Chapter in Book

Fly Ash Concrete for Construction Purpose

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Abstract: *All precast concrete producers can now use a group of materials called fly ash to improve the quality and durability of their products. Fly ash improves concrete's workability, cohesiveness, finish, ultimate strength and durability as well as solves many problems experienced with concrete today and all for less cost. Fly ash, however, must be used with care. Without adequate knowledge of its use and taking proper precautions, problems can result in mixing, setting time, strength development and durability. The fly ash mix content with different percentage will be used in this study. Therefore, in order to study the strength and durability of each types of fly ash when partially mix with concrete, the bricks will be exposed to different atmospheric pressure, temperature as well as humidity. The increase of construction industry has contributed to an increase in environmental pollution as the production of building materials leads to greenhouse effect. Fly ash bricks however are environmentally friendly and hence allows many businesses to take a step towards sustainable development. Apart from that, considering the climate in Malaysia, it is suitable for us to increase the use of fly ash bricks as the building blocks on our building as it is far more light and stronger compared to clay bricks.*

Keywords: Fly Ash; Concrete; Construction; Sustainable

1. INTRODUCTION

Concrete is a composite building material largely made of gravel, cement, and water. Concrete is commonly regarded as the first extensively utilized construction material in the world. It has been widely utilized in the development of buildings, bridges, highways, dams, and a variety of other civil infrastructures over the years. Any development effort that aims to improve livability will have both good and bad consequences. The development project should be planned in such a way that it has the greatest beneficial influence on the environment and the least negative impact (Kaur M. and Arora S., 2012). Construction is likely to harm the fragile ecosystem due to its the negative impacts. This involves the impacts on resource depletion, biological diversity losses due to raw material extraction, landfill issues due to waste generation, lower worker productivity, negative human health due to poor indoor air quality, global warming, acid rain, and smog caused by emissions generated by building product manufacture and transportation that consumes energy (Lippiatt, 1999).

Over the previous two decades, Malaysia's construction industry has regularly contributed between 3% and 5% of the national Gross Domestic Product (GDP) (Construction Industry

Development Board, 2000). The construction sector also contributes to the majority of the negative environmental consequences, such as soil erosion and sedimentation, flash floods, natural resource depletion, and the use of building materials that are hazardous to human health (CIDB Malaysia, 2007). Sustainable development has emerged as one of the most important problems in the Eighth Malaysia Plan (2001–2005). One of the highlights is that the government prioritizes research and development as one of its methods for achieving sustainable development (Eight Malaysia Plan, 2001).

Nowadays, most concrete mixes include supplementary cementitious elements that contribute to the cementitious component of concrete. These are often byproducts of other processes or natural materials. They might be further processed for use in concrete or not. Some of these minerals are known as pozzolans, which have no cementitious capabilities on their own but react with Portland cement to generate cementitious compounds. According to (Bakar et al., 2010), supplementary cementitious ingredients have shown to be efficient in meeting the majority of the requirements for long-lasting concrete, and blended cements are now widely utilized across the world.

2. COMPRESSIVE STRENGTH TEST

Compressive strength is measured by breaking cylindrical concrete specimens in a machine created specifically for this purpose. Compressive strength is crucial since it is the primary criterion used to decide whether a certain concrete mixture will fulfil the requirements of a specific application. The compressive strength of concrete is computed by dividing the failure load by the cross-sectional area resisting the load and is reported in pounds per square inch (PSI) in US customary units and megapascals (MPa) in SI units.

In general, the compressive strength test specimens improved after 7 days, with the highest increase of 800% recorded in the composition of 70% cement, 15% coconut husk ash, and 15% fly ash. It demonstrates that the proportions of the combination are well matched. However, when compared to the control variables, a specimen with a composition of 70% cement, 25% coconut husk ash, and fly ash shows a 5% difference in compressive strength of positive value up to the age of 7 days. From 3 to 7 days, the compressive strength of this compound increases by 500%. As a result, the composition containing 70% cement, 25% coconut husk ash, 25% fly ash, and 5% is the best cement composition that can replace 100% cement composition. Figure 1 and Figure 2 shows the results of compressive strength test of coconut husk ash and fly ash for 3 to 7 days (Riky et al., 2016).

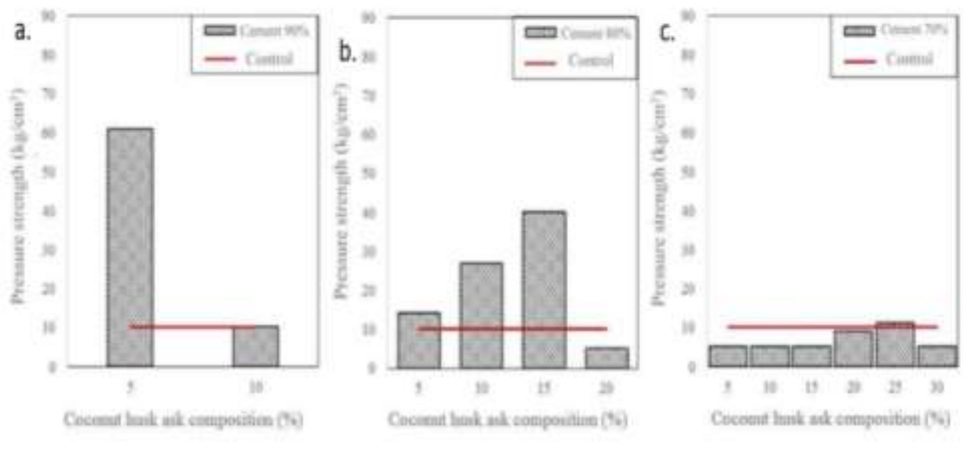

Figure 1. Comparison diagram of paste compressive strength on 3 days hydration age of various percentage of coconut husk ash compared to cement percentage a. 90% b. 80% and c. 70%

