Experimental Investigation of Flow and Convection Heat Transfer of Supercritical CO_2 in a Horizontal Tube During Cooling

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The pressure drop and heat transfer coefficients for carbon dioxide at super-critical pressures in horizontal tube during cooling were measured experimentally. The tube in which carbon dioxide flows is made of copper with an inner diameter of 1.97 mm. The local heat transfer coefficients were determined through a combination of experimental measurements and numerical simulations. The CFD code FLUENT 6.3 was used to simulate the convection heat transfer of the cooling water in the outside channel to determine the local heat flux on the outside wall of the tube for the experimental conditions. The local heat transfer coefficients were then calculated from measured temperatures on the outside wall of the test section and the local heat flux from the numerical simulations. Validity of the method for calculating the local heat flux was verified in some related experiments. The maximum error of the local heat flux between the validation experiments and the numerical simulation was less than 15 %. Experiments were conducted for various CO_2 mass flow fluxes, inlet temperatures and system pressures. Finolenko's equation was found to be able to give reasonable prediction to pressure drop under conditions this paper concerned. The convection heat transfer is greatly intensified when the wall temperature was nearing the pseudo critical temperature and the bulk temperature was a little higher than the pseudo critical temperature.