Pressure Drop Test Facility for TROI Debris Bed and Shakedown Test Results

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1. Introduction

Ex-vessel debris cooling is applied as a severe accident mitigation strategy for OPR1000 in Korea. Important safety issue is how to secure the coolability of ex-vessel debris bed. For the resolution of this issue, KAERI plans to conduct the two-phase pressure drop tests with real corium particles which were collected after TROI tests during several years. A two-phase pressure drop model in the debris bed will be developed based on the test results and it will be incorporated in the analysis code so called COLAS. A test facility has been constructed and shakedown tests have been performed. This paper deals with a brief description of test facility and shakedown test results.

2. Methods and Results

2.1 Test Facility

A photo of the test facility is shown in Fig. 1. The test facility is composed of a test section, air and water supply system, and instrumentation system. The test section is made of cylindrical Acryl with an inner diameter of 100 mm, a thickness of 10 mm and a height of 500 mm. TROI particle analysis showed that there are many small particles with a size of less than 0.5 mm [1]. To prevent the small particle from falling down the test section, a fine mesh is provided at the lower part of test section. Air supply system is composed of a flow meter, regulator, and filter. Water supply system is composed of a pump, flow meter, regulator, and filter. Water is recirculated to minimize the liquid radioactive waste. A differential pressure meter is provided to measure a pressure loss.

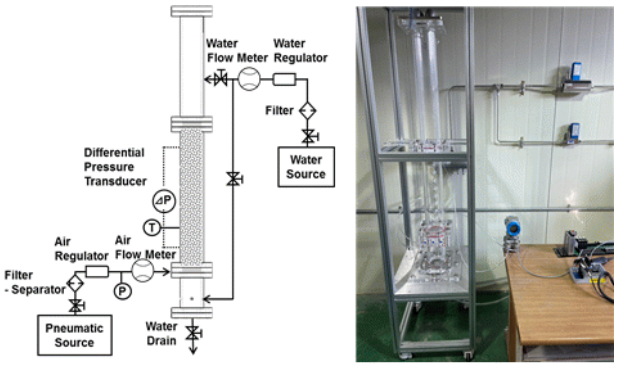

Fig. 1 Photo of test facility

Table 1 shows a specification of major component and instrumentation.

Table 1 Specification of major component and instrumentation

Pump	-power; 0.75 kW -max. flow; 33 m^3/min -head; 35 m
Air flow meter	-range; 0 ~ 1000 SLPM
Water flow meter	-range; 0 ~ 50 SLPM
Differential pressure meter	-range; 0 ~ 1.5, 37.3, 186.5 kPa

2.2 Shakedown Test

Steel spheres with a diameter of 3 mm are used for the shakedown tests. Test section is filled with 17.8 kg of steel spheres. It is noted that the porosity of the steel sphere is about 0.4. Porosity and sphere diameter are the major parameters for the analysis of the test results using Ergun equation [2].

In the single phase shakedown test, air or water is supplied through the small holes at the lower part of the test section and flows upward through the test section. Differential pressure is measured between lower and upper part of the test section using differential pressure meter. Two phase shakedown tests with using air and water are planned in the near future.

Fig. 2 shows a comparison of air test results with previous ones. The test data are a little bit lower than the other existing ones [3, 4]. It is shown that existing models can predict the test results reasonably [2, 4-7].

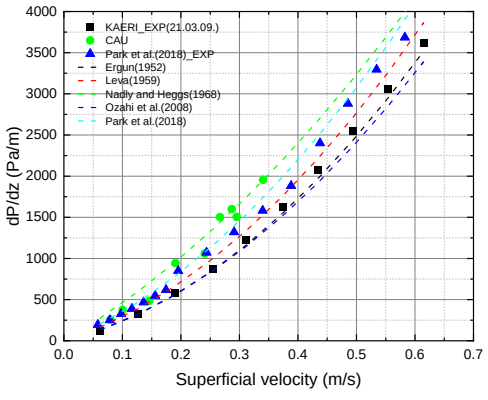

Fig. 2 Air test results

Fig. 3 shows a comparison of air test results with previous ones. The test data are a little bit lower than the other existing one [3]. It is shown that existing models can predict the test results reasonably [2, 4-7].

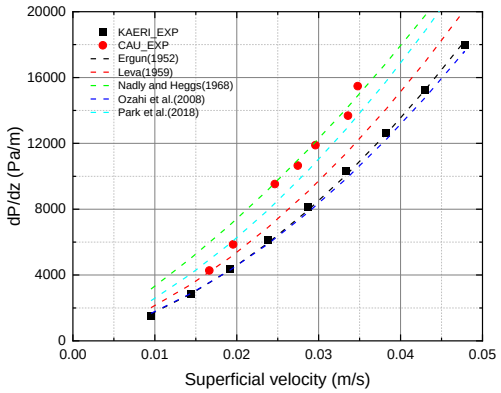

Fig. 3 Water test results

2.3 Future Plan

Non-explosive TROI particles were sieved and analyzed at KAERI in the past [1]. Through the analyses, representative test is selected as follows; mass ratio of UO_2 to ZrO_2 = 70:30, free fall = 1 m, total particle mass=18.12 kg. Main tests will be performed using the representative TROI particles. Fig. 4 shows the particle size distribution for the main tests.

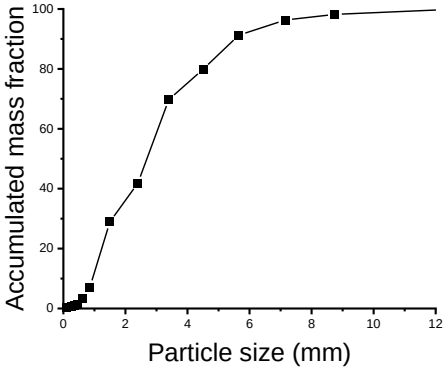

Fig. 4 Particle size distribution for main tests

3. Conclusions

Two-phase pressure drop test facility has been constructed and shakedown tests using steel spheres with a diameter of 3 mm have been performed at KAERI. Air or water was used for the single phase shakedown tests. The test results showed that they were in a good agreement with existing ones. In the near future, main tests with real corium particles will be carried out and a pressure drop model will be developed for the debris bed coolability analysis code so called COLAS.

ACKNOWLEDGEMENTS

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