

煤催化气化过程中钾的迁移及其对气化反应特性的影响

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Transformation of potassium during catalytic gasification of coal and the effect on gasification

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摘要 在固定床反应器中研究了钾在热解和水蒸气气化过程中的变迁,并在TG-DSC上考察了钾系催化剂对煤焦水蒸气气化的催化效果以及随钾化合物形态变化的关系。结果表明,干混法和浸渍法添加碳酸钾对煤焦水蒸气气化的催化效果显著,煤焦的气化反应性随着钾添加量的增加而增大,当催化剂添加到一定量时催化效果陡增,同时神府煤钾的负荷饱和和添加量为10%。在煤样热解和气化过程中,钾的化学形态会发生变化,发现并定量了还原态钾中间体的生成。在气化过程中碳酸钾的催化规律和还原态钾中间体的数量之间存在对应关系,当碳转化率为0.2~0.4时,气化速率和还原态钾中间体的数量达到最大值。在700~800℃,钾系催化剂的催化作用和还原态钾中间体的数量之间也存在对应关系,即碳酸钾催化效果较好,氯化钾的催化效果较差,硫酸钾的催化效果随温度的变化明显。

关键词: 催化气化 碳酸钾 氯化钾 硫酸钾 钾变迁

Abstract: The transformation of potassium during pyrolysis and gasification was studied in a fixed bed. The effects of potassium based catalyst on the steam gasification reactivity and the transformation of potassium were investigated by TG-DSC. Results show that all the potassium carbonate loaded by either impregnation or mechanical mixing has a marked catalytic effectiveness. The reactivity of Shenfu char increases with potassium loadings up to a saturation loading of about 10%. The catalytic effect has a maximum value. The transformation of potassium and the amount of potassium intermediate have been confirmed during pyrolysis and gasification. And the reactivity of chars depends on the amount of potassium intermediate. Potassium carbonate has an obvious catalytic effect, and potassium chloride has a poor catalytic effect. However, the catalytic effect of potassium sulfate increases obviously with the increasing of temperature in the range of 700~800℃.

Key words: catalytic gasification potassium carbonate potassium chloride potassium sulfate transformation of potassium

