HEAT LOSS ANALYSIS OF METAL HYDRIDE BED STRUCTURE

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The metal hydride bed for the storage and delivery of tritium is one of the essential components of tokamak fuel cycle. Its primary vessel and outer jacket compose double confinement for two important reasons. One is for the safe storage of tritium considering tritium permeation and leakage. The other is for the accuracy of tritium accountancy. Helium in-bed calorimetry measures the inventory of tritium by absorbing the decay heat with helium gas flow. Its accuracy depends on the measurement of temperature and helium flow rate, and the decay heat loss. The outer jacket of metal hydride bed is evacuated by vacuum pumping during in-bed calorimetry procedure to prevent the convective heat loss. Thermal reflectors are installed between the primary vessel and outer jacket for minimizing the radiative heat loss. However, it is impossible to avoid the conductive heat loss through the gas tubing, connections and support structures. To improve the accuracy of tritium accountancy, it is found that the heat loss analysis of the metal hydride bed structure is necessary and should be accounted for the design and fabrication of the bed.

In this study, the heat loss through hydrogen and helium gas tubing, heater and/or thermocouples is calculated using the heat transfer analysis code (CFX). The effects of various size of gas tubing, the installation of heaters or thermocouples penetrating the outer jacket directly without using electrical feedthroughs are considered. The proportion of heat loss obtained from the calculation is to be accounted for the design and to be used as a validation data for the in-bed calorimetry calibration experiments.