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Stabilisation of Dredged Soil for Road Pavement

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Abstract: Solid wastes are all the waste which arise from human being and mammal activities that are normally solid and are surplus as unwanted material. In this study, the firm waste has been generated by dredging the Dal Lake, which posesses grave dumping and ecological problems around the Dal Lake. In this study, different percentages of dredged material (by weight) were added to normal silty clay soil samples (obtained from Srinagar city in India) and their index properties and compaction characteristics (using Modified Proctor Compaction tests) were determined. Disturbed soil specimens for various laboratory tests were prepared in the laboratory at 0.95□$_{dmax}$ and corresponding water content on the dry side of optimum. CBR sample stabilize with dredged soil were experienced for unsoaked and soaked (soaked for 4 days) conditions. Tests results shows great improvement in engineering properties and CBR value with rise in normal silty clay soil contents in dredged soil. therefore, dredged soil has both rewards. First, to avoid the remarkable ecological problems caused by large scale discarding of dredged soil and second, to help in suitable development of environment about well-known dal lake.

Keywords: Dredging, Dallake, stabilisation, siltysoil,

I. INTRODUCTION

Dredging of the Dal Lake generate the dredged matter in huge quantities which possess grave dumping and ecological troubles all over the DalLake. Its mineralogy and engineering properties meet the criteria for use in manufacture of high value, beneficial useful products. some regions of the world, dredging is used to have material used for construction which is a common practice.

Because of the increasing demand for building material decreasing inland resources, this may be an important beneficial use. In many cases, dredged material consist of a mixture of sand and clay fraction and other organic matter which require some type of separation process. Dewatering may also be required because of high water content. Depending on sediment Dredging of the Dal Lake generate the dredged matter in huge quantities which possess grave dumping and ecological troubles all over the Dal Lake.

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Its mineralogy and engineering properties meet the criteria for use in manufacture of high value, beneficial useful products. In some regions of the world, dredging is used to have material used for construction which is a common practice. Because of the increasing demand for building material decreasing inland resources, this may be an important beneficial use. In many cases, dredged material consist of a mixture of sand and clay fraction and other organic matter which require some type of separation process. Dewatering may also be required because of high water content. Depending on sediment problems, but also there is scarcity of land around for its disposal. Therefore, there is a dire need for stabilization of this material for its various beneficial uses in engineering practice.Addition of Silty soil improved workability of the soil considerably.

Dredging is the expulsion of silt and flotsam and jetsam from the base of lakes, waterways, harbors, and other water bodies. It is a standard need in conduits around the globe since sedimentation the regular procedure of sand and residue washing downstream step by step fills channels and harbors. The unearthing procedure ordinarily alluded to as "digging" includes the expulsion of silt in its regular (new-work development) or as of late saved (upkeep) condition, either precisely or using pressurized water. After the residue has been exhumed, it is moved from the digging site to the position site or transfer zone. This vehicle task, as a rule, is cultivated by the dig itself or by utilizing extra gear, for example, freight ships, scows, and pipelines with sponsor siphons. When the dug material has been gathered and moved, the last advance in the digging procedure is situation in either vast water, close shore, or upland areas. The decision of the board choices includes an assortment of elements identified with the digging procedure including ecological worthiness, specialized practicality, and monetary attainability of the picked option.

II. OBJECTIVES

The prinicpal objectives of the Geotechnical testing is to know the properties and behavior of soil as an engineering material. Soil is a natural product. It exhibit inherently variable and complex character.The performance is greatly affected by the natural environmental condition imposed by construction of structure. The main objective of my project work are summarized as below To study the various Geotechnical parameters of the dredged material from Nishat, Shalimar and Tailbal Basin of Dal Lake and Silty soil.

To study the effect of silty soil (silty soil) on some physical and engineering properties of the dredged material(dm).

To determine the feasibility of silty soil (silty soil) stabilized dredged material from Dal Lake for use in road construction.therefore with dredged material as source has a two-fold advantages.Firstly, to evade the hazardous environmental problems caused by large scale disposal of dredged material and the second one, to be used as a Road construction material.

III. SAMPLE COLLECTION

The soil samples for the present study were taken from three sites Nishat, Shalimar and Tailbal Basin. At each location disturbed soil samples were collected carefully for its geotechnical evaluation as per considerable test standards. The samples were then with varying percentages of silty soil to modify its some physical and engineering properties.The silty soil was obtained from anchar area

IV. METHODOLOGY

In this study, the test were conducted in two stages. In stage-I, the basic properties of dredged material(physical and engineering properties) is determined. All the test have been carried out as per relevant Indian Standards [IS: 2720]. In stage-II, the weakest soil were mixed with percentage of silty soil (20%, 40%, 60% and 80% by weight) and subjected to various tests.

