ORIGINAL RESEARCH PAPER

Engineering

A STUDY ON DIFFERENT TYPES OF SOIL IN SAGAR DIVISION

KEY WORDS: Bottom ash, Fly ash, Sisal fiber, Emulsion, Indirect tensile strength, Static creep test, Tensile strength ratio

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ABSTRACT

Coal-based thermal power plants have been a key source of power generation in India. The prime waste product of a coal thermal power plant is fly ash and bottom ash. Heavy dumping of the waste products causes lathell environment pollution to air, water, and land, besides impairing human health. This research work is done to deliver the optimum use of ash, namely bottom ash as fine aggregate and fly ash as mineral filler with natural fiber (such as sisal and filament fiber) used to improvise the engineering properties of bituminous paving mixes. For national interest these waste products, which are available generally and abundantly can be used economically for bituminous paving are extremely strong purpose, which fundamentally helps in saving the natural aggregate resources of the nation.

In the present study, dense grade of bituminous mix specimens are prepared using natural aggregate as coarse aggregates, bottom ash as fine aggregates, fly ash as filler and sisal fiber as submission. Proportion of aggregate for dense graded bituminous macadam (DBM) grading has been considered as per MORTH (2013) having nominal maximum aggregates size (NMAS) 26.5 mm. To strengthen the mix, slow setting emulsion (SS1) coated sisal fiber is added in meaning percentage of 0, 0.25%, 0.5%, 0.75%, and 1% by weight of the mix, with different length alternatives such as 5mm, 10 mm, 15 mm and 20 mm. At the initial stage of the research, specimens were prepared with the two types of paving bitumen i.e. VG30 and VG20, out of which the remaining trials resulting better Marshall characteristics with VG30 bit mastic and hence was conformed for subsequent read . Detailed study with Marshall test results were used to determine the marshall method characteristics, optimum binder content and also optimum fiber content including by the optimum length of fiber. Marshall stability as high as 15kN was obtained with optimum bitumen content of 5.57%, with optimum fiber content of 0.5% with optimum fiber span of 10 mm. Further, for delivering they accomplishment of the pavement, many performance tests were also conducted such as moisture susceptibility test, indirect tensile strength (ITS), creep test and water sensitivity test ratio of bitumen mixes. It is fallen observed then not only sufficient, but also much improved engineering properties result with coal ash as fine aggregate and filler, stabilized ,Utilization of non-conventional aggregate like coal ash and behavior fiber together thus may help to find a new way of bituminous reinforced construction. The coal ash dumping which is a serious concern about to everyone in respect of its waste disposal and environmental pollution, can find one way for its reuse in an economical way by substituting behaviors resources of sand and brick dust.

1. INTRODUCTION

Soil moisture plays a cardinal role in sustaining ecological balance and agricultural development. Unfortunately this resource is finite and its usage has not been very prudent. In spite of several water management programs organized in this country, the actual water utilized in agriculture is only one third of the total utilizable surface and ground water resources. Therefore there is a distinct need for a critical review and proper planning for the optimal utilization of water for crop production. The different physical processes making up the soil water balance are infiltration from rainfall or irrigation, redistribution of the infiltrated water in the soil water zone, plant water uptake mainly in the form of actual evaporation and percolation out of or capillary rise into the reservoir of soil water. The better utilization of rain fall, irrigation facilities and effective control of soil erosion and run off depend largely on the water retention characteristics and erodibility indices of the soil. Soil texture, organic matter and cation exchange capacity to a large extent determine the water retention/ release and infiltration rate in soil (Sharma and Verma 1972; sharma et al. 1987). The water movements in the unsaturated zone, together with the water holding capacity of this zone, are very important for the water demand of the vegetation, as well as for the recharge of the ground water storage. The water that falls on the land or added to a soil by irrigation moves in a number of directions. In vegetated areas, 5 – 40% is usually intercepted by plant foliage and returns to the atmosphere by evaporation without ever reaching the soil. In some evergreen forest areas, one third to one half the precipitations is intercepted and does not reach the soil. In level areas with friable soils, most of the added water penetrates the soil. But in rolling to hilly areas, especially if the soil is It is essential to maintain readily available water in the soil if crops are to make satisfactory growth. The plant growth may be retarded if the soil-moisture is either deficient or excessive. If the soil moisture is only slightly more than the wilting coefficient, the plant must expend extra energy to obtain it and will not grow healthy. Similarly, excessive flooding fills the soil pores with water, thus driving out air. Since air is essential for satisfactory plant growth, excessive water supply retards plant growth. The optimum moisture percentage is thus that which leads to optimum growth of the plant. When watering is done, the amount of water supplied should be such that the water content is equal to the field capacity. 'Field Capacity' (FC) is the amount of water remaining in the soil after all gravitational water has drained. Water will gradually be utilized consumptively by plants after the water application, and the soil moisture will start falling. When the water content in the soil reaches a specific value, called the Permanent Wilting Point (PWP) , fresh dose of irrigation may be done so that water content is again raised to the field capacity of soil. Moisture conservation and efficient utilization of rainfall are important for the successful production of crops in dry land agriculture. Soils differ among themselves in some or all the properties depending on the differences in the genetic.

MATERIALS AND METHODS

In order to study how the irrigation water passes through the soil fabric and how the retention capacity of each soil type is influenced by its geotechnical properties, soil samples were collected from farm lands of seven different locations in Trivandrum district. The soils were then treated with admixtures like coir pith, coir pith compost and vermi compost to improve the water retention capacity and to identify the parameters that influence the retention

Soils

Bulk samples of soils were collected in jute bags from seven different locations prepared for cultivation, in Sagar district viz. Bina, Damoh, Naryawali, Deori, Rahatgarh, Banda and Khurai. Since the soil that is used for cultivation is only the top soil, soil samples were collected from the top 30 cms only. All the samples were air dried and the lumps were broken by pulverising between

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thumb and fingers. The soil samples collected from the above seven locations were given the following nomenclatures;

Soil S1 - Bina
Soil S2 - Damoh
Soil S3 - Naryawali
Soil S4 - Deori
Soil S5 - Rahatgargh
Soil S6 - Banda
Soil S7 - Khurai

The grain size distribution of various soils was determined by wet sieve analysis and hydrometer analysis. Each soil mainly consists of silt with fine to coarse sand and clay. The soils are fertile and suitable for farming activities. The particle size distribution curves of the seven soils are shown in Fig.3.1 and 3.2 . Organic content and the physical properties were also determined. Soils were classified as per I.S classification, Textural classification and Modified Textural classification taking into consideration the practices followed by both geotechnologists and agricultural scientists.

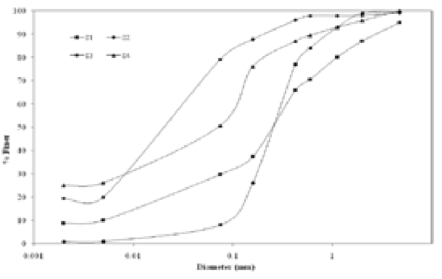
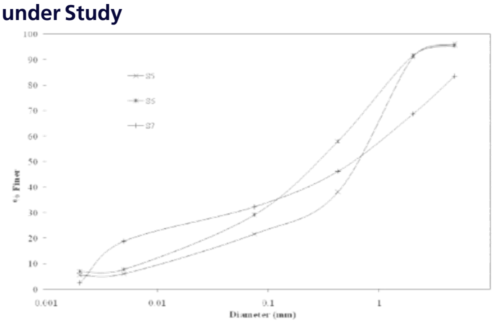


Fig. Particle Size Distribution curve for Soils S1, S2, S3, and S4 under Study



3. STUDIES ON RETENTION CAPABILITY OF TREATED SOILS

Parameters for Selection of Admixtures

The available water capacity is an important hydrological characteristic of a soil and it is often used as a basis for the evaluation of different soils and melioration treatments. A major factor of soil water management, which can influence the available water capacity, is the field capacity . The amount of water remaining in the soil after all gravitational water has drained off is called the field capacity. Improvement in field capacity increases the available water to the plants. However an increase in field capacity can be achieved by improving the soil composition or texture and it can be provided by organic amendments (admixtures). The function of the admixture is to change the soil texture and thereby increase the water holding capacity and certain other chemical properties of the soil. The admixtures find application as an amendment in problem soils such as those with poor moisture retentivity, poor drainage and aeration, salinity, alkalinity etc.

Selection of an admixture depends upon many factors such as soil texture and porosity, crop type, organic content, moisture condition, nutrient content and rapid fermentative process of the admixture. As different kinds of organic matter may be added to the soil for agro- environmental purposes, they may differently affect both the soil water retention values and their temporary changes and the nutrient condition. With this in view, three admixtures coir pith - a byproduct of coir industry, coir pith compost - a manure developed from coir pith and vermi compost an excreta of earth worm, which has a far higher fertilizer value, were selected for the present study. An attempt has been made here for a comparative assessment of the efficiency of the above three admixtures in promoting water retention and nutrient capabilities of soils.

