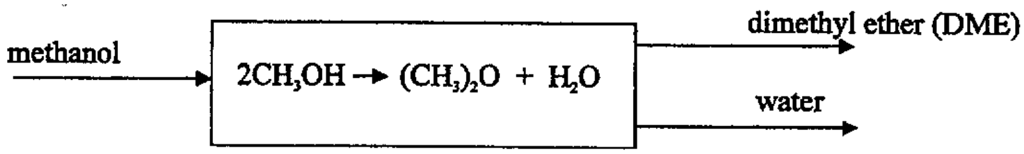
6.3 a. DME process from Figure B.1

1 Reaction only : $2CH_3OH \Rightarrow (CH_3)_2O + H_2O$

methanol dimethyl ether

b. input - output diagram



c.

Input Streams	Stream No.	Chemicals not taking place in Reaction
methanol	1	water (enters with feed methanol)

Output Streams	Stream No.	Chemicals not produced in Reaction
DME	10	-
waste water	15	- (contains some water from stream 1)

d. Utilities

cooling water	E-203, E-205, E-207, E-208
medium pressure steam	E-201, E-204, E-206
electricity	P-201, P-202, P-203

e. Identification of Equipment functions in terms of the Generic PFD

Equipment Identification	Generic PFD Function Block
E-201	Reactor Feed Preparation
E-202	Reactor Feed Preparation
E-203	Separator Feed Preparation
E-204	Separator
E-205	Separator
E-206	Separator
E-207	Separator
E-208	Separator
T-201	Separator
T-202	Separator
R-201	Reactor
P-201 A/B	Reactor Feed Preparation
P-202 A/B	Separator
P-203 A/B	Separator/Recycle*
V-201	Separator
V-202	Separator

*reflux pump provides reflux to T-201 and also recycles the unrecovered methanol back to the front-end of the process.

All other equipment falls unambiguously in the categories shown above.

Chapter 7

7.1 Main reactant and product chemical pathways for the DME process, Figure B.1

<u>Main reactant pathway - methanol</u>

Stream 1 → Stream 2→ Stream 3 → Stream 4→ Stream 5

<u>Main product pathway - DME</u>

Stream 6 → Stream 7→ Stream 8 → Stream 9→ Stream 10

<u>Main product pathway - water</u>

Stream 6 → Stream 7→ Stream 8 → Stream 9→ Stream 11 → Stream 12→ Stream 14 → Stream 15

8.6 Areas of Special Concern in the DME process - Figure B.1

For the equipment in Figure B.1 construct a process conditions matrix.

	Reactors and Separators Tables 8.1-8.3					Other Equipment Table 8.4		
Equip't	High Temp	Low Temp	High Pres.	Low Pres.	Non-Stoich Feed	Exchrs.	Valve	Mix
R-201	X	-	X	-	-	-	-	-
V-201	-	-	X	-	-	-	-	-
V-202	-	-	-	-	-	-	-	-
T-201	-	-	X	-	-	-	-	-
T-202	-	-	-	-	-	-	-	-
E-201	-	-	-	-	-	-	-	-
E-202	-	-	-	-	-	X	-	-
E-203	-	-	-	-	-	X	-	-
E-204	-	-	-	-	-	-	-	-
E-205	-	-	-	-	-	-	-	-
E-206	-	-	-	-	-	-	-	-
E-207	-	-	-	-	-	-	-	-
E-208	-	-	-	-	-	-	-	-
P-201	-	-	-	-	-	-	-	-
P-202	-	-	-	-	-	-	-	-
P-203	-	-	-	-	-	-	-	-
P-204	-	-	-	-	-	-	-	-
PCV Srm 8	-	-	-	-	-	-	X	-
PCV Srm 11	-	-	-	-	-	-	X	-

Justification for areas of special concern.

R-201 - Dehydration reaction is exothermic but not equilibrium controlled (see Appendix B.1). The reason for the high temperature must be to increase the reaction rate. A discussion of the important considerations of the reactor operation are given in the introduction section of Appendix B.1. The use of the high pressure (13.9 bar) in the reactor allows the reactor to be smaller (higher gas phase concentration) and also allows the rest of the process to operate without additional pressurization. In addition, this pressure is only just above the 10 bar criterion that was set in Chapter 8 so that this pressure is not excessively high.

T-201 - The separator operates just above the 10 bar pressure limit. As the pressure is lowered the overhead condenser temperature will drop and this may require the use of refrigerated water - see Problem 8.7a. Although the use of 10.3 bar will cause T-201 to have thicker walls it makes the diameter smaller (higher vapor density) so the net overall effect is probably not large.

V-201 - The pressure of this vessel is tied directly to that of T-201.

E-202 - The temperature of the outlet stream (Stream 5) exceeds 250°C. However, no utilities are used for this service therefore there is no real area of concern here. This is an energy recovery exchanger.

E-203 - The temperature of Stream 7 drops from 281 to 100°C in this exchanger. It might be worth recovering some of this additional heat in a waste heat boiler prior to final cooling using cooling water.

PCV in Stream 8 - There is a significant pressure drop across this valve (3.0 bar). However, recovery of this lost work using a turbine would almost certainly not be economically justified.

PCV in Stream 11- There is a significant pressure drop across this valve (3.1 bar). However, recovery of this lost work using a turbine would almost certainly not be economically justified.