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STABILIZATION OF SOIL

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ABSTRACT

Long-term performance of pavement structures is significantly impacted by the stability of the underlying soils. In situ subgrade often do not provide the support required to achieve acceptable performance under traffic loading and environmental demands. Although stabilization is an effective alternative for improving soil properties, the engineering properties derived from stabilization vary widely due to heterogeneity in soil composition, differences in micro and macro structure among soils, heterogeneity of geologic deposits, and due to differences in physical and chemical interactions between the soil and candidate stabilizers. These variations necessitate the consideration of site-specific treatment options which must be validated through testing of soil-stabilizer mixtures. This report addresses soil treatment with the traditional calcium-based stabilizers: *Portland cement, lime, and fly ash. The report describes and compares the basic reactions that occur between these stabilizers and soil and the mechanisms that result in stabilization. The report presents a straight forward methodology to determine which stabilizers should be considered as candidates for stabilization for a specific soil, pavement, and environment. The report then presents a protocol for each stabilizer through which the selection of the stabilizer is validated based on mixture testing and mixture design. The mixture design process defines an acceptable amount of stabilizer for the soil in question based on consistency testing, strength testing, and in some cases (resilient) modulus testing. Within each additive validation and mixture design protocol, an assessment of the potential for deleterious soil additive reactions is made*

For successful soil stabilizer applications, it is imperative to understand the mechanism of stabilization of each additive. A basic understanding of stabilization mechanisms assists the user agency in selecting the stabilizer or additive best suited for a specific soil not only from the standpoint of developing the engineering properties desired for the pavement sub layers but also to minimize the risk of long-term deleterious reactions that might compromise pavement structural capacity.

I. TYPES OF SOIL

Types of Soil in India differ on the basis composition, climate and altitude of different regions. There are mainly seven types of soils in India. There are various types of soils found in India and the formation of soil is primarily influenced by major factors such as climate, altitude and composition of bedrock etc. Disproportion in the annual distribution of rainfall in the country and excessive heat contribute special characters to the soils of the country. The soils of the Sutlej-Ganga plain and the valleys of Narmada River and Tapti River are essentially the transported ones.

The eight major types of soils in India are-

Laterite soils

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Black soils

Desert soils

Red and Yellow soils

Saline soils

Alluvial soils

Mountain soils

Peat

Soils of Madhya Pradesh

Soils of Madhya Pradesh contain a large amount of organic materials because the rock formation determines the structure and composition of the soils found extensively in the state of Madhya Pradesh. There are five major types of soils found in the state of Madhya Pradesh. Soils of Madhya Pradesh vary as per the structure, colour, texture and composition in the different regions. Madhya Pradesh is that part of the peninsular plateau of India where residual soils are found in an extensive area. The rock formation determines the soil structure and composition in this state. As a result of this organic materials are found at a large scale in soils. In this state the problem of soil erosion is almost negligible but due to excessive use of the land, the problem of soil erosion is accelerating. Madhya Pradesh comprises of a variety of soils ranging from rich clayey to gravelly. According to the survey done in the state, the major groups of soils found in the state can be divided into five major categories namely Alluvial Soil, Black Soil or Regur Soil (medium and deep black, shallow and medium black, mixed red and black coloured), Clayey Soil, Mixed Soil and Red and Yellow Soil. Alluvial soil is mostly found in the northwest part of Madhya Pradesh, mainly Morena district, Behind district, Gwalior district and Shivpuri district. It is spread over a large area in the frontier region of the Gangetic Valley, which is made of Bundelkhand gneiss and soil deposited by the Chambal River and its tributaries. Due to lack of Nitrogen, biotic components and phosphorus, the vegetal cover over the part of land is very thin. Medium and deep black coloured soil is extensively found in the Valley of Narmada River Sapura mountain range, which contains about 20 to 60 percent clay and has a depth of near soil is highly fertile for the production of wheat, oilseeds, and lower crops. Shallow and constitute the maximum part of the black soil. It is comparatively less fertile than the medium northern part of the Malawi plateau and Nomad region comprises this soil. It is 15 cm to one metre soil is grey or light black. Mixed red and black soil spreads about 75 lakh hectares land comprising Most of the part of the region has very shallow soil. Three districts namely Chinaware district Seoni district comprise this type of soil.

Clayey soil is mostly found in the flood plain, and it is mainly transported and deposited by soil is favourable for the production of wheat, sugarcane, and cotton. The areas which consist of Behind, Morena, and Gwalior. Clayey soil is mainly deposited by the river C hambal and its tributaries. The central part of the state of Madhya Pradesh have a deposition of mixed soil composed by The soil lacks phosphate, nitrogen, and carbon, and hence it is less fertile. Mostly, the entire Baghelkhand region including Blight district, Mandal district, Dinmore district state have a deposition of red and yellow soils.

