

Eco-concrete for sustainability: utilizing aluminium dross and iron slag as partial replacement materials

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Abstract Emphasis on utilizing the industrial waste/discarded materials can be brought about by discovering innovative methods of disposal. One such a way of waste disposal can be through utilizing them in concrete production as a filler material or pozzolana. In this regard, the present study proposes to use the aluminium dross and granular iron slag as partial replacement materials for cement and natural sand, respectively, to develop eco-concrete. Nine mixes were produced with different proportions of cement, aluminium dross, sand and granular iron slag content. The aluminium dross was replaced at 5, 10, 15 and 20% of the weight of the cement. Initially, the optimal substitution percentage of aluminium dross was found without the substitution of iron slag based on the strength results. Later, by adopting the optimal aluminium dross percentage with cement, the granular iron slag was partially substituted at 10, 20, 30 and 40% of natural sand to find the overall optimal blend. The strength and durability properties of the M40 grade concrete employing

these two admixture combinations were analysed. It was noticed that the strength and durability properties of the eco-concrete produced by incorporating aluminium dross –5% and iron slag –20% were comparable to that of conventional concrete. Furthermore, from the toxicity analysis, it was seen that the leaching of heavy and trace elements from the eco-concrete was negligibly small and within the limits. In near future, the cost-effective, eco-friendly materials and technologies can be opted as a perpetual strategy to overcome severe material shortages for resource conservation and economy.

Keywords Eco-concrete · Aluminium dross · Iron slag · Sustainability · Toxicity analysis

Introduction

It becomes a prime agenda of any government to provide rural and urban infrastructural facilities for every citizen of the country and is not that easy for the real estate sector to develop it all at once. In many developing countries like India, currently, there is a massive shortage of urban housing units which is likely to shoot up in coming days (Ramalingam 2012). This issue needs to be addressed in a sustainable approach without causing any distress to the natural resources. The presently available stock of building materials may be relatively less than the requirement at various locations to meet the overgrowing demand. The conventional construction materials like bricks, cement, sand, steel and timber are fast depleting due to unscientific and indiscriminate utilization in a decentralized manner (CIDB 2007). The activities such as excessive quarrying of limestone, sand mining from streams, timber extraction from forests, hill quarrying for rocks are some of the

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