Mechanical Properties of High Strength SCC Made with Hybrid Steel Fibers from Discarded Bead Wires

Mezaal, Abdulrahman Mohammed, Najim, Khalid Battal, Noaman, Ahmed Tareq

The tire manufacturing sector occupies a significant portion of the global economy. The production of vehicle tires requires the utilization of different raw and processed materials. Steel beads are one of these main ingredients, used to reinforce the treads and sidewalls of car tires. In this study, the effect of incorporating steel fibers cut from discarded bead wire (DBW) during the tire manufacturing process on the rheological, mechanical, and flexural toughness of high-strength self-compacting concrete (SCC) was investigated. Four SCC mixes were prepared with four discarded bead wires, at volume fractions of 0%, 0.3%, 0.6%, and 1%. Four lengths of the discarded bead wires were used in the term of hybridization: 10, 20, 30, and 35 mm. These were mixed together, with each length comprising 25% of the total. Investigations of fresh and hardened concrete properties were carried out. The results showed that DBW affected the rheological properties of high-strength SCC adversely, where a slight reduction in slump flow was found with 3.94%, the required time to pass the V-funnel was increased by 31%, the blocking ratio of L-box test also was found to be increased with 15%, as well as the segregation index decreased by 28% by the addition of 1% of DBW. On the other hand, compressive and splitting tensile strength were found to be enhanced due to effect of DBW. Moreover, investigations of flexural toughness were conducted. Overall, the presence of different lengths of the DBW helped to transfer the load from the cementitious matrix to the short fibers, and then to the long ones, leading to the enhanced energy absorption capacity of high-strength SCC.