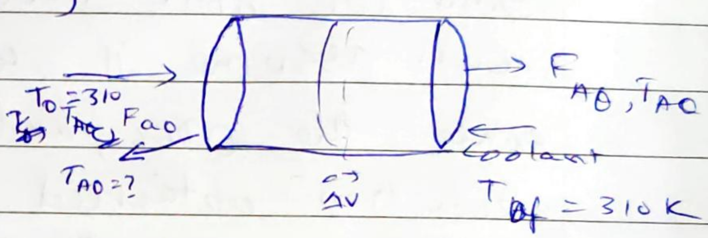
$$U_a(T_a - T) - \sum v_i H_i(-r_A) - \sum F_i C_{p_i} \frac{dT}{dV} = 0$$

$$\therefore \quad \frac{dT}{dV} = \frac{r_A \Delta H_{Rx} - U_A(T - T_A)}{\sum F_i C_{p_i}} \quad \text{—} (1)$$

Also $F_i = F_{A0}(\Theta_i + \nu_i X)$

$$\frac{dX}{dV} = \frac{-r_A}{F_{A0}} \quad \text{—} (2)$$



Since coolant temp. is also varying:

$$\frac{dT_a}{dV} = \frac{U_a(T_a - T)}{\dot{m}_c C_{pc}} \quad \text{—} (3)$$

Initial ~~Boundary~~ conditions:

$V = 0$, $X = 0$, $T_a = T_{az}$

$V = V_f$, $T_a = T_{a0}$

$C_A = C_{A0}(1 - X)$

$C_B = C_{A0} X$

$$k = k_0 e^{-\left(E/R\left(\frac{1}{T} - \frac{1}{T_1}\right)\right)}$$

$$K_c = K_{c0} e^{-\frac{\Delta H_{rxn}}{R}\left(\frac{1}{T} - 1/T_2\right)}$$

$$-r_A = k\left(C_A - \frac{C_B}{K_c}\right)$$

At equilibrium:

$$1 - X_e = \frac{X_e}{K_c} \quad \therefore X_e = \frac{K_c}{1 + K_c} = f(T)$$

$$C_{p\,net} = \frac{141 + 161}{9}$$

Algorithm:

~~We know initial values of T and v initial at~~
We know value of T at $V=0$. Using an ODE solver in matlab, we can solve the 3 ODEs. ~~and~~ ~~ots~~
Since we dont know value of T_a at $V=0$, we can assume it ~~and~~ ~~then~~ as some T_{a0}. Then solve the ODEs, and compare our T_{az} with the solution obtained. Accordingly ~~fluctua~~ shift T_{a0} by a small amount δ till we have reached the point where $\| T_{az} - \hat{T}_{az} \| \leq \simeq 0$.

obtained from odE solver

Solver used: ~~ODE~~ ode23 which internally uses ~~the~~ an implementation of the Runge-Kutta method.