

5-2 Carbon structure in chars with heat treatment and the reaction between carbon and mineral matter at high temperature

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In coal gasification and coal combustion systems, coal chars pass through various temperature regions, owing to recycling of char, multi stage operation and temperature distribution in reactor.

The aim of this work is to investigate the effect of heat treatment on chemical and physical properties of coal char. Twenty-one coals ranging from brown coal to anthracite coal were heat-treated at 900-1700 and the chars were characterized with TG, XRD, TEM and N₂ adsorption.

The gasification rate of char heated at heat treatment temperature ranging from 900-1700 decreased with an increase heat treatment temperature and the degree of decrease of the rate depended on coal rank. The decrease of gasification rate with heat treatment was occurred by decrease of catalytic activity of mineral matter and graphitization of carbonaceous.

The micro structure of coal char depends on the heat treatment temperature and the type of coal. For low rank coal and anthracite coal, the most part of coal char heat-treated at 900 were amorphous and cage-like carbons were developed for chars heated at 1700. The gasification manner strongly depended on the micro structure of carbon. Amorphous structural carbon in low rank coal char was easily gasified and small particles were remained. As the gasification proceeded, the outer layers of highly stacked carbon which were observed in the chars prepared at high temperature were disordered, then transformed to cluster structure and gasified.

The carbothermal reactions of quartz and kaolinite in coal char began, respectively, at temperatures as low as 1200 and 1500, with the evolution of CO. The formation of reaction products was quite dependent on heating conditions. Under Ar, the main products were SiC for quartz, and SiC and Al₂O₃ for kaolinite. Above 1550, Al₂O₃ gradually formed Al₄C₃. Under N₂, the carbothermic nitridation occurred for both quartz and kaolinite in company with the formation of SiC. For quartz, the products were SiC and hexagonal Si₃N₄ at 1600; however, no crystalline nitrides were distinctly observed at 1400. For the case of kaolinite, Si₃N₄ was appreciably formed at 1400 and it disappeared at 1600; above 1500, AlN was formed from Al₂O₃. Silicon carbide and aluminum nitride were the major products in the coals treated under nitrogen at 1600 for 10min.

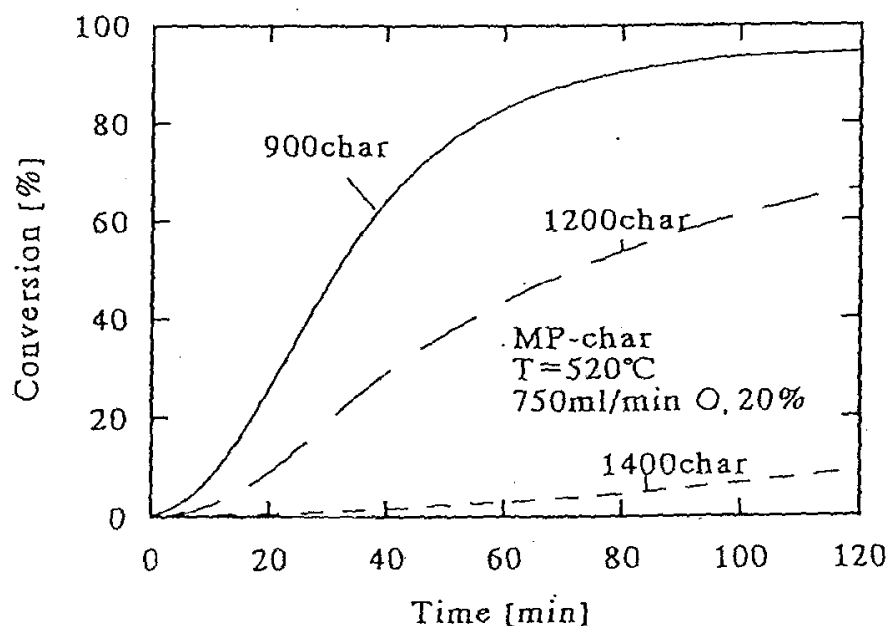


Fig. 1 Gasification profile of MPchar heat-treated