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Stabilization of Dredged Material using Polymers for its Potential Use as Subgrade Material

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Abstract: *Soils being strong in compression but weak in tension have put forth the demand to modify the strength of the soils to meet the design specifications. There are many techniques employed to improve the engineering and mechanical properties of poor soils. The techniques employed to improve the properties of soil in respect of strength and other relevant characteristics of soil are Soil stabilization. Soil can be stabilized using other material like chemical additives, rewetting, soil replacement, compaction control, moisture control, surcharge loading, and thermal treatment. All these methods are expensive and do not last for a long time. This study primarily aims at in making use of dredged material for potential use as road subgrade in the design of flexible pavements. It was decided to evaluate use of polymer-based additives for stabilization of such soil.*

Key Words: Soil Stabilization, dredged material, polymers, compaction, compression, Surcharge loading, thermal treatment, etc.

1. Introduction

Soil stabilization is the process of altering some soil properties by different methods, mechanical or chemical in order to produce an improved soil material which has all the desired engineering properties. Soils are generally stabilized to increase their strength and durability or to prevent erosion and dust formation in soils. The main aim is the creation of a soil material or system that will hold under the design use conditions and for the designed life of the engineering project. The properties of soil vary a great deal at different places or in certain cases even at one place. The success of soil stabilization depends on soil testing. Various methods are employed to stabilize soil and the method should be verified in the lab with the soil material before applying it on the field.

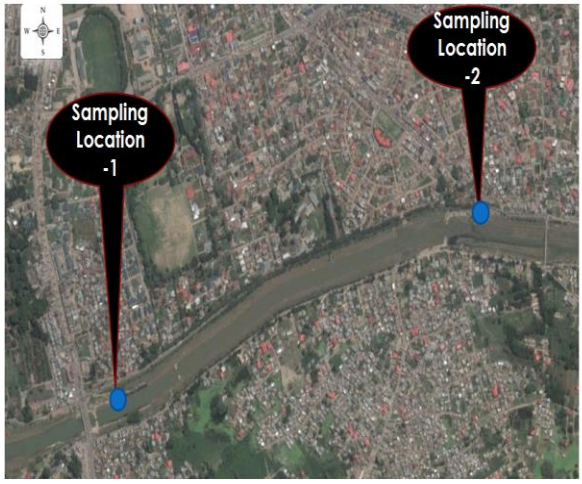
2. Geological and Geomorphologic investigation

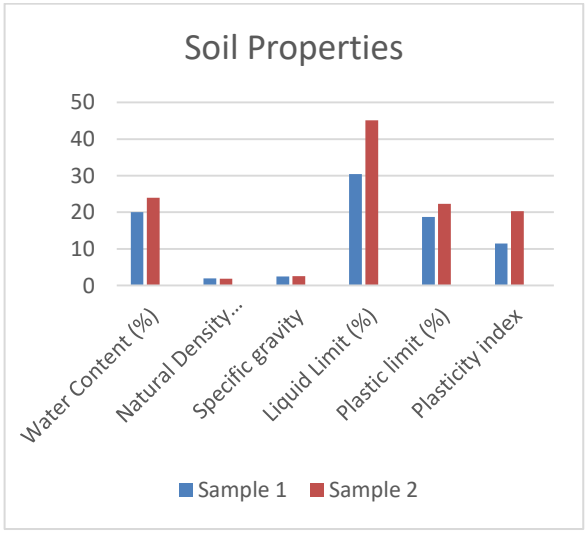
Geological and geomorphologic investigations were carried out to predict the lithology / nature of formation at the site. The site is located at Rambagh [flood spill channel], within Srinagar District of Kashmir Valley, which predominantly comprises of old alluvium up to large depths. The sub-soil strata at such location can broadly be categorized under natural alluvium/ water laid deposits (Alluvial/Flood Outwash Deposits), which generally include silty-clay or clayey-silt type soil in intermixed layers with potential seams of fine to coarse sand. Such alluvial deposits are consistently associated with matrix of highly decomposed organic silts/peat/trapped partially decomposed fibrous organic matter etc. The proposed site has very close proximity of major watercourse (River Jhelum), approximately 4.4 km.

3.2 SAMPLING

In this experimental investigation samples were collected from two different locations .The sample 1 was collected from Rambagh flood spill channel [Srinagar] and sample 2 was collected from Mehjoor Nagar flood spill channel [Srinagar].In the collection of soil samples, top layer of soil was removed up to the depth of 20 cm .The soil was dug with the help of spade and samples were collected in air tight containers with the help of trowel and were further transported to the place of laboratory.

SAMPLE NO.	GPS READING
1	N34°3’ 17.55” E 74°48’ 21.40”
2	N 34°3’31.70” E 74°49’ 19.24”





4. Test Methodology

Tests were conducted from two different samples and water content, Natural density, specific gravity, liquid limit, plastic limit and plasticity indices were calculated followed by conduction of California Bearing Ratio Test at different proportions of fibre. The results so obtained are mentioned below:-

S.No.	Property	Sample 1	Sample 2
1	Water Content (%)	20	24
2	Natural Density (g/cm^3)	1.93	1.89
3	Specific Gravity	2.5	2.6
4	Liquid limit(%)	30.40	45.13
5	Plastic Limit (%)	18.70	22.30
6	Plasticity Index	11.50	20.30

The results of California Bearing ratio Test are mentioned here under:-

Def. (mm)	Load					CBR 1	CBR 2	CBR 3	CBR 4	CBR 5
	0.0%P	0.25%P	0.5%P	0.75%P	1%P					
0.5	7.9	3.95	7.9	7.9	13.43					
1	25.28	8.69	27.65	11.06	31.6					
1.5	48.19	14.22	52.93	48.98	54.51					
2	63.2	18.96	76.63	75.05	75.84					
2.5	75.05	25.28	98.75	100.3	96.38	5.47	1.84	7.20	7.32	7.03
3	81.37	31.6	116.92	125.61	115.34					
3.5	86.9	37.92	132.72	146.15	132.72					
4	90.85	44.24	144.57	165.11	148.52					
4.5	94.8	51.35	157.21	184.07	163.53					
5	98.75	57.67	169.85	201.45	176.17	4.80	2.80	8.26	9.80	8.57
5.	10	64.	18	21	19					

5	1.91	78	2.49	8.04	0.39					
6	105.07	71.1	194.34	234.63	203.03					
6.5	109.02	79	206.19	252.01	217.25					
7	112.97	86.11	218.04	267.81	230.68					
7.5	116.13	93.22	229.1	284.4	244.9					
8	119.29	100.33	240.76	300.2	257.54					
8.5	122.45	107.44	251.22	314.42	271.76					
9	125.61	113.76	261.49	329.43	286.47					
9.5	128.77	120.87	271.76	342.86	300.99					
10	131.93	127.98	282.03	355.5	313.63					