Coir Based Admixtures

India is one of the leading countries of the world in the production of coconuts. The area under coconut has been steadily increasing and in Kerala the annual production of coconut is close to 5000 million. Though the nut and coir are considered to be the economic product, the other parts of the coconut like the coir pith consisting of dust and bits of fibres of lesser length are considered as waste and dumped on the land in mounts. The tannins that ooze out from the dump yards during monsoon, are a major concern as they create environmental pollution problems. Attempts have been made by the Central Coir Board of India and other agencies in the public sector and coir industrialists in the private sector to find better ways and means of utilisation of this waste material. The abundant availability of coir pith in the southern states, the problems associated with its disposal and environmental pollution, and the physico-chemical characteristics of the material attracted the attention of the agriculturists and technologists to find an application for this waste material. Present indications are that this waste material can become an important source of organic matter. The current boom in fertilizer prices and such other considerations necessitated the development of a programme for organic based recycling in agriculture. This review prompted the farmers, scientists as well as the owners of the coir industries to use coir pith in agricultural activities. The very attractive moisture retention properties of coir pith and availability in abundance drew their attention for its large scale use as an organic material that can improve the soil properties.

4. STUDIES ON ADMIXTURES

When an admixture is incorporated into a soil, its organic matter undergoes microbe-induced changes, triggered by soil structural and micro environmental factors. The admixtures selected for the study as mentioned above were coir pith, coir pith compost and vermi compost. Though coir pith is difficult to biodegrade, its phenomeni moisture retention properties made the scientists and farmers to use it as an ameliorant for improving the soil properties. Coir pith compost is also a product developed from coir pith to reduce its volume and increase its biodegradability. Vermi compost is an excreta of earthworm largely used as a farm manure. The chemical properties of the selected admixtures are given section 3.2.3 (Table 3.6) and the water retention characteristics of admixtures and soils are given in Table 5.1. The histograms in Fig. 5.1 shows that the water retention capacity of coir pith is several times higher than that of vermi compost. From the Tables 5.1 and 5.2, it can be seen that coir pith has a very high field capacity of 556.2% and a high value of organic carbon so that it can be used as an organic manure with high water retention capacity. The higher value of C:N ratio of 112:1, offers stiff resistance to microbial degradation. Coir pith compost and vermin compost have very good N, P and K values and low C:N ratio which indicate the potential of that as a fertilizer. From Table 5.2, Soil S2 has the highest field capacity and plant available water compared to soils S1, S3 and S4.

Table 5.1 Water Retention Characteristics of Admixtures and Soils

Name of Admixtures and Soils	Designation	Field Capacity FC (%)	Permanent Wilting Point PWP (%)	Plant Available Water PAW (%)
Coir Pith	CP	556.20	253.45	302.75
Coir Pith Compost	CC	174.20	59.72	114.48
Vermi Compost	VC	41.20	20.10	21.00
Sandy Loam	S1	20.25	9.15	11.10
Silty Clay Loam	S2	39.84	20.25	19.59
Sand	S3	21.42	9.78	11.64
Sandy Clay Loam	S4	28.24	16.12	12.12

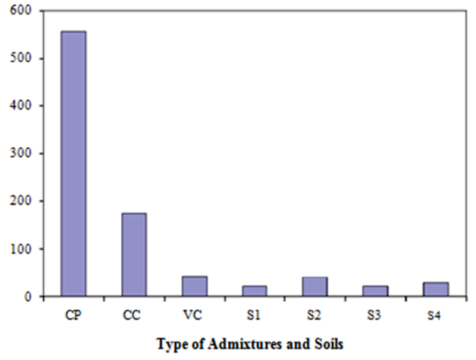


Fig. Field Capacities of Different Admixtures and Soils

5. CONCLUSIONS

The most important object in irrigated agriculture is to minimize the utilization of applied water- the single most vital input for crop production.

As more and more food production is required with limited supply of water, timely irrigation with proper quantity of water is essential to achieve maximum benefit from the given quantity of water. Irrigation scheduling refers to the actual time or stage of the crop when the irrigation should be applied to replenish the soil water already consumed by plants before they are affected by the shortage of water.

How much water is to be added and when it is applied are decided to a larger extent by the geotechnical and physical properties of soil.

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