combustion note dump

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May 8, 2025

1 description

Heat Equation:

$$\rho c_p \frac{\partial T}{\partial t} = \frac{\partial}{\partial x}\left(k \frac{\partial T}{\partial x}\right) + G \tag{1}$$

Non-dimensional Heat Equation:

$$\frac{\partial \tilde{T}}{\partial \tilde{t}} = \frac{1}{Da}\frac{\partial^2 \tilde{T}}{\partial \tilde{x}^2} + e^{\tilde{T}} \tag{2}$$

Damkohler number (confirmed by Toby):

$$D_a = \frac{k_0 \Delta H L^2}{k T_0 e^{\beta}} \frac{E_a}{R_g T_0} \tag{3}$$

Done: -steady state solution for 1D flat model; conclusion (temporary): no steady state soln as c=0; maybe do limit?

$\tilde{x} > 0$

$$\frac{1}{\sqrt{c}} \log\left|\frac{\sqrt{-2e^{\tilde{T}}D_a + c} \pm \sqrt{c}}{\sqrt{-2e^{\tilde{T}}D_a + c} \mp \sqrt{c}}\right| = \tilde{x} + a \tag{4}$$

where the top case applies to $x > 0$, and the bottom case applies to $x < 0$.

C in terms of $\tilde{T}_0$, where $\tilde{T}_0$ is $\tilde{T}$ at $\tilde{x} = 0$. This would be constant for a steady state, as $\frac{\partial \tilde{T}}{\partial \tilde{t}} = 0$.

$$c = 2e^{\tilde{T}_0} D_a \tag{5}$$

$$a = \frac{1}{\sqrt{2e^{\tilde{T}_0} D_a}} \log \left| \frac{\sqrt{e^{\tilde{T}_0} - 1} \mp \sqrt{e^{\tilde{T}_0}}}{\sqrt{e^{\tilde{T}_0} - 1} \pm \sqrt{e^{\tilde{T}_0}}} \right| \mp 1, \tag{6}$$

where the top case applies to $x > 0$, and the bottom case applies to $x < 0$.

-"1D" cylinder assuming axisymmetric temperature - look at steady state sols

To do: