UTILIZATION OF POLYETHYLENE TEREPHTHALATE (PET) BOTTLES AS PARTIAL REPLACEMENT OF FINE AGGREGATES IN CONCRETE PAVING BLOCKS

THESIS

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June 2019

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Undergraduate Thesis
Submitted to the Faculty of
College of Engineering and Information Technology
Cavite State University
Indang, Cavite

In partial fulfillment
Of the requirements for the degree
Bachelor of Science in Civil Engineering

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June 2019

ABSTRACT

LABUTAP, NICOLE ANNE AND NAVARRO, SHASHEIL MAUREEN S., Utilization of Polyethylene Terephthalate (PET) Bottles as Partial Replacement of Fine Aggregates in Concrete Paving Blocks. Undergraduate Thesis. Bachelor of Science in Civil Engineering, Cavite State University, Indang, Cavite. June 2019. Adviser: Engr. Roslyn P. Peña

The main objective of the study was to determine the feasibility of shredded PET bottles as partial replacement of fine aggregates in concrete paving blocks. Specifically, it aimed to determine the physical properties of PET bottles; determine the density weight of paving blocks with PET bottles; determine the compressive strength of paving blocks at 7, 14 and 28 days after curing; determine and compare the compressive strength of ordinary paving blocks to paving blocks mixed with PET bottles as supplementary fine aggregates; determine the PET bottles content which will produce the paving blocks with the highest compressive strength; find out the most economical and acceptable mixture using PET bottles as partial substitute for fine aggregates, and observe other effects of PET bottles in paving blocks. The study used five mix design of concrete paving blocks with partial replacement of PET bottles to fine aggregates which ranges from 0 percent, 5 percent, 10 percent, 15 percent and 20 percent PET bottles with 7.44 L of water.

Different tests were used in evaluating the effect of different proportions of sand and PET bottles in concrete paving blocks making. These test includes fineness and sieve analysis, density determination (loose and compact), determination of specific gravity, slump test for freshly mixed concrete, and compressive strength test of concrete paving blocks. With respect to physical properties, PET bottles had smooth, angular shape with size ranging from 1.18 to 2.36 and light in weight.

After conducting a series of compression test, the results of average compression test obtained on their 7th day for Treatment 5 containing 20% shredded PET bottles attained the highest compressive strength of 40.57 MPa. Treatments 1, 2, 3, and 4 obtained a compressive strength of 35.43 MPa, 36.59 MPa, 39.51 MPa, and 31.76 MPa, respectively. It implies that the compressive strength of concrete paving blocks increases as the PET bottles also increases.

For the 14th day curing, the highest compressive strength acquired in the Treatment 5 with strength of 51.56 MPa while Treatments 1, 2, 3, and 4 obtained a compressive strength of 45.93 MPa, 50.74 MPa, 51.99 MPa, and 51.51 MPa, respectively. It entails that the strength in Treatment 4 decreases but still Treatment 5 has the highest compressive strength. For the 28th day, Treatment 5 has the highest compressive strength of 61.51 MPa. While 60.98 MPa, 58.51 MPa, 59.03 MPa, and 59.46 MPa were the compressive strengths obtained by Treatments 1, 2, 3, and 4, respectively. This shows that there is uneven decrease and increase but still the highest compressive strength for the 28th day curing is Treatment 5.

Results showed that there is uneven change in 15 percent PET bottles content but all treatments obtained compressive strengths which are higher than the control and passed the required compressive strength of paving blocks. The proportion that acquired the highest compressive strength was the mixture with the most amounts of shredded PET bottles (80% - 20%) with compressive strength of 61.71 MPa (8956 psi). Also, concrete paving blocks is considered light weight as PET bottles content increases. Moreover, the authors have determined that the use of PET bottles as aggregates can cause savings ranging from PHP 2.28 to PHP 8.29 depending on the amount of PET

bottles used. The mixture with the highest compressive strength also garnered the lower cost. Treatment 5 with 28 curing days is determined as the most economical mix design with the amount of PHP 16.72 and a compressive strength of 61.71 MPa, which has a cost comparably lower than that of load bearing commercial paving blocks costing PHP 19.00 per unit. Hence, PET bottles as partial replacement to fine aggregates is feasible and highly economical in terms of strength, cost and environmental impact. Further research may be conducted increasing the amount of shredded PET bottles to determine the limit of sand to PET bottles proportion; lower class of concrete mixture may be used to produce paving blocks with lower strength for pedestrian walks and parks; the use of coarse aggregates may also be removed from the mixture to produce non load-bearing blocks; utilization of other polymers as fine aggregates in concrete; and abrasion test may be conducted to determine the abrasive resistance and hardness property of the paving blocks.

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An undergraduate thesis submitted to the faculty of the Department of Civil Engineering, College of Engineering and Information Technology, Cavite State University, Indang, Cavite, in partial fulfilment of the requirements for the degree of Bachelor of Science in Civil Engineering with Contribution No. CEIT 2018-19-2-052. Prepared under the supervision of Engr. Roslyn P. Peña.

INTRODUCTION

Modern construction industry seeks for more innovative materials challenging the spirit of young engineers to achieve a study that could possibly change the history. Wide variety of materials such as wastes and by-products that would otherwise be discarded as harmful environmental pollutants must be counted as appreciated resources and used in civil engineering applications.

Plastics are a major component of the solid waste stream in many countries. It can be found in many forms, including Polyvinyl Chloride (PVC) bags, Polyethylene Terephthalate (PET) bottles such as blown bottles for soft drink use, containers for the packaging of food and other consumer goods are finding wide range of applications in all fields of life (Savolkar, 2011). According to Nishikant (2016), at present, although some plastics are used in recycling, these non-biodegradable products are used and thrown out