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Examining Polyethylene Terephthalate (PET) as Artificial Coarse Aggregates in Concrete

Erniati Bachtiar [a*], Mustaan [a], Faris Jumawan [a], Meldawati Artayani [a], Tahang [a], Muhammad Junaedy Rahman [b], Arman Setiawan [c], Muhammad Ihsan [d]

[a] *Faculty of Engineering, Fajar University, Makassar, Indonesia.*

[b] *Department of Building Engineering, Universitas Negeri Makassar, Makassar, Indonesia.*

[c] *Faculty of Engineering, Universitas Bosowa, Makassar, Indonesia.*

[d] *Department of Civil Engineering, Sekolah Tinggi Teknik Baramuli, Makassar, Indonesia.*

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Abstract

This study aims to examine the effect of recycled Polyethylene Terephthalate (PET) artificial aggregate as a substitute for coarse aggregate on the compressive strength and flexural strength, and the volume weight of the concrete. PET plastic waste is recycled by heating to a boiling point of approximately 300°C. There are five variations of concrete mixtures, defined the percentage of PET artificial aggregate to the total coarse aggregate, by 0, 25, 50, 75, and 100%. Tests carried out on fresh concrete mixtures are slump, bleeding, and segregation tests. Compressive and flexural strength tests proceeded based on ASTM 39/C39M-99 and ASTM C293-79 standards at the age of 28 days. The results showed that the use of PET artificial aggregate could improve the workability of the concrete mixture. The effect of PET artificial aggregate as a substitute for coarse aggregate on the compressive and flexural strength of concrete is considered very significant. The higher the percentage of PET plastic artificial aggregate, the lower the compressive and flexural strength, and the volume weight, of the concrete. Substitution of 25, 50, 75, and 100% of PET artificial aggregate gave decreases in compressive strength of 30.06, 32.39, 41.73, and 44.06% of the compressive strength of the standard concrete (18.20 MPa), respectively. The reductions in flexural strength were by respectively 19.03, 54.50, 53.95, and 61.00% of the standard concrete's flexural strength (3.59 MPa). The reductions in volume weight of concrete were by respectively 8.45, 17.71, 25.07, and 34.60% of the weight of the standard concrete volume of 2335.4 kg/m^3

Keywords: Concrete; Plastic Waste; Polyethylene Terephthalate (PET); Boiling Point; Compressive Strength; Flexure Strength.

1. Introduction

Infrastructure development has progressed at an unprecedented pace, especially in the construction of buildings and infrastructures. This situation has led to the problem of the availability of construction materials, including raw materials of concrete, leaving environmental deterioration concerns. Coarse aggregates constitute the largest portion of concrete mixtures, about 65-80% of the total concrete volume. Therefore, a more sustainable alternative to natural coarse aggregate is necessary.

On the other hand, economic developments and changes in human consumption and production patterns have led to a drastic increase in plastic waste worldwide. Solid waste in the form of plastic is a very complex problem in urban areas, including in Indonesia. Data from the Indonesian Plastics Industry Association (INAPLAS) and the Central

* Corresponding author: erni@unifa.ac.id; erni_nurzaman@yahoo.com

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