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Sequential production of methyl ester, bioethanol and briquette from spent coffee ground

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In this study, methyl-ester, bioethanol and briquette samples were sequentially produced from spent coffee ground. The oil extracted from spent coffee ground with solvent extraction route at hexane to spent coffee ground ratio of 22.5 g/g with an extraction time of 30.4min resulting in 11.892% of oil yield. This was comparable with literature values and subsequently used for methyl-ester production experiments using a 1% by wt of NaOH at reaction temperatures and residence times ranging from 50 to 65°C and 20 to 60min, respectively. The optimization carried out using central composite design methodology gave 81.507% of methyl-ester yield at a reaction temperature of 57.133°C and reaction time (residence time) of 45.117 min with model determination coefficient (R2) of 0.9465 while the optimum reducing sugar yield for dilute acid hydrolysis experiments for ranges of operating parameters of temperature (70-100°C) and (1-3M) of H_2SO_4 concentrations was found to be 39.161% at a temperature of 98.313°C and H_2SO_4 acid concentration of 2.962M.The central composite design optimization results for trans-esterification and dilute acid hydrolysis experiments were verified by running experiments at optimum conditions and in turn resulted 79.65% of biodiesel yield (out of 11.892 g of oil) and reducing sugars yield of 37.28% (out of the hydrolysate). This implied that the verification experimental results weren't far from the predicted values so that the experimental results were sufficiently represented by the central composite design models. The bio ethanol produced by simple distillation having alcohol by volume yield of 55% can be considered as a good result and it can be easily concentrated to a fuel grade ethanol by using fractionating column. Moreover, the characteristics of the biodiesel produced were in good agreement with ASTM and EN standards. The end product of the process which is briquette has been produced from 75% wt of dilute acid hydrolysis residue and 25% wt of glycerol, resulted a calorific value of 13.35 MJ/kg, volatile matter value of 88.15%, ash content of 3.95%, and fixed carbon contents of 1.74% with its easily moldable physical status showed that it can as well be used for fueling purpose like firewood and charcoal. This study signifies the value addition that can be affected from spent coffee ground and the potential and results obtained in this regard are discussed.

Recent Publications

1. Molla Asmare (2014) Synthesis and Characterization of Biodiesel from Castor Bean as Alternative Fuel for Diesel Engine. American Journal of Energy Engineering 2:1.
2. Muche A and Sahu O (2014) Biofuels from Biomass in Rural Area. J. Biotechnol. Bioinformatics.
3. Ayúe Özyu uran (2017) Prediction of Calorific Value of Biomass from Proximate Analysis Technical University, Istanbul. Turkey Energy Procedia 107:130-136.
4. Pichai E and Krit S (2014) Department of Mechanical Engineering, Faculty of Engineering, Prince of Songkla University, Hat Yai, Songkhla, Thailand 10:16.

Biography

Muluken Eshetu Tefera has been working as a Lecturer at Jimma University, Jimma Institute of Technology under the school of Chemical Engineering since Aug 2014. He has been working on giving Lectures on fluid mechanics for chemical engineers, mass transfer unit operation and entrepreneurship for engineers courses, assisting undergraduate students in thermal and mass transfer unit operations laboratory, advising graduating students, mentoring industrial intern students and many more activities.

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