

# Stabilization of Expansive Soil by Fly Ash and Stone Dust

Abhay Pratap Singh<sup>1</sup>, Dr. N. K. Saxena<sup>2</sup>, Anupam Verma<sup>3</sup>

Student of M.Tech in Geo-technical Engineering, KNIT, Sultanpur, UP (India)

Professor of Civil Engineering Department, KNIT, Sultanpur, UP (India)

Assistant Professor of Civil Engineering Department, KNIT, Sultanpur, UP (India)

**Abstract:** Soil stabilization is the alteration of soil properties to improve the engineering performance of soils. The properties most often altered are density, water content, plasticity and strength. The primary reason fly ash is used in soil stabilization applications is to improve the compressive and shearing strength of soils. The performance of fly ash and stone dust was studied by conducting California Bearing Ratio (CBR) tests. Studies were made with different percentage of fly ash and stone dust. The results have shown that the fly ash and stone dust enhances the sub grade strength. During this work, the effect of moisture content, degree of compaction, etc. on various geotechnical properties of soil are studied. A series of tests such as heavy weight compaction and CBR test are done to estimate the strength characteristics of compacted soil using fly ash and stone dusts as well as tests like specific gravity test, grain size distribution test by mechanical sieve analysis etc. are performed to obtain some physical properties of soil. These results will be very much helpful for the successful utilization of fly ash and stone dust in different fields such as embankment construction, road base and sub-base construction, designing of retaining walls etc. in an eco friendly manner.

**Keywords:** stone dust, fly ash, waste material

## 1. Introduction

In last few years, environmental and economical issues have stimulated interest in the development of alternative materials and reuse of industrial waste/by-products that can fulfil specification. A material such as fly ash is a residue collected from thermal power plants and also have problem disposal of fly ash, it requires a lot of land use and also have hazardous effect to environment. To minimise these problems fly ash has been used in several fields like filling of low lying area, used in concrete as small replacement of cement, used in bituminous pavement etc. Fly ash is a non-plastic and lightweight material having the specific gravity relatively lower than that of the similar graded conventional earth material. Fly ash is a fine-coarse, powder recovered from the gases of burning coal during the production of electricity. These micron-sized earth elements consist primarily of silica, alumina and iron. Massive generation of Fly ash by thermal power plants has become a major cause of concern for people living in and around thermal power plants. The current rate of generation of coal ash in India has reached 150 million tons per annum with about 85,000 acres of precious land under the cover of abandoned ash ponds. It is estimated that the generation of Fly ash from coal fired generation units in India will reach 210 million tons per annum by the year 2020 whereas, the current rate of utilization of ash is about 35%. This leads to an ever increasing area for storing ash and related environmental issues. On the other hand, the construction of highways and roads in India, which has taken a boom in the recent years, requires a huge amount of natural soil and aggregates. To meet this demand ruthless exploitation of fertile soil and natural aggregate is being adopted. This has brought the situation to an alarming state. To address these problems Fly ash has been tried in the low lying areas as structural fills and embankment construction for highways. However, due to lack of sufficient knowledge and confidence its use has

not taken momentum. The basic and essential parameters of Fly ash, to be used either as structural fill or embankment material. Fly ash, the by-product of thermal power plants is considered as solid waste and its disposal is a major problem from environment point of view and also it requires lot of disposal areas. Utilization of Fly ash to the maximum possible extent is a worldwide problem. To solve the problem, Fly ash can be used as a structural fill for developing low-lying areas to construct structures on it. There are two types of ash produced by thermal power plants, viz., Top ash and bottom ash. These two ash mixed together are transported to the ash Fly and this deposit is called Fly ash. Improvement of load bearing capacity of shallow foundation on Fly ash may be possible by introducing jute-geo textile sheet into the fly ash as reinforcement, mixing of polypropylene fibre or some other material which increase its cohesion value.

Stone dust is also a solid waste material that is generated from stone crushing industry which is abundantly available in India. Soosan et al. (2001) identified that crusher dust exhibits high shear strength and is beneficial as a geotechnical material. Stone dust is a material that possesses pozzolonic as well as coarser contents in it while other materials like fly ash possesses only pozzolonic property and no coarser soil particles.

## 2. Experimental Investigation

In this investigation water content, specific gravity, liquid limit. Plastic limit, hydrometer analysis, MDD, UCS test and CBR test for soil and MDD, UCS and CBR test for different proportion of stone dust and fly ash.

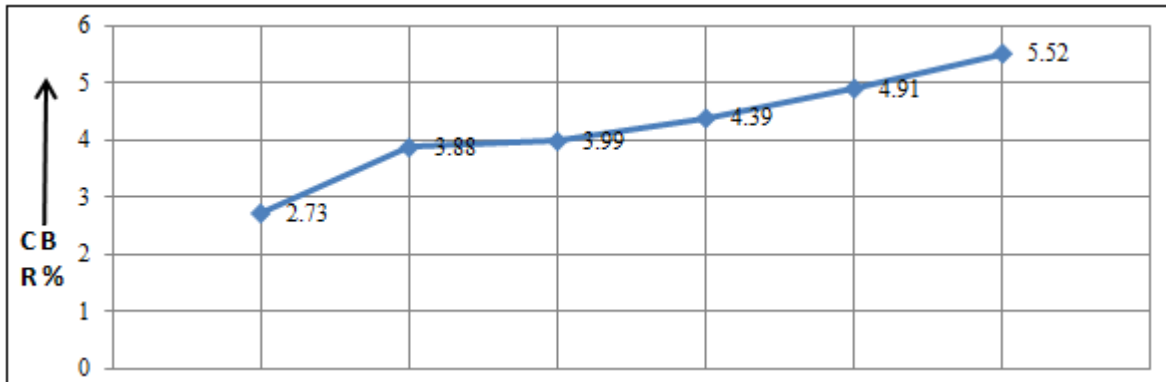
Soil properties with different proportion of fly ash and stone dust

