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Micromixing Effects on a Parallel Reaction in Flow Reactors

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Using the micromixing concepts of Danckwerts and Zwietering, the Peclet number Pe has been correlated mathematically to the degree of segregation J for the axial dispersion model. The results were applied to compare the micromixing effects on a model, mixed-order parallel reaction system in continuous flow reactors. Axial dispersion model, and Ng and Rippin's two-environment model were used to find the micromixing effects in tubular and stirred tank reactors, respectively. The performance of these reactors, with varying geometries, has been evaluated in terms of overall conversion, selectivity, and yield under identical operating and reaction conditions. The overall conversion increases in a tubular reactor with the increase in J, irrespective of the kinetic orders. However, in a stirred tank reactor, the conversion is found to be micromixing-sensitive, depending on the order of reaction. For $m = 1$ and $n = 2$ (case 1), the conversion is fairly insensitive to micromixing effects while it decreases for $m = 0.5$ and $n = 1$ (case 2) with increasing J. For the same extent of micromixing, a tubular reactor gives, in both cases, a higher conversion than a stirred tank reactor. The selectivity, in either case, decreases in both reactors with increasing segregation effects. However, in each case, the selectivity of a tubular reactor was fairly close to that of a stirred tank reactor at the same value of J. As far as the yield is concerned, both reactors achieve nearly the same value, without significant micromixing effects.