

Chapter 3

Lecture # 1-1

Title: Tracing Chemicals through the Process Flow Diagram

Topics:

- 1) Guidelines and Tactics for Tracing Chemicals.**
- 2) Tracing Primary Paths Taken by Chemicals in a Process.**
- 3) Recycle and Bypass Stream.**

Guidelines and Tactics for Tracing Chemicals.

Two Important Operations for tracing chemical pathways in a PFD:

1) Adiabatic Mixer (m)

Two or more streams are combined to form a single output stream with defined phase, T, P, and X.

Guidelines and Tactics for Tracing Chemicals.

2) Adiabatic Splitter (s)

A single input stream is split into two or more streams with identical phase, T, P, and X but with different flow rate.

Tracing Primary Paths Taken by Chemicals in a Chemical Process.

Primary Chemical

A chemical species identified in the BFD.

Primary flow Paths

the path followed by primary chemicals between the reactor and the boundaries of the process.

Tracing Primary Paths Taken by Chemicals in a Chemical Process.

Reactants

Starts with the feed (LHS of a PFD) and trace chemical **forward** to the reactor.

Products

Starts with the product (RHS of a PFD) and trace chemical **backward** to the reactor.

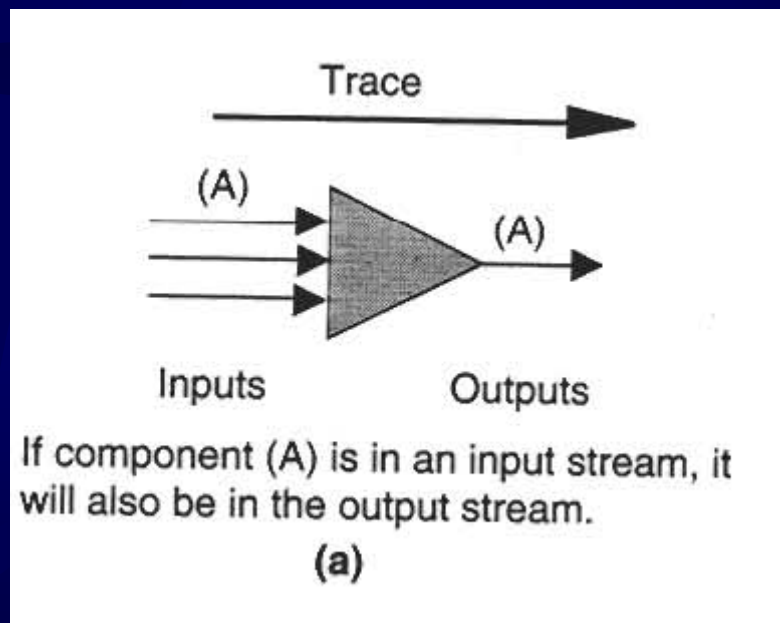
Tracing Primary Paths Taken by Chemicals in a Chemical Process.

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Tactics

1)

Any Unit Operation or group of operations, that has a single or multiple input streams and a single output streams should be traced in a forward direction.

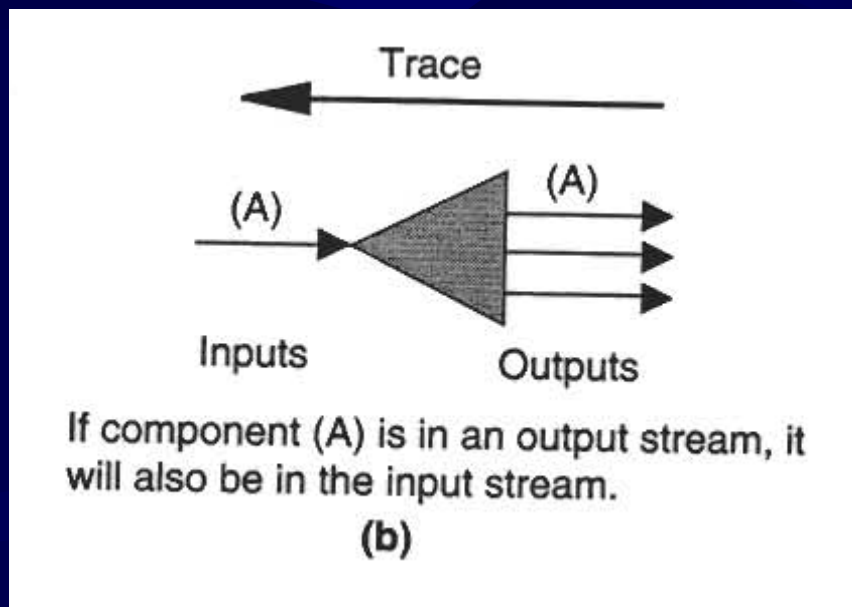


Tracing Primary Paths Taken by Chemicals in a Chemical Process.

Tactics

2)

Any Unit Operation or group of operations, that has a single input stream and a single or multiple output streams should be traced in a backward direction.



Tracing Primary Paths Taken by Chemicals in a Chemical Process.

Tactics

3)

Systems such as distillation columns are composed of multiple unit operations with a single input or output stream. It is some times necessary to consider such equipment combinations as blocks before implementing tactics 1 and 2.

