International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 10 Issue 1 ǁ 2022 ǁ PP. 54-60

The Characterisation of the Stabilised Dredged Material As Road Construction Material

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ABSTRACT
Solid wastes are all the wastes arising from human and animal activities that are normally solid and are discarded as unwanted material. In this study, the solid waste has been generated by dredging the world-famous Dal Lake, which poses serious disposal and environmental problems all-around the Dal Lake. Concerns about dredging's environmental consequences, dredged soil disposal, and the growing scarcity of acceptable disposal locations have pushed for characterisation of this soil as a resource for a variety of beneficial uses/engineering applications. 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 $0.95\gamma_{dmax}$ *and corresponding water content on the dry side of optimum. CBR samples stabilized with dredged material were tested for unsoaked and soaked (soaked for 4 days) conditions. Tests results showed tremendous improvement in engineering properties and CBR value with increase in normal silty clay soil contents in dredged soil. Hence, using dredged soil has a two-fold advantage. First, to avoid the tremendous environmental problems caused by large scale dumping of dredged soil and second, to help in sustainable development of environment around famous Dal Lake.*

Author keywords*: Dredged soil, Soilstabilisation, Dal Lake, Sustainable Development, Campus Soil.*

Date of Submission: 10-01-2022 Date of acceptance: 24-01-2022

I. Introduction

Dal is a famous lake in Srinagar's northeast, at an elevation of around 1586 metres above sea level and with geographical coordinates of 34°07′N 74°52′E. The lake is shallow, with a saucer-shaped basin and open drainage, meaning that water flows in and out on a regular basis. There are two theories about the lake's origins: one claims that it is a post-glacial lake, while the other claims that the Dal Lake was produced by floods from the Jhelum River. Dal Lake has a maximum depth of 20 feet and an average depth of roughly 5 feet. The Dal Lake is a section of a typical wetland that covers an area of 18 sq. kms and is part of a larger wetland that covers a larger area. Of around 21 km2 which incorporates floating gardens. Bod Dal, Nagin (a separate lake), Gagribal, and Lokut Dal are the four basins that make up the Dal Lake. Sona lank is a small island in the middle of Bod Dal. Rup Lank and Char Chinari are additional names for Lokut Dal. A sample of dredging material that had accumulated in the lake owing to floods was taken from the basin of the dal lake near the beachfront road's road to garden. Dredging from the lake yields a large amount of dredged debris. The challenges surrounding the transportation of such a large amount of material will have a substantial impact on the region's economics as well as the environment. Mir (2016) [4] observed that in-situ dredged soil is made up of silt, sand, clay, and organic materials, making it unsuitable for use as a construction material. Treated dredging soil, on the other hand, can be used as a resource for a variety of engineering applications and as a stabiliser to improve the behaviour of fine-grained soils. The current plan is to dump the uncontaminated dredged soil from the lake either on the shoreline or in low-lying areas around the lake, both of which are met with opposition from environmental groups and local fisherman. Existing living spaces at both the dredged site and the transfer site are disrupted by the transit of large amounts of dredged material from one region to the next. Due to the large amount of dredging silt produced by the lake, it is far more important to consider reuse rather than transfer. Fill for highways is one such application. Around 25% of India's total Solid Waste is generated as a result of coal combustion. Fly ash, bottom ash, and pond ash are among the remnants. Dry fly ash and bottom ash are combined to make pond ash. 88 thermal power stations in India used roughly 408 million tonnes of coal per year and produced more than 130 million tonnes of fly ash per year between 2010 and 2012. Pond ash contributes to two significant environmental problems: the production of respirable particulate matter (a major air pollutant) and heavy metal poisoning of soil and water due to leaching. Suresh, I. V., et al. (1998)[5] concluded that the presence of fly ash ions (macro and micro such as Fe, Ca, Mg, and others) which were leached out of the ash to some extent degraded ground water quality. With the passage of time, the pollution of hazardous and other ions is likely to grow. Pond ash from the National Thermal Power Corporation (NTPC) at Ramagundam, Telangana, India, was employed to stabilise the dredged material in this study. A lengthy literature review inspired the notion of employing pond ash as a stabilising agent. With an increase in the percentage of pond ash, Kolay, et al. (2011) [3] found that maximum dry density (MDD) and unconfined compressive strength (UCS) rise but optimum moisture content (OMC) declines. The various features of pond ash employed in the investigation are listed in Table I. Material and methods