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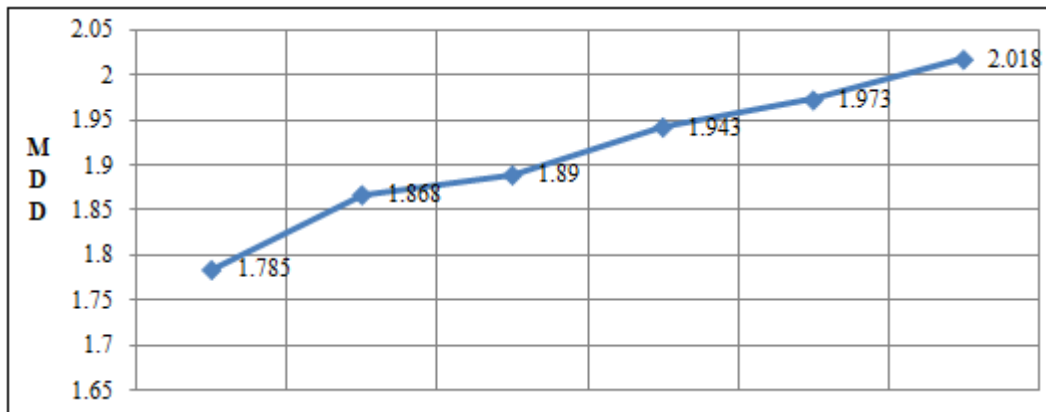
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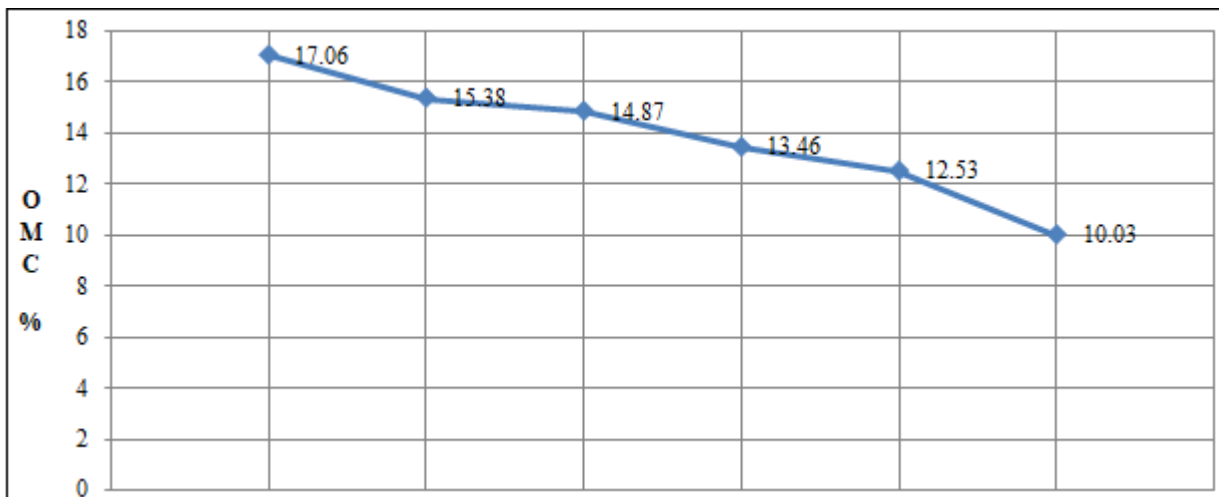
Particular of the test	Soil	Soil+5% flyash+5% stone dust	Soil+5% flyash+10%stone dust	Soil+5% flyash+15%stone dust	Soil+5% flyash+20%stone dust	Soil+5% flyash+25%stone dust
OMC (%)	17.06	15.38	14.87	13.46	12.53	10.03
MDD (gm/cc)	1.785	1.868	1.890	1.943	1.973	2.018
CBR (%)	2.73	3.88	3.99	4.39	4.91	5.52
UCS ( Kg/cm <sup>2</sup> )	2.802	3.688	3.802	3.823	3.906	4.095



**CBR % value of soil with varying proportion of fly ash & stone dust**



**MDD % value of soil with varying proportion of fly ash & stone dust**



**OMC % value of soil with varying proportion of soil**

### 3. Conclusion

This thesis is the outcome of the extensive laboratory research work carried out to explore the possibility of utilising fly ash and stone dust, for the construction for the stabilization of soil. This was accomplished by performing elaborate laboratory investigations in different aspects. The

main focus in the present investigation was to conduct systematic research work on the behavior of fly ash with stone dust, so that new methods of application can be evolved.

- a) Fly Ash is a non plastic light weight material having specific gravity relatively lower than similar graded material.

- b) CBR value of VIRGIN SOIL is observed exceptionally low but on mixing it with 5% of fly ash and varying proportion of stone dust the CBR value increases exceptionally high and the desirable value of CBR may be achieved.
- c) With the increase in the proportion of stone dust the value of moisture content decreases which is a desirable property which is advantageous in decreasing quantity of water required during compaction.
- d) With the increase in the proportion of stone dust the unconfined compressive strength increases.
- e) If the value of fly ash increases then the problem created in doing compaction so that the value of fly is fixed by 5% of soil weight.
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