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VALORIZATION OF DIVERSE SIZES OF COAL BOTTOM ASH AS FINE AGGREGATE IN THE PERFORMANCE OF LIGHTWEIGHT FOAMED CONCRETE

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Abstract. In recent years, research work on the use of coal bottom ash (CBA) as a partial alternative for aggregate in concrete is on the rise. This research is aimed at examining the characteristics of lightweight foamed concrete with CBA as fine aggregate to produce environmentally sustainable product. With the volume replacement technique, CBA was used as 25%, 50%, 75%, and 100% replacement for conventional mining sand with different sieve sizes of smaller than 4.75, 2.36, and 0.6 mm in concrete. Water absorption, porosity as well as mechanical characteristics tests, including compressive strength, splitting tensile strength, and modulus of elasticity (MOE) were conducted and analyzed. X-ray diffraction and scanning electron microscopy microstructural investigations were also performed to correlate test results. The quality of concrete was investigated using a non-destructive ultrasonic pulse velocity test. According to the findings, the highest replacement level of CBA with a sieve size smaller than 0.6 mm had an impact in reducing workability. The effect of CBA particles on water absorption, MOE, compressive strength, and tensile strength depends on the size of the fine aggregate, the replacement ratio and the density. In general, substituting mining sand with CBA aggregate improved the mechanical performance of concrete, notably for the aggregate size of less than 0.6 mm. Moreover, the SEM images indicate that the addition of CBA particles decreased the size and quantity of voids in the foamed concrete.

Keywords: lightweight foamed concrete, compressive strength, splitting tensile strength, modulus of elasticity, microstructure, mining sand, coal bottom ash.

Introduction

Soil, energy, and water are among the most treasurable assets of humankind that contribute to climate change depending on their utilization method and extensiveness of exploration (Gielen et al., 2019). Extravagant exploitation of these worthy assets without regard for the natural environment would be detrimental to future generations. The United Nations General Assembly (UNGA) adopted Sustainable Development Goals (SDGs) in 2015 after realizing the grave consequences of inadequate resource management in the coming years. It established a framework for global collaboration in order to create a sustainable future (Gielen et al., 2019). At the same time, being one of the oldest industries, the construction sector continues to play an important role in human development and is responsible for contributing to this goal. The construction industry is the least sustainable in the world, using almost half of all non-renewable sources (Opoku, 2019). As a result, with the expected increase in the number of construction projects in the following years, there is a clear need to take a 'greener route' in the construction sector to

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