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Increasing the performance of a methane steam reforming reaction in a membrane reactor by multi-objective optimization

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Steam reforming of methane (SRM) is the main route of hydrogen production process. It is possible to carry out this reaction in a membrane reactor (MR). A hydrogen perm-selective membrane is able to separate the produced H_2 in the reactor and increase methane conversion by shifting the equilibrium. This H_2 removal may also increase the risk of catalyst deactivation due to coke formation in the system. The amount of permeation through the membrane and membrane position/configuration are some of the main parameters that can affect methane conversion, H_2 recovery and coke formation. In this study, an MR is simulated by using a one dimensional model. In order to find the optimum condition for this MR, in which CH_4 conversion, H_2 recovery are maximized and the risk of coke formation is minimized, a multi-objective algorithm is employed to achieve the Pareto front in a three objective space. In the optimized condition methane conversion and hydrogen recovery are improved and also, the possibility of coke formation in the MR is reduced.

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