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Prediction of Low-Pressure Critical Heat Flux using SPACE-RR Code

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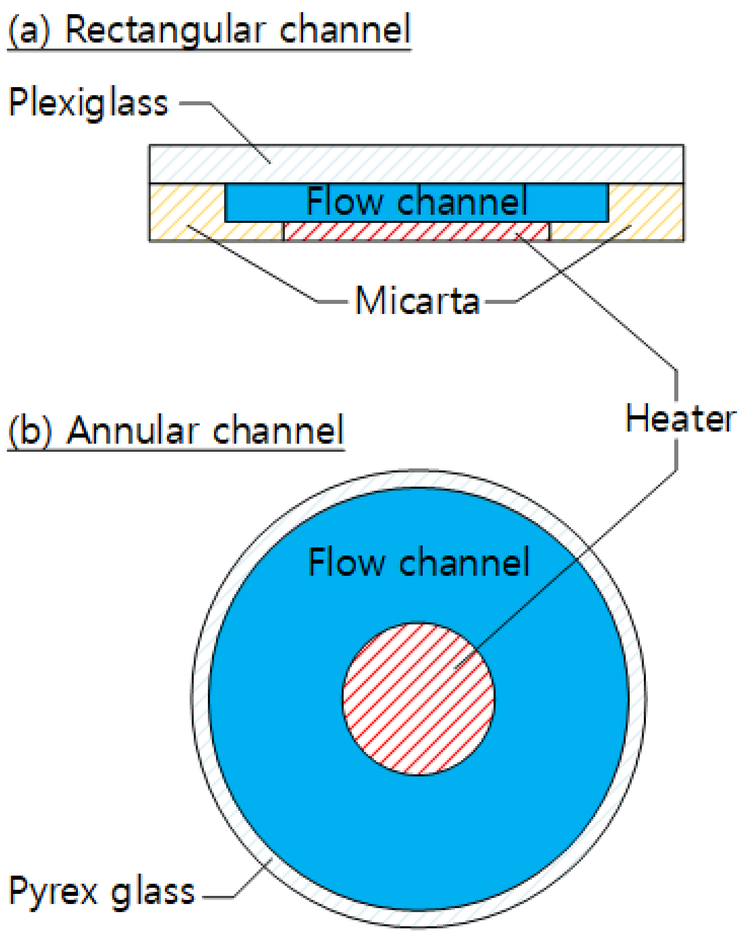
Introduction

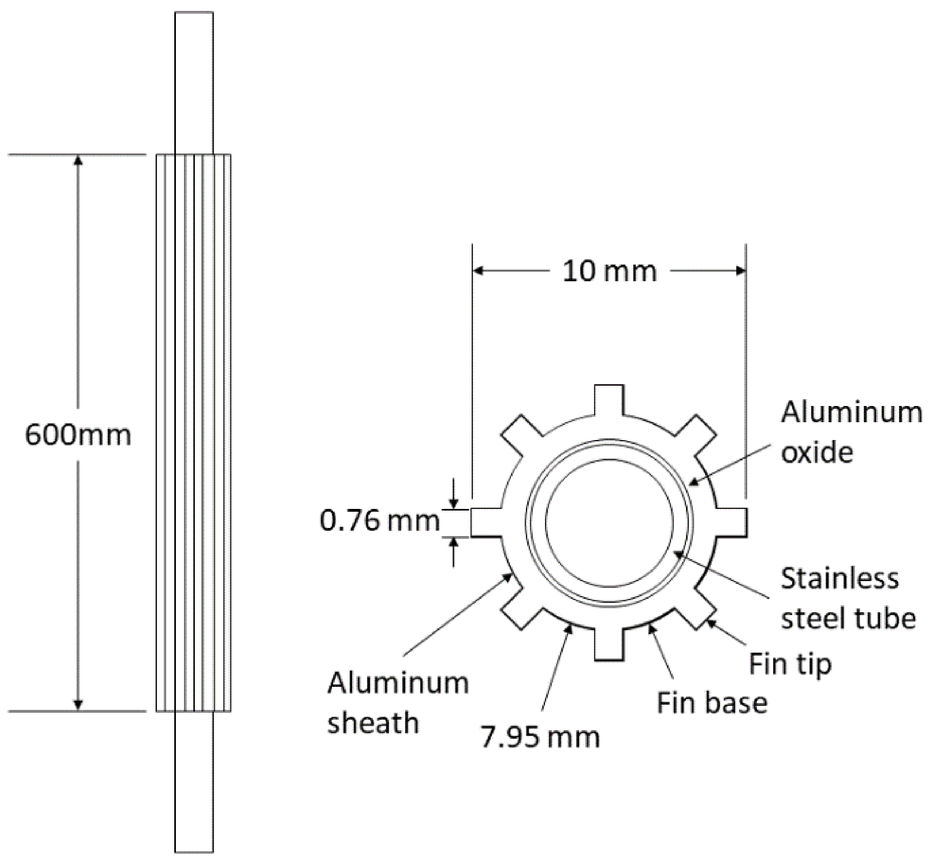
- SPACE-RR code is developed from SPACE for RR safety analysis.
- Two CHF correlations are newly added which are Kaminaga et al. (1998) and HANARO (1992) correlations developed for plate-type and finned rod geometries, respectively.
- This study checked prediction capability of embedded CHF correlations by comparing calculation results with those from experiments.

