DEVELOPMENT OF FUNCTIONAL POLYURETHANE-CENOSPHERES HYBRID NANOCOMPOSITE COATINGS FROM *Ricinus communis* SEED OIL

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A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE (M.Sc.) DEGREE IN INDUSTRIAL CHEMISTRY IN THE DEPARTMENT OF CHEMISTRY, COLLEGE OF SCIENCE AND TECHNOLOGY, COVENANT UNIVERSITY

JULY, 2022

ACCEPTANCE

This is to attest that this dissertation has been accepted in partial fulfilment of the requirements for the award of the degree of Masters of Science in Industrial Chemistry in the Department of Chemistry, College of Science and Technology, Covenant University, Ota, Ogun State.

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DECLARATION

I, **ADEBOWALE, ADEDAMOLA DANIEL (14CC017704),** declare that this dissertation is a representation of my work, and is written and implemented by me under the supervision of Dr. Tolutope Oluwasegun Siyanbola of the Department of Chemistry, College of Science and Technology, Covenant University, Ota, Nigeria. I attest that this dissertation has in no way been submitted either wholly or partially to any other university or institution of higher learning for the award of a masters' degree. All information cited from published and unpublished literature has been duly referenced.

ADEBOWALE, DANIEL ADEDAMOLA

Signature and Date

CERTIFICATION

We certify that this dissertation titled "**DEVELOPMENT OF FUNCTIONAL POLYURETHANE-CENOSPHERES HYBRID NANOCOMPOSITE COATINGS FROM *Ricinus communis* SEED OIL**" is the original research work carried out by **ADEBOWALE, ADEDAMOLA DANIEL (14CC017704)** in the Department of Chemistry, Covenant University, Ota, Ogun State, Nigeria under the supervision of Dr. Tolutope O. Siyanbola of the Department of Chemistry. We have examined and found this research work acceptable as part of the requirements for the award of the degree of Master of Science (M.Sc.) in Industrial Chemistry.

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(Dean, School of Postgraduate Studies) **Signature and Date**

DEDICATION

This dissertation is dedicated to God Almighty.

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LIST OF ACRONYMS AND ABBREVIATIONS

^{13}C NMR	Carbon nuclear magnetic resonance
^{1}H NMR	Hydrogen nuclear magnetic resonance
CFA	Cenospheres Fly Ash
CSO	Castor Seed Oil
FT-IR	Fourier Transform Infrared
IPDI	Isophorone Diisocyanate
MIBK	Methyl Isobutyl Ketone
NMR	Nuclear Magnetic Resonance
PU	Polyurethane
PU-CFA	Polyurethane-Cenospheres Fly Ash
SEM	Scanning Electron Microscope
TMP	Trimethylolpropane
WPU	Waterborne polyurethane

ABSTRACT

The utilisation of plant seed oils as a sustainable and biodegradable substitute for petroleum-based chemicals cannot be overemphasised. This renewable feedstock is vital for the development of polymeric organic coatings. This report investigates the one-spot synthesis of castor seed oil, Isophorone diisocyanate, Trimethylolpropane (cross linker), and the percentage composition of prepared cenosphere nanoparticles incorporated within the polymer matrix. The hybrid coatings were characterised using FT-IR, XRD, SEM, and NMR, as they all confirm the presence of the cenosphere fly ash nanoparticles in the polyurethane. The FT-IR spectrum shows the presence of absorption peaks at 1350 cm^{-1}, 1102 cm^{-1}, and 1000 cm^{-1} which represent the (Al=O), (SiO-Si), (AlO_4) functional groups respectively. The SEM EDX of the PU-CFA revealed that aluminium, silica and carbon have a percentage weight of 2.8 Wt.%, 4.6 Wt.%, 40.2 Wt.% respectively. The thermal stability of the synthesised composites was evaluated on a thermogravimetric analyzer (TGA). The TGA revealed that PU-CFA lost 50%, 30%, and 90% of its weight at 418.16°C, 470.17°C, 506.96°C respectively. The antimicrobial activity shows that PU-CFA composite showed improved resistance towards *Staphylococcus aureus* and *Escherichia coli*.

Keywords: Castor, Cenospheres, Antimicrobial, Polyurethane, Nanoparticles.