A Review on Soil Stabilization in Road Construction by Using Bituminous Mixture

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Abstract: Soil stabilization is a method of improving soil properties by blending and mixing bituminous materials. Soil is used sub base and base material, if strength of soil is poor, then stabilization is usually required. Sub grade is sometimes stabilized or changed with solider soil .Soil could be black cotton or as fly ash which could fly in interaction with air. There are many stabilizers used for stabilizing the soil such as, cement, lime, bitumen, fly ash etc., in this paper bitumen as stabilizer. Bitumen mixture is expensive material in road construction. So it's quantity play vital part to stabilize the soil. It increases the stability of soil mechanically. It does not react with soil. It is just fill the pores of soil.

Keywords: Stabilization, Soil, Fly Ash, Bitumen, Road Construction.

Introduction:

The prime dispassionate of soil stabilization is to increase the California Bearing Ratio of in-situ soils by 5 to 7 times. The other prime dispassionate of soil stabilization is to increase on-site materials to create a solid and strong sub-base and base courses. In certain regions of the world, normally developing nations and now more commonly in developed nations, soil stabilization is being used to construct the whole road. The soil in sub grade is normally stressed to assured minimum level of stresses due to the traffic loads. Sub grade soil should be of good quality and properly compacted so as to operate its full strength to resist the stresses due to traffic loads for a specific pavement. This leads the monetary situation for overall pavement thickness. On the other hand the sub grade soil is characterized for its strength for the determination of design of at all pavements. Development of soil engineering properties is mentioned to soil stabilization. There are two main methods of soil stabilization. One is mechanical method and the other one is chemical methods. Soil is a store of earth material, determined often from the collapse of rocks or corrosion of scrub that could be exposed promptly with force materials in the field or split by delicate reflex earnings in the lab. The supporting soil below pavement and its different under course is known as sub grade soil. Short of break soil below the pavement is known as consistent sub grade. Compacted sub grade is the soil compacted by reserved development of individual types of substantial compactors. At present every road construction project will use one or both of these stabilization approaches. The most famous type of mechanical soil stabilization is compaction of the soil, while the addition of cement, lime, bituminous or alternate executors is mentioned to as an artificial or added substance approach for stabilization of soil.

American Association of State Highway and Transportation Officials (AASHTO) classification system is a soil classification system specially intended for the construction of roads and highways used by transportation engineers. The system used the grain-size distribution and Atterberg limits, such as Liquid Limits and Plasticity Index to categorize the soil properties. There are different types of extracts available. Not all extracts work for all soil types. Usually, a stabilizer may be used to act as a binder, after the conclusion of moisture, increase the soil density. Succeeding are some most widely used extracts: Portland cement, Quicklime or Hydrated.

Review of Literature:

Abandoned sites due to undesirable soil bearing capacities dramatically increased, and the outcome of this was the scarcity of land and increased demand for natural resources. Affected areas include those which were susceptible to liquefaction and those covered with soft clay and organic soils. Other areas were those in a landslide and contaminated land. However, in most geotechnical construction, it is not possible to obtain a construction site that will meet the design requirements without ground modification. The current practice is to modify the engineering properties of the native problematic soils to meet the design specifications. Nowadays, soils such as, soft clays and organic soils can be improved to the civil engineering requirements. This state of the art review focuses on soil stabilization method which is one of the several methods of soil improvement. Soil stabilization aims at improving soil strength and increasing resistance to softening by water through bonding the soil particles together, water proofing the particles or combination of the two. Usually, the technology provides an alternative provision structural solution to a practical problem. The simplest stabilization processes are compaction and drainage (if water drains out of wet soil it becomes stronger). The other process is by improving gradation of particle size and further improvement can be achieved by adding binders to the weak soils. Soil stabilization can be accomplished by several methods. All these methods fall into two broad categories namely:

- **Mechanical Stabilization**: Under this category, soil stabilization can be achieved through physical process by altering the physical nature of native soil particles by either induced vibration or compaction or by incorporating other physical properties such as barriers and nailing. Mechanical stabilization is not the main subject of this review and will not be further discussed.
- **Chemical Stabilization**: Under this category, soil stabilization depends mainly on chemical reactions between stabilizer (cementitious material) and soil minerals to achieve the desired effect. A chemical stabilization method is the fundamental of this review and, therefore, throughout the rest of this report, the term soil stabilization will mean chemical stabilization.

