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Valuation of High-Speed Fluids by Flow Properties Devices in the IFMIF/EVEDA Project

IFMIF/EVEDAプロジェクトにおける高速流体の流動特性装置による評価

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Abstract

The Engineering Validation and Engineering Design Activities (EVEDA) for the International Fusion Materials Irradiation Facility (IFMIF) were started under a collaborative international project known as the ITER Broader Approach from 2007. The various validation experiments using the 1/2.6 scale in the flow channel of the width of the Li target in EVEDA Li Test Loop (ELTL) have been performed. In parallel to the ELTL experiments, the experimental water flowing device was fabricated in order to compare the flow properties obtained from two kinds of the ducts which simulate the quench tank through the downstream of Target assembly (TA). One duct simulates the duct which is installed in ELTL, while other duct simulates the duct which has been installed in Fusion Materials Irradiation Test Facility (FMIT). The visualized high-speed liquid flows under various flow rates and vacuum conditions were obtained from the two kinds of the ducts in order to compare their performances.

1. Introduction and Background

The IFMIF is a plant to test effects of neutron irradiation on candidate materials for fusion reactors. Fig.1 shows the lithium target of the IFMIF system. The objective of IFMIF is to generate high intensity neutrons, which are similar to fusion neutrons with 14 MeV, by injecting the deuteron beams accelerated to high energy onto the 260 mm wide and 25 mm thick free-surface lithium flow. Guiding the liquid lithium along the concave back plate at a speed of 15 m/s is required to increase the pressure in the lithium flow by centrifugal force, to avoid boiling by the heat input of the deuteron beams, and to remove heat by the lithium flow circulation [1]. The cross section of TA and the picture of Li flow with free surface are shown in Fig.2 [2].

In this study, the experimental water flowing device was fabricated in order to visualize high-speed liquid flows under various flow rates and vacuum conditions.

2. Experimental

2.1 *Fabrications*

The specification of fabricated device, i.e the experimental water flowing device, is shown in Table 1. Two kinds of the ducts which simulate the quench tank through the downstream of TA were fabricated. The over view of this device and its state of the duct are shown in Figs. 3 and 4, respectively.

In Fig.4 (a), the simulated piping of ELTL is shown, while Fig.4 (b) shows the simulated piping of FMIT. Fig.5 shows the liquid flows at ELTL [3] and the fabricated device. Similar liquid flow is obtained in the device.

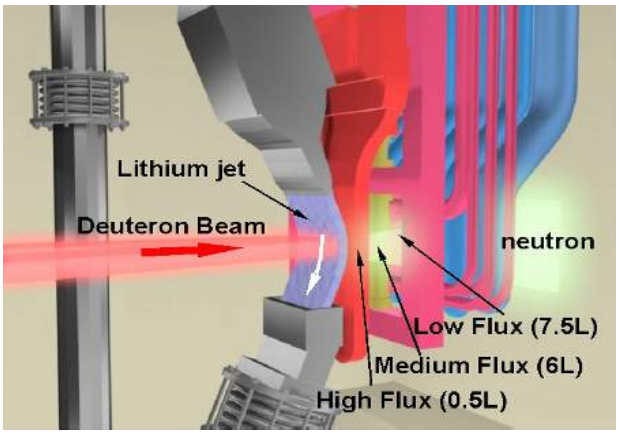

Fig.1. The lithium target of the IFMIF system.

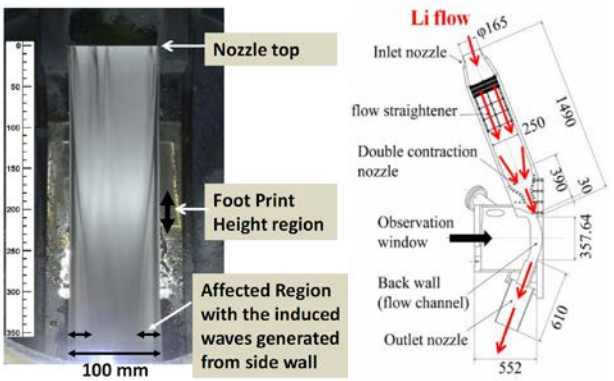

Fig.2. The lithium flow and the cross section of TA.

Table 1 Spec. of the experimental water flowing device

Testing fluid	Water
Temp.	5°C
Flow rate	650 L/min (maximum)
Material	TA: Acrylic / Pipes: Stainless steel
Flow speed at outlet of nozzle	15 m/s (maximum)
Oprating pressure	100 kPa- 100 Pa

Fig.3. Over view of the experimental water flowing device.

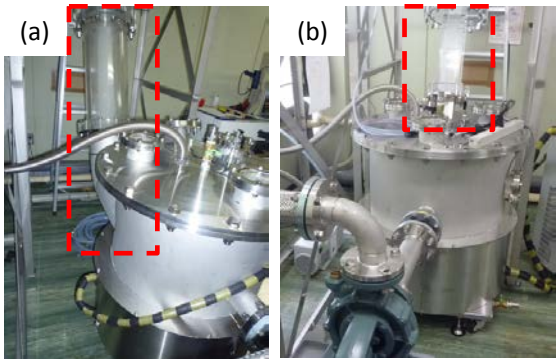

Fig.4. Details of the simulated piping.

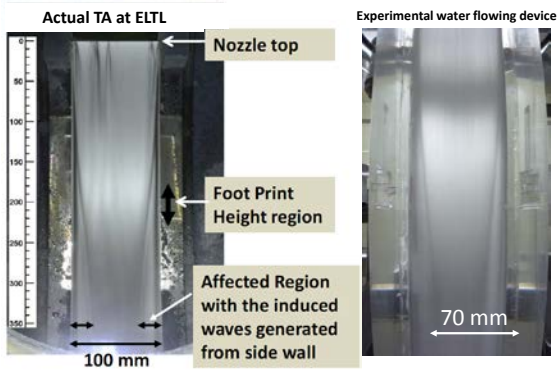

Fig.5. Liquid flows at ELTL and the fabricated device.

2.2 *Valuation Tests*

The visualized high-speed liquid flows at the flow rates of 8 m/s ~ 15 m/s under 100 kPa ~ 100 Pa will be obtained with using the two kinds of the ducts in order to compare their performances.

3. Evaluation of the Valuation Tests Results

The valuation tests results will be evaluated by comparing the vibration generated at the quench tank. Then, the evaluated results will be reported in the poster during the presentation.

4. Summary

The experimental water flowing device was fabricated in order to visualize high-speed liquid flows under various flow rates and vacuum conditions. Two kinds of the ducts which simulate the quench tank through the downstream of TA were fabricated.

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The results will be evaluated by comparing the vibration generated at the quench tank. Then, the evaluated results will be reported in the poster during the presentation.

Acknowledgments

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References

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