

Aliran *slug* cair-gas banyak ditemui pada berbagai aplikasi industri antara lain transportasi fluida menggunakan pipa, pembangkit tenaga listrik, alat penukar kalor, proses pada industri kimia, proses pengolahan minyak, reaktor nuklir, sistem refrigrasi, dll. Aliran *slug* merupakan salah satu jenis aliran dua fasa yang mendapat perhatian lebih karena memiliki beberapa perilaku yang unik. Salah satunya adalah tingginya variasi kecepatan serta tekanan lokal gas dan cairan pada aliran *slug*. Berbagai macam metode digunakan untuk mengenali karakteristik aliran seperti perbedaan konduktivitas, CECM, dan *X-ray tomography*. Selain itu, berkembang juga metode *Image Processing* yang dapat digunakan untuk pengenalan pola aliran serta menganalisa beberapa parameter penting dari aliran *slug* seperti yang digunakan oleh Morales dkk (2011) serta Do Amaral dkk (2013).

Aliran slug direkam menggunakan *high speed video camera* 1200 fps dan diekstrak menjadi potongan-potongan gambar. Pengamatan dilakukan pada pipa berdiameter 26 mm dengan variasi kecepatan superficial air antara dan variasi kecepatan superficial udara antara sampai dengan Beberapa teknik seperti *image complement*, *noise reduction*, *tophat filtering* dan *bottomhat filtering*, digunakan agar mendapatkan gambar hasil biner yang maksimal. Gambar biner digunakan untuk mengetahui karakteristik aliran *slug* seperti topologi aliran, kecepatan gelembung, panjang gelembung, serta frekuensi *slug*.

Dari penelitian diketahui bahwa peningkatan kecepatan superficial udara (J_G) pada kecepatan superficial air (J_L) konstan mengakibatkan peningkatan kecepatan gelembung serta panjang gelembung. Sedangkan peningkatan kecepatan superficial air (J_L) pada kecepatan superficial udara (J_G) konstan mengakibatkan peningkatan kecepatan gelembung dan frekuensi *slug* serta pemendekan panjang gelembung.

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

Abstract

Slug flow is a part of intermittent flow which is avoided in industrial application because of its irregularity and high pressure fluctuation. Those characteristics cause some problems like internal corrosion and damage pipeline construction. In order to understand slug characteristic better, some of measurement techniques can be applied such as wire-mesh sensors, CECM, and high speed camera. This present study was aimed to determine slug characteristic by using image processing techniques. Experiment has been carried out in 26 mm i.d. acrylic horizontal pipe with 9 m long. Air-water flow was recorded 5 m from inlet mixer by using high speed video camera. Each of image sequence were processed using MATLAB. There are some steps including top-hat filtering, image complement, and background subtraction, that used in this algorithm to produce binary images. Special treatment also were applied to reduce the disturbance effect of dispersed bubble around the bubble. Furthermore, binary images was used to calculate slug parameter such as gas slug length, gas slug velocity, and frequency. As a result the effect of superficial gas velocity and superficial velocity on calculated parameter can be understood. Good agreement between this method and theoretical predictions shows that image processing techniques is a useful and potential method that can be used to measure slug characteristics and also developed in future because there is still plenty of room for improvement such as better segmentation and time processing reduction.

Keywords : air-water flow, slug flow, visualization study, image processing technique