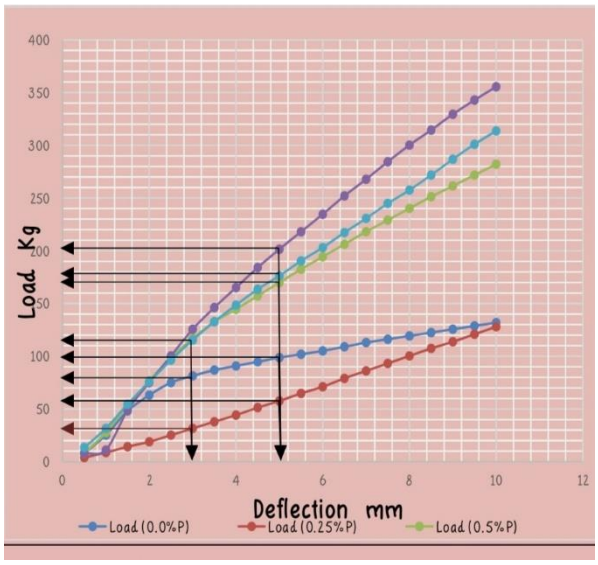
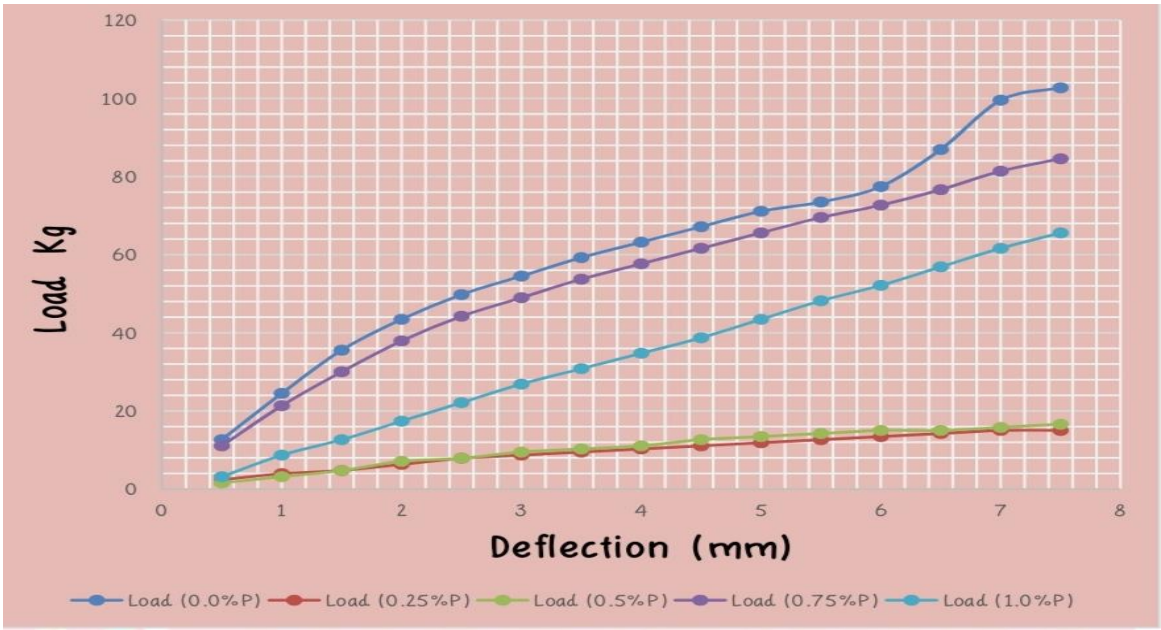


