Power-to-gas through high temperature electrolysis and carbon dioxide methanation: reactor design and process modeling

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Description
This work deals with the coupling between high temperature steam electrolysis using solid oxide cells (SOEC) and carbon dioxide methanation to produce a synthetic natural gas (SNG) directly injectable in the natural gas distribution grid via a power-to-gas (P2G) pathway. An intrinsic kinetics obtained from the open literature has been used as the basis for a plug flow reactor model applied to a series of cooled multitube fixed bed reactors for methane synthesis. Evaporating water has been considered as coolant, ensuring a high heat transfer coefficient within the shell side of the reactor. A methanation section has been designed and optimized in order to moderate the maximum temperature within the catalytic bed and to minimize the catalyst load. Then, process modeling of a plant coupling high temperature electrolysis and methanation is presented: the main goal of this analysis is the calculation of overall plant …