Design of Flash Unit

Any impatient student who is irked by having algebraic symbolism thrust upon him should try to get along without it for a week.

Eric Temple Bell

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- Unless the relative volatility is large, the degree of separation achievable in a two components in a single unit is poor.
- Flashing is usually an auxiliary operation used to prepare the stream for further processing (vapor recovery system, liquid recovery system).

Flash Unit

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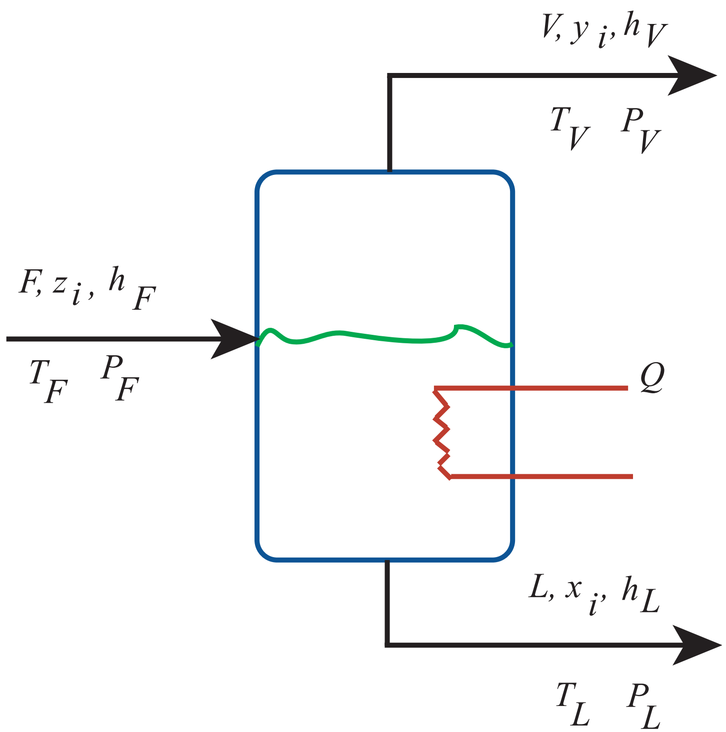

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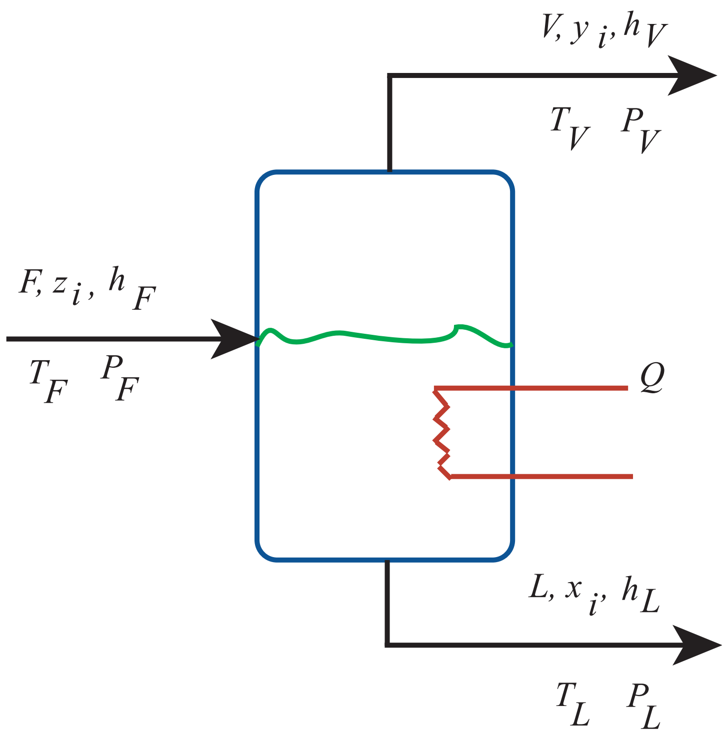

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$T_F, T_V, T_L, P_F,$
P_V, P_L, Q

