

LB/TH/38/2025
TH5968

**DEVELOPMENT OF A NATURAL SURFACE COATING
FOR SOIL-BASED MATERIALS**

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August 2025

DECLARATION

I confirm that this thesis/dissertation is my original work and does not include, without proper acknowledgment, any material that has been previously submitted for a degree or diploma at any other university or institution of higher education. To the best of my knowledge and belief, it contains no material previously published or written by anyone else, except where explicitly acknowledged within the text. I reserve the right to use all or part of this work in future publications, such as articles or books.

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I hereby confirm that the above candidate conducted the research presented in this PhD thesis/dissertation under my supervision. I also verify that the student's declaration above is accurate and truthful.

Name of Supervisor: Sr. Prof. R.U. Halwatura

Signature of the Supervisor:

Date: 01/09/2025

DEDICATION

To my Dada, the first person who saw the spark in me and planted a dream in my
heart long before I understood it myself,

To my Momma, who taught me the meaning of life, strength, and love,
And to my brother, my built-in best friend, who loves me without conditions,

This is for you.

ACKNOWLEDGEMENT

I would like to express my deepest gratitude to Prof. R.U. Halwathura of the Faculty of Engineering, University of Moratuwa, for his unwavering support, expert guidance, and technical insight throughout this research. His invaluable supervision was instrumental in the successful completion of this study. I also extend my sincere appreciation to Dr. Malsha Mendis (Faculty of Engineering, NSBM Green University) and Dr. Harsha Galabada (Faculty of Engineering, ESOF Metro Campus) for their significant support and direction as co-supervisors.

My heartfelt thanks go to Mr. Damindra De Silva (Deputy General Manager, Nippon Paint Lanka) for granting access to laboratory materials and testing facilities critical for the research. I am equally grateful to Mr. Srinith (Assistant General Manager), Ms. Nilanthi, and Mr. Sampath at the Nippon Sri Lanka Matara plant for their generous assistance.

I extend my special thanks to Dr. (Mrs.) S.N. Malkanthi for her invaluable guidance and continuous support throughout the research, as the chair of the review panel. I wish to acknowledge Prof. H.R. Pasindu, Research Coordinator of the Department of Civil Engineering, along with the former research coordinators, for their continuous guidance and constructive feedback. My appreciation also goes to Prof. Udeni Nawagamuwa (Head of the Department of Civil Engineering) and the department's former Heads, as well as all academic and non-academic staff, for their support throughout the research period.

Special thanks are due to the Technical Officers and Lab Attendants of the Departments of Civil Engineering and Environmental Science and Engineering Lab, University of Moratuwa, for their assistance in completing the laboratory experiments. I am also thankful to Ms. Priyantha, Ms. Rukma, and Mr. Naween from the Construction Management Division for their support during the research.

I gratefully acknowledge the contributions of all members of the Pro-Green Laboratory for their collaborative support. Lastly, I wish to express my heartfelt appreciation to my beloved parents and brother for their constant encouragement, emotional support, and invaluable contributions throughout this journey. Additionally, I would like to express my gratitude to my loving aunt, Mrs. Renuka Colombage, for her valuable support in collecting materials for the research.

ABSTRACT

A coating is a thin film of material applied to a substrate surface to protect against environmental, chemical, and mechanical exposure. Coatings not only enhance surface durability but also significantly prolong the service life of construction materials. Among widely adopted industrial coatings, acrylic and epoxy resin systems are predominant due to their favorable performance profiles. However, growing environmental and economic pressures have necessitated the development of sustainable alternatives derived from renewable resources. Bio-based construction materials are increasingly recognized for their environmental compatibility and socio-economic benefits. Despite advancements, the coating industry faces critical challenges, including escalating production costs, resource scarcity, complex handling protocols, and the toxicity associated with synthetic coating by-products. These concerns underscore the urgent need for non-toxic, environmentally benign, and economically viable coating solutions. Traditional Sri Lankan technologies present a promising foundation, having historically utilized naturally sourced materials such as *Dorana* oil, *Dummala*, and plant-derived gums/resins for durable coating formulations. This study investigates the potential of three plant gums: Cashew (*Anacardium occidentale*) gum, Wood apple (*Limonia acidissima*) gum, and Pine (*Pinus spp.*) gum as bio-based binders. Considering their availability and other performance characteristics, Pine gum was selected as the best binder for the coating formula. The final coating formula consisted of *Dorana* oil, *Dummala*, Pine gum, and ethanol. Among the formulations evaluated, the composition containing 40 g/L of *Dummala* and 40 g/L of pine resin exhibited the best performance across key property parameters. This formulation achieved a density of 0.9529 kg/L, a solid content of 55.48% by mass, a viscosity of 21 seconds, an opacity of 10.48%, and a gloss level of 33.5 gloss units at a 60° incident angle. This formula was compared to commercially available synthetic coatings and was found to have similar or superior properties. Furthermore, a sustainability assessment encompassing environmental, social, and economic dimensions was performed to evaluate the feasibility of the proposed formulation. The findings suggest that the developed coating system presents a viable, sustainable alternative for protecting soil-based materials, aligning with the ongoing shift toward environmentally responsible building practices. This research contributes to the field by bridging traditional knowledge with modern material science, providing a foundation for future innovations in sustainable coating technologies.

Keywords: Ancient Coating Technology, Natural Coating, Plant Gums, Soil-based, Sri Lanka

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LIST OF ABBREVIATIONS

Abbreviation	Description
ASTM	American Society for Testing and Materials
EPA	Environmental Protection Agency
CG	Cashew Gum
DMSO	Dimethyl Sulfoxide
FTIR	Fourier Transform Infrared Spectroscopy
ISO	International Organization for Standardization
PG	Pine Gum
WG	Wood apple Gum
VOC	Volatile Organic Content

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