ABSTRAK

Penelitian ini bertujuan untuk menganalisis pengaruh debit air terhadap karakteristik permulaan *flooding* pada aliran dua fase berlawanan arah di geometri *hot leg* berdiameter 1 inci menggunakan konfigurasi katup bukaan kanan. Fenomena *flooding* dikaji sebagai bagian dari perilaku aliran dua fase udara-air yang relevan terhadap kajian termohidraulika pada sistem reaktor air bertekanan, khususnya dalam kondisi yang merepresentasikan terjadinya pembatasan aliran berlawanan arah atau *counter current flow limitation* (CCFL).

Penelitian dilakukan secara eksperimental pada tekanan sistem 1 bar dengan konfigurasi debit air sebesar 3, 6, 9, 12, 15, 18, 21, 24, 27, dan 30 gph. Debit udara dikonfigurasikan secara bertahap sebesar 5 lpm pada setiap kondisi pengujian hingga mencapai kondisi permulaan *flooding*. Data yang diperoleh meliputi debit aliran dua fase, *water level*, beda tekanan, serta visual pola aliran selama proses pengujian. Seluruh data kemudian dianalisis untuk mengetahui karakteristik permulaan flooding akibat variasi debit air.

Hasil penelitian menunjukkan bahwa peningkatan debit air berpengaruh terhadap terjadinya *onset of flooding*, perubahan *water level*, dan peningkatan beda tekanan pada seksi uji. Pada debit air yang rendah, aliran masih cenderung stabil, sedangkan pada debit air yang lebih tinggi interaksi antara fase gas dan fase cair semakin kuat sehingga menimbulkan gelombang pada antarmuka aliran dan akhirnya memicu *flooding*. Visualisasi aliran menunjukkan perubahan pola dari *stratified flow* menjadi *wavy flow*, kemudian berkembang menuju kondisi *flooding* ketika cairan tidak lagi mampu mengalir turun secara kontinu.

Kata kunci: *flooding*, aliran berlawanan arah, CCFL, *hot leg*, debit air, *water level*, beda tekanan.

ABSTRACT

This study aims to analyze the effect of water flow rate on the onset flooding two phase characteristics during counter-current flow in a 1-inch diameter hot leg geometry with a right side valve opening. The flooding phenomenon was investigated as part of the air–water two-phase flow behavior, which is relevant to thermohydraulic studies of pressurized water reactor (PWR) systems, particularly under conditions representing counter current flow limitation (CCFL).

The research was conducted experimentally at a system pressure of 1 bar using water flow rate variations of 3, 6, 9, 12, 15, 18, 21, 24, 27, and 30 gph. The air flow rate was increased gradually in increments of 5 lpm for each test condition until the onset flooding condition was reached. The collected data included flow rates, water level, differential pressure, and visual of the flow patterns during the experiments. All data were subsequently analyzed to determine the changes in flow characteristics resulting from variations in the water flow rate.

The results indicate that increasing the water flow rate significantly affects the onset of flooding, changes in the water level, and the increase in differential pressure across the test section. At low water flow rates, the flow remained relatively stable, whereas at higher water flow rates, the interaction between the gas and liquid phases became stronger, generating interfacial waves that eventually triggered flooding. Flow visualization revealed a transition in the flow pattern from stratified flow to wavy flow, which subsequently developed into flooding when the liquid phase could no longer flow downward continuously.

Keywords: *flooding, counter-current flow, CCFL, hot leg, water flow rate, water level, differential pressure.*