Reference: Ch. 15, Biegler, Grossmann, Westerberg (1997)

Application 1: NH_3 Processing Flowsheet Alternatives
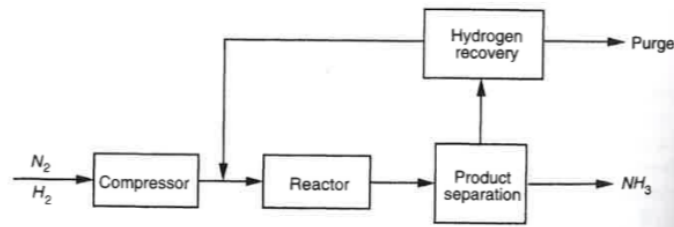

FIGURE 15.3   Major processing steps for NH_3 production.

Technology Choices

Reactor: tubular or multibed-quench

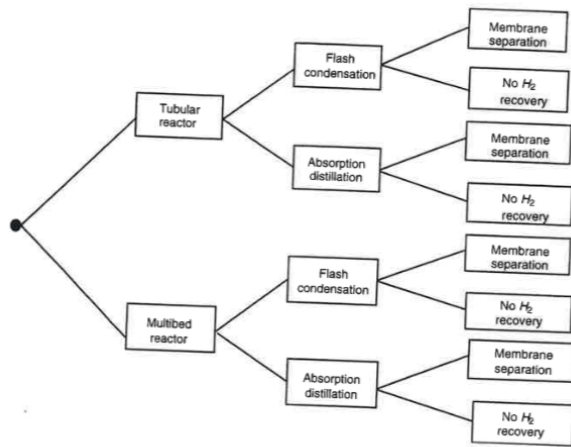Separator: flash or absorption/distillation

H_2 recovery: none or membrane

FIGURE 15.4   Tree representation for alternatives in NH_3 flowsheet.
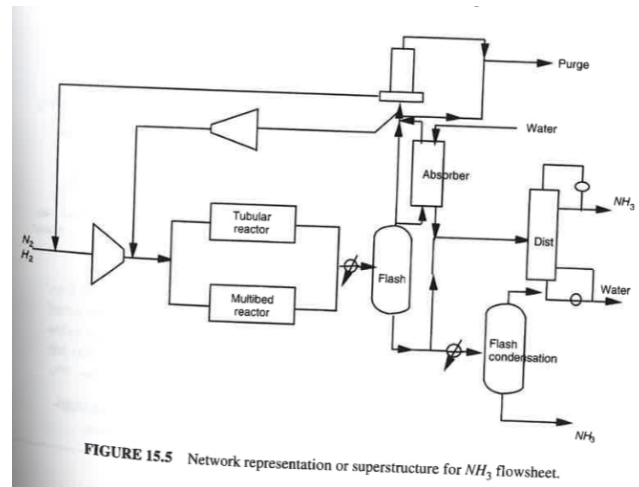

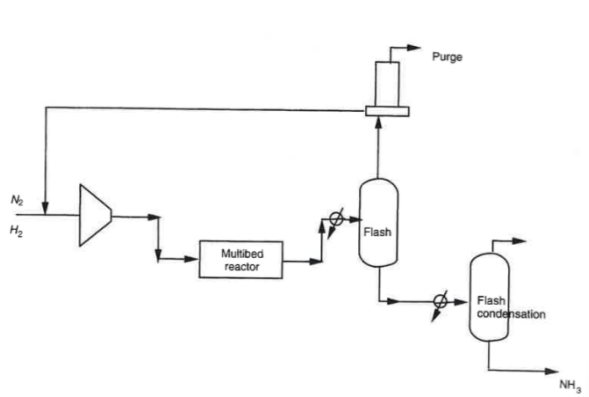FIGURE 15.5   Network representation or superstructure for NH_3 flowsheet.

