



Comprehensive assessment of ceramic ETP sludge waste as a SCM for the production of concrete

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Highlights

- The ETP sludge waste can be used a SCM for a maximum replacement of 10% of OPC.
- ETP sludge waste contributes to increase in mechanical properties due to filling capabilities.
- Properties like drying shrinkage, pull off strength and porosity increase with increase in ETP sludge content.

Abstract

With the intention of improving sustainability of ceramic manufacturing and construction industry this study evaluates the use of ceramic effluent treatment plant (ETP) sludge as a supplementary cementitious material (SCM). ETP sludge which was source from the manufacturing plant of vitrified porcelain stoneware tiles had a specific surface area of 22858cm²/g. This waste was used to replace cement in steps of 10% from 0 to 50% for the manufacture of concrete with two different w/b ratios of 0.35 and 0.45. Tests like slump, hardened density, compressive, flexural, split tensile strengths, resistance to water penetration and abrasion, drying shrinkage were evaluated. The results indicated that at a minimal substitution rate of 10%, ETP sludge improved workability and apparent density of the mixes. Mechanical properties also increased marginally at the same utilization ratio. This improvement in properties of the mixes were due to the waste materials cohesivity and void filling capabilities. However, the water absorption capacity increased with increase in usage of ETP sludge along with a corresponding reduction in abrasion resistance. Drying shrinkage was lesser for mixes with up to 30% usage of the waste. Retrospectively, these results were verified using various microstructural analysis and was understood that ETP sludge was not pozzolanic and its excessive usage diluted the hydration products, leading to the fall in all the properties. Hence it is recommended that ceramic waste procured from the manufacturing stage can be used to replace ordinary Portland cement (OPC) to a maximum of 10% for the manufacture of medium strength concrete.