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EFFECT OF POLYMER STABILIZER ON THE GEOTECHNICAL PROPERTIES OF BLACK COTTON SOIL

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ABSTRACT

In the present situation soil adjustment has turned into an imperative term in the field of geotechnical designing because of the development of overwhelming structures, for example, elevated structures, huge dams, underground structures and so on. These structures force huge weight on soil. More often than not designs are not sufficiently fortunate to get the dirt strata having adequate quality to maintain this weight, particularly if there should arise an occurrence of exceptionally strong soil which experience colossal variety in quality in dry and wet conditions. Subsequently it ends up plainly basic to pick an elective answer for upgrade the geotechnical properties of poor soil. In this paper, an endeavor has been made to discover an answer for these issues by leading a definite research center examination on the dirt example balanced out with polymer stabilizer. The geotechnical properties of the balanced out soil are resolved and endeavor has likewise been made to comprehend the adjustment component of the polymer stabilizer. The locally accessible dark cotton soil because of its high shrinkage and swelling qualities is chosen in the present investigation. A large portion of the territory in the focal area secured with the dark cotton soil. This dirt is very strong and contains huge measure of montmorillonite, which makes it sporadic for any development venture. The polymer stabilizer is utilized as a part of conjunction with concrete to enhance its proficiency with the dirt molecule. The dirt example was treated with various measurements of polymer stabilizer and bond. The outcomes got from the geotechnical tests directed on dark cotton soil treated with polymer stabilizer were dissected. The different tests, for example, Liquid Limit, Plastic Limit, Differential Free Swell, Unconfined Compressive Strength, and California Bearing Ratio were performed on each example. Filtering Electron Microscope investigation was likewise led to examine the smaller scale auxiliary changes in the treated and untreated soil example. Polymer stabilizer was turned out to be successful on poor soil as critical upgrade in the designing properties and list properties of soil was watched.

Keywords: Atterberg limits, California Bearing Ratio, Polymer Stabilizer,Soil Stabilization, Unconfined CompressiveStrength.

I. INTRODUCTION

Soil adjustment is a procedure to modify any property of the given soil. It is required when the bearing limit or the quality of soil accessible at the development site isn't according to prerequisite or particular. All things considered these properties are improved by utilizing distinctive mechanical or concoction implies soil

adjustment. The significance of soil adjustment is expanding step by step as a result of the development of gigantic structures, for example, multistory building, extensive traverse spans, colossal dams and so forth. Polymer adjustment of soil is likewise considered as one of the critical and powerful approach to enhance the properties of soil.

Polymer is basically a long chain of monomers which is associated with each other by an adequately solid and adaptable ponder divider powers. As indicated by J. S. Shiver (2007) the polymer stabilizer makes polymer covering around the dirt molecule which in the end interfaces soil molecule with each other by an adaptable bond. Along these lines a dirt polymer framework is shaped which can securely oppose high force stack. It is found from the past research work that with soil it marginally carries on as a latent material, consequently it ought to be utilized as a part of conjunction with any coupling operators, for example, bond lime and so on to improve the response with soil. Since polymer settles the dirt by covering the dirt particles, in this manner for fine soil its proficiency decreased.

An assortment of common polymers, for example, lignosulfonates and engineered polymers are advertised, however the constituents of the polymers are regularly undisclosed by providers. Because of which the correct physical or synthetic responses that occur between the dirt and polymer isn't accessible. Notwithstanding, it is realized that the polymers comprise of hydrocarbon chains, and it is imagined that these chains move toward becoming laced inside the dirt particles along these lines creating a settling impact. In actuality, the polymers go about as a fastener to stick the dirt particles together diminishing dust, and notwithstanding balancing out the whole soil network (Brown et al., 2004).

In this study the geotechnical properties of polymer soil stabilizer is broke down with the assistance of itemized geotechnical examination. In Talera, kota the vast majority of the region is secured with dark cotton soil, which is exceptionally durable and costly in nature. The dark cotton soil has a considerable measure of issue to any structure built over it due to

its exceptionally shrinkage and swelling properties. The utilization of polymer in this examination paper is a push to discover a most practical answer for this issue. The polymer stabilizer is utilized as a part of conjunction with bond to enhance its productivity with the dirt molecule. The dirt example was treated with various measurements of polymer stabilizer and concrete. The vital outcomes are seen from the geotechnical tests directed on dark cotton soil treated with polymer stabilizer.

II. MATERIALS AND METHODS

2.1 Materials

2.1.1 Soil Sample:

The soil used in this study is light grey in colour and is known as black cotton soil, it wasobtained along talera, Kota Local Government Area of Rajasthan State using the method of disturbed sampling.

The chemical properties of the black cotton soil are given in table 1.

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Table-1: Properties of untreated black cotton soil.

