MEMORANDUM

DATE: March 15, 2018

TO: Whom it may concern

FROM: Coty Forretser
Chandler Parsons
Quentin Price

SUBJECT: Successful Preliminary Design of Dimethyl Ether Plant

As desired, a dimethyl ether (DME) product was created from methanol (MeOH) at a rate of 6497 barrels/day with a purity of 99.95%, respectively. The process was modeled, simulated, and optimized using Aspen HYSYS. Hand calculations were used to validate these results.

Economic analyses were conducted based on 15-year MACRS depreciation over a 20-year project life starting in the year 2019. The estimated net present value is $207,200,000 with discounted cash flow rate of return 11.1%. Based on both NPV and DCFROR analyses, the DME system was determined to be economically attractive.

A detailed report of the preliminary design study is attached to this memo.

CHE 4224

Spring 2018

AIChE 2018 Student Design Competition

Manufacture of Dimethyl Ether for Transport

March 15, 2018

Group Number _____

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I. Tables

Executive Summary

The objective of this design is to synthesize a stream of dimethyl ether (99.95 mass percent) for use as an alternative fuel source in diesel engines. This is accomplished through the dehydration of methanol over a Gamma Alumina catalyst. The products of this reaction are then sent through two distillation columns, one to separate the DME from the water and methanol, and the other to separate the methanol from the water. The methanol is recycled to the feed of the reactor, and the waste water is sent to a treatment facility. The equipment necessary to implement this design includes six pumps, seven heat exchangers, two distillation columns, and one reactor vessel. Utilities for this process include high pressure steam, cooling water, catalyst, and power. The manufacture and installation costs of the equipment amounts to $2,850,000, and the cost of the utilities per year is $20,200,000. Methanol is purchased and shipped to the facility (110,500,000 gal/year), along with a lubricant (60,000 gal/year) for the DME product that is added to achieve a concentration of 900 PPM. The total cost for these raw materials is $167,500,000 per year. DME is produced at a rate of 99,600,000 gal/year, with a flexible selling price set at $2.40/gal, so that a profit is still achieved while the selling price is low enough to attract consumers to the alternative fuel. Thus, DME revenues amount to $227,000,000 per year. Economic analysis found that the NPV is $207,000,000 and DCFROR is 11.1% with a hurdle rate of 8% and a project life of 20 years. Sensitivity analysis indicates that a low sale price or high raw material cost could cause the DCFROR to dip below the hurdle rate (although the NPV remains positive). However, because the selling price of DME was conservative (average ultra-low sulfur diesel prices over the last 12 years was $3.13/gal), the selling price would likely be higher. Therefore, this team is comfortable with recommending that this project go forward.

Introduction

The primary focus of this project is the synthesis of dimethyl ether (DME) from methanol (MeOH). The reaction chosen to produce the DME is an exothermic equilibrium reaction that uses an acid catalyst. The acid catalyst that was chosen for this reaction is gamma alumina oxide (γ-Al_3O_2). Interest in creating DME has been generated due to the fact that DME could serve as a cleaner burning alternative to ultra-low sulfur diesel.

A production rate of 250,000 US gal/day of DME is required, which should be capable of supporting a shipping region consisting of 2000 trucks. The process also needs to be capable of operating with a turn down rate of 50% from normal production without any issues. A MeOH mixture consisting of 0.9972 mass% MeOH and 0.0028 mass% water will be considered the feed material. The feed will be delivered by railcar from the Lake Charles MeOH plant at a price of 0.02 $/gal. The final DME fuel product must contain at least 98.5 mass% DME, and the fuel is not allowed to exceed 0.05 mass% of MeOH and 0.03 mass% of water. Lubricant is also purchased and added to the DME product stream at concentrations of 900 PPM.