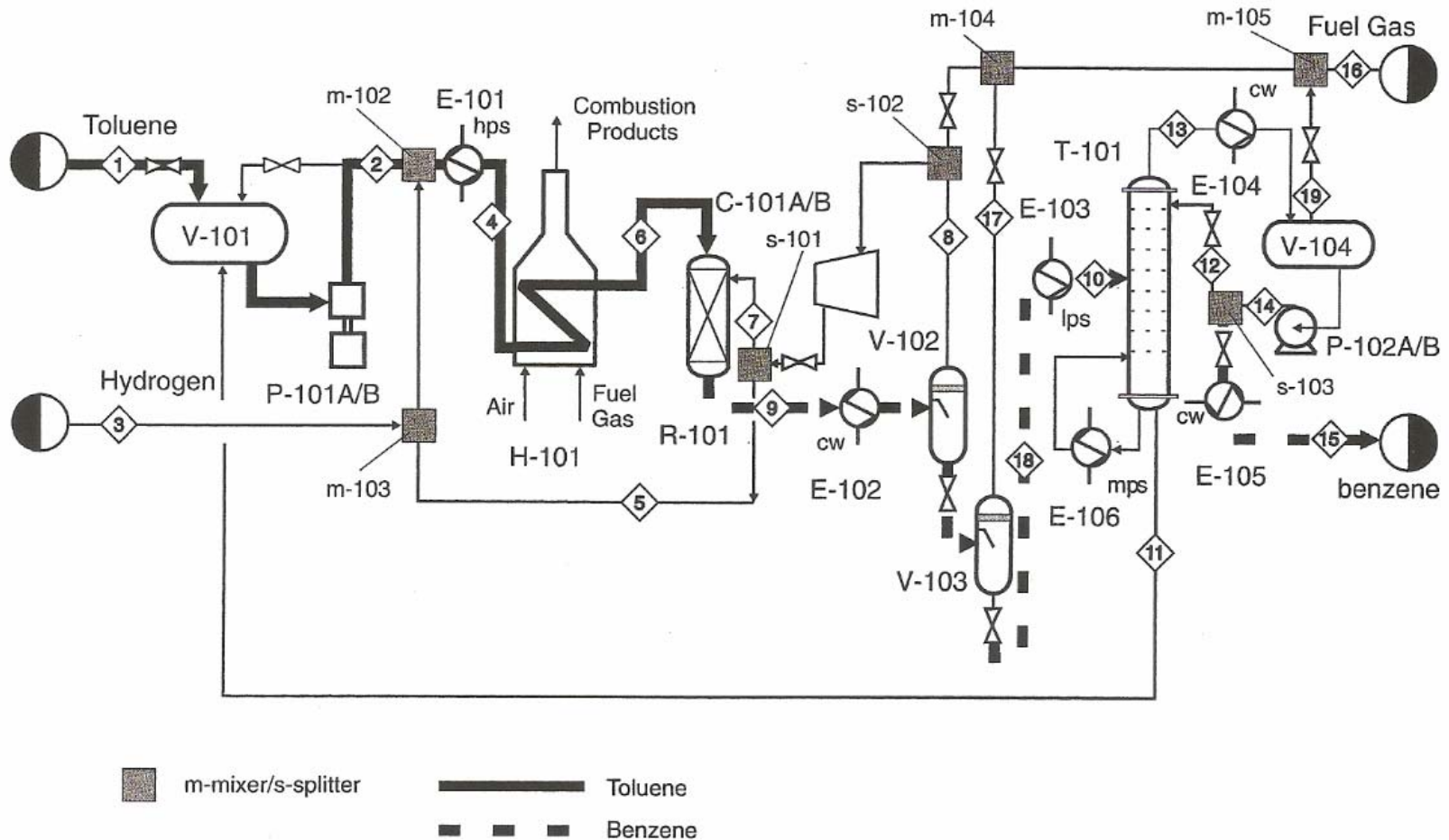
Tracing Primary Paths Taken by Chemicals in a Chemical Process.