Total: $3C + 10$

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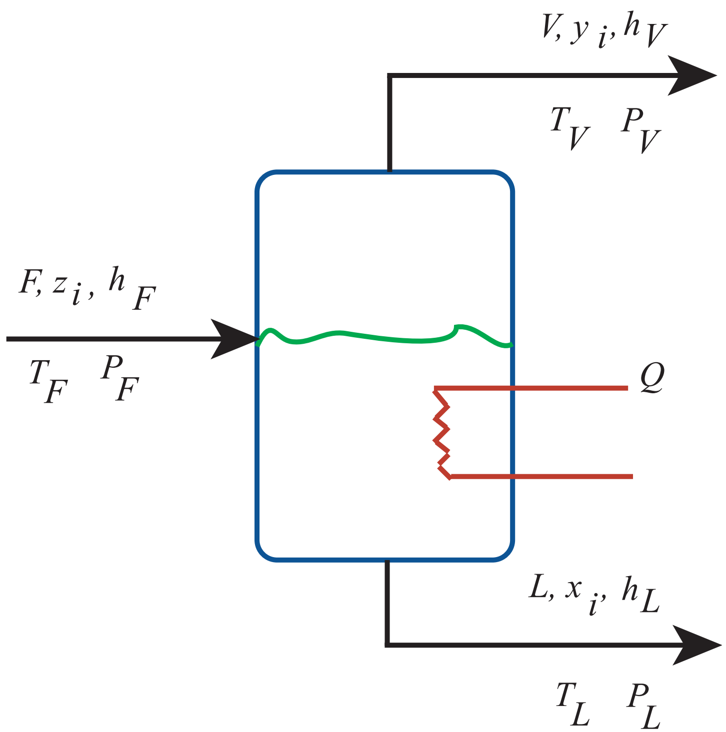

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Typically, the feed is specified (F, z_i, T_F, P_F).

Thus, $C + 3$ variables are known.

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Q, P_V	Nonadiabatic flash
$V/F,\ P_V$	Percent vaporization flash

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and the equation:

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- Solve model equations sequentially.

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  - The key component is usually the most abundant in the mixture. If all components are nearly equal in moles, choose the one with intermediate volatility.

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$$\alpha_{k/n} = \frac{K_k}{K_n} = \frac{\xi_k L/(1-\xi_k)V}{\xi_n L/(1-\xi_n)V} = \frac{\xi_k(1-\xi_n)}{\xi_n(1-\xi_k)}$$

- Rederive flash equations

$$K_k = \frac{y_k}{x_k} = \frac{v_k/V}{l_k/L} = \frac{\xi_k f_k/V}{(1-\xi_k)f_k/L} = \frac{\xi_k L}{(1-\xi_k)V}$$

Similarly:

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Rearranging:

$$\boxed{\xi_k = \frac{\alpha_{k/n}\xi_n}{1+(\alpha_{k/n}-1)\xi_n}}$$

P, T and composition at Equilibrium

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Note that the ratio K_i/K_n is the relative volatility α_i. Thus, we can define an average relative volatility as follows:

$$\boxed{\sum_{i=1}^{n} \frac{K_i}{K_n} x_i = \sum_{i=1}^{n} \alpha_i x_i \equiv \bar{\alpha}}$$

Recall that:

$$\alpha_{k/n} = \frac{K_k}{K_n} = \frac{P_k^0}{P_n^0} \qquad K_k = \frac{P_k^0}{P}$$

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Substituting, K_n in terms of $\bar{\alpha}$, we have:

$$\boxed{\frac{P_k^0}{P} = \frac{\alpha_{k/n}}{\bar{\alpha}}}$$

which is a simplified bubble point equation.

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The objective is to find a relation between pressure P and temperature T. We will use the dew point equation for this calculation. At the dew point, we have:

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T or P Specified at Bubble Point

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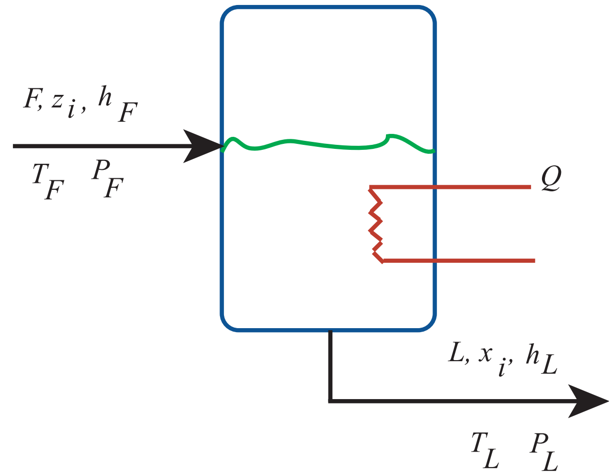
At the bubble point, all the feed comes out as liquid.



