Recycling of Sewage Sludge Ash in Soil

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ABSTRACT

ISSA is an Incinerated Sewage Sludge Ash desired from the incineration of the residual stream of fine organic and inorganic solids (sewage solids). Recycling and disposal routes for sewage sludge itself are Agriculture (54%), Incineration (22%), Landfill (11%), Land reclamation (5%) and other (8%). To overcome the scarcity of soil, Incinerated ash can be reused with black cotton soil for stability of soil. Inthis study ISSA is been mixed with Black cotton soil at different proportions such as 2%, 4%, 6%, 8% and 10%. Liquid limit, Plastic limit, Shrinkage limit, Specific gravity for the samples are been done. Physical test such as UCC, CBR and compaction are been done. pH test was also carried out for testing the chemical nature of the soil. From the results, it is observed that at optimum percentage of 8% of ISSA can be suggested for improving the strength of soil.

Keywords: Black cotton soil, Sewage sludge ash, Soil properties.

1. INTRODUCTION

ISSA is an inorganic ash derived from the incineration of the residual stream of fine organic and inorganic solids (sewage sludge). This arises from municipal wastewater treatment works. The incineration process thermally destroys the organic matter. The total quantity of ISSA produced in the UK (through nine incinerators throughout England and one in Northern Ireland), is approximately 100,000 tonnes per annum, Less than a quarter of the sewage sludge produced is incinerated and there is a potential to increase to 450,000 tonnes if all the UK sludge were incinerated in the future. Recycling and disposal routes for sewage sludge itself are agriculture (54%), incineration - producing ISSA (22%), landfill (11%), land reclamation (5%) and other (8%).Potential uses of ISSA in construction products include aerated concrete (as aggregate), ceramic materials (as sand and clay replacement), cement (as cement replacement /filler), fine aggregate for concrete products, and the manufacture of synthetic coarseaggregate.

2. OBJECTIVE

The main objective of our project is to determine the change in the behaviour of soil using sewage sludge ash.

3. RESULTS AND DISCUSSION

Incinerated sewage sludge ash is been used in this study which was collected from STP of KCET,Madurai.

3.1 SAMPLE TEST

3.1.1 Specific Gravity

Specific gravity is the ratio of the mass of a substance to the mass of a reference substance for the same given volume. Specific gravity can be determined by using pycnometer and the value of fine aggregate as 2.48.

3.1.2. Plastic Limit

The plastic limit signifies the percentage of moisture at which the soil changes, with decreasing wetness, from a plastic to a semi-solid state, or with increasing wetness, from the semisolid to the plastic state. It is the lower limit sof theplastic state. It is the moisture content at which a thread of soil can be rolled without breaking until it is only 3 mm in diameter, when it just begins to crumble under pressure exerted by the hand.Plastic limit of soil that is tested was 29.35.

3.1.3. Liquid Limit

The liquid limit of fine-grained soil is the water content at which soil behaves practically like a liquid, but has small shearstrength. It is the minimum water content at which the soil is still in the liquid state, but has a small shearing strength against flow. Obtained liquid limit of soil that is tested was 45%.

3.1.4 Shrinkage Limit

The shrinkage limit is the water content of the soil when the water is just sufficient to fill all the pores of the soil and the soil is just saturated. The volume of the soil does not decrease when the water

content is reduced below the shrinkage limit. Shrinkage limit of soil tested is 53.83%.

3.2 PHYSICAL TEST

3.2.1 Dry density

Bulk density is the weight of soil in a given volume. The Standard Proctor compaction test is a laboratory method of experimentally determining the optimal moisture content at which a given soil type will become most dense and achieve its maximum dry density. A greater compactive effort reduces the optimum moisture content and increases the maximum dry density.

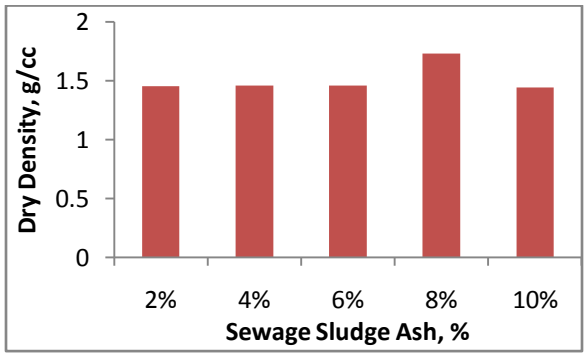


Fig. shows that thevariation of the Maximum dry density of soil with partial replacement of sewage sludge ash and the maximum value obtained with 8% replacement as 1.73g/cc.

3.2.2 Shear strength

Shear strength is a term used to describe the magnitude of the shear stress that a soil can sustain. The shear strength of a soil mass is the internal resistance per unit area that the soil mass can offer to resist failure and sliding along any plane inside it. If soil expands its volume, the density of particles will decrease and the strength will decrease.