As per ASTM standards the necessary tests for the index and other properties were carried out.

Table1 gives us the various physical properties of the dredged soil samples and silty soil sample.particle size distribution curve for nishat,shalimar , tailbal basin and silty soil is shown in fig.1.air dried and oven dried flow curves for three basins and soils is shown in fig.2&3

Grain size analysis of coarse grain soil is carried out by sieve analysis while as a fine grained soils are analyzed by hydrometer method. In general, as most soil contain both coarse and fine grains particle, a combine analysis is usually carried out. In the present study, soil grading of dredged material and silty soil were carried out on oven dried sample by dry and wet sieve analysis as per IS: 2720(Part-4)- 1980. The particle size distribution curves for dredged soils from three locations (Tailbal, Shalimar and Nishat basins) and silty soil are given in Fig. 3.1. Particle size distribution analysis revealed that dredged material contains about 12.16%, 11.48%, 11.40, 9.05% and 9.68% clay in Tailbal, Shalimar, Nishat and silty soil respectively.

The particle size distribution curves is used in the classification of coarse grained soils. The particle size distribution curve is essential for the design of drainage filters, to determine hydraulic conductivity of soils and an guide to the shear strength of the soil. Generally, a well graded soil has more strength as compared to weakly/uniformly graded soil.Atterberg limits like plastic limit,liquid limit,shrinkage limit of the soil samples were determined as per the relevant standards of ASTM.

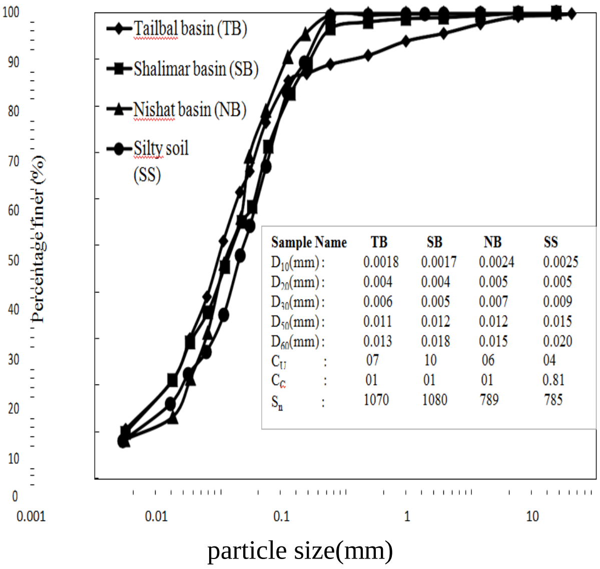

Fig.1 Particle size distribution curve .

