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RESPONSE SURFACES FOR PROPERTIES OF CONCRETE WITH CLAY BRICK POWDER AS SUBSTITUTE FOR CEMENT

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This study examined the application of pulverize clay brick wastes as alternative constituent for Portland cement replacement in green concrete production using the response surface methodology (RSM). The adopted response surface approach is central composite design (CCD). The statistical models were developed between the concrete constituents (clay brick powder and water cement ratio) and their response variables (slump, compressive and split tensile strength). Relationships were established and mathematical models in terms of actual factors from predicted responses were developed. The influence of the considered factors on the properties of response were visually observed from the contour and response surface plots. The statistical models of experimental values clearly depict that the obtained experimental values are in close agreement with the predicted values, which validates the response surface models with desirability value of 1. The results show that pulverized clay brick waste have significant influence on the properties of concrete than the water cement (w/c) ratio, however, a declining trend was seen for all analyzed concrete properties. In addition, this study showed that the pulverized waste brick can be used as alternative substitute for Portland cement up to 20% in the production of sustainable concrete.

Keywords: Mathematical modeling, Waste clay brick, Cement, Sustainable concrete.

1 INTRODUCTION

Sustainability is a key issue for the construction industry because the industry relies more on nonrenewable resources for construction materials (Calkins 2009). Moreover, these materials constitute major components for the construction of engineering infrastructures; hence, limiting the impact of these materials on the environment is now very crucial. Concrete is one of the commonly used construction materials and finding ways to reduce its production impact on the environment is important (Akinwumi *et al.* 2016, Olofinnade *et al*. 2018b). Moya *et al*. (2010) reported that the process of producing concrete demands a considerable amount of raw materials and energy thus resulting in the emission of significant quantity of greenhouse gases (GHG) into the atmosphere. Previous studies emphasized on the impact of CO_2 emission on the environment (Shakir *et al*. 2014, Olofinnade *et al*. 2016). Meanwhile, studies also depicted that the impact of cement on the environment can be limited through the use of supplementary cementitious materials such as metakaolin, fly ash and slag used as alternative material to partially replace cement (Bektas *et al.* 2008, Schneider *et al*. 2011). Moreso, additional benefits include energy