JQ.2.4

September 3, 2014

(2.4) Show that the pressure rise $P - P_o$ in a closed rigid vessel of volume V for net heat addition $\dot{Q}$ is

$$\frac{P - P_o}{P_o} = \frac{\dot{Q}t}{\rho_o V c_v T_o}$$

Start with the fixed mass form of the first law (see problems 1 and 3 in HW1) in an unsteady formulation. Recognize that there is no work being done.

Convert the total internal energy to the product of the mass specific internal energy and the mass.

Model the change in internal energy as the specific heat capacity multiplied by the change in tempeature.

Because the heat addition rate is constant, perform simple integration of the 1st law.

Use ideal gas equation of state to simplify expression.

In []: