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Local Heat Transfer Coefficients for Reflux Condensation Experiment in a Vertical Tube in the Presence of Noncondensible Gas

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Abstract

The local heat transfer coefficient is experimentally investigated for the reflux condensation in a countercurrent flow between the steam-air mixture and the condensate. A single vertical tube has a geometry which is a length of 2.4m, inner diameter of 16.56mm and outer diameter of 19.05mm and is made of stainless steel. Air is used as a noncondensible gas. The secondary side is installed in the form of coolant block around vertical tube and the heat by primary condensation is transferred to the coolant water. The local temperatures are measured at 15 locations in the vertical direction and each location has 3 measurement points in the radial direction, which are installed at the tube center, at the outer wall and at the coolant side. In three different pressures, the 27 sets of data are obtained in the range of inlet steam flow rate 1.348~3.282kg/hr, of inlet air mass fraction 11.8~55.0%. The local heat transfer coefficient increases as the increase of inlet steam flow rate and decreases as the decrease of inlet air mass fraction. As an increase of the system pressure, the active condensing region is contracted and the heat transfer capability in this region is magnified. The empirical correlation is developed represented with the 165 sets of local heat transfer data. As a result, the Jacob number and film Reynolds number are dominant parameters to govern the local heat transfer coefficient. The rms error is 17.7% between the results by the experiment and by the correlation.