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P2.184 Design of an industrial catalytic membrane reactor prototype for tritiated gaseous effluent treatment

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In the framework of gloveboxes tritiated gaseous effluent treatment, efficiency of packed bed membrane reactors has been successfully demonstrated under lab scale. In such an intensified process, tritium from tritiated water can be recovered under the valuable Q2 form (Q = H, D or T) thanks to isotope exchange reactions on catalyst surface. In the meanwhile, the use of permselective Pd-based membrane allows extraction of reactions products all along the reactor, and thus limits reverse reaction rate to the benefit of the direct one (shift effect). In such a process, it is possible to obtain a conversion rate of tritiated water up to nearly 90-95% and recover tritium under pure mixture of hydrogen isotopes. Based on former experimental studies, a phenomenological model was built to predict the efficiency of a fixed catalytic membrane reactor (CMR) design but this model does not allow optimizing the design of a CMR to reach fixed performance. However, the phenomenological model has given sufficient precise knowledge on the phenomena occurring in the CMR to allow the implementation of a CMR calculation module in the Prosimplus process simulation software environment. This paper describes the transfer step from phenomenological model to chemical process simulation tool and presents the methodology to be used to optimize the design of an industrial CMR under the Prosimplus software environment. The application of the proposed methodology for the design of a CMR for the Tokamak Exhaust Processing system of DEMO is given as an example.

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