In Madhya Pradesh the problem of soil erosion is mostly found in Chambal valley, where common and known as Chambal ravines. Soil contents are characterised by soft and alluvial formation of these channels. Further, the semi-arid climate aggravated the agent of erosion Chambal valley is characterised by heavy soil erosion. Soil

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erosion is also active in the valleys of Narmada, Chambal, Kali Sindh, Betwa, Son, etc. Soils of again into several categories according to availability of major nutrients like nitrogen, phosphorus and carbon in the soils.

PAVEMENT MATERIALS

Overview:

Pavements are a conglomeration of materials. These materials, their associated properties, and their interactions determine the properties of the resultant pavement. Thus, a good understanding of these materials, how they are characterized, and how they perform is fundamental to understanding pavement. The materials which are used in the construction of highway are of intense interest to the highway engineer. This requires not only a thorough understanding of the soil and aggregate properties which affect pavement stability and durability, but also the binding materials which may be added to improve these pavement features

Desirable properties:

The desirable properties of sub grade soil as a highway material are-

Stability

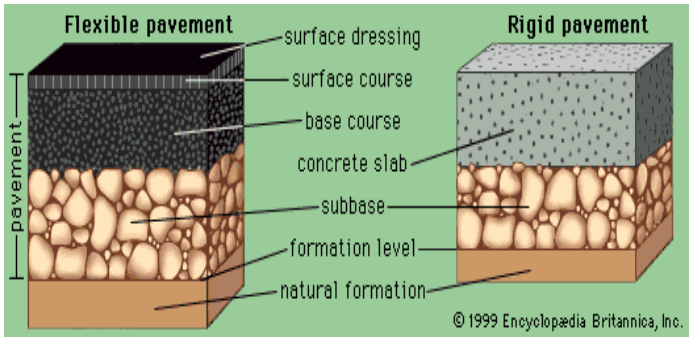
Incompressibility

Permanency of strength

Minimum changes in volume and stability under adverse conditions of weather and ground water

Good drainage, and

Ease of compaction



Indian standard grain size soil classification system

Gravel: These are coarse materials with particle size under 2.36 mm with little or no fines contributing to cohesion of materials.

Moorum: These are products of decomposition and weathering of the pavement rock. Visually these are similar to gravel except presence of higher content of fines.

Silts: These are finer than sand, brighter in colour as compared to clay, and exhibit little cohesion. When a lump of silty soil mixed with water, alternately squeezed and tapped a shiny surface makes its appearance, thus dilatancy is a specific property of such soil.

Clays: These are finer than silts. Clayey soils exhibit stickiness, high strength when dry, and show no dilatancy. Black cotton soil and other expansive clays exhibit swelling and shrinkage properties. Paste of clay with water when rubbed in between fingers leaves stain, which is not observed for silts.

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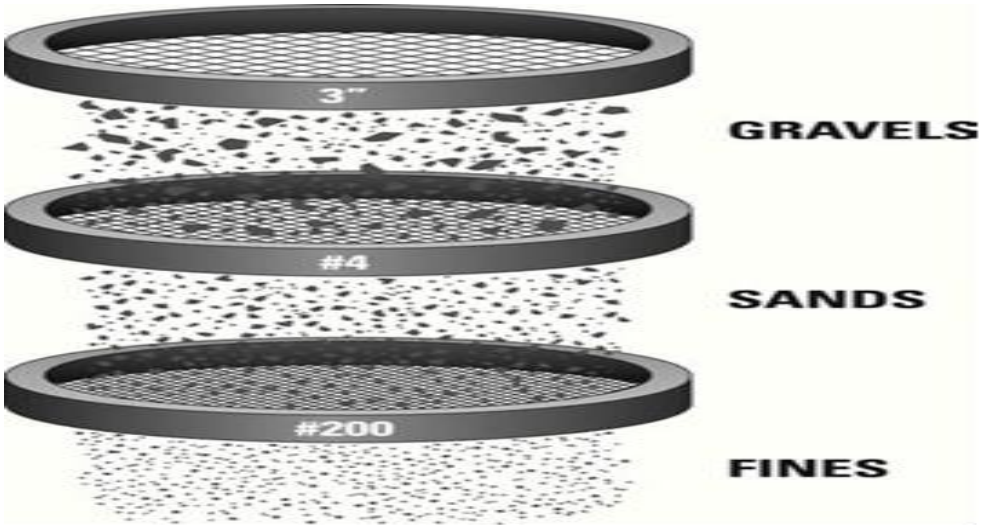

Black Cotton Soil Peculiar Characteristics

Black cotton soil (BC soil) is a highly clayey soil. It is so hard that the clods cannot be easily pulverized for treatment for its use in road construction. This poses serious problems as regards to subsequent performance of the road. Moreover, the softened sub grade has a tendency to up heave into the upper layers of the pavement, especially when the sub-base consists of stone soling with lot of voids. Gradual intrusion of wet Black cotton soil (BC soil) invariably leads to failure of the road.

