

Jet

A Study on the Characteristics of the Jet Type Condensation

150

20 mm) - , 20 °C - 95 °C, 4 가 (5, 10, 15, 30 kg/hr - 280 kg/hr) 가 .

Abstract

To investigate the condensation mechanism of steam injected into the water, and to generate test data for the design of steam sparger, a series of steam-water condensation tests were conducted. Steam was injected horizontally through nozzles of different diameters (5, 10, 15, 20 mm) in the middle of the water chamber. The experimental ranges of water temperature and steam mass flow rate were 20 °C - 95 °C and 30 kg/hr - 280 kg/hr, respectively. From the test results, condensation regime map was constructed and the effects of steam mass flux and water temperatures on the condensation loads were evaluated. In addition, optimal size of steam injection hole for steam sparger was proposed.

1.

- 가 가 가

[1].

가
가

()

[2,3].

, BWR

[4].

가
가

[5-7]. , 가

2.

(1).

1.0 MPa , 400 kg ,

가

1 m 가 1.5 m ,

1 m³ ,

Plexiglass 가

2

가

(Thermocouple) 가 3

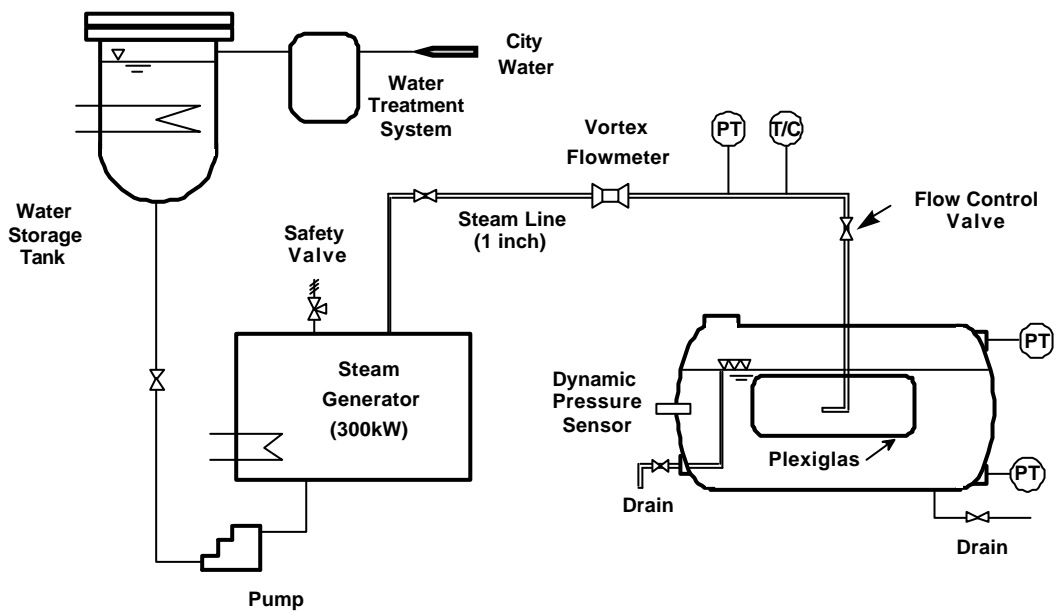


Fig. 1. Schematic Diagram of Condensation Test Facility

4 가 (5, 10, 15, 20 mm)
 30 cm , 가
 Vortex
 75 cm
 1 inch , 0.5, 1 inch Vortex 가
 20 °C 95 °C
 30 kg/hr 280 kg/hr
 가
 15 mm
 5 mm

Data Acquisition System (DAS)

DAS
 Video Camera
 Converter 가
 DAS IBM-Compatible PC 16-bit A/D

1. -

(mm)	(°C)	(cm)	(kg/m ² -s)
5	20, 40, 60	30	424 – 1,132
10	70, 75, 80		106 – 849
15	85, 90, 95		47 – 377
20			27 – 212

3.

가

3.1

Chugging, (CO: Condensation Oscillation), (Stable Condensation) [3]. Chugging
 가

10 mm 가 2 Chugging
 15 mm 가
 가 Core 가 (Plume) 가
 , Plume 가
 Core Core
 가 (Transient Condensation)
 Core Plume
 가 Core 가 가 가
 가 40 °C Plume 가
 가 60 °C Plume
 가 가 가
 가 가 가
 가 가 70 °C

