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Liquid Holdup Studies in a Cocurrent Gas-Liquid Upflow Moving Packed Bed Reactor with Porous Catalyst Using Gamma Ray Densitometry

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Upflow moving packed bed reactors are widely used in industries for hydrotreating like hydrodenitrogenation, hydrodesulfurization, hydrodemetallization, etc. In these reactors, deactivated catalyst are removed from the bottom, and fresh catalyst are added from the top, gas and liquid phase move concurrently upwards. The catalyst removal occurs only once in a week and that too in small increments. Some of the common problem associated with this reactor are maldistribution, hot spot, and reduced expected conversion. To overcome these challenges detailed study to enhance the understanding of hydrodynamics in this reactor is still required. In this work line-average liquid holdup is determined using Gamma-Ray Densitometry (GRD) in a scaled down lab scale upflow packed bed column. Gamma ray densitometry is noninvasive radioactive technique and can be implemented to monitor the flow distribution even at industrial scale. There are no studies reported on determination of line average phase distribution for packed bed with the porous catalyst using GRD. In this study, a new methodology has been developed to determine the line average liquid holdup for a porous catalyst. Which gives the line average holdup in the void space of catalyst bed plus the line average internal porosity of catalyst. This study has been conducted on a Plexiglas column of 11-inch ID and 30-inch height, randomly packed with extrudate catalyst of 3mm diameter till 24-inch height. GRD scanning is conducted at various axial and radial location. The line average liquid holdup is determined at superficial liquid (water) at 0.017 cm/sec and varying superficial gas (air) velocity in the range of 0.6-7.7 cm/sec. The result showed that the liquid holdup decreased as the superficial gas velocity increased. It was also found that the liquid holdup radial distribution was not uniform. This kind of information is essential to improve the performance of the reactor.

Country/Organization invited to participate

United States of America

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