



FACULTY OF ENGINEERING OF TECHNOLOGY
DEPARTMENT OF POLYMER, TEXTILE, AND INDUSTRIAL
ENGINEERING

INVESTIGATION OF THE IMPACT OF POLYETHYLENE
TEREPHTHALATE POWDER AND GRAPHITE MATERIALS ON
WATER ABSORPTION, MECHANICAL AND RHEOLOGICAL
PROPERTIES OF CONCRETE

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(MASTERS OF SCIENCE IN MATERIALS ENGINEERING)

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ABSTRACT

This study investigated the impact of incorporating Polyethylene Terephthalate (PET) powder and graphite nanomaterials on the concrete's water absorption, mechanical and rheological properties. The primary objective was to evaluate how these materials, when used as a partial replacement for cement, influence concrete performance. After characterization, the PET-NANO material was found to be highly crystalline (86.6%). A series of concrete mixes were produced based on a Response Surface Methodology (RSM) design, with varying percentages of nano-sized PET and graphite (from 0% to 5%). Results showed that the inclusion of nano-sized PET and graphite materials generally reduced the slump of the concrete mixes. However, an optimal mix containing 3% PET and 1% graphite demonstrated a significant enhancement in mechanical properties compared to the control mix at 28 days, compressive strength increased by 6.04%, flexural strength by 34%, and tensile splitting strength by 2.7%. This optimal mix also exhibited a 9% reduction in water absorption. Conversely, replacement levels above 3% and using larger particle sizes (1.18mm and 2.36mm) caused a significant deterioration in all measured properties. The study concluded that adding a low percentage of nano-sized PET and graphite enhanced concrete's strength, but the particle size and replacement percentage are critical factors.

Key words: Graphite, mechanical properties, Polyethylene terephthalate, rheological property and water absorption.

DECLARATION

I, Auma Nancy, hereby attest that this submission is entirely original with no content that has been previously published or written by someone else or accepted for the award of any other degree from a University or other higher education institution, with the exception of instances in which appropriate credit has been given in the text and reference list.

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APPROVAL

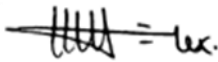
The undersigned approve that they have read and hereby recommend for submission to the Department of Polymer, Textile and Industrial Engineering in the Faculty of Engineering and Technology of Busitema University, a graduate final year research project report entitled “Investigation of the impact of Polyethylene Terephthalate powder and graphite materials on water absorption, mechanical and rheological properties of concrete” in the partial fulfillment of the requirements for the award of Degree of Master of Science in Materials Engineering of Busitema University.



.....

9th September 2025

Dr. Eng. Otim Daniel (Supervisor)



.....

24th August 2025

Dr. Musinguzi Alex (Supervisor)

DEDICATION

I would want to dedicate this report to my parents and siblings, who have supported me financially, emotionally, and physically throughout my education. The strongest support system for my research is my supervisors. May the Good Lord lavishly bless them.

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LIST OF ABBREVIATIONS AND ACRONYMS

%	Percentage
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACV	Aggregate Crushing Value
AIV	Aggregate Impact Value
ASTM	American Standard for Testing of Materials
BS	British Standard
CNM	Carbon-based nanomaterials
CS	Compressive Strength
FS	Flexural Strength
FTIR	Fourier transform infrared
GNP	Graphene nano platelets
GRAP	Graphite
HDPE	High-density polyethylene
LAAB	Loss Angeles Abrasion Value
MC	Moisture Content
mm	Millimetres
MPa	Megapascals
OVAT	One Variable at a Time
PC	Portland cement
PE	Polyethylene
PET	Polyethylene terephthalate
PP	Polypropylene
SEM	Scanning Electron Microscopy
SG	Specific Gravity
STS	Tensile Split Strength
UTCL	Uganda Technical College Lira
UV	Ultra-Violet
W/C	Water to Cement ratio

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