Conceptual Flow Diagrams

Understanding Chemical Processes

The most effective way of communicating information about a process is through the use of flow diagrams

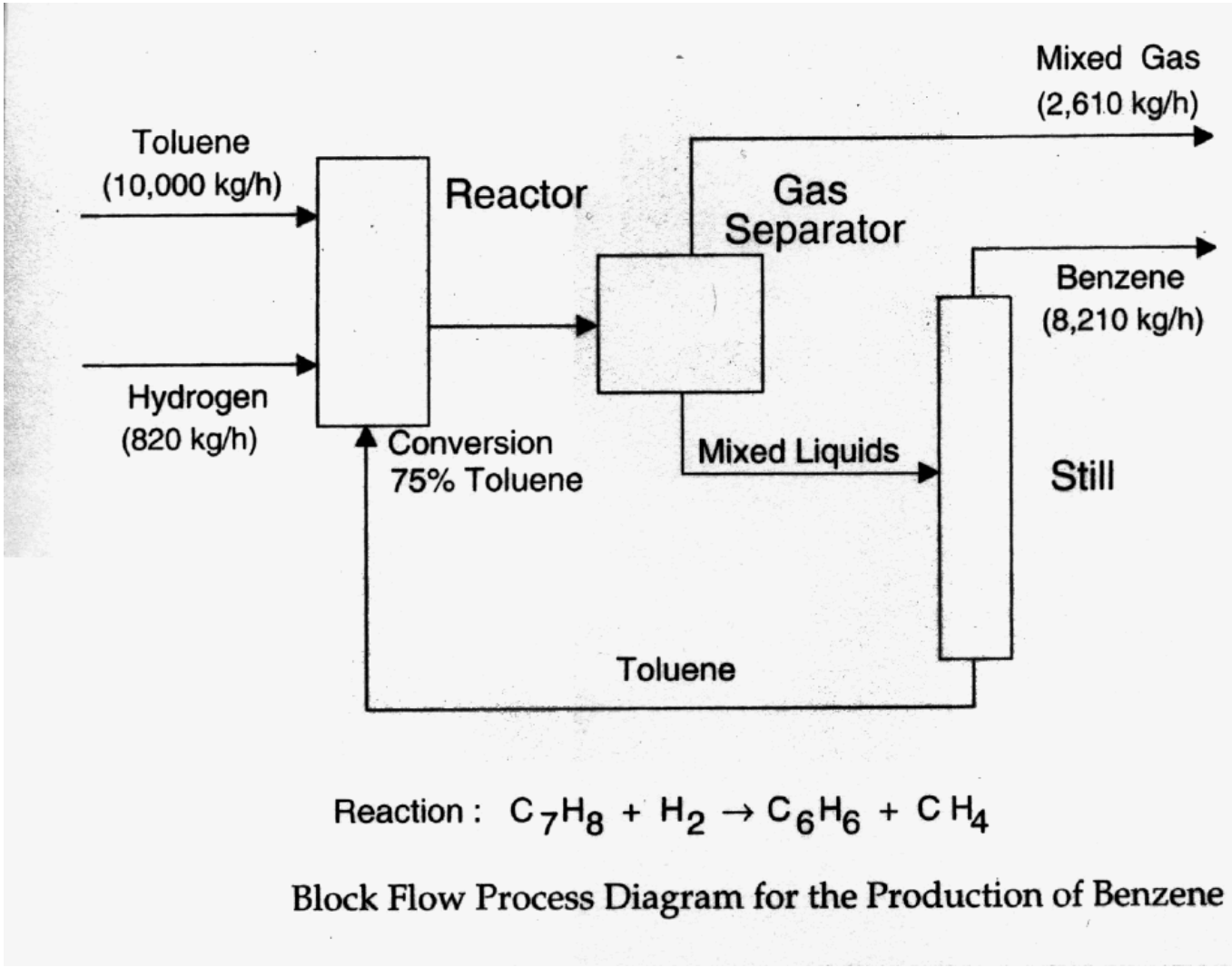
- Block Flow Diagram (BFD)
- Process Flow Diagram (PFD)
- Piping and Instrumentation Diagram (P & ID)

Example: Production of Benzene

Toluene and hydrogen are converted in a reactor to produce benzene and methane. The reaction does not go to completion, and excess toluene is required. The noncondensable gases are separated and discharged. The benzene product and the unreacted toluene are then separated by distillation. The toluene is then recycled back to the reactor and the benzene removed in the product stream.

Draw the BFD, PFD, and P & ID diagrams for this process.

