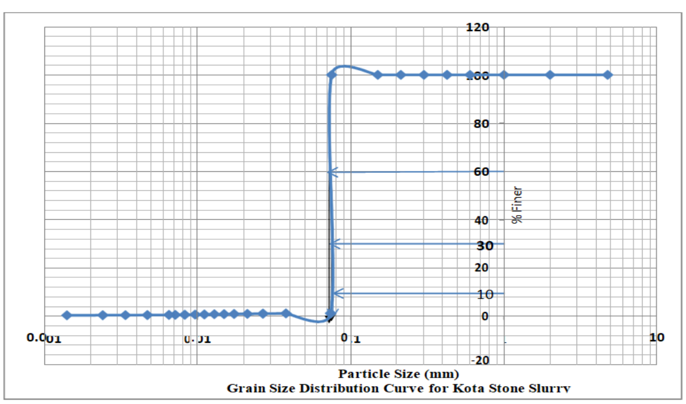

Figure 2. Grain size distribution curve for kota stone slurry dust (KSSD)

Table 1. Value of Cu and Cc of BCS and KSSD

Determination	Coefficient of uniformity (C_u)	Coefficient of curvature (C_c)
BCS	1.006	1.02
KSSD	1.01	1.00

Table 2. Variation in the Liquid Limit (LL) value for BCS mixed with KSSD

Test Material	Liquid Limit (%)	% Decrease in Liquid Limit
BCS	42.56	0.00
BCS + 3% KSSD	42.22	0.81
BCS + 6% KSSD	41.65	2.18
BCS + 9% KSSD	40.84	4.21
BCS + 12% KSSD	39.99	6.43
BCS + 15% KSSD	39.68	7.26
BCS + 18% KSSD	39.57	7.56
BCS + 21% KSSD	38.81	9.66
BCS + 21% KSSD	38.48	10.60

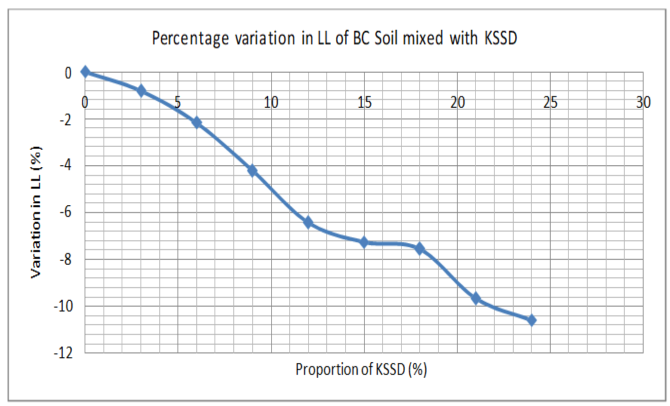

Figure 3. Variation in liquid limit (LL) value for BCS mixed with KSSD

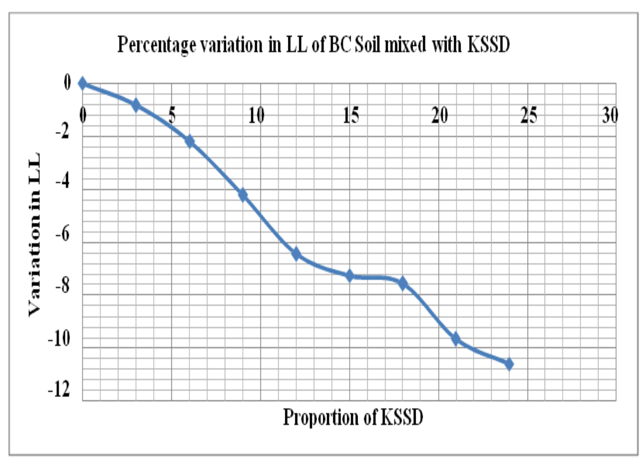

Figure 4. Percentage variation in the LL value for BCS mixed with KSSD

From the above shown graph and the recorded data it can be concluded that with the increase in the KSSD content the liquid limit (LL) decreases .It varies from 42.56 % for Soil to 38.48 % for soil mixed with 24% of KSSD. The percentage decrease in the liquid limit was equal to 10.60 % than compare to BCS at 24 % of KSSD. From the experimental work the data for the determination of plastic limit for the BCS was found to be equal to 16.75 %. In order to identify the effect of KSSD on BCS, the variation of Plastic Limit (LL) due to addition of %3,6%,9%,12%,15%,18%,21% and 24% KSSD with Soil was recorded.

