

Effect of Mixing of Rice Straw to Enhance the Characteristics of Soil



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Abstract: The foundation should have sufficient strength to support any land based structure. The soil surrounding the foundation plays a very important role. The strength of soil should be maintained according to the loading conditions. The soil reinforcement process helps to attain the required engineering properties in soil for the construction purpose. The necessity of enhancing soil properties came to the light from the beginning of construction work. Soil reinforcement was used in India in 1970's but proper techniques and skilled labour was not available that's why in India ancient methods for soil reinforcement was using, show the soil reinforcement lots lost its importance. Recently, the demand for infrastructure, raw materials and fuel is improving show the process of soil reinforcement rising its importance up again. According to the better research, materials and equipment, soil reinforcement is the cost effective and popular method for improving the soil properties. Here, in this paper, soil reinforcement analysis completed with the mixing of soil with the powder produced from burning of rice straws fibers (parali) by an specific method. The main motive of this analysis is to find out the utilization of waste rice straw fiber materials in foundation construction without open burning of waste so we can reduce the pollution which create by the open burning of rice straw in the fields.

Keywords : About four key words or phrases in alphabetical order, separated by commas.

I. INTRODUCTION

Different types of soil present in India and every soil has its own characteristics. Some soils have good physical and mechanical properties and some soils have good fertility characteristics. According to the point of view of a geotechnical engineer, the soil should have good bearing capacity but such type of soil is not present in overall country so the soil reinforcement word has been introduce to solve this problem. Soil reinforcement can be define as the inserting of a strengthen material into the soil to increase the bearing capacity and stability characteristics of soil, so in this review paper we are focusing on such type of soil which required soil reinforcement. If the load coming on soil is greater than soil bearing capacity then soil needed the treatment like soil stabilization or soil reinforcement.⁽¹⁾

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In traditional way the soil reinforced with the help of lime but it has poor tensile strength and there is also a problem of cracking.⁽³⁾ after some experiments geotechnical scientists attract towards the use of waste plant fibers to modify the strength of soil. Plant fibers can improve the properties of soil by reinforcement because good internal exists friction between soil particles and plant fibers⁽³⁾.

Agricultural residue burning is a very big issue in worldwide because it creates lots off negative impact on our environment. It creates air pollution by increasing the amount of carbon in environment due to burning which cause climatic changes and global warming. The biomass waste obtained from rice straw creates many problem of management even rice straw burning in open fields by farmer a big cause of air pollution. The rice straw burning is a cause of methane emission. In this paper we are analyzing to avoid burning of rice straw (parali) by farmers in their field. The air pollution due to rice straw burning is a very big issue in North Central Region of India including the area of Uttar Pradesh and Haryana which attached with this region. Over the last few decades, a large interest of scientists occurs for the utilization of rice straw in the field of construction. So by this analysis we propose the utilization of rice straw without open burning to improve the bearing capacity of soil. It is well known that the roots of a plant consume silicon elements with water and transfer it to the plant. In case of rice plant the maximum amount of silica stored in husk and then the amount of silica stored by rice straw less than the amount of silica store by husk. Lastly roots of rice plant store very less amount of silicon elements.⁽²⁾ In this study we are analyzing rice straw because Rice straw ash have the good concentration of SiO₂ as 40.07% .and 27.5% content of K₂O⁽²⁾. The mentioned characteristics of rice straw ash obtained without rice straw burning in open fields.

This ash produced by an specified method. This rice straw ash has good pozzolonic property also. Silica is a basic component which needed for the pozzolonic activity thus the content of reactive silica plays a great role for the development of geopolymer with high performance. Pozzolona can we define as a broad class of siliceous or Aluminium material, due to which cementitious characteristics less or negligible but its component forms convert into calcium hydroxide chemically in the presence of water. Volcanoes are the origin of natural pozzolona. Geopolymers are the good material for the reinforcement of soil.⁽¹⁾ So the high concentration of silica in rice straw ash is main basis to focus on this material to reinforce the soil. After the chemical reaction analysis of this ash we get a C-H-S gel which have good cementing property and represent the pozzolonic characteristic⁽²⁾.

According to another research the rice straw have the good tensile strength also⁽³⁾. Rice straw ash percentage varying from 5 to 35% by weight of soil use to stabilize the clayey soils.⁽⁵⁾

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II. LITERATURE REVIEW

B.C punmia⁽¹⁾ (2011) Soil reinforcement means to improve the characteristics of soil to improve performance of soil in the field of civil engineering. Cement soil stabilization is a traditional method. The process of cement stabilization is similar to the lime stabilization.

Josefa Roselló and Lourdes Soriano⁽²⁾ et. al. (2017) To maintain the original characteristics of rice straw for testing the collected rice straw stored in air tight bags at 4°C. To remove the soil residue the fresh rice straw washed thoroughly by water and cut the roots from the rice straw properly. Cut the rice straw in one inch length with the help of cutter to make it easy for processing purpose. Now these pieces clarified with the help of 50% sodium hypochlorite. Then distilled water use to wash it. After this process it dried in oven at 105° C for 24 hours. After this process grind it well to mix with soil of low bearing capacity. The ash obtain from this method gave good result with concrete to replace OPC 10% and 25% by rice straw ash.