Fig. Load Deflection Curve for sample 1

Results of California Bearing Test for Samplev 2 are given below :-

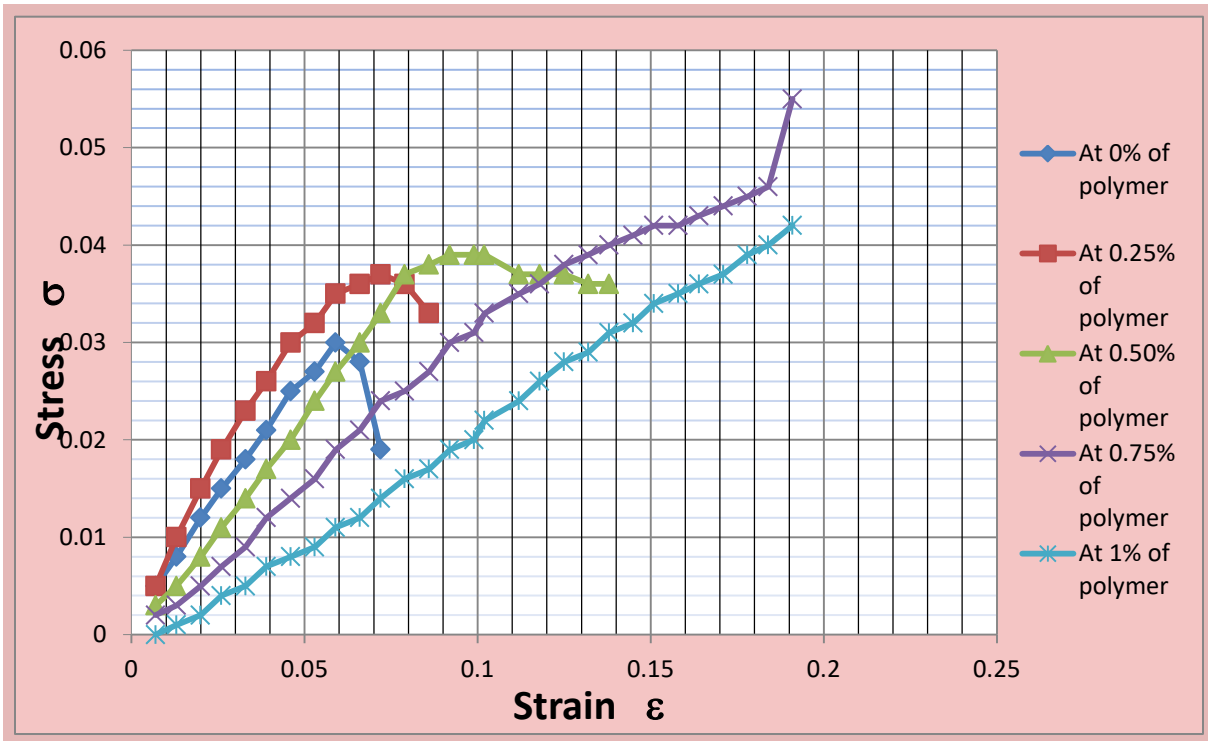
Def. (mm)	**Load**					**CBR 1**	**CBR 2**	**CBR 3**	**CBR 4**	**CBR 5**
	0.0%P	**0.25%P**	**0.5%P**	**0.75%P**	**1%P**					
0.5	12.64	2.37	1.58	11.06	3.16					
1	24.49	3.95	3.16	21.33	8.69					
1.5	35.55	4.74	4.47	30.02	12.64					
2	43.45	6.32	7.11	37.92	17.38					
2.5	49.77	7.9	7.9	44.24	22.12	3.63	0.57	0.57	3.22	1.61
3	54.51	8.69	9.48	48.98	26.86					
3.5	59.28	9.48	10.27	53.72	30.18					
4	63.2	10.27	11.06	57.67	34.76					
4.5	67.15	11.06	12.64	61.62	38.71					
5	71.1	11.85	13.43	65.57	43.45	3.46	0.57	0.65	3.19	2.11
5.5	73.47	12.64	14.22	69.52	52.14					
6	77.42	13.43	15.01	72.68	56.88					
6.5	86.9	14.22	15.01	76.63	61.62					
7	99.54	15.10	15.8	81.37	65.57					
7.5	102.4	15.10	16.59	84.53	69.36					



