Burning Behaviors of Pulverized Coal and Biomass Chars





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SEM of Partially Oxidized Chars

@=25%





 $t = 47 \text{ ms} \qquad S_g = 243 \text{ } m^2/g \\ m/m_0 = 0.77 \qquad \rho_a = 1.18 \text{ } g/cm^3 \\ D = 56.6 \text{ } \mu m$





 $t = 95 ms \qquad S_g = 248 m^2/g \\ m/m_0 = 0.50 \qquad \rho_a = 1.11 g/cm^3 \\ D = 41.6 \ \mu m$



















Burning Behavior: Weak Zone II Burning

In the Zone II burning regime, an oxygen concentration gradient exists inside the char particle. Under weak zone II burning conditions (which occur at moderate temperatures), burning initially occurs at constant diameter before a transition to variable size and density burning at high extents of conversion.



Burning Behavior: Weak Zone II Burning

Under weak zone II burning conditions (low to moderate temperatures), appreciable amounts of oxygen are inside the particle throughout its lifetime.



The oxygen that penetrated the particle at early times is consumed by 10% to ~15% conversion. The mean pore size increases during this time.

By 20% to 25% conversion, the mean pore size has increased to the extent that oxygen more readily penetrates the particle.

In the late stages of burning, the oxygen concentration is nearly uniform inside the particle.



Burning Behavior: Strong Zone II Burning

At high temperatures (strong zone II burning conditions), burning occurs with reductions in size and apparent density after a very short initial period of nearly constant diameter burning.



The power-law mode of burning model with constant parameters somewhat describes the changes in this burning regime.

$$\rho_c / \rho_{c0} = (m_c / m_{c0})^{\alpha}$$
$$D / D_0 = (m / m_0)^{\beta}$$

Initially, $\alpha = 1$, $\beta = 0$. During the middle to late stages of burning, $\alpha = 0.1$, $\beta = 0.3$

No model has been developed that describes the evolution in specific surface area.

Burning Behavior: Strong Zone II Burning

At high temperatures (strong zone II burning conditions), the oxygen that penetrated the particle at early times is quickly consumed. Before significant mass loss, an oxygen concentration profiles is established inside the particle that is quite steep near the particle periphery.



Although the particle diameter is decreasing with mass loss, the oxygen concentration profile established after about 20 ms is more or less maintained.

Conversion is only about 3% after 20 ms of burning under these conditions.

Burning is significant only at the particle periphery, in a layer less than 3 μ m thick.













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