

CM416. First Exam Part I

Dec. 14, 1995

6:30pm-8:30pm

- (15 pts) Figure 1 shows a P&ID in which all five control valves are connected in an erroneous manner. Briefly describe five errors in the diagram (using only one sentence for each error).

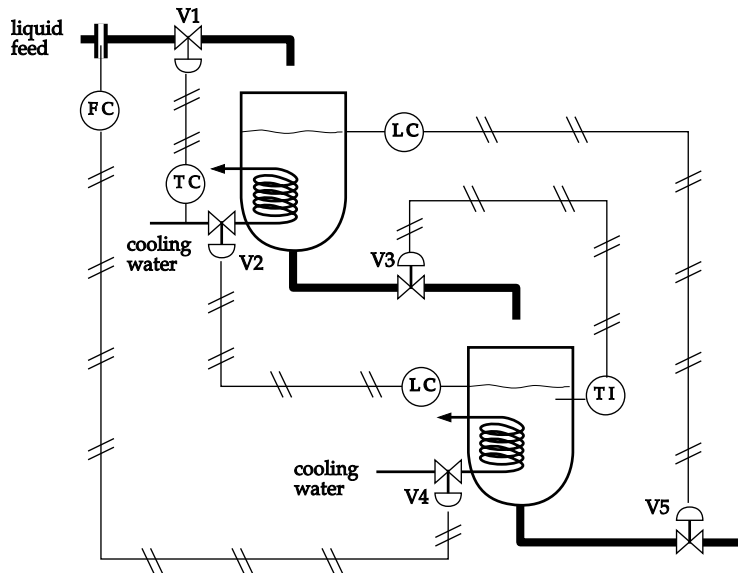


Figure 1: P&ID diagram containing at least five errors.

- Figure 2 shows two isothermal pressure vessels which are connected in series. The pressure upstream of vessel 1 is held constant at P_0 atm, while the pressure downstream of vessel 2 is held constant at P_3 atm. The relationship among the pressures are: $P_0 > P_1 > P_2 > P_3$. The mass flow rate of gas in each stream are:

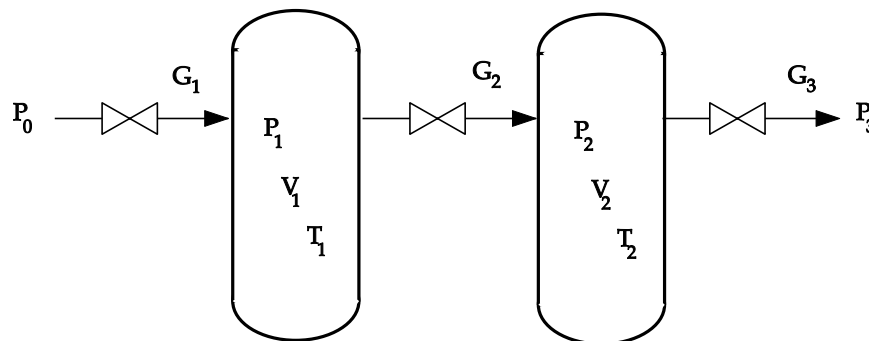


Figure 2: P&ID diagram containing at least five errors.

$$G_1 = k_1 \sqrt{P_0 - P_1}$$

$$G_2 = k_2 \sqrt{P_1 - P_2}$$
$$G_3 = k_3 \sqrt{P_2 - P_3}$$

- (a) (20 pts) Obtain a dynamic process model for P_1 and P_2 , assuming that the gas is ideal having a molecular weight MW .
- (b) (15 pts) What are the steady state values of P_1 and P_2 ? Are the steady states P_{1s} and P_{2s} dependent on T and/or V ?
3. (25 pts) Let x and y be the mass fractions of components A and B in a CSTR. The dynamic models for x and y were obtained as

$$\frac{dx}{dt} = \frac{1}{\tau}(x_{in} - x) - k_1xy$$
$$\frac{dy}{dt} = \frac{1}{\tau}(y_{in} - y) + k_1xy - k_2y$$

Obtain a linearized model for x and y with $\tau = 10$, $k_1 = 2$ and $k_2 = 0.5$, around the steady state with $x_{ins} = 0.9$, $y_{ins} = 0.1$.