Through soil stabilization, unbound materials can be stabilized with cementitious materials (cement, lime, fly ash, bitumen or combination of these). The stabilized soil materials have a higher strength, lower permeability and lower compressibility than the native soil. The method can be achieved in two ways,

namely: situ stabilization, ex-situ stabilization. Note that, stabilization not necessary a magic wand by which every soil properties can be improved for better. The decision to technological usage depends on which soil properties have to be modified. The chief properties of soil which are of interest to engineers are volume stability, strength, compressibility, permeability and durability. For a successful stabilization, a laboratory tests followed by field tests may be required in order to determine the engineering and environmental properties. Laboratory tests although may produce higher strength than corresponding material from the field, but will help to assess the effectiveness of stabilized materials in the field. Results from the laboratory tests, will enhance the knowledge on the choice of binders and amounts. Soil stabilization involves the use of stabilizing agents (binder materials) in weak soils to improve its geotechnical properties such as compressibility, strength, permeability and durability. The stabilization technology includes soils and or soil minerals and stabilizing agent or binder's cementitious materials.

Soils: Most of stabilization has to be undertaken in soft soils in order to achieve desirable engineering properties. According to fine grained granular materials are the easiest to stabilize due to their large surface area in relation to their particle diameter. A clay soil compared to others has a large surface area due to flat and elongated particle shapes. On the other hand, silty materials can be sensitive to small change in moisture and, therefore, may prove difficult during stabilization. Peat soils and organic soils are rich in water content of up to about 2000%, high porosity and high organic content.

Stabilizing Agents:

These are hydraulic (primary binders) or non-hydraulic (secondary binders) materials that when in contact with water or in the presence of pozzolanic minerals reacts with water to form cementitious composite materials.

Cement:

Cement is the oldest binding agent since the invention of soil stabilization technology in 1960's. It may be considered as primary stabilizing agent or hydraulic binder because it can be used alone to bring about the stabilizing action required. Cement reaction is not dependent on soil minerals, and the key role is its reaction with water that may be available in any soil. This can be the reason why cement is used to stabilize a wide range of soils. Numerous types of cement are available in the market; these are ordinary Portland cement, blast furnace cement, sulfate resistant cement and high alumina cement. Usually the choice of cement depends on type of soil to be treated and desired final strength.

Lime:

Lime provides an economical way of soil stabilization. Lime modification describes an increase in strength brought by cation exchange capacity rather than cementing effect brought by pozzolanic reaction. In soil modification, as clay particles flocculates, transforms natural plate like clays particles into needle like interlocking metal line structures. Clay soils turn drier and less susceptible to water content changes. Lime stabilization may refer to pozzolanic reaction in which pozzolana materials reacts with lime in presence of

water to produce cementitious compounds. Slurry lime also can be used in dry soils conditions where water may be required to achieve effective compaction.

Fly–Ash:

Fly ash is a byproduct of coal fired electric power generation facilities; it has little cementitious properties compared to lime and cement. Most of the fly ashes belong to secondary binders; these binders cannot produce the desired effect on their own. However, in the presence of a small amount of activator, it can react chemically to form cementitious compound that contributes to improved strength of soft soil. Fly ashes are readily available, cheaper and environmental friendly.