Example 3.1

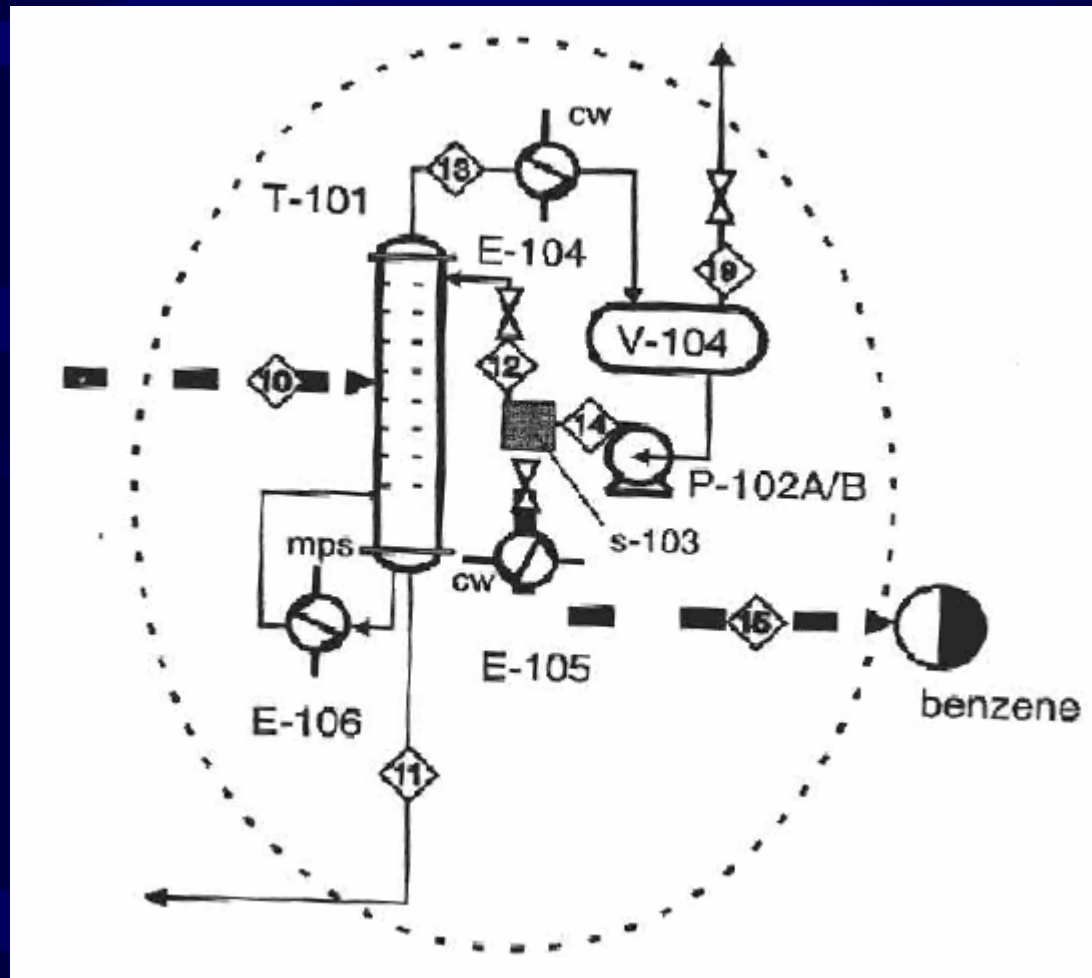
For the THDA process, establish the primary flow paths for:

- a. Toluene between the feed (stream 1) and the reactor.
- b. Benzene between the reactor and the product (stream 15)

Tracing Primary Paths Taken by Chemicals in a Chemical Process.



Tracing Primary Paths Taken by Chemicals in a Chemical Process.



Tracing Primary Paths Taken by Chemicals in a Chemical Process.

Example 3.2

For the THDA process, establish the primary flow paths for:

- a. Hydrogen between the feed and the reactor.
- b. Methane between the reactor and the product.

Tracing Primary Paths Taken by Chemicals in a Chemical Process.

