

REUSING WASTE FOUNDRY SAND AS FINE AGGREGATE IN CONCRETE FOR PAVING BLOCKS

E. Momanyi¹, R. Mutuku² and Z. Gariy³

¹*Civil Engineering Department, Pan African University Institute of Basic Sciences Technology and Innovation, Nairobi, Kenya*

²*Civil Construction and Environmental Engineering Department, Jomo Kenyatta University of Agriculture and Technology, Nairobi, Kenya*

³*Civil Engineering Department, Technical University of Mombasa, Mombasa, Kenya*

Abstract

Acquisition of natural sand for construction and disposal of industrial by-products is becoming unattractive worldwide due to their associated negative economic and environmental impacts. The option of re-using Waste Foundry Sand (WFS) as fine aggregate in concrete offers benefits to both construction and industrial sectors.

The present study aimed at investigating the re-use of WFS as replacement fine aggregate in producing concrete paver blocks that meet the quality standard specified in BS EN 1338:2003 and in ASTM 1988. The study assessed the physical and chemical properties of Green and Chemically Bonded WFS. It also investigated the separate effects of the two types of WFS in equal proportions as partial replacement of fine aggregates at 0%, 5%, 10%, 20%, and 30% on concrete properties such as compressive strength, tensile strength and water absorption.

The results showed that Natural sand, Green and Chemically Bonded WFS used are in grading zones II, III and IV respectively and that the two types of WFS have different chemical compositions. The water absorption of the concrete paver blocks containing different proportions of WFS was comparable to those of the control mix, with a range of 4.3-4.6% by mass. The 28 days tensile strength was in the range of 3.50-3.78 MPa and 3.15-3.73 MPa for partial replacement with Green and Chemically Bonded WFS respectively while blocks from the control mix had the highest tensile strength of 3.79 MPa. Similarly, the observed 28 days compressive strength was in the range of 50.2-55.2 MPa and 50.5-53.7 MPa for Green and Chemically Bonded WFS respectively whereas blocks from the control mix had the highest compressive strength of 61.0 MPa. Lastly, it was observed that in the blocks containing WFS, the highest tensile and compressive strengths were observed at 5% and 10% replacement for Green WFS and 20% and 10% replacement for Chemically Bonded WFS.

In conclusion, the different performance of the two WFS types is due to their varied chemical composition whereas the higher strengths in the control mix are attributed to the coarser particle size of natural sand relative to WFS. Nonetheless, the replacement of WFS from 0-307 can make concrete paver blocks with, $\leq 6\%$ by mass water absorption and 50 MPa compressive strength at 28 days, which is the standard quality.

Key words: Waste foundry sand (WFS), concrete paver blocks, compressive strength, tensile strength, water absorption