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Development of Helium Leak Detection Methods for Canisters (Part 2) - Leak Evaluation by a Horizontal Small Canister Model

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Long-term storage management and soundness monitoring methods of spent fuel are now receiving world-wide attention. For the metal cask, pressure monitoring between its lids is mandatory. Meanwhile, in the concrete cask, its lid is welded and high sealing property is maintained, so that a leak of helium is not monitored. However, considering long-term storage, there is concern about the loss of the sealing property due to stress corrosion cracking (SCC). To resolve this issue, we have been developing a leak detector utilizing the phenomenon that the surface temperature changes at the time of the leak. Furthermore, in order to investigate the applicability of this detector to horizontal silo storage, a leak test was conducted with a small canister model in a horizontal attitude. A basket was installed in the small canister, and 12 heater rods were installed in it. In the test, after reaching a steady state, the internal pressure was changed to 5atm, 3atm, and 1atm, and the temperature data of each position in each state was acquired. When the pressure was reduced, the canister bottom temperature and the canister side bottom temperature increased. In contrast, the temperatures of the top of the canister lid and the top of the canister side surface decreased. Therefore, it was confirmed that a highly sensitive detection method is possible with each combination using these four positions as detection points. In addition, by performing CFD analysis, the phenomena inside the canister were grasped. In this case, three-dimensional steady state CFD analysis with a polyhedral mesh using STAR-CCM+® was performed. Three kinds of internal pressure (5atm, 3atm, and 1atm) and four kinds of arrangement of the basket inside the canister were combined, which resulted in a total of 12 calculations. As a result, it was confirmed that the temperatures of the top and bottom of the canister and the top and bottom of the canister side surface vary according to the canister internal pressure as in the test results. In addition, it was also confirmed that there is significant difference in temperature distribution on the canister surface due to difference in the arrangement of the basket inside the canister.

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Japan

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