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Role of biomass during co-gasification of coal and biomass

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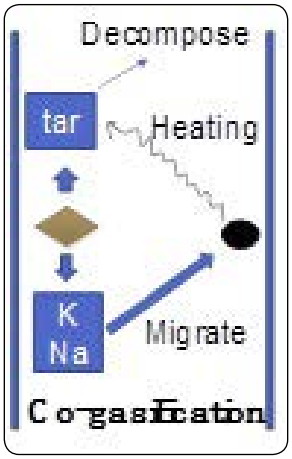
This article academically discusses the role of biomass during the co-gasification of coal and biomass, according to the effects of addition ratio of biomass, biomass ash, alkali metal compounds in biomass ash, and mineral matters in the coal on anthracite char gasification under CO_2 atmosphere. The transformation of organic structure and mineral matter in coal-biomass mixtures during co-gasification, the anthracite and rice straw addition with different ratios were isothermally gasified at 1100°C. The phase-mineral composition, morphology and organic structure of solid residues produced at different gasification time were analyzed by X-ray diffraction, scanning electron microscopy coupled with energy dispersive spectrometer, Raman spectroscopy and other methods. Results revealed that the organic structure was changed in char as it became less ordered with the addition of biomass. The bulk concentrations of K and Na and their bearing minerals and phases in char increased with the addition of biomass during gasification process. The transformation of mineral matter played a significant role in promoting the coal gasification. Biomass ash containing alkali metals has been proven as a natural and disposable catalyst for the thermal conversion of carbon-containing material. Meanwhile, it was observed that 50% biomass ash addition resulted in the agglomeration of the co-gasification ash. The catalytic effect of alkalis in biomass ash was attributed to the H_2O soluble and HCl insoluble forms alkali metal containing chemicals during gasification process. Catalytic activity of 2.5% biomass ash addition to demineralized coal char is similar to the 30% biomass ash addition to coal char. The mineral matter in the coal was observed to decrease the catalytic activity of the biomass ash which could be partially remedied by calcium additives. The catalytic mechanism of biomass ash on coal char gasification was elucidated. We researched the fusion process from sintering to melting of anthracite coal ash, rice straw ash and their mixture with different rice straw ash additions. Two different fusion mechanisms were applied to elucidate the fusion process with the increment of rice straw ash addition. The above results can be used in the development of coal-biomass co-gasification technology.



Recent Publications

1. Vassilev S V et al. (2017) Ash contents and ash-forming elements of biomass and their significance for biofuel application. Fuel. 208:377-409.
2. Qin Y H et al. (2017) Impact of biomass addition on organic structure and mineral matter of char during coal-biomass co-gasification under CO_2 atmosphere. Fuel. 202:556-562.
3. Zhang S et al. (2016) An advanced biomass gasification technology with integrated catalytic hot gas cleaning. Part III: effects of inorganic species in char on the reforming of tars from wood and agricultural wastes. Fuel. 183:177-184.
4. Du Z Y et al. (2016) Evolution properties of cellulose- and lignin-derived pyrolysis tars after interacting with coal chars. Journal of Analytical and Applied Pyrolysis. 122:332-341.

5. Du Z Y et al. (2016) Effects of secondary reactions on the destruction of cellulose-derived volatiles during biomass/coal co-gasification. Energy and Fuels. 30(2):1145-1153.

Biography

Wen Ying Li has her current research focused entirely on enabling discovery and design of processes and catalysts for sustainable energy, including converting coal to liquid and fuels, providing clean conversion technology from lower rank of coal and poor quality coal, clean and efficient catalytic pyrolysis and gasification of lignite and biomass, and optimizing traditional coal conversion processes and integrating carbon-based polygeneration system of carbon mitigation initiative.

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