Numerical Study of Smoldering Combustion of Activated Carbon in Ⅱ Iodine Absorber

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Abstract

Iodine absorber is a widely used purification equipment for purifying air in a nuclear power plant. In China, the common type is Ⅱ iodine absorber. Impregnated activated carbon is the main absorber within the iodine absorber. Because of the decays exothermic of radioactive iodine, heat is generated in the adsorption process. Carbon is a combustible material. Moreover, air is always supplied in the process. The three elements a fire needs to ignite are present. So it is necessary to study the fire risk of iodine absorber. COMSOL Multiphysics® software was adopt in the study. The effects of inlet velocity on smoldering combustion, the distribution characteristics of the velocity field, and the effect of thermal conductivity on the smoldering combustion were investigated in the study .The results showed that smoldering combustion is more stable when the wind speed was about 2m/s; that the utilization rate of activated carbon is uneven in the absorber; and that the smoldering flame is very hard to spread when the thermal conductivity was larger than 0.10Wm-1 • k-1.

Reference

[1] 王 ,王茂, 杰等,除 化机 消防 淋系 的 合 [J]. 空 技 ,2012.9（3）.
[2] 王建民, 英 等,核 高效 吸附器[D].北京：原子能出版社,1988,8.
[3] 云,高雷等,III型活性炭 吸附器 完整性分析[D].上海核工程 究 院,2012.
[4] 肖 ,朱立新等, 吸附器在核 通 系 中的 用[J].核安全, 2011.2.
[5] 莫善 ,袁灼新,梁 等. 敞 件下多孔可燃物 燃 究[J].中山大 （自然科 版）,2013.4.（52）
[6] 王笑微.唐金 .童楚 等.核 机 蒸汽管道保 燃原因分析及防治. 力 . 2013.2.（42）
[7] 山. 充床 燃 播的 模 及 燃着火一熄火、向明火 特性分析[D]. [博士 位 文]. 大 ：大 理工大 ,2007,9.
[8] Stephanie L. Macphee, Jason I. Gerhard, Guillermo Rein. A novel method for simulating smoldering propagation and its application to STAR (Self-sustaining Treatment for Active Remediation) [J].Environmental Modelling & Software 31 (2012) 84-98.
[9] Amanda B. Dodd, Christopher Lautenberg, Carlos Fernandez-pello. Computational modeling of smolder combustion and spontaneous transition to flaming[J]. Combustion and Flame 159 (2012) 448–461.
[10] Fang He, Frank Behrendt. Experimental investigation of natural smoldering of char granules in a packed bed[J]. Fire Safety Journal 46 (2011) 406–413.
[11] Kinbara T, Endo H, Sega S. Downward propagation of smoldering combustion through solid materials. Eleventh Symposium on Combustion. Pittsburgh：The Combustion Institute,1967：525.
[12] M.S. Saidi, M.R. Hajaligol, A. Mhaisekaretc. A 3D modeling of static and forward Smoldering combustion in a Peaked bed of materials. Applied Mathematical Modelling,2007,31(9):1970-1996.

Figures used in the abstract

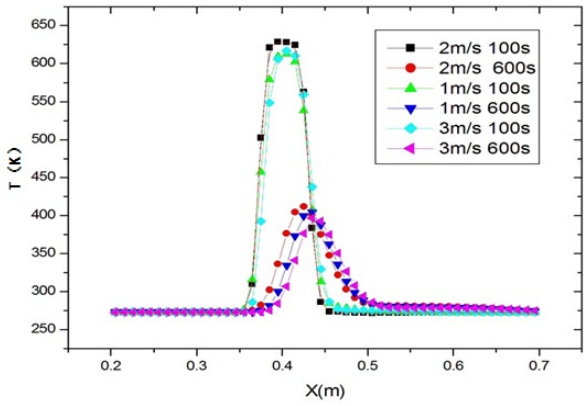

Figure 1: Temperature curves under different inlet velocity.

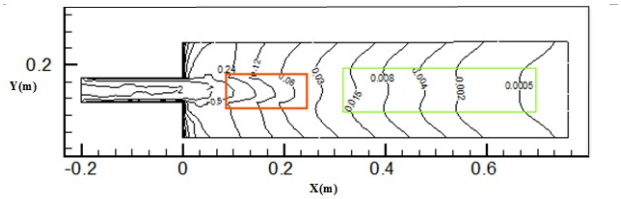

Figure 2: Contours of the velocity in iodine absorber (m.s-1).

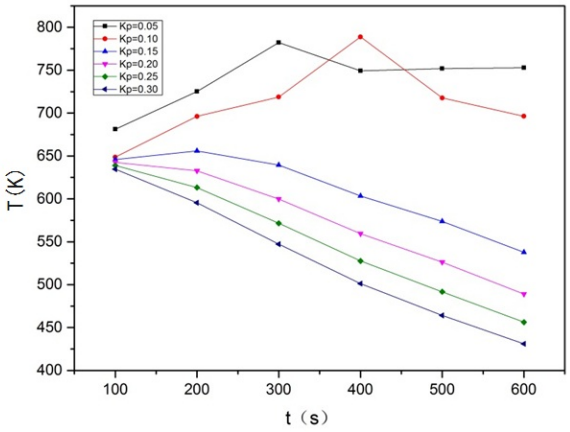

Figure 3: Graph of temperature under different thermal conductivity.

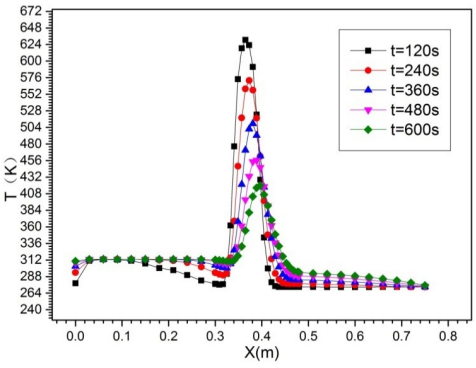

Figure 4: Heat at different time points of the temperature profile.