P-100 Feed Pump

E-100 Preheater For E-101

GBR-100 Gibbs Reactor

E-101 Heat Exchanger

E-102 Reactor Outlet Condenser

P-102 Pump To DME Column

T-100 DME Column

E-104 DME Vapor Product Condenser

P-104 DME Product/ Reflux Pump

E-105 DME Column Kettle Reboiler

T-101 WW Column

E-103 WW Vapor Product Condenser

P-103 WW Recycle/ Reflux Pump

E-106 WW Column Kettle Reboiler

P-105 WW Product Pump

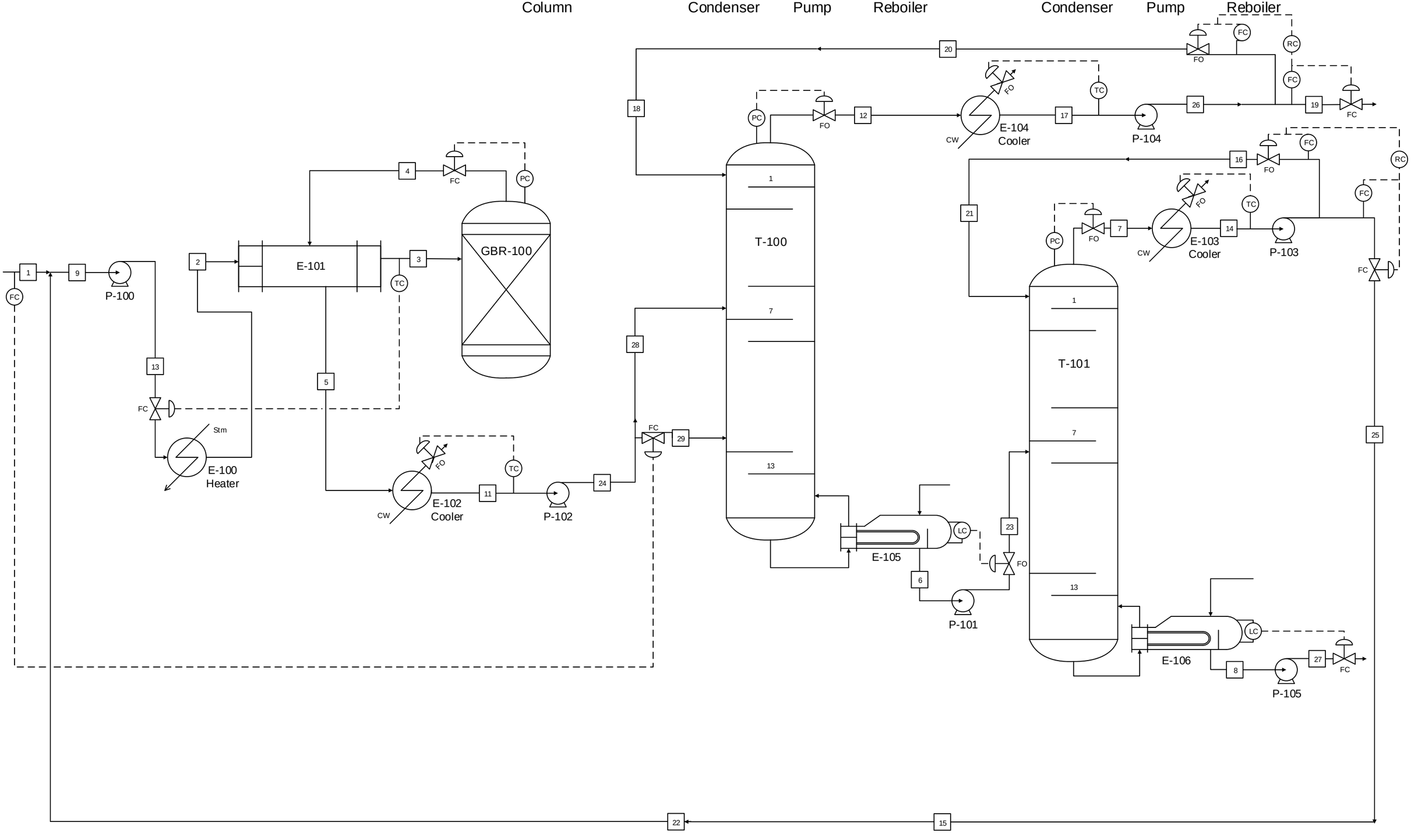


Table 1: Stream table (1)

Name	Meth feed	meth feed 3	reactor feed
Stream Number	1	2	3
Vapour Fraction	0	1	1
Temperature [C]	25	136	250
Pressure [kPa]	100	790	790
Molar Flow [kgmole/h]	1251	1576	1576
Mass Flow [kg/h]	40000	49823	49823
Liquid Volume Flow [m3/h]	50	62	62
Heat Flow [kJ/h]	-299840727	-311018979	-300871246

Table 2: Stream table (2)

