

## The study of EMF calibration in the sodium loop

Choon-Ho CHO\*, Jong-Hyun CHOI, Jong-Man KIM, Young-II CHO, Jong-Gan HONG, Yong-Bum LEE  
Division of Fast Reactor Technology Demonstration, Korea Atomic Energy Research Institute  
150 Dukjin-dong, Yuseong-Gu, Daejeon, Korea, 305-353  
\*Corresponding author: [ex-kaeri@kaeri.re.kr](mailto:ex-kaeri@kaeri.re.kr)

### 1. Introduction

Sodium of liquid metals is superior to others in the aspect of nuclear or thermal-hydraulic character and it is industriously so abundant that it is widely used for the cooling material of liquid metal reactor [1].

Sodium-cooled fast reactor studying in KAERI adopts the decay heat removal system of a self-developed safety rating. To prove the inherent design concept and its performance, it constructs Sodium integral effect TEST Loop for safety simulation and Assessment.

Before the an efficiency test utilizing this large-scaled facility is done, this research preferentially studied about the impurities such as oxygen and hydrogen included in sodium and about flow calibration, making use of small-sized sodium loop of such a function.

That is because the impurities included in liquid sodium makes safe drive of liquid metal reactor hard, especially the rate of oxygen corrosion fast and the rate of movement of carbon contents increase.

Oxygen mainly creates sodium oxide in the response with sodium and it causes plugging not melted in sodium but deposited in cold spot so that the oxygen concentration in liquid sodium must be kept lowly.

Thus the removal of impurity can low the concentration as simple as possible, using the device of cold trap so that it is considerably used [2]. In driving of liquid sodium loop, oxygen is also permeated so that the oxygen concentration of sodium gets higher. In order to keep a watch on this, the concentration should be able to be measured periodically. A way to collect direct specimen in the measure of oxygen concentration is spent much time and has a problem that is easily oxidized in the process of collecting specimen. Thus most vastly utilized measure as more reliable thing is the plugging meter by plugging of orifice.

To purify and measure we must know the first concentration of oxygen that is impurity. The Electronics Magnetic Flow used for the measure is designed and manufactured according to a pipe size. Therefore, it is demanded to test for calibration. This study present contents performed in respect to this.

### 2. Methods and Results

The EMF used for this test is composed of one EMF of the 1/2 inch in the inlet of Plugging Meter, one bypass EMF of the 1/4 inch applicable of the outlet of Plugging Meter, and one orifice EMF of 1/2 inch respectively. The permanent magnet for the EMF is neodymium

magnet. This EMF used the electro-magnetic induction by Faraday's law. It was made by the principle that when the liquid sodium moves in a magnetic field, both the direction of magnetic field in liquid sodium and the direction of movement by-laterally generated electric motive force to the vertical way and the size is proportionate to the magnet density and velocity. The direction that electro motive force generates follows the principle of Fleming's right-hand law.

When the fluid in the pipe vertically installed to the direction of magnetic field flows with the average velocity, the electrode generated the signal volt (E) among electrodes like the below formula

$$E = k B D V$$

Where:

k: Proportionality Constant

B: Magnetic field strength

D: Diameter of conductor

V: Velocity of conductor

The test of Electronics Magnetic Flow measured the signal values of three Electronics Magnetic Flows. It used the electronic pump and was done by flowing the liquid sodium of 200°C melted in buffer tank toward the device of PM with a constant pressure.

This signal value was converted the signal value that is output to 4~20mA to 1~5V using the converter. It gradually used the converter to 0~20mV, 0~10mV, and 0~5mV to find the exact measure range of EMF.

Because the plugging test should flow in the small range of 0.5~1 lpm, we finally used the converter of 0~5mV and tried the EMF calibration test.

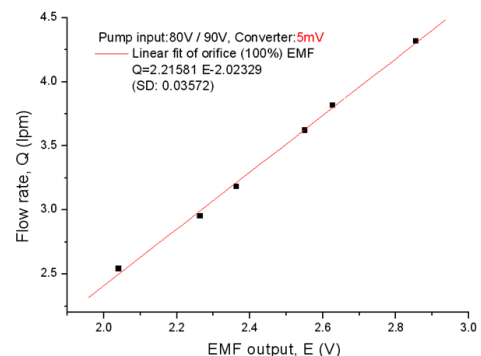


Fig.1 Calibration curve of the orifice EMF

The Fig.1 is to perform the EMF calibration test, setting up the pressure of electronic pump with 80V and 90V. This plot is the EMF value relevant to orifice of PM and changed the flow with the integral calculus that the volume decreased in buffer tank is according to the hour.

### **3. Conclusions**

This study is for the test to decide the little range of flow correspond to plugging and tried to get an exact signal value correspond to the range of 1 lpm. It drew a conclusion as performing the processes of many variables in experiment such as replacement of converter and reinstallation of PM.

The EMF of orifice is verified to flow a range of 3.3 lpm on average.

Therefore, the result of this study means that the EMF that is self-developed through the device of sodium loop produced the successful result of calibration value for the first time.

### **ACKNOWLEDGEMENT**

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