II. MATERIALS

2.1 Dredged soil:

In the present investigation, dredged material from three locations surrounding Dal Lake has been collected for evaluating the effect of college campus soil (silty soil) on various properties of dredged soil, and its stabilization for its effective use as well as bulk utilization. At each site, undisturbed and disturbed soil samples were collected for project with care. Before attempting to bring out the effect of college campus soil (silty soil) stabilization on various properties of dredged soil, it is worthwhile to study the basic properties, which have an influence on their engineering behaviour.

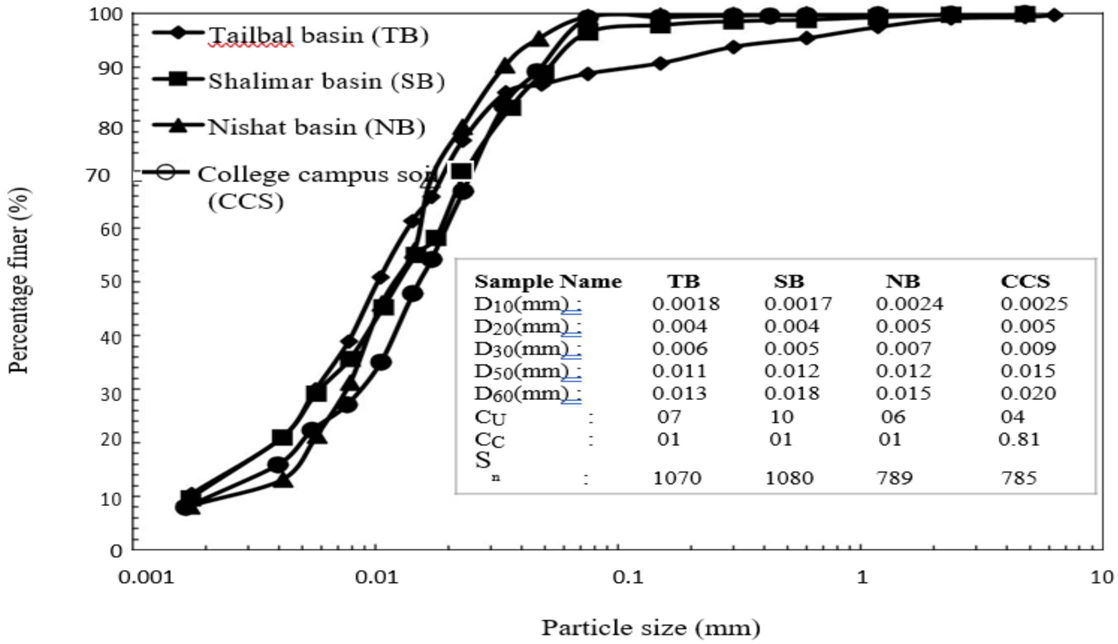

Figure 1 Grain Size distribution curves

2.2 College campus soil

For the project work undisturbed and disturbed soil samples were collected from college campus (near the transportation engineering laboratory) and basic characterization of sample had been done.

III. EXPERMENTAL PROGRAME

The physical and engineering qualities of dredged soil from the Dal lake basins and college campus were determined by a series of laboratory tests, as shown in table 1.

Table 1 physical properties of soil samples.

