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EFFECT OF POND ASH AND EGGSHELL POWDER FOR THE STABILIZATION OF SOIL IN ROAD CONSTRUCTION

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ABSTRACT

Soil is a vital substance for all creatures in the world, soil has vast usage in different parts such as agriculture, civil work, foundation, bridges, embankment, buildings, canals, tunneling etc. Soil has different types and all the types of soil cannot fulfill all requirements of engineering properties and cannot stand against the properties such as mechanical strength, permeability, compressibility etc. among the different types of soils expansive soil is a weak soil which has less shear strength and should be stabilized for various construction purposes. Stabilization is the process of blending materials with soil in order to improve certain properties of soil like plasticity index, gradation, texture or act as a binder for the cementation of soil. Normally stabilization of soil is done by adding additives like lime, cement, etc. Cement stabilization is one of the effective stabilization processes but proves to be very costly in a long run. So, it needs an economic replacement by such materials which possess the same properties as that possessed by cement. It is being found that Pond ash possesses pozzolanic properties having silica as main component and Egg shell powder is having calcium oxide as its main component both being the main constituents of cement. Therefore, cement can be replaced partially or fully by these two waste materials in soil stabilization. A huge amount of eggshell and pond ash wastes is produced every year and there is an absence of effective waste disposal. Hence it is proposed to utilize ESP and pond ash for soil improvement which serves two purposes like waste utilization and also soil stabilization. In this present study, the two waste materials used are PA and ESP in different proportions. PA is first added in natural soil in different proportions like 3%, 5%, 7%, 9%and 11% by weight of soil and 5% PA was found an optimum proportion based on UCS values. After finding the optimum proportion of PA-soil

mix i.e., 5% Then ESP was added in different proportions like 2%, 4%, 6%, 8% and 10% to the Soil-PA mix. From test results it was found that the UCS got a maximum value of 271.24 KN/m^2 at 6% ESP.

Keywords: Pond Ash, Egg Shell Powder, maximum dry density, unconfined compressive strength

1.INTRODUCTION

The biggest challenge in civil engineering comes in play when we lay roads, built structures, railway lines etc. in the soil which have not enough capacity to with-stand the load of these structures. In order to overcome this problem, we have to stabilize the soil before building any civil engineering structure. Different techniques are used to stabilize the soil to increase its load carrying capacity. The stabilizing agents such as lime, cement etc. are used to stabilize the soil, but this type of stabilization involve huge cost. In order to overcome this problem, we use new type of materials which are not so costly but possess good pozzolanic properties such as Pond ash, Rice husk ash, Fly ash, Silica fume and Egg shell powder. They are the by-products of different materials having good pozzolanic properties which are helpful to bind the soil particles to increase its load carrying capacity. So, the imperative use of these waste products which we utilize as a replacement for soil in developmental projects solve issues of removal of wastes, environment contamination and also the normal soil is saved. This gives various advantages to the construction industry just as to the nation overall by protection of resources, through decrease in the quantity of waste items to landfills, through bringing down expense of the development materials, and by reducing the waste disposal cost. This study involves the combined effect of Pond ash and Egg shell powder on the properties of soil in road construction.

2.LITERATURE REVIEW

Nitish Kumar, Et al (1) Examined the combined effect of pond ash and terrazyme on clayey soil. It was found that there was reduction in liquid limit, plastic limit and MDD on adding pond ash alone. The addition of terrazyme and pond ash to soil improved maximum dry density to highest value. The CBR value shows maximum value at 20% pond ash and 0.24 ml of terrazyme which was around eight times higher than that of clayey soil

Ramesh, Et al (2) illustrated the consequences of using fly ash, pond ash and lime for stabilization of black cotton soil. Various tests were carried to observe the properties of pond ash, fly ash and lime on strength characteristics as well as compaction properties of (BCS) black cotton soil. The soil samples were prepared by using 5% fly ash and various percentages of pond ash like 10%, 20%,30% and 40% and various percentages of lime like 4%, 6%, 8% and 10%. The soil and fly ash mixes shows that the OMC increased and MDD decreased with increasing the percentage of fly ash. The angle of friction and cohesion was increased by increasing the percentage of lime and pond ash. The result of UCS, which differs up to 23.85 N/mm2 from 7.7 N/mm2 by adding dosage of 10% lime with 30% pond ash shows the maximum compressive strength.

Er. Dharm Raj, Et al (3) It was found that the FSI decreased on addition of PA. This research work is sighted that on addition of 50% PA to Black Cotton Soil the Free swell decreased about 58.33%. The UCS values also showed a decrease with increased % age of PA.