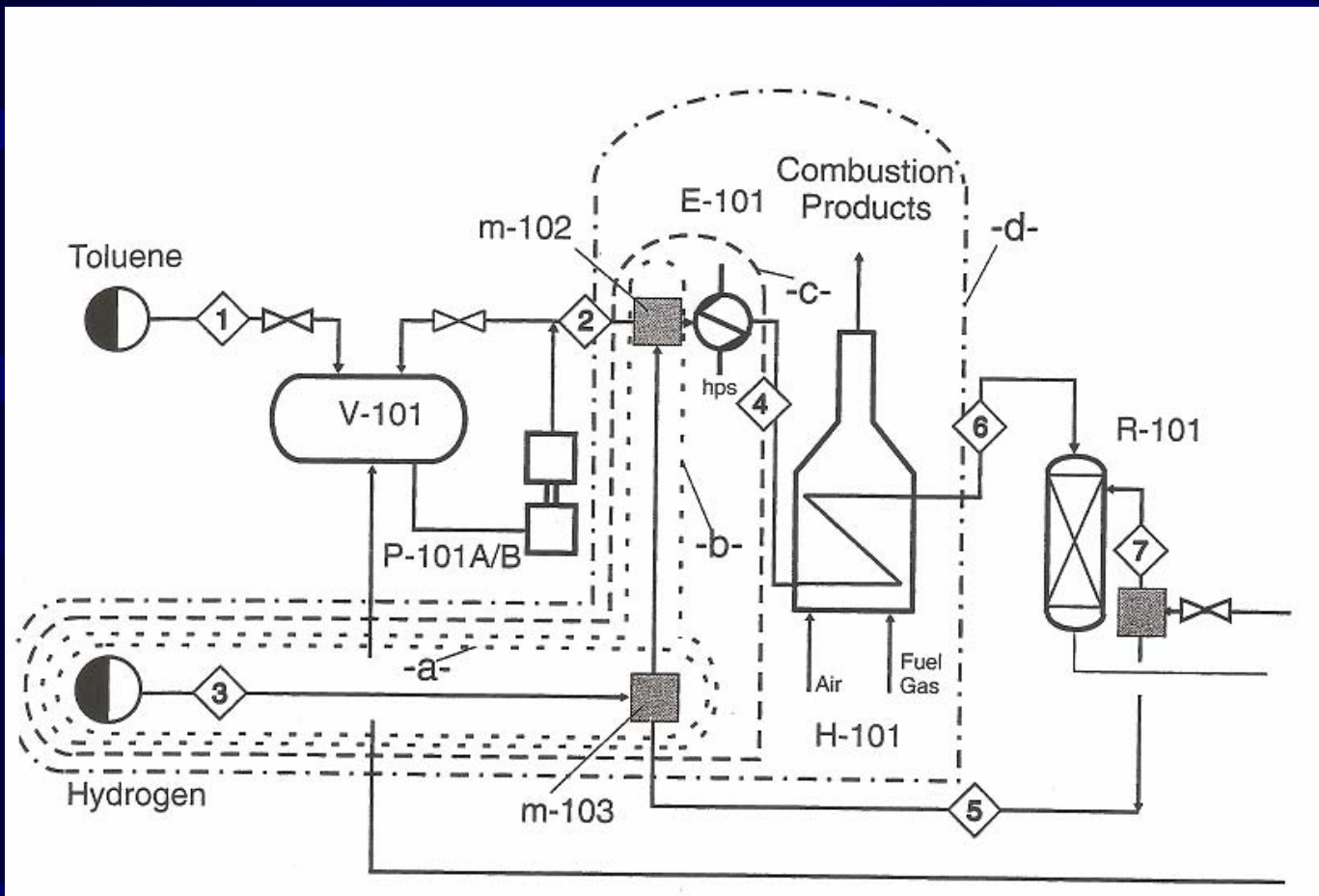
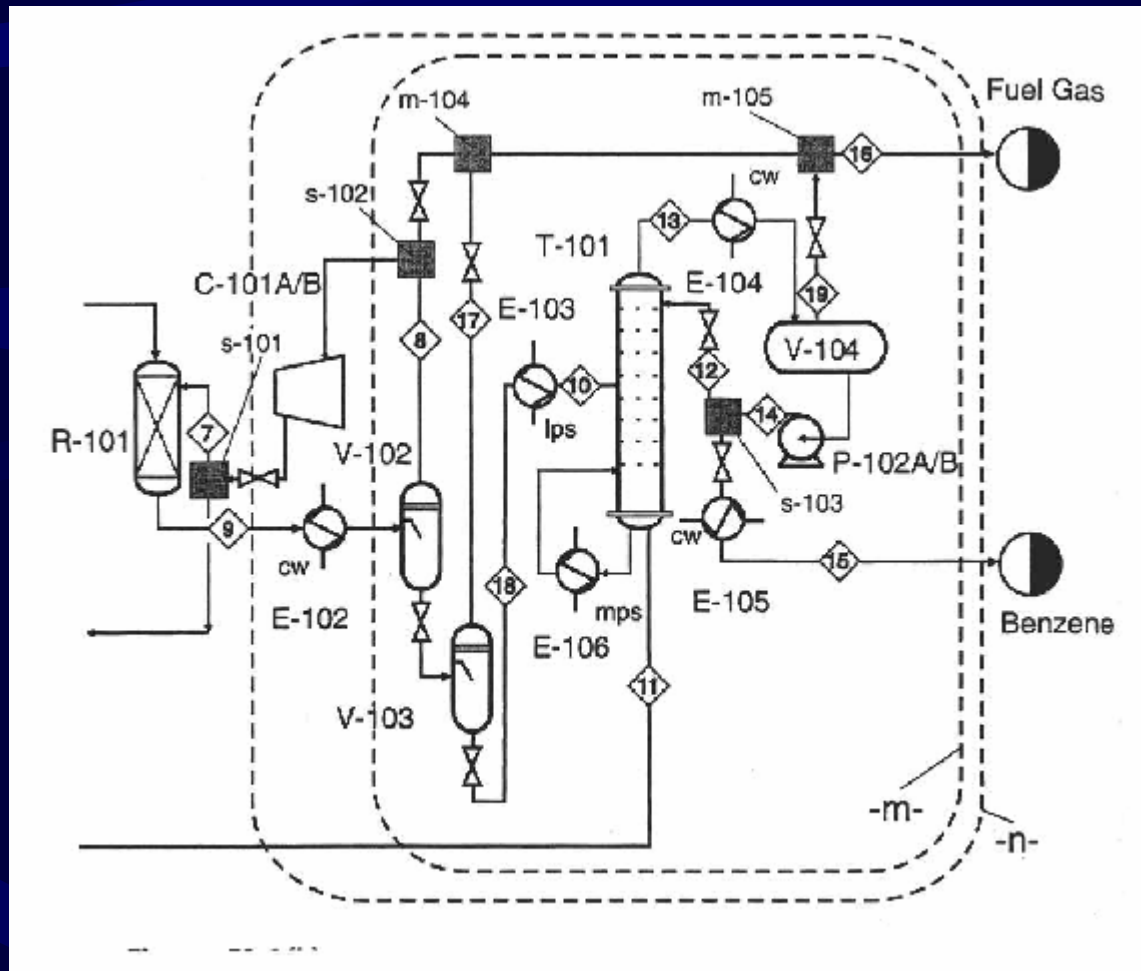


Figure E3.2(a) Tracing Primary Chemical Pathways Using the Envelope Method

Tracing Primary Paths Taken by Chemicals in a Chemical Process.



Recycle and Bypass Stream

Tactics

4)

If the stream in a loop flow so that the flow path **forms** a complete circuit to the point of origin, then this is a recycle loop.