Name	reactor out	D1 feed	Meth H2O
Stream Number	4	5	6
Vapour Fraction	1	1	0
Temperature [C]	367	274	145
Pressure [kPa]	790	790	840
Molar Flow [kgmole/h]	1576	1576	955
Mass Flow [kg/h]	49824	49824	21207
Liquid Volume Flow [m3/h]	66	66	24
Heat Flow [kJ/h]	-300871247	-311018980	-248743896

Table 3: Stream table (3)

Name	Meth Recycle	Waste Water	meth feed 2
Stream Number	7	8	9
Vapour Fraction	1	0	0
Temperature [C]	136	174	35
Pressure [kPa]	870	890	100
Molar Flow [kgmole/h]	650	630	1576
Mass Flow [kg/h]	19647	11385	49823
Liquid Volume Flow [m3/h]	24	11	62
Heat Flow [kJ/h]	-131193114	-172111575	-377787545

Table 4: Stream table (4)

Name	Purge	D1 feed cooled	DME outlet
Stream Number	10	11	12
Vapour Fraction	0	0	1
Temperature [C]	367	74	38
Pressure [kPa]	790	790	820
Molar Flow [kgmole/h]	0	1576	1253
Mass Flow [kg/h]	0	49824	57706
Liquid Volume Flow [m3/h]	0	66	86
Heat Flow [kJ/h]	0	-377813544	-229701575

Table 5: Stream table (5)

Name	meth feed 2 high P	Cooled meth recycle	meth to rctr
Stream Number	13	14	15
Vapour Fraction	0	0	0
Temperature [C]	36	76	76
Pressure [kPa]	790	870	910
Molar Flow [kgmole/h]	1576	650	325
Mass Flow [kg/h]	49823	19647	9823
Liquid Volume Flow [m3/h]	62	24	12
Heat Flow [kJ/h]	-377728593	-155889805	-77944197

Table 6: Stream table (6)

Name	meth to tower	DME out2	DME reflux
Stream Number	16	17	18
Vapour Fraction	0	0	0
Temperature [C]	76	37	37
Pressure [kPa]	910	820	860
Molar Flow [kgmole/h]	325	1253	632
Mass Flow [kg/h]	9823	57706	29090
Liquid Volume Flow [m3/h]	12	86	43
Heat Flow [kJ/h]	-77944197	-253341929	-127707274

Table 7: Stream table (7)

Name	DME product	meth to rctr	meth to tower
Stream Number	19	15	16
Vapour Fraction	0	0	0
Temperature [C]	37	76	76
Pressure [kPa]	860	910	910
Molar Flow [kgmole/h]	626	325	325
Mass Flow [kg/h]	28853	9823	9823
Liquid Volume Flow [m3/h]	43	12	12
Heat Flow [kJ/h]	-126668336	-77944197	-77944197

Table 8: Stream table (8)

Name	DME out2	DME reflux	DME product
Stream Number	17	18	19
Vapour Fraction	0	0	0
Temperature [C]	37	37	37
Pressure [kPa]	820	860	860
Molar Flow [kgmole/h]	1253	632	626
Mass Flow [kg/h]	57706	29090	28853
Liquid Volume Flow [m3/h]	86	43	43
Heat Flow [kJ/h]	-253341929	-127707274	-126668336

Table 9: Stream table (9)

Name	DME reflux 1	METH reflux	meth to rctr 2
Stream Number	20	21	22
Vapour Fraction	0	0	0
Temperature [C]	37	76	76
Pressure [kPa]	860	910	910
Molar Flow [kgmole/h]	626	325	325
Mass Flow [kg/h]	28853	9825	9823
Liquid Volume Flow [m3/h]	43	12	12
Heat Flow [kJ/h]	-126668336	-77952879	-77946818

Table 10: Stream table (10)

Name	Meth H2O Pumped	D1 feed pumped	CMR2
Stream Number	23	24	25
Vapour Fraction	0	0	0
Temperature [C]	145	74	76
Pressure [kPa]	880	830	910
Molar Flow [kgmole/h]	955	1576	650
Mass Flow [kg/h]	21207	49824	19647
Liquid Volume Flow [m3/h]	24	66	24
Heat Flow [kJ/h]	-248742458	-377809637	-155888394

Table 11: Stream table (11)