Block Flow Diagram (BFD)



Reaction : $C_7H_8 + H_2 \rightarrow C_6H_6 + CH_4$

Block Flow Process Diagram for the Production of Benzene

Conventions and Format for BFD

- Operation shown by blocks
- Major flow lines shown with arrows giving direction of flow
- Flow usually goes from left to right
- Light streams (gases) toward top with heavy streams (liquids and solids) toward bottom
- Critical information unique to process
- If lines cross, then the horizontal line is continuous and the vertical line is broken
- Simplified material balance provided

Process Flow Diagram (PFD)

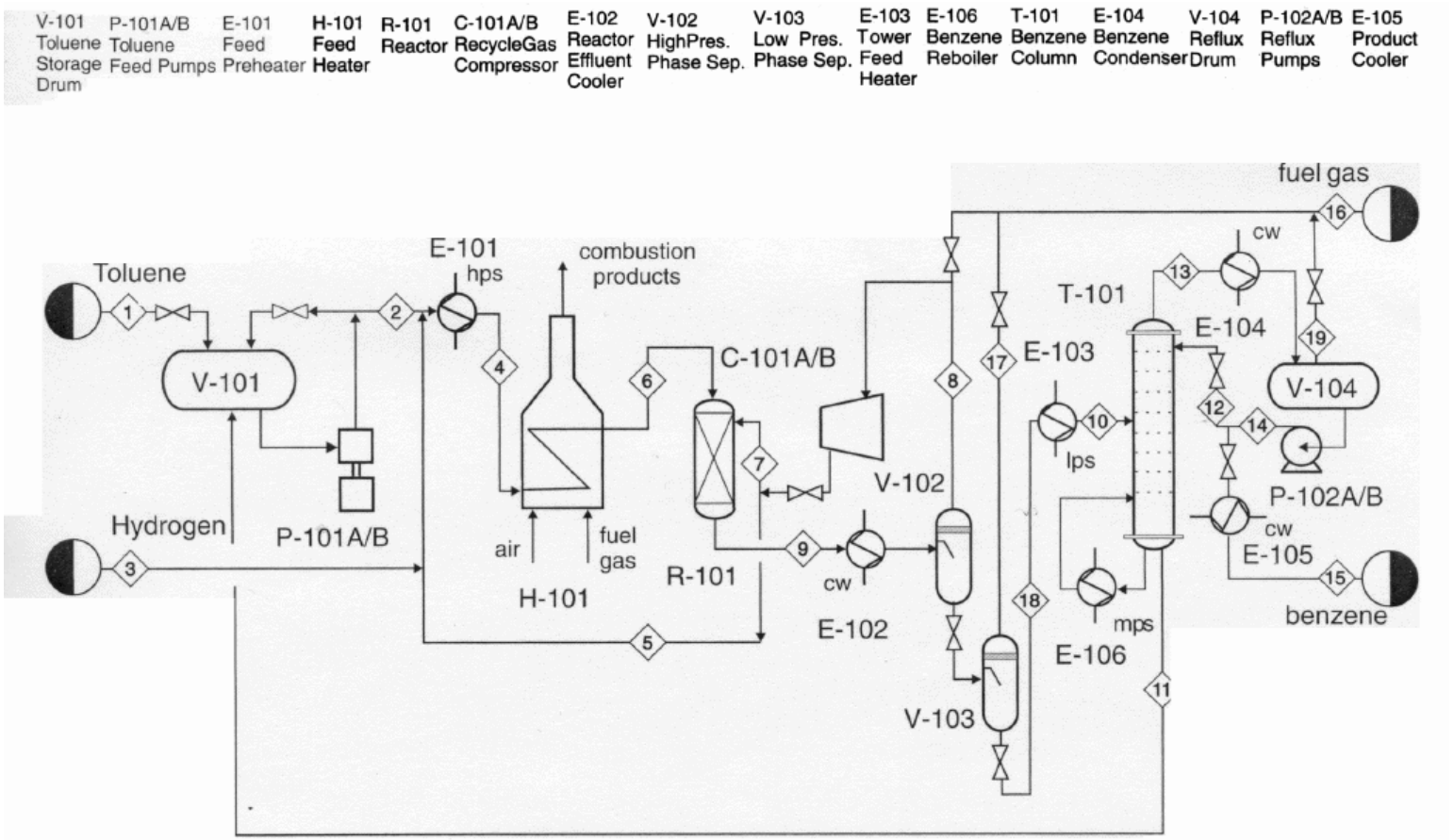


Figure 1.3 Skeleton Process Flow Diagram (PFD) for the Production of Benzene via the Hydrodealkylation of Toluene

Process Flow Diagram (PFD)

