CO2 fixation by recycled aggregates (C&DW)

Summary

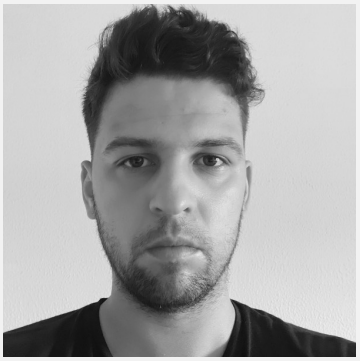
In the first year of the PhD, bibliographic research was carried out, which allowed the definition of the ideal parameters for forced and accelerated carbonation of the recycled aggregates. In the first experimental carbonation campaign, the conditions were as follows: 60% relative humidity and 23°C temperature, with a CO_2 concentration in the chamber of 25%. For a better understanding of the carbonation of C&DW, several reference samples were studied, such as red ceramic, cement mortar, lime mortar, virgin concrete and pure calcium hydroxide and calcium carbonate. With the carbonation of these samples, it was possible to identify which compounds were present that could be carbonated, namely portlandite and some cementitious compounds (CSH, CAH and AFt). The study of the pure samples was carried out with the aim, in the case of calcium carbonate, to verify if during the carbonation process there would be any chemical reaction that would promote its decomposition, having proven that this did not happen. With the carbonation of calcium hydroxide, it was verified that the experimental conditions were sufficient for the carbonation reaction to occur, leading to the formation of calcium carbonate.

Afterwards, it took place the study of mixed recycled aggregates (MRA) carbonation with the objective of determining the carbonation potential and respective CO_2 fixation rate in each aggregate. The study was divided into several stages: First, a pre-carbonation analysis (TGA and XRD) of the mixed aggregates and their respective cement fraction (Rc) to determine their carbonation potential. It was found that the mixed recycled aggregates (MRA) present none or low-content portlandite. However, it was verified that they had carbonation potential due to the presence of other cementitious compounds (CSH, CAH and AFt). Previously, the carbonation period selected was seven and nine days, designated by long carbonation periods. The study revealed that after seven days the samples were already carbonated (due to the absence of compounds capable of carbonating) and that from seven to nine days there was no great variation. It was concluded that seven days of carbonation is an excessive period and the chamber carbonation time was changed to short periods (1h, 2h, 3h, 5h, 8h, 24h, 48h and 72h), giving rise to a new experimental short-term carbonation campaign. From the results, it was observed that 5 hours would be an ideal period of carbonation for MRA, as it was verified by TGA a higher release of CO_2 (due to decarbonation). Due to the low carbonation potential identified in the MRA, it was decided to study another type of aggregate with greater potential for CO_2 capture. Thus, another campaign was started with the purpose of studying the carbonation of recycled concrete aggregates (RCA). The RCA carbonation campaign was carried out in short periods. As expected, the results showed in the pre-carbonation analysis have higher carbonation potential than the MRA. Using the same conditions as previous campaigns, with these results It was possible to identify the ideal carbonation period for each aggregate studied and their respective amount (%) of CO_2 captured. The study of alternative solutions has already started to increase the carbonation potential of CDW, through the addition of residual water rich in calcium (wastewater) from the washing of concrete mixer trucks, and the impregnation of amines in the C&DW.

Keywords

Carbonation, C&DW, MRA, RCA, TGA.

Carbonation chamber TEST/TESCAL CT-TT 300 ECP 20.



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