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# Engineering properties of concrete with partial utilization of used foundry sand

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ABSTRACT

Solid wastes generated from manufacturing industries are increasing at an alarming rate and it is consistently increasing. One such industrial solid waste is Used Foundry Sand (UFS). On the other hand, fine aggregates involved in the concrete are generally river sand, which is scarce, high cost and excavation of the river sand that promote environmental degradation. So, there is an urge to find some alternative solution to dispose UFS and to limit the use of river sand. In this research work, river sand was partially replaced by UFS. The percentage replacements were 0, 5, 10, 15, 20 and 25 wt% respectively. Experimental investigations were carried out to evaluate the mechanical, durability and microstructural properties of M20 concrete at the age of 7, 28 and 91 day. XRD (X-ray Diffraction), EDX (Energy Dispersive X-ray) and optical-microscopic imaging analysis were performed to identify the presence of various compounds and micro cracks in the concrete with UFS. Comparative studies on control mix against trial mix were carried out. It was found that compression strength, flexural strength and modulus of elasticity were approximately constant up to 20 wt% UFS and decreased with further addition. Whereas, split tensile strength was increased after 20 wt% addition but it affects the other properties of concrete. The durability test results showed that the resistance of concrete against abrasion and rapid chloride permeability of the concrete mixture containing UFS up to 20 wt% were almost similar to the values of control mix. The findings suggest that UFS can effectively replace river sand. However, it is recommended that the replacement should not exceed 20 wt%.



## 1. Introduction

The use of concrete in the development of architecture and constructions is an integral part of modern human civilization. The key constituents of modern concrete are cement, river sand and aggregate which play significant roles in mix design. Since the consumption of river sand is high in the rapid infrastructure growth, the demand for the same is also very high in developing countries. Replacing river sand, either partially or fully, is being investigated as an approach to tackle this problem. Replacement of this component is a key challenge to address the negative effect of this substitution, which is mainly related to strength development in concrete (Neramitkornburi et al., 2015). Waste materials like recycled demolition materials, slag, foamed recycled glass, calcium carbide residue, UFS, fly ash, etc. are already being used as supplementary cementitious materials and have been studied in recent decades (Arulrajah et al., 2015; Phetchuay et al., 2014; Rahman et al., 2015). Among these materials, the use of UFS has not been researched considerably and it still remains an unexplored area in terms of its use as a supplement for river sand (Arulrajah et al., 2017). Therefore, studies on the potential use of these replacements are ultimately important.

UFS from ferrous and non-ferrous metal casting industries are mostly discarded as land filling material or dumped in open baron lands (Saraswati et al., 2013; Md et al., 2013; Amritkar et al., 2015). In contrast several countries have facing the problem in the supply of river sand to meet the increasing construction requirements (Bahoria et al., 2013; Prabhu et al., 2015). UFS creates nuisance to the public by the means of air and water pollution. Because of increased urbanization, scarcity of lands for disposal, stringent government rules and regulations, awareness of the public,

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