Development of Remote Fastening System for IASCC Test Facility

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1. Introduction

IASCC (Irradiation Assisted Stress Corrosion Cracking) test facility has been recently installed at the mock-up hot cell in KAERI (Korea Atomic Energy Research Institute) [1]. Autoclave, a high-temperature and high-pressure vessel as the main equipment of the IASCC test facility, consists of a main body, delta packing, and cover plate made of Type 316 stainless steel as shown in Fig. 1. Delta packing is mounted between the main body and cover plate to maintain air-tightness. Sealing of autoclave is done by fastening nuts and bolts. If the test specimen is a neutron-irradiated metal that radiates gamma-ray, the operator may be exposed to a large amount of radiation when he fastens or loosens the nuts and bolts. In order to avoid radiation exposure of the operator, an automatic fastening system, which allows the operator to easily perform fastening and loosening nuts from outside the hot cell, is strongly needed. For the purpose, the remote fastening system has been developed and applied to the mock-up hot cell. This fastening system will be utilized for training the operator and development of IASCC test procedure.

2. Development of Remote Fastening System

Fig. 2 shows configuration of the remote fastening system developed in this work. The fastening system consists of a power tool, a tool holder, a spring balancer, a vertical/horizontal handle mount, a hand grip, a reaction arm, a floor mount, and a remote controller.

The power tool combined with the reaction arm was installed inside the mock-up hot cell to fasten and loosen the nuts and bolts for sealing the autoclave. The power tool is operated with two manipulators of the mock-up hot cell. The spring balancer serves to maintain the tension of the tool, and the floor mount supports the force as it tightens and loosens the nut. The maximum torque value for tightening the autoclave is designed to be 120 Nm, and the nuts are sequentially tightened diagonally from 20 Nm.

The controller was equipped outside of the hot cell to remotely control the torque of the tool and to configure/monitor the fastening process. The controller is user-friendly with a 7-inch touch screen and intuitive software, allowing you to configure and monitor the controller from any device with a web browser.

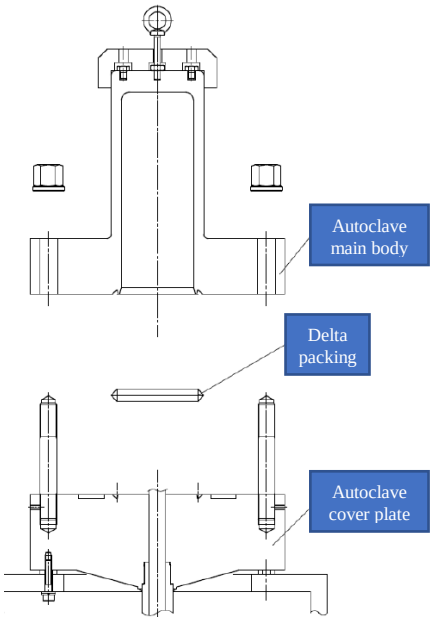

Fig. 1. Schematic drawing of autoclave in IASCC test facility

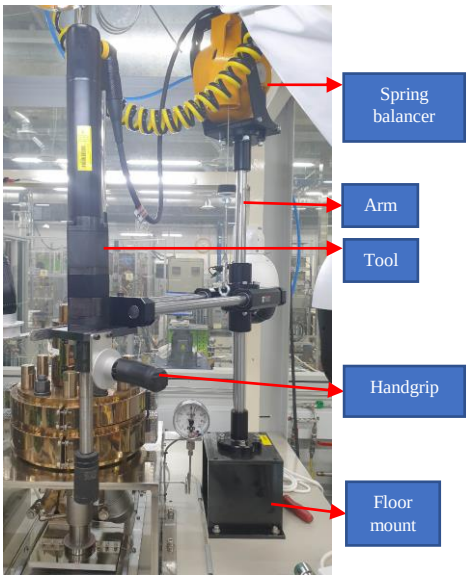

Fig. 2. Remote fastening system developed in this work

Fig. 3 shows a controller unit with built-in software to remotely control torque and speed of power tools. With this equipment, you can see the fastening start time, run time, and stop time for each step, and you can easily find the bolt with the bottleneck. It shows all the process

of signing in a graph, and you can view 20 graphs at the same time.

Fig. 3. Remote controller of the remote fastening system

The remote fastening system developed in this work was found to be easily operated with the manipulator of the mock-up hot cell. The touch screen-type controller provided the well-optimized interface for the operator by supporting various operation modes. This fastening system is used for training the facility operator and development of the IASCC test procedure.

3. Conclusions

The remote fastening system for IASCC test facility was developed and installed in the mock-up hot cell at KAERI. The system allowed the operator to easily perform fastening and loosening nuts and bolt to seal the autoclave for high-temperature and high-pressure environmental test. It is expected to avoid the radiation exposure of the operator during the IASCC test.

REFERENCES

[1] S. H. Cho, S. W. Kim, D. J. Kim, and J. H. Lee, Development of Ion Exchange Resin Saturation Loop for IASCC Test Facility in Hot Cell, Korean Nuclear Society, P010C09, Autumn, 2020.