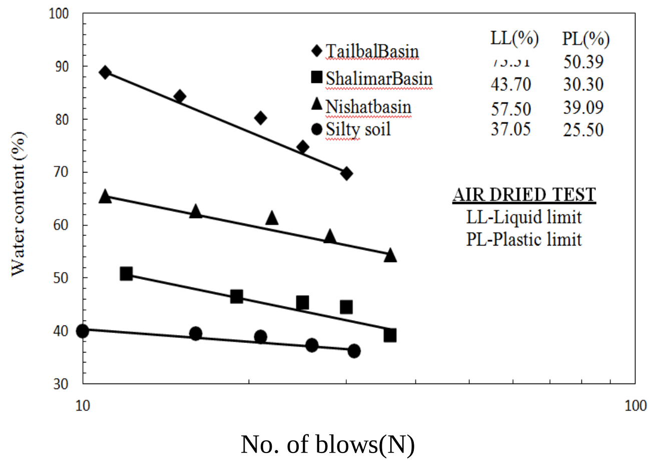

Fig.2 Flow curve for oven dried soil sample

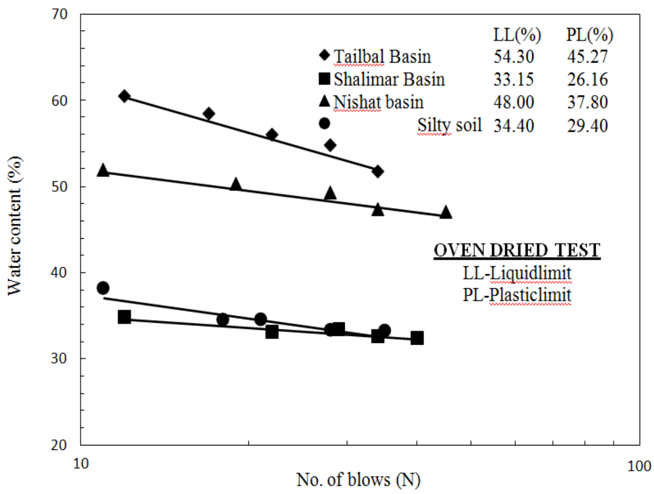

Fig.3 Flow curve for oven DRIED soil sample

TABLE 1 PHYSICAL PROPERTIES OF SOIL SAMPLES

Sr. No.	Properties	Tailbal Basin	Shalimar Basin	Nishat Basin	Silty soil
1.	Silt (%)	76.66	85.02	90.38	89.46
2.	Clay (%)	12.16	11.48	9.05	9.69
3.	Coefficient of uniformity, Cu	7.98	10.65	6.22	9.34
4.	Coefficient of curvature, Cc	1.37	1.07	1.47	1.37
5.	Suitability number, S_n	1070	1080	789	785
6.	Specific gravity (G)	2.46	2.48	2.53	2.65
7.	Liquid limit (%)	54.27	33.15	48.0	34.40
8.	Plastic limit (%)	45.27	26.16	37.80	29.40
9.	Shrinkage limit (%)	30.53	20.22	26.25	22.17
10.	Plasticity index (%)	9	7	10.2	5
11.	Plasticity index – A-line (%)	25	9.59	20.44	10.51
12.	Plasticity index – U-line (%)	41.64	22.63	36	23.76
13.	Classification	MH-OH	OL	OI	ML
14.	Shrinkage index	14.74	5.94	11.55	7.23
15.	Consistency-index, I_c	1.09	1.11	0.13	2.13
16.	Flow index, I_f	38.1	8.2	14.9	19.1
17.	Toughness index, I_T	0.24	0.85	0.68	0.26

V. COMPACTION CHARACTERISTICS

The test results of the compaction tests are presented in a plot of dry unit weight versus water content as soon in Figure below. From the plot, maximum dry unit weight and optimum moisture content (OMC) were determined as 13.5 kN/m^3 and 28% for Tailbal basin 17.39kN/m^3 and 15.12% for Shalimar basin, 15.86kN/m^3 and 22.14% for Nishat basin 19.1 kN/m^3 and 12.9% of silty soil respectively.

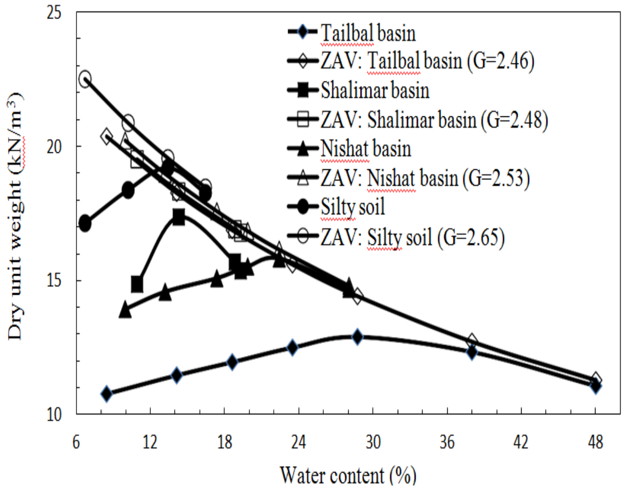

Fig.4 compaction curve for different soil samples

The initial CBR values obtained on dredged and silty soil are 5.5% at and 2.5mm and 8.46% at 5mm and 11% at and 2.5mm and 13.97% after soaking for 4days on the laboratory floor respectively. Which had been shown in Fig.7 (unsoaked condtion) and Fig. 9 (soakedcondtion).

VI. RESULTS AND DISCUSSIONS

Effect of stabilization on properties of dredged soils

The weakest soil was found from Dal lake basin dredged material by above mentioned basic tests which was Tailbal basin dredged material or Tailbal dredged soil and then Tailbal dredged soil had been stabilized by silty soil.The experiments were carried out on the untreated dredged soil and dredged soil stabilized with silty soil. Different soil samples are made with different percentage of silty soil (20%, 40.0%, 60 % and 80% by dry weight of dredged sample). The experimental programme is given in Table 2.