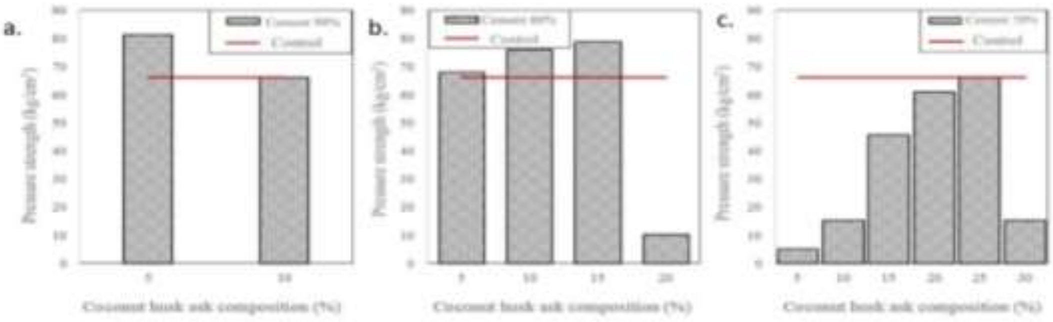

Figure 2. Comparison diagram of paste compressive strength on 7 days hydration age of various percentage of coconut husk ash compared to cement percentage a. 90% b. 80% and c. 70% (Riky et al., 2016).

3. SPLITTING TENSILE TEST

Concrete is brittle, making it weak in strain and prone to cracking. As a result, the tensile strength of concrete must be tested. A method of testing the tensile strength of concrete that involves splitting a cylinder across its vertical diameter. It is a method of determining the tensile strength of concrete that is performed in an indirect manner. A minimum of three samples should be evaluated, and an average result should be computed (Bureau Of Indian Standard, 1999). According to a study by (M. Kanta et al., 2012), on the 180th day, the greatest tensile strength is 4.9N/mm^2 with 30% fly ash substitution in cement composition, as shown in table 6 and figure 6. A splitting tensile strength test is performed on four distinct days in this scenario: the 28th, 56th, 90th, and 180th (Table 1).

Table 1. Splitting tensile strength of the FAC with mix proportions of 0.4W/B ratio

Fly ash%	$\frac{350kg}{m^3}$, and 0.4W/B ratio Splitting tensile strength ($\frac{N}{mm^2}$)			
	28 days	56 days	90 days	180 days
0	3.4	3.66	3.86	4.04
10	3.52	3.85	4.12	4.25
20	3.59	4	4.25	4.44
30	3.61	4.15	4.39	4.49
40	3.35	3.85	4.11	4.2
50	2.93	3.36	3.65	3.8
60	2.62	2.95	3.29	3.41
	$\frac{450kg}{m^3}$, and 0.4W/B ratio			
0	3.74	4.02	4.2	4.49
10	3.93	4.24	4.45	4.65
20	4.04	4.36	4.58	4.78
30	4.06	4.45	4.67	4.9
40	3.76	4.25	4.4	4.5
50	3.28	3.55	3.78	3.9
60	2.9	3.15	3.6	3.51

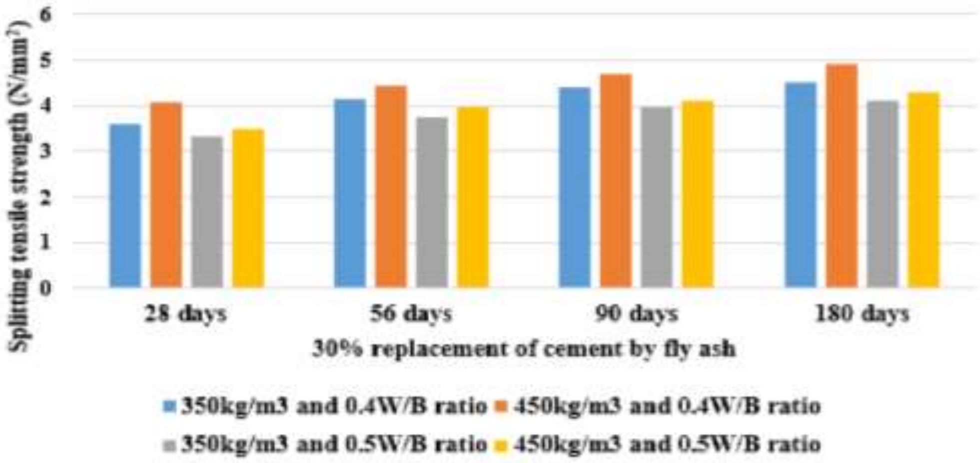

Figure 3. Graphical representation of the FAC with the mix proportions of 0.4 and 0.5W/B ratio in terms of split tensile strength

Concrete with a 30% cement substitution by fly ash is used for large section members in construction due to its hard brittle strength.The specimens with 30% cement substitution by fly ash have higher splitting tensile and compressive strength, however increasing the cementitious material and fly ash decreases the concrete strength. The concrete's shear deflection improves as well, as indicated by the results of the splitting tensile and compressive strength tests. The concrete sample produced is ecologically friendly and may be used in both low and high-rise buildings.

4. CONCLUSION

This review present a future application of fly ash in concrete application. Researchers show a promising properties of the fly ash based on the compressive strength test and splitting tensile test.

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