RETASTE Conference Abstracts
Vol. 3 RETASTE-BDZ-341-Oral
Athens, Greece, 27-29 September, 2023

rethink food resources, losses, and waste 2023 retaste

Optimal Production Capacity of Biodiesel Production from Spent Coffee Grounds in Supercritical Ethyl Acetate: Computer Simulation

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Abstract

The amount of spent coffee grounds (SCGs), solid waste generated from the coffee industry is increasing annually worldwide. Furthermore, SCGs is the promising feedstock for biodiesel production due to the high lipid content, approximately 23 g oil per 100 g dried SCGs. Hence, valorization of SCGs as biodiesel feedstock simultaneously reduce the amount of waste and produce renewable biofuel. In our previous work, we used ethyl acetate as green solvent to extract coffee oil from SCGs and to react with coffee oil in supercritical condition to produce biodiesel. Instead of glycerol, the interesterification reaction of coffee oil and ethyl acetate generates triacetin–a fuel additive improving cold flow properties of biodiesel. The objective of this work is to estimate the optimal capacity of biodiesel production plant from spent coffee grounds by using ethyl acetate as extracting solvent and reactant. Aspen plus V11 was used as simulation software in this study. Since linoleic acid is a major fatty acid in coffee oil, trilinolein was assumed as a mimic feedstock in the simulation. The process flow diagrams were constructed comparing with the conventional catalytic process at the same the SCGs input. The result shown that biodiesel production with supercritical ethyl acetate gave a higher amount of biodiesel product than that of the conventional process. However, the net annual profit still did not make the positive net present value (NPV) until the feed flow rate of SCGs t reached 46,675 kg/hr. The biodiesel production capacity of 30,000 ton/year generated the internal rate of return (IRR) of 23% and the payback period of in the process is 7 years.

Keywords: Biodiesel; Spent coffee ground; Supercritical fluid; Economic analysis

References

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Acknowledgments: Thailand Science research and Innovation Fund Chulalongkorn University (IND66610028)