Results of Unconfined Strength test are given below:-

1. Sample 1:-

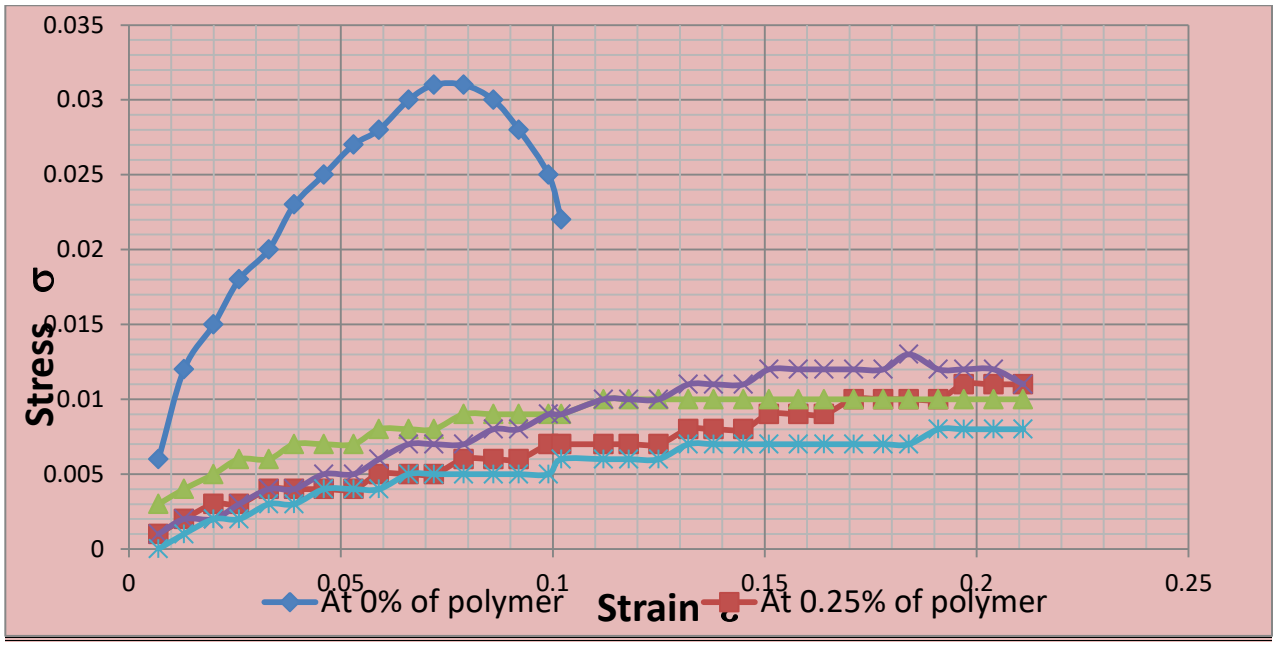
S.NO.	Proving ring reading	No.of divisions	load ,P	ΔL(mm)	e=ΔL/L L=76mm	Area .A_0	Ā	σ
1	4.2	22	5.2	0.5	0.007	1134.11	1141.6	0.005
2	8	40	9.4	1	0.013	1134.11	1149.2	0.008
3	11.2	57	13.4	1.5	0.020	1134.11	1156.9	0.012
4	14.3	73	17.2	2	0.026	1134.11	1164.8	0.015
5	17.3	88	20.7	2.5	0.033	1134.11	1172.7	0.018
6	20.4	104	24.4	3	0.039	1134.11	1180.7	0.021
7	25.1	126	29.6	3.5	0.046	1134.11	1188.9	0.025
8	28	140	32.9	4	0.053	1134.11	1197.1	0.027
9	30.3	153	36.0	4.5	0.059	1134.11	1205.5	0.030
10	29.1	146	34.3	5	0.066	1134.11	1214.0	0.028
11	20.1	101	23.7	5.5	0.072	1134.11	1222.6	0.019



2. Sample 2:-

S.No.	Proving ring reading	No.of divisions	Load ,P	Deformation ΔL(mm)	strain,ε	Area, A_0	$\bar{A}= A_0/(1-\varepsilon)$	$\sigma=P/\bar{A}$
1	5.4	29	6.8	0.5	0.007	1134.11	1141.6	0.006
2	11.2	57	13.4	1	0.013	1134.11	1149.2	0.012
3	14.4	74	17.4	1.5	0.020	1134.11	1156.9	0.015
4	17.4	89	20.9	2	0.026	1134.11	1164.8	0.018
5	20.2	102	24.0	2.5	0.033	1134.11	1172.7	0.020
6	22.4	114	26.8	3	0.039	1134.11	1180.7	0.023
7	25	125	29.4	3.5	0.046	1134.11	1188.9	0.025
8	27	135	31.7	4	0.053	1134.11	1197.1	0.027
9	29	145	34.1	4.5	0.059	1134.11	1205.5	0.028
10	30.4	154	36.2	5	0.066	1134.11	1214.0	0.030
11	32.2	162	38.1	5.5	0.072	1134.11	1222.6	0.031

12	32.2	162	38.1	6	0.079	1134.11	1231.3	0.031
13	31.2	157	36.9	6.5	0.086	1134.11	1240.2	0.030
14	30	150	35.3	7	0.092	1134.11	1249.2	0.028
15	27.1	136	32.0	7.5	0.099	1134.11	1258.3	0.025
16	23.3	118	27.7	8	0.105	1134.11	1267.5	0.022



5. Conclusions

- It has been observed that for Sample-1 significant increase in CBR and UCS values were obtained at a dosage of around 0.75%.
- There has been almost 44% increase in CBR with polymer stabilization in comparison to un-stabilized sample.
- It may be observed that stabilized sample of soil at 0.75% of polymer has better strain absorption capacity with considerable increase in strength at the same time.
- It has been observed that for Sample-2 not much increase in strength in terms of CBR and UCS has been observed indicating that sample-2 is not fit for stabilization using polypropylene and same may respond to any other method of stabilization.

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