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OPTIMIZATION OF THE PERFORMANCE OF A CROSS-FLOW GAS MIXER FOR A PARTIAL OXIDATION REACTOR THROUGH NUMERICAL MODELLING

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Abstract – Efficient mixing of gases has many different applications in science and engineering. Gas mixers are often used in chemical reactors that use pre-mixed gases in their reaction process. In this work, we vary the geometry of a mixer in order to maximize the uniformity of the mixed gases. The mixing happens in several pipes that have small cross-flow inlets on the sides that stimulate turbulent mixing. The mixer geometry is varied by changing the configuration of the small cross-flow inlets on the pipes, and the mixing quality is quantified by the distribution of gases at certain distances from the cross-flow inlets. The flow was modelled by using open-source finite volume code. We show that standard RANS k-ϵ steady state numeric models greatly overestimate the mixing rate between different gasses, as it ignores transient changes in the flow. Transient simulations using a LES turbulence model show that the gas concentrations in the mixing pipe exhibit a pulsating behavior. The amount and the configuration of the cross-flow inlets play a significant role in how the gases mix and how the concentrations vary over time. The resulting mixer geometry will be used as a part of a partial oxidation reactor design in the future.

Keywords – Computational fluid dynamics; gas mixing; partial oxidization; shape optimization; syngas production

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