Reuse of Recycled Concrete Fines for the Production of High Performance Fiber-reinforced Concrete

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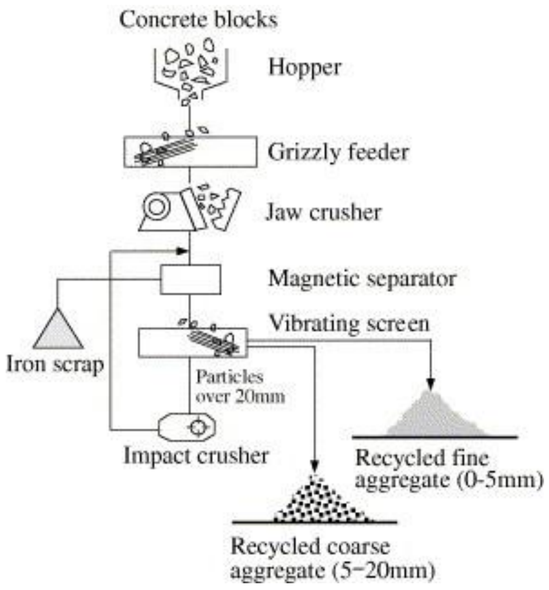
Recycled concrete fines (RCF) are fine aggregates and particles from the demolition waste of old concrete. Unlike recycled coarse aggregates, RCF is seldom used to replace the sand in concrete due to its high surface area and attached old mortar on the surface of RCF. This research reports on a study of the replacement of the sand by RCF in the production of High performance fiber-reinforced concrete (HPFRC).

1. Background

The reuse of construction and demolition waste not only reduces the environmental burden by minimizing landfill, but also preserves the finite raw materials. Recycled concrete aggregate is available currently in large quantities, which results from the demolition of old concrete structures. Coupled with shortage of non-reactive natural aggregate, it is a real and urgent need to reuse the waste aggregate.

Generally, it is believed that fine fraction of recycled concrete aggregate, known as recycled concrete fines (RCF), has limited application because of its larger water absorption which can jeopardize the concrete properties. This is attributed to the high surface area, and old mortar attached to the particles, which also prevents the proper bonding between the matrix and aggregate.



Production of Recycled Concrete aggregate

- *Landfill capacity*
- *Land shortage*

- *Recycle*
- *Reuse*

Zero waste!!!

2. New application–High performance fiber-reinforced concrete

High performance fiber-reinforced concrete (HPFRC) known as ductile material is characterized by their ability to sustain higher levels of loading after first cracking while undergoing large deformation due to distributed micro-cracking, which is called strain-hardening behavior as shown in ***Figure 1***. Generally, HPFRC exhibits tensile strain hardening behavior with strain capacity in the range of 3%-5%, hundreds times with that of concrete.

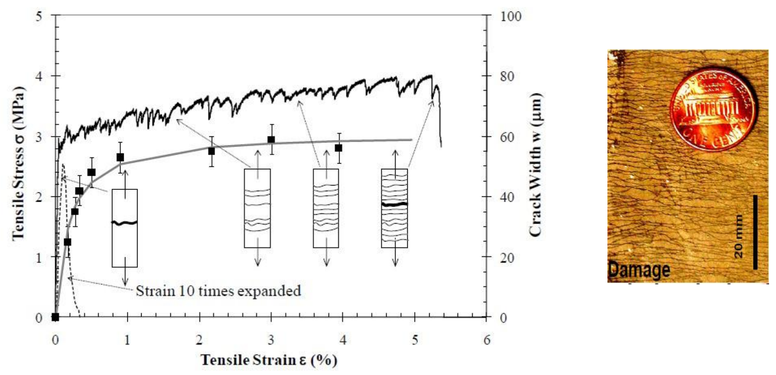


Figure 1. Strain hardening behavior and distributed micro-cracking of HPFRC

3. Methodologies and current findings

Scanning electron microscope (SEM) was used for the microstructure analysis of RCF. Evaluation of surfaces provided morphological and bonding information related to the composite mechanical properties as shown in ***Figure 2***. To evaluate composite performance, compressive test and flexural test were performed. The results are shown in ***Table 1*** and ***Figure 3***.

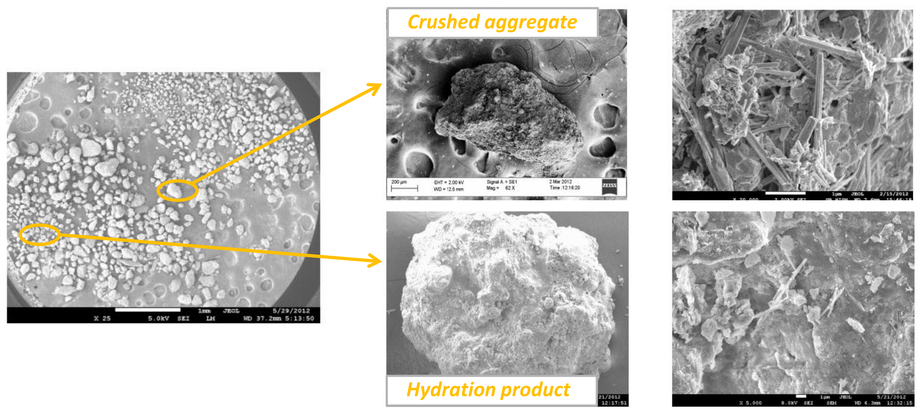
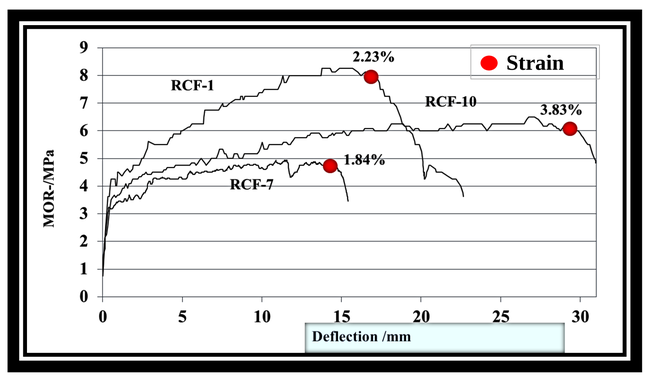


Figure 2. SEM micrograph of Recycled Concrete Fines

Table 1. Mix proportion and mechanical properties

RCF size	Mix	Cement	Water	RCF	σ_c /MPa	MOR /MPa	Strain capacity (%)
0~600 μm	RCF-1	0	0.35	0	52.8	8.3	2.23
	RCF-7	0.8	0.35	0.8	24.6	4.8	1.84
0~300 μm	RCF-10	0.8	0.35	0.8	28	6.3	3.83



- *Good strain capacity*
- *High ductility*

Figure 3. MOR-deflection of RCF-ECC

An experimental program indicates that it is viable to produce ECC made with RCF. RCF-ECC can exhibit strain hardening behavior with high RCF content. Moreover, the scanning electron microscope (SEM) study of RCF particles provides information from a view of microstructure, which can give some guidance for use of RCF in other applications.