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Behavioral Study on the Usage of Biopolymers with Bagasse Ash on Red Soil

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ABSTRACT—In construction engineering, improving soil characteristics such as stability, strength, and erosion resistance is the basic goal of soil treatment. Traditional soil remediation methods have a number of drawbacks, particularly in terms of the environment. Therefore, a suitable eco-friendly substitute for traditional materials is needed. Xanthan Gum is a polysaccharide that is frequently used as a rheology modification and food ingredient. In the current study, guar gum in varied percentages was employed in experimental experiments on red soil as a material for soil improvement. In this investigation, soil was also replaced with agro waste up to 10% of its volume and its strength attributes were assessed. Through tests using various Xanthan Gum concentrations, it was discovered that the soil's strength was enhanced.

KEYWORDS:—Soil, Bagasse ash, Xanthan Gum

I. INTRODUCTION

Soil improvement is a process in which soil is improved in a site to enhance the prospects of on-time and safe project delivery. Soil improvement is crucial in the construction industry because, it enhances the density and stiffness of the soil; hence, preventing liquefaction which can damage the structures around earthquake-sensitive regions. It also prevents excessive settlement of reclaimed land when it is being used for roads, bridges, airports, and other construction purposes. It stabilizes contaminants in dredged soil to mitigate and consequently eliminate environmental impacts. Soil improvement can improve the shear strength of the soil; hence, preventing slips failure and increasing the bearing capacity of the soil.

Numerous soil treatment methods are already in practice; among these, cement is the most commonly used material for soil treatment. However, even with the many benefits that ordinary cement provides, it has several shortcomings, especially when viewed from an environmental perspective. The most critical of these problems are CO₂ and NO_x (nitrogen oxides) emissions and particulate air suspensions.

Biopolymers are organic polymers that are produced by different biological organisms. In nature, biopolymers can be found in large amounts. They are biodegradable and have no negative effects on the environment; therefore, they might be favorable soil-improvement material. Biopolymers can increasingly replace the conventional admixtures for the application of soil improvement and soil stabilization. Numerous studies have been conducted in the past decades to investigate the suitability and efficiency of various biopolymers for soil improvement.

The purpose of this study was to verify the engineering performance and efficiency of Xanthan Gum biopolymer-treated soil. Experimental tests were carried out to identify the strengthening characteristics of soils replaced by agro waste and treated with a Xanthan Gum biopolymer. The effect of Xanthan Gum treatment on the consistency limits, compaction characteristics, permeability, unconfined compressive strength, ageing and durability of the soil are studied at various percentages of Xanthan Gum replacement – 4% and 6%. The results of the study shows promising applications of Xanthan Gum as a sustainable and economical option for improving soil properties.

II. MATERIALS

A. Soil

Soil is a mixture of organic matter, minerals, gases, liquids, and organisms that together support life. Soil samples are collected from Bannur (Mysore district) and are tested for their geotechnical properties and strength.



B. Bagasse ash

Bagasse ash is a byproduct of sugar factories found after burning sugarcane. Bagasse which itself is found after the extraction of all economical sugar from sugarcane. The disposal of this material is already causing environmental problems around the sugar factories. In many tropical countries there are substantial quantities of Bagasse is rich in amorphous silica indicated that it has pozzolanic properties.

C. Xanthan Gum

Xanthan gum is a polysaccharide commonly used as a food additive and rheology modifier; it is produced by fermentation of glucose or sucrose by the *Xanthomonas campestris* bacterium. This anionic polysaccharide is composed of D-uronic acid, D-mannose, propylated mannose, 6-O-acetylD-mannose, and 1,4-linked glucan. The basic chemical structure of Xanthan gum (C₃₅H₄₉O₂₉) is a linear linked b-D glucose backbone with a trisaccharide side chain on every other glucose. The trisaccharide side chain is aligned with the backbone, which provides stability and overall conformation through the use of hydrogen bonds. The most well-known characteristic of Xanthan gum is its pseudo-plasticity (i.e., viscosity degradation depending on the shear rate).