Name	DME out3	WWT	normal op
Stream Number	26	27	28
Vapour Fraction	0	0	0
Temperature [C]	37	174	74
Pressure [kPa]	860	930	830
Molar Flow [kgmole/h]	1253	630	788
Mass Flow [kg/h]	57706	11385	24912
Liquid Volume Flow [m3/h]	86	11	33
Heat Flow [kJ/h]	-253336672	-172110884	-188904818

Table 12: Stream table (12)

Name	turn down
Stream Number	29
Vapour Fraction	0
Temperature [C]	74
Pressure [kPa]	830
Molar Flow [kgmole/h]	788
Mass Flow [kg/h]	24912
Liquid Volume Flow [m3/h]	33
Heat Flow [kJ/h]	-188904818

Process Description

The purpose of the design is to create a process that is capable of producing dimethyl ether (DME), an economically viable replacement for diesel fuel from methanol (MeOH) by using an acid catalyst.

To accomplish this design, a mixture of 99.5 mole percent methanol is fed into the process at a rate of 40,000 kg/h. This feed stream is mixed with a recycle stream from the second distillation column and then fed to a pump. This pump serves to increase the stream pressure by 100 psia to a total pressure of 115 psia, which allows for easier heating and condensation later in the process, and its outlet stream is fed to a heater. The heater vaporizes and increases the temperature of the stream to decrease the burden on the subsequent heat exchanger, which utilizes the outlet stream of the reactor to preheat the reactor's inlet stream to 250°C. After being heated to 250°C the stream is fed to the reactor. Once in the reactor the methanol is dehydrated using a gamma-alumina oxide catalyst (γ-Al_3O_2) and the process is allowed to reach equilibrium upon which it is discharged from the reactor. The reactor discharge is then fed to the heat exchanger as previously stated. After passing through the heat exchanger, the reactor outlet needs to be condensed and cooled further and is fed to a cooler which drops its temperature from 274°C to 74°C. Next, the stream is fed to a pump which raises its pressure by 5.8 psia to a total of 120 psia in order to move the fluid into the first distillation column.

The stream is split into two and is fed into the column at stages 4 and 9. The split serves to prevent weeping in the column during turn down by changing the feed location of the majority of the mixture. Column T-100 is operating with a top and bottoms pressure of 119 psia and 122 psia respectively. The vapor product leaving the column is mixture of DME and MeOH with mass fractions of 0.9995 and 0.0005 respectively. The vapor product is then fed to a cooler in order to condense it. Once the DME mixture has been condensed, it is pumped out and into two different streams of nearly equal flow rates, the first of which is a recycle stream, and the second is the outlet stream for the DME product. The bottoms product leaving the column is pumped to a second distillation column to separate excess MeOH from the water that was produced in the reactor.

Column T-101 operates with a top and bottoms pressure of 126 psia and 129 psia respectively. The vapor product has mass fractions of 0.8679 MeOH, 0.0926 water, and 0.0395 DME. After exiting the tower, the vapor stream is fed to a cooler to condense it. Once it has passed through the cooler the stream is fed to a pump to generate the pressure needed to separate

the stream into two streams and send them to their recycle points. One stream is sent back into the tower as reflux, and the other is recycled back to the beginning of the process where it is merged with the initial feed stream. The bottoms product has mass fractions of 0.9923 water and 0.0077 MeOH. This stream is pumped to a waste water disposal facility.

Energy Balance and Utility Requirements

Utility requirements for this plant include cooling water, high pressure steam, power, and catalyst. The necessary amount of cooling water was calculated based on the heat transfer in each cooler. With heat known, the mass flow rate could be found via Equation 1 once heat capacity and change in temperature were calculated. Temperature change was calculated based on a known inlet temperature and either the maximum allowable temperature of water at 115 degrees F or a temperature that allowed for sufficient heat transfer (this applies only to E-104). The heat capacity of water was assumed to be nearly constant and was calculated based on an equation found in the NIST database (1).

$$q = (\dot{m} * C_p * \Delta T) \qquad \textit{Equation 1}$$

Steam flow requirements were calculated in a similar manner. Once the heat transfer was known, the mass flow rate was determined by dividing q by the change in enthalpy of steam at its given temperature and pressure, as recorded in the stream tables by Moran et al (2). Power requirements were simply found by converting the brake horsepower into kilowatts. The γ-Al_3O_2 catalyst mass necessary for the process was determined via Equation 2, where the reaction rate was found in kinetic data described in the original problem statement. Once volume was known, the density of the catalyst was used to determine the weight of catalyst required. Last, the weight of catalyst was divided by its average lifespan to determine the amount needed per year. See table 32 for further information regarding the utility consumption values.

$$V = Fao * \int_0^X \frac{dx}{-ra} \qquad \textit{Equation 2}$$

Equipment List and Unit Descriptions

The equipment utilized in this design was sized in accordance with information from both literature, course notes, and data from an Aspen HYSYS simulation. This design required the use of six pumps, seven heat exchangers (including two kettle reboilers on the columns), two distillation columns, and one reactor.

