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A Review Paper on Study of Soil-Fly Ash Mix Effect on The Stability of Rigid Pavement Subgrade

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Abstract
The stabilization of sub grade soil is one of the principal and major processes in the construction of any highway. The aim of this study is to investigate the effect of soil-fly ash mix on the stability of rigid pavement sub grade. In this regard a laboratory experimental program will be considered to study the effect caused by the action of fly ash stabilization on the geotechnical trademarks of expansive sub grade soils. Expansive soil treated with different percentages of fly ash i.e. 15, 20, 25 and 30 percent will be taken into account. The initial values for this study includes Liquid Limit (LL), Plastic Limit (PL), Maximum Dry Density (MDD), Plasticity Index (Pl), Optimum Moisture Content (OMC) & Unconfined Compressive Strength (UCS) with the fraction of Fly Ash added (F.A in %) in sub grade soil.
For the purposes of present study a road stretch of concrete mix slab has been considered on NH-73 Panchkula-Roorkee Highway.

I. Introduction

Fly ash is a substantive industrial by-product that comes from the combustion of coal. In our country, only a small percentage of fly ash is used for the construction of technical projects while the rest is dumped which causes severe problems to the accessible environment. It has been found that stabilization with fly ash increase the mechanical and engineering characteristics of soil, so it is a better option to use fly ash as a modifier. Stabilization of soils and pavement base courses with coal fly ash is earning popularity among pavement engineers.

1. Rigid Pavements

Rigid pavements normally use Portland cement concrete as the prime structural element. It has a high degree of rigidity. Depending on conditions, engineers may design the pavement slab with plain, lightly reinforced, continuously reinforced, pre-stressed, or fibrous concrete. The concrete slab usually lies on a compacted granular or treated base course, which is supported, in turn, by a compacted sub grade. The base course provides uniform stable support and may provide subsurface drainage. The concrete slab has considerable flexural strength and spreads the applied loads over a large area.

a. Concrete Slab (Surface Layer): The concrete slab provides structural support to the aircraft, provides a skid-resistant surface, and prevents the infiltration of excess surface water into the sub base.
b. **Base course:** The base course provides uniform stable support for the pavement slab. It also serves to control frost action, provide subsurface drainage, control swelling of subgrade soils, provide a stable construction platform for rigid pavement construction, and prevent mud pumping of fine-grained soils. Rigid pavements generally require a minimum base course thickness of 4 inches (100 mm). All new rigid pavements designed to accommodate aircraft weighing 100,000 pounds (45,000 kg).
c. **Subgrade:** The subgrade is the compacted soil layer that forms the foundation of the pavement system. Subgrade soils are subjected to lower stresses than the surface and base courses. These stresses decrease with depth. The soils investigation should check for these conditions. The pavement above the subgrade must be capable of reducing stresses imposed on it to values that are low enough to prevent excessive distortion or displacement of the subgrade soil layer. Soil conditions are related to the ground water level, properties of the soil, including soil density, particle size, and moisture content, and frost penetration. Since the subgrade soil supports the pavement and the loads imposed on the pavement surface, it is critical to examine soil conditions to determine their effect on grading and paving operations and the need for underdrains.

For the purposes of present study a road stretch of concrete mix slab has been considered on NH-73 Panchkula-Roorkee Highway.

II. Materials

- Soil sample: Dispersive soil
- Stabilization material: Fly ash
- Fly ash Source: Thermal Power Plant, Yamuna Nagar

Dispersive Soil: These are the soils which dislodged easily in flowing water is called dispersive soils. These gets disperse into basic particles (sand, silt and clay) even in still water. So, these creates problem for a civil engineer to design some project. In appearance, they are like normal clays that are stable and somewhat resistant to erosion, but in reality they can be highly erosive and subject to severe damage or failure. Dispersive clays differ from ordinary erosion resistant clays because they have a higher relative content of dissolved sodium in the pore water. Ordinary clays have calcium and magnesium dissolved in the pore. Dispersive soils are most easily eroded by water that is low in ion concentration, such as rain water.

Fly Ash: It is also known as pulverised fuel ash. It is a coal combustion product that is comprised of the particulates (fine particles of burnt fuel) that are driven out of coal-fired boilers together with the fuel gases. Ash that falls to the bottom of the boiler is called bottom ash. In modern coal-fired power plants, fly ash is generally captured by electrostatic precipitators or other particle filtration equipment before the fuel gases reach the chimneys. Depending upon the source and composition of the coal being burnt, the components of the fly ash vary considerably but all fly ash includes substantial amount of silicon dioxide ($SiO2$), Aluminium oxide ($Al2O3$) and calcium oxide (CaO).

III. Litreature Review

Minnick, L.J, Mayors, W.F (1953) [1] have stated that the evaluation of field project in which fly ash is used for the stabilization

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of several types of soil indicates that the resulting compositions are very satisfactory as road base courses. The evaluation includes laboratory tests for unconfined compressive strength, wetting and drying, freezing, thawing and pulse group velocity.

Chopra (1979) [2] grouped Indian fly ashes into two categories based on Blaine's fineness, however, no such classification was found to be possible based on the residues of 90 micron sieve. The fact that it also gives a good indication on the presence of finer particles makes it preferable for specifying characteristics of fly ash.

Terrel et al. (1979a) [3] have developed specifications that provide suggestions for stabilizing soil with fly ash. These specifications cover topics from construction of the stabilized section through quality control testing. Most specifications are broken up into some or all of the following areas (1) laboratory testing procedures prior to construction (2) construction requirements and operations (3) quality control and assurance (4) measurement and operations (5) payment services and materials.

Ferguson and Leverson (1999) [4] have stated that the most widely used application of self-cementing fly ash is that it increases the strength of unsuitable or unstable sub grade materials. The strength of soils stabilized with self-cementing fly ash is usually determined from unconfined compression tests and CBR tests.

Younus Ahmad Dar (2001) [5] has stated that the stabilization of subgrade soil is one of the principal and major processes in the construction of any highway. In his report various researches regarding stabilisation of soil were studied. On the basis of results, it is recommended that fly ash admixture be considered a feasible option for the stabilization of expansive subgrade. Fly ash increases stability, changes property like density or swelling.

Joel H. Beeghly 2003 [6] has stated that highway engineers have long recognized remote future benefits of increasing the strength and durability of pavement sub grade soil by mixing fly ash with subgrade soil during new construction. For cohesive soil and silty soil lime and class C fly ash stabilization can be economically engineered for long-term performance. For appropriate soils, lime-fly ash can offer cost savings by reducing material cost upto 50% as compared to Portland cement stabilization.

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