Investigating Bio-Diesel Production using Potash from Agricultural Wastes

BY

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DECLARATION

I Efeovbokhan Vincent Enontiemonria declare that this thesis was done entirely by me under the supervision of Prof. J. A. Omoleye (Major supervisor) of the Department of Chemical Engineering, Covenant University, Ota, Ogun State and Prof. E. E. Kalu (Co-Supervisor) of the Department of Chemical Engineering, College of Engineering FAMU-FSU, Tallahassee, Florida. This thesis has not been presented either wholly or partly, for any degree elsewhere before. All sources of scholarly information used in this thesis were duly acknowledged.

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Efeovbokhan, V. E.

CERTIFICATION

This thesis titled Investigating Bio-diesel Production using Potash from Agricultural Wastes carried out by EFEOVBOKHAN Vincent Enontiemonria under our supervision meets the regulation governing the award of the degree of Doctor of philosophy (PhD) in Chemical Engineering of the Covenant University, Ota, Ogun state, Nigeria. We certify that it has not been submitted for the degree of PhD or any other degree in this or any other University, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This thesis is dedicated to GOD – The Father, The Lord Jesus Christ and The Holy Spirit

To my lovely wife Mrs. Bridget Efeovbokhan and my children

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ABSTRACT

The application of potassium hydroxide (KOH) extracts from four different biomass *materials: Water hyacinth, Coconut husk, ripe plantain peels and palm frond in the trans-esterification of two vegetable oils; refined rapeseed and crude jatropha oils has been carried out. Potassium hydroxide obtained from the ash of ripe plantain peels recorded the highest biodiesel conversion with both vegetable oils. The highest percentage conversion obtained with rapeseed oil was 71.01% using 1g of KOH extract from ripe plantain ash at reaction temperature and time of 75^{o}C and 4 hours respectively. Under the same reaction conditions, 1g of commercial caustic potash recorded 70.06% conversion of the rapeseed oil at the same reaction conditions. From the optimized batch process, 97.15% conversion was achieved with crude jatropha oil using 1g caustic potash extract from ripe plantain peels ash; at reaction temperature and time of 83^{o}C and 4 hours respectively. Under the same condition, the conversions of the oils to biodiesel using KOH from coconut husk, palm fronds and water hyacinth recorded low values of; 53.11%, 46.88% and 33.31% respectively. Generally, the percentage conversion increased with both time and temperature of trans-esterification of the vegetable oils using potassium hydroxide extracted from the ash of the agricultural waste materials. Using KOH from ripe plantain peels, the conversion increased from 75.20% at 83^{o}C and 1 hour to 97.15% at 83^{o}C and 4 hours while the conversion increased from 35.18% at 75^{o}C and 1 hour to 95.73% at 75^{o}C and 4 hours. The Potash content recorded per g of the biomass materials investigated was: palm fronds (13.9%), coconut husk (17.5%) water hyacinth (18.9%), and ripe plantain peels (40.1%). These respective amounts represent the total recoverable KOH from the optimized extraction process of the ashes of the four biomass materials, at well defined extraction temperatures of 30 - 50^{o}C and varied times of 1-6 hours as against 100^{o}C (boiling water) and 24 hours employed in the traditional extraction method. The cumulative weights of KOH obtained per g of ash at the different temperatures and times, increased progressively with water volume for the 1st and 2nd stages of extraction (100ml/200ml, 150ml/300ml and 200ml/400ml). The effectiveness in using 400ml water*

in two equal portions in the two stages of KOH extraction was about 9.3% better on the average than using the least volume of 200ml under the same conditions. To attain optimized extraction; 5-10 times the weight of ash is required in water for a given biomass ash extraction on a two-stage basis.

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