TABLE 2 EXPERIMENTAL PROGRAMME

Trial No.	Dredged soil (%)	Silty soil (%)
1	100	0
2	80	20
3	60	40
4	40	60
5	20	80

VII. EFFECT OF STABILIZATION ON PROPERTIES OF DREDGED SOIL.

Particle size distribution, specific gravity and consistency limits of the samples were determined as per standard procedures. Particle size distribution analysis revealed that the dredged soil samples contain about 12.1% of clay size and silty soil is mainly silt sized .Grain size distributions of the soil were altered by the addition of the silty soil. The sand fraction increased where the clay and organic fractions decreased with increasing amount of admixtures.

VIII. EFFECT OF STABILIZATION ON COMPACTION CHARACTERISTICS

The density of soils is an important parameter since it controls its strength, compressibility and permeability.
Modified proctor compaction test was carried out and it has been observed that as coarser fraction increases maximum dry density and the moisture content decreases upto addition of 50% of silty soil.

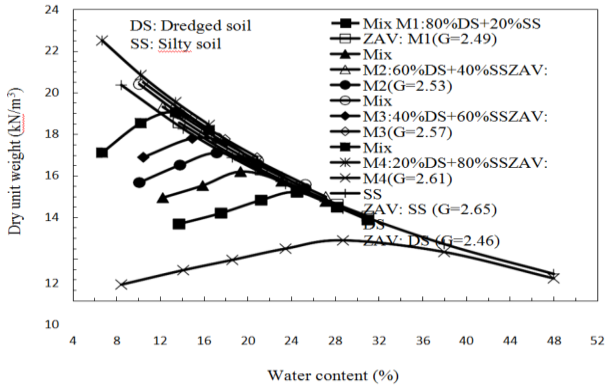

fig. 5 Effect of silty soil on compaction characteristics of Dredged soils

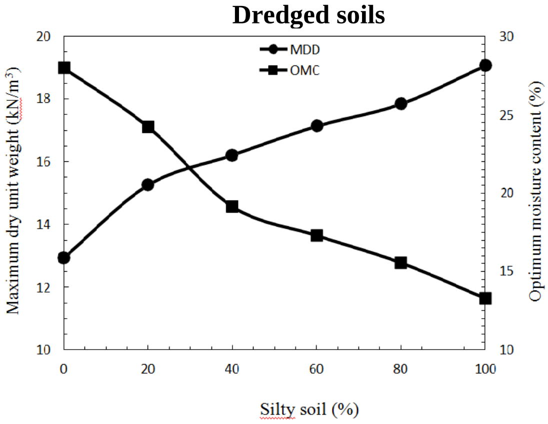

fig.6 Variation of OMC and ODD with addition of silty soil to dredged soil

it is seen that with addition of silty soil to dredged soil with increment of 20%, there is gradual decrease in OMC value and increase in MDD values. The decrease in moisture content may be attributed due to change in soil matrix by adding relatively coarser material and also increases the unit weight of composite specimens due to higher specific gravity for silty soil. Silty soil exhibits higher specific gravity compared to dredged soil and results in granular soil mass most suitable for construction of base/sub-base courses for the flexible pavements. The variation of OMC and MDD with addition of silty soil to dredged soil of Tailbal basin of Dal Lake is shown in Fig.6

IX. EFFECTS OF STABILIZATION ON CBR

Soaked and unsoaked CBR tests were conducted as per IS standard on sample compacted at 95% of modified proctor maximum density and corresponding water contentThe load-penetration curves for dredged soil admixed with silty with different proportions are shown in Fig.7 and Fig.9. Fig. 8 represents the variation of CBR with addition of silty soil (CS) for both unsoaked and soaked condition at 2.5mm and 5mm. The CBR of dredged soil was found to be 19.47% at 2.5mm and 23.28% at 5mm (unsoaked condition) and 5.5% at 2.5mm and 8.46% at 5mm soaked condition). The CBR of silty soil was found to be 40% at 2.5mm and 45.10% at 5mm (unsoaked condition) and 11% at 2.5mm and 13.97% at 5mm (soaked condition). The decrease in the CBR upon soaking is due to the decreased effective stress and loss of surface tension forces. It can be seen from Fig7 and Fig 9 that the CBR value of dredged soil is low compared to silty soil. The lower value of CBR of dredged soil is credited to its inbuilt low strength due to the dominance of clay and organic fraction. Addition of silty soil to dredged soil increases the CBR of the mix upto 60% (60% silty soil +40% dredged soil) due to the frictional resistance from silty soil along with the cohesion from the dredged soil.