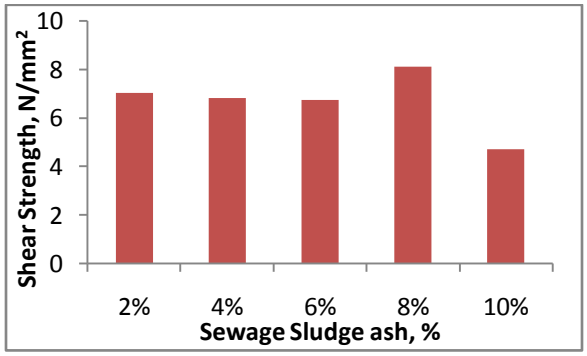


Fig. shows that the variation of the Shear strength of soil with partial replacement of sewage sludge ash and the maximum value obtained with 8% replacement as 8.11 N/mm^2.

4.CHEMICAL TEST

4.1 pH Test

pH (short for potential Hydrogen) is the measurement of acidity and its opposite, alkalinity in a solution. Neutral pH is 7.0 pH. Acidity measures below seven pH (7.0pH) with alkalinity measuring above it (7.0pH).

SLUDGE RATIOS	pH VALUES
0%	6.93
2%	6.97
4%	6.50
6%	6.60
8%	6.30
10%	6.88

5. COMPARISON OF SEWAGE SLUDGE ASH AND BOTTOM ASH:

Sewage sludge ash is the ash produced after incinerating the dried sludge where as Bottom ash is the residue which was collected at the bottom of the boiler at NLC. The comparison of sewage sludge ash was made with bottom ash and checked the suitability of low cost products.

Figure shows the comparison of Maximum dry density of Sewage sludge ash with that of bottom ash and the results obtained for sewage sludge ash as 1.73g/cc for 8% replacement and for bottom ash as 1.92g/cc for 40% replacement. It indicates that the suitability of sewage sludge ash with bottom ash since there was not much variations between them.

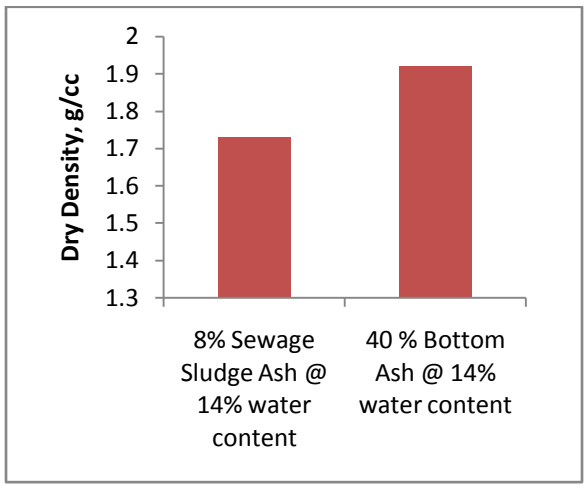
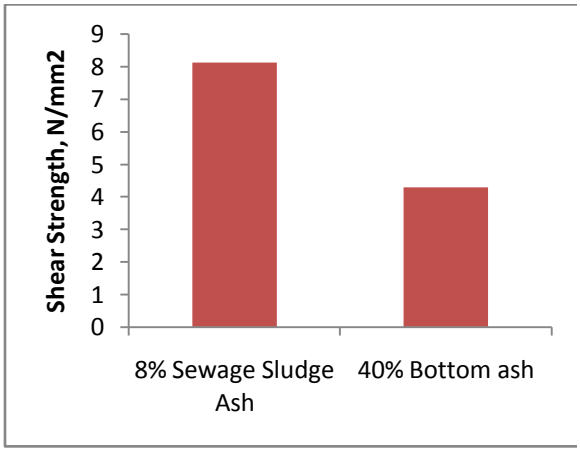


Figure shows the comparison of Shear Strength of Sewage sludge ash with that of bottom ash and the results obtained for sewage sludge ash as 8.11 $N/mm^2$for 8% replacement and for bottom ash as 4.28$N/mm^2$for 40% replacement. Sewage sludge shows the best result than the bottom ash since the arrangement of particles and friction may be high in sewage sludge ash than bottom ash.



6. CONCLUSION:

The use of sludge ash was done which was collected from STP at KCET,Madurai.So recycling of sewage sludge ash with black cotton soil in a proper proportion will make us to use the waste material in a useful way .From the test done above it can be suggested that 8% replacement of sewage sludge ash in soil will provide a better improvement in soil properties As compared to all other ratios as done such as 2%,4%,6% and 10% , the replacement of 8% in soilhas good shear strength , dry density and optimum moisture content. Also the suitability of sewage sludge ash was checked with bottom ash.

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