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- [1] KITSUKA T, HAYASHI J, LI C Z. Some recent advances in the understanding of the pyrolysis and gasification behaviour of Victorian brown coal[J]. Fuel, 2007, 86(12/13): 1664-1683. 
- [2] LI C Z. Some recent advances in the understanding of the pyrolysis and gasification behaviour of Victorian brown coal[J]. Fuel, 2007, 86(12/13): 1664-1683. 
- [3] QUYN D M, HAYASHI J, LI C Z. Volatilisation of alkali and alkaline earth metallic species during the gasification of a Victorian brown coal in CO₂[J]. Fuel Process Technol, 2005, 86(12): 1241-1251. 
- [4] 林驹, 张济宇, 钟雪晴. 黏胶废液对福建无烟煤水蒸气催化气化的动力学和补偿效应[J]. 燃料化学学报, 2009, 37(4): 398-404. (LIN Ju, ZHANG Ji-yu, ZHONG Xue-qing. Kinetics and compensation effects during steam gasification of Fujian anthracite using viscose liquor as catalyst[J]. Journal of Fuel Chemistry and Technology, 2009, 37(4): 398-404.)
- [5] 杨景标, 蔡宁生, 张彦文. 催化剂添加量对褐煤焦水蒸气气化反应性的影响[J]. 燃料化学学报, 2008, 36(1): 15-22. (YANG Jing-biao, CAI Ning-sheng, ZHANG Yan-wen. Effect of catalyst loading on the gasification reactivity of a lignite char with steam[J]. Journal of Fuel Chemistry and Technology, 2008, 36(1): 15-22.) 
- [6] OHTSUKA Y, ASAMI K J. Ion-exchanged calcium from calcium carbonate and low-rank coals: High catalytic activity in steam gasification[J]. Energy Fuel, 1996, 10(2): 431-435. 
- [7] HAYASHI J I, IWATSUKI M, MORISHITA K, TSUTSUMI A, LI C Z, CHIBA T. Roles of inherent metallic species in secondary reactions of tar and char during rapid pyrolysis of brown coals in a drop-tube reactor[J]. Fuel, 2002, 81(15): 1977-1987. 
- [8] 战书鹏, 王兴军, 洪冰清, 于广锁, 王辅臣. 褐煤催化加氢气化实验[J]. 燃料化学学报, 2012, 40(1): 8-14. (ZHAN Shu-peng, WANG Xing-jun, HONG Bing-qing, YU Guang-suo, WANG Fu-chen. Experimental study on catalytic hydrogasification of lignite[J]. Journal of Fuel Chemistry and Technology, 2012, 40(1): 8-14.)
- [9] HUHN F, KLEIN J, JÜNTGEN H. Investigations on the alkali-catalysed steam gasification of coal: Kinetics and interactions of alkali catalyst with carbon[J]. Fuel, 1983, 62(2): 196-199. 
- [10] MOULIJN J A, KAPTEIJN F. Towards a unified theory of reactions of carbon with oxygen-containing molecules[J]. Carbon, 1995, 33(8): 1155-1165. 
- [11] KARIMI A, SEMGINA N, GRAY M R. Kinetics of catalytic steam gasification of bitumen coke[J]. Fuel, 2011, 90(3): 1285-1291. 
- [12] LINARES-SOLANO A, LOZANO-CASTELLÓD, LILLO-RÓDENAS M A, CAZORLA-AMOR S D. Carbon activation by alkaline hydroxides: Preparation and reactions, porosity and performance[J]. Chem Phys Carbon, 2007, 30(1): 1-62.
- [13] HUTTINGER K J, MINGES R. Influence of the catalyst precursor anion in catalysis of water vapour gasification of carbon by potassium: 1 Activation of the catalyst precursors[J]. Fuel, 1986, 65(8): 1112-1121. 
- [1] 王兴军, 陈凡敏, 刘海峰, 于广锁, 王辅臣. 煤水蒸气气化过程中钾催化剂与矿物质的相互作用[J]. 燃料化学学报, 2013, 41(01): 9-13.
- [2] 张思文, 沈来宏, 肖军, 顾海明, 宋涛. 基于碱金属和过渡金属修饰铁矿石载氧体的煤催化燃烧[J]. 燃料化学学报, 2012, 40(10): 1179-1187.
- [3] 洪冰清, 陈凡敏, 王兴军, 于广锁. KOH负载量对不同煤样加氢气化效果影响的实验研究[J]. 燃料化学学报, 2012, 40(09): 1032-1037.
- [4] 洪冰清, 战书鹏, 王兴军, 王辅臣, 于广锁. 不同金属化合物催化呼浩特煤加氢气化实验研究[J]. 燃料化学学报, 2012, 40(07): 782-789.
- [5] 战书鹏, 王兴军, 洪冰清, 于广锁, 王辅臣. 褐煤催化加氢气化实验研究[J]. 燃料化学学报, 2012, 40(01): 8-14.
- [6] 吴雁, 王豪, 钟婷, 赵伟威, 翟迎春. 水滑石负载碳酸钾的微波法制备及其催化酯化原油脱酸性能[J]. 燃料化学学报, 2011, 39(11): 831-837.
- [7] 崔阳, 徐龙, 刘艳, 马晓迅, 杨建丽. 基于改进BP神经网络的煤催化气化预测模型研究[J]. 燃料化学学报, 2011, 39(02): 90-93.
- [8] 林驹, 张济宇, 钟雪晴. 黏胶废液对福建无烟煤水蒸气催化气化的动力学和补偿效应[J]. 燃料化学学报, 2009, 37(04): 398-404.
- [9] JAFFRI Gul-e-rana, 张济宇. 混合气气氛下纸浆黑液和钙混合催化剂的催化气化特性[J]. 燃料化学学报, 2008, 36(04): 406-414.
- [10] 杨景标, 蔡宁生, 张彦文. 催化剂添加量对褐煤焦水蒸气气化反应性的影响[J]. 燃料化学学报, 2008, 36(01): 15-22.
- [11] JAFFRI G R, 张济宇. 热重法福建无烟煤二氧化碳催化气化的研究[J]. 燃料化学学报, 2007, 35(02): 129-135.
- [12] 林荣英, 张济宇, 陈志昊. 高变质程度无烟煤热天平二氧化碳加压催化气化动力学——热天平等温热重法[J]. 燃料化学学报, 2006, 34(05): 530-535.
- [13] 林驹, 张济宇. 福建无烟粉煤纸浆黑液富氧流化床催化气化研究[J]. 燃料化学学报, 2006, 34(03): 270-274.
- [14] 王黎, 张占涛, 陶铁托. 煤焦催化气化活性位扩展模型的研究[J]. 燃料化学学报, 2006, 34(03): 275-279.
- [15] 林荣英, 张济宇, 陈峰, 季春晗. 低活性无烟煤固定床二氧化碳催化气化反应动力学研究[J]. 燃料化学学报, 2005, 33(06): 677-682.

