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Paper Information

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Title: Transient Characteristics of a Porous Steam Methane Reforming Reactor

Presenter Short CV

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Abstract

Steam–methane reforming (SMR) remains the workhorse for large-scale hydrogen, yet real plants face transients during start-up, load changes, and control actions. This work develops and validates a two-dimensional transient porous-media CFD model of a single SMR tube in ANSYS Fluent 2024 R2, with user-defined functions (UDFs) implementing reforming kinetics and porous source terms. After mesh/time-step independence and validation against literature data – steam to carbon ratio (S/C) = 3 and P = 5 bar, the model is used to quantify how temperature (700–1000 K), pressure (5–20 bar), and S/C (2–5) shape both the dynamic approach to steady state and the final methane conversion. At P = 10 bar and S/C = 3, raising temperature increases plateau conversion from 15% (700 K) to 76% (1000 K) and shortens the response. At 1000 K and S/C = 3, lower pressure improves conversion (90% at 5 bar vs 60–65% at 20 bar). Increasing S/C boosts conversion with diminishing returns beyond 4 (=96–97%). Transient trajectories exhibit a fast near-wall response followed by a slower core warm-up, with outlet compositions (H_2, CO_2, CH_4) settling over 120–300 s depending on conditions.