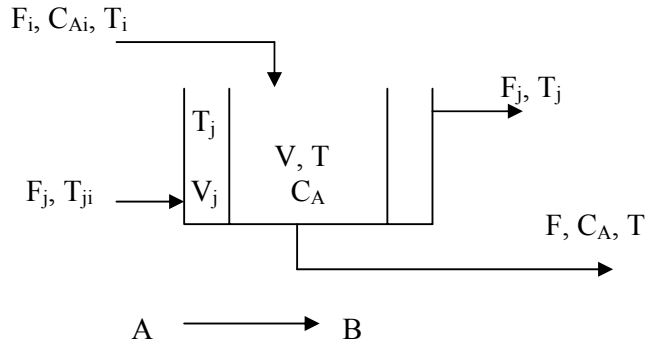
King AbdulAziz University
College of Engineering
Chemical engineering Department

CHE 442 **Project # 1** **Fall 2004**

An irreversible, exothermic reaction is carried out in a single perefctly mixed CSTR as shown below:



The reaction is n^{th} order in reactant A and has a heat of reaction (H_{rx} cal/mol of A reacted). To remove the heat of reaction, a cooling jacket at a volumetric flow rate F_j and with an inlet temperature of $T_{ji.}$ The volume of the water in the jacket is V_j is constant. The mass of the metal walls is assumed negligible. A proportional controller is used to manipulate the output flow rate from the ractor (F) as alinear function of the volume in the tank.

$F= F_s – 10(V_{min}-V)$

Asecond controller manipulates the flow rate of cooling water to the jacket , F_j,in direct proportion to the temperasture of the reactor.

$F_j = F_{js}- K_c(T_{SP}-T)$

Initial values:
$F_s = 40\ ft^3/h$, $C_{Ai}= 0.5$ lb.mol/ft^3, $C_{As} = 0.245$ lb.mol A/ft^3, $T_s = 600\ ^oR$, $T_{js} = 594.6\ ^oR$, $T_{is} = 530\ ^oR$, $F_{js} = 49.9\ ft^3/hr$

Parameter values:
$V_j = 3.85\ ft^3$, $k_0 = 7.08\ hr^{-1}$, E = 30,000 Btu/lb.mol, R = 1.99 Btu/lb.mol ^oR, U= 150 Btu/h ft^2. ^oR
$A_H = 250\ ft^2$, $V_{min}=48\ ft^3$, $T_{ji} = 530\ ^oR$, $\Delta H_{rx} = -30{,}000$Btu/lb.mol, $C_P= 0.75$ Btu/lb_m. ^oR,
$C_j = 1.0$ Btu/lb_m.^oR, $\rho = 50\ lb_m/ft^3$, $\rho_j = 62.3\ lb_m/ft^3$, $K_c = 4\ ft^3$ / hr. ^oR, $T_{SP} = 600\ ^oR$