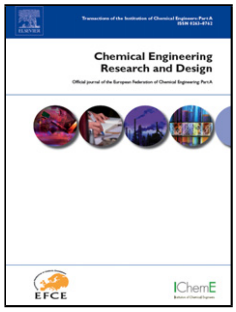

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Author: Marco Gianotti Pret Domenico Ferrero Andrea Lanzini Massimo Santarelli

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Thermal design, modeling and validation of a steam-reforming reactor for fuel cell applications

Marco Gianotti Pret, Domenico Ferrero*, Andrea Lanzini, Massimo Santarelli

Department of Energy, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129, Torino, Italy.

**Corresponding author*. Tel.: +39 011 0904560; E-mail address: domenico.ferrero@polito.it

Highlights

- CFD model of a steam reforming reactor operating within an SOFC plant is validated.
- Novel reactor integrated with after-burning section of SOFC system is designed.
- Integrated reactor shows increased CH_4 conversion and improved performance.

Abstract

This work deals with the design and modeling of a fuel processor integrated in a Solid Oxide Fuel Cell (SOFC) system. The reactor performs the steam reforming of the primary fuel of the SOFC anode, and it is thermally sustained by the combustion of the lean anode exhaust stream.

A computational fluid dynamic (CFD) model of the catalytic bed reactor that takes into account the steam-reforming kinetic mechanisms was implemented and validated against experimental measurements on an electrically heated reactor that is operated in conjunction with an SOFC stack. The numerical model was subsequently applied to the design and simulation of a novel reactor that is thermally integrated with the rest of the plant. The purpose of this work is to find a reactor's configuration that is suitable for full-scale applications, in which the endothermic reforming reaction is sustained by the exothermicity of other components within the fuel cell plant. The new reactor has been designed by integrating the reformer and the after-burning section of the SOFC system in a single device, in which the reactor is heated by the combustion of the anode's exhaust.