Sugar Cane Bagasse Ash and Coconut Shell as Aggregate Replacement

Mustaqqim Abdul Rahim[1,*], Shao-Wen Cheah[2], Afizah Ayob[1], Nor Faizah Bawadi[1], Norlia Mohamad Ibrahim[1], Shamilah Anudai@Anuar[1], Shahiron Shahidan[3]

[1]Faculty of Civil Engineering Technology, University Malaysia Perlis, 02600, Arau, Perlis, Malaysia
[2]Sepakat Setia Perunding Sdn. Bhd., Jalan SR 8/3, Taman Serdang Raya, 43300 Seri Kembangan, Selangor
[3]Faculty of Civil and Enviromental Engineering, Universiti Tun Hussein Onn, 86400, Batu Pahat,Johor, Malaysia

[*]Corresponding author's email: mustaqqim@unimap.edu.my

ABSTRACT: Sugar cane bagasse ash (SCBA) and coconut shell (CS) is one of the agricultural waste that suitable to use as cement replacement and coarse aggregates replacement. In this study 0, 5%, 7.5%, 10% of SCBA used to replace for cement and 10%, 15%, 20% of CS to replace for coarse aggregates and to obtain the optimum percentage of SCBA (partial replacement for cement) and optimum percentage of CS (partial replacement for coarse aggregates). The size of the cube samples to be casted is 100 x 100 x 100 mm and were cured for 7 and 28 days. The study shows that the optimum percentage for SCBA concrete is 5% and for CS concrete is 10% due to in this percentage of replacement, it gives the highest compressive strength value compare to other percentage at 28 days.

Keywords: *Sugar cane bagasse ash (SCBA), coconut shell (CS), cement & coarse aggregates replacement, compressive strength*

INTRODUCTION

In order to decrease the usage of cement in a concrete, partial cement replacement from other material especially from the agricultural wastage should be used. The burning of organic waste of sugar industry will produce an adequate amount of ash which known as sugar cane bagasse ash (SCBA). SCBA is freshly acknowledged as a pozzolanic material [1]. Malaysia have been produced 30271 tons of sugar cane in year 2015, 28038 tons in year 2016 and 29990 tons in year 2017. Coconut also is one of the agricultural wastes that are familiar in Malaysia.

In Malaysia, coconut have been produced 505614 tons in year 2015, 504663 tons in year 2016 and 517689 tons in year 2017 [2]. However, it also generate serious waste disposal problems to the green environment due to it will lead to the increasing of landfills to cover all the non-biodegradable wastes as well as a threat to the environment where the toxic gases will release from landfills and harm to human health. Because of the coconut shell can produce acceptable strength which is the strength required for structural concrete and also its lightweight properties, it can be reused to replace either for coarse aggregates or fine aggregates in concrete production.

METHODOLOGY

The materials that used in this research were cement, coarse aggregates, fine aggregates, water, sugar cane bagasse ash (SCBA), coconut shell (CS). Cement, aggregates and water are the main material to produce the concrete meanwhile SCBA and CS is used as replacements.

The sugar cane bagasse need to put under the dry and grind by using mechanical grinder before burnt in a furnace for 2 hours with temperature of 800°C [3]. SCBA was obtained after passing through 45 µm sieve size [4]. Coconut shells washed to remove fibers and mud before were dried and finally grinded to obtain size that can passes through a 20 mm sieve and retained on 4.75 mm [4].

Figure 1 SCBA

Figure 2 Coconut Shell

Cube specimen of dimension 100 x 100 x 100 mm will be cast. The cement mortar was prepared with ratio 1:1.5:3 and water cement ratio 0.5. Table 1 show the mixes in this experiment.

Table 1 Concrete Samples

Sample	Condition
Control	0% CS & 0% SBCA
SCBA Replacement	5%, 7.5 % & 10%
CS Replacement	10%, 15%, 20%

RESULTS AND DISCUSSION

For each type of concrete cubes, 3 cubes are to be tested for 7 and 28 days curing ages to get the average of the compressive strength which is used to ensure the accuracy of the results. The compressive strength result SCBA concrete and CS concrete were showed below.