Characteristics	Quantity
Percent passing BS No. 200 sieve (%)	89.9
Natural moisture content (%)	26.05
Liquid limit (%)	55
Plasticity index (%)	38.09
Linear Shrinkage (%)	35.41
USCS Classification	CH
AASHTO Classification	A-7-6
Specific gravity	2.26
Ph	7.2
Color	Greyish light black
Dominant clay mineral	Montmorillonite

2.1.2 Cement:

The soil sample is also treated with cement in addition with polymer stabilizer. For this purpose Portland Pozzolona Cement (PPC) is used which is normally available in market. The properties of cement used are given in Table -2.

SR. NO.	**Property**	**Value**
1	Average Specific Gravity	3.1
2	Initial Setting Time	27 min
3	Final Setting Time	558 min

As per the literature available most suitable range of cement content for the stabilization black cotton soil with polymer stabilizer is 5-7% by weight of soil. In present study the variation of cement content is done on the higher side as well as on the lower side of cement content recommended by manufacturer. Cement is varied from 2-8% by weight of soil.

2.1.3 Polymer Stabilizer:

The polymer soil stabilizer used in this study was Renolith. The chemical properties of the polymer stabilizer are shown in table 3.

S. No.	Properties	Values
1.	Boiling Point	100 °C
2.	Specific Gravity @25°C	1.00 – 1.02
3.	Viscosity @25°C	1,200 – 2,000 cps
4.	Solubility in water	Miscible in water
5.	pH value @25°C	11.0 – 12.5
6.	Appearance/ Colour	Milky white
7.	Evaporation Rate	Same as water
8.	Melting point	Liquid
9.	Reactivity data	Stable
10.	Materials to avoid	Caustics and strong bases
11.	Hazardous content	None

Table 3: Properties of polymer stabilizer

2.2: TESTING METHODS

2.2.1 Liquid Limit:

Liquid limit test is conductedafter 24 hours of mixing the stabilizer into the soil sample. The liquid limit of untreated black cotton soil was 54.

2.2.2 Plasticity Index:

The plasticity index of soil sample decreased with increase in the polymer and cement content. Fromthe test results, it is clear that the stabilizer is effective in controlling the plastic properties of black cotton soil.

2.2.3 California Bearing Ratio Test:

The CBR test was performed on untreated black cotton soil and on the soil samples with variation in percentage for cement and polymer stabilizer. The specimens were prepared as per the relevant IS Code. The untreated black cotton soil gave the soaked CBR Value as 2.63.

2.2.4 Unconfined Compressive Strength:

Unconfined Compressive Strength Test was conducted on the soil sample at optimum moisture content as determined from the compaction test. The specimen were prepared by heavy compaction and allowed to cure for 1day and 7day. The UCS value of untreated soil was 612 KPa. The cement and polymer content is varied in same proportion as done in CBR test.

III.RESULTS

3.1 Liquid Limit:

The liquid limit reaches of untreated dark cotton soil was 54.For the polymer treated soil test the liquid limit reaches of soil test diminished extensively to an estimation of 36. The rate decrease saw in as far as possible was up to 33.2% for the polymer regarded soil when contrasted with untreated soil.

3.2 Plasticity Index:

The plasticity index of the polymer treated soil is decreased with increase in content of stabilizer. This demonstrates the polymer is exceedingly powerful in decreasing the plastic attributes of dark cotton soil. The plasticity index of untreated dark cotton soil test was 26, while versatility file of dark cotton soil treated with polymer changed from 23.4 to 8.5. Most extreme lessening of 67% is seen in the versatility record when it is treated with higher measurements of polymer stabilizer.

3.3 California Bearing Ratio:

The CBR test directed on dark cotton soil demonstrated huge change in splashed CBR esteem when the bond and polymer stabilizer content is expanded. The CBR esteem for the untreated soil was 2.63. The most extreme rate increment in CBR esteem for treated soil test was 772%. The CBR estimations of the dirt example treated with polymer stabilizer upgraded by 2 to 8 times the estimation of untreated soil.

3.4 Unconfined Compressive Strength:

The UCS test was directed on soil examples for two distinctive curing period i.e. 1day and 7 day. For untreated soil test the UCS esteem was 672 KPa, which is improved from 712 KPa to 2214 KPa with increment in the substance of concrete and polymer. The quality increment was likely because of the polymer covering around the surface of the dirt particles causing increment in the shear quality of soil test due to between molecule holding.

IV. CONCLUSIONS

In this investigation, the expansion of polymer caused a critical alteration in building properties. The polymer expansion indicated significant change in quality, CBR, and in addition swelling attributes. The expansion in these building properties was because of polymer holding on the surface of the dirt particles.the polymer treated soil sample the liquid limit of soil sample decreased considerably to a value of 36 from 54. The plasticity index

of untreated black cotton soil sample was 26, while plasticity index of black cotton soil treated with polymer varied from 23.4 to 8.5.The CBR value for the untreated soil was 2.63. The maximum percentage increase in CBR value for treated soil sample was 772%.untreated soil sample the UCS value was 672 KPa, which is enhanced from 712 KPa to 2214 KPa with increase in the contents of cement and polymer.

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