Li Wei, Shou Xi Chai, Hu Yuan Zhang and Qian Shi⁽³⁾ et. al. (2018) The length of rice straw taken as the 30% to 40 % of the soil sample to ease with the testing. The unconfined compressive test and triaxial test use to determine the compressive and tensile strength of rice straw respectively. The comparative study shows that the unconfined compressive strength of soil which mixed with rice straw is greater than the unconfined compressive strength of normal soil. The unconfined compressive strength continuously increases by increasing the amount of rice straw mixing with the soil. Plant fibers can increase the bearing capacity of stabilized soil. In the testing of tensile strength the strength improves by increasing the length of rice straw. The use of fiber may reduce the chance of cracks also by changing the propagation direction of cracks.

Mohamed A. El-Sayed and Taher M. El-Samni⁽⁴⁾ et. al. (2006) After the burning of rice straw in an special incinerator at 550° C, it converts in ash. The weight of rice straw ash converted by above method is equal to 15% of the

rice straw weight. The burning of rice straw in this special manner the rice straw ash attains maximum pozzolonic characteristics. This burning process removes the organic matters and reduces the amount of carbon emission.

Aditya Kumar Anupam, Praveen Kumar and G D Ransinchung R⁽⁵⁾ et. al. (2013) India is the second largest country in the field of rice production, so the management of rice residue is must otherwise creates lots of problems. In the research there is the experimentation on rice straw ash which has good properties for the stabilization purpose. All the testing of rice straw ash conducted on different percentage of rice straw ash mixing with soil from 5 to 35 % by the weight of soil.

Junjun LIU, Chanjuan JIA and Chunxia HE⁽⁶⁾ et. al. (2012) To determine the flexural properties of rice straw it prepared by a specified process. In this process rice straw washed from water to remove dust and then placed in oven at 103°C for drying process. Then this material placed in plastic container to prevent from any microbial attack and named it CRS (controlled rice straw). Before the testing CRS soaked in sodium hydroxide solution for two hours at room temperature followed by distilled water several times to neutralize the affect of sodium hydroxide solution. After this process CRS soaked in hot water at 100°C for two hours and leveled it as HRS (hot water treated rice straw). Use hot compression moulding to make 10cm x10 cm mould mixing with 4.4 mm thickness sample for flexural strength testing.

III. RESULT AND DISCUSSION

Pozzolonicity test (frattini) of rice straw ash gives positive results so it is confirm that rice straw has the properties of pozzolona.⁽²⁾ The ash of rice straw belongs to medium acidic zone according to the Vassilev's classification. The formed gel C-H-S worked well for the pozzolonic action which formed at room temperature. Rice straw has good compressive strength⁽²⁾. The maximum tensile strength calculated with the help of Triaxial testing is 5.4 MPa. Rice straw has the maximum elongation of 2.3 %.⁽³⁾ the use of rice straw for reinforcement of soil is better option as compare to the wheat straw. The unconfined compressive strength of stabilized soil improves by increasing amount of rice straw. The tensile strength of stabilizes soil improve by increasing the length of rice straw. The cracks developed in soil which mixed with rice straw is less than the use of any other type of plant fiber as shown in figure⁽³⁾.

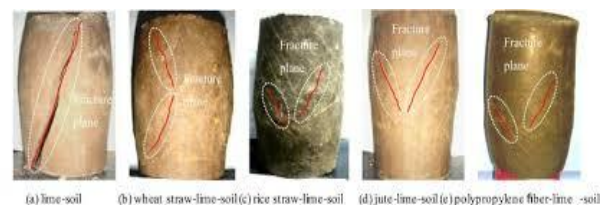


Figure 1: Failure pattern of fiber-soil⁽³⁾

The specific gravity of rice straw ash after burning in special incinerator is 2.25, specific surface Area is 18460 cm²/gm and the color is grey. This ash have the maximum percentage of silica dioxide which is responsible for the pozzolonic activity⁽⁴⁾.

The ash proceed from the rice straw have good engineering properties⁽⁵⁾ like specific gravity and lime reactivity as 1.81 and 28 kg/cm² respectively. The optimum moisture content and Maximum dry density determined by standard Proctor's test is 64% and 1.3 gm/cm² respectively. But the ash obtained from rice straw by open burning process which creates equal pollution which creates by farmers by burning rice residue in fields. The results of CBR testing are best on 20% of rice straw ash by weight of soil⁽⁵⁾.

Hot water treated rice straw gives better flexural strength.⁽⁶⁾

IV. CONCLUSION

According to above analysis the ash of rice straw which proceeds by a specified method to reduce the air pollution is good as a pozolona. It has good compressive strength also so it will increase the strength of soil. It can use as reinforcement material for the soil stabilization. It is well known that the rice straw is a agricultural waste which burnt by farmers in their field and it has no cost. So, it will take only transportation cost.

If it is available near the construction site than cost of construction will decrease. Lime stabilization and cement stabilization are the traditional methods for inhancing the bearing capacity of soil and the method of application of both materials is same. The rice straw ash satisfies all the pozzolonic characteristics so it is a good supplement of cement in case of soil reinforcement. The application of rice straw ash will be same as the method use in cement stabilization.

The properties of soil increased dramatically by mixing with ash produced by rice straw. The use of this ash is good in both manners as following

- i. Improve the bearing strength of soil on in foundation construction and in slope stability as well
- ii. Reduce the air pollution which caused by the rice straw burning in open fields.

The use of rice straw ash in construction will also cost effective.

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