Sr. No.	Properties	Tailbal Basin	Shalimar Basin	Nishat Basin	College Campus 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

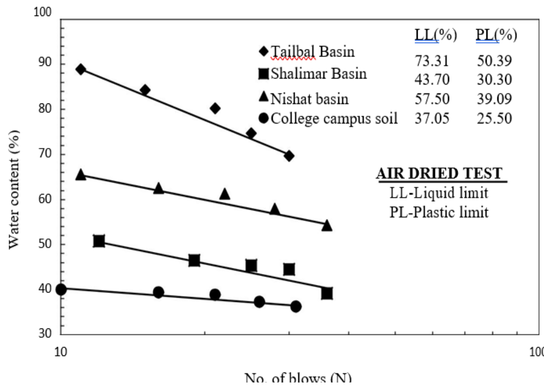

Figure 2 Flow curves of Air-dried samples

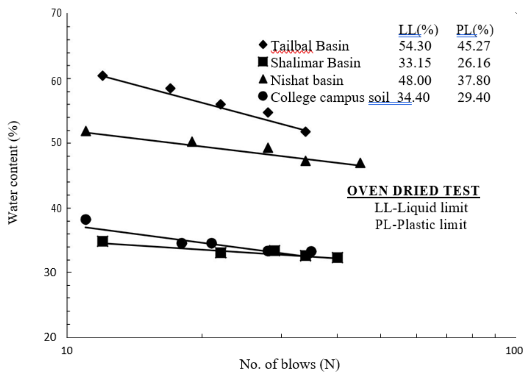

Figure 4 flow curves of oven dried samples

3.1 Compaction characteristics

The compaction test were conducted using the modified proctor test (Heavy compaction test). The apparatus consists of mould of internal diameter 10 cm and a height of 12.5 cm (volume of 1000 cm^3). A removal collar of 3.36cm in height and 10cm diameter was used. A hammer of 4.9 kg in weight and height of free fall 45cm were used. The number of blows require to achieve compaction energy per layer is 25 in 5 each layer.

The test results of the compaction tests are presented in a plot of dry unit weight versus water content as soon in Fig. 4 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, 17.39 kN/m^3 and 15.12% for Shalimar basin, 15.86 kN/m^3 and 22.14% for Nishat basin and 19.1 kN/m^3 and 12.9% of college campus soil respectively.

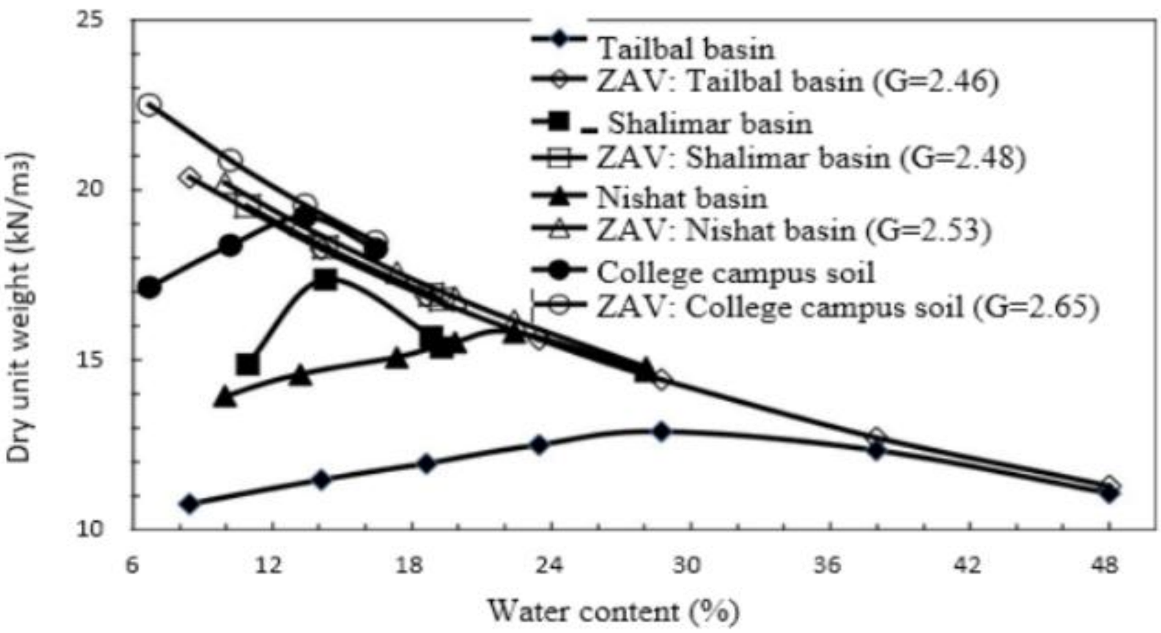

Figure 3 compaction curves for different soil samples.

