Transactions of the Korean Nuclear Society Autumn Meeting
Changwon, Korea, October 21-22, 2021

Pressure Drop Prediction of Rectangular Channel Thermal Hydraulic Test Loop

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Introduction

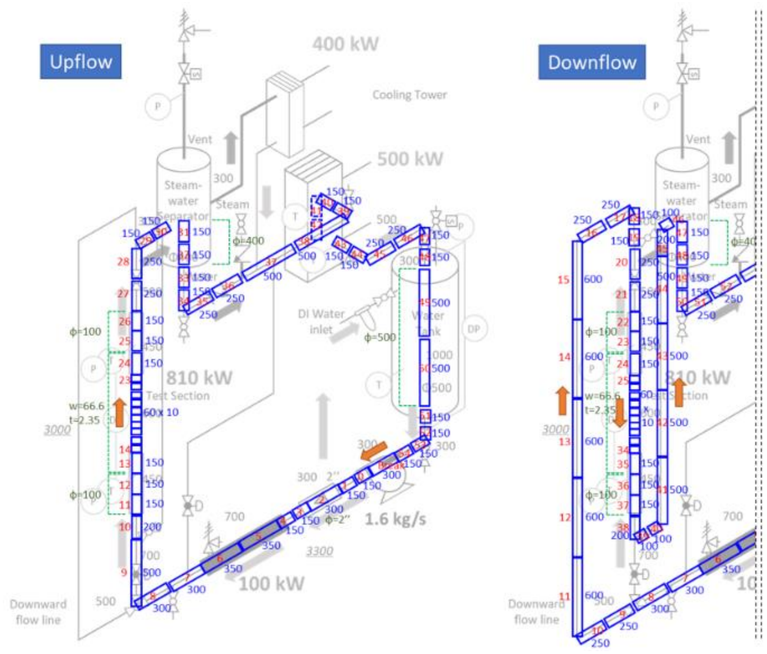
- KAERI is designing an experimental loop for testing TH characteristics of rectangular channel under single and two-phase conditions (up to CHF).
- Two-phase pressure drop characteristics of test loop has been analyzed for pump selection.
- Single phase pressure drop of loop has been evaluated and combined with multiplier to predict loop pressure drop under CHF condition.

Single-phase Pressure Drop Characteristics

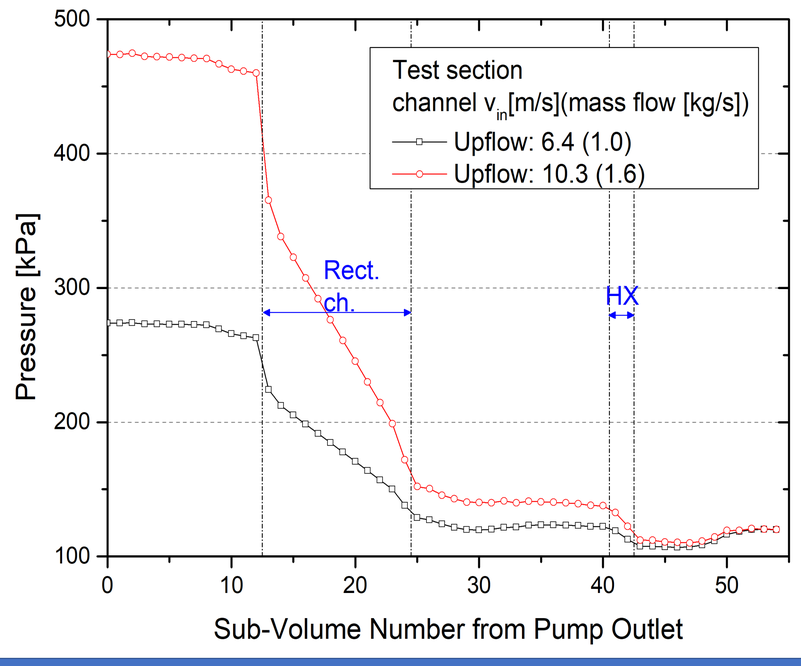
- Single-phase pressure drop of the loop is evaluated utilizing in-house code CORAL.
- Analyses show that most of pressure drop occurs in rectangular channel region, and its portion is increased with velocity.

Analysis condition for single-phase flow

Item	Value
Test section geometry	width: 66.6 mm, thickness: 2.35 mm
Flow rate	0.2~2.0 kg/s
Coolant temperature	35 °C
Pump inlet pressure	120 kPa



