DDT Math Write Up

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October 2024

$$\frac{dT_h}{dt} = -\frac{\dot{Q_h}}{m_h C_{ph}} + \frac{V^2 R_h}{R_{sys}^2}$$

$$\frac{dT_{a1}}{dt} = \frac{\dot{Q_h}}{2m_{a1}C_{pc}} - \frac{\dot{m_a}}{m_{a1}}T_{a1} + \frac{\dot{m_a}}{m_{a1}}T_{a4}$$
$$\frac{dT_{a2}}{dt} = \frac{\dot{Q_h}}{2m_{a2}C_{pc}} - \frac{\dot{m_a}}{m_{a2}}T_{a2} + \frac{\dot{m_a}}{m_{a2}}T_{a1}$$
$$\frac{dT_{a3}}{dt} = -\frac{\dot{Q_{ab}}}{2m_{a3}C_{pc}} - \frac{\dot{m_a}}{m_{a3}}T_{a3} + \frac{\dot{m_a}}{m_{a3}}T_{a2}$$
$$\frac{dT_{a4}}{dt} = -\frac{\dot{Q_{ab}}}{2m_{a4}C_{pc}} - \frac{\dot{m_a}}{m_{a4}}T_{a4} + \frac{\dot{m_a}}{m_{a4}}T_{a3}$$

$$\frac{dT_{b1}}{dt} = \frac{\dot{Q_{ab}}}{2m_{b1}C_{pc}} - \frac{\dot{m_b}}{m_{b1}}T_{b1} + \frac{\dot{m_b}}{m_{b1}}T_{b4}$$
$$\frac{dT_{b2}}{dt} = \frac{\dot{Q_{ab}}}{2m_{b2}C_{pc}} - \frac{\dot{m_b}}{m_{b2}}T_{b2} + \frac{\dot{m_b}}{m_{b2}}T_{b1}$$
$$\frac{dT_{b3}}{dt} = -\frac{\dot{Q_{bc}}}{2m_{b3}C_{pc}} - \frac{\dot{m_b}}{m_{b3}}T_{b3} + \frac{\dot{m_b}}{m_{b3}}T_{b2}$$
$$\frac{dT_{b4}}{dt} = -\frac{\dot{Q_{bc}}}{2m_{b4}C_{pc}} - \frac{\dot{m_b}}{m_{b4}}T_{b4} + \frac{\dot{m_b}}{m_{b4}}T_{b3}$$

$$\frac{dT_{c1}}{dt} = \frac{\dot{Q_{bc}}}{2m_{c1}C_{pc}} - \frac{\dot{m_c}}{m_{c1}}T_{c1} + \frac{\dot{m_c}}{m_{c1}}T_{in}$$
$$\frac{dT_{c2}}{dt} = \frac{\dot{Q_{bc}}}{2m_{c2}C_{pc}} - \frac{\dot{m_c}}{m_{c2}}T_{c2} + \frac{\dot{m_c}}{m_{c2}}T_{c1}$$

$$\dot{Q}_h = -h_h A_h l_H \frac{(T_{a1} - T_{a2})}{ln(\frac{T_h - T_{a1}}{T_h - T_{a2}})}$$

$$\dot{Q}_{ab} = -h_{ab} \pi d_{ab} l_{ab} \frac{(T_{a3} - T_{b2}) - (T_{a4} - T_{b1})}{ln(\frac{T_{a3} - T_{b2}}{T_{a4} - T_{b1}})}$$

$$\dot{Q}_{bc} = -h_{bc} \pi d_{bc} l_{bc} \frac{(T_{b3} - T_{c2}) - (T_{b4} - T_{c1})}{ln(\frac{T_{b3} - T_{c2}}{T_{b4} - T_{c1}})}$$