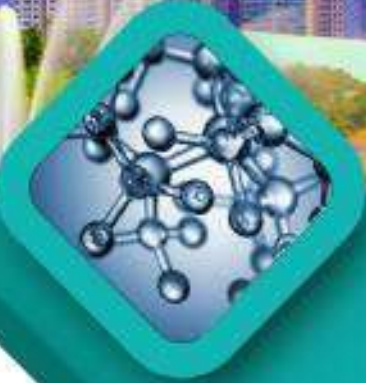


Promoting Innovative Multidisciplinary Research
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PREFACE

The 3rd International Conference on Science, Engineering and Social Sciences, ICSESS'17 is organised jointly by Universiti Teknologi Malaysia (UTM), International Student Society-Nigeria (ISS-Nigeria), UTM International and International Student Center (ISC). The theme for this year conference is "*Promoting Innovative Multidisciplinary Research for Sustainable Development*". This promotes and encourage innovative and novelty for sustainable development in wide range of science, engineering, social science researches in terms of approaches and methods, advanced technology, professionalization, experiences, and culture.

The responses from participants for this conference is overwhelming, well attended, and successful. Our participants are from Universiti Teknologi Malaysia (UTM), School of Business, Yogyakarta, Indonesia, Universiti Tun Hussein Onn Malaysia (UTHM), University Andalas, Kampus UNAND Limau Manih, Padang, West Sumatera, Indonesia, Universiti Teknologi Mara (UITM), University of Jos Nigeria, Federal University of Technology Minna Nigeria (FUTMINNA), University of Dammam Saudi Arabia just to mention a few. Hence, this conference provides a good platform for professionals, academicians and researchers to widen their knowledge and approach on latest advances in research and innovation. Papers presented in these conference cover a wide spectrum of science, engineering and social sciences.

Finally, a note of thanks must go to ICSESS'17 central working committee for their remarkable dedication in making these conference a success. We hope the event will prove to be an inspiring experience to all committee members and participants.

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Setting Time of Self-Compacting Concrete Made with Gum Arabic as a Plasticizer

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ABSTRACT

The drive for green materials and desire for cheap sustainable construction additives lead the research to investigate the effects of Gum Arabic in cement paste as used in Self-Compacting concrete. Different samples with varying Gum Arabic dosages and varying W/C were used. The research discovered that Gum Arabic increases the setting time of cement thereby improving the time for transportation and placement of concrete because it takes about twice the amount of time needed for normal concrete to set for SCC made with Gum Arabic to set.

Key words: Setting time, Self-compacting Concrete, plasticizer

INTRODUCTION

When water is added to cement, paste is formed which gradually stiffens and then hardens. The stiffening of cement paste is called setting (Baradan, 1998). Basically, setting is a process of transformation from an initial state, a scattered concentrated suspension, to a final state, a connected and strengthened system of particles (Jiang *et al.*, 1995). This transformation in the presence of cement and concrete is obtained by chemical reactions between cement particles and water (i.e., cement hydration). The setting time characteristics of cement is influenced by some factors such as cement type, cement content, water content and to a large degree the amount of additive present as well as its properties in the mixture. The initial setting time of cement represents the time at which a fresh cement paste can no longer be handled or injected properly; and the final setting time is the time that approximately shows when hardening and strength development commences (Tan and Zaimoglu, 2003). Gum arabic (*Acacia senegal*) is a carbohydrate based compound made up of approximately galactose (44%), rhamnose (13%), arabinose (27%), glucuronic acid and 4-O-methyl glucuronic acid (16%). It also contains 2-3% peptide moieties as an integral part of the structure (Williams and Phillips, 2006).