Table 3. Variation of Plastic Limit (PL) with different proportion of KSSD in BCS

Test Material	Plastic Limit (%)	% Decrease in Plastic Limit
BCS	16.75	0.00
BCS + 3% KSSD	18.75	11.94
BCS + 6% KSSD	19.56	16.78
BCS + 9% KSSD	20.68	23.46
BCS + 12% KSSD	21.42	27.88
BCS + 15% KSSD	22.22	32.66
BCS + 18% KSSD	24.32	45.19
BCS + 21% KSSD	24.61	46.93
BCS + 24% KSSD	25.11	49.91

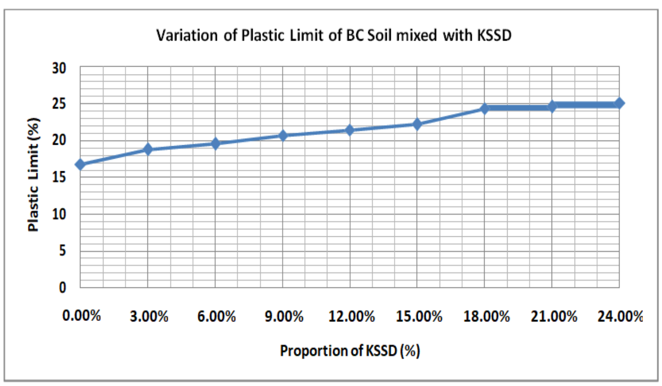

Figure 5. Variation of PL of BCS with numerious proportion of KSSD

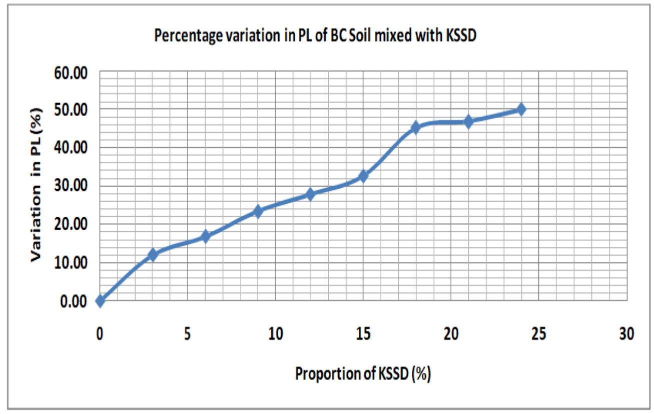

Figure 6. Percentage variation in PL of BCS mixed with KSSD

From the table 3 and figure 6 shown above it can be concluded that the plastic limit goes on increasing with the increase in KSSD content. It varies from 16.75 % (for soil) to 25.11 % (for 76 % Soil +24 % KSSD). It occurs possibly due to the fact that since KSSD is finer than the Soil alone so due to the greater specific surface it requires more water to bring the sample in plastic state. In the laboratory work it was found that the sample of KSSD delicately drawn to 3 mm thread hence it is non-plastic material.

The Shrinkage Limit Tests were conducted on the BCS, Kota stone slurry dust (KSSD) and soil mixed with KSSD at varying proportion and data was recorded. The specimens were prepared with Kota stone slurry dust content of 3%, 6%, 9%, 12%, 15%, 18%, 21% and 24%. From the experimental work the Shrinkage limit for the BC Soil was found to be equal to 10.46 % and for KSSD it was found to be equal to 35.51 %. In order to identify the effect of KSSD on Soil , the variation of Plastic Limit due to addition of %3, 6%, 9%, 12%, 15%, 18%, 21% and 24% KSSD with Soil was recorded.