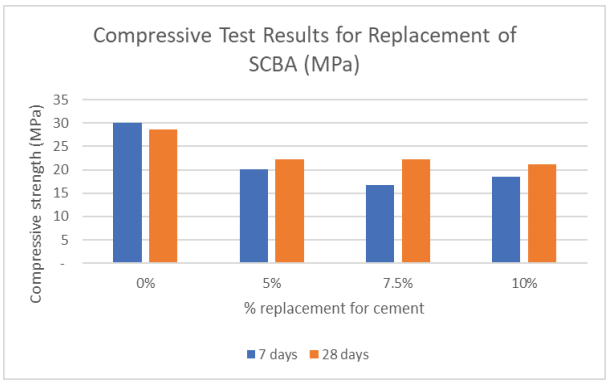

Figure 3 Compressive Strength of SCBA

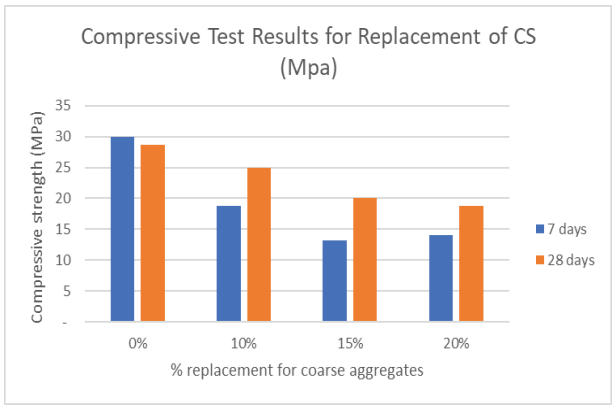

Figure 4 Compressive Strength of CS

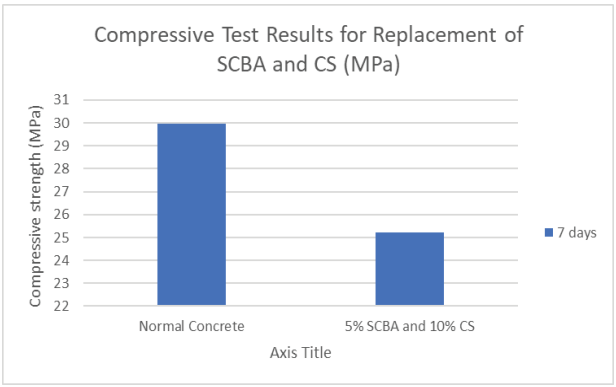

Figure 5 Compressive Strength of SBCA and CS

From figure 3, it shows that the optimum percentage replacement of SCBA is 5% due to the compressive strength in 5% is the highest compare to 7.5% and 10% of replacement. Hence for the combination of the SCBA and CS concrete cubes, the optimum percentages of SCBA replacement for cement is 5%. From figure 4, it shows that the optimum percentage replacement of CS is 10% due to the compressive strength in 10% is the highest compare to 15% and 20% of replacement. Hence for the combination of the SCBA and CS concrete cubes, the optimum percentages of CS replacement for cement is 10%. The compressive strength result for combination replacement concrete as shown in Figure 5 is higher than previous sample which is SCBA concrete cube and CS concrete cube because of the binder properties of SCBA works well in CS compare ordinary coarse aggregates. It makes a good effect to bind the raw material together and produce a high compressive strength concrete.

CONCLUSSION

i. The compressive strength of SCBA concrete is decreasing when the percentage of replacement increasing under 28 days of curing ages. It achieve a maximum compressive strength which is 22.246 MPa when it is having a 5% of replacement. It is because the SCBA didn't provide a higher pozzolanic activity rate compare to cement which make the role as a binder cannot be fully functioning and result in a lower compressive strength.

ii. The compressive strength of CS concrete is decreasing when the percentage of replacement increasing under 28 days of curing ages. It achieve a maximum compressive strength which is 24.972 MPa when it is replaced by 10% of CS for coarse aggregates. It is because of CS have a higher amount of voids and porosity inside the concrete cube compare to normal concrete cube and result in lower compressive strength.

iii. The combination replacement of concrete is 5% of SCBA replace for cement and 10% of CS replace for coarse aggregates. This combination replacement of concrete provide a lower workability compare to normal concrete due to CS have the ability with high water absorbing and moisture retaining capacity which will decrease the workability of the concrete.

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