Design of a Basket Lifting Mechanism for Pyroprocessing Automation Verifying Mockup

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1. Introduction

The equipment in a hot cell should be simple and easy to operate, because the human operator is not allowed to access inside and executes all operation by using remote devices. Pyropocessing, one methods to recycling spent fuel, has been studied, and the related equipment should be considered in view of remote operation. To enhance the operability and reliability of the developing equipment, a new non-radioactive experimental space, the PAVM (Pyroprocessing Automation Verifying Mockup) was planned.

In this research, a basket lifting module for simplifying some operations of the testing equipment in PAVM is discussed.

2. Basket Lifting Module for Oxide Reduction Process

2.1 needs for the basket lifting module

One of the key process of the Pyroprocessing is the oxide reduction. A vessel is enclosed by a heater, and the vessel is kept warmed as 600 degree Celsius to melt the LiCl salt. Anode and cathode are installed in the molten salts, and high current is engaged. The cathode is designed as a basket shape to Uranium oxide (UO_2), and the UO_2 in the Cathode are reduced when the current is engaged. The separated Oxygen turns to gas and exhausted off at the Anode.

The cathode basket should be replaced after each batch of the oxide reduction process, and the mechanical replacing operation is annoying and physically difficult.

The Fig. 1 shows the basic concept for the oxide reduction, and installing operation of cathode basket.

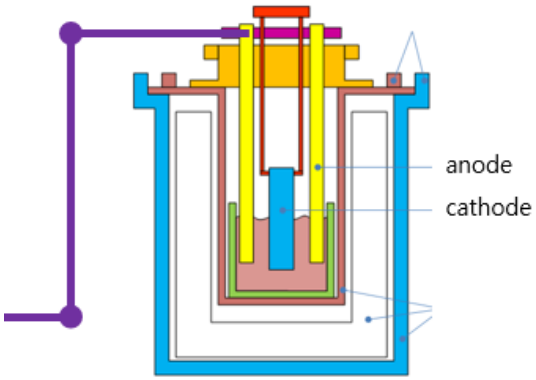

Fig. 1. Concept of oxide reduction, and replacing cathode basket.

A dedicating mechanism for replacing cathode basket was discussed to simplify the operation, and the design requirement was deduced as below.

◆ The cathode basket lifting module
- The basket is automatically lifted by the mechanism
- The capacity of the list is 50kg or more
- The lift is controlled as 3 positions (top, middle, and bottom position)
- Bus-bar is connected at the bottom position
- The mechanism is modularized.

2.2 Design of the basket lifting module

The basket lifting module was designed by four different modules, testing basket, basket socket, fork lift module, and actuation module, as shown in Fig. 2.

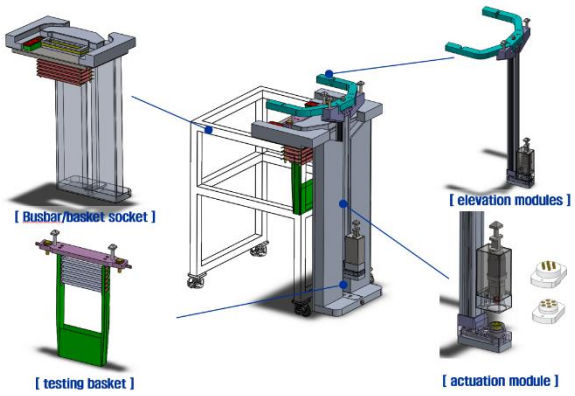

Fig. 2. modularized design of the basket lifting module.

Basically the testing basket is loaded on the fork lift module, and the fork lift module is controlled as three different positions, top, middle, and bottom. A ball screw is installed in the fork lift module enough to elevate 50kg load. A commercial high current bus-bar connector was embedded on the testing basket and the basket socket. When the basket is lowered down to the bottom position, the bus-bar connector is physically connected by the weight of the basket. Oppositely, the connector is departed when the basket is lifted up. The Fig. 3 shows the applied commercial bus-bar connector.

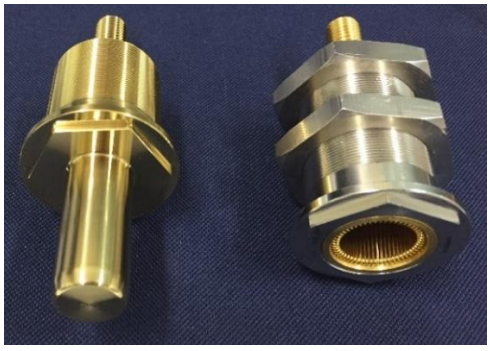

Fig. 3. 750 A high current commercial connector.

The reason why the basket lifting mechanism is designed by an assembly of multiple modules is for the convenience in maintenance. The modules are able to be assembled and disassembled by crane and master slave manipulator. Classically, the power plug or signal connectors should be inserted after mechanical attachment. The electric connection by remote operation is annoying job for human workers and bring troubles. In the proposed mechanism, spring loaded pins are utilized instead of the classic connectors, so that the modules are electrically connected when those are mechanically assembled.

3. Conclusion

The basket lift mechanism was designed for Pyroprocessing automation verifying mockup (PAVM). The remote operation of basket replacing is difficult due to high pay load and interference at the entrance of the basket socket. The proposed mechanism dedicated to the basket replacing operation. In existing operation manual, the bus-bar connection was separate task after basket replacing task. The proposed basket lift mechanism is able to connect the bus-bar, when it replace the basket.

REFERENCES

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