Optimum characteristics of plastic fibres for sustainable self-compacting concrete SCC

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The main aim of this research is to optimize various characteristics of Polyethylene terephthalate PET fibres in a sustainable self-compacting concrete in terms of volume fraction Vf, aspect ratio Ar and method of surface treatment. In the first stage, the performance of fibre-reinforced self-compacting concrete was analysed in terms of main fresh and hardened properties. Nine different SCC mixtures were designed using three different ratios of Vf and Ar. The fresh tests were evaluated through the examination of the slump flow and T500 while the hardened tests include compressive and splitting tensile strength test. The optimal mixture was selected based on a statistical program (Minitab19) for the next stage. The optimized mix in stage two is selected to be a control mix in addition to other two mixtures with PET fibres treated chemically (NaOH solution), and mechanically (surface roughness). The fresh tests in this stage include slump flow, T500mm, L-box, sieve segregation whereas the hardened tests include compressive, splitting tensile, flexural, impact strength, porosity, and water absorption. The multi-objective optimization results from first stage indicated that the optimum Vf and Ar for PET fibres, to achieve the optimum performance in terms of the tested properties and the partitioning of sustainability aspects, were 0.7% and 24.4 respectively. The results of the two modifications used for PET fibres reduced the fresh properties slightly (flow, L-box, T500, sieve segregation) yet they were within the specification limits for SCC. However, the mechanical and related durability properties (strength, tensile, flexural, impact, less porosity, less absorption) were increased

considerably. It can be deduced that treatment of PET fibres by increasing the roughness surface with the optimum characteristics of PET fibres from stage one, in terms Vf and Ar, can give the best performance.