燃料化学学报
JOURNAL OF FUEL CHEMISTRY AND TECHNOLOGY
ISSN 0253-24
CN 14-1140/T

燃料化学学报 » 2012, Vol. 40 » Issue (09): 1074-1080　DOI:

重油残渣焦水蒸气气化反应特性的研究

张乾[1,2], 李庆峰[1], 房倚天[1], 张林仙[1]
1. 中国科学院山西煤炭化学研究所, 山西 太原 030001;
2. 中国科学院研究生院, 北京 100049

Steam gasification reactivity of chars from heavy oil residue

ZHANG Qian[1,2], LI Qing-feng[1], FANG Yi-tian[1], ZHANG Lin-xian[1]
1. Institute of Coal Chemistry, Chinese Academy of Sciences, Taiyuan 030001, China;
2. Graduate University of Chinese Academy of Sciences, Beijing 100049, China

- 摘要
- 参考文献
- 相关文章
- 点击分布统计
- 下载分布统计

全文: PDF (637 KB)　HTML (1 KB)　输出: BibTeX | EndNote (RIS)　背景资料

摘要 采用常压热重分析仪,研究了重油残渣焦的水蒸气气化反应性,主要考察了热解温度、升温速率、停留时间及气化反应温度、气化剂分压对重油残渣焦水蒸气气化反应的影响,并借助XRD对残渣焦进行了分析表征。结果表明,气化温度950℃,60%水蒸气分压条件下,快速热解焦比慢速热解焦的气化反应性高;随制焦温度(500~900℃)的提高及停留时间的延长,焦的气化反应性降低。气化温度是影响重油残渣焦气化反应的主要因素,在900~1 050℃,温度每提高50℃,重油残渣焦气化反应时间几乎减半;随着水蒸气分压的提高,气化反应速率增加,但当气化剂分压高于60% 时,其对气化反应影响较小。采用均相模型和缩核模型对重油残渣焦气化曲线进行模拟,结果发现,缩核模型模拟相关性较好,其活化能为195.0 kJ/mol,指前因子A_0为$2.6\times10^7 min^{-1}$。

关键词: 重油残渣　热解焦　气化反应性　动力学

Abstract: The gasification reactivity of heavy oil residue chars in steam atmosphere was studied by Thermal Gravimetric Analyzer (TGA) and micro-crystalite of the char was analyzed by X-ray diffraction (XRD). The effects of heating rate, pyrolysis temperature, residence time, gasification temperature and the partial pressure of steam were evaluated separately. The results show that at 950℃ and 60% partial steam pressure, gasification reactivity of chars formed at slow heating rate is lower than that formed at fast heating rate. With increasing pyrolysis temperature and residence time, the reactivity of char decreases. Gasification temperature is the main factor influencing the gasification rate. From 900 to 1 050℃ the gasification time is almost halved with the increasing temperature of 50℃. The increasing of steam partial pressure can improve the gasification rates greatly until the partial pressure comes to 60%, and after that it has no significant effect. The homogeneous model and the shrinking core model were used to characterize the gasification kinetic parameters. The later model is better and the apparent activation energy is 195.0 kJ/mol, the preexponentiol factor A_0 is $2.6\times10^7 min^{-1}$.

Key words: heavy oil residue　char　gasification reactivity　kinetics

收稿日期: 2012-02-16;

基金资助:

国家重点基础研究发展规划(973计划, 2010CB22690603)。

通讯作者: 李庆峰,副研究员,主要从事煤气化研究,E-mail:lqf@sxicc.ac.cn。　E-mail: lqf@sxicc.ac.cn

引用本文:

张乾,李庆峰,房倚天等. 重油残渣焦水蒸气气化反应特性的研究[J]. 燃料化学学报, 2012, 40(09): 1074-1080.

ZHANG Qian,LI Qing-feng,FANG Yi-tian et al. Steam gasification reactivity of chars from heavy oil residue[J]. J Fuel Chem Technol, 2012, 40(09): 1074-1080.

服务
- 把本文推荐给朋友
- 加入我的书架
- 加入引用管理器
- E-mail Alert
- RSS

作者相关文章
- 张乾
- 李庆峰
- 房倚天
- 张林仙

[1] 李志强. 渣油加工仍是21世纪重要的石油炼制技术[J]. 当代石油石化, 2005, 13(4): 10-15. (LI Zhi-qiang. Residuum processing is still an important oil refining technology in 21 century[J]. Petroleum & Petrochemical Today, 2005, 13(4): 10-15.)