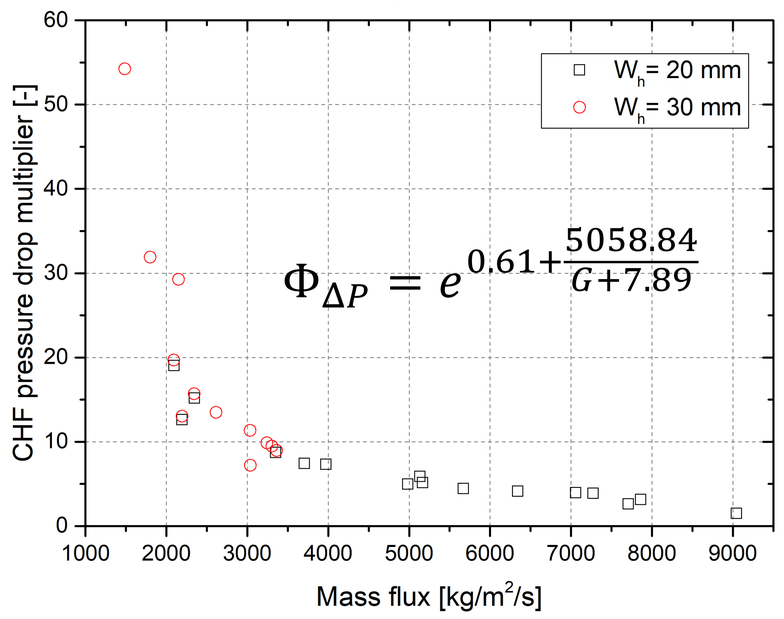
Primary circuit schematics / code nodalization



Pressure distribution for single-phase flow

Pressure Drop Multiplier

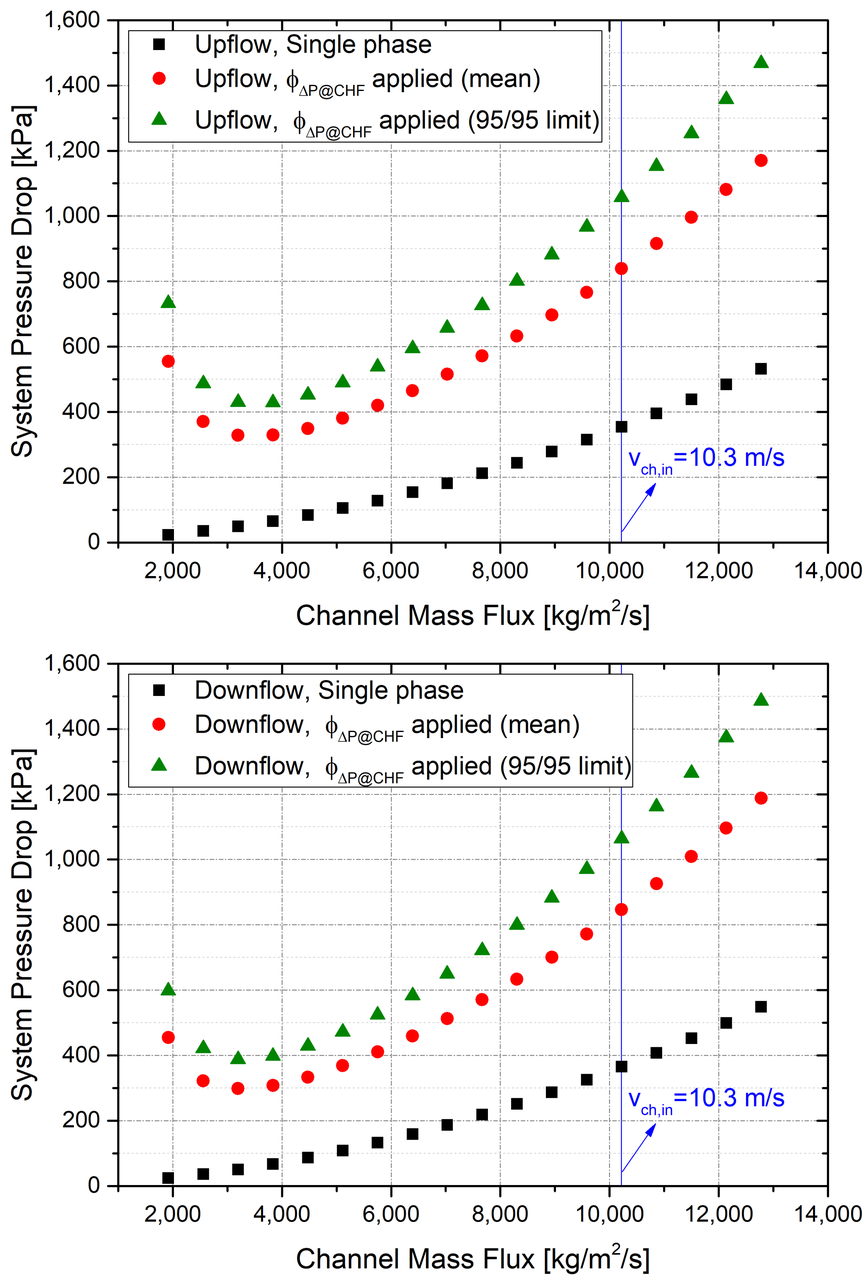
- PNU CHF pressure drop measurement data has been analyzed to yield ΔP multiplier (ϕ) relation.
- Simple mass flux dependent ϕ regression curve is obtained which shows R^2_{adj} value of 97%.



Pressure drop multiplier at CHF condition

CHF Pressure Drop

- Considering 95/95 probability and confidence level of ϕ regression curve, system at CHF condition for target channel velocity (~10 m/s) was evaluated to be less than 1,100 kPa.



Predicted system pressure drop at CHF condition (upper: upflow, lower: downflow)