Trans-critical Carbon Dioxide Flow in a Tubular Heat Exchanger: Applications in Waste Heat Recovery[1]

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ABSTRACT

Non-linear thermo-physical property variations in near-critical fluids give rise to large heat transfer coefficients, thus making it an ideal fluid for harnessing waste heat. Heat recovery from a power plant steam condenser by utilizing a trans-critical flow of carbon dioxide in a bottoming cycle is considered. Thermal transport characteristic of trans-critical carbon dioxide flowing in a tubular heat exchanger is numerically investigated. Trans-critical carbon dioxide flowing in a circular cross-section tube with the outer wall heated by condensing steam (isothermal wall) is considered for both horizontal and vertical configurations. The thermal transport characteristics for both configurations are examined. Due to the rapid and large variations of thermo-physical properties with small temperature changes, trans-critical fluid flows are usually characterized by the development of mixed convection and buoyancy plays a significant role on the flow dynamics. Effect of buoyancy on the thermal transport characteristics is also investigated. The predicted results from the present study can be used in designing waste heat driven Organic Rankin Cycles (ORC) for power generation.

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