

Experimental Study on Flooding Phenomenon

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1. Introduction

Because of the high temperature of core part, some of the coolant, such as water for PWR, boils and becomes vapor. Therefore, two-phase of coolant flows along the coolant channel. Usually, two-phase of fluid in the coolant channel may flow in the opposite direction. However, in some cases, the flow of a fluid in one direction is too large to impede the flow of another fluid in the opposite direction and may cause unstable or cocurrent flow. This situation is called flooding.

One of large break LOCA is breaking in cold leg. Often, this kind of accident is divided into three phase to analyze the accident; blowdown, refill and reflow. During this kind of accident and reflowing to core occurs, flow inside of pipe appears variously by mixing of air and water.

Having on eye on this point, in this research, air and water was used as a working fluid to observe many kinds of two phase flow pattern in the vertical flow in this experiments. Also, the condition of flooding was predicted and it was confirmed through experiments to understand the phenomenon in nuclear power plant during this kind of accident.

2. Method

In order to simulate flooding phenomenon, test loop with vertical tube was designed for two phase flow system of air and water. Pressure decrease in vertical tube was measured in electrical current signal with DAS system. Measuring point was at upper part of test section to get the data of fully developed flow. Air was mixed in water flow through many holes below the test section and water and air flow rate was controlled by pump and flow meter.

3. Results

Experiment was carried out in three steps. Single phase flow of water, two phase flow of air and water and flooding phenomenon are those three steps.

3.1 Single phase flow

At first reliability of designed instrument was checked by single phase flow experiment. Pressure decrease was measured by instrument and its theoretical value was calculated with flow rate of water that was used in each experiment. Error between experimental pressure decrease and theoretical value is approximately 20%, which means good result for this experiment. This error is mainly due to the measuring capability.

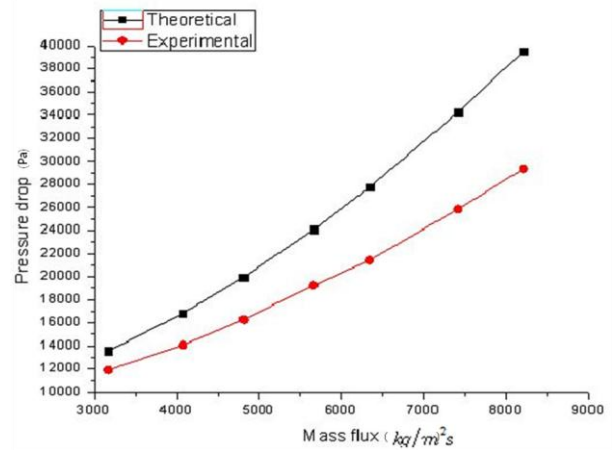


Fig. 1. Pressure drop data for single phase flow

3.2 Two-phase flow

In order to confirm various flow pattern in two phase flow, water and air flow rate was set using Hewitt and Roberts flow pattern map. Theoretical value of pressure decrease was calculated with flow rate of water and air and void fraction. It was assumed to be homogeneous model to get void fraction in given information. Data of pressure decrease was compared with theoretical value and photo shows characteristics of each flow pattern. Photo was taken to confirm characteristics of each flow pattern.

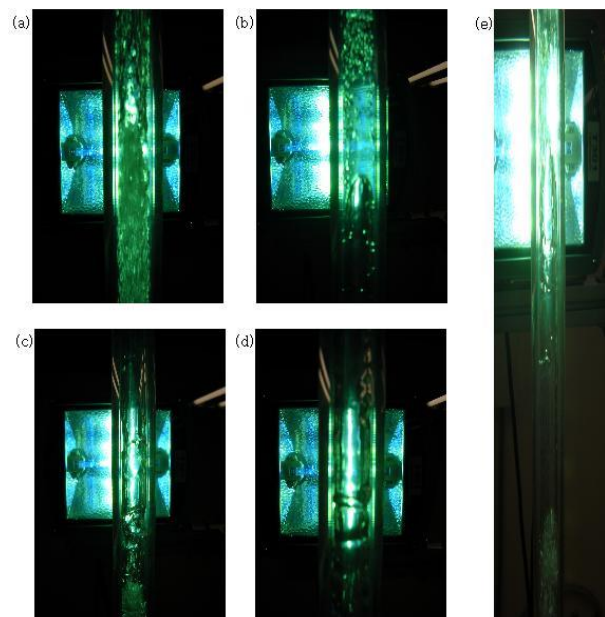


Fig.2. Various flow pattern (a)Bubbly (b),(e)Slug (c)Churn (d)Annular

3.3 Flooding phenomenon

In order to observe flooding phenomenon, flow in pipe section of low water flow rate and high air flow rate was made. Then, the flow rate of air was decreased steadily to confirm when water falls down from the upper part of test section. This falling down of water is flooding phenomenon.

Table. 1. Results of flooding experiment

	Water flow rate	Air flow rate when flooding was observed
1	0.00002m ³ /s	53L/min
2	Almost no flow	87L/min



Fig. 3. Flooding phenomenon

4. Conclusion

Various flow pattern and flooding phenomenon was confirmed through above experiments. Single phase flow experiment supported reliability of experiment and no flow experiment gave a standard correction for calculation of experimental data which have electrical current form. For two-phase flow, pressure decrease showed quite large error but photos gave good characteristics for each flow pattern. During flooding experiment, it was hard to distinguish flooding and non-flooding because there was no clear standard for flooding. Because experiments for predicting flooding phenomenon was not carried out many times further research and experiment with condition for flooding would carried out.

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