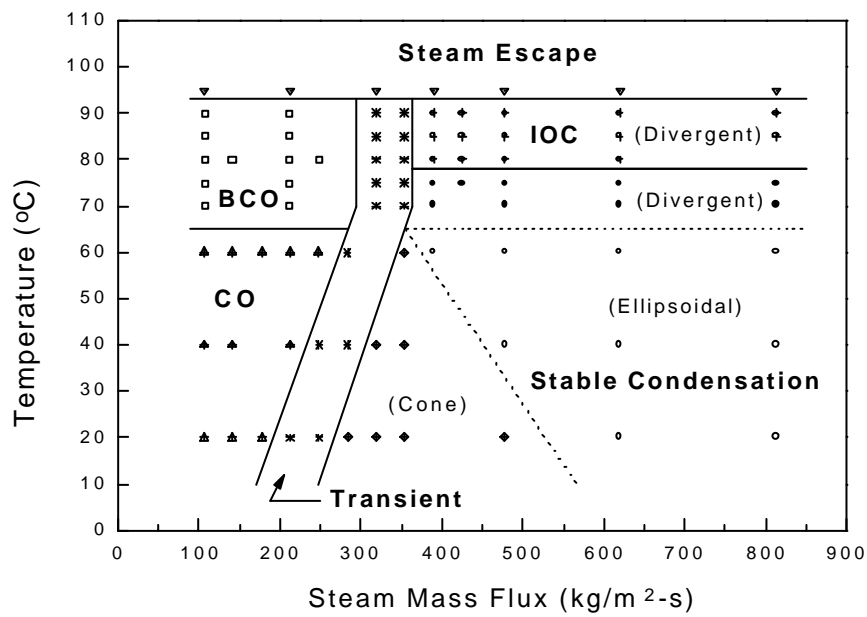


Fig. 2. Condensation Regime Map for 10 mm Nozzle

Core (Cone) 가 (Ellipsoidal) 가 70 °C
 Core (Divergent) 가
 Jet Kudo [8], Kerney [9],
 Weimer [10] Core 가
 Jet 가
 Core , Plume 가 ,
 가
 가 70 °C 가
 (BCO: Bubbling Condensation Oscillation)
 가 80 °C (IOC:
 Interfacial Oscillation Condensation) Core
 가 90 °C (Steam
 Escape).

가 10 mm
 (30 kg/hr), 가 15 20 mm
 , Chugging
 10 mm ,
 가 70 °C , 300 kg/m²-s 15 mm
 280 kg/m²-s , 20 mm 200 kg/m²-s
 10, 15, 20 mm 370, 350, 280 kg/m²-s 가

3.2

(), 가

3.2.1

가 가 가 가
 (3). 가
 가 가 , 가
 가 Plume 가 가

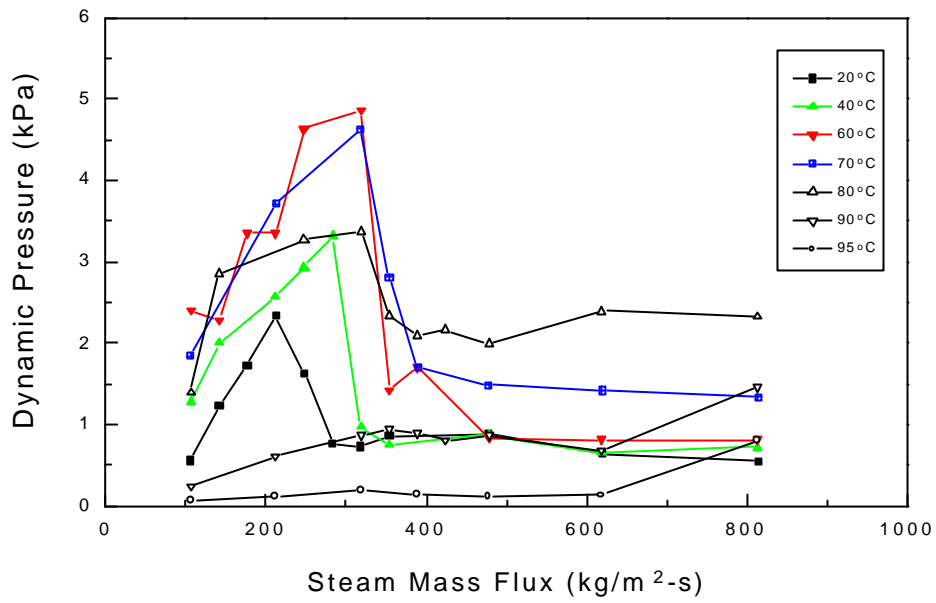


Fig. 3. Dynamic Pressure vs. Steam Mass Flux in 10 mm Nozzle

가 Plume 가 가 . 가
 가 가 , 가
 Jet 가 가 가 가 [11].
 Jet 가 가 가 , 가
 ,
 가 ,
 가 . 가 20 °C 60 °C
 가 가 70 °C ,
 mm). 10 mm , 가 (90 °C)
 가 .

