UNIVERSITI TEKNOLOGI MARA

OPTIMIZATION OF MICROCRYSTALLINE CELLULOSE (MCC) ISOLATED FROM RICE HUSK (RH) AS REINFORCEMENT FILLER IN POLYLACTIC ACID (PLA) BIOCOMPOSITE

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MSc

August 2020

AUTHOR'S DECLARATION

I declared that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

In this study, microcrystalline cellulose (MCC) was isolated from rice husk (RH) cellulose via acid hydrolysis process using nitric acid (HNO_3) in comparison with sulphuric acid (H_2SO_4) and hydrochloric acid (HCl). The parameters used to isolate MCC from RH were extensively studied by using 0.5M and 1.0M of different acid concentration at 30 min, 60 min and 120 min reaction time. The optimum condition of acid hydrolysis process was undergone with 0.5M of HNO_3 and 30 min reaction time successfully produced the highest percentage yield of MCC-RH at 83.5% as compared to H_2SO_4 and HCl at 80.6% and 81.8% respectively. Besides, the analysis of Fourier Transform Infrared (FTIR) spectroscopy affirmed the successive elimination of non-cellulosic material from RH cellulose resulting highly purified MCC-RH. X-ray Diffraction (XRD) analysis showed MCC-RH treated with HCl produced the highest crystallinity index value of 54.2% while HNO_3 and H_2SO_4 produced comparable results of 52.4% and 49.7% respectively. TGA analysis showed the thermal stability of the MCC-RH treated with 0.5M HNO_3 was enhanced as the degradation temperature at T_{on}, T_{20} and T_{50} increased compared with the untreated RH. The highest MCC-RH yielded by 0.5M of HNO_3 was further analyzed as reinforcement filler in polylactic acid (PLA) biocomposite preparation through solvent casting technique. The incorporation of 1%, 3%, 5%, 7% and 9% of MCC-RH filler in the prepared PLA/MCC-RH biocomposite were successfully enhanced the physical and mechanical properties of PLA. Thermogravimetric analysis (TGA) has proved 3% MCC loading has the highest thermal stability as it degraded at higher temperature, 380 ℃ compared with pure PLA and 9% MCC loading which degraded at 365 ℃ and 350 ℃ respectively due to good interaction of MCC filler and PLA matrix. The good incorporation of 3% MCC loading with PLA matrix of the prepared PLA/MCC-RH biocomposite was further proved by SEM analysis with no agglomeration, filler pulled-out and void observed. In addition, PLA/MCC-RH biocomposite with 3% MCC loading has the highest tensile strength at 25.08 MPa with 56.6% increment compared with pure PLA which only produced tensile strength at 16.02 MPa due to good dispersion between MCC filler and PLA matrix that produced a good filler and matrix interaction. Whilst the addition of 5%, 7% and 9% of MCC loading caused declination in tensile strength and Young's modulus due to agglomeration of MCC, filler pull-out and voids observed during SEM analysis. PLA/MCC-RH biocomposite with minimal water absorption properties is favorable to prolong the lifetime of the prepared PLA/MCC-RH biocomposite. Hence, water immersion test was done on the prepared biocomposites to determine its water absorption properties. PLA/MCC-RH bioomposite with 3% MCC loading was observed with minimal water absorption and thickness swelling recorded at 1.59% and 5.65% respectively compared with 9% MCC loading resulted 5.28% water absorption and 7.40% thickness swelling.

ACKNOWLEDGEMENT

In the name of Allah, the Most Gracious and the Most Merciful.

Alhamdulillah, all praises to Allah for the strengths and His blessing in completing this thesis. I would like to express my deepest appreciation to my supervisor, Dr. Zuliahani Ahmad for giving me continuous support, encouragement and guidance since day one until I have completed thesis writing. Her valuable help with constructive comments and suggestions throughout the experimental and thesis writing have contributed to the success of this research. Not forgotten my gratitude to my co-supervisor, Dr. Wan Izhan Nawawi for his support and help during lab work completion.

Special appreciation goes to my husband, Muhammad Safwan Che Fadzil for his enormous support, love and encouragement for completing this long and challenging journey. Thank you for always believe in me and supports every decision I have made. My gratitude to my beloved parents, Abu Seman Morad and Wan Norlida Wan Ismail as well as my siblings for their endless prayers, supports and love throughout the years. Not forgetting my daughter, Naura Sofea for being a sweet, loving and easygoing daughter while accompanying me throughout this journey.

Sincere thanks to all my teammates of Arau Catalyst (ARAUCAT) for their continuous help and kindness along the way in completing my research study. Last but not least, I have to appreciate the guidance given by former Head of Postgraduate UiTM Perlis, Dr Syukor Sanim, lecturers and all the panels that help to make my research a success. I have gained so much knowledge and improved my writing and presentation skills through their comments and advices. My acknowledgement also goes to all staffs of School of Applied Sciences for their support and cooperation. To those who indirectly contributed in this research, your kindness means a lot to me. Thank you very much.

TABLE OF CONTENTS