3.2 California bearing ratio (CBR) test

Dredged materialand college campus soil was oven dried at 600C and 1050C for 24 hours and it passed by IS sieve 4.75mm. As per dry density and size of mould, soil samples were taken and water was added to the soil equal to optimum moisture content. Soil was filled in the mould of diameter of 15cm and height of 17.5cm after keeping the disc of diameter 10cm and height 4.7cm of the mould in 5 layers of equal thickness and by giving the 55 number of blows with hammer, weight of 4.89 kg and free fall of 45cm. The initial CBR values obtained on dredged and campus 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. 5 (unsoaked condition) and Fig. 6 (soaked condition).

IV. EFFECT OF STABILIZATION ON PROPERTIES OF DREDGED MATERIAL

4.1 Effect of stabilization on compaction characteristics

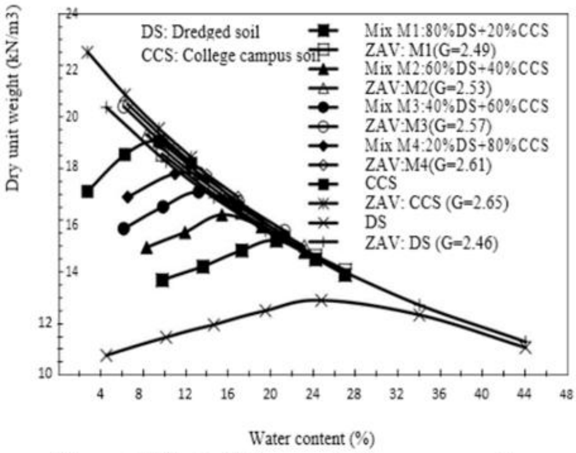

***Figure 5** Effect of Campus Soil on compaction characteristics of Dredged soil*

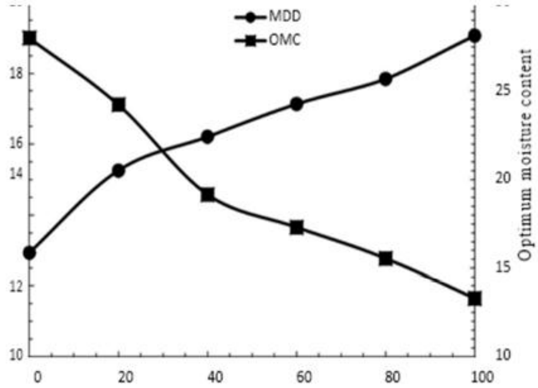

***Figure 6** variation of OMC and MDD with addition of Campus soil to dredged soil*

4.2 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 content. The load penetration curves for dredged soil admixed with campus with different proportions are shown in Fig. 8 and Fig. 9 for unsoaked and soaked conditions respectively. Fig. 7 represents the variation of CBR with addition of campus 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 campus 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 uponsoaking is due to the decreased effective stress and loss of surface tension forces. The CBR of the material is contributed by its cohesion and friction components.