5)

If the stream in a loop flow so that the flow path **does not form** a complete circuit back to the point of origin, then there is a bypass.

Recycle and Bypass Stream

Example 3.3

For the THDA process flow diagram, identify all recycle and bypass streams.

Recycle and Bypass Stream

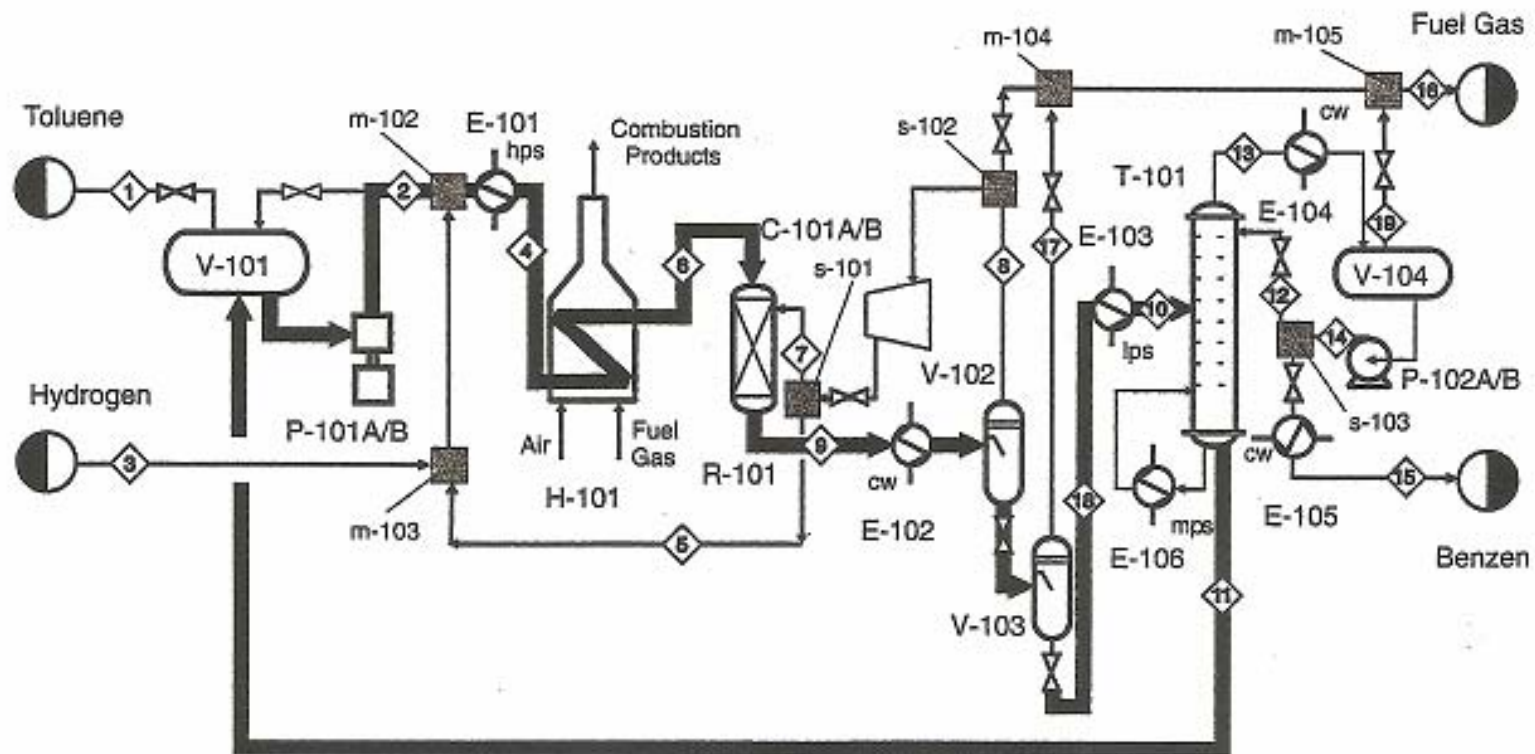
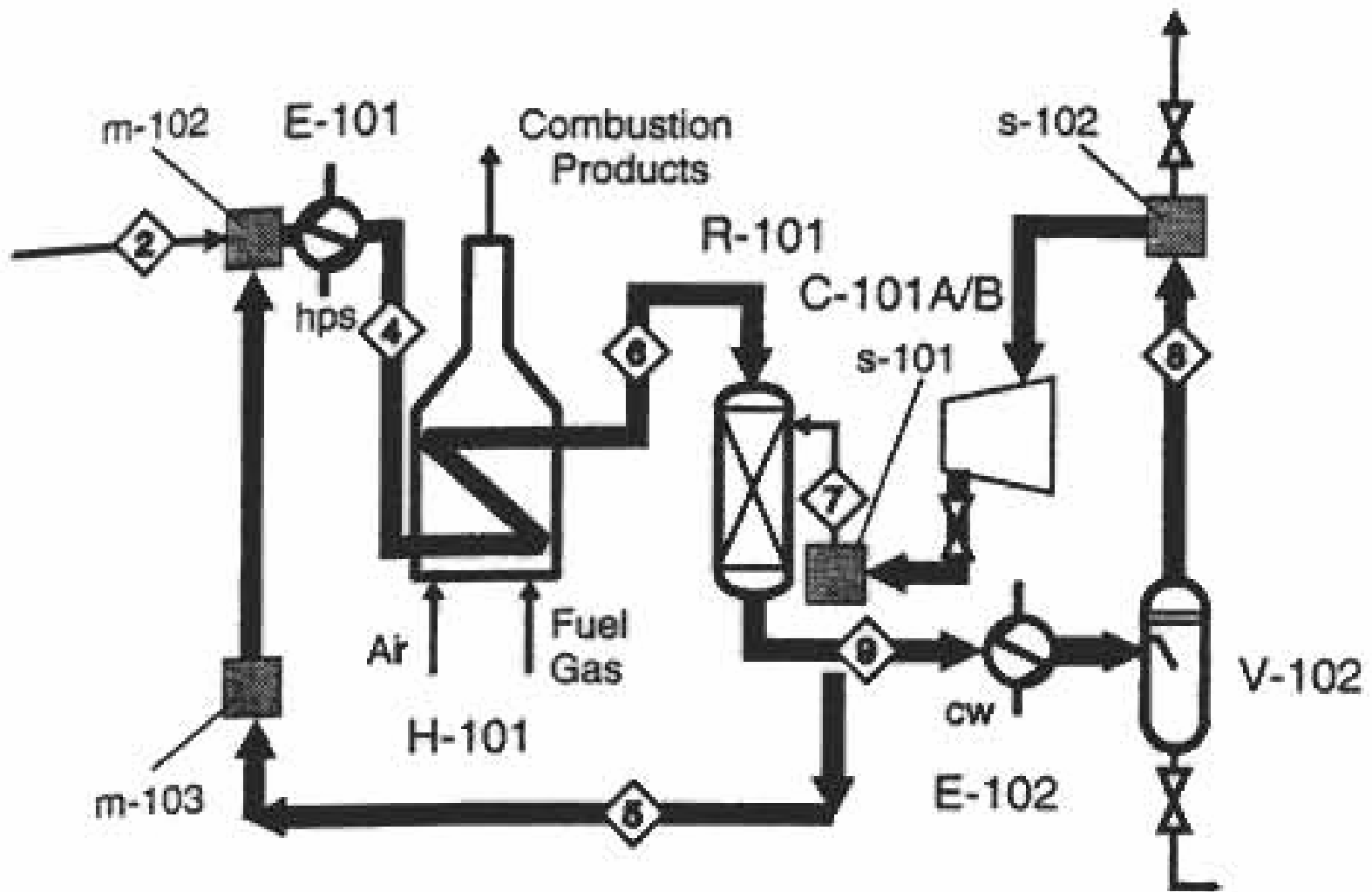
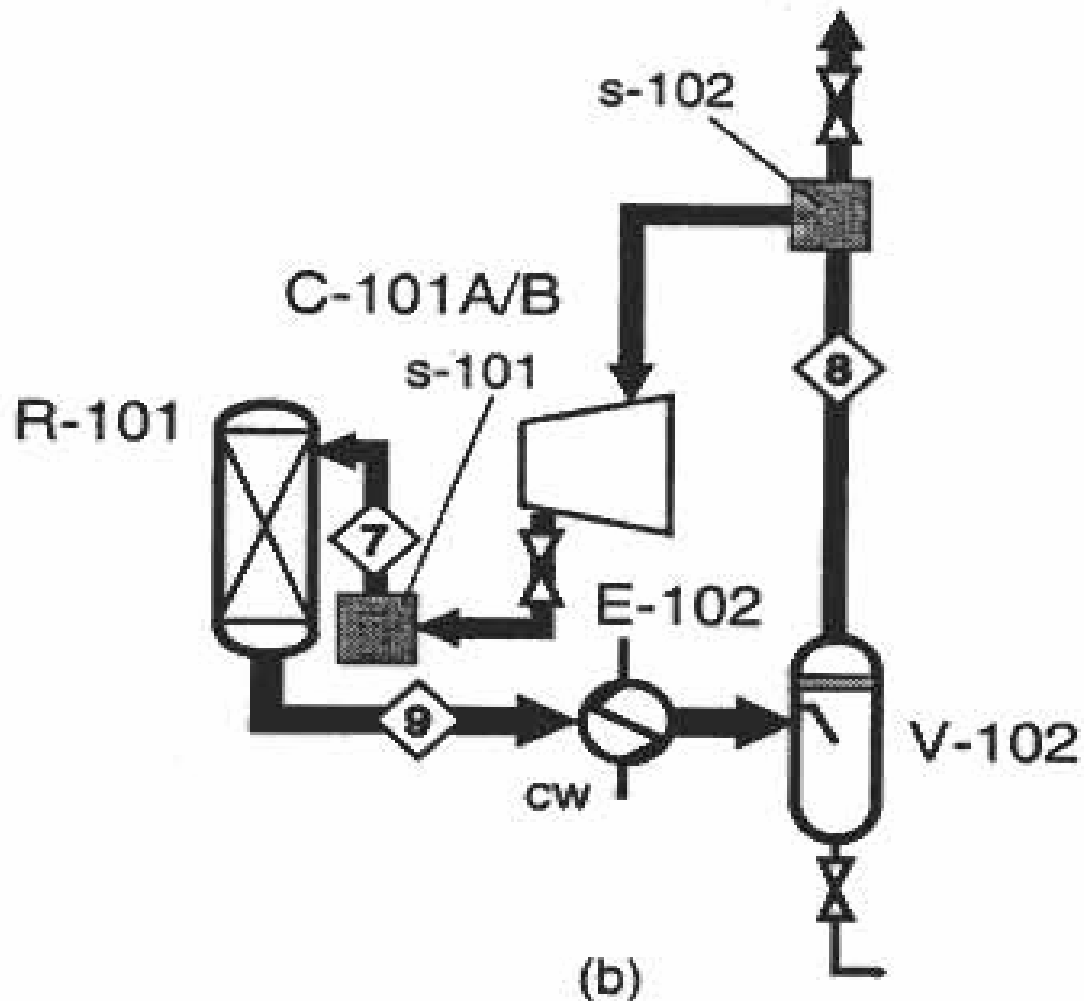


