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PII: S1385-8947(17)31475-4
DOI: http://dx.doi.org/10.1016/j.cej.2017.08.125
Reference: CEJ 17576

To appear in: *Chemical Engineering Journal*

Received Date: 8 June 2017
Revised Date: 14 August 2017
Accepted Date: 29 August 2017

Please cite this article as: L. Yan, Y. Cao, B. He, On the kinetic modeling of biomass/coal char co-gasification with steam, *Chemical Engineering Journal* (2017), doi: http://dx.doi.org/10.1016/j.cej.2017.08.125

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Abstract:

Co-gasification of biomass/coal blends is very promising due to many advantages. Kinetic modeling of the co-gasification process is, however, lagged behind, which is adverse to the development of the co-gasification technology. In this work, a scheme to set up kinetic models for the co-gasification of biomass/coal char blends is proposed. Based on the scheme, a kinetic model for the steam co-gasification of the blended biomass/coal char is built. The intra-particle diffusion, particle structure evolution and peripheral fragmentation are allowed for, and the effects of biomass blending ratio (BBR), gasification temperature, and steam partial pressure on the apparent co-gasfication kinetics are considered. The model prediction is compared against a series of experimental data in literature, and good agreement is achieved. It is concluded that the effects of BBR on the co-gasfication kinetics can be treated as a net increment of the coal char conversion rate, and the net increment can be well predicted by the random pore model. BBR has great impact on the particle structure and composition which greatly affect both the intrinsic kinetics and the intra-particle diffusion.

Keywords: Co-gasification; Alkali metals; Synergistic effect; Intra-particle diffusion; Kinetic modeling

1 Introduction

Catalytic gasification is very promising and has attracted many concerns due to the higher reaction rate at lower reaction temperature [1]. It is now commonly believed that the alkali and alkaline earth metals (AAEM) are among the most effective catalysts for gasification of solid carbonaceous fuels with H_2O and/or CO_2 [2]. However, it is also found that the alkali metals like potassium suffer incomplete recovery due to the formation of non-leachable compounds by reacting with the mineral matters in the coal ash, which makes the catalytic gasification uneconomical [3]. Since biomass is rich in

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