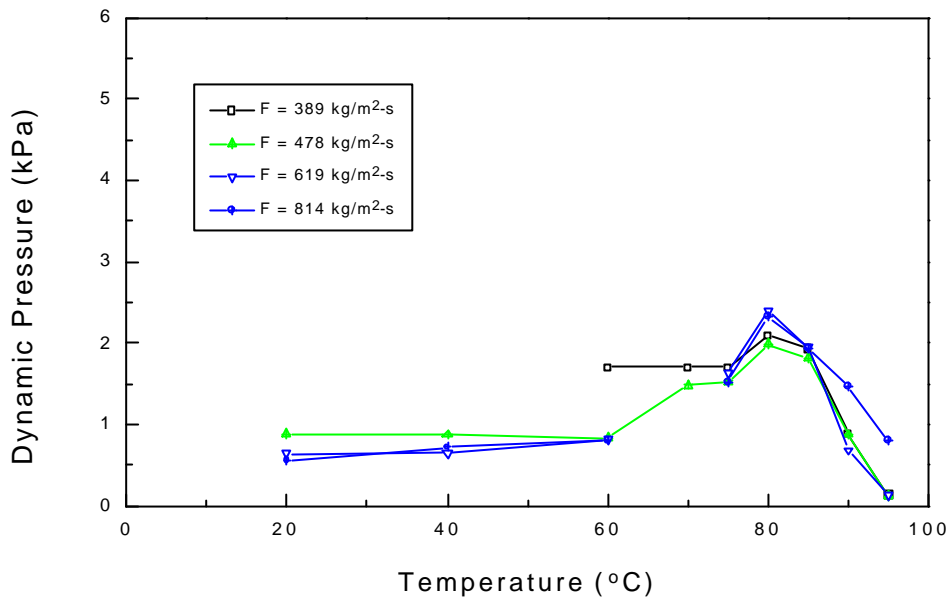


Fig. 5. RMS Pressure vs. Pool Water Temperature in the Stable Condensation Region for 10 mm Nozzle

Onset of Instability , 90 °C 가 .
 가 . 가 95 °C 가 .
 , 가 가 .
 . ()
 . 15 mm 20 mm , ,
 20 °C 40 °C 가 .
 10 mm .
 4.
 , .
 가 , .
 가 , .
 가 .
 . 6 4 가 .
 . 400 kg/m²-s .
 RMS Peak 가 RMS Peak . 400 kg/m²-s
 RMS 15 mm, 10 mm, 20 mm . Chan

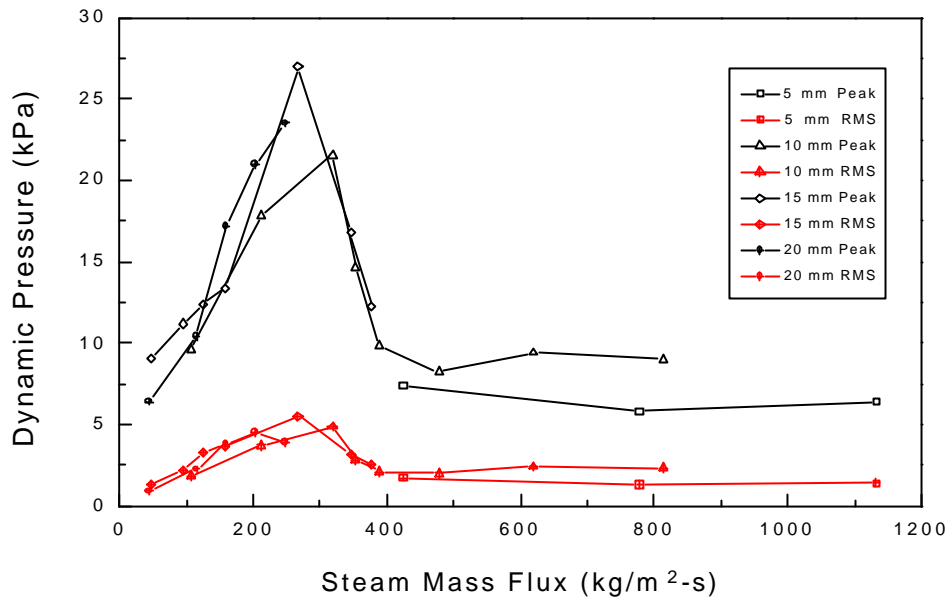


Fig. 6. Maximum RMS and Peak Pressures Measured for 4 Different Size Nozzles

Chan 가 [12].
 가 (3.7-12 mm vs. 5-20 mm). 400
 kg/m²-s Peak 15 mm, 20 mm, 10 mm
 가 10 mm
 5 mm, 400 kg/m²-s
 5 mm 10 mm
 5 mm 가
 10 mm 12.5 mm
 가
 10 mm
 가 90 °C
 가 가 가

5.

4 가

가

()
 가 가
 10 mm 가 가

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