Harikaran M., Et al (4) studied the treatment of soil with lime and eggshell powder by conducting a series of experiments. The unconfined compressive strength of the expansive soil increased after the inclusion of additives. The UCS of the expansive soil with respect to the addition of 9% lime, 12% waste eggshell powder and combined admixtures were found to be 273 kPa, 188 kPa and 306 kPa respectively. A higher strength was attained for the combined inclusion of lime and waste eggshell powder. CBR of the expansive soil increased after the inclusion combination of lime and waste eggshell powder. A significant decrease in swell pressure was observed to 2.32% after the combined inclusion of lime and waste eggshell powder. The free swell index of the expansive soil with respect to the 9% lime, 12% waste eggshell powder and combined inclusion of lime and waste eggshell powder were observed to be 41%, 49% and 36% respectively.

3.MATERIALS USED

1.SOIL The soil taken for this project or investigation was chosen locally. Before taking the soil sample the top layer of soil was removed to get the best outcome as top layer generally consists of vegetation and which is not suitable for construction etc. but is suitable for agricultural purposes. After removal of top layer now we get soil for investigation. We go deep from that point to 1.5 meter below to get the sample for research work. According to IS Code classification, the soil is Inorganic clay in nature having much low tendency to get compressed. The properties of soil are as under:

S. No	Properties	Confirming to IS Code	Value
1	Natural Water Content	IS:2720 (Part 2)-1973	10
2	Specific Gravity	IS:2720 (Part 3)-1980	2.44
3	LL%	IS:2720 (Part 5)-1985	23.338
4	PL%	IS:2720 (Part 5)-1985	13.86
5	PI%	IS:2720 (Part 5)-1985	9.478
6	Classification of Soil	From Plasticity Chart (Jackson)	CL
7	Maximum Dry Density (g/cc)-Standard Proctor Compaction	IS:2720 (Part 8)-1983	1.912
8	OMC (%)	IS:2720 (Part 7)-1983	12
9	UCS (kg/m^2)	IS:2720 (Part 10)-1991	82.44

Tab. 3.1 Properties of Natural Soil

2. POND ASH

Pond Ash used in this study was collected from the NABHA THERMAL POWER PLANT RAJPURA PUNJAB. The Pond Ash was dried in open air and was put out through 2mm IS Sieve to remove out the vegetative matters and then after stored in the airtight container for subsequent use.

Physical Parameter	Value
Color	Grey
Silt and Clay%	26
Fine Sand %	73.4
Medium Sand	5.6
Specific Gravity	1.85

Tab. 3.2 The Physical properties of PA

3. EGG SHELL POWDER

The eggshell powder used in this research was bought from market in fine powder form and was sieved through 75 microns IS sieve. Eggshell powder has chemical composition same as that of lime with calcium oxide as its major constituent. Specific gravity of eggshell powder was calculated by pycnometer and is equal to 2.08. Chemical composition of ESP is shown below in the table.

Mineral content	Percentage (%)
SiO_2	2.64
Al_2O_3	1.12
Fe_2O_3	.034
MgO	2.3
CaO	77.29
K_2O	.002
Na_2O	11.6

Tab. 3.3 Chemical Composition of ESP

4.METHODOLOGY

The study work is performed in two phases. In the first phase Normal Soil and Pond Ash are mixed in different proportions. The distinct mixes are examined for MDD and OMC by Proctor test. After obtaining the MDD and OMC, the strength of each mix is determined by conducting the UCS test. In the second phase of the study work, Eggshell powder is added to the optimum mix of (Normal Soil and Pond Ash mix) obtained in first phase. The distinct mixes are analyzed for MDD and OMC by Proctor test. After getting the values of MDD and OMC, the strength of each of the mix is determined by conducting UCS test.

5.RESULTS AND DISCUSSIONS

5.1. STANDARD PROCTOR TEST

Proctor compaction test was done based on IS 2720-part VII, varying percentage of pond ash were added to the parent soil and mixed thoroughly. In the below table and graph drawn b/w different PA percentages and MDD and different ESP percentages and MDD, it was found that MDD increases up to 5% and then decreases with increase in percentage of PA and MC remains constant and then after various percentages of egg shell powder (2%,4%,6%,8% and 10%) are added to optimum percentage of soil- pond ash mix and it was found that MDD also increases up-to 6% with increase in percentage of ESP and then decreases.

