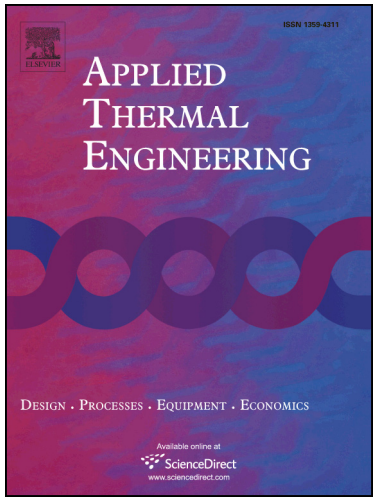

Research Paper

Visualization Study of the Influence of Non-Condensable Gas on Steam Condensation Heat Transfer

Qiujie Yi, Maocheng Tian, Weijie Yan, Xiaohang Qu, Xianbing Chen

PII: S1359-4311(16)30812-2
DOI: http://dx.doi.org/10.1016/j.applthermaleng.2016.05.134
Reference: ATE 8349

To appear in: *Applied Thermal Engineering*

Received Date: 5 March 2016
Revised Date: 6 May 2016
Accepted Date: 23 May 2016

Please cite this article as: Q. Yi, M. Tian, W. Yan, X. Qu, X. Chen, Visualization Study of the Influence of Non-Condensable Gas on Steam Condensation Heat Transfer, *Applied Thermal Engineering* (2016), doi: http://dx.doi.org/10.1016/j.applthermaleng.2016.05.134

Visualization Study of the Influence of Non-Condensable Gas on Steam Condensation Heat Transfer

Qiujie Yi[1,2], Maocheng Tian[1*], Weijie Yan[3], Xiaohang Qu[1], Xianbing Chen[1]

(1 School of Energy and Power Engineering, Shandong University, Jinan 250061, Shandong Province, China; 2 College of Mechanical and Electronic Engineering, Shandong University of Science and Technology, Qingdao 266590, Shandong Province, China; 3 School of Electric Power Engineering, China University of Mining and Technology, Xuzhou 221116, Jiangsu Province, China)

Abstract: This paper experimentally investigates the influence of non-condensable gas on water vapor condensation heat transfer on an isothermal vertical aluminum plate in an air mass fraction range of 0.05-0.5. A high-speed digital camera was employed to capture real-time images of water vapor condensation in non-condensable gas under different wall temperatures and air concentrations. The experimental results showed that the condensation modes varied with surface subcooling and air concentration. Four condensation modes were observed in the experiments: drop, drop-streak, film, and streamlet. Under identical air concentrations, the condensation mode varied from the fine drop and film mode to the larger drop-streak mode; the condensation drop diameters departing the plate became obviously bigger, the drops fell off the plate more quickly, and the heat transfer coefficients decreased gradually as surface cooling increased. Under identical surface cooling conditions, the condensation drops grew and fell off more quickly when the air mass fraction was low, the condensation drops irregularly varied from drop, drop-streak, to ribbon stream, and the condensation had a tendency to spread out. The heat transfer coefficients decreased with the increase of the air mass fraction. The heat transfer coefficient declined greatly under a lower air mass fraction (5-10%), while it declined slightly under a higher air mass fraction (40-50%).

Keywords: high-speed camera system; non-condensable gas; condensation heat transfer; condensation mode