Effect of baffles in multi-tube membrane reactor for hydrogen production by steam methane reforming

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The hydrogen production as future energy includes the steam reforming of fossil fuels, and the products are purified into hydrogen through membranes. A catalytic membrane reactor (CMR) that combines these processes is a process intensification system that simultaneously handles chemical reforming reactions and physical separation phenomena. However, the multi-tube CMR commonly used to increase productivity is accompanied by degradation of mass and heat transfer rate due to the limitation of the spatial structure. In this study, a multi-tube CMR with baffles is simulated using computational fluid dynamics (CFD). The CFD has the strength to numerically approach the fluid flow and physicochemical phenomena. Therefore, the efficiency degradation of the multi-tube CMR is observed through the analysis of the reactor internal fluid flow, hydrogen concentration, and temperature distribution. In addition, the effect of baffles is quantitatively analyzed using the concentration polarization coefficient, compared to the CMR with baffles. It is revealed that the baffle has the effect of reducing the amount of catalyst required compared to the CMR.