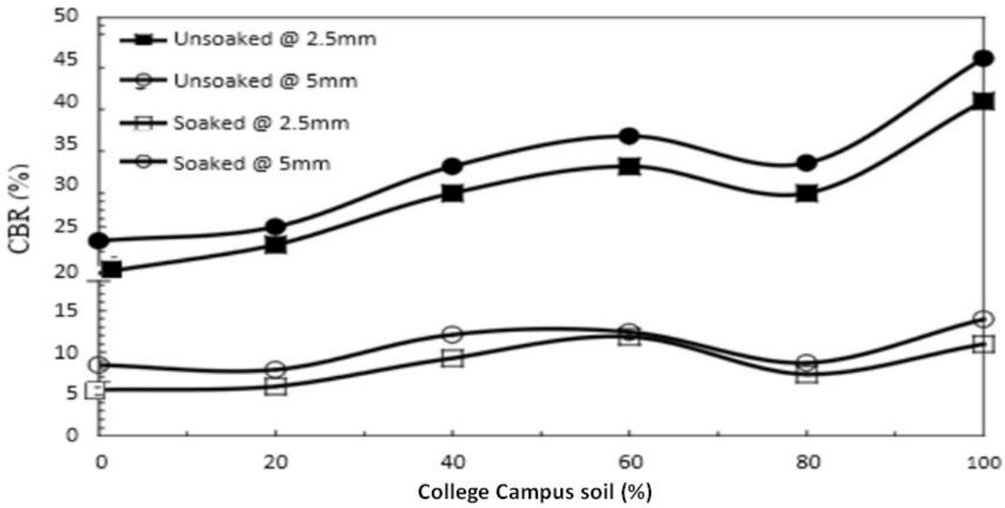

Figure 7 Variation of CBR values at 2.5mm and 5mm (unsoaked and soaked condition)

For dredged soil mainly cohesion contributes and for college campus soil the friction due to coarse particles mainly contributes to the mobilization of strength. It can be seen from Fig. 4.3 and Fig. 4.4 that the CBR of dredged soil is low compared to campus soil. The low CBR of dredged soil is attributed to its inherent low strength due to the dominance of clay and organic fraction. Addition of campus soil to dredged soil increases the CBR of the mix up to 60% (60% college campus soil+40% dredged soil) due to the frictional resistance from college campus soil in addition to the cohesion from the dredged soil.

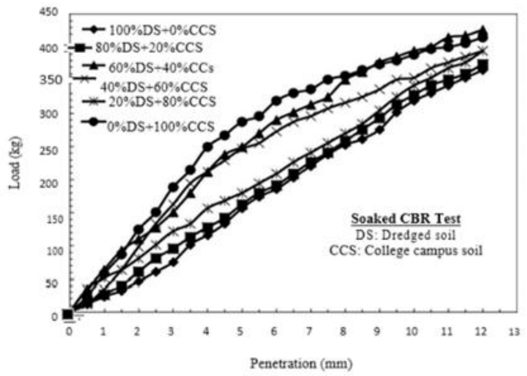

Figure 8 Load penetration curves for dredged soil (soaked condition)

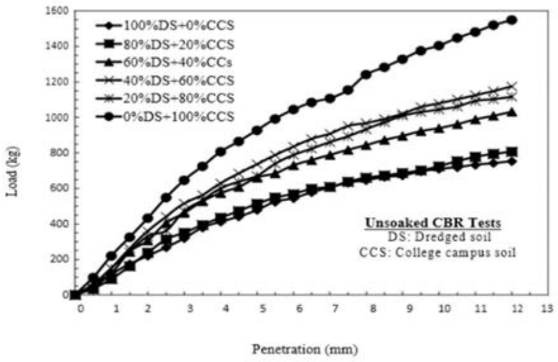

Figure 9 Load penetration curves for dredged soil (unsoaked condition)

The addition of the college campus soil beyond 60% and up to 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 college campus soil (i.e. increase in sand content). It is the proper mix proportion that optimizes the frictional contribution of college campus soil and cohesive contribution from dredged soil leading to the maximization of CBR. It can be further observed from Fig. 4.5 that the CBR is maximum with about 60-40 % of campus soil which could be effective stabilizer to improve the CBR of the dredged soil.

Table 2 Variation of CBR values (unsoaked).

CBR (%) (Unsoaked)				
Sr. No.	**Dredged soil (DS) (%)**	**College campus soil (CCS)(%)**	**CBR (%) @2.5mm (unsoaked)**	**CBR (%) @5mm (unsoaked)**
1	100	0	19.47	23.28
2	80	20	22.86	24.97
3	60	40	29	32.17
4	40	60	32.17	35.84
5	20	80	29	32.59
6	0	100	40	45.1

Table 3 Variation of CBR values (soaked).

CBR (%) Soaked				
Sr. No.	**Dredged soil (DS) (%)**	**College Campus soil (CCS) (%)**	**CBR (%) @2.5mm (soaked)**	**CBR (%) @5mm (soaked)**
1	100	0	5.5	8.46
2	80	20	5.92	7.9
3	60	40	9.3	12.13
4	40	60	11.85	12.41
5	20	80	7.4	8.74
6	0	100	11	13.97

V. Conclusions

On the basis of present investigation following conclusions are drawn:
Dredged soil consist of uniformly graded silt containing organic content 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 college campus 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 college campus soil. The sand fraction increased where the clay and organic fractions decreased with increasing amount of admixture (College campus soil).

