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Flow Regime Identification in a Co-Current Gas-Liquid Upflow Moving Packed Beds Reactor Using Gamma Ray Densitometry

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In industries, upflow moving packed bed reactors are widely used as guard reactor to residual desulfurization unit (RDS). Efficient working of these reactors has a huge impact regarding efficiency and product quality from RDS units. Identification of flow regimes is one of the important aspects of design, scale up, predictive model and reactor performance. Flow regime identification in this reactor was studied using gamma-ray densitometry (GRD). GRD is an important noninvasive measurement technique and flow identification can be determined by on-line monitoring. Time domain, frequency domain, and state space or chaotic methods are employed on photon count time series of GRD to determine flow regime. Time domain analysis includes determination of Standard Deviation, Mean, and Variance. Frequency domain analysis includes power spectrum and wavelet analysis. Chaotic analyses include determination of Kolmogorov entropy (KE). All analysis are done using in-house developed programs. GRD experiments were performed on a lab scale upflow packed bed reactor built by scaling down the industrial reactor. The lab scale reactor is Plexiglas column of 11”I.D and 30” height, and it is packed randomly with 3mm diameter catalyst till 24”height. Various axial and radial position are selected to conduct GRD scanning. The selected test location covers the bottom, middle and top of the packed bed. The measurements are conducted at superficial liquid (water) velocity 0.017 cm/s and superficial gas (air) velocity in the range of 0.6-7.7 cm/s. All analysis showed similar flow regime trend. When compared with flow regime map for upflow packed bed, the results indicate bubbly and pulse flow are the main regimes under this operating conditions. In this presentation, results and findings are discussed.

Country/Organization invited to participate

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