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Improvement of concrete performance through treatment of coarse recycled concrete aggregates with acid solutions and addition of aluminium sulphate

Summary

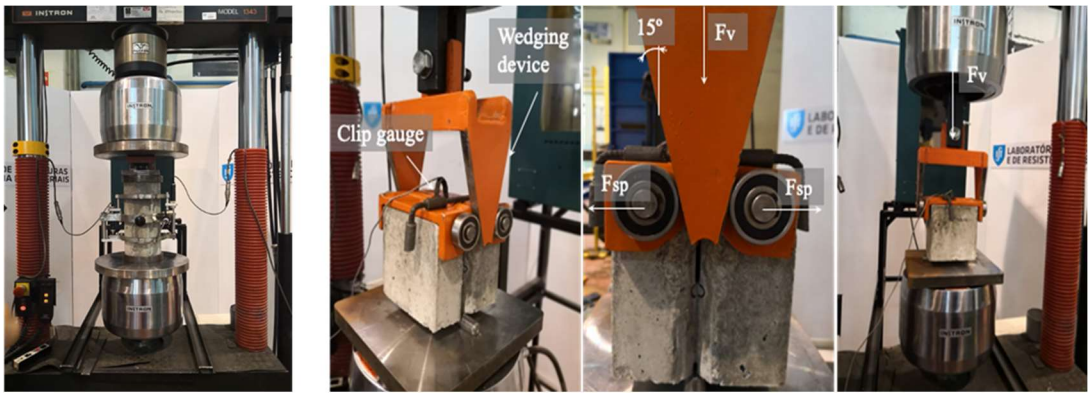
The heterogeneity of Recycled Concrete Aggregate (RCA) originates mainly from the sources from which it is generated. For this reason, there are several techniques in the literature that help improve the performance of aggregates to achieve similarity with natural aggregate (NA). Although in previous studies there are several authors who report this technique for removing the adhered mortar from NA using acid solutions, there is still no consensus on the appropriate immersion time and acid concentration for improving RCA. A two-phase experimental campaign was conducted in this investigation.

The first phase focused on identifying the optimal concentration in terms of molarity (M) and immersion time using hydrochloric acid (HCl) and sulphuric acid (H_2SO_4), as well as conducting an analysis of their physical properties. The second phase focused on producing concrete mixes with RCA treated with acid solutions of HCl and H_2SO_4, and mixes incorporating RCA and aluminium sulphate (AS). Both compositions were evaluated in terms of their mechanical properties, fracture, and durability. After analysing the macro effects, a microstructure analysis of the interfacial transition zone (ITZ) between the treated RCA and the cementitious matrix was carried out to observe and describe the improvement of the ITZ. In the first phase, it was concluded that concentrations between 1 M and 3 M of HCl and H_2SO_4 do not significantly improve mortar removal. Similarly, the immersion time does not have a considerable influence on mortar removal from RCA.

Regarding the second phase, the results of mechanical behaviour, durability, and fracture demonstrated improvements in mixes incorporating RCA treated with acid solutions at concentrations up to 1 M and the addition of AS compared to untreated reference mixes with RCA. However, it was also concluded that the use of high molarities (3 M) of H_2SO_4 tends to be negative in terms of mechanical durability and fracture properties relative to reference mixes with non-treated RCA. As a result, all these findings have led to a more nuanced understanding of the appropriate use of these techniques in concretes employing such aggregates.

Keywords

Pre-treatment methods (HCl, H_2SO_4), Recycled Concrete Aggregate (RCA), fracture properties, mechanical properties, durability, concrete.



Mechanical tests on concrete (Modulus of elasticity and fracture energy).

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Period
2019-2023

Funding
FCT scholarship