(Road Re claimer mixes Soil with Moist conditioned Fly Ash)

Wet Mixing:

Applications of wet deep mixing involve binder turned into slurry form, which is then injected into the soil through the nozzles located at the end of the soil auger. The mixing tool comprise of drilling rod, transverse beams and a drill end with head. There are some modifications to suit the need and applications. The Trench cutting Re-mixing deep method (TRD) is effective tool for construction of continuous cutoff wall without the need for open trench. The method uses a crawler mounted, chainsaw like mixing tool to blend in situ soil with cementitious binder to create the soil cement wall. It further consists of a fixed post on which cutting, scratching teeth ride on a rotating chain and injection ports deliver grout into treatment zone. Wall depths up to 45 m having width between 0.5 m and 0.9 m are achievable. The wall quality for groundwater barrier is high with permeability between 1 x 10-6 and 1 x 10-8 cm/s. The FMI machine has a special cutting arm (trencher), along which cutting blades are rotated by two chain system. The cutting arm can be inclined up to 80 degrees and is dragged through the soil behind the power unit. Like TRD, the soil is not excavated, but mixed with binder which is supplied in slurry form through injection pipes and outlets mounted along the cutting arm.

(FMI and TRD Trenching Machine for Construction of Deep Walls)

Dry Mixing:

Dry mixing (DM) method is clean, quiet with very low vibration and produces no spoil for disposal (Hayward Baker Inc). It has for many years extensively used in Northern Europe and Japan. The method involves the use of dry binders injected into the soil and thoroughly mixed with moist soil. The soil is premixed using specialized tool during downward penetration, until it reaches the desired depth. During withdrawal of the mixing tool, dry binder are then injected and mixed with premixed soil leaving behind a moist soil mix column. In many countries, this method is referred to as Lime Cement Column (LCC), whereas, the method is termed as Trevimix and the same technology is called dry jet mixing (DJM). A typical DM machine consists of track mounted installation rig and a drill motor. Binder is fed into compressed air through the hose into mixing shaft to the outlet of mixing shaft into the ground. Powdery binders under compressed air are injected into soft ground without processing into slurry form. Blade rotates creating a cavity in the soil in which air and binders fill in during withdrawal. During construction, the most efficient sequence is to work the stabilizing machine within its operational radius as much as possible. It suggested about Bench Scale Evaluation of Asphalt Emulsion Stabilization of Dirtied Soils. In this study, it was conversed about the use are discussed to the environmental fixation of soils contaminated by organic contaminants. They give an experimental study on Gravelly Stabilized Roads. Bitumen was used as a stabilizing agent act as a binder or as a water proofing material. Soil bitumen systems had found the highest used in road bases and surfaces. The concentrated on the effects of compaction dampness content on the shear quality of an unsaturated sludge. The effects of compaction dampness substance and soaking on the unsaturated shear quality parameters of sludge were examined. Experiments were carried out on varieties compacted at optimum dampness content, on the dry side of optimum and on the west side. It was found that edge of corrosion reductions quickly with increasing dampness substance, the union segment of shear quality attained its top rate at around optimum Moisture substance and subsequently diminishes. They Suggested about performance evaluation of mixed in place bituminous stabilized assume gravel. Here it was showed a cheap maintenance of gravel shoulders, a very common problem is facing by highway agencies. Sub grade may be defined as the compacted soil layer, usually of logically occurring local soil, assumed to be 300 mm in thickness, just below of the pavement crust. It provides a suitable foundation for the pavement. Therefore it is very important to increase strength of sub grade soil; it may be by replacing good soil or by stabilization of existing soil. To check the sub grade soil stability California bearing ratio (CBR) test is very commonly used test.

Conclusion:

From this study it is clear that there is a considerable improvement in California Bearing Ratio of sub grade due to use of MS bitumen mixture if proper mixing is done. It is seen that it best results are obtained if the soil emulsion mix is left for about five and half hours after mixing. In each formal of condition it was found that California Bearing Ratio value has increased consecutively from Case to Case. In this particular experimental study California Bearing Ratio value has increased up to fifty percent of the unmodified soil California Bearing Ratio. Detecting its financial cost and quality of stabilization improvement, it is clear that this type of stabilization may be applicable in gravel soil. As we increase the amount of mixture California Bearing Ratio value of soil is increases. But the cost of mixture is so high so the amount of mixture also depends upon budget and importance of structure.

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