Critical Heat Flux in Tight Lattice Three-Pin Bundle with and without Wire Spacer

Dan Tri LE[1], *Sho TANABE[1], Minoru TAKAHASHI[2] and Masatoshi KONDO[2]

[1]Dept. Nucl. Eng. Tokyo Tech, [2] RLNR Tokyo Tech

Abstract Critical heat flux (CHF) behavior in tight lattice core in boiling two-phase flow was clarified experimentally for three-pins tight rod bundle with wire spacer with the parameter of the ration of pitch to diameter ratio (*p/d*).

Keywords: Critical heat flux, Bundle pin, Tight lattice, Wire spacer, Two-phase flow.

1. Introduction Reduced Moderation BWR can be fast neutron reactors for Pu breeding and MA burning by means of tight lattice core with wire spacers. The effect of wire spacer on critical heat flux (CHF) was investigated experimentally for single pin with wire spacer [1]. In the present study, the CHF behavior is investigated for simulated tight lattice core using a three-pin-bundle with the wire spacers. The effects of the wire spacers with its axial pitch and pitch to diameter ratio (*p/d*) are investigated.

2. Experimental The forced convection boiling water loop was used. The CHF in tight lattice three-pin bundle (Fig.1) with and without the wire spacers was measured. Heater pin made of stainless steel tubes (Diameter *d*= 4.57 mm, length *L*=400 mm) was connected to the copper electrodes at both ends by DC Joule heating. The rod-to-rod pitch *p* was 5.0 mm and 5.4 mm at which the *p/d* equal to 1.10 and 1.18, respectively. The axial pitches of the wire spaces were 100 and 200 mm.

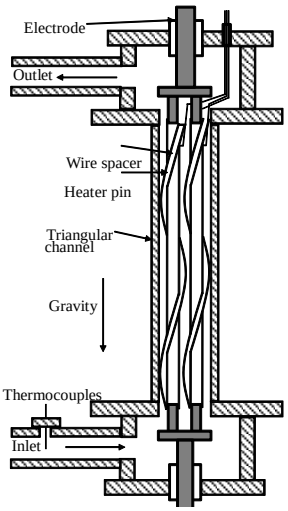

Fig.1 Test section

3. Results The CHF in three-pin bundle with wire spacers was higher than that without wire spacers. The difference in CHF value was larger at the quality region from x_{local}= -0.06 to 0 than at the quality region from x_{local}=0 to 0.02 (Fig.2). The CHF values for the *p/d* = 1.10 were much higher than that for the *p/d* = 1.18 under the same mass flow rate condition particularly in lower range of x_{local} (Fig.3).

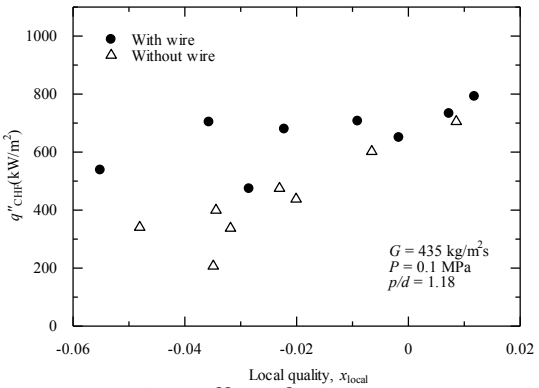

Fig.2 Effect of wire on CHF

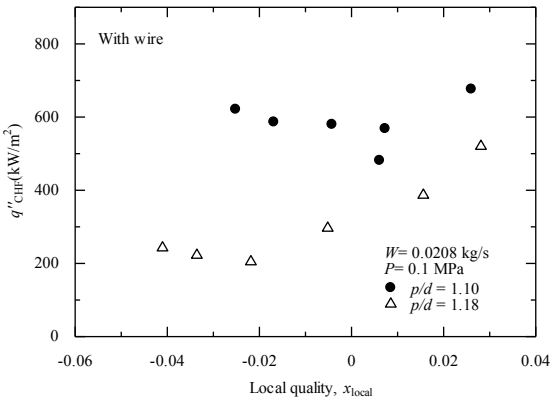

Fig.3 Effect of *p/d* on CHF

4. Conclusion The CHF was enhanced by up to 50% with the wire spacers under constant mass flux condition. The decrease of *p/d* from 1.18 to 1.10 increased the CHF values by up to 150% under constant flow rate conditions. Thus, the coolability in the tight lattice core could be optimized by using the wire spacers.

References [1] Tri Dan LE, M. Takahashi, *J. Energy and Power Eng.*, Vol. 9, (2015) pp.844-851.