Pumps

For all pumps used in this process, this team specified the pressure changes between inlet and outlet streams, and the flow rates were determined by mass balances conducted by Aspen HYSYS. Of the six pumps used in this design, five were employed for the purpose of moving liquid streams from one piece of equipment to the next. These pumps were designed to increase stream pressure by 5.8 psi, as this was judged to be sufficient for that purpose. P-100, however, was included in order to increase the pressure of the stream entering E-100 by 100.1 psi, so that throughout the process methanol, DME, water, or any mixture of the three would have low enough dew points such that they could be condensed without the use of refrigerants. Flow rates through and pressure increases across each pump were used in tandem with Figure 12-3 in the GPSA handbook (3) to determine that a single stage centrifugal pump was the best type to use for all pumps. Pump efficiencies were all found in or inferred from Figure 12-7 in the GPSA handbook (3). Pertinent equations used to size the pumps may be found below, and relevant data may be found in Table 13.

Table 13: Pump specifications

Pump No.	Q (gpm)	ΔP (psi)	Pump Efficiency	Bhp
100	275	100.1	0.6	26.74
101	104	5.8	0.45	0.78
102	292	5.8	0.6	1.65
103	107	5.8	0.45	0.81
104	377	5.8	0.7	1.82
105	50.0	5.8	0.45	0.38

$$Hyd\ hp = \frac{Q(gpm) * \Delta P\ (psi)}{1715} \qquad \textit{Equation 3}$$

$$Brake\ hp = \frac{Hyd\ hp}{\eta_p}$$ *Equation 4*

Heat Exchangers

A total of seven heat exchangers were deemed necessary to accomplish the synthesis and subsequent purification of DME. There is one kettle reboiler for each distillation column and five shell and tube heat exchangers. High-pressure steam (P=160 psia, T_{sat}=363.6°F) (4) was used in both kettle reboilers and the E-100 heat exchanger. Cooling water was used in E-102, E-103, and E-104. E-101 was used to decrease the amount of steam needed in E-100. The general approach to calculating the area for each heat exchanger is as follows.

The heat loss or gain by each stream is first calculated via Equation 5, where mass flow rate and enthalpy changes are provided by Aspen HYSYS. For the reboilers, however, the heat duty from Aspen HYSYS was used instead of calculated.

$$q = (\dot{m} * \Delta H)$$ *Equation 5*

The overall heat transfer coefficient is then determined with Equation 6. The inner and outer tube diameters were all estimated to be 0.60 inches and 0.75 inches, respectively (5). Heat transfer and fouling resistance values were ascertained from Table 4.1.1 of the CRC Handbook of Thermal Engineering (6).

$$U_0 = \left[\left(\frac{d_o}{h_i * d_i}\right) + \left(R_{fi} * \frac{d_o}{d_i}\right) + \left(\frac{d_o * \ln\left(\frac{d_o}{d_i}\right)}{2 * K_w}\right) + R_{fo} + \left(\frac{1}{h_o}\right) \right]^{-1}$$ *Equation 6*

The inlet and outlet stream temperatures in Aspen HYSYS are then used to calculate the LMTD. It should be noted that outlet temperatures for steam and cooling water were estimated. The steam is assumed to impart heat from its condensation alone, so an outlet temperature slightly under its saturation temperature was assumed. For cooling water, an outlet temperature of 115 °F was used so that biological growth in the cooling water would be avoided. Note that this is not true of E-104, where the outlet temperature was designated to be 86 °F so that a sufficient temperature difference could be maintained in the heat exchanger.

$$LMTD = \frac{(T_{hi} - T_{co}) - (T_{ho} - T_{ci})}{\ln\left(\frac{T_{hi} - T_{co}}{T_{ho} - T_{ci}}\right)}$$ *Equation 7*

