Proceedings of the 2nd International Conference on Science, Technology and Social Sciences 2016 (ICSESS2016)

The Effect Of Blended Palm Oil Fuel Ash And Pulverised Burnt Clay On Properties Of Self-Consolidating Concrete

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ABSTRACT. The application of palm oil fuel ash and pulverised burnt clay in self-consolidating concrete has been acknowledged to have significant influence on the fresh properties of the concrete. In contrast, the effect on the hardened properties has not yet been established. In this study, a blend of Palm oil fuel ash (POFA) and pulverised burnt clay (PBC) was used as partial replacement of Ordinary Portland cement (OPC) to produce self-consolidating high performance concrete (SCHPC). Fifteen different mixes were prepared with varying percentages of blended POFA/PBC, with water to binder ratio (W/B) ranging from 0.30-0.40. The key hardened properties investigated were compressive strength, tensile strength, flexural strength, ultrasonic pulse velocity, drying shrinkage and modulus of elasticity. The durability properties were also investigated based on the permeability, total porosity, heat endurance, sulphate resistance, acid attacks, and electrical resistivity. The research findings revealed strong correlations between most of the hardened properties of the respective SCHPC.

Keyword: *Blended; Concrete; Palm oil fuel ash; Pulverised burnt clay; Self-consolidating*

INTRODUCTION

One of the basic solutions towards achieving improved concrete characteristics both in the fresh and hardened state is the employment of self-consolidating concrete (SCC) or self-consolidating high performance concrete (SCHPC). Because it tends to transform the concreting operation by completely eliminating the need for vibration and allows the concrete to be consolidated through sections with congested reinforcement under its self-weight without any segregation [1, 2].

The three basic categories of hardened properties of SCHPC are influenced by the W/B, the quantity of SCM, volume fraction of paste, volume fraction of fine and coarse aggregates and the interfacial bond between the aggregates and the bulk paste matrix [3-5]. The mechanical strengths, deformation characteristics and the durability properties of SCHPC may be alternately influenced, either directly or indirectly by the aforementioned factors. Therefore, evaluation of the correlation between these properties will be the key to successful design, production and application of SCHPC.

The evaluation of the correlations between mechanical strengths and deformation characteristics, and the mechanical strengths and durability properties of the concretes were carried out. Fifteen different mixes of SCHPC were prepared using a blend of POFA and PBC at a replacement levels ranging between 0-30% (0%/0%, 5%/5%, 10%/5%, 10%/10%, and 15%/15% of POFA/PBC respectively) as partial replacement of OPC. The W/B used was 0.30, 0.35 and 0.40 respectively.

RESULTS AND DISCUSSION

Correlation between mechanical properties (compressive, tensile and flexural strengths): The correlation between the splitting tensile strength (f_{sp}) and flexural strength (f_r) of the respective SCHPC had a strong correlation with the square root of the compressive strength ($\sqrt{f'_c}$). The correlation was linear and positive as shown in figure 1, 2 and 3. The correlation determined for compressive strength in the range of 53.44 MPa to 94.95 MPa, splitting tensile strength in the range of 4.56 MPa to 6.22 MPa and flexural strength in the range of 4.59 MPa to 9.85 MPa respectively. The correlation coefficient between compressive strength and tensile strength was found to be +0.96 and the coefficient of determination was 0.91, while between flexural strength was found to be +0.97 and the coefficient of determination was 0.90, respectively which were indications of an excellent relationship.

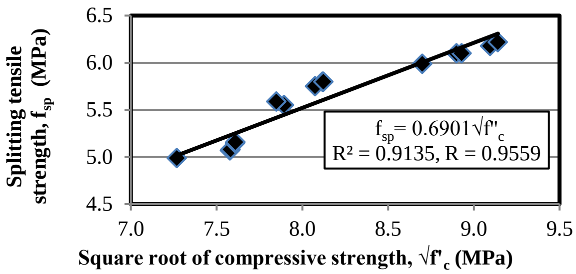

Figure 1: Correlation between compressive strength and tensile strength

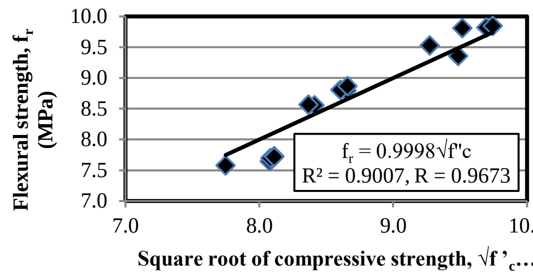

Figure 2: Correlation between compressive strength and flexural strength

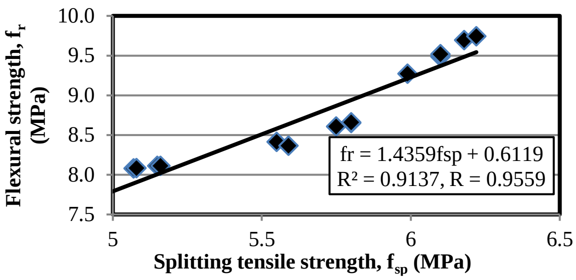

Figure 3:Correlation between tensile strength and flexural strength

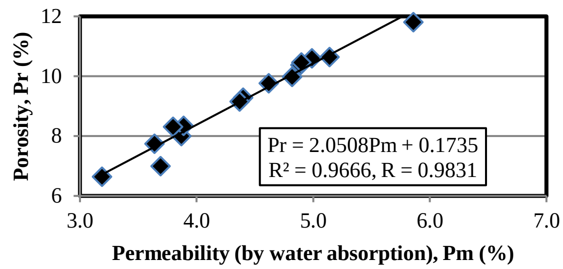

Figure 4: Correlation between porosity and permeability (by water absorption)

Correlation between permeability (by water absorption) and porosity: The permeability (Pm, as a function of water absorption) and porosity (Pr) of the respective SCHPC were strongly correlated, as highlighted in figure 4. The porosity obtained by cold water method varied from 6.64% to 12.30%and the permeability obtained by water absorption varied in the range of 3.19 to 6.10%. Such positive linear relationship was observed, due to the fact that permeability and porosity varied similarly with the W/B and the blended POFA/PBC content. Similar relationship was also reported for SCHPC containing RHA.

CONCLUSION

A very god correlation was observed between the square root of compressive strength, splitting tensile strength and flexural strength. The relationship is linear and positive which could be attributed to the similarity in the response to the variation in W/B and the blended POFA and PBC content. The compressive strength and porosity were strongly negatively correlated with a correlation coefficient of –0.87. The negative correlation was observed because compressive strength and porosity varied oppositely with the W/B and blended POFA/PBC content.

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