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# A Review Study of Effect of Flyash on Engineering properties of soil

[1]Kshitij Verma, [2]Abhijeet Mitra, [3]Deepak Sagar, [4]Mohd. Fayaz, [5]Ravi Kumar

[1234]*UG Student, Department of Civil Engineering, MIT Moradabad, Uttar Pradesh, India*

[5]*Asst Professor, Department of Civil Engineering, MIT Moradabad, Uttar Pradesh, India*

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**Abstract:-** *This paper investigates the effect of fly ash (generated from Hirakud Dam, Orissa, India) on geotechnical properties of local soil, Ram Ganga Vihar, Moradabad, INDIA. The fly ash used in the experimental work was of Class 'C' and soil was clayey in nature .Fly ash collected from the Moradabad Institute Of Technology Concerning the major challenges regarding the safe reuse, management and disposal of these wastes an attempt has been made to mix fly ash at 5, 10, 15, 20, 25, and 30% on the basis of dry weight with local clay soil. To understand the behavior of fly ash with soil, numbers of laboratory experiments were performed on the local soil (clay) and contaminated soil with varying percentage of fly ash. As the result, on adding fly ash the liquid limit, plasticity index, shrinkage limit, maximum dry density decreases but plastic limit first increases then decreases and optimum moisture content increases in increase in fly ash content. The objective of this study was to evaluate the effect of fly ash in stabilization of clay soil.*

*Keywords:* Flyash, Properties, Improve, Performance, Stabilization.

## 1. INTRODUCTION

Any country's economic & industrial growth depends on the availability of power. In India also, coal is a major source of fuel for power generation. About 60% power is produced using coal as fuel. Indian coal is having low calorific value (3000-3500 Kelvin) & very high ash content (30-45%) resulting in huge quantity of ash is generated in the coal based thermal power stations. Fly ash is under the manufacturing hazardous waste category. Presently in India, there is reported 7.2 million tone hazardous waste generation from more than 40,000 registered industries according to Controller and Auditor General's report (CAG-2012) and there is no estimate of unregistered hazardous waste generating industries. This industrial hazardous waste has recyclable, landfill able and incredible components. Thus recycling and reusing of fly ash has become an immediate concern in recent years due to increasing in cost current interest in sustainable development.

Contamination of land may be due to the disposal variety of wastes and chemicals on or in the soil. Sources of land contamination could be several. Some contamination sources are as follows industrial waste, electronic waste, municipal waste.

The objectives of the study are:

i. To determine the properties of the local soil collected from the Ram ganga Vihar, Moradabad.

ii. To evaluate the performance of the sample when stabilized with fly ash as an admixture and its suitability.

iii. To find the Atterberg limit.

### *1.2 LITERATURE REVIEW*

Many authors have reported the effect of fly ash on soil properties.

**Bhuvaneshwari and S.R. Gandhi:** A study was carried out by S.Bhuvaneshwari and S.R. Gandhi on the effect of engineering properties o expansive soil through an experimental programme. Infrastructure projects such as highways, railways, water reservoirs, reclamation etc. requires earth material in very large quantity. In urban areas, borrow earth is not easily available which has to be hauled from a long distance. Quite often, larger

areas are covered with highly plastic and expansive soil, which is not suitable for such purpose. Extensive laboratory / field trials have been carried out by various researchers and have shown promising results for application of such expansive soil after stabilization with additives such as sand, silt, lime, Fly Ash, etc. As Fly Ash is freely available, for projects in the vicinity of a Thermal Power Plants, it can be used for stabilization of expansive soils for various uses. The present paper describes a study carried out to check the improvements in the properties of expansive soil with Fly Ash in varying percentages. Both laboratory trials and field tests have been carried out and results are reported in this paper. One of the major difficulties in field application is thorough mixing of the two materials (expansive soil and Fly Ash) in required proportion to form a homogeneous mass.[1]

**Bose**: used fly ash to stabilize a highly plastic clay. The geo-engineering properties such as, atterberg limits, grain size distribution, linear shrinkage, free swell index, welling pressure, compaction characteristics, unconfined compressive strength and CBR value of virgin clay and stabilize with fly ash were evaluated. Expansive soil was stabilized with various proportion of fly ash. The results showed that plasticity index of clay-fly ash mixes decreased with increase in fly ash content. Thus addition of fly ash increases its workability by colloidal reaction and changing its grain size. The free swell index value and swelling pressure of expansive clay mixed with fly ash decreased with increase in fly ash content. Furthermore, addition of fly ash reduced the optimum moisture content but the dry density increased and unconfined compressive strength of clay-fly ash mixes is found to be maximum. So, it is concluded that the fly ash has a good potential for improving the engineering properties of expansive soil.[2]

**Erdal Cokca (2001):** Effect of Fly Ash on expansive soil was studied by Erdal Cokca,FLY ASH consists of often hollow spheres of silicon, aluminium and iron oxides and unoxidized carbon. There are two major classes of Fly Ash, class C and class F. The former is produced from burning anthracite or bituminous coal and the latter is produced from burning lignite and sub bituminous coal. Both the classes of Fly Ash are pozzolans, which are defined as siliceous and aluminous materials. Thus Fly Ash can provide an array of divalent and trivalent cations (Ca2+,Al3+,Fe3+etc) under ionized conditions that can promote flocculation of dispersed clay particles. Thus expansive soils can be potentially stabilized effectively by cation exchange using Fly Ash.[3]