III. METHODOLOGY

- **Step 1:** Suitable soil sample will be collected for Testing.
- ❖ (The soil contents should be having the particles as 50% Sand+20% Clay+15% Gravel and +15% silt).
- **Step 2:** Basics tests are conducted on the materials to know its index and engineering properties.
- **Step 3:** The mix proportion: A suitable cohesive soil is mixed with 4% and 6% of Xanthan gum biopolymer along with Bagasse Ash at a weight ratio of Xanthan gum to soil, and tested for its strength and stability.
- **Step 4:** The soil is treated with 10% Bagasse Ash along with 4% and 6% of XanthanGum.

Table 3.1: Mix Proportion

Soil Proportion	Bagasse Ash Proportion	Xanthan Gum Proportion
100%	-	-
100%	10%	4%
100%	10%	6%

Table 3.2: Properties of Materials

Materials	Tests Conducted	Result
Soil	Specific Gravity	2.45
	Unconfined Compressive Strength test	C(kN/m ²) φ (Degree)
	Liquid Limit	21%
	Plastic Limit	38.21%
	Maximum Dry Density OMC	1.67g/cc 19%
Bagasse Ash	Specific Gravity	2.42
Xanthan Gum	Specific Gravity	2.13



Table 3.3: Tests conducted on materials

Materials	Tests Conducted
<ul style="list-style-type: none"> • Soil 	<ul style="list-style-type: none"> ➤ Specific gravity ➤ Consistency ➤ Dry density & OMC ➤ Unconfined Compressive Strength Test
<ul style="list-style-type: none"> • Bagasse ash • Xanthan Gum 	<ul style="list-style-type: none"> ➤ Specific gravity
Soil mixed with Bagasse ash & Biopolymer	<ul style="list-style-type: none"> ➤ Specific gravity ➤ Consistency ➤ Dry density & OMC ➤ Unconfined Compressive Strength Test

IV. RESULTS & DISCUSSION

The Soil is mixed with 10% of Bagasse Ash and 4% to 6% of Xanthan Gum and Tested for its consistency limits, Maximum Dry Density, OMC, and Shear Strength Test. The following Results were obtained.

Table 4.1: Tests results on soil & Mix Proportion

Test conducted	Soil + 10% Bagasse + 4% Xanthan Gum	Soil + 10% Bagasse + 6% Xanthan Gum
<input type="checkbox"/> Consistency limits <ul style="list-style-type: none"> • Liquid Limit (%) • Plastic Limit (%) • Flow Index (%) 	<p style="text-align: center;">24</p> <p style="text-align: center;">35.42</p> <p style="text-align: center;">48.3</p>	<p style="text-align: center;">26</p> <p style="text-align: center;">32.68</p> <p style="text-align: center;">49.6</p>
<input type="checkbox"/> MDD g/cc <input type="checkbox"/> OMC (%)	<p style="text-align: center;">1.72</p> <p style="text-align: center;">22</p>	<p style="text-align: center;">1.82</p> <p style="text-align: center;">24</p>
<ul style="list-style-type: none"> • C (kN/m²) • φ (Degree) 	<p style="text-align: center;">0.54</p> <p style="text-align: center;">12</p>	<p style="text-align: center;">0.61</p> <p style="text-align: center;">9</p>

