Abstract

Environmental issues, such as global warming and pollution, could be solved by reducing the carbon dioxide (CO_2) footprint on the surrounding atmosphere. Utilizing by-products as a cement substitute in cement production, such as cement kiln dust (CKD), could reduce CO_2 emissions from burning raw materials in cement plants. This study investigated the effect of cement kiln dust on cement mortar's physical, flow, and mechanical properties. Cement was replaced with CKD up to 100% (by weight of dry cement). The optimum content of CKD was determined based on compressive strength; loss on ignition (LOI); and chloride (Cl), sulfate (SO_3), and magnesium oxide (MgO) contents. Standard sand with a maximum diameter of 2 mm was used in this study, with a sand-to-binder ratio (s/b) of $3:1$. Three different models—multiexpression programming (MEP), nonlinear regression (NLR), and an artificial neural network (ANN)—were employed for estimating the compressive strength of CKD-modified cement mortar using the present study data (110 data sets) and 152 data collected from other research studies. The compressive strength of cement mortar was predicted as a function of water-to-binder ratio (w/b), sand-to-binder ratio, cement kiln dust content, silicon dioxide content in the binder, calcium oxide content in the binder, the maximum aggregate diameter (MDA), and curing ages (t). Based on the statistical assessments, the ANN models outperformed the MEP and NLR models in the testing phase. According to the sensitivity analysis, curing time is the most critical parameter affecting the compressive strength of CKD-modified cement mortar, and the SiO_2 content percentage affected the compressive strength more than did the CaO content percentage.