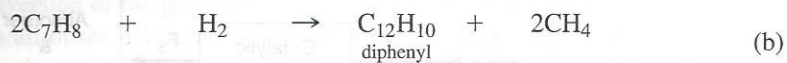


Figure P12.19

Toluene reacts with  $H_2$  to form benzene (B), but a side reaction occurs in which a by-product diphenyl (D) is formed:



The process is shown in Figure P12.20. Hydrogen is added to the gas recycle stream to make the ratio of  $H_2$  to  $CH_4$  1 to 1 before the gas enters the mixer. The ratio of  $H_2$  to toluene entering the reactor at G is  $4H_2$  to 1 toluene. The conversion of toluene to benzene on one pass through the reactor is 80%, and the conversion of toluene to the by-product diphenyl is 8% on the same pass.

Calculate the moles of  $R_G$  and moles of  $R_L$  per hour.

|              |           |       |        |          |          |                |
|--------------|-----------|-------|--------|----------|----------|----------------|
| <i>Data:</i> | Compound: | $H_2$ | $CH_4$ | $C_2H_6$ | $C_7H_8$ | $C_{12}H_{10}$ |
|              | M W:      | 2     | 16     | 78       | 92       | 154            |

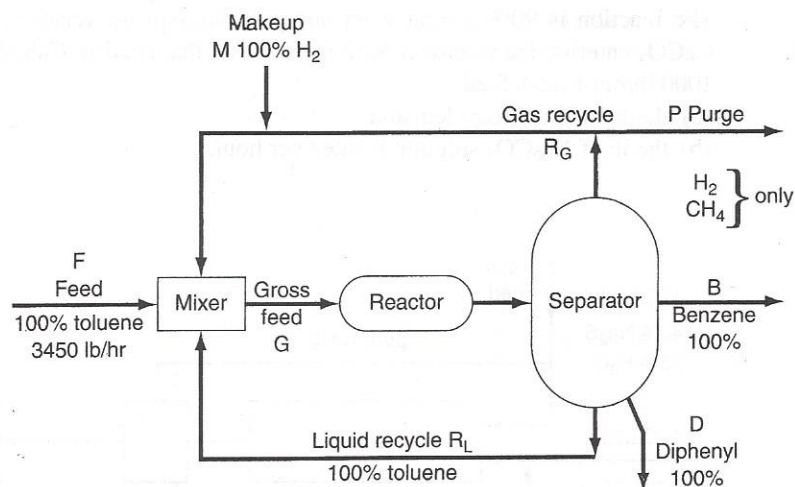
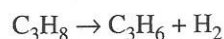


Figure P12.20

- \*\*12.21** The process shown in Figure P12.21 is the dehydrogenation of propane (C<sub>3</sub>H<sub>8</sub>) to propylene (C<sub>3</sub>H<sub>6</sub>) according to the reaction



The conversion of propane to propylene based on the *total* propane feed into the reactor at  $F_2$  is 40%. The product flow rate  $F_5$  is 50 kg mol/hr.

- Calculate all the six flow rates  $F_1$  to  $F_6$  in kg mol/hr.
- What is the percent conversion of propane in the reactor based on the *fresh* propane fed to the process ( $F_1$ ).

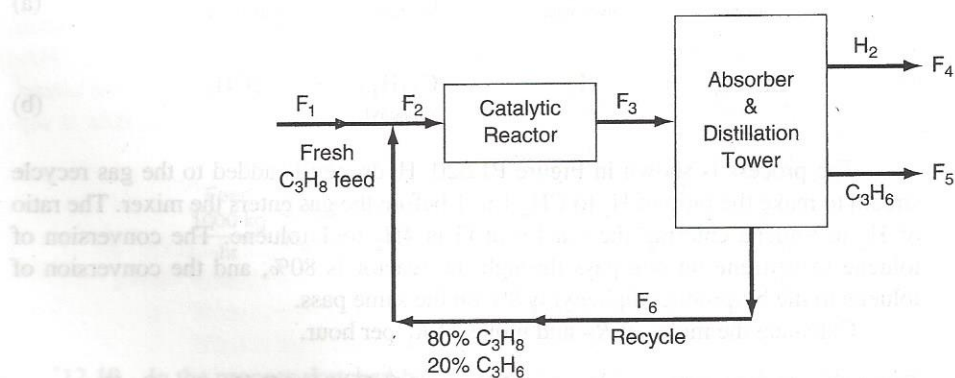


Figure P12.21