



Use Of Saw Dust Ash In Soil Stabilization

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Abstract

Due to rapid urbanization and infrastructure developments, there is scarcity of stable construction/foundation sites and Geo-technical Engineers often encounter situations where the selected site is not found suitable to take the load of the proposed structure. In such cases, various methods of soil stabilization can be used to improve the ground conditions. Though there are various soil stabilization techniques available, use of saw dust Ash (SDA) has been successfully used in recent times to improve the shear parameters of the marginal/weak soils. Among various stabilizing materials saw dust Ash (SDA) can be used as to enhance the shear strength and bearing capacity of a clayey soil for sustainable use of waste materials and sustainable development of infrastructures in a rapid urbanization. Saw dust is a natural waste material obtained from sawmills, timbering works etc., which creates health and environmental problems if not disposed-off in scientific manner. This is available in abundance at a very low cost and can be easily used as a stabilizing material not only to improve poor/unsuitable construction sites for sustainable construction but also to avoid its disposal problems. Therefore, this project presents some studies on strength properties of clayey soil stabilization with saw dust Ash. The SDA randomly distributed in clayey soil samples were tested for its engineering properties by performing CBR and Unconfined test on a number of samples by using the different percentage of saw dust Ash and comparing the results with non-stabilized soil. The test results revealed that the strength significantly improves with the inclusion of SDA and also prevents the sampling from cracking.

Keywords; Sawdust Ash , Soil Stabilization ,Bearing Capacity, Clay Stabilization

1. Introduction

Man does not have any control on the process of soil formation. As such the soil strata at a site are to be accepted as they are and any construction has to be adopted to suit the sub soil conditions. The existing soil at a given site may not be suitable for supporting the desired facilities such as buildings, bridges, dams and so on because safe bearing capacity of the soil may not be adequate to support the given load. Quite often, engineers may encounter situations where the selected site is not found suitable to take the load of the proposed structure. In such cases, various methods of soil stabilization can be used to improve the ground conditions. The main objective of the soil stabilization is to improve the characteristics of the soil at the site. Soil stabilization is a rapidly developing field because good sites for construction are becoming limited day to day. The geotechnical engineer has the challenge of construction of foundation at the sites which are previously considered unsuitable and unacceptable.

The geotechnical engineers design foundations and other structures on the soil after investigation of the type of soil, its characteristics and its extent. If the soil is good at shallow depth below the ground surface, shallow foundation such as footing and rafts are generally most economical. However if the soil just below the ground surface is not good but a strong stratum exist at a great depth, then deep foundation such as piles, wells and caissons are required. Deep foundations are quite expensive and are cost effective only where the structure to be supported is quite heavy and huge. Sometimes the soil conditions are very poor even at greater depth and it is not practical to construct even deep foundation. In such cases various methods of soil improvement (stabilization) techniques are adopted. The objective is to improve the characteristics at site and make soil capable of carrying load and to increase the shear strength, decrease the compressibility of the soil, so that the bearing capacity of the soil is increased and the settlement of the structures built on it are reduced. Sometimes, the aim is to decrease the permeability of the soil.

Scientists, engineers and technologists are continuously on the lookout for materials which can be used as substitute for conventional materials or which possess such properties which would enable their use for new designs and innovations.

Soil Stabilization is the process of improving the engineering properties of the soil and thus making it more stable. It is required when soil available for construction is not suitable for the intended purpose. In its broadest senses, stabilization includes compaction, pre-consolidation, drainage and many other such processes which alter the soil material itself for the improvement of its properties. A cementing material or a chemical is added to the natural soil for the purpose of stabilization.

Soil stabilization is used to reduce the permeability and compressibility of the soil mass in structures and to increase its shear strength. Soil stabilization is required to increase the bearing capacity of foundation soils. However, the main use of stabilization is to improve the natural soils for the construction of highways

and airfields. The principles of soil stabilization are used in the construction of bases and sub-bases of the highways and airfields. Soil stabilization is also used to make an area trafficable within a short period of time for military and other emergency purposes. Sometimes, soil stabilization is used for city and sub-urban streets to make them more noise- absorbing.

The materials for soil stabilization are essentially limitless, since practically all the earth's crust can be utilized, if associated cost and energy requirements can be compiled with, this course of action cannot be taken as there are other constraints that demand closer action.