[2] 许志明, 陈平平, 朱厚兴, 赵锁奇. 辽河减压渣油-正戊烷体系的相态变化特性[J]. 燃料化学学报, 2010, 38(6): 691-695. (XU Zhi-ming, CHEN Ping-ping, ZHU Hou-xing, ZHAO Suo-qi. Phase characteristics of Liaohe vacuum residue - pentane system[J]. Journal of Fuel Chemistry and Technology, 2010, 38(6): 691-695.)

[3] 林世雄. 石油炼制工程[M]. 北京: 石油工业出版社, 2000. (LIN Shi-xiong. Petroleum refining engineering[M]. Beijing: Petroleum Industry Press, 2000.)

[4] IRFAN M F, USMAN M R, KUSAKABE. Coal gasification in CO_2 atmosphere and its kinetics since 1948: A brief review[J]. Energy, 2011, 36 (1): 12-40.

[5] SENNECA O. Kinetics of pyrolysis, combustion and gasification of three biomass fuels[J]. Fuel Process Technol, 2007, 88(1): 87-97.

[6] STRAKA P, BUCKO Z. Co-gasification of a lignite/waste-tyre mixture in a moving bed[J]. Fuel Process Technol, 2009, 90(10): 1202-1206.

[7] BARAKOS N, PASIAS S, PAPAYANNAKOS N. Transesterification of triglycerides in high and low quality oil feeds over an HT2 hydrotalcite catalyst[J]. Bioresource Technol, 2008, 99(11): 5037-5042.

[8] ALONSO D M, MARISCAL R, MORENO-TOST R, POVES M D Z, GRANADOS M L. Potassium leaching during triglyceride transesterification using K/-Al_2O_3 catalysts[J]. Catal Commun, 2007, 8(12): 2074-2080.

[9] ZOU J H, ZHOU Z J, WANG F C, ZHANG W, DAI Z H, LIU H F, YU Z H. Modeling reaction kinetics of petroleum coke gasification with CO_2 [J]. Chem Eng Process, 2007, 46(7): 630-636.

[10] 颜芳, 袁振宏, 吕鹏梅, 罗文, 杨玲梅, 邓利. 亚铁锌双金属氰化络合物固体催化剂催化合成生物柴油[J]. 燃料化学学报, 2010,38(3): 281-286. (YAN Fang YUAN Zhen-hong, LV Peng-mei, LUO Wen, YANG Ling-mei, DENG Li. Synthesis of biodiesel by Fe(Ⅱ)-Zn double-metal cyanide complexes [J]. Journal of Fuel Chemistry and Technology, 2010,38(3): 281-286.)

[11] 董喜贵, 雷群芳, 俞庆森. 石油沥青质的热解动力学研究[J]. 浙江大学学报, 2004, 31(6): 652-656. (DONG Xi-gui, LEI Qun-fang, YU Qing-sen. Thermal pyrolysis kinetics of asphaltenes from several crude oils[J]. Journal of Zhejiang University (Science Edition), 2004, 31(6): 652-656.)

[12] 靳福全, 孟丽君, 王晶晶, 李霞, 刘强. 蓖麻油生物柴油的减压蒸馏及气-质谱分析[J]. 中国油脂, 2011,(8): 69-73. (JIN Fu-quan, MENG Li-jun, WANG Jing-jing, LI Xia, LIU Qiang. Vacuum distillation and GC/MS analysis of castor biodiesel[J]. China Oils and Fats, 2011,(8): 69-73.)

[13] GONG J-S, FU W-B, ZHONG B-J. A study on the pyrolysis of asphalt[J]. Fuel, 2003, 82(1): 49-52.

[14] DO P T, CHIAPPERO M, LOBBAN L L, RESASCO D E. Catalytic deoxygenation of methyl-octanoate and methyl-stearate on Pt/Al_2O_3[J]. Catal Lett, 2009, 130(1/2): 9-18.

[15] ARASH K, NATALIA S, MURRAY R G. Kinetics of catalytic steam gasification of bitumen coke[J]. Fuel, 2011, 90(3): 1285-1291.

[16] LJUBISA R, KATARZYNA S, PHILIP L. Combined effects of inorganic constituents and pyrolysis conditions on the gasification reactivity o coal chars[J]. Fuel Process Technol, 1985, 10(3): 311-326.