With q, U_0, and LMTD known, the area of the heat exchanger was determined via

Equation 8. A value of 0.9 was assigned to the correction factor F based on heuristics (4). All calculations and constants used for each heat exchanger can be found in the specification sheets below.

$$A_0 = \frac{q}{U_0 * F * LMTD} \qquad \textit{Equation 8}$$

Distillation columns

Column T-100

The column is fed a stream composed of 39.91 mole% DME, 17.1 moel% MeOH, and 42.98 mole% water. The feed is flowing at a rate of roughly 10000 barrels per day with a temperature of 73.7°C and a pressure of 120.4 psia. Before entering the column the feed is split between two streams. The stream for normal operation of the tower enters at stage 4, and the stream that is used during turn down operation of the tower enters at stage 9. This, along with the use of bubble cap trays as the bottom two trays of the column, is implemented to prevent the tower from weeping when it is operating at less than its full capacity.

A bottom operating pressure of 121.8 psia and a top operating pressure of 118.9 psia were selected for the column. The pressure difference between these two levels is the driving force for the vapor traveling in the column.

Internally the column is designed to have 10 trays, but due to a tray efficiency of 0.8, 13 actual trays are necessary. For his column, 11 of these are sieve trays, and 2 are bubble trays. The pressure drop between trays ranges between 0.3 psia and 0.4 psia.

Trays were spaced at 2 ft. Using this and the number of trays a height of 37.1 ft was calculated using the following equation.

Column Height (ft) = (# of trays)(tray spacing) + 7 + (1 + tray spacing) *Equation 9*

The reason for adding 7 feet and (1 + tray spacing) feet to the column height is to account for the extra space needed at the bottom and top of the column.

A column diameter of 5.09 ft allowed for the process to achieve the desired separation. The tray diameter is determined by the column diameter hence the tower diameter has to be designed around the desired surface area for liquid flow.

Carbon steel was selected as the material to construct the tower. There were no concerns about corrosions with the materials flowing through it so carbon steel was selected because it was the cheapest material.

In order to cost and size the tower based on actual trays and not theoretical trays a tray efficiency (ε) of 80% was assumed (4). Actual trays can be calculated from theoretical trays based on the equation below.

$$Number\ of\ actual\ trays = \frac{Number\ of\ theoretical\ trays}{\varepsilon} \qquad Equation\ 10$$

The columns internals were altered until there was no potential issues with weeping, resulting in the choice of stages 4 and 9 as the inlets to the column.

The top product consisted of 0.9995 mass% DME and 0.0005 mass% MeOH flowing at roughly 13000 barrels per day. This stream was split between the final product stream and a reflux stream. The reflux stream was fed back into the tower at a rate of 6500 barrels per day. The Reflux ratio was calculated to be 1.

The bottoms product of the column was a mixture of 0.0179 mass% DME, 0.4066 mass% MeOH, and 0.5755 mass% water flowing to the reboiler at roughly 7600 barrels per day. The stream is split and 4050 barrels per day is returned to the tower as boilup. The other stream is pumped to column T-101 at a rate of 3550 barrels per day. The boil up ratio was calculated to be 0.84.

Column T-101

The column is fed the bottoms outlet stream from T-100. The composition of the stream is 0.0086 mole% DME, 0.2819 mole% MeOH, and 0.7095 mole% water. The feed is flowing at approximately 3500 barrels per day with a temperature of 145.4°C and a pressure of 127.6 psia. \ A bottom operating pressure of 129.1 psia and a top operating pressure of 126.2 psia were selected for the column. The fluids in column T-101 undergo the same process as the fluids in column T-100.

Internally the column has 13 actual trays all of which are sieve trays. The pressure drop between the trays ranges between 0.3 psia and 0.4 psia.

Trays were spaced at 2 feet. Using this and the number of trays a height of 37.1 feet was calculated using the same equation as that used for T-100.

A column diameter of 4.27 ft allowed for the column to achieve the desired separation. The materials in column T-101 pose no corrosion issues so carbon steel was selected as the material of construction. Carbon steel was selected because of the minimal risk of corrosion and the fact that it is the cheapest material. Just as in T-100, a tray efficiency of 0.8 was used.

