SO_2 oxidation input data from Example 8-10, H. S. Fogler, "Elements of Chemical Reaction Engineering," 2nd ed., Prentice-Hall (1992):

The feed gas is 7900 lb-mol/h of 11% SO_2, 10% O_2, and 79% inert which is mostly N_2. The simulation accounts for gas pressure drop down the adiabatic bed and the changing heat capacity of the gas as conversion changes.

$$-r_{SO2} = k\sqrt{\frac{P_{SO2}}{P_{SO3}}}\left[P_{O2} - \left(\frac{P_{SO3}}{K_P P_{SO2}}\right)^2\right]$$

$$k = \exp\left[\frac{-176008}{T} - 110.1\ln(T) + 912.8\right]$$

$$K_P = \exp\left[\frac{42311}{RT} - 11.24\right]$$

where k has units (lb-mol SO_2/lb-catalyst/s/atm), K_P has units (atm$^{-1/2}$), and T has units (°R). This rate can be used above a conversion of SO_2 of 5% and larger. Below that conversion, assume the rate is equal to the rate at 5% conversion.

$$\Delta H_R(800\,°\mathrm{F}) = -42471\ \mathrm{Btu/lb\text{-}mol\text{-}SO_2}$$

diameter of spherical catalyst pellets = 0.015 ft
bed void fraction = 0.45
bulk density of catalyst bed = 33.8 lb/ft^3