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The durability of concrete produced from pozzolan materials as a partially cement replacement: A comprehensive review

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ABSTRACT

Recently, the construction industry used innovative, cost-ecofriendly, and efficient materials in infrastructure development to mitigate the negative impact on the environment due to manufacturing Ordinary Portland cement (OPC). Many efforts have been conducted to improve sustainable materials to be used as cementitious material in pozzolanic materials such as fly ash (FA), slag, metakaolin (MK), rice husk ash (RHA), palm oil fuel ash (POFA), silica fume (SF), etc. Therefore, this paper introduced to review the results from previous studies that investigated the influence of waste materials with high pozzolanic materials on the numerous durability properties. The results show many advantages due to using those pozzolanic materials as partial cement replacements for the environment, saving energy and cost, and improving durability. Ground quartz and SF have the highest silica oxide (SiO2) content, it was recorded as higher than 90%, producing more pozzolanic activity than other waste materials. The resistance of the concrete containing POFA against acid and sulfate attacks increased when increasing POFA fineness. Besides, sorptivity values were reduced importantly for the blended concrete samples, the addition of 55% FA in binary blended concrete considerably reduced sorptivity of cement concretes. In addition to that, these pozzolanic materials improved other concrete properties. This paper can be a good base for researchers and construction players to adopt waste materials in improving the durability of concrete. Lastly, numerous possible studies were recommended for future studies.
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1. Introduction

Recently several industrial and agriculture waste materials as by-products with a high pozzolanic reaction, such as slag [1], fly ash (FA) [2], and palm oil fuel ash (POFA) [3–5], have been utilized as cementitious materials [4–6]. Typically, these materials significantly reduce the concrete permeability by changing the pore structure, improving resistance against acid and sulfate attacks, and decreasing the reinforcement corrosion. The high-Pozzolan materials such as silica fume (SF), RHA, pulverized fuel ash (PFA), ground granulated blast furnace slag (GGBS), POFA, and FA mainly enhance durability against acid and sulfate environmental. Thomas

Abbreviations: AAC, Alkali-activated concrete; MgO, Magnisum oxide; Al_2O_3, Alumina oxide; $MgSO_4$, Magnesium sulfate; ASR, Alkali-silica reaction; Na_2O, Sodiume oxide; CaO, Calcium oxide; Na_2SO_4, Sodium sulfate; CO_2, Carbon dioxide; OPC, Ordinary Portland cement; FA, Fly ash; POFA, Palm oil fuel ash; Fe_2O_3, Iron oxide; RHA, Rice husk ash; GGBS, Ground granulated blast furnace slag; SCM, Supplementary cementitious materials; HL, Hydrated lime; SF, Silica fume; HSC, High strength conceret; SiO_2, Silica oxide; LOI, Loss on igntiton; SO_3, Sulfure oxide; MK, Metakaolin; TiO_2, Titanium oxide.

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