Test by Mirshak et al. (1959)/WNRE (1989)

Test section cross-section (Mirshak et al. (1959))



Test section cross-section (WNRE (1989))



Test section specification (Mirshak et al. (1959))

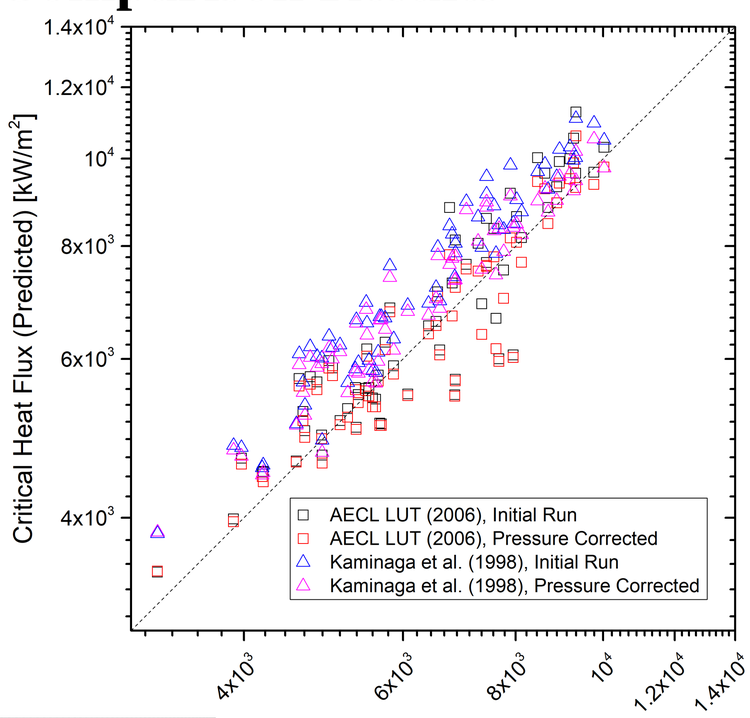
Item	Value
Geometry (Rectangular channel)	
Width/Thickness	2.5”, 1/2”(max.)
Length	22.25”
Heater plate width/thickness	2”, 0.0038” (or 0.025”)
Heated length	19.25”
Geometry (Annular channel)	
Inner/Outer diameter	0.5” (or 0.790”)/0.5625” (or 0.8425”)
Heater rod diameter	0.5” (or 0.790”)
Heated length	24”
Test condition (65 cases)	
Velocity	5.4~41.6 ft/s
Pressure	24.5~85.7 psia
Subcooling	6~74 ℃
Flow direction	Downward

Test section specification (WNRE (1989))

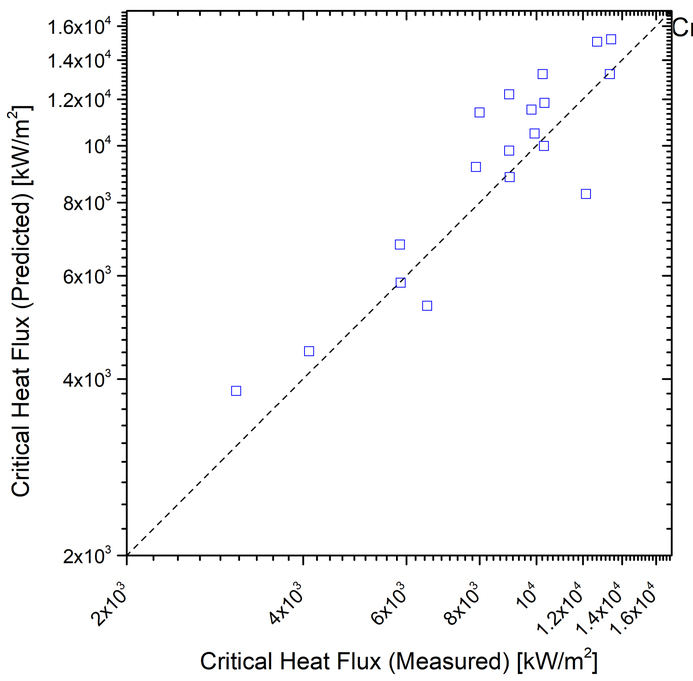
Item	Value
Geometry (Tube I.D.= 17 mm)	
Hydraulic diameter	7.3 mm
Length	600 mm
Heater diameter	10 mm (including fin)/7.95 mm (base)
Fin thickness	0.76 mm
Geometry (Tube I.D.= 24 mm)	
Hydraulic diameter	13.66 mm
Length	600 mm
Heater geometry	Same as above
Test condition (19 cases)	
Mass flux	1,000~5,900 kg/m²/s
Pressure	110~350 kPa
Inlet temperature	15~62 ℃
Flow direction	Upward

Experiment-Code Comparison Results

<M/P statistics>
Kaminaga et al. (1998):
- Mean=0.91, s=0.07
AECL LUT (2006):
- Mean=1.00, s=0.11



<M/P statistics>
HANARO (1992):
- Mean=0.93, s=0.18



Implemented correlations follow overall behavior of experiment.