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Feasibility of Electrical Resistance Tomography for Measurements of Liquid Holdup Distribution in a Trickle Bed Reactor

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Abstract

Trickle bed reactors (TBRs) are widely used in chemical and oil industries. Owing to complex nature of flow in TBRs, measurements of local liquid holdup distribution are rather limited. While several non-invasive measurement techniques have been used to measure liquid distribution in TBRs, the applicability of Electrical Resistance Tomography (ERT) for quantitative measurement of liquid holdup distribution is not yet verified. In the present work, measurements of local liquid distribution in a laboratory-scale TBR are carried out using ERT for trickle to transition flow regimes. The time-averaged liquid holdup distributions measured using the ERT and BLC methods were compared using the liquid maldistribution factor to demonstrate the feasibility of the ERT to measure liquid holdup distribution. The effect of liquid-distributor configurations (semi-uniform, local and one-sided) was investigated on the radial liquid distribution at different axial locations of TBR. Further, the ability of ERT to measure time-resolved local liquid distribution was verified using multi-point conductivity sensors for artificially created pulsing flow. Also, the comparison of liquid pulse width with multi-point conductivity sensor measurements was carried out and of the dispersion of liquid pulse along the length of TBR was analyzed. The ERT measurements were performed to quantify the effects of gas and liquid flow rates, and particle size on the local liquid holdup. The void-scale flow structure measured by multi-point conductivity sensors was used to analyze the macroscopic