COIL-IN-TANK, NONISOTHERMAL COOLING MEDIUM:

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

$$\ln \frac{T_1 - t_1}{T_2 - t_2} = \frac{wc}{MC} \left( \frac{K_2 - 1}{K_2} \right) \theta \tag{18.11}$$

EXTERNAL HEAT EXCHANGER, ISOTHERMAL HEATING MEDIUM. Con-

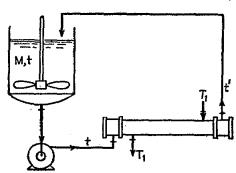


Fig. 18.2. Agitated batch with external 1-1 exchanger.

sider the arrangement in Fig. 18.2 in which the fluid in the tank is heated by an external exchanger. Since the heating medium is isothermal, any type of exchanger with steam in the shell or tubes will be applicable. The advantages of forced circulation on both streams recommend this arrangement.

The variable temperature out of the exchanger t' will differ from the

variable tank temperature t, and the differential heat balance is given by

$$\frac{dQ'}{d\theta} = Mc \frac{dt}{d\theta} = wc(t' - t) = UA \Delta t$$

$$t' = T_1 - \frac{T_1 - t}{e^{UA/wc}}$$
(18.12)

Let

$$K_{2} = e^{UA/wc}$$

$$\ln \frac{T_{1} - t_{1}}{T_{1} - t_{2}} = \frac{wc}{Mc} \left( \frac{K_{2} - 1}{K_{2}} \right) \theta$$
(18.13)

EXTERNAL EXCHANGER, ISOTHERMAL COOLING MEDIUM:

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

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

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