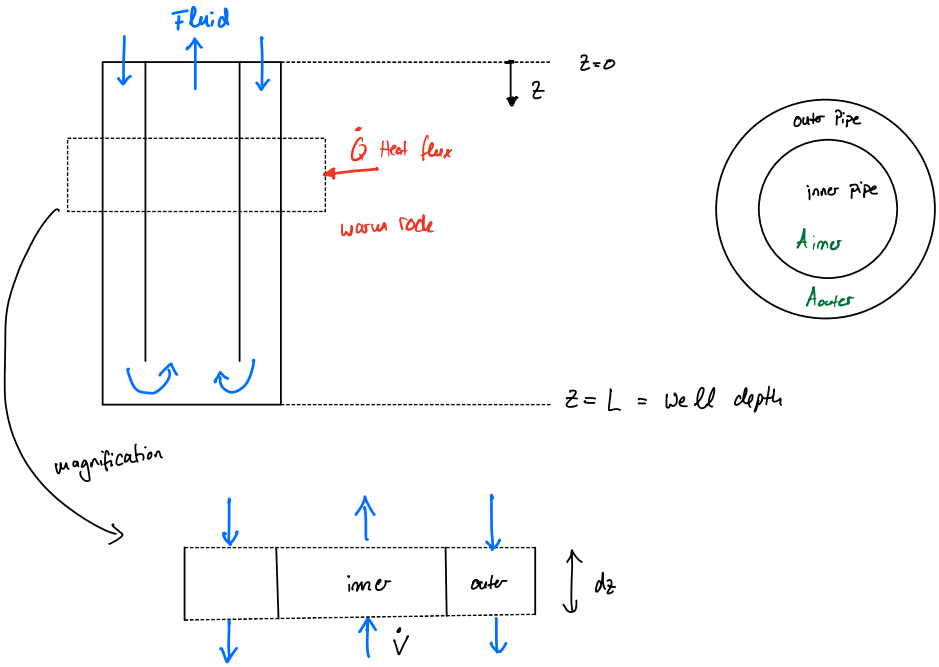

Energy balance:

$$\Rightarrow 0 = A_{inner}\, \rho c_p \frac{\partial T_{inner}}{\partial t} - \dot{V} \rho c_p \frac{\partial T_{inner}}{\partial z} = -U_{inner}\, \alpha_{inner} (T_{inner} - T_{outer})$$

$$0 = A_{outer}\, \rho c_p \frac{\partial T_{outer}}{\partial t} + \dot{V} c_p \frac{\partial T_{outer}}{\partial z} = U_{inner}\, \alpha_{inner} (T_{inner} - T_{outer}) + U_{outer}\, \alpha_{outer} (T_{ambient} - T_{outer})$$

Boundary Conditions:

$$T_{inner}(t, z=L) = T_{outer}(t, z=L)$$

$$T_{outer}(t, z=0) = T_{ambient}(z=0)$$