Table 4. Variation of Shrinkage Limit with different proportion of KSSD in BCS

Test Material	Shrinkage Limit (%)	% Decrease in Shrinkage Limit
BCS	10.46	0.00
BCS + 3% KSSD	10.71	2.33
BCS + 6% KSSD	11.21	6.69
BCS + 9% KSSD	12.15	13.91
BCS + 12% KSSD	12.81	18.35
BCS + 15% KSSD	13.48	22.40
BCS + 18% KSSD	14.17	26.18
BCS + 21% KSSD	14.42	27.46

BCS + 24% KSSD	15.65	33.16

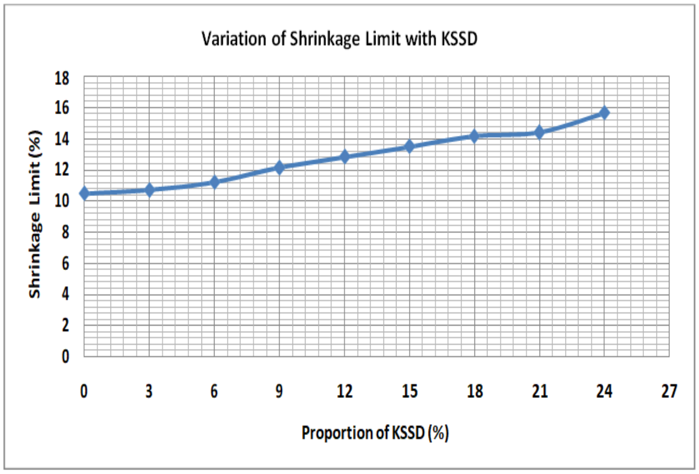

Figure 8. Variation of shrinkage limit with different proportion of KSSD

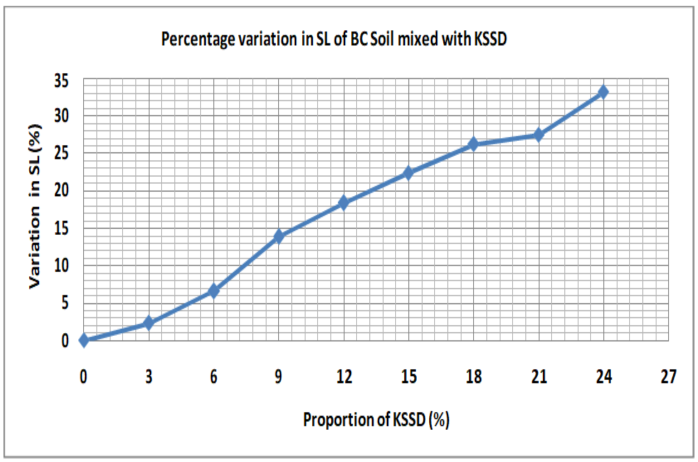

Figure 9. Percentage variation in shrinkage limit mixed with KSSD

From the table 4 and figure 8 and 9 shown above it can be concluded that the shrinkage limit goes on increasing with the increase in KSSD content. It varies from 10.46% (for soil) to 15.65 % (for 76 % Soil +24 % KSSD). The percentage increment at 24 % of KSSD with soil is found to be equals to 33.16%.

IV.CONCLUSION

The kota stone waste and slurry makes ecological contamination issue in the surrounding of mining and industrial region. There is no innovation for proper disposal of kota stone waste. There is enormous number of stores of kota stone slurry made by dumping the waste surrounding the whole region. For the present investigation soil samples and stone slurry was collected form Jhalawar district. Kota soil sample and KSSD was collected form Jhalawar region. Soil is the final destination of every construction on which load of structure rests. Therefore strength of soil is most important and in general, soil strength depends upon density, moisture content, and texture of the soil. In this performance of black cotton soil (BCS) with KSSD in varied proportion has studied by conducting grain size distribution, liquid limit, plastic limit and shrinkage limit of the soil alone and of the mixtures. Various experiments were performed to determine index properties and engineering properties as required on different mix proportions of soil and Kota stone slurry dust. The investigation was done to study the feasibility of kota stone slurry dust as stabilization material for road construction purpose. Experiments were done using KSSD in different proportion (3%, 6%, 9%, 12%, 15%, 18%, 21% and 24%) and study the impact of utilizing BCS and KSSD, an industrial waste in diminishing the expanding potential is analyzed.

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