PA%	OMC	MDD
0	12	1.912
3	12	1.917
5	12	1.928
7	12	1.901
9	12	1.874
11	12	1.850

Tab.5.1 Observations of OMC and MDD values of soil with the admixture PA by various percentages

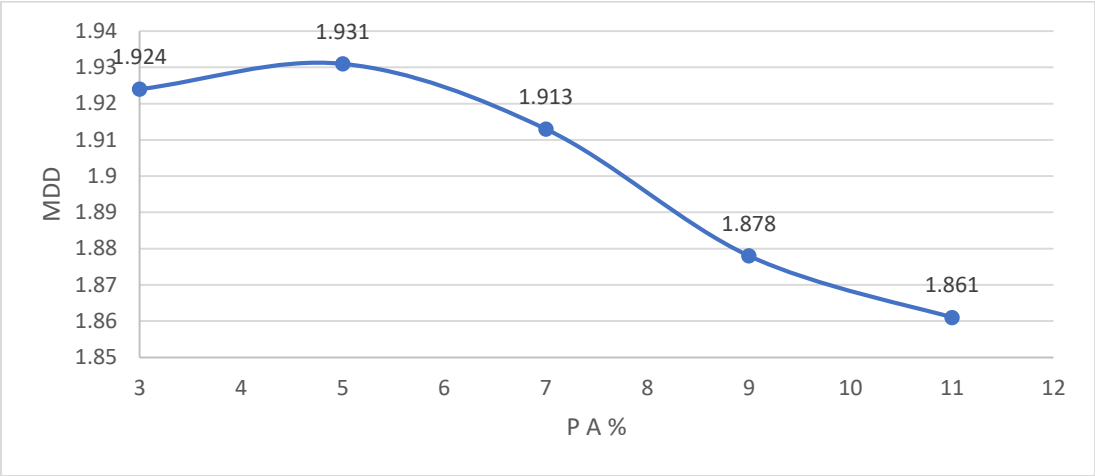

Fig.5.1 MDD vs PA%

ESP%	OMC	MDD
2	10	1.922
4	10	1.932
6	10	1.953
8	10	1.880
10	10	1.871

Tab.5.2 Observations of OMC and MDD values of Soil-PA Mix with various proportions of ESP

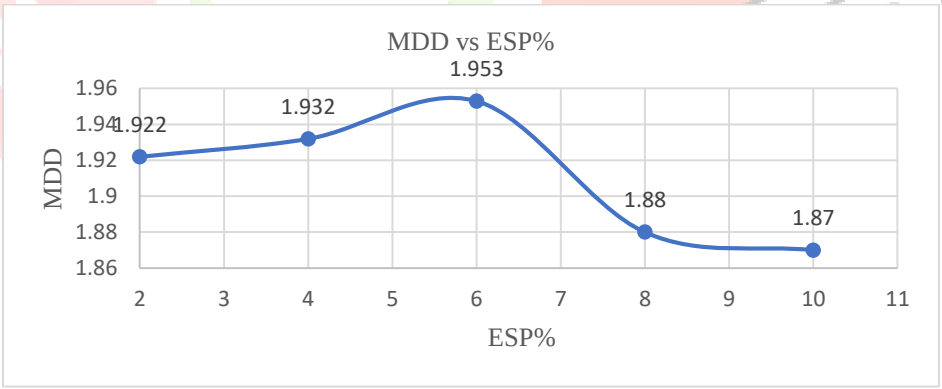

Fig.5.2 MDD vs ESP%

5.2. UNCONFINED COMPRESSION TEST

The unconfined compression test was conducted according to IS 2720-part X. It is used to determine the compression strength of the soil. Also, we analyze the change in properties of soil with addition of pond ash and eggshell powder in the soil sample in different proportions. The unconfined compressive strength of parent soil was 82.44 and by the addition of pond ash it is increased upto 223.08 at optimum value of 5% PA

and by addition of ESP the unconfined compressive strength of soil increases upto 271.24 at optimum value of 6% ESP.

Serial No.	PA%	UCS of Soil in (KN/M^2)
1	Un-Treated	**82.44**
2	3%	**203.00**
3	5%	**223.08**
4	7%	**217.94**
5	9%	**205.60**
6	11%	**196.67**

