AFCoKaRE Practice Problem 13.2

Purpose: This problem allows you to practice the analysis of kinetics data obtained using a CSTR.

Problem Statement: Suppose that the liquid-phase decomposition of isobutyl iodide (1-Iodo-3-methylpropane) according to reaction (1) was studied in hexachlorobutadiene solution using a CSTR. At the temperature studied, 160 °C, the reaction is effectively irreversible. In a series of experiments using a feed containing iodine and isobutyl iodide in varying concentrations, the space time was varied and the steady state conversion of isobutyl iodide was measured. Using the resulting data, shown in Table 1, determine whether the rate expression in equation (2) accurately predicts the reaction kinetics. If it does, determine the best value for the rate coefficient, including 95% confidence limits.

$$2\ (CH_3)_2CHCH_2I \rightarrow (CH_3)_3CH + (CH_3)_2C{=}CH_2 + I_2 \qquad (1)$$

$$r_1 = k_1 C_{(CH_3)_2CHCH_2I} \sqrt{C_{I_2}} \qquad (2)$$

Table 1. CSTR Kinetics Data for AFCoKaRE Problem 13.2

Space Time (s)	***Isobutyl Iodide Feed Concentration (M)***	***Iodine Feed Concentration (M)***	***Fractional Conversion of Isobutyl Iodide***
10000	0.3	0	0.041
10000	0.3	0.15	0.065
10000	0.3	0.3	0.058
10000	0.65	0	0.013
10000	0.65	0.15	0.046
10000	0.65	0.3	0.054
10000	1	0	0.011
10000	1	0.15	0.047
10000	1	0.3	0.079
50000	0.3	0	0.18

Space Time (s)	*Isobutyl Iodide Feed Concentration (M)*	*Iodine Feed Concentration (M)*	*Fractional Conversion of Isobutyl Iodide*
50000	0.3	0.15	0.222
50000	0.3	0.3	0.285
50000	0.65	0	0.11
50000	0.65	0.15	0.268
50000	0.65	0.3	0.303
50000	1	0	0.142
50000	1	0.15	0.227
50000	1	0.3	0.282
100000	0.3	0	0.292
100000	0.3	0.15	0.38
100000	0.3	0.3	0.429
100000	0.65	0	0.364
100000	0.65	0.15	0.427
100000	0.65	0.3	0.47
100000	1	0	0.322
100000	1	0.15	0.41
100000	1	0.3	0.494