Figure E3.3(a) Identification of Toluene Recycle Loop in Toluene Hydrodealkylation PFD

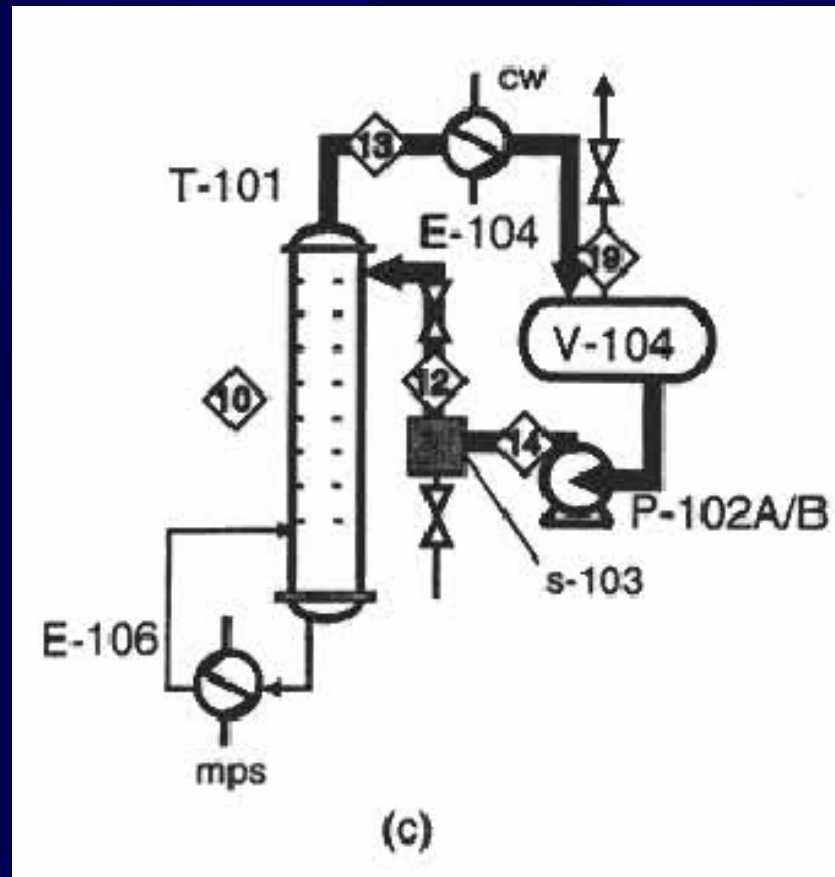
Recycle and Bypass Stream



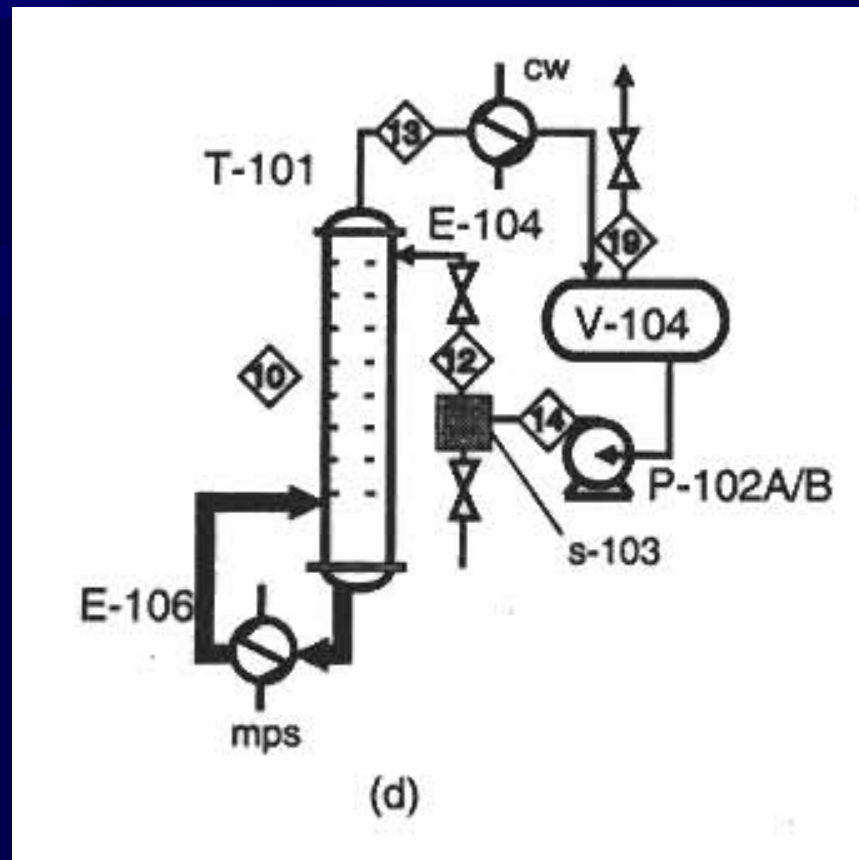
Recycle and Bypass Stream



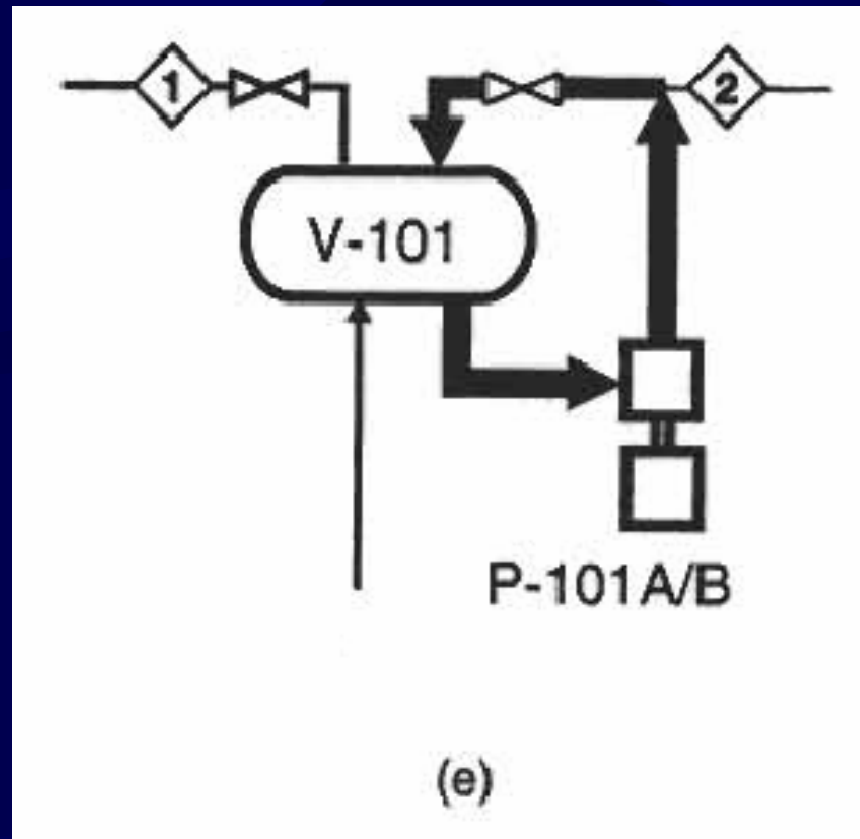
