INTISARI

Penelitian ini bertujuan menyelidiki karakteristik sub-rezim aliran *slug* dua fase udara-air, khususnya pada kondisi *Low Aerated Bubbles* dan *High Aerated Bubbles* dalam pipa horizontal. Aliran *slug* menyebabkan fluktuasi tekanan dan dampak mekanis signifikan, berpotensi menimbulkan kelelahan material dan kerusakan struktur pada sistem perpipaan industri. Meskipun klasifikasi sub-rezim *slug* telah banyak diteliti, belum terdapat studi mendalam membahas secara simultan mengenai pengaruh kecepatan superfisial terhadap parameter utama *slug* (frekuensi, panjang dan kecepatan)

Metode penelitian menggunakan visualisasi eksperimental dengan kamera berkecepatan tinggi pada pipa transparan berdiameter 26 mm sepanjang 10 meter. Kecepatan superfisial gas (J_G) divariasikan dari 0,66 hingga 9,24 m/s dan cairan (J_L) dari 0,2 hingga 0,77 m/s, menghasilkan 32 kombinasi kondisi pengujian. Data visualisasi diolah untuk mengidentifikasi struktur *slug* serta menghitung panjang, frekuensi, dan kecepatan *slug*, lalu dianalisis menggunakan *probability density function* (*PDF*).

Hasil penelitian menunjukkan peningkatan kecepatan superfisial gas secara signifikan memengaruhi karakteristik *slug*, terutama pada sub-rezim *High Aerated Bubbles* dengan peningkatan aerasi yang jelas. Sebaliknya, pada sub-rezim *Low Aerated Bubbles*, struktur *slug* relatif stabil dengan sedikit gelembung udara terdistribusi dalam cairan. Hubungan antara frekuensi, panjang, dan kecepatan *slug* dengan variasi J_G dan J_L memberikan wawasan baru mengenai dinamika aliran dua fase, menjadi acuan penting dalam pengembangan model prediktif yang lebih akurat.

Kata Kunci : Aliran dua fase, Aliran *slug*, Sub-rezim aliran *slug*, Visualisasi eksperimental, Parameter aliran *slug*

ABSTRACT

This study investigates the characteristics of slug flow sub-regimes in two-phase air-water systems, focusing specifically on Low Aerated Bubbles and High Aerated Bubbles in horizontal pipes. Slug flow can induce significant pressure fluctuations and mechanical impacts, potentially leading to material fatigue and structural damage in industrial piping systems. Although the classification of slug sub-regimes has been widely studied, comprehensive simultaneous investigations addressing the influence of superficial velocity on key slug parameters (frequency, length, and velocity) remain limited.

An experimental visualization method employing a high-speed camera was conducted on a transparent pipe with an internal diameter of 26 mm and a length of 10 meters. Superficial gas velocity (J_G) was varied from 0.66 to 9.24 m/s, while superficial liquid velocity (J_L) ranged from 0.2 to 0.77 m/s, yielding 32 experimental combinations. Visual data were processed to identify slug structures and quantify their length, frequency, and velocity, subsequently analyzed using the probability density function (PDF).

Results indicated that an increase in superficial gas velocity significantly influenced slug characteristics, notably in the High Aerated Bubbles sub-regime, characterized by marked aeration enhancement. Conversely, the Low Aerated Bubbles sub-regime exhibited relatively stable slug structures with limited air bubble dispersion within the liquid phase. The relationships between slug frequency, length, and velocity with variations in J_G and J_L provide new insights into the dynamics of two-phase flow, serving as crucial references for developing more accurate predictive models.

Keywords : Two-phase flow, Slug flow, Slug flow sub-regimes, Experimental visualization, Slug flow parameters