OPTIMIZATION OF SELECTED PYROLYSIS PARAMETERS IN BIOCHAR PRODUCTION AND QUALITY FROM ACACIA TWIGS

Baqe Sharu Doti[1,*], Samwel Nyakach[1], Jane Nyaanga[2], Oscar Ingasia[3], Daudi Nyaanga[1]

[1]Department of Agricultural Engineering, Egerton University, Nakuru, Kenya

[2]Department of Crops, Horticulture and Soils, Egerton University, Nakuru, Kenya

[3]Department of Agricultural Economics and Agribusiness, Egerton University, Nakuru, Kenya;

samwel.nyakach@egerton.ac.ke; jgnyaanga@egerton.ac.ke; ingasiaoa@egerton.ac.ke; dmnyaanga@egerton.ac.ke; [*]Phone: +254704134251

***[*]Corresponding author**: baqedoti95@gmail.com*

ABSTRACT

The consistent use of renewable energy sources is an effective way of reducing the dependency on fossil fuels and it can make a remarkable contribution to the reduction of CO_2 emissions and as a result reducing the carbon footprint hence eliminating the greenhouse effect. Biomass materials which goes to waste can be recovered through pyrolysis process in order to produce usable product like biochar which can be used as bio-fertilizer or source of energy for cooking. The aim of this research was to optimize the selected pyrolysis parameters in biochar production and quality from acacia twigs. The parameters varied were feedstock moisture content (10%, 15% and 20%), pyrolysis residence time (in minutes) 90, 135 and 180 and chimney inclination angle (30^o, 45^o and 60^o). An experimental insulated metallic carbonization kiln (1 m high and 0.5 m diameter) was developed and used. Response Surface Methodology technique by using *Box-Behnken Design* was used to develop a mathematical equation to predict the production and quality of the biochar with respect to varied parameters which was later optimized to determine the optimal conditions for biochar production and quality. The biochar quality was based on its moisture content (MC), volatile matter (VM), ash content (AC), fixed carbon (FC) and pH. The combined optimal conditions were 10% feedstock moisture content, 126.93 min pyrolysis residence time and 30^o chimney inclination angle resulting to production of 42.87%, MC = 4.78%, VM = 21.73%, AC = 3.72%, FC = 69.76% and pH = 9.04. The mathematical equation developed had a composite desirability of 0.9490 at p-value$\leq$0.05 which made it viable. These research findings are of importance since pyrolysis of the biomass material will maintain a balance in the environment and also serve as a source of livelihood when the product is sold as source of energy for cooking.

Keywords: *Renewable Energy, Pyrolysis, Biochar, Optimization, Carbonization Kiln*