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Optimization of Syngas Quality for Fischer-Tropsch Synthesis

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Abstract : This research received no grant or financial support from any public, commercial, or none governmental agency. The author conducted this work as part of his normal research activities as a professor of Chemical Engineering at the University of Khartoum, Sudan. Abstract While fossil oil reserves have been receding, the demand for diesel and gasoline has been growing. In recent years, syngas of biomass origin has been emerging as a viable feedstock for Fischer-Tropsch (FT) synthesis, a process for manufacturing synthetic gasoline and diesel. This paper reports the optimization of syngas quality to match FT synthesis requirements. The optimization model maximizes the thermal efficiency under the constraint of H2/CO≥2.0 and operating conditions of equivalent ratio (0 ≤ ER ≤ 1.0), steam to biomass ratio (0 ≤ SB ≤ 5), and gasification temperature (500 °C ≤ Tg ≤ 1300 °C). The optimization model is executed using the optimization section of the Model Analysis Tools of the Aspen Plus simulator. The model is tested using eleven (11) types of MSW. The optimum operating conditions under which the objective function and the constraint are satisfied are ER=0, SB=0.66-1.22, and Tg=679 - 763°C. Under the optimum operating conditions, the syngas quality is H2=52.38 - 58.67-mole percent, LHV=12.55 - 17.15 MJ/kg, N2=0.38 - 2.33-mole percent, and H2/CO≥2.15. The generalized optimization model reported could be extended to any other type of biomass and coal. Keywords: MSW, Syngas, Optimization, Fischer-Tropsch.

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