Process Intensification: A Study of Micromixing and Residence Time Distribution Characteristics in the Spinning Disc Reactor 6

Continued:

84. Positive initial results of testing the 30 cm grooved disc vs the 30 cm smooth disc led to additional testing to determine whether or not back mixing was occurring.
85. In comparing multiple disc rotation speeds using both the smooth and grooved discs at the same reactant flow rate (3 ml/s), it was found that the grooved disc produced less variance in RTD, indicating a more plug like flow.
86. When the reactant flow rate was increased above 9 ml/s the benefit of higher disc speed and grooved vs smooth has less impact. At, and above, 9 ml/s the RTD is very uniform for all disc speeds and disc surfaces. This reduced variance at higher volume indicates that at a certain reactant flow rate, the liquid movement across the disc will become more uniform and plug-like.
87. The author suggests that, quote – higher flow rates will allow better use of available surface area of grooved discs ... and also result in better mixing– unquote.
88. Additional testing with 30 cm smooth and grooved discs indicated that increased reactant viscosity creates increased RTD as well as increased RTD variance.
89. Similar to the disc rotation speed testing, at a certain flow rate 9 ml/s and greater the effect of the increased viscosity is negligible.
90. After performing all investigations involved with this study, the author concludes that, quote – the best micromixing conditions in the SDRs were generally achieved at high disc rotational speeds, high feed flowrates and on the large rotating discs – unquote.
91. These ideal parameters created the most uniform, thinnest films on the spinning disc surface with the greatest shear forces all of which contribute positively to micromixing.
92. In comparing experimental data with previous works by Baldyga and Pohorecki, the author demonstrates that SDRs, quote – have excellent micromixing efficiency – unquote.
93. Comparisons with other intensified mixing processes showed that, quote – SDRs give significantly better micromixing performance than the SBR and NCRs – unquote.
94. The author suggests that further investigation is needed in visualization and mathematical characterization of the fluid movements on the surface of the disc so that better predictive models can be built for future SDRs.
95. Results from this investigation highlight the importance of disc surface area on the micromixing efficiency of the system. One recommendation for future development was to employ multiple discs that flow from one to the next.
96. Overall, the author clearly recognizes the benefits and micromixing efficiencies offered by the SDR as opposed to other intensified mixing processes. With better understanding of the relevant forces at work and design features influencing them, there is much potential for SDR use in multiple industries.

Source: Al-hengari S. Process Intensification: A Study of Micromixing and Residence Time Distribution Characteristics in the Spinning Disc Reactor. October 2011.
https://theses.ncl.ac.uk/dspace/bitstream/10443/1771/1/Al-Hengari (12mnth).pdf

Review by: SP