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Pyrolysis Kinetics of Rice Hull: Influence of Soda Cooking

Bwire S. Ndazi[1*]

[1]*Department of Mechanical and Industrial Engineering, University of Dar es Salaam, P.O.Box 35131, Dar es Salaam, Tanzania.*

Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

The effect of soda cooking as an effective defibrillation technique of rice hull on its thermal stability has been investigated in this paper. The goal was to investigate the impact of the decomposition of lignin and silica during soda cooking on the thermal stability and kinetics of pyrolysis of the resulting rice hull products by thermal gravimetric analysis (TGA). Soda cooking was carried out using 2.5, 5, 7.5 and 10% NaOH in the cooking liquor at 170°C for 60 minutes. The resulting crude fiber was heated from 25 to 700°C under N_2 environment. The results have demonstrated that the removal of silica and lignin from the bulk structure of rice hull by soda cooking affect the thermal stability and pyrolysis kinetics of the rice hull. The final degradation temperature was reduced by 80°C from around 560°C to around 480°C and peaks of maximum decomposition temperatures of the second and third degradation steps shifted to lower temperatures by at least 50°C. The activation energies ranged from 84 to 202 kJ/mol. This revealed increasing trend of pyrolysis energies, from lower to higher decomposition steps. The pyrolysis reaction was a single order reaction since the reaction orders ranged from 0.5 to 0.98. Pyrolysis kinetics can be used to study the effect of chemical treatments of agricultural fibers e.g. by soda cooking.

Keywords: Activation energy; rice hull; soda cooking; pyrolysis; kinetics.

**Corresponding author: E-mail: bndazi@udsm.ac.tz;*