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

Addition of campus 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 college campus soil.

The structure of the soil particle changes from flocculated to a dispersed structure as the water content is increased from the dry of optimum to the wet side of optimum.

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

From the results it can be concluded that stabilized material can be suitably used in a beneficial 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.

Hence, using dredged material as a resource has two-fold advantages-

- To avoid the tremendous environment problems caused by its large-scale dumping and
- Bulk utilization of dredged material. It can be used for number of engineering purposes.
- Use as foundation soil for roads and buildings.
- Use as backfill material.
- It can be used to reclaim marshy land

5.1 Future scope

Some studies that can be undertaken in future are summarized below:

- To study the compressibility characteristics of dredged soil and treated soil.
- To evaluate the permeability of dredged soil and treated soil.

REFERENCES

[1]. Arora, K.R Soil mechanics and foundation engineering.
[2]. A.S.R. Rao and Gopal Ranjan, Soil mechanics and foundation engineering.
[3]. Soil Stabilization using Natural Sand, MIT School of Engineering MITADT University. Jan 2018
[4]. Ashish Kumar, Prof. Tula Institute Dehradun, 2019 A study on stabilisation of dredged soil my mixing with lime which can be used for construction of embankment and stabilisation of subgrade soil
[5]. Mir, B.A and Mir, F.A, Applications and Geotechnical Evaluation of Dredged material obtained from Dal Lake in Srinagar.
[6]. Mir, B.A. (2015) some studies on geotechnical characterization of dredged soil for sustainable development of Dal Lake and environmental restoration. International Journal of Technical Research and Applications, Special Issue 12 (Jan-Feb 2015: 04-09).
[7]. Prakash, A. (2016) A Study on Stabilization of Marine Dredged Soil Using Quarry Dust. International Journal of Scientific Engineering and Research (IJSER), Volume 4 Issue 3, March 2016, 83-86.
[8]. Amu, O. O., Adewumi, I. K., Ayodele, A. L., Mustapha, R. A., & Ola, O. O. (2005). Analysis of California bearing ratio values of lime and wood ash stabilized lateritic soil. Journal of Applied Sciences, 5(8), 1479-1483.
[9]. Suresh, I. V., Padmakar, C., Padmakaran, P., Murthy, M. V. R. L., Raju, C. B., Yadava, R. N., & Venkata Rao, K. (1998). Effect of pond ash on ground water quality: a case study. Environmental Management and Health, 9(5), 200-208.
[10]. Kolay, P. K., Sii, H. Y., & Taib, S. N. L. (2011). Tropical peat soil stabilization using class F pond ash from coal fired power plant. International Journal of Civil and Environmental Engineering, 3(2), 79-83.
[11]. H Yusuf, M SPallu, Samang, Characteristically Analysis of Unconfined Compressive Strength and CBR Laboratory on Dredging Sediment Stabilized with Portland Cement, International Journal of Civil and Environmental Engineering, 12:25-31, 2012.
[12]. IS: 2720-part 1 (1980) Indian Standard Code for preparation of soil samples. Bureau of Indian standards (BIS), New Delhi.
[13]. IS: 2720-part 3(2) (1980) Determination of specific gravity of fine, medium and coarse-grained soils. Bureau of Indian standards, New Delhi.
[14]. IS: 2720-part 4 (1985) Determination of grain size distribution. Bureau of Indian standards, New Delhi.
[15]. IS: 2720-part 5 (1985) Determination of Atterberg limits. Bureau of Indian standards, New Delhi.
[16]. IS: 2720-part 8 (1980) Determination of water content-dry density relation using heavy compaction. Bureau of Indian standards, New Delhi.
[17]. IS: 2720-part 16 (1979) Method of test for soils: Laboratory determination of CBR. Bureau of Indian standards, New Delhi.
[18]. IS: 9669(1980) Specification for CBR moulds and its accessories. Bureau of Indian standards, New Delhi.