[17] 李春玉, 房倚天, 赵建涛, 王洋.晋城无烟煤加压快速热解特性及其对气化反应的影响[J]. 燃料化学学报, 2010, 38(4):391-397. (LI Chun-yu, FANG Yi-tian, ZHAO Jian-tao, WANG Yang. Pressurized fast pyrolysis of Jincheng anthracite and its effect on gasification reactivity[J]. Journal o Fuel Chemistry and Technology, 2010, 38(4): 391-397.)

[18] REN H, ZHANG Y, FANG Y, WANG Y. Co-gasification behavior of meat and bone meal char and coal char[J]. Fuel Process Technol, 2011 92(3): 298-307.

[19] DONNIS B, EGEBERG R, BLOM P, KNUDSEN K. Hydroprocessing of bio-oils and oxygenates to hydrocarbons. understanding the reaction routes[J]. Top Catal, 2009, 52(3): 229-240.

[20] ZHANG L, HUANG J, FANG Y, WANG Y. Gasification reactivity and kinetics of typical Chinese anthriacite chars with steam and CO_2[J]. Energy Fuels, 2006, 20(3):1201-1210.

[21] SENOL O I, RYYMIN E M, VILJAVA T R, KRAUSE A O I. Effect of hydrogen sulphide on the hydrodeoxygenation of aromatic and aliphatic oxygenates on sulphided catalysts[J]. J Mol Catal A, 2007, 277(1/2): 107-112.

[22] 黄艳琴, 阴秀丽, 吴创之, 汪从伟, 谢建军, 周肇秋, 马隆龙, 李海滨. 稻杆半焦与CO_2气化反应特性的研究[J]. 燃料化学学报, 2009, 37(3): 289-295. (HUANG Yan-qin, YIN Xiu-li, WU Chuang-zhi, WANG Cong-wei, XIE Jian-jun, ZHOU Zhao-qiu, MA Long-long, LI Hai-bin. Study on CO_2 gasification reactivity of rice straw chars[J]. Journal of Fuel Chemistry and Technology, 2009, 37(3): 289-295.)

[23] 陈壹华. 石油焦热处理过程的研究[J]. 轻金属, 1992, 6: 46-51. (CHEN Yi-hua. Investigation of heat-treated petroleum cokes[J]. Light Metals, 1992, 6: 46-51.)

[24] 王明敏, 张建胜, 张守玉, 吴晋沪, 岳光溪. 热解条件对煤焦结构及孔隙结构及气化反应活性的影响[J]. 煤炭转化, 2007, 30(3): 21-24. (WANG Ming-min, ZHANG Jian-sheng, ZHANG Shou-yu, WU Jin-hua, YUE Guang-xi. Effect of pyrolysis conditions on the strcture and gasification reactivit

of char[J]. Coal Conversion, 2007, 30(3): 21-24.)

[25] LOTERO E, LIU Y, LOPEZ D E, SUWANNAKARN K, BRUCE D A, GOODWIN J G. Synthesis of biodiesel via acid catalysis[J]. Ind Eng Chem Res, 2005, 44(14): 5353-5363.

[26] WU Y, WU S, GU J, GAO J. Differences in physical properties and CO_2 gasification reactivity between coal char and petroleum coke[J]. Process Safety Environ Protect, 2009, 87(5): 323-330.

[27] 何选明. 煤化学[M]. 北京: 冶金工业出版社, 1984. (HE Xuan-ming. Coal chemisitry[M]. Beijing: Metallurgical Industry Press, 1984.)

[28] 李庆峰, 房倚天, 张建民, 王洋, 时铭显, 孙国刚. 石油焦水蒸气气化反应特性[J]. 燃料化学学报, 2003, 31(3): 204-208. (LI Qing-feng, FANG Yi-tian, ZHANG Jian-min, WANG Yang, SHI Ming-xian, SUN Guo-gang. Setam gasification characteristics of pertroleum coke[J]. Journal of Fuel Chemistry and Technology, 2003, 31(3): 204-208.)

[29] 文芳. 热重法研究煤焦H_2O气化反应动力学[J]. 煤炭学报, 2004, 29(3): 350-353. (WEN Fang. Study on reaction kinetic of steam-coal chars gasification with TGA[J]. Journal of China Coal Society, 2004, 29(3): 350-353.)

[1] 黎柴佐, 冉景煜. 生物质焦油热裂解动力学参数实验研究[J]. 燃料化学学报, 2012, 40(09): 1060-1066.

[2] 王美君, 付春慧, 常丽萍, 谢克昌. 逐级酸处理对锡盟褐煤的结构及热解特性的影响[J]. 燃料化学学报, 2012, (08): 906-911.