**Kate**: explored the possibility of utilizing the fly ash with or without lime for stabilizing the expansive soils to improve strength and volume change behavior. The free swell index, swell, swelling pressure and unconfined compressive strength tests have been conducted on expansive soils with mixing bentonite with kaoline clay in different proportions. The results showed that the swelling characteristics such as free swell index, maximum swell and swelling pressure decreased with increase in percentage of fly ash. These values are decreased considerably by addition of small percentage of lime to fly ash. However, curing caused a remarkable increase in their strengths. As a final result, the soils with low expansivity can be stabilized with appropriate percentage of fly ash alone. [4]

**Kumar Pal and Ghosh:** presented the consolidation and swelling characteristics of fly ash and montmorillonite clay blends. Different types of fly ash with different percentage of montmorillonite

clay were added to each samples. In this regard, the standard Proctor compaction tests were used. Furthermore, the effect of permeability, free swell index and plasticity of fly ash– montmorillonite clay mixtures were evaluated. The results showed that immediate settlement of fly ash takes place in a short period of time during consolidation, and secondary settlement is negligible. There was not any significant change in vertical compression of fly ash samples, in soft soils, fly ash can be used to reduce embankment settlement[5]

**Lopes et al:** examined the applicability of fly and bottom ash on the layers of pavements by mixing these ashes with a non-lateritic sandy-silty soil, with and without lime addiction. This study, presented the results of physical and chemistry characterization, and compression, resilient modulus and permanent deformation, after environmental testing solubilization and leaching. The results showed that the soil is dependent on confining pressure and the inclusion of fly ash and the mixture cure and these parameters increase the value of resilient modulus. On the other hand, the addiction of bottom ashes increased immediately the resilient modulus of the mixtures. The mixtures with or without the addition of lime, with the presence of bottom and fly ash, had mechanical behavior compatible with the requirements of pavement with low traffic volume.[6]

**Mir and Sridharan :** *studied* adding, high calcium and low calcium fly ashes in different proportions to a highly expansive black cotton soil. The objective of the study was to study the effect of fly ashes on the physical, compaction, and swelling potential of black cotton soils that were reached from laboratory tests and utilization of waste material without disruptive effect on the environment. The results showed that the liquid limits, compaction characteristics and swelling potential of expansive soil–fly ash mixtures are significantly modified and improvedFurthermore, compressibility characteristics of the expansive soil are improved with the addition of fly ash.[7]

**Pandian et.al. (2002):** Studied the effect of two types of Fly Ashes Raichur Fly Ash (Class F) and Neyveli Fly Ash (Class C) on the CBR characteristics of the black cotton soil. The Fly Ash content was increased from 0 to

100%. Generally the CBR/strength is contributed by its cohesion and friction. The CBR of BC soil, whichconsists of predominantly of finer particles, is contributed by cohesion. The CBR of Fly Ash, which consists predominantly of coarser particles, is contributed by its frictional component. The low CBR of BC soil is attributed to the inherent low strength, which is due to the dominance of clay fraction. The addition of Fly Ash to BC soil increases the CBR of the mix up to the first optimum level due to the frictional resistance from Fly Ash in addition to the cohesion from BC soil. Further addition of Fly Ash beyond the optimum level causes a decrease up to 60% and then up to the second optimum level there is an increase. Thus the variation of CBR of Fly Ash-BC soil mixes can be attributed to the relative contribution of frictional or cohesive resistance from Fly Ash or BC soil, respectively. In Neyveli Fly Ash also there is an increase of strength with the increase in the Fly Ash content, here there will be additional puzzolonic reaction forming cementitious compounds resulting in good binding between BC soil and Fly Ash particles.[8]

**Phanikumar and Sharma (2004):**

A similar study was carried out by Phanikumar and Sharma and the effect of Fly Ash on engineering properties of expansive soil through an experimental programme. The effect on parameters like free swell index (FSI), swell potential, swelling pressure, plasticity, compaction, strength and hydraulic conductivity of expansive soil was studied. The ash blended expansive soil with FLY ASH contents of 0, 5, 10, 15 and 20% on a dry weight basis and they inferred that increase in FLY ASH content reduces plasticity characteristics and the FSI was reduced by about 50% by the addition of 20% Fly Ash. The hydraulic conductivity of expansive soils mixed with Fly Ash decreases with an increase in Fly Ash content, due to the increase in maximum dry unit weight with an increase in Fly Ash content. When the Fly Ash content increases there is a decrease in the optimum moisture content and the maximum dry unit weight increases. The effect of Fly Ash is akin to the increased compactive effort. Hence the expansive soil is rendered more stable. The untrained shear strength of the expansive soil blended with Fly Ash increases with the increase in the ash.[9]

**Vizcarra et al:** presented the characteristics of municipal solid waste (MSW) incineration ash and evaluates this ash in road pavement layers through the mixture of ash with a clay soil. Chemical, physical, and mechanical tests and the mechanistic-empirical design for a pavement structure were carried out on the pure soil and also in the soil mixture with the addition of different ash content. The results showed that fly ash reduced the expansion of the material, showing an increase in the California bearing ratio (CBR) and resilient modulus value. Furthermore, content and type of ash was important in final results and it showed the efficacy of MSW fly ash for its use in base road pavement layers.[10]

## 3. CONCLUSIONS

The following conclusions are made based on the above results and discussions. In general, when we add the fly ash there is decrease in values of specific gravity, plasticity index and shrinkage limit . With the increase of ash content in the soil-ash mix samples, this material may be used as land filling, embankments .

## 4. DISCUSSIONS:

In this review paper, we studied the effect of fly ash on the properties of soil. On adding the fly ash (5%, 10%, 15% and so on) the liquid limit, shrinkage limit, plasticity index, maximum dry density are decreases. Plastic limit first increases then decreases.

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