Dynamic simulation of Shell entrained flow gasifier with high-moisture coal

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The effects of coal rank on the dynamic behaviors and efficiency variation of coal gasifier were studied by using a rigorous mathematical simulation model for the Shell coal gasification system. The dynamic model contains not only the inside gasifier but also wall structure, syngas quenching and cooling system after the gasifier because it can be applied for a part of an overall IGCC process simulation. To solve the complicated system, the model consists of several sub-models, such as devolatilization zone, reaction zone, quenching zone, and wall zone. For the validation of the dynamic model, the results using a standard coal were confirmed with the reference Shell data at steady state. Then five arbitrary coals with different moisture contents were selected for the simulation. As time increased, syngas was produced near the entrance of gasifier and started to come out at exit of the reaction zone within 0.5s. As using the dried coal, more CO and less H_2 was produced with almost the same total gas flow rate. The gas and slag temperatures were increased when the coal was dried. Therefore, the drying level of coal gave the syngas amount as well as steam generation in the membrane wall. It is expected that these simulated results can give a guideline to operate the gasifier according to coal rank.