INTISARI

Aliran *slug* cair-gas banyak ditemui pada berbagai aplikasi industri. Karakteristik aliran *slug* mendapat perhatian lebih karena keterkaitannya terhadap efisiensi dan keamanan pada sistem transportasi fluida. *Salah satu* metode yang sering digunakan untuk mempelajari karakteristik aliran *slug* adalah *image processing*. Kelebihan dari metode ini yaitu termasuk metode pengukuran *non-intrusive* dan kalibrasi yang cenderung mudah. Penelitian ini bertujuan mengaplikasikan teknik *image processing* untuk menghitung parameter serta melakukan analisa mengenai pengaruh kecepatan superfisial fluida serta perbedaan diameter terhadap parameter tersebut. Data yang didapat dari penelitian dapat digunakan sebagai *database* pendukung penelitian selanjutnya, contohnya seperti validasi teknik pengukuran aliran dua fase lainnya ataupun sebagai dasar pengembangan suatu model.

Penelitian dilakukan pada pipa berdiameter 16 mm dan 50 mm. Daerah pengamatan diletakkan pada jarak 190 D dari posisi *inlet* untuk mengetahui perilaku aliran *slug*. Kamera yang digunakan adalah kamera Phantom Miro M310 dengan kemampuan merekam hingga 3200 fps pada resolusi maksimal. Data yang direkam selanjutnya diolah menggunakan MATLAB® R2013a. Secara umum, terdapat tujuh tahapan image processing yang diaplikasikan pada gambar mencakup pemuatan gambar ke dalam program, pengurangan dengan gambar *background*, serta konversi ke citra biner. Perhitungan dilakukan menggunakan metode *object tracking algorithm*. Parameter yang dapat diperoleh adalah kontur moncong dan ekor gelembung, kecepatan gelembung dan liquid slug, frekuensi slug, serta panjang gelembung dan liquid slug.

Dari data penelitian, dapat diketahui bahwa posisi moncong gelembung akan semakin turun seiring dengan meningkatnya kecepatan superfisial fluida. Kecepatan gelembung dan *liquid slug* meningkat seiring dengan bertambahnya kecepatan superfisial air dan udara. Peningkatan kecepatan superfisial air menyebabkan bertambahnya frekuensi *slug*. Sedangkan efek perubahan kecepatan superfisial udara terhadap frekuensi *slug* tren yang berbeda tergantung dari *range* kecepatan superfisial air dan udara. Panjang gelembung meningkat seiring dengan meningkatnya kecepatan superfisial udara dan berkurang seiring dengan menurunnya kecepatan superfisial air; Pada *liquid slug*, peningkatan kecepatan superfisial air menyebabkan memendeknya *liquid slug* sedangkan perubahan kecepatan superfisial udara meimbulkan tren yang fluktuatif.Selain itu dijabarkan juga pengaruh diameter terhadap parameter parameter yang telah disebutkan tadi.

Kata Kunci : Aliran air udara, aliran *slug*, parameter *slug*, teknik *image processing*, studi visualisasi.

ABSTRACT

Gas-liquid slug flow often occured in industrial process. This flow, which attracted researchers due it's characteristics, can cause some problems related to efficiency and safety factor in industrial fluid transportation system. One of measurement method developed to get in-depth understanding about *slug* behaviour is image processing technique which has some advantages like non intrusive characteristics and easy to calibrate. The objective of this research is to developed image processing technique to evaluate some slug parameters. The parameter calculated are nose and tail bubble contour, slug and liquid slug velocity, slug frequency, and slug and liquid slug length. Futhermore the effect of superficial velocity and diameter is also investigated.

This experiment use two set of horizontal pipe with the diameter of it is 16 mm and 50 mm. Observation area, consist of correction box, LED lamp, and high speed video camera, was placed on 190 D to capture the image and observe slug flow behavior. A high speed video camera Phantom Miro M310, which is able to record 1280 x 800 (maximum size) at 3200 fps, was used to record the flow visualization Recorded data was transferred to the computer selected images were processed through *MATLAB® R2013a*. Sequence algorithm has been applied to images including image filtering and binary conversion. The air-water interface is clearly seen so the elongated bubble and liquid slug can be easily recognized. Moreover, those mentioned steps are able to remove dispersed bubble around liquid slug. The parameter calculated are bubble and liquid slug velocity, slug frequency, bubble and liquid slug length, and nose and tail bubble contour.

From the experiment, it can be seen that the position of bubble nose tend to move to the pipe centerline when the gas superficial velocity increases. Meanwhile on bubble tail, the increase of gas superficial velocity cause the hydraulic jump becomes higher. On slug velocity, the increase of both water and gas superficial velocity cause bubble and liquid slug became faster. The increase of water superficial velocity in constant gas superficial velocity cause the slug frequency increases too. On other side, the change of gas superficial velocity in water superficial velocity shows different behavior depend on both fluid superficial velocity. The slug length behaviour can is explain next. The increase of water superficial velocity in constant gas superficial velocity changes the bubble shorter. In contrast, the bubble become shorter as the water superficial velocity increases in constant water superficial velocity In contrast, the change of both gas and water superficial velocity produces fluctuative trend. In each parameter, the effect of diameter change also investigated. Finally, compared to previous study, the result of this research show good agreement.

Keywords: Air-water flow, slug flow, slug parameter, image processing technique, visualization study.