KOLLOQUIUM ÜBER NEUERE ARBEITEN AUF DEM GEBIETE
DER MECHANIK UND STRÖMUNGSLEHRE
an der Technischen Universität Wien

EINLADUNG

zum Vortrag von Herrn

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über

"Modeling Condensation of Steam in the Presence of Air in a Shell-and-Tube Condenser Based on Film Theory"

Zeit: Mittwoch, 30. Sept 2009, 16:00 Uhr c.t.

Ort: SEM 322
Institut f. Strömungsmechanik und Wärmeübertragung,
Resselg. 3, Stiege 2, 1. Stock, 1040 Wien

Mit finanzieller Unterstützung durch
AIC-ANDROSCH INTERNATIONAL MANAGEMENT CONSULTING GMBH

“Modeling Condensation of Steam in the Presence of Air in a Shell-and-Tube Condenser Based on Film Theory”

Yousef Haseli

When condensation of a binary or multi-component mixture takes place, Film Theory presents a clear formulation of the phenomena; which was initially presented by Colburn and co-workers in 1930s. This work aims to scale up the heat and mass transfer equations of Film Theory – originally derived for a local condensation domain – for a commercial scale condenser. Through development of the fundamental equations of Film Theory, condensation of steam in the presence of air in a horizontal counter-current shell and one-path tube condenser is modeled. The interaction between heat and mass transfer and hydrodynamics in the shell-side is taken into consideration. A comparison between the predictions of the model and a set of experimental data available in the archival literature indicates excellent accuracy of the new formulation. Additionally, the effects of air leakage and upstream cooling water temperature are investigated to determine how they influence the total condensation rate, shell-side gas temperature and pressure drops. The results show that the total condensation rate decreases 5% and 20.5% for an air leakage of 1% and 5%, respectively, compared to the situation of pure vapor. Also, increasing the inlet cooling water temperature from 46.5°C to 48.5°C leads to 16.2% reduction in the total condensation rate, i.e., 8.1% per °C. However, this ratio is higher at high temperatures. For example, as the cooling water temperature rises from 50°C to 51°C under identical process conditions, the total condensation rate decreases 11.7% (per °C).