Recycle and Bypass Stream



Recycle and Bypass Stream



Recycle and Bypass Stream



Recycle and Bypass Stream

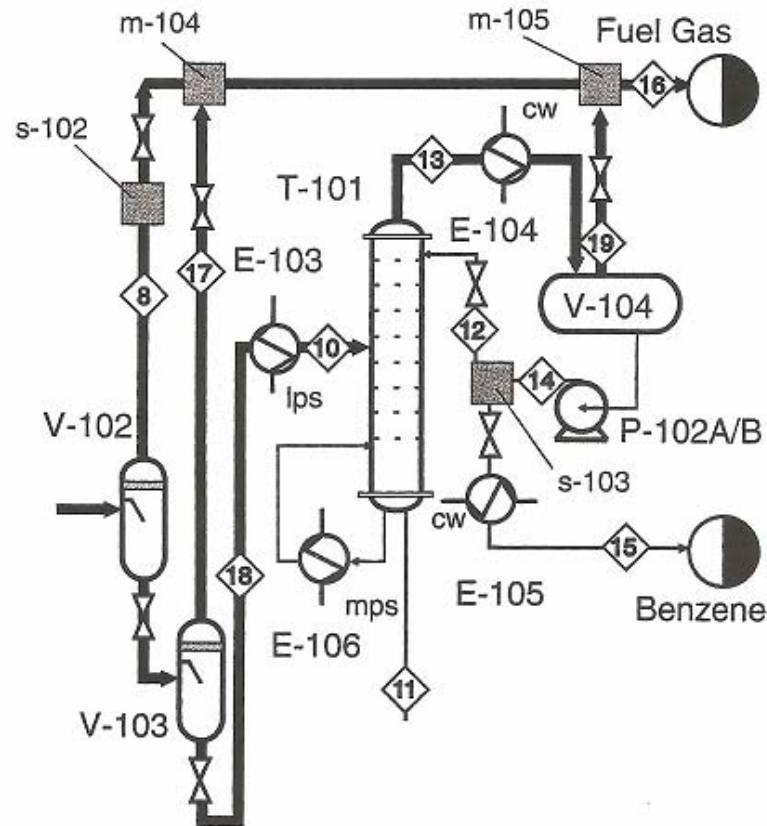


Figure E3.3(c) Identification of Bypass Streams in Toluene Hydrodealkylation PFD