2. METHODOLOGY

2.1. Materials

The material used in the present investigation have been described in the following sections

2.1.1. Saw Dust Ash

Saw dust is one such by-product from Timber industries and Wood cutting factories. Saw dust by itself has little cementitious value but in the presence of moisture it reacts chemically and forms cementitious compounds and attributes to the improvement of strength and compressibility characteristics of soils. So in order to achieve both the need of improving the geotechnical properties of clays and also to make use of the industrial wastes, the present experimental study has been taken up.

The Saw dust was collected from local Saw mill at Chersoo Awantipora @Rs 5 per Kg. The saw dust collected was obtained from sawing of deodar and kail wood. Saw dust is actually by- products of sawmills generated by sawing timber. It is the loose particles or wood chippings obtained by sawing wood into useable sizes. After collection, clean saw dust not having much bark and so not much organic content was air dried and burnt. The Saw dust ash (SDA) was then sieved through 600 micron sieves to remove the lumps, gravels, unburnt particles and other materials which are deleterious to soil. The Saw dust ash passing through 600 microns sieve was used for the laboratory work.

Table 1 Physical Properties of Saw dust ash

Colour	Greyish Black
Specific Gravity	1.335
Fineness	600 microns
Water Absorption	224%
Rate of burning	3 hours per Kg



Figure 1 Saw Dust - Burning of Saw Dust - Saw Dust Ash

2.1.2. Soil

We brought soil samples from the Galander Pampore area situated at a distance of 25 km from Rajpora (33.59⁰N 74.93⁰E) Prototypes for soils were created in SSM College of Engineering Parihaspora Pattan Geotechnical Engineering lab. The various preliminary tests for the index properties and strength properties were done. Sieve analysis was carried out for all the samples. Compaction characteristics of the soil have been determined by conducting

Standard Proctor's test in accordance with IS -2720- 1980 (IS light compaction). The samples for Unconfined Compression and CBR testing were prepared at maximum dry density and optimum moisture content (OMC) as obtained from standard Proctor's test.



Figure 2 Collection of Soil from Site

3.1. Consistency Limits

3.1.1. Plastic Limit

1. Sample of Soil (100g) + 0% saw dust ash

Table 9 Plastic Limit of Soil with 0% SDA

Observation	Determination (gm)
Mass of empty container (M ₁)	6.8
Mass of container + wet soil (M ₂)	27.7
Mass of container + dry soil (M ₃)	23.6
Calculation	
Mass of water = (M ₂ -M ₃)	4.1
Mass of dry soil = (M ₃ -M ₁)	16.8
Water content = (M ₂ -M ₃)/(M ₃ -M ₁)	24.4%

Result: Plastic Limit = 24.4%

2. Sample of Soil (100g) + 4% saw dust ash

Table 10 Plastic Limit of Soil with 4% SDA

Observation	Determination (gm)
Mass of empty container (M ₁)	11.9
Mass of container + wet soil (M ₂)	17.3
Mass of container + dry soil (M ₃)	16.2
Calculation	
Mass of water = (M ₂ -M ₃)	1.1
Mass of dry soil = (M ₃ -M ₁)	4.3
Water content = (M ₂ -M ₃)/(M ₃ -M ₁)	25.58%

Result: Plastic Limit = 25.58%

3. Sample of Soil (100g) + 8% Saw Dust Ash

Table 11 Plastic Limit of Soil with 8% SDA

Observation	Determination (gm)
Mass of empty container (M ₁)	11.9
Mass of container + wet soil (M ₂)	15.3
Mass of container + dry soil (M ₃)	14.6
Calculation	
Mass of water = (M ₂ -M ₃)	0.7
Mass of dry soil = (M ₃ -M ₁)	2.7
Water content = (M ₂ -M ₃)/(M ₃ -M ₁)	25.92%

