

Recycling industrial slags in production of fired clay bricks for sustainable manufacturing

- Gencil O.^a,
- Munir M.J.^b,
- Kazmi S.M.S.^b,
- Sutcu M.^c,
- Erdogmus E.^d,
- Velasco P.M.^{e, f},
- Quesada D.E.^{g, h}

Abstract

Due to the production of industrial slags in massive amounts, there is a high demand for recycling these slags and avoiding their dumping in landfills. This article aims to recycle industrial slags in brick manufacturing and investigates the performance of fired clay bricks incorporating different kinds of industrial slags such as granulated blast furnace slag (GBS), ferrochromium slag (FCS), and steel slag (STS). For this purpose, two different dosages of slags (i.e., 10 and 20 wt % of clay) and two different firing temperatures (i.e., 1000 and 1100 °C) were considered. Various physical, mechanical, and durability tests were performed to evaluate the properties of bricks incorporating industrial slags. Results show that the compressive strength of the bricks incorporating industrial slags are well above the minimum compressive strength limits of bricks as per different building standards. The bricks incorporating industrial slag can be classified as load-bearing bricks for structural applications in accordance with the ASTM C469 standard. An increase in the porosity of bricks is observed with the addition of STS. However, reduced porosity is observed for bricks incorporating FCS and GBS than traditional bricks. Based on the water absorption and efflorescence test results, bricks incorporating industrial slags can be used as severe weather resistant bricks following ASTM C62 standard and slight efflorescence bricks per ASTM C67 standard. The amounts of heavy metals in the leachates of bricks are observed below the specified limits of the Environment Protection Authority. SEM images and EDS analysis of bricks are also supporting the results of this study. Based on the results, utilizing industrial slags in brick manufacturing can help recycle the abundant industrial wastes and develop the fired clay bricks with desired properties. © 2021

Author keywords

Building materials; Fired clay brick; Industrial slags; Recycling; Sustainability