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Enhancing mechanical properties of concrete by utilizing lathe waste generated from Sri Lankan lathe industries

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In this modern industrial era, waste is considered as a valuable resource due to the economic benefits achieved through proper utilization. Effective waste utilization is an attractive way to reduce environmental pollution and ensure resource conservation. Lathe waste is an unavoidable waste generated during lathe operations in industries. This creates a significant environmental problem since the limited biodegradability of the fibre. Disposal of this waste in barren land causes ground water contamination creating an unhealthy environment. Fibre-Reinforced Concrete (FRC) is a well-known composite material comprising of cement, sand, coarse aggregate, water & uniformly distributed short discrete fibres. It offers excellent mechanical properties than plain concrete and many other construction materials of similar cost. In common practice, steel fibres, glass fibres, synthetic fibres, and natural fibres are used in FRC to enhance the structural integrity of the concrete. The primary goals of this research work are to examine the potential of incorporation waste lathe scrap replacing the steel fibre used in FRC and determine the improvements of mechanical properties of concrete. M25 concrete grade was selected for this investigation and lathe waste scrap fibre was added up to 2% by weight, at a gap of 0.5% (i.e. 0%, 0.5%, 1%, 1.5%, 2%). The lathe waste collected from the mechanical workshop of Faculty of Technology, University of Ruhuna, and manually cut into smaller pieces ranges in thickness from 0.45 to 1 mm and in length from 15 mm to 50 mm. For each mix, 150 x 150 x 150 mm cubes were cast for the compression strength test and 100 mm x 100 mm x 400 mm beams were cast for the flexural strength test. After casting, the specimen was left for 24 hours. The specimens were then de-molded and kept in a curing tank for 28 days. An analytical comparison was conducted between the compressive strength and flexural strength of plain concrete and lathe waste fibre reinforced concrete specimens. All the tests were carried out in triplets and average values were taken for the analysis. The 1% lathe waste fibre volume fraction reinforcement achieved the highest compressive strength of 52.5% N/mm^2, which was 51% higher than the control sample (34.8 N/mm^2). It was observed that further increase in fibre content beyond 1% substantially declines the compressive strength. The same behavior was observed in the flexural strength that recorded the highest value of 3.05 N/mm^2 at 1% lathe waste content and beyond that flexural strength got reduced. These declines may be since higher fibre content may result in congestion of fibres, thus causing balling effect and inadequate bonding with concrete. According to the results, the optimum volume fraction of fibres was determined to be 1%, at which the maximum properties were achieved. In conclusion, the utilization of waste lathe steel scrap fibres in minor quantities in concrete is an effective and innovative way to enhance the mechanical properties of the concrete and reduce the cost. Further, it is a successful substitute material for factory-made steel fibres while providing a sustainable solution for lathe waste management.

Keywords: Lathe waste fibre, Compressive strength, Flexural strength, Waste management, Fibre reinforced concrete