

Catalytic effect of K_2CO_3 in steam gasification of lignite char on mole ratio of H_2/CO in syngas

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Abstrak

To fulfill the requirement for synthetic fuel (synfuel) production in Fischer Tropsch process, in which syngas feed to the process has H_2/CO mole ratio approaching 2, a lignite coal gasification is needed to satisfy this requirement. In this research, char particles were prepared by pyrolysis of lignite coal at controlled heating rates to obtain the highest possible surface area for gasification. The gasification used char with surface area of $172.5 \text{ m}^2/\text{g}$, and catalyst K_2CO_3 in a fixed bed reactor. Steam/char mass ratio used in this research was varied 2.0; 3.0; 4.0 and the gasification temperature was varied 675, 750, 825°C. The result of this research showed that the highest H_2/CO mole ratio of 2.07 corresponding to the mole ratio of gas yield/carbon of 1.13 was achieved at gasification temperature of 675°C using catalyst K_2CO_3 and at steam/char mass ratio of 2.0. However, at the same gasification conditions, but using no catalyst, H_2/CO mole ratio and corresponding mole ratio of gas yield/carbon achieved were 3.02 and 0.42 respectively. This research found that the addition of catalyst K_2CO_3 in lignite coal char gasification adversely reduces mole ratio H_2/CO ratio compared to that without catalysis. It is suspected that the high composition of mineral ash in ash reacts with K_2CO_3 catalyst which renders Boudouard reaction to considerably compete with water-gas reaction. The increases of gasification temperature and steam/carbon ratio both lower the mole ratio of H_2/CO in syngas.