The aim of the research was to determine the setting time of cement paste made with Gum Arabic as a plasticizer as used in Self-Compacting concrete. The plasticizer proportion adopted was 0.9% and 1.5% by weight of cement. Also, an optimum fly ash content of 20% by volume of cement was found to be the most suitable for this research. The three controls were chosen because the proportioning for normal concrete used on site for structural members usually has more coarse aggregates than fine aggregates. The second and third controls have the same composition of cement, fine aggregates and coarse aggregates as the self-compacting concrete. The initial and final setting times for the various mixes were carried out using the Vicat apparatus. The concrete was hand-mixed for about 6mins. The tests carried out for the fresh normal concrete was the slump test and compaction factor tests. The Gum Arabic used was gotten from acacia senegal which is only native to Nigeria and Sudan and produces a grade I gum as observed by Makwunye and Aghughu

(2010). The high water solubility of the gum Arabic used confirms the findings of Williams *et al.* (1990) that gum arabic can in a concentration of 50% by volume of water, whereas other gums cannot dissolve above 5% the volume of water because of their high viscosity. The samples were given coded identities for easy identification. The following are their identities:

C = Control,

(i) C1= Control 1 (1:2:4; W/C= 0.55), (ii) C2 = Control 2 (1:2 1/2:2; W/C= 0.40)

(iii) C3 = Control 2 (1:2 1/2:2; W/C= 0.45), (iv) SCC = Self Compacting Concrete,

(v) P = Plasticizer (vi) SCC 1= (1:2 1/2:2; W/C= 0.40; P= 0.9%), (vii) SCC 2= (1:2 1/2:2; W/C= 0.40; P= 1.5%), (viii) SCC 3= (1:2 1/2:2; W/C= 0.45; P= 0.9%), (ix) SCC 4= (1:2 1/2:2; W/C= 0.45; P= 1.5%).

MAIN RESULTS

The Table below shows the result for the setting time of the cement paste made for the various types of concrete. The results obtained for the initial setting time for the Ordinary Portland Cement (OPC) sample without gum arabic and a water/cement ratio of 0.55 was 1hour 40minutes and a final setting time of 3hours 30minutes. The initial setting time for OPC paste with a water/cement ratio of 0.40 was 1hour 15minutes and the final setting time was 2hours 50minutes. The initial setting time for OPC paste with a water/cement ratio of 0.45 was 1hour 35minutes and the final setting time was 3hours 15minutes. The initial setting time for the paste made with a water/cement ratio of 0.40 and a gum arabic content of 0.9% content was 3hours 10minutes and a final setting time of 5hours 7minutes. The initial setting time for the paste made with a water/cement ratio of 0.4 and a gum arabic content of 1.5% content was 3hours 40minutes and a final setting time of 5hours 43minutes. The initial setting time for the paste made with a water/cement ratio of 0.45 and a gum arabic content of 0.9% was 4hours 10minutes and a final setting time of 6hours 36minutes. The initial setting time for the paste made with a water/cement ratio of 0.45 and a gum arabic content of 1.5% was 4hours 48minutes and a final setting time of 6hours 54minutes. The setting time for the samples fall within the allowable limits provided by ASTM-C 150 (1994). The table further shows that the initial and final setting times of the cement pastes produced increased with increase in the amount of gum arabic. This result shows that gum arabic increases the setting time of concrete as contained in the findings of AGRIGUM (2006) when gum arabic was used as a plasticizer in concrete as well as the findings of Rico (2000).

Table 1: Setting Time of Cement

Mix Identity	Water/Cement Ratio	Gum Arabic Content (G.A 1)	Gum Arabic Content (G.A 2)	Initial Setting Time (Hour+ Minutes)	Final Setting Time (Hour+ Minutes)
C1	0.55	0	0	1 + 40	3 + 30
C2	0.40	0	0	1 + 15	2 + 50
C3	0.45	0	0	1 + 35	3 + 15
SCC1	0.40	0.9%	-	3 + 10	5 + 7
SCC2	0.40	1.5%	-	3 + 40	5 + 43
SCC3	0.45	-	0.9%	4 + 10	6 + 36
SCC4	0.45	-	1.5%	4 + 48	6 + 54

CONCLUSION

The research concludes that the presence and subsequent increase in the dosage of Gum Arabic in the cement mixture increases the initial and final setting times of cement. Therefore, the presence of Gum Arabic in SCC will increase its setting time thereby increasing the time for transportation and placement of concrete compared to normal concrete.

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