

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

Hwan Yeol KIM*, Keun Sang CHOI, Ki Han PARK, Chang Wan KANG, Seokgyu JEONG, JaeHoon JUNG, and Sang Mo AN
Korea Atomic Energy Research Institute, 989-111, Daedeok-daero, Yuseong-gu, Daejeon, Korea

*Corresponding author: hykim1@kaeri.re.kr

Motivation

Background

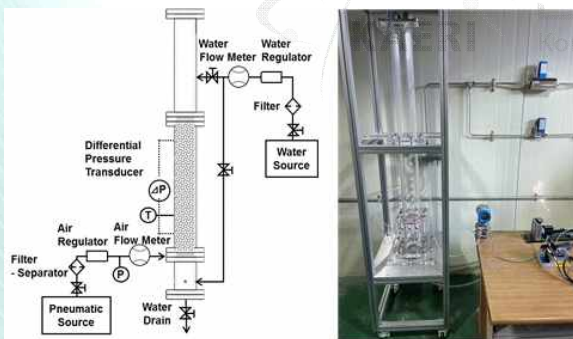
- Ex-vessel debris cooling is applied as a severe accident mitigation strategy for OPR1000 in Korea.
- In case of a severe accident, fragmented molten corium is accumulated on the cavity surface in a form of debris bed.
- Important safety issue is how to secure the coolability of ex-vessel debris bed.

Scope & Objective

- Two-phase pressure drop test with real corium particles is planned at KAERI in 2021.
- A test facility has been constructed and shakedown tests have been performed.
- A brief description of test facility and shakedown test results are presented.

Test Facility

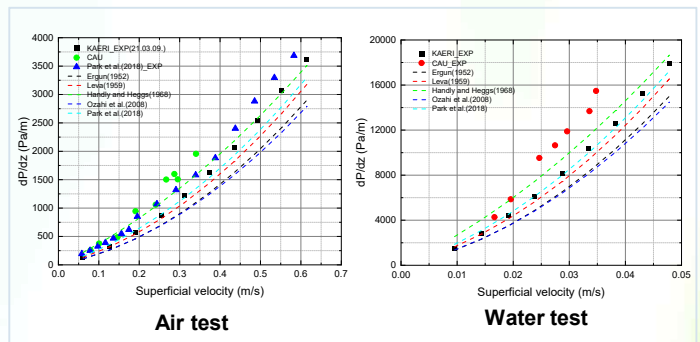
- Test section; cylindrical Acryl with an inner diameter of 100 mm, a thickness of 10 mm and a height of 500 mm
- Air supply system; composed of a flow meter, regulator, and filter
- Water supply system; composed of a pump, flow meter, regulator, and filter
- Differential pressure meter; provided to measure a pressure loss



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

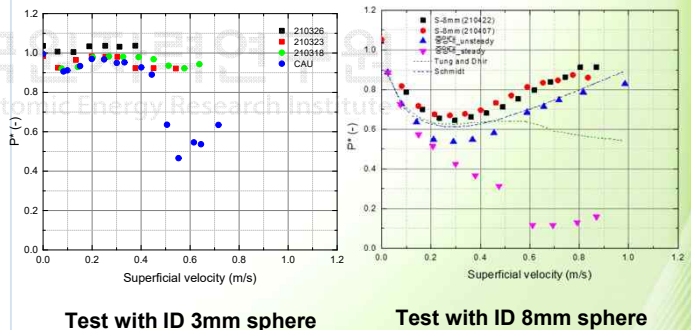
Single Phase Shakedown Test

- Steel spheres with a diameter of 3 mm are used.
- Test section is filled with 17.8 kg of steel spheres.
- 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.
- Differential pressure is a little bit lower than the other existing ones. Existing models can predict the test results reasonably.



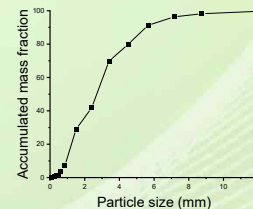
Two Phase Shakedown Test

- Steel spheres with a diameter of 3 mm or 8 mm are used.
- Test section is filled with 18.4 ~ 18.8 kg of steel spheres.
- Air is supplied through the small holes at the lower part of the test section filled with water and flows upward through the test section.
- Differential pressure is measured between lower and upper part of the test section using differential pressure meter.
- Reasonable results as a shakedown test are obtained. More investigation on pressure drop at high superficial velocity is needed



Future Plan

- Test with representative TROI particles (mass ratio of UO₂ to ZrO₂ = 70:30, free fall = 1 m, total particle mass=18.12 kg) is planned.
- Size distribution of the particles is as follows.



Conclusions

- Two-phase pressure drop test facility was constructed to perform the tests using non-explosive TROI particles at KAERI in 2021.
- Before the main tests, shakedown tests with steel spheres were performed and reasonable results were obtained.