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Gum Arabic as an admixture for cement concrete production

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HIGHLIGHTS

- Addition of gum Arabic to OPC improved the properties of the concrete because of minerals such as sepiolite, palygorskite and mordenite.
- Compressive strengths of the GAC increased as the dosage of GA was increased, and that dosage range of 0.50–0.75% is adequate for use.
- Optimum strength was achieved at 0.50% dosage, with percentage increase of 29.5% to 39.5%, above the control.
- Statistical analysis showed that the behaviours of the generated data on density, water absorption and compressive strength can be adequately represented by linear, natural log and square root models, respectively.
- These models were found to be appropriate and significant.

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ABSTRACT

The effects of gum Arabic as an admixture on the mechanical properties of cement concrete were evaluated using dosages of 0.00–1.00%, wt% by cement, and cured for periods of 3–90 days, before testing to failure. Properties of the gum Arabic concrete (GAC) such as workability, density, water absorption and compressive strengths were determined and their effects evaluated using experiments, X-ray diffraction and microstructure methods to generate data that were analysed by statistical methods using the Minitab 17 Software. The study found among other things, that the addition of gum Arabic to OPC improved the properties of the concrete because of minerals such as sepiolite, palygorskite and mordenite. The compressive strengths of the GAC increased as the dosage of GA was increased, and that dosage range of 0.50–0.75% is adequate for use. The optimum strength was achieved at 0.50% dosage, with percentage increase of 29.5–39.5%, above the control. The statistical analysis showed that the behaviours of the generated data on density, water absorption and compressive strength can be adequately represented by linear, natural log and square root models, respectively. These models were found to be appropriate and significant.

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1. Introduction

Gum Arabic (GA) was characterized as viscosity-enhancing admixture with potentials for application in the construction and building industries [1]. GA is a natural material with a dispersing effect on cement particles by steric hindrance. It has low viscosity with emulsifying characteristics and a long polymer chains called the functional groups of carboxyl acids (COOH) These have the ability to adsorb to particle surfaces by electrostatic bonding, hydrogen bonding and/or Van der Waals forces. Preliminary works on this material to be used in cement and concrete productions were extensively discussed by Elinwa and Mohammad [2].

GA was confirmed in their works, and other related works to improve the properties of the cement paste and concrete [2,1,3]. It is compatible with Ashaka Portland cement with good affinity for water. The water requirement when gum Arabic was used with cement paste increased as the dosage of GA increased. It was therefore suggested in their work that GA should be used with a water reducing agent [2]. It was furthered confirmed that adding GA in cement produced sound concrete which is free from aggregate sulphate attack (ASR) because of the presence $BaCO_3$. And for ASR to be minimized or eliminated, it was suggested to limit the dosages of GA wt% by cement, from 0.50% to 0.75%. This is because at these levels of dosages, $BaCO_3$ which inhibits the

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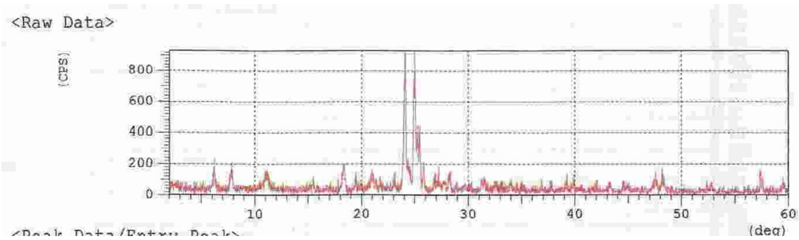
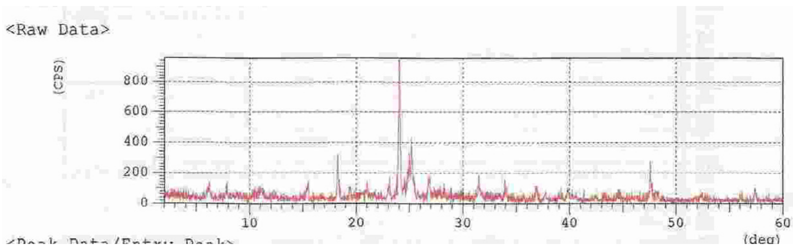


(a) @ 0.00% Dosage

Table (a)

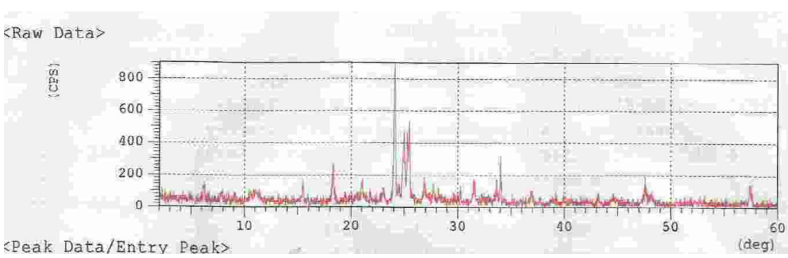
2 Theta	d (Å)	I/II	Int . Counts
24.1301	3.68526	100	82
25.0344	3.55415	85	70
25.5101	3.48894	37	30



(b) @ 0.25 % Dosage

Table (b): Strongest Peak

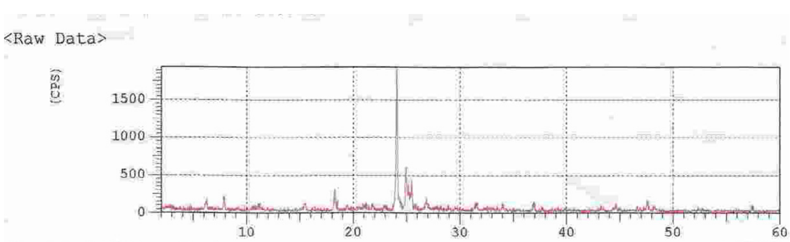
2 Theta	d (Å)	I/II	Int. Count
24.0346	3.69968	100	88
25.2067	3.53024	35	31
47.5825	1.90949	30	26



(c) @ 0.50 % Dosage

Table (c): Strongest Peak

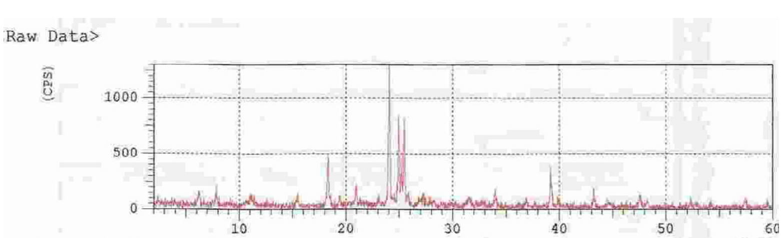
2 Theta	d (Å)	I/II	Int. Count
24.0759	3.69343	100	87
25.4400	3.49839	46	40
24.9466	3.56646	45	39



(d)@ 0.75 % Dosage

Table (d): Strongest Peak

2 Theta	d (Å)	I/II	Int. Count
24.1292	3.68539	100	208
24.9899	3.56038	28	59
25.5296	3.48632	18	37



(e) @ 1.00 % Dosage

Table (e): Strongest Peak

2 Theta	d (Å)	I/II	Int. Count
24.0465	3.69788	100	113
24.9341	3.56822	76	86
25.4567	3.49614	4572	81

Fig. 1. X-ray Diffraction Spectra.

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