Tab.5.3 Observations of UCS values of PA-Soil Mix

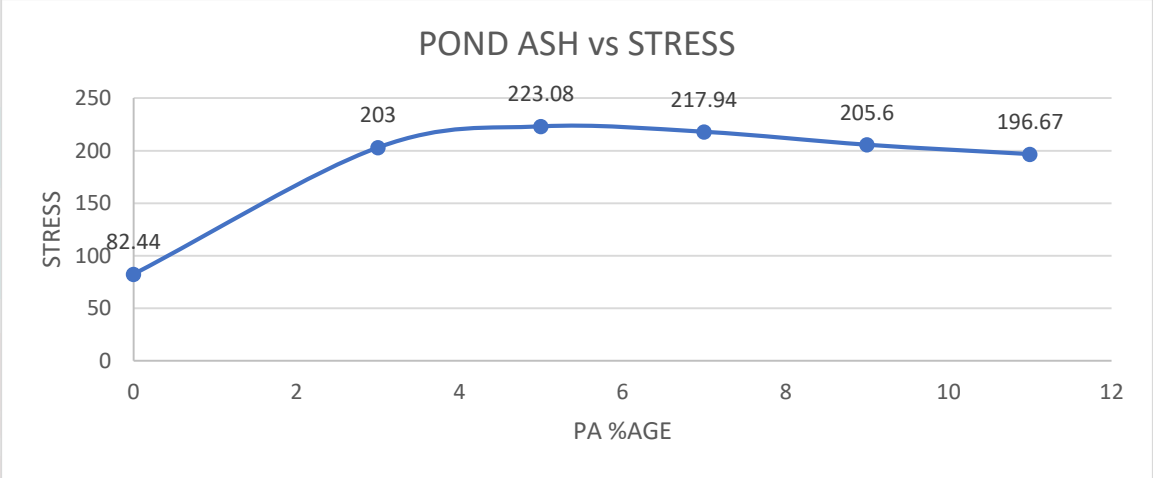

Fig.5.3 percentage of PA vs Stress

S NO.	PA%	ESP%	UCS of Soil in (KN/M^2)
1	**5**	**0**	**205.60**
2	**5**	**2**	**244.01**
3	**5**	**4**	**248.92**
4	**5**	**6**	**271.24**
5	**5**	**8**	**236.55**
6	**5**	**10**	**210.43**

Tab.5.4 Observations of UCS values of ESP& PA-Soil Mix

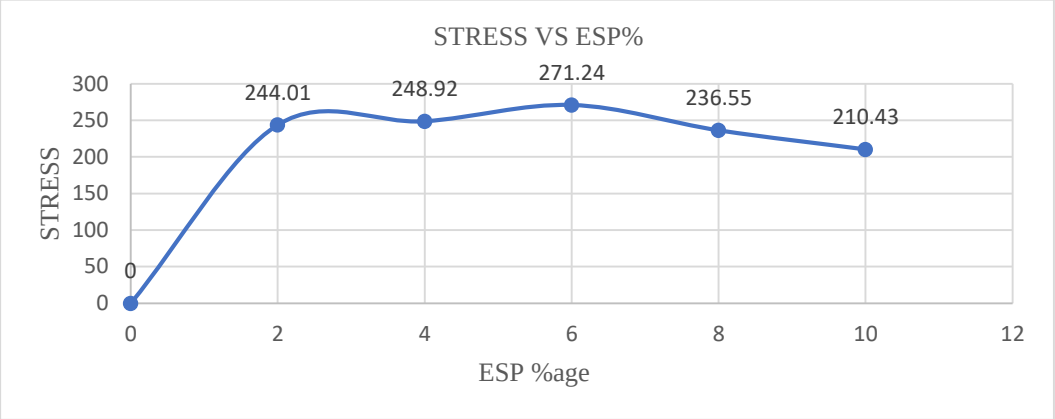

Fig.5.4 Percentage of ESP vs Stress

6.CONCLUSION

- The MDD of un-treated soil increases from 1.912g/cc to 1.931g/cc on addition of 5% PA and thus it showed a further increase up to 1.953 g/cc in MDD on addition of 6% ESP when added to optimum proportion of soil-PA mix.
- The OMC remains constant on addition of different dosages of Pond Ash and decreases (From 12% to 10%) on addition of ESP to the soil Pond Ash mix.
- The UCS value of untreated soil showed a maximum value of 223.08 KN/m^2 on addition of 5% PA. The 5% PA was considered as optimum proportion based on UCS values and was kept constant when the different ESP proportions was added to soil-PA mix.
- When the different ESP proportions are added to soil-PA mix, from the results of UCS it was found that on addition of 6% ESP to soil-PA mix, the UCS values showed a tremendous improvement in strength of 271.24 KN/m^2.

REFERENCES

1. . NITISH KUMAR, ABHISHEK SHARMA AND KANWAR PREET SINGH (2022) influence of pond ash on compaction and strength of clayey soil mixed with terrazyme, Springer (2022)

2. Ramesh S.T and Naik U.P, "Stabilization of Expansive soil" International Journal of Engineering and Innovative Technology, vol.5 no.12, pp.71-77,2016.

3. Harikaran M., Kulanthaivel P., Gokulakannan S. and Vinodhkumar S., (2023), Eco-friendly soil stabilization: a combined approach using lime and waste eggshell powder, Global NEST Journal, vol. 25, issue 7,2023.

4. Er. Dharm Raj Suwalka Etal, "Study of Engineering properties of Black Cotton Soil with Pond Ash", International Journal of Advance Research in Science and Engineering, vol.no. 07, issue 02, January 2018.

5. Soil Mechanics and Foundation Engineering by DR.K. R ARORA.

6. IS 2720:1980(PART3) (SEC 1), Determination of specific gravity –Fine grained soils.

7. IS 2720:1985(PART5)-Determination of consistency limits.

8. IS 2720:1980(PART7) Determination of water content –dry density relation using light Compaction.

9. IS 2720:1991(PART 10)-Determination of un-confined compressive strength.