proceedings

MDPI

Abstract

Physical Characterization of Dutch Fine Recycled Concrete Aggregates: A Comparative Study †

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† Presented at the 1st International Conference on Smart Materials for Sustainable Construction—SMASCO 2019, Luleå, Sweden, 10–12 December 2019.

Published: 18 November 2019

Abstract: In the Netherlands, yearly 20 Mt Construction- and Demolition waste (CDW) is being produced mainly consisting of concrete and masonry rubble. This is two third of the yearly production of concrete (33 Mt). Currently, less than 1 Mt/year of the 20 Mt/year CDW is recycled in new concrete (mainly as coarse recycled concrete aggregates). This preliminary study being part of a larger study, is aiming to increase that amount, amongst others by focusing on use of the fine recycled concrete aggregates. Fine recycled concrete aggregates (fRCA) appear promising for (partial) replacement of natural fine aggregates (sand) and cement in new concrete. Nevertheless, they can be expected to have adverse properties and components that may reduce the performance of the concrete. Their physical, chemical and mechanical properties, which thus may significantly differ from that of natural sand, are still far from being fully investigated. The present paper focusses on characterization of physical properties of fRCA for finding the most critical indicators for fRCA quality. The tests include particle size distribution, morphology, BET surface area, solid density and water absorption of individual and total fractions (0–0.25 mm, 0.25–4 mm and 0–4 mm). The tests are performed on three fRCAs with different origin. Natural river sand with 96 wt.% of SiO_2 was also studied to provide a baseline for comparison. Experimental results showed that, on the one side, the particle size distribution, surface area and amounts of individual fractions of fRCAs are significantly different from that of natural sand and that there is a large difference between each other. This is caused by variations of the parent concrete properties and by the type of recycling technique and processes (one step or multiple steps crushing). On the other side, fRCAs have comparative solid densities, which were still lower than that of natural sand. It was also shown that difference in water absorption between fractions 0.25–4 mm and 0–4 mm is very small in all three fRCAs groups. The results of this study will be used for future correlations between investigated properties of fRCAs with properties of concretes with fRCAs. This will be investigated in the next stage of the project, such that these correlations can enable production of durable concretes with fRCAs and assist recyclers in optimization of their production processes based on quality control of fRCAs.

Keywords: construction- and demolition waste; concrete recycling; sustainable construction; fine recycled concrete aggregates; BET surface area