Available online at www.sciencedirect.com
ScienceDirect
Cement & Concrete Composites 29 (2007) 337–338
Cement & Concrete Composites
www.elsevier.com/locate/cemconcomp

Discussion

A discussion of the paper "Physico-mechanical properties of aerated cement composites containing shredded rubber waste" by A. Benazzouk, O. Douzane, K. Mezreb and M. Quéneudec

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Received 26 July 2006; received in revised form 20 November 2006; accepted 20 November 2006
Available online 4 January 2007

Abstract

This discussion focuses on the composite behavior, utilization of waste rubber and examination of the test results. In experimental studies, six cement–rubber composite (CRC) and six aerated cement–rubber composite (ACRC) specimen were prepared, respectively to investigate the physico-mechanical properties of cement–rubber composites.

Keywords: Rubber wastes; Cement based composite; Physico-mechanical properties; Workability

The paper reported the effect of rubber waste on cement based concrete composites produced with proteinic air-entraining agent. The authors made an interesting study but some points should be clarified by the authors. This discussion focuses on the composite behavior, utilization of waste rubber and examination of the test results. In experimental studies, six cement–rubber composite (CRC) and six aerated cement–rubber composite (ACRC) specimen were prepared, respectively to investigate the physico-mechanical properties of cement–rubber composites. The mechanical behavior of cement–rubber composites is determined, in part, by the properties of its constituent phases: cement paste as the binding phase and rubber aggregates as inclusions. These phases show different behavior in the composite material. However, authors made a comparison of physico-mechanical properties of the CRC and ACRC with reference cement paste specimen which is a one phase material containing only cement matrix. Reference specimens are composed of cement matrix thus, they cannot be considered as composite materials. Consequently, the comparison of two phase composite materials (CRC and ACRC) with reference specimen containing only cement phase is not appropriate. Furthermore, the authors should produce two phase composite mortar samples by using standard RILEM sand in order to compare physico-mechanical properties of the CRC and ACRC with the ordinary cement based composite materials. Therefore, the authors can compare the CRC and ACRC properties with the reference mortar properties and provide sufficient data for the objective of their study. The previous comparison does not provide a reliable approach.

Rubber aggregates used in specimens act as a partial replacement of the cement. However, waste rubber is not a cementitious material. Basing the investigations merely on the rubber content is a handicap when determining and comparing the physico-mechanical properties of CRC and ACRC. The cement based composite properties such as compressive strength; durability and hydration are strongly associated with the water-to-cement ratio and the size distribution of the cement particle [1]. Amount of hydration products have influence on physico-mechanical properties of cement based composites. Calcium silicate hydrates (C–S–H) are the main binding phases in all

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doi:10.1016/j.cemconcomp.2006.11.006

Table 1
Physico-mechanical properties of cement–rubber composite (CRC) specimens [7]

Volume ratio of rubber particles (%)	w/c	Air-entrainment (%)	Fresh unit weight (kg/m^3)	Hardened dry unit weight (kg/m^3)	Compressive strength (MPa)	Flexural strength (MPa)	Elasticity dynamic modulus (GPa)
0	0.30	2.0	2010	1910	82	3.4	25
10	0.32	5.0	1917	1752	49.7	3.8	18.5
20	0.35	8.7	1834	1649	40.2	4.2	15.3
30	0.39	11.8	1772	1473	23.3	4.0	12.0
40	0.44	14.0	1706	1297	16.0	3.8	9.5
50	0.52	17.0	1600	1150	10.5	3.2	6.2

Portland cement-based systems; their exact nature is central to the science of cement and concrete [2]. Waste rubber in CRC and ACRC mixtures should be replaced with another aggregate as a percentage which used in reference specimen. Various authors [3–6] used water-to-cement and sand-to-cement ratios constant because, mix proportions of CRC which are given in Table 1 [7] shows that cement content is reduced depending on replacement with waste rubber as aggregate.

Furthermore, w/c ratio is increased due to the constant workability of the fresh mixture. Consequently, the variation of the physico-mechanical properties of CRC and ACRC is not merely dependent on the rubber content ratio or air entrainment in the cement based composite mixture. In our opinion, rubber effect on physico-mechanical properties of CRC and ACRC as mentioned title should be determined with constant cement dosage and w/c ratio. Thus variable parameters should eliminate and physico-mechanical properties are dependent only with rubber ratio in the mixture.

At last workability of CRC and ACRC is determined with slump test according to EN 12350-2. This standard is for determination of the workability of fresh concrete. However, the experimental studies are performed with two phase mortar specimens. There is no coarse aggregate in the CRC and ACRC mixtures. Therefore, consistency of specimens should be determined with flow table test according to ASTM C-230 or EN 1015 [8,9]. This method should be more practicable for examining the water requirement and consistency of CRC and ACRC mixtures.

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