STABILISATION OF HIGH COMPRESSIBLE SILT USING GRANITE DUST AND SURKHI

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Abstract - *Unsuitable highway subgrade requires stabilization to improve its properties. Clay and silt soils are commonly stiff in dry state but lose their stiffness when saturated with water. Expansive clays have low bearing capacity and high compressibility. Laboratory tests were undertaken conforming to Indian Standard Code of practice to stabilize the soil with a combination of Granite dust and surkhi. Surkhi is added to the soil at range of 30%, 35%, 40%, 45%. Granite dust is added at range of 5%, 10%, 15%, and 20%. Index property, grain size analysis, standard proctor compaction, unconfined compressive strength, California bearing ratio (CBR) were performed for natural soil and treated soil sample. Then the results and graphs of various mixes are compared to see their effects in subgrade stabilization.*
The results show significant reduction in plasticity index and corresponding increase in density of the soil.

Key Words: Stabilization, surkhi, Granite dust, angle of internal friction, unconfined compressive strength.

1. INTRODUCTION

All in all soil stabilization is by all accounts a successful option for improving the index and engineering properties of soil. There are sure strategies for soil stabilization, for example, mechanical stabilization, chemical stabilization and bio-enzymatic soil stabilization. Stabilization utilizing construction based solid waste is one of the various techniques for the treatment of soil to improve its building properties for balancing the swell- recoil behaviour. Some conspicuous construction based solid squanders which have been utilized for soil stabilization are rock dust, Surkhi, quarry dust, wood dust and so on. Granite dust is a solid powder squander which is acquired from the ventures which cut granite stones. Granite dust is a waste item which has an exceptionally less monetary incentive in the market and it is accessible for nothing in many spots. The silica content of Granite dust is extremely high which helps in the stabilization of soil. In addition to granite dust, Surkhi which is otherwise called brick dust is included. It is a powdered broken block arranged by finely crushing well burnt great quality blocks, free from under burnt particles like solvent salts and silt. Surkhi is added to build the effectiveness in the stabilization of soil.

1.1 Granite dust

The structure of granite comprises of quartz and feldspar with limited quantities of mica, amphiboles, and different minerals. The Granite dust is a byproduct of cutting businesses, around 3000 metric ton of granite dust/slurry is obtained every day. All the waste created from granite industry is dumped in dumping yards, which cover 25% of the total territory of granite industry. This prompts natural contamination and loss of tremendous territory of land particularly after the water in the slurry evaporates. This residue is conveyed by cooling water to Sedimentation Lake. Granite dust which is taken from lake, is utilized in soil stabilization. Granite dust was utilized in road development as an stabilization material .Potential impact of granite dust on geotechnical properties of expansive soils was inquired about. And it was found that liquid limit and plasticity index diminished. Apart from that, Maximum dry density increased and optimum water content diminished CBR, angle of shear resistance expanded and cohesion diminished.

1.2 Surkhi

Surkhi is called as Trass, or brick dust in England. Surkhi is utilized as a substitute for sand for cement and mortar, and has nearly a similar capacity as of sand yet it likewise gives some quality and hydraulicity. Surkhi is made by crushing to powder burnt blocks, brick bats or burnt clay; under-burnt or over- burnt blocks ought not to be utilized, nor blocks containing high extent of sand

2. MATERIALS USED

A. Soil: It was acquired from Mepco Schlenk Engineering College near "The Rifle range (under construction)". The soil sample was disturbed.

Table -1: Physical properties of soil

Physical properties of soil			
Color	Black	Classification	Highly compressible (MH)
Texture	Fine grained	Maximum dry density	1.47 g/cc

Specific gravity	2.9	Shear strength	35N/mm^2
Liquid limit	55%	CBR 2.5mm	2.23%
Plastic limit	36%	Optimum moisture content	12%

B. Granite Dust: The size of the granite dust was obtained by sieving under 425µ sieve and its specific gravity was2.46

Fig -1: Granite dust

C. Surkhi: Specific gravity of the selected surkhi powder which was finely crushed and sieved to the size of 425µ is 2.77

Fig -2: Surkhi

3. FOR MIX RATIO (Surkhi: Granite dust)

The additives such as Surkhi and granite dust for the stabilization of soil is added to the soil in certain definite ratios. The initial approximate ratios are obtained from the study of literature review. The following table depicts the different ratios in which the mixtures are going to be added.

Table 2 – Various ratios of Surkhi and Granite dust

	Granite dust			
	(%)	15	20	25
	30	(30:15)	(30:20)	(30:25)
Surkhi	35	(35:15)	(35:20)	(35:25)
	40	(40:15)	(40:20)	(40:25)
	45	(45:15)	(45:20)	(45:25)

4. EXPERIMENTAL WORK

4.1 *Direct Shear Test*

The shear strength for the soil sample of size 6cmX6cmX2cm was conducted in Direct shear test apparatus as per IS 2720 (Part 15). A normal stress of 0.5 kgf / cm^2 (50 kN / m2). The dial gauge for shear deformation is set in position. The soil specimen is allowed to accumulate under normal charge for drained tests.and the test was repeated with three normal loads of 100,200 and 400 kN / m^2 stresses. For the mix proportion of 20% granite and 45% surkhi the maximum value of angle of internal friction was obtained and was shown in the table 3