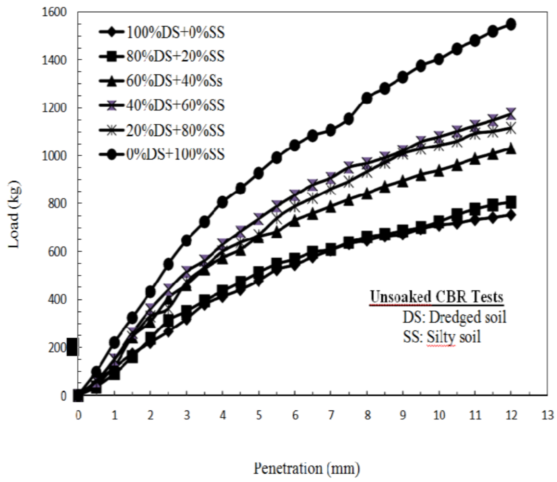

fig.7 Load penetration curve (unsoaked)

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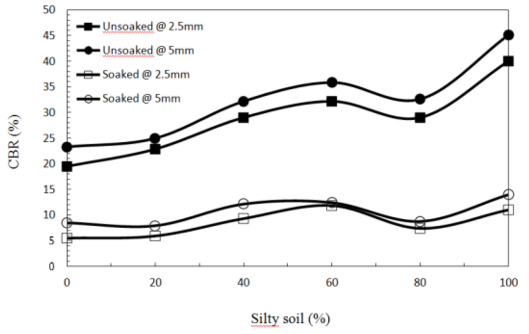

Fig.8 variation of CBR values at 2.5mm and 4.5mm(soaked and unsoaked)

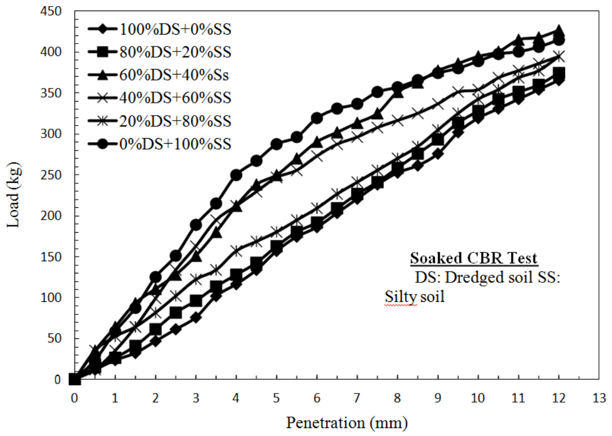

Fig.9 Load Penetration curve for dredged soil(soaked for 4 days)

The addition of the silty soil beyond 60% and upto 80% causes a little reduction in CBR value due to the reduction in cohesion because of decreasing dredged soil (i.e. reducing clay fraction) in spite of the increase of strength due to the increase in silty soil (i.e. increase in sand content). It is the proper mix proportion that optimizes the frictional contribution of silty soil and cohesive contribution from dredged soil leading to the maximization of CBR.It can be further observed from Fig.8 that the CBR is maximum with about 60-40 % of silty soil which could be effective stabilizer to improve the CBR of the dredged soil.

X. CONCLUSIONS

From the outcome it can be established that stabilized material can be properly used in a advantageous way. Earlier dredged material was regarded as a waste material and nuisance to the public because of the rubbish it creates all around the disposing site. It can be used for number of engineering purposes.

Use as foundation soil for roads and buildings.

Use as back fill material.

it can be used to reclaim marshy land.

Dredged soil consist of uniformly graded silt containing organic cont.ent with poor fill material characteristics.

Specific gravity of untreated dredged soil was very low and this low specific gravity is attributed to poor gradation of dredged soil. Specific gravity of dredged material increases with addition silty soil.

Liquid limit of air dried samples is more than 30% of oven dried sample which indicate the presence of organic content. Grain size distributions of the dredged soil were altered by the addition of the silty soil. The sand fraction increased where the clay and organic fractions decreased with increasing amount of admixture (Silty soil).

Dredged material can be recommended as fill material for low lying areas, land improvement and agricultural uses.

Addition of silty soil to dredged soil with increment of 20%, there is gradual decrease in OMC value and increase in MDD values. The decrease in moisture content may be attributed due to change in soil matrix by adding relatively coarser material and also increases the unit weight of composite specimens due to higher specific gravity for silty soil.

A proper mix proportion improves the CBR value. It has been observed that 60% of silty soil is optimum amount required to maximize the CBR of dredged soil.

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