The top products consists of a stream of 0.0395 mass% DME, 0.8679 mass% MeOH, and 0.0926 mass% water flowing at roughly 3700 barrels per day. This stream is split between a reflux stream and a recycle stream. The reflux stream is sent back to the tower at a rate of 1850 barrels per day. The reflux ration was calculated to be 1.

The bottoms product consists of a stream of 0.0077 mass% MeOH, and 0.9923 mass% water flowing to the reboiler to at a rate of 3500 barrels per day. The stream is split between the boilup and the waste water product which are flowing at 1780 and 1720 barrels per day respectively. The boilup ratio was calculated and found to be 1.01.

Reactor

The reactor feed stream consists of 0.0053 mole% DME, 0.9586 mole% MeOH, and 0.036 mole% water at a flow rate of 9400 barrels per day. The stream is entering the reactor at a temperature of 250°C and a pressure of 114.6 psia. The stream then undergoes a reaction with the γ-Al_3O_2 catalyst in the reactor and using the following equation the conversion rate of the reaction was determined (7).

$$FA = FA0\ (1 - X) \qquad \textit{equation 11}$$

The rate of conversion was found to be 82.2%. Then using polymath the rate of reaction was found (figure) to be 44.49 kmol/m^3*h. This rate of reaction and the percent conversion were then used to find the volume of catalyst that would be needed for the reactor using equation 2.

After performing the calculations it was found that the volume of catalyst needed was 27.8 m^3. Using the density of the catalyst the mass was found to be 24520 kg. Once the necessary mass of catalyst was found the void fraction of 0.4 and the following equation were used to calculate the volume of the reactor.

$$\textit{Volume of reactor} = (\textit{mass/density}) + ((\textit{mass/density})*\textit{void fraction}) \qquad \textit{equation 12}$$

The calculations showed that the reactor needed to be a volume of 40 m^3.

After passing through the reactor the fluid stream is at a temperature of 367°C and a pressure of 114.6 psia. The composition of the outlet stream is 0.3991 mol% DME, 0.171 mol% MeOH, and 0.4298 mol% water.

Specification Sheets

Table 14: T-100 Specification Sheet

Distillation Column					
Identification:	Item	Distillation Column		Date:	*15 March, 2018*
	Item No.	T-100		By:	CP, QP, CF
	No. required	1			
Function:	To separate DME from water and methanol				
Operation:	Continuous				
Materials:	28	29	18	6	12
Flow (lb/hr)	54920	54920	64130	46750	12720
DME mole%	0.3991	0.3991	0.9993	0.0086	0.9993
Methanol mole%	0.171	0.171	0.0007	0.2819	0.0007
Water mole%	0.4298	0.4298	0	0.7095	0
Design Data:	Number of trays (actual): 13			Reflux ratio: 1	
	Pressure: 171 psi			Tray spacing: 2 ft	
	Functional height: 37 ft			Skirt heigth: 1 inch	
	Material of Construction: Carbon Steel				
	Diameter: 5.08 ft				
	Tray Efficiency: 0.80				
	Feed Stage: stage 4 for normal op				
	Reflux Stage: 1				
Utilities:	N/A				
Controls	Pressure control at top of column, level control at the bottom				

Table 15: T-101 Specification Sheet

Distillation Column					
Identification:	Item	Distillation Column		Date:	*15 March, 2018*
	Item No.	T-101		By:	CP, QP, CF
	No. required	1			
Function:	To separate water from methanol				
Operation:	Continuous				
Materials:	21	6	7	8	
Flow (lb/hr)	21660	46750	43310	25100	
DME mole%	0.0264	0.0086	0.0259	0	
Methanol mole%	0.8177	0.2819	0.8187	0.0043	
Water mole%	0.1558	0.7095	0.1554	0.9957	
Design Data:	Number of trays (actual): 13			Reflux ratio: 1	
	Pressure: 179 psi			Tray spacing: 2 ft	
	Functional height: 37 ft				
	Material of Construction: Carbon Steel				
	Diameter: 4.26 ft				
	Tray Efficiency: 0.80				
	Feed Stage: stage 6				
	Reflux Stage: 1				
Utilities:	N/A				
Controls	Pressure control at top of column, level control at the bottom				