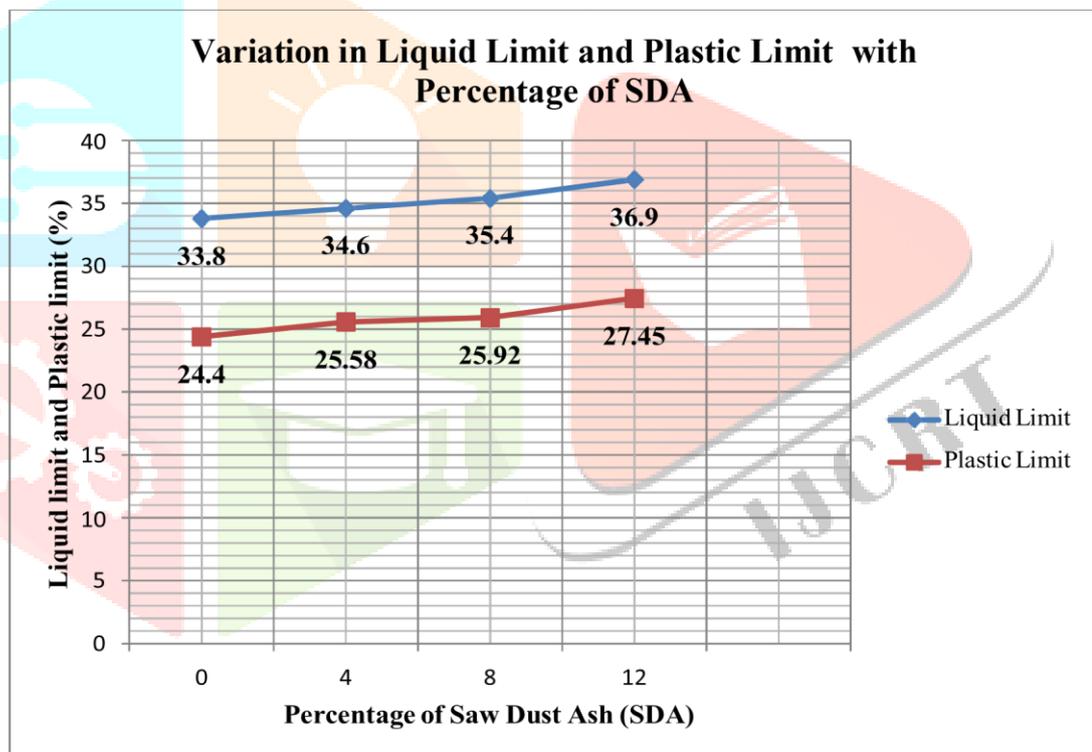
Result: Plastic Limit = 25.92%

4. Sample of Soil (100g) + 12% Saw Dust Ash

Table 12 Plastic Limit of Soil with 12% SDA

Observation	Determination (gm)
Mass of empty container (M1)	13.3
Mass of container + wet soil (M2)	19.8
Mass of container + dry soil (M3)	18.4
Calculation	
Mass of water = (M2-M3)	1.4
Mass of dry soil = (M3-M1)	5.1
Plastic limit % = (M2-M3)/(M3-M1)	27.45%

Result: Plastic Limit = 27.45%



Graph 6 Variation in Liquid limit and Plastic Limit with Percentage of SDA



4. Discussion

The variation in consistency limits with Saw Dust Ash content (%) is shown in Graph 6. The Plastic limit increased from 24.4% to 25.58%, 25.92% and 27.45% on addition of 0%, 4%, 8% and 12% Saw Dust Ash content respectively. This can be considered to be a result of addition of saw dust ash, which has higher water absorption affinity.

5. Conclusion

The physical properties and engineering characteristics of virgin soil is studied, which includes moisture content, Atterberg's limits, compaction characteristics, CBR and unconfined compressive strength. The addition of Saw Dust Ash (SDA) improved the properties of the virgin soil, making it good for sub-base material.

1. It is noticed that the liquid limit of the clayey soil has been increased from 33.8% to 34.6%, 35.4% and 36.9% on the addition of 4%, 8% and 12% SDA respectively.
2. It is observed that the plastic limit of the clayey soil has been increased from 24.4% to 25.58%, 25.92% and 27.45% on addition of 4%, 8% and 12% SDA respectively.
3. It is observed that the maximum dry density decreased from 1.81 gm/ml to 1.55 gm/ml, 1.38 gm/ml and 1.365 gm/ml on addition of 4%, 8% and 12% SDA respectively.
4. It is noticed that the optimum moisture content of the clayey soil increased from 11% to 13.2% and 25.7% on addition of 4% and 8% SDA respectively.
5. It is observed that the CBR value increased from 6.75% to 13.71%, 12.24% and 13.21% on the addition of 4%, 8% and 12% SDA respectively. Hence, Plain Clayey soil is good for sub- grade while addition of saw dust ash makes it suitable for sub- base.
6. It is observed that the shear strength of the clayey soil increased from 124 KN/m² to 156.57 KN/m² on addition of 4% SDA but decreased to 92.214 KN/m² and 91 KN/m² on addition of 8% and 12% SDA respectively.

7. The optimum values of un-soaked CBR and unconfined compressive strength (Shear strength) were achieved at 4% Saw Dust Ash (SDA) content.

Thus it is concluded that saw dust ash is a satisfactory stabilizing agent for clayey soils. The utilization of the industrial wastes like saw dust ash is an alternative to reduce construction cost of the roads particularly in the rural areas of developing countries like India.

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