

Application of Waste Glass Powder as a Partial Cement Substitute towards more Sustainable Concrete Production

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Abstract: Use of waste materials in concrete is now a global trend for efficient waste management so as to achieve a sustainable green environment and with the added advantages of preserving the natural resources as well as producing a better performing concrete. This study examined the properties of concrete containing ground waste glass powder (GP) as partial replacement for cement. The waste glass was finely grounded into powder and the morphology imagery of the powder materials was carried out using scanning electron microscopy (SEM). Moreover, the chemical composition of the glass powdered material was determined using X-ray fluorescence (XRF). Laboratory tests were carried out to determine the strength activity index, workability, split tensile and compressive strength properties of the concrete with 0%, 15%, 18%, 21%, 24%, 27% and 30% partial replacement of cement with the ground waste glass powder. The results showed that the oxides composition of the glass powder meets the requirements for pozzolanic material, while the SEM morphology shows materials of amorphous flaky solid masses, and based on the 28-day strength activity index, concrete containing 21% cement replacement shows a higher strength index above the recommended 75%. It was also observed that workability of the concrete reduced with increase in percentage glass content while significant improvement of the compressive strength of the concrete was achieved at 21% cement replacement, after which a decrease in strength with increasing percentage glass content was observed. The revealed results were confirmed by the microstructural examination using SEM showing a denser concrete at 21% cement replacement but increase porosity as the glass content increases. However, a decrease in split tensile strength was observed with increasing glass content. The results clearly showed that it is possible to produce moderate strength sustainable concrete for structural application using 20% glass powder as cement replacement.