EVOLUTION OF LONG-TERM STRENGTH AND SHRINKAGE STRAIN IN SEAWATER-MIXED CEMENTITIOUS SYSTEMS

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The use of potable or fresh water (FW) in the production of raw materials and the mixing of concrete can increase the water stress in regions facing water scarcity [1] The inclusion of supplementary cementitious materials (SCMs) and alternative reinforcements in concrete can facilitate the use of non-potable waters in concrete production [2]. Seawater and sea sand (SW-SS) concretes have been extensively researched in recent times to understand the fundamental mechanisms of hydration and the strength development of the same [3]. However, limited information is available on the long-term strength and shrinkage strain development of SW-SS concretes produced with SCMs. Current work focuses on evaluating the compressive strength and total unrestrained shrinkage strain in seawater-mixed (SW) cementitious systems.

A total of 20 mixes (10 FW and 10 SW-mixed) of concrete were produced with binary and ternary-blended binder compositions using fly ash, slag, and metakaolin as SCMs, along with CEM I 42.5 R. Concrete cubes of size 100 mm were produced and cured in under-water immersion for a period of 28 days. The compressive strength of the concrete was measured at 7, 28, and 90 days according to EN 12390 – Part I. Similarly, mortar prisms of dimension 40×40×160 mm were produced using the above-mentioned compositions, and the unrestrained shrinkage of these specimens was measured using the Grauf-Kaufmann method. The shrinkage values were measured for up to 90 days to assess the variations in shrinkage strain between FW and SW-mixed mortars.

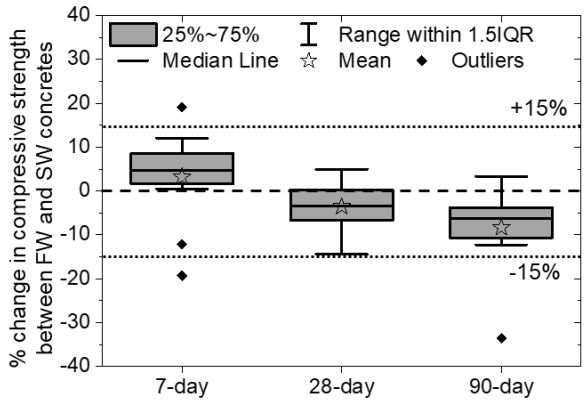

Fig. 1: Evolution of percentage change in compressive strength between FW and SW-mixed concretes over time

Fig 1 shows the evolution of percentage change in strength between FW and SW concretes. Up to 28 days there is no significant reduction in compressive strength compared to the 90th day strength. Even at 90 days the box plot values indicate that the median value of reduction in strength of concretes was lesser than 15%.

Fig 2 shows the total shrinkage strain between FW and SW-mixed mortars at 90 days. In general, a significant increase in the total unrestrained shrinkage strain of SW-mixed mortars is observed. MF30 mix, a binary combination of fly ash added mix showed a significantly higher shrinkage strains compared to other mixes.

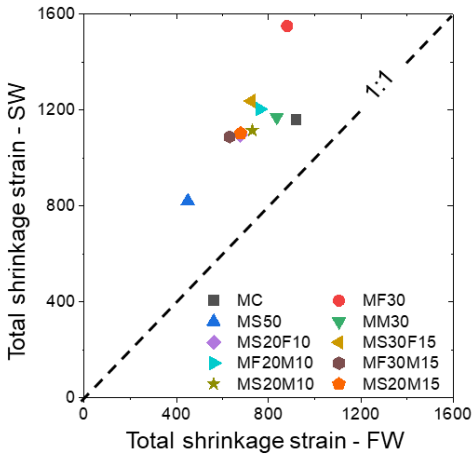

Fig. 2: Influence of SW-mixing on unrestrained total shrinkage of cementitious systems

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