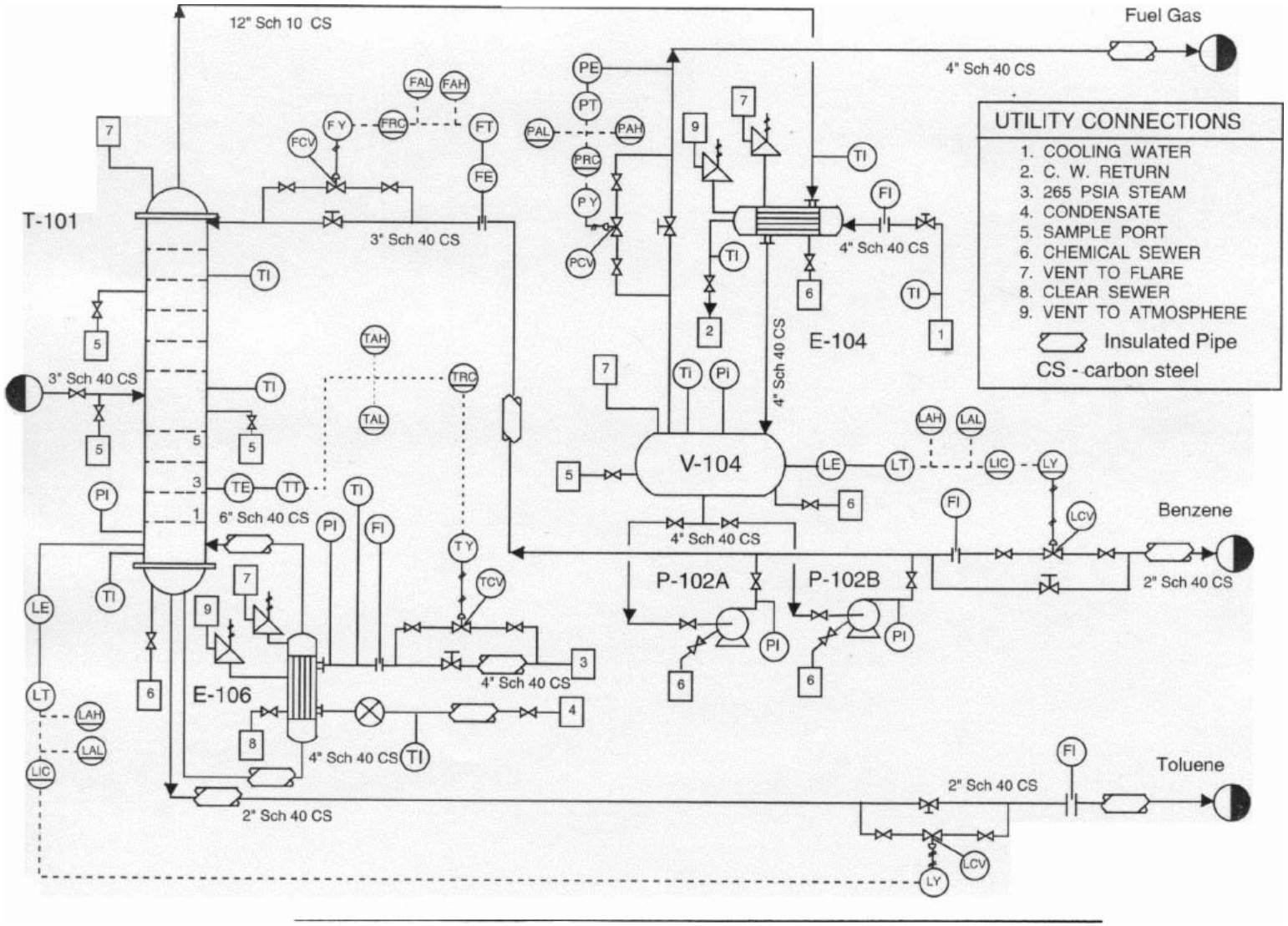
- The location of all the major pieces of equipment in the process are represented symbolically by icons.
- Each major piece of equipment is identified by a number. A list of equipment numbers along with a brief descriptive name of the equipment is printed on top of the page. More details of the equipment are given in a separate table (see Table 1.6 and 1.7 in TBWS).
- All process flow streams are shown along with a description of the process conditions and chemical composition. Typically, this stream description is given in a separate table (see Table 1.5 in TBWS).
- All utility streams supplied to a major equipment are shown.

Process Flow Diagrams (PFD)

The text-book distinguishes between a skeleton PFD and a PFD. Compare Figures 1.3 and 1.5 for the difference between the two PFDs.

In this course, when we say PFD, we mean skeleton PFD.

Piping & Instrumentation Diagram



Piping & Instrumentation Diagram

Based on the information in this diagram:

- Mechanical and civil engineers design and install pieces of equipment
- Instrument engineers specify, install, and check control systems
- Piping engineers develop plant layout and elevation drawings
- Project engineers develop plant and construction schedules

We will talk more about P&IDs in ECH 4323