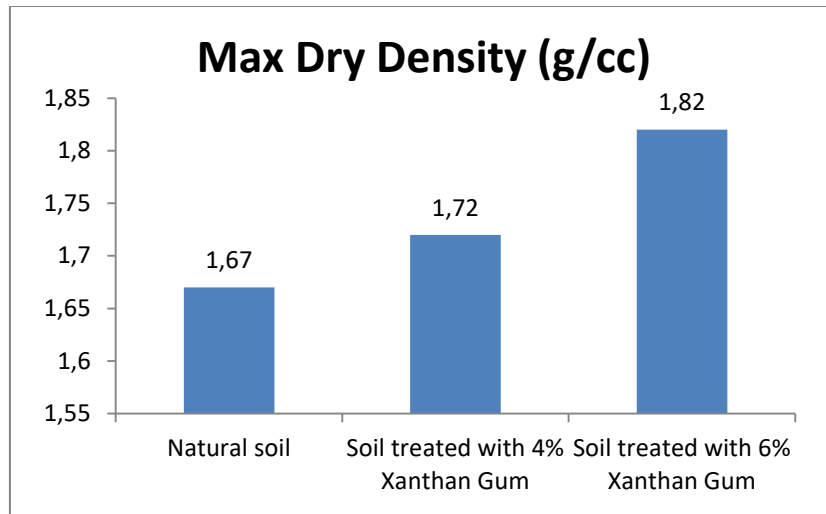


Fig 4.1: Variation of MDD in soil & treated mixture

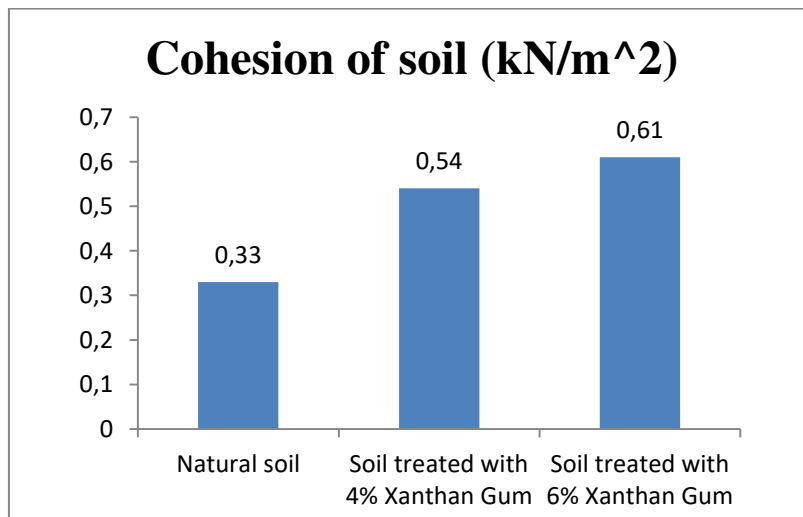


Fig 4.2: Variation of Cohesion in soil & treated mixture

V. CONCLUSION

1. Bagasse ash can be used as a replacement for soil upto 10%.
2. Usage of Xanthan Gum (Biopolymer) as an additive improves the engineering properties of the red soil.
3. Increase in Xanthan Gum percentage enhances the liquid limit & plastic limit which indicates the soil becoming viscous.
4. Soil replaced with 10% of Bagasse ash and treated with 4% guar gum enhances the cohesion by 64%
5. Soil replaced with 10% of Bagasse ash and treated with 6% guar gum enhances the cohesion by 85%.
6. The percentage of Xanthan Gum usage can be limited to 6% in treating the soil to enhance its strength. Higher the Xanthan Gum makes the soil viscous.

REFERENCES

1. Rosalam S, England R. Review of xanthan gum production from unmodified starches by *Xanthomonas campestris* sp. *Enzyme Microbe Techno* 2006;39(2):197–207.
2. Cadmus MC, Jackson LK, Burton KA, Plattner RD, Slodki ME. Biodegradation of xanthan gum by *Bacillus* Sp. *Appl Environ Microbial* 1982;44(1):5–11.
3. Casas JA, Santos VE, Garcia-Ochoa F. xanthan gum production under several operational conditions: molecular structure and rheological properties. *Enzyme Microbe Techno* 2000;26(2–4):282–91.



4. Zohuriaan MJ, Shokrolahi F. Thermal studies on natural and modified gums. *Polymer Testing* 2004;23(5):575–9.
5. Katzbauer B. Properties and applications of Xanthan gum. *PolymDegrad Stab*1998;59(1–3):81–4.
6. Chenu C. Clay- or sand-polysaccharide associations as models for the interfacebetween micro-organisms and soil: water related properties and microstructure.
7. Geoderma 1993;56(1–4):143–56.Marion D, Nur A, Yin H, Han DH. Compressional velocity and porosity in sand–clay mixtures. *Geophysics* 1992;57(4):554–63.
8. Shogren RL, Doane WM, Garlotta D, Lawton JW, Willett JL. Biodegradation ofstarch/polylactic acid/poly (hydroxyester–ether) composite bars in soil. *PolymDegrad Stab* 2003;79(3):405–11.



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