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Co-hydrothermal Carbonization of *Chlorella vulgaris* and Sewage Sludge

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Structured Abstract

Background: The concerns about climate change, energy security, and the depletion of fossil fuel supplies have increased the importance of developing and deploying renewable energy sources. Due to its availability, renewability, and potential for minimising greenhouse gas emissions, biomass, particularly microalgae and sewage sludge, has emerged as a possible feedstock for biofuel production. Chlorella vulgaris is a microalga rich in organic matter that has been researched for its biofuel generation potential. While sewage sludge is a residual that form from the wastewater treatment. However, hydrothermal carbonization (HTC) has been recognised as the most efficient option for both Chlorella vulgaris and sewage sludge.

Methods: The sewage sludge and *Chlorella vulgaris* were undergo co-hydrothermal carbonization with different mixing ratio at various temperature range between 150℃ to 220℃ for 30 minutes as retention time. For the characteristics of raw materials and product was analysed using ultimate and proximate analysis which are identified elemental composition, moisture content, volatile matter, ash content and fixed carbon. FTIR analysis was employed to identify the difference functional group presence in each products obtained.

Results: This study shows that sewage sludge and *Chlorella vulgaris* was successfully produced hydrochar from co-hydrothermal carbonization process. The result indicates that hydrochar produced from different mixing ratio at various temperature have different composition for 30 minutes retention time. The maximise hydrochar yield occur at temperature 180℃ and 210℃ which is 92.81% and 84.14%, accordingly. In ultimate analysis, carbon, hydrogen, nitrogen, sulfur and oxygen has mbeen measured for each hydrochar product. For the proximate analysis, the moisture content and volatile matter decreased through the carbonization process which resulting in increased fixed carbon of hydrochar. While for the functional group obtained in hydrochar compound have phenols, alcohol, alkanes and others.

Conclusion: In conclusion, the findings of this study indicated that there is considerable potential in produced a renewable energy from sewage sludge and Chlorella vulgaris in form hydrochar and bio-oil. The utilization of sewage sludge and microalgae help in reducing the waste and the greenhouse gas pollution.

Keywords: Sewage sludge, Chlorella vulgaris, Co-hydrothermal carbonization, hydrochar

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