

Fabrication of three kinds of small mock-ups for an ITER TBM First Wall

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1. Introduction

The Korea (KO) has developed liquid a breeder blanket and participated in the Test Blanket Module (TBM) program within the International Thermonuclear Experimental Reactor (ITER) with a Helium Cooled Molten Lithium (HCML) concept. Ferritic Martensitic Steel material is used as structural material for the TBM first wall (FW). In order to develop the fabrication method for the TBM FW, the various manufacturing and joining methods have been developed.

In this study, three mock-ups were fabricated to verify the manufacturing of a 1/6-scale mock-up of the TBM FW and preliminary analyses were performed to design a manifold of a 1/6-scale mock-up for uniform flow in the channels. Using Ferritic Martensitic Steel material, three kinds of small mock-ups were fabricated such as a cooling channel shape of straight, two cooling channels shape of straight, and a cooling channel shape of U-type. The small mock-ups were manufactured by wire cutting and machining for components of the mock-ups and a welding and HIP, at 1050 °C and 100 MPa for two hours, were performed for bonding. The fabricated small mock-ups were performed pressure tests between the joints to evaluate bonding of the mock-ups.

2. Fabrication of small mock-ups for the ITER TBM FW

Three small mock-ups were designed and fabricated to verify manufacturing method of the ITER TBM FW. A small mock-up consists of three parts components: a front plate which has cooling channel, 20 mm in width and 10 mm in height, cover of the front part, and back plate. The diagram of three parts for components of a mock-up and manufacturing process of the U-type mock-up is shown in Fig. 1.

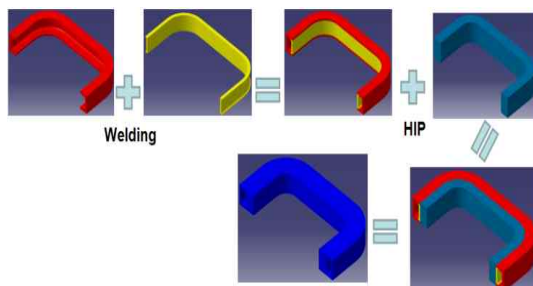


Fig. 1. Schematic diagram of the manufacturing process of the U-type small mock-up

A front plate and cover plate are being bonded by welding, and the welded part and back plate are being jointed using HIP. Using Ferritic Martensitic Steel material, three kinds of small mock-ups were fabricated such as a cooling channel shape of straight, two cooling channels shape of straight, and a cooling channel shape of U-type. The photo of the three parts of U-type mock-up is shown in Fig. 2.



Fig. 2. Photo of three parts of a U-type small mock-up

A helium leak test was carried out to verify bonding condition after welding between a front plate and a cover plate. The photo of performing a helium leak test is shown in Fig. 3. A joint of a welded block and back plate was conducted by using HIP, at 1050°C and 100 MPa for two hours.



Fig. 3. Helium leak test of a welded block of a U-type small mock-up

3. Performance of the fabricated mock-ups

The hiped mock-ups were checked the bonding conditions between three parts of each mock-up using helium leak test and pressure test. The helium leak test was performed during evacuating the gas in mock-up canned through a 1/8-inch tube as shown in Fig. 4.

The figure 5 showed fabricated three kinds of mock-ups after a series tests.

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Fig. 4. Photo of a hiped U-type mock-up



Fig. 5. Fabricated three kinds of small mock-ups

4. Conclusions

The three kinds of small mock-ups are fabricated to check and verify manufacturing process of 1/6 scaled mock-up of an ITER TBM FW. A fabrication method of the 1/6-scale TBM mock-up was verified through manufacture of the small mock-ups Experimental loop.

The 1/6-scale mock-up of an ITER TBM FW will be fabricated through manufacturing methods of small mock-ups

References

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