Table 3 – Angle of internal friction for modified soil

	Granite dust			
	(%)	15	20	25
	30	30	23.70	25.17
	35	35	24.64	25.44
Surkhi	40	40	26.49	31.80
	45	45	29.89	30.37
	45	45	29.89	30.37

4.2 *Califronia Bearing Ratio Test*

About 5 kg of air-dried soil going through I.S 4.75 mm sieve is taken. The load estimating gadget is associated with the compression machine. The cylindrical plunger, diameter 49.5 mm and cross - sectional area of 1935 mm^2 is connected with the heap estimating gadget. The readings of the load penetration of 2.5 and 5mm were observed and the results were discussed in the table 4 and 5

Table 4 – CBR for 2.5mm Penetration

		Granite dust		
Surkhi	(%)	15	20	25
	30	2.23	2.98	3.72
	35	2.23	3.72	4.46
	40	3.72	5.21	4.46
	45	2.98	3.72	4.46
	45	2.23	2.98	3.72

Table 5 – CBR for 5mm Penetration

4.3 *Unconfined Compression Strength test*

An axial load is applied utilizing either strain- control or stress-control condition. The unconfined compressive strength is characterized as the maximum unit stress got inside the first 20% strain in a soil mould of size 40mm as per IS 2720 (Part 10). The soil mix which is blended with Surkhi (45%) and granite dust (15%, 20%, and 25%) is tested in the UCS testing machine. The stress increases correspondingly with the increase in dial gauge reading and at a certain point, maximum stress value is attained and as a result the soil sample breaks and after that the stress value starts to decrease for the soil mix .The stress value at which the soil sample breaks is the maximum stress that the soil mix can withstand and from all the values from the table we can find that the soil mix of ratio 45:20 (Surkhi - 45% and granite dust – 20%) bears he maximum stress value of 0.192 N/mm2.

Fig -3: Unconfined Compressive Strength Test Samples

4.4 *Atterberg Limits*

From the engineering properties test the mix proportion for the effective increase in properties are identified as (Surkhi - 45% and granite dust – 20%). Thus for the fixed proportion the liquid limit, Plastic limit values obtained by using Casagrande Liquid limit apparatus as per IS 2720 (Part 5) are 30% and 42% respectively.

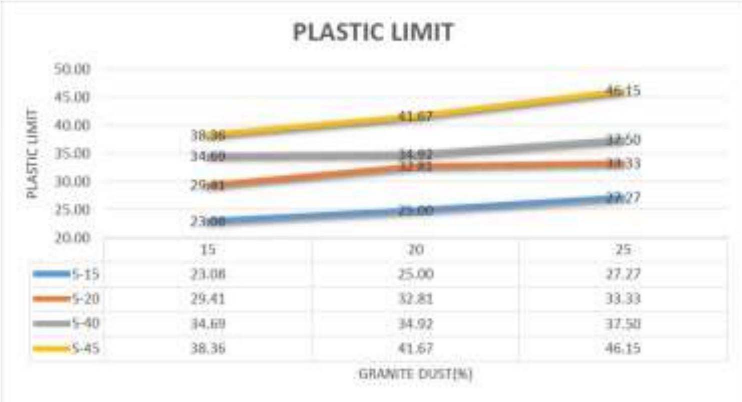

Fig -4: Plastic Limit values for different mix proportions

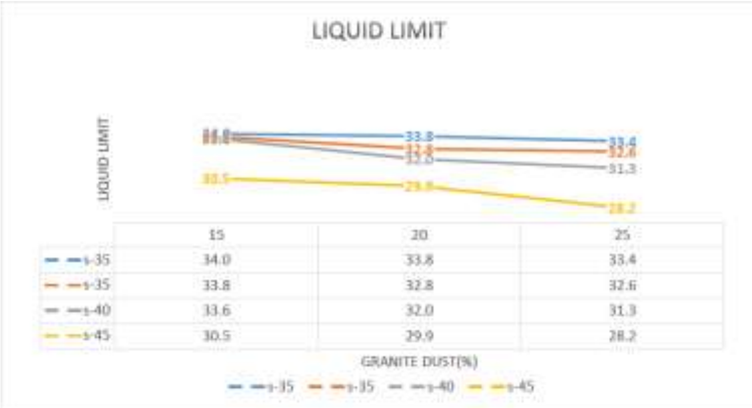

Fig -5: Liquid Limit values for different mix proportions

5. CONCLUSIONS

Most of the engineering properties of clay soil are improved by combination of Surkhi and granite dust. The properties of such mixtures vary and depend upon the type of soil. A series of experiments were conducted by mixing soil have found the optimum percentage of granite dust as 20% and the optimum percentage of Surkhi was found to be 40% for engineering properties. The liquid limit of soil decreases when Surkhi and granite dust is added which causes reduction in thickness of diffuse double layer around the soil particles.The plasticity index decreases with increased Surkhi and granite dust content and eventually reaches zero. This indicates that the clay soil tends to behave like cohesionless particles. The Direct shear value increases with addition of Surkhi and granite dust. Granite dust contains high penetration value. When added with soil it significantly increases the shear strength characteristics by 27%. The UCS value increases with addition of Surkhi and granite dust when added with soil it significantly increases the shear strength characteristics by 38%.The CBR value increases with addition of Surkhi and granite dust. With addition of Surkhi with granite dust, the CBR value further increases and 5.21% is achieved when 40% Surkhi and 20% granite dust was added.

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