Chapter 1  
In-Class Problem

A8. Large central power stations (about 1000 MW electrical) using fluidized bed combustors may be built some day. These giants would be fed 240 tons of coal/hr (90% C, 10% H2), 50% of which would burn within the battery of primary fluidized beds, the other 50% elsewhere in the system. In one design the battery of fluidized beds would consist of 10 beds, each 20 m long, 4 m wide, and containing solids to a depth of 1 m. Find the rate of reaction (in terms of ton·mole, hour, and cubic meters) and within the fluidized beds, based on the oxygen used.

There are two reactions

\[ C + O_2 \rightarrow CO_2 \]
\[ H_2 + \frac{1}{2} O_2 \rightarrow H_2 O \]

Since 50% does not get consumed in the fluidized bed the total consumption of coal is given by

\[ \text{consumption} = 240 \text{ tons/hr}^{0.5} \]

\[ \frac{120 \text{ tons}}{\text{hr}} \]

\[ \text{mcc} = \frac{\text{consumption} 0.9}{12 \frac{\text{tons}}{\text{tonmole}}} \]

\[ \frac{9 \text{ tonmole}}{\text{hr}} \]

\[ \text{mhc} = \frac{\text{consumption} 0.1}{2 \frac{\text{tons}}{\text{tonmole}}} \]

\[ \frac{6 \text{ tonmole}}{\text{hr}} \]

\[ \text{moc} = \text{mcc} + \frac{1}{2} \text{mhc} \]

\[ \frac{12 \text{ tonmole}}{\text{hr}} \]

\[ V_r = 20 \text{ m} \times 4 \text{ m} \times 1 \text{ m} \]

\[ 80 \text{ m}^3 \]
The rate is given by

$$-r_A = -\frac{1}{V} \frac{dN_A}{dt}$$

$$r_0 = \frac{1}{V_c} \text{ moc}$$

0.15 ton/mole

hr m$^3$