Contribution ID: **18** Type: **Oral**

Bed Expansion Studies in Upflow Moving Catalytic Packed/Expanded Bed Hydrotreating Reactror Using Gamma Ray Densitometry

Tuesday, 25 April 2017 11:30 (15 minutes)

Upflow moving catalytic packed or expanded bed reactor are widely used in industries for hydrotreating of feeds with a higher level of contaminants including heavier feeds. In these reactors spent catalyst are replaced periodically by adding fresh catalyst at the top and removing spent catalyst from the conical bottom which supports catalyst bed. While the catalyst moves downwards periodically, gas and liquid phase move upwards. The catalyst is removed in small increments once a week. The other times the reactor operates in upflow packed or expanded bed condition. The problem associated with these reactors is maldistribution, which causes hotspots, sintered carbon deposition and reduces expected conversions. It is seen that the main reason for these issues is maldistribution of phases at the local level inside the catalyst bed region. Bed expansion plays a huge role in local flow distribution of phases. In these reactors the expanded bed region gives the better radial distribution of phases, but less overall mixing intensity of phases as compared to packed bed region. Furthermore, the movement of catalyst particle in expanded bed profoundly affects reaction kinetics in these areas. It is seen that at industrial best operating condition of these reactors the catalyst bed exhibit packed and expanded bed region. Expanded bed can be seen at the top part of the bed. There are no studies done yet to demarcate the expanded and packed bed region. In this work quantification of bed expansion will be done on scaled down lab scale reactor by online monitoring with gamma-ray densitometry (GRD) along the bed height. The time series data obtained from GRD will be analyzed to identify flow regime, and variation in flow regime trend between packed bed with expanded bed region will be used to demarcate the boundary. The analysis of time series are done on time domain (Standard Deviation, Mean, and Variance), Frequency domain (Power Spectrum, Wavelet Analysis) and chaotic analysis (Kolmogorov Entropy (KE)). We focus in this work on the catalyst bed section, which is a plexiglass column of 11-inch (ID) and 30-inch height, filled with extrudate catalyst of 3mm diameter till 24-inch height. The measurements were conducted at superficial liquid (water) velocity of 0.017 cm/sec to 1.78 cm/sec and superficial gas (air) velocity of 1.27 cm/sec to 8.8 cm/sec. This kind of information is essential at industrial scale, for efficient design and operation of these reactors. In this presentation, results and findings are discussed.

Country/Organization invited to participate

United States of America

Primary author: Mr ALEXANDER, Vineet (Chemical Engineering and Biochemical Engineering Department Missouri University of Science and Technology, Rolla, MO 65409-1230. United States of America)

Co-authors: Mr AL-BAZZAZ, Hamza (Kuwait Institute of Science Research, P.O Box 24885, 13109 Kuwait); Mr AL-DAHHAN, Muthanna (Chemical Engineering and Biochemical Engineering Department Missouri University of Science and Technology, Rolla, MO 65409-1230. United States of America)

Presenter: Mr ALEXANDER, Vineet (Chemical Engineering and Biochemical Engineering Department Missouri University of Science and Technology, Rolla, MO 65409-1230. United States of America)

Session Classification: B05

Track Classification: RADIATION TECHNOLOGIES FOR MEASUREMENT