EFFECT OF REACTION CONDITIONS IN HYDROTHERMAL CARBONIZATION (HTC) OF CELLULOSE FROM COTTON WASTE

By

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This report is submitted in partial fulfilment of the requirements
needed for the award of
Bachelor of Chemical Engineering (Environment) with Honours

CENTRE OF CHEMICAL ENGINEERING STUDIES
UNIVERSITI TEKNOLOGI MARA

AUGUST 2022

AUTHOR'S DECLARATION

I declare that the work in the thesis was carried out in accordance with the regulation of Universiti Teknologi MARA. It is original and is the result of my own, unless otherwise indicated or acknowledge as reference work.

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

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ACKNOWLEDGEMENT

First, I want to thank Allah S.W.T for all of His blessings and generosity, which have allowed me to finish this Final Year Project (FYP) report within the time period set by FYP coordinator.

Without the help of numerous people, the production of this FYP report would not have been feasible. Many thanks to Ir. Dr. Wan Zuraida binti Wan Kamis, my supervisor, who looked over all my edits and helped me make sense of it all. Ir. Dr. Wan Zuraida has been an excellent instructor, mentor, and FYP supervisor, providing insightful and humorous advice and support. She has helped me every inch of the process, from the start to complete this report, with a good attitude and joy. She always ready to answer my questions and ensured that I completely comprehended the report standards before submitting it. My experience learning with Ir. Dr. Wan Zuraida is something I am proud of, and I am grateful for it.

Besides, I want to convey my thanks to my parents for their constant support and encouragement throughout the report-writing process. I believe that I would have not been able to finish my report on time if it had not been for their prayers and support.

In addition, I want to convey my sincere appreciation to all my friends for their continuous support and cooperation. Without their help and cooperation, I would not be able to finish my report.

Finally, I would like to extend my appreciation to any other parties or persons that assisted me in completing this study, whether directly or indirectly, and I hope that my research will be useful to others in the future.

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ABSTRACT

Nowadays, the amount of textile wastes is increased and most of the waste discarded. Textile wastes can be converted into biomass which is a renewable energy source that may be utilized to replace fossil fuels. Hydrothermal carbonization (HTC) is a thermochemical process in which organic wastes such as rubbish, biosolids, agricultural waste, and organic waste from industrial operations are treated in an aqueous environment to produce hydrochar, a solid fuel. Zn catalyst active site in ZnCTW hydrothermal carbonization was observed at different reaction temperatures and residence times to produce high energy density hydrochars. There is limited information about the $ZnCl_2$ acting as the catalyst for the HTC process. Reaction temperature at 190°C, 200°C, 210°C, and 220°C and residence time at 1, 2, 3, and 4h were used in the procedure to analyze the changes. Besides, the characteristics of physicochemical properties of hydrochars at different reaction temperatures and residence times were determined in terms of proximate analysis, ultimate analysis, and energy density. Cotton textiles wastes (CTW) was used as the feedstocks while $ZnCl_2$ as the catalyst. $ZnCl_2$ was mixed with CTW for the synthesis of ZnCTW in 100 ml deionized water. HTC process was performed in the 100 mL Parr Batch Reactor at different reaction temperatures at 190°C, 200°C, 210°C, and 220°C, and residence time at 1, 2, 3, 4h. For the characterization of hydrochars, a thermogravimetric analyzer was used to determine the proximate analysis. The characteristics that have been observed for proximate analysis are volatile matter, moisture content, and fixed carbon content. Carbon, hydrogen, nitrogen, and sulfur were analyzed via the ultimate analysis by using a CHNS analyzer. Mass and energy yield and HHV were calculated for the energy density. As a result, the volatile matter for the hydrochar decreased slightly until it reached 41.02% when the reaction temperature and residence time increase while fixed carbon content had the opposite behavior. The HHV was increased up to 24.83% with reaction temperature and residence time since the carbon elements in the hydrochar increased. Even though the energy yield was higher than the mass yield, the energy yield shows the same trend as the mass yield. In total, the high performance of sustainable solid fuels will have better energy densification and rich in carbon content.