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Behaviors of Concrete with Recycled Clay Brick as Fine Aggregate

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1 Introduction

Vast amounts of waste materials are produced by the construction and demolition industry every year. The volume of these materials has reached an unacceptable level from an environmental, economic and social point of view (Vieira *et al*., 2016). In residential construction, clay bricks are dominant materials, which account for a large proportion of C&DW (Formoso *et al*., 2002). Using crushed bricks in concrete is an effective way to preserve natural aggregate and to reduce construction and demolition waste. This paper investigateed the mechanical properties and durability of concrete with recycled clay brick as fine aggregate.

2 Experimental Program

The grading of recycled clay brick aggregate was controlled as the requirements of Chinese National Standard GB/T 25176-2010. The mixture proportions of reference concrete are shown in Table 1. The recycled clay brick was introduced as volume percentage of the concrete fine aggregate, four levels of replacement, 25%, 50%, 75% and 100%, were investigated. The recycled clay brick aggregate was added to mixtures in a saturated surface dry condition.

The compressive strength, flexural strength and permeability of concrete to chlorides were tested at 28d age. The carbonation depth was determined at the start of exposure to CO_2 with concentration of 20% and after 3, 7, 14 and 21 days.

Table 1. Mixture proportions of reference concrete (kg/m^3).

W/C	Water	Cement	Sand	Gravel	Super plasticizer
0.35	175	500	629	1106	4.5
0.47	175	372	702	1151	4.5

3 Test Results and Discussion

3.1 Mechanical Properties

Table 2 demonstrates the compressive strength and the flexural strength obtained from the concrete samples with different replacement of recycled clay bricks. Each data represents the average of three samples. It was observed that with increasing of recycled clay brick content, both the compressive strength and the flexural strength decreased.

Table 2. Mechanical properties of concrete (28d).

W/C	0.35					0.47				
Replacement percentage (%)	0	25	50	75	100	0	25	50	75	100
Compressive strength (MPa)	51.8	42.3	41.5	35.2	32.3	48.3	33.2	31.2	26.8	24.3
Flexural strength (MPa)	6	4.8	4.1	3.8	3.6	4.5	4.1	3.7	3.4	3.1

3.2 Permeability

The results of concrete permeability to chlorides is described in Figure 1. It can be found that with the increasing of the recycled clay brick content, the permeability decreased.

3.3 Carbonation Resistance

The carbonation depth also increased with the increasing of the test age and the replacement level of recycled clay brick, as shown in Figure2.

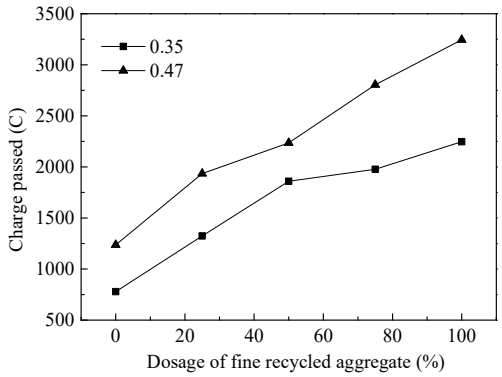

Figure 1. Permeability of concrete with fine recycled aggregate.

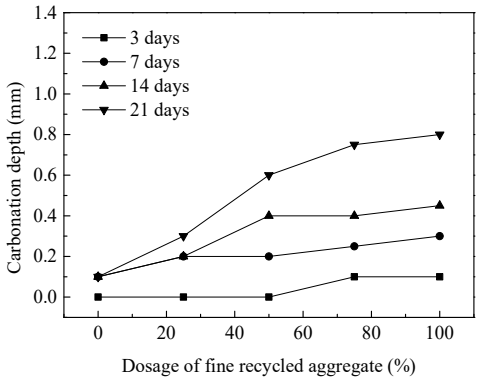

Figure 2. Carbonation depth of concrete with fine recycled aggregate (W/C=0.35).

4 Conclusions

- Both the compressive strength and the flexural strength decreased with the increasing of the replacement percent of recycled clay brick.
- The impermeability of concrete decreased with the increasing of the replacement percent of recycled clay brick. But the permeability of concrete with *W/C* 0f 0.35 was still kept at “Low” level when the replacement percent was less than or equal to 75%.
- The carbonation resistance of concrete with recycled clay bricks was degraded.

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