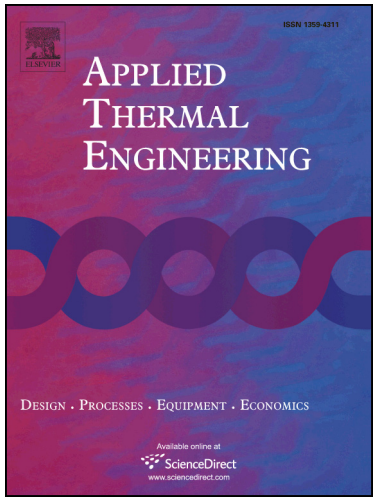

Research Paper

Numerical Investigation of Condensation in Inclined Tube Air-cooled Condensers

Kaipo Kekaula, Yitung Chen, Ting Ma, Qiu-wang Wang

PII: S1359-4311(16)33220-3
DOI: http://dx.doi.org/10.1016/j.applthermaleng.2017.03.001
Reference: ATE 10002

To appear in: *Applied Thermal Engineering*

Received Date: 10 November 2016
Accepted Date: 1 March 2017

Please cite this article as: K. Kekaula, Y. Chen, T. Ma, Q-w. Wang, Numerical Investigation of Condensation in Inclined Tube Air-cooled Condensers, *Applied Thermal Engineering* (2017), doi: http://dx.doi.org/10.1016/j.applthermaleng.2017.03.001

Numerical Investigation of Condensation in Inclined Tube Air-cooled Condensers

Kaipo Kekaula[a], Yitung Chen[a,*], Ting Ma[b], Qiu-wang Wang[b]

[a] Department of Mechanical Engineering, University of Nevada, Las Vegas, 4505 Maryland Parkway, Box 454027, Las Vegas, NV 89154-4027, United States
[b] Key Laboratory of Thermo-Fluid Science and Engineering, MOE, Xi'an Jiaotong University, Xi'an, Shaanxi 710049, China

*Corresponding Author: Yitung.Chen@unlv.edu

ABSTRACT

Air-cooled condensers (ACC) have the potential to drastically reduce water consumption in power plants using a steam Rankine cycle operating; however, there are very few comprehensive models to simultaneously describe the heat and mass transfer effects for both the air and steam domains. This paper presents a coupled model for laminar film condensation and air side convective cooling for an inclined air cooled condenser tube. The air-side fluid flow is modeled using ANSYS Fluent. A Nusselt thin film analysis is then used to describe the film thickness in the upper region of the tube interior with a pool condensation model used to define the axial flow in the lower region. The commonly used isothermal boundary condition is relaxed by applying the heat transfer at the tube surface on the air-side to the inside tube surface during the film analysis to investigate the impact on the local film thickness and the overall heat transfer coefficient of the condenser. The results are related to the heat transfer on both staggered and inline tube configurations.

Highlights:

- The thermal performance of air-cooled heat exchangers is studied analytically and numerically.
- A stratified film condensation model is introduced for flow in an inclined tube with convective cooling.
- A film condensation model is coupled to a measured air-side local heat transfer coefficient distribution.
- Numerically predicted local heat transfer coefficients for a tube bundle are coupled to a film condensation model.

Keywords: Air-cooled Condensers, Multiphase Flow, Condensation, Heat Exchanger

1 INTRODUCTION