The Black cotton soil (BC soil) has a high percentage of clay, which is predominantly montmorillonite in structure and black or blackish grey in colour. 40 to 60% of the Black cotton soil (BC soil) has a size less than 0.001 mm.

At the liquid limit, the volume change is of the order of 200 to 300% and results in swelling pressure as high as 8 kg/cm2/ to 10 kg/cm2.

Problems of Highway Construction in Black Cotton Soil Areas

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Figure 2: Typical Cracks in Black Cotton Soil in a Dried State

It is a well-known fact that water is the worst enemy of road pavement, particularly in expansive soil areas. Water penetrates into the road pavement from three side viz. top surface, side berms and from sub grade due to capillary action. Therefore, road specifications in expansive soil areas must take these factors into consideration. The road surfacing must be impervious, side berms paved and sub grade well treated to check capillary rise of water.

It has been found during handling of various road investigation project assignments for assessing causes of road failures that water has got easy access into the pavement. It saturates the sub grade soil and thus lowers its bearing capacity, ultimately resulting in heavy depressions and settlement. In the base course layers comprising of Water Bound Macadam (WBM), water lubricates the binding material and makes the mechanical interlock unstable. Generally, road construction agencies do not pay sufficient attention to the aspects of construction and maintenance of side berms. It is emphasized that road formation consisting of carriageway and berms must be considered as one single unit. In expansive soil areas, unpaved berms pose the maximum problem as they become slushy during rains, as they are most neglected lot. Development of alligator cracks and extensive depression as well as upheavals respectively in bituminous surfacing in Black cotton soil (BC soil) areas.

Design Problems in Black cotton soils

Figure 3: Construction of Road Embankment with Cohesive Non Swelling Soil (Moorum)

In India, CBR method developed in USA is generally used for the design of crust thickness. This method stipulates that while determining the CBR values in the laboratory and in the field, a surcharge weight of 15 kg and 5 kg per 62 mm and 25 mm thickness respectively should be used to counteract the swelling pressure of Black cotton soils (BC soils). BC soils produce swelling pressure in the range of 20-80 tons/m2 and swelling in

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the range of 10-20%.Therefore, CBR values obtained are not rational and scientific modification is required for determining CBR values of expansive soil.

Having heavy-duty traffic of 4500 commercial vehicles per day and msa150 as generally found on our National Highways and taking CBR value of 2%, total crust thickness of flexible pavement works out to 830 mm which is practically an impossible preposition. It is felt that CBR design curves require modification for expansive soils. Assuming heavy traffic intensity of 4500 commercial vehicles per day and masa 150, crust thickness of rigid pavement works out approximately 300-320 mm, which is about one third of thickness needed for flexible pavement. Therefore, it sounds reasonable to adopt cement concrete pavement in Black cotton soil areas.

Soil Stabilization

soil stabilization means the improvement of stability or bearing power of the soil by the use of controlled compaction, proportioning and/or the addition of suitable admixture or stabilizers.

Need for Soil Stabilization

Limited Financial Resources to Provides a complete network Road System to build in conventional method.

Effective utilization of locally available soils and other suitable stabilizing agents.

Encouraging the use of Industrial Wastages in building low cost construction of road.

Methods of Soil Stabilization

- Mechanical Stabilization
- Soil Cement Stabilization
- Soil Lime Stabilization
- Soil Bitumen Stabilization
- Lime Fly ash Stabilization
- Lime Fly ash Bound Macadam.

STANDARD SPECIFICATIONS FORBLACK COTTON SOIL

S.NO	PROPERTIES OF SOIL	STANDARD RANGES
1.	LIQUID LIMIT	40-100%
2.	PLASTICITY INDEX	20-60%
3.	SHRINKAGE LIMIT	10-15%
4.	OPTIMUM MOISTURE CONTENT	25-30%

S. NO	DEGREE OF EXPANSIVENESS	DIFFERENTIAL FREE SWELL
1.	LOW	<20
2.	MODERATE	20-35
3.	HIGH	35-50
4.	VERY HIGH	>50

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INGREDIENT	QUANTITY	RATE
CEMENT	1KG	RS 6
LIME	1KG	RS 8

ECONOMICS

Both the materials are locally available but cement is Rs 2 per kg cheaper than lime. Thus to achieve the economy and better performance we have use both the materials, by doing so we have reduced the cost by 12.5%

REFERENCES

Geotechnical Testing & Instrumentation VOL-1, 2.-ALAM SINGH

Soil Mechanics-B.C PUNMIA

IRC: 37-1970 CBR Recommendations

www.indianetzone.com

National programme on Technology Enhanced learning.(