Biogas reforming integrated with PEM and liquid oxygen storage system for green hydrogen production: Design to uncertainty quantification

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PEM is a mature technology to produce hydrogen using fluctuated renewable energy, but still utilization of oxygen from PEM has potential to integrate with reforming process. In this study, we proposed biogas autothermal reforming integrated with PEM and oxygen liquefaction system, to achieve continuous production of green hydrogen. Under uncertainties of renewable power and biogas composition, the surrogate model based on spare polynomial chaos expansion (PCE) is constructed for prediction of outputs including hydrogen production rate and levelized cost of hydrogen (LCOH). Using latin hyper cub sampling, 2000 samples are used to constructing the surrogate model and leave-one-out error is 2.04e-16. In certain range of the uncertainties, the proposed sysetm shows distribution of production rate from 120 to 240kmole/hr and LCOH from 0.5 to 5, respectively. Conclusively, the constructed model, which highly predicts the output under uncertainties, is used for robust optimization of minimal LCOH to determine design parameters of the proposed system.