

CAPER modifications and first experimental results on highly tritiated water processing with PERMCAT at the Tritium Laboratory Karlsruhe

D. Demange*, T.L. Le, K.H. Simon, R. Wagner, S. Welte

*Karlsruhe Institute for Technology, Institute for Technical Physics, Tritium Laboratory Karlsruhe,
Herrmann-von-Helmholtz-Platz 1, D-76344 Eggenstein-Leopoldshafen, Germany*

Large amounts of low and middle active tritiated water are routinely produced in tritium facilities and handling procedures as well as processing routes are well established. However, lower amounts at higher specific activity (above 2×10^3 Ci/kg) seem more difficult to apprehend. Among the candidates for highly tritiated water (HTW) processing, isotope exchange reactions performed in a palladium membrane reactor using the so-called counter current swamping technique appear promising.

The PERMCAT process originally designed for the final clean-up of exhaust gases has been studied at the Tritium Laboratory Karlsruhe for more than 15 years [1, 2]. A comprehensive background accumulated throughout an intense experimental program including tests with high tritium levels as well as inactive tests performed with water has motivated the use of PERMCAT for HTW processing. The CAPER facility has been recently upgraded to carry out in a staged approach a full experimental demonstration at the laboratory scale (up to 10 mL/min tritiated water vapour) but at relevant tritium activity with stoichiometric DTO (1.4×10^6 Ci/kg) as a target for inlet activity.

The paper will describe the successive modifications of the CAPER facility to produce HTW upstream of the existing single-tube PERMCAT reactor [3] (using either a metal oxide reactor or a micro-channel catalytic reactor) and to collect the water after detritiation. The main results on detritiation efficiency for different experimental conditions (throughput, water/purge flow rate ratio) obtained along the earlier stages will be reported. Such experiments will serve as basis for the design of a future technical scale facility comprising a multi-tube PERMCAT reactor [4].

[1] M. Glugla, et al. "Tritium tests with a PERMCAT reactor for isotopic swamping" Fusion Technol. (1996) 1193.

[2] B. Bornschein et al. "Tritium tests with a technical PERMCAT for final clean-up of ITER exhaust gases" Fusion Eng. Des. 68 (2003) 51.

[3] D. Demange et al. "Tritium processing tests for the validation of upgraded PERMCAT mechanical design" Fusion Sci. Technol. 54 (2008) 14.

[4] S. Welte et al. "Mechanical design and first experimental results of an upgraded technical PERMCAT reactor for tritium recovery in the fuel cycle of a fusion machine" (presented at 9th ISFNT Dalian China Oct 2009, to be published in Fusion. Eng. Des.)