Transactions of the Korean Nuclear Society Autumn Meeting
Gyeongju, Korea, October 26-27, 2023

Status of unit process development using oxidation of Q_2 to Q_2O in coolant purification system

Seok-Kwon Son[a*], Chang Wook Shin[b], Myungho Kim[a], Soon Chang Park[a], Youngmin Lee[a], Mu-Young Ahn[a], Seungyon Cho[a]

[a] *Korea Institute of Fusion Energy, Daejeon, Republic of Korea*
[b] *Korea Atomic Energy Research Institute, Daejeon, Republic of Korea*

**Corresponding author: skson@kfe.re.kr*

1. Introduction

For fusion reactor operation, the efficiency and stability of ancillary systems should be confirmed. In order to develop a relevant design for the ancillary systems, research and development activities are being carried out at Korea Institute of Fusion Energy (KFE). One of the ancillary systems, the Coolant Purification System (CPS), plays a crucial role in maintaining the coolant composition and reducing the tritium permeation phenomenon connected to Helium Cooling System (HCS) [1-3]. Four components are designed to remove Q_2 from the coolant gas: Oxidizer, AMSB, Getter bed and Reducing bed.

As the evaluation of AMSB characteristics was almost complete in the previous studies [2, 3], this paper presents the status of a specific unit process development within the coolant purification system: the oxidation of Q_2 to Q_2O and regeneration of catalyst oxidizer (CuO). Preliminary design of the experimental apparatus has been completed and construction of the apparatus is in progress. By evaluating the characteristics and performance of these oxidation and regeneration processes, this paper can contribute to the development of the oxidizer design and operational procedures.

2. Experimental setup

The experimental apparatus, oxide module, is designed to confirm the Q_2 oxidation and regeneration using CuO as a catalyst. The oxide module is also added to existing apparatus [2, 3] (Research Apparatus for Vapor Adsorption and Desorption, RAVAD) to confirm the unit processes and test the integral effect as shown in Fig. 1.

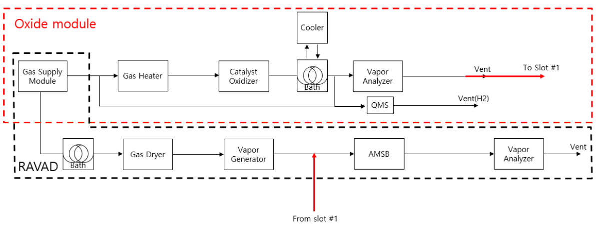

Fig. 1. Schematic diagram of the oxide module and RAVAD

The experimental setup includes Q_2 or O_2 of the concentrations in the mixed gas at each process, the characteristics of the catalyst oxidizer and the operating procedure of the oxidation and reduction based on the CuO column. Through a series of experiments, the validation of the processes and potential challenges will be investigated. We expect the experimental results to provide a valuable database for the development of the Q_2 oxidation and regeneration process.

3. Conclusions and future work

This paper not only establishes the foundation for the characteristics of the CuO column within the CPS, but also enables the achievement of optimal oxide column design and performance. Further studies will consider various models to determine the geometric design, taking into account the operational requirements. The results of these studies will be reflected in the advanced operation of the CPS, which is expected to improve the stability and overall performance of the system.

Acknowledgments

This work was supported by the R&D Program through the Korea Institute of Fusion Energy(KFE) and funded by the Ministry of Science and ICT of the Republic of Korea (KFE-IN2303 and KFE-CN2301).

REFERENCES

[1] S. Cho et al., Status of HCCR TBM program for DEMO blanket, Fusion Engineering and Design, Vol. 171, 112553, 2021.
[2] C. W. Shin et al., Design and experimental study of adsorption bed for the helium coolant purification system, Fusion Engineering and Design, Vol.155, 111687, 2020.
[3] C. W. Shin et al., Vapor adsorption testing of ambient molecular sieve bed in coolant purification system, Fusion Engineering and Design, Vol.167, 112371, 2021.