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Effects of Equations of State Selection in Numerical Simulations of Supercritical Carbon Dioxide[1] ELIZABETH RASMUSSEN, Mechanical Engineering Department, University of Washington, MICHAEL MARTIN, SHASHANK YELLAPANTULA, National Renewable Energy Labratory, JOHN KRAMLICH, Mechanical Engineering Department, University of Washington — Supercritical carbon dioxide (sCO_2) is employed in a growing range of applications including novel material synthesis and advanced energy systems. However, a lack of understanding of how the complex behavior of sCO_2 near the critical point 304.25 K and 7.39 MPa affects the flow field, accompanied by numeric challenges of simulating under these conditions, limits the use of simulation as a predictive tool in these systems. Initial simulations using the high-fidelity Span-Wagner equation of state at a pressure of 8 MPa, fluid and wall temperatures ranging from 305 K to 390 K, and Reynolds numbers ranging from 0.1 to 35, show complex changes in flow and heat transfer. When simulations are repeated using the ideal gas law, Soave-Redlich-Kwong, and Peng-Robinson equations of state to the system, many of these effects are not fully captured. We compare the drastically different flow characteristics between non-ideal and ideal models as well as present on the computational cost of the varying degrees of accuracy.

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