FIGURE 15.6   Alternative for multibed reactor/flash condensation/membrane separation that is contained in the network of Figure 15.5.
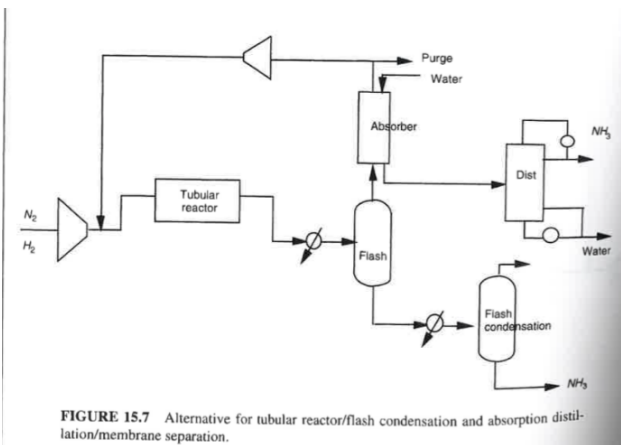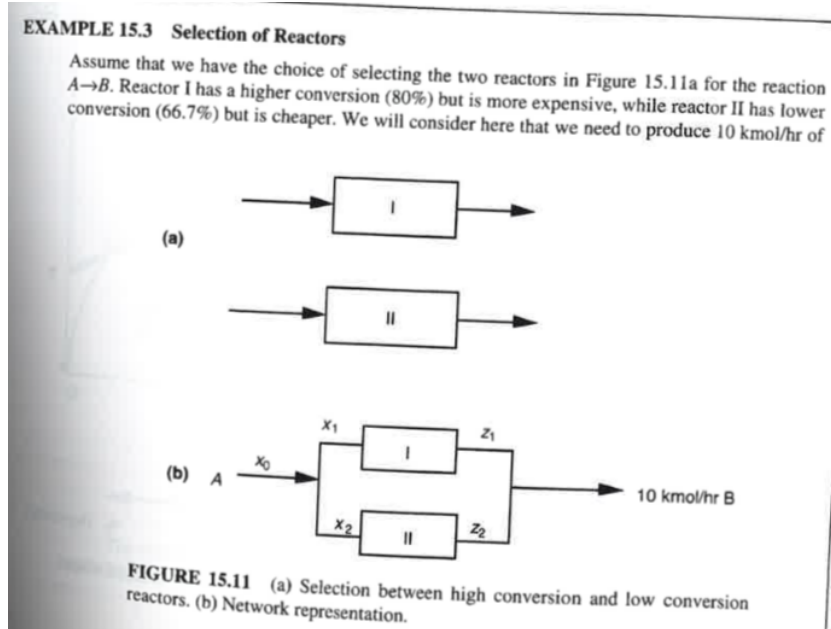

FIGURE 15.7   Alternative for tubular reactor/flash condensation and absorption distillation/membrane separation.

Application 2: Selection of Reactors

EXAMPLE 15.3   Selection of Reactors

Assume that we have the choice of selecting the two reactors in Figure 15.11a for the reaction $A \rightarrow B$. Reactor I has a higher conversion (80%) but is more expensive, while reactor II has lower conversion (66.7%) but is cheaper. We will consider here that we need to produce 10 kmol/hr of

(a)

(b) A $\xrightarrow{x_0}$ $\xrightarrow{x_1}$ I $\xrightarrow{z_1}$ $\xrightarrow{x_2}$ II $\xrightarrow{z_2}$ 10 kmol/hr B

FIGURE 15.11   (a) Selection between high conversion and low conversion reactors. (b) Network representation.

product B, and that the cost of the feed A is \$5/kmol. To select the reactor that minimizes the cost of the reactor and the cost of the feed, we can develop the small network in Figure 15.11b to account for the choice of either reactor, or a combination of the two.
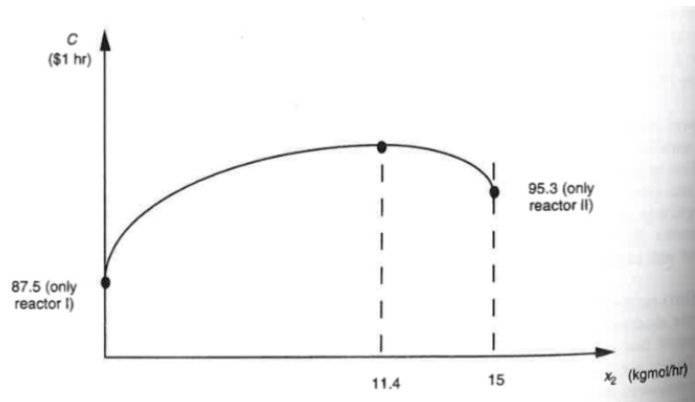
FIGURE 15.12   Cost as a function of x_2 when cost Eqs. (15.5) and (15.6) are used for the network in Figure 15.11a.
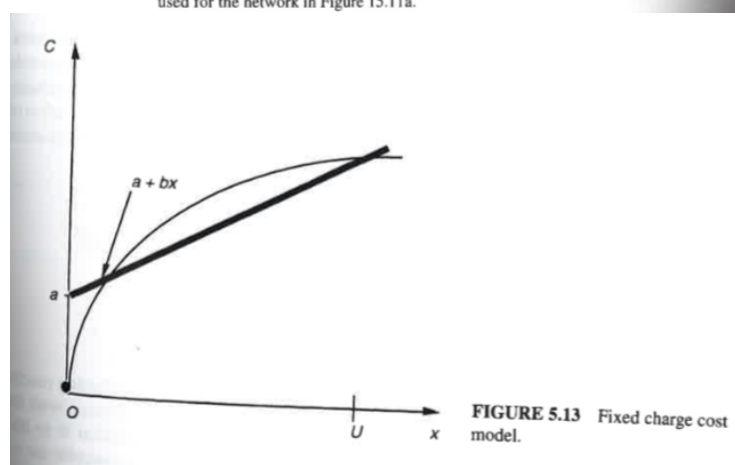
FIGURE 5.13   Fixed charge cost model.