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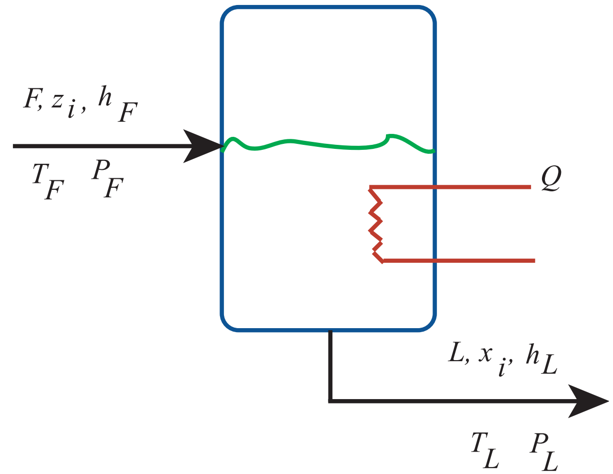

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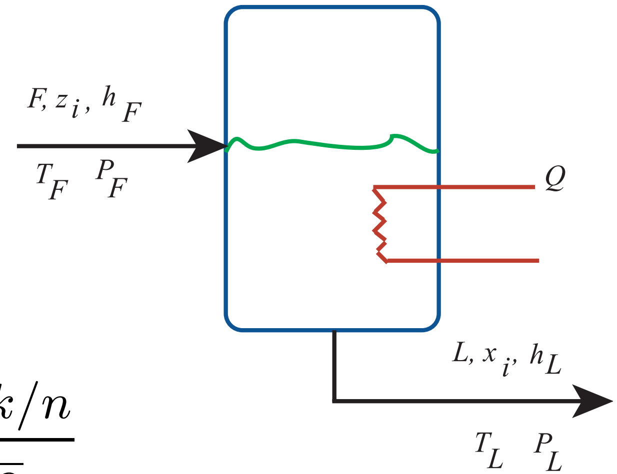

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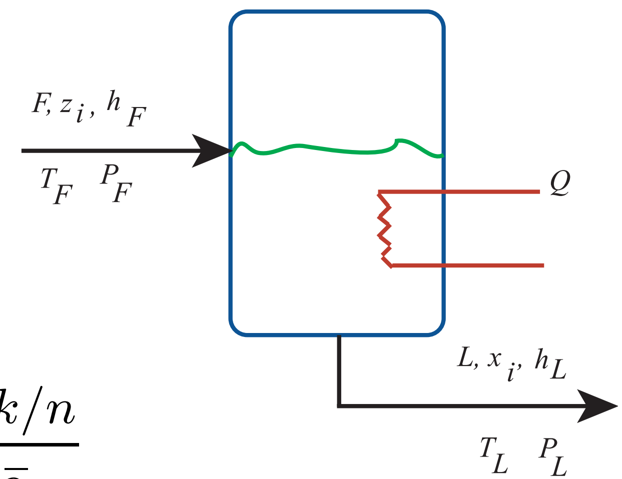

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Choose k to be the most abundant component in the liquid phase. The bubble point equation simplifies to $\dfrac{P_n{}^0}{P} = \dfrac{1}{\bar{\alpha}}$.

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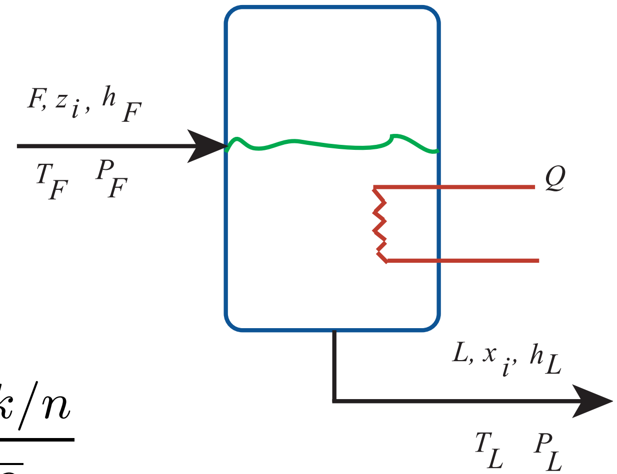

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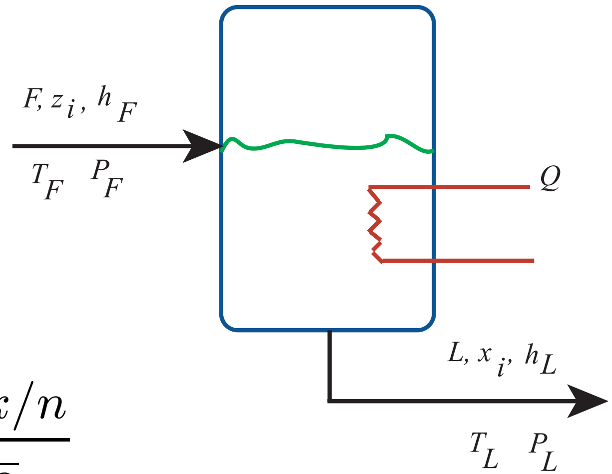

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Vapor Fraction and Split Fraction:

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