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Abstract	:	The supercritical Carbon Dioxide Extraction (ScCO₂E) process is a sustainable method that relies on effective solute-solvent interactions. However, the prevailing focus among chemical engineers has overlooked the solute-solvent interaction due to the inherent high-pressure and high-temperature conditions of the process. This study compares the performance of two multiphase models, Mixture and EMVOF, in simulating three-phase flow dynamics in a fluidized bed reactor with supercritical CO₂ (ScCO₂) and solid particles. A properly multiphase model selection will facilitate the evaluation of the phase's interaction during the extraction process which could enhance its performance. Using the Ansys Fluent platform, the models were assessed for their ability to simulate phase interactions during the extraction process. Time-series plots, probability density functions (PDFs), and statistical analyses of ScCO₂ and particle velocities were compared with experimental results. The Mixture and EMVOF models with sharp/disperse interface modelling and a disperse viscous scheme demonstrated reasonable error ranges of 59% to 85% and 30% to 68%, respectively, for ScCO₂ velocities. The sharp/disperse interface model successfully distinguished the boundary between air and the solute-solvent phases, while the disperse model exhibited broader phase interfaces. However, the simulations revealed no significant circulation of phases, likely due to the absence of drag and lift forces in the models.