

Comparison of CMFR and PFR Steady-State Performance for Pollutant with First-Order Reaction

CENG 340–Introduction to Environmental Engineering

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The ideal CMFR and PFR are fundamentally different, and, thus perform differently. When a parcel of fluid enters a CMFR, it is immediately mixed throughout the reactor. In contrast, when a parcel of fluid enters a PFR it remains separate as it moves through the reactor.

The goal of following problems is to illustrate how this difference affects the performances of CMFRs and PFRs at steady state. In both problems assume that the influent concentration, C_{in} ; the flowrate, Q ; and the first-order reaction rate constant, k , are known and are the same for both reactors. $Q = 5 \text{ L/s}$; $k = 0.05 \text{ s}^{-1}$.

1. If the volumes of a CMFR and PFR are each 100 L, what is the effluent concentration, C_{out} , as a function of C_{in} for a

(a) CMFR?

(b) PFR?

2. If an effluent concentration, C_{out} , equals half of C_{in} ($C_{\text{out}} = 0.5 \times C_{\text{in}}$), what volume of reactor is required for a

(a) CMFR?

(b) PFR?