

## COIL-IN-TANK, NONISOTHERMAL COOLING MEDIUM:

$$\frac{dQ'}{d\theta} = -MC \frac{dT}{d\theta} = wc(t_2 - t_1) = UA \Delta t \quad (18.10)$$

$$K_2 = e^{UA/wc}$$

$$\ln \frac{T_1 - t_1}{T_2 - t_1} = \frac{wc}{MC} \left( \frac{K_2 - 1}{K_2} \right) \theta \quad (18.11)$$

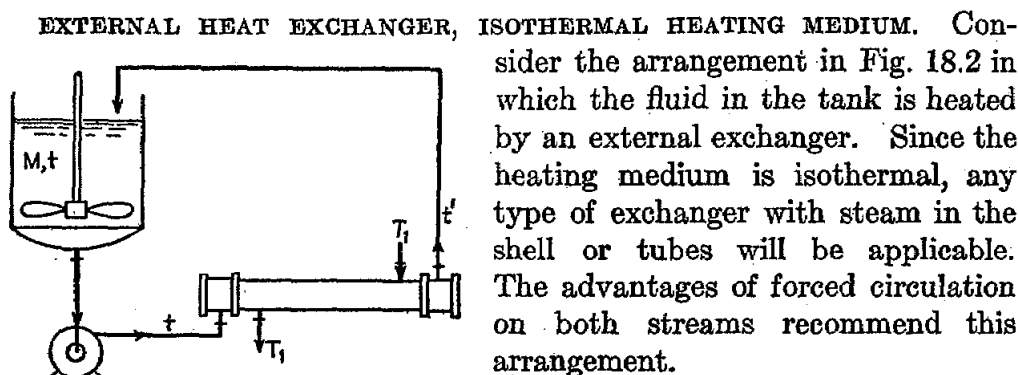


Fig. 18.2. Agitated batch with external 1-1 exchanger.

The variable temperature out of the exchanger  $t'$  will differ from the variable tank temperature  $t$ , and the differential heat balance is given by

$$\begin{aligned} \frac{dQ'}{d\theta} &= Mc \frac{dt}{d\theta} = wc(t' - t) = UA \Delta t \quad (18.12) \\ t' &= T_1 - \frac{T_1 - t}{e^{UA/wc}} \end{aligned}$$

Let

$$\begin{aligned} K_2 &= e^{UA/wc} \\ \ln \frac{T_1 - t_1}{T_1 - t_2} &= \frac{wc}{Mc} \left( \frac{K_2 - 1}{K_2} \right) \theta \quad (18.13) \end{aligned}$$

## EXTERNAL EXCHANGER, ISOTHERMAL COOLING MEDIUM:

$$\ln \frac{T_1 - t_1}{T_2 - t_1} = \frac{WC}{MC} \left( \frac{K_1 - 1}{K_1} \right) \theta \quad (18.14)$$

EXTERNAL EXCHANGER, NONISOTHERMAL HEATING MEDIUM. The differential heat balance is given by

$$\frac{dQ'}{d\theta} = Mc \frac{dt}{d\theta} = wc(t' - t) = WC(T_1 - T_2) = UA \Delta t \quad (18.15)$$