Table 16: GBR-100 Specification Sheet

Reactor					
Identification:	Item	Reactor		Date:	*15 March, 2018*
	Item No.	GBR-100		By:	CP, QP, CF
	No. required	1			
Function:	To boil bottoms product back into T-101				
Operation:	Continuous				
Materials:	3	4			
Flow (gpm)	275	292			
DME mole%	0.0053	0.3991			
Methanol mole%	0.9586	0.171			
Water mole%	0.03602	0.4298			
Design Data:	Reactor Volume: 40 m^3				
	Percent conversion: 82.2%				
	Inlet temperature: 250°C				
	Outlet temperature: 367°C				
	Pressure: 114.6 psia				
Utilities:	53943 lb of catalyst				
Controls	pressure control at the outlet				

Table 17: P-100 Specification Sheet

Pump					
Identification:	Item	Pump		Date:	*15 March, 2018*
	Item No.	P-100		By:	CP, QP, CF
	No. required	2			
Function:	To increase the pressure of the methanol feed stream				
Operation:	Continuous				
Materials:		9	13		
Flow (gpm)	274.9	274.9	274.9		
DME mole%		0.005338	0.005338		
Methanol mole%		0.9586	0.9586		
Water mole%		0.036	0.036		
Design Data:	Pump efficiency: 0.6				
	Pressure increase: 100.1 psi				
	Flow rate: 274.9 gpm				
	Material of Construction: Carbon steel				
	Hydraulic horsepower: 16.0				
	Brake horsepower: 26.7				
Utilities:	19.9 kW				
Controls	None directly associated with this piece of equipment				

Table 18: P-101 Specification Sheet

Pump					
Identification:	Item	Pump		Date:	*15 March, 2018*
	Item No.	P-101		By:	CP, QP, CF
	No. required	2			
Function:	To move the distillation feed to the column T-101				
Operation:	Continuous				
Materials:		6	23		
Flow (gpm)	104.0	104.0	104.0		
DME mole%		0.0086	0.0086		
Methanol mole%		0.2819	0.2819		
Water mole%		0.795	0.795		
Design Data:	Pump efficiency: 0.45				
	Pressure increase: 5.8 psi				
	Flow rate: 104.0 gpm				
	Material of Construction: Carbon steel				
	Hydraulic horsepower: 0.352				
	Brake horsepower: 0.782				
Utilities:	0.583 kW				
Controls	None directly associated with this piece of equipment				

Table 19: P-102 Specification Sheet

Pump					
Identification:	Item	Pump		Date:	*15 March, 2018*
	Item No.	P-102		By:	CP, QP, CF
	No. required	2			
Function:	To move the distillation feed to column T-100				
Operation:	Continuous				
Materials:		11	24		
Flow (gpm)	292.0	292.0	292.0		
DME mole%		0.3991	0.3991		
Methanol mole%		0.171	0.171		
Water mole%		0.4298	0.4298		
Design Data:	Pump efficiency: 0.6				
	Pressure increase: 5.8 psi				
	Flow rate: 292.2 gpm				
	Material of Construction: Carbon steel				
	Hydraulic horsepower: 0.987				
	Brake horsepower: 1.65				
Utilities:	1.23 kW				
Controls	None directly associated with this piece of equipment				

Table 20: P-103 Specification Sheet

Pump					
Identification:	Item	Pump		Date:	*15 March, 2018*
	Item No.	P-103		By:	CP, QP, CF
	No. required	2			
Function:	To move the methanol reflux stream to T-101 and recycle stream P-100				
Operation:	Continuous				
Materials:		14	25		
Flow (gpm)	107.5	107.5	107.5		
DME mole%		0.02589	0.02589		
Methanol mole%		0.8187	1.8187		
Water mole%		0.1554	0.1554		
Design Data:	Pump efficiency: 0.45				
	Pressure increase: 5.8 psi				
	Flow rate: 107.5 gpm				
	Material of Construction: Carbon steel				
	Hydraulic horsepower: 0.363				
	Brake horsepower: 0.808				
Utilities:	0.602 kW				
Controls	None directly associated with this piece of equipment				

Table 21: P-104 Specification Sheet

Pump					
Identification:	Item	Pump		Date:	*15 March, 2018*
	Item No.	P-104		By:	CP, QP, CF
	No. required	2			
Function:	To move DME reflux stream to T-100 and product stream to storage				
Operation:	Continuous				
Materials:		17	26		
Flow (gpm)	377.0	377.0	377.0		
DME mole%		0.9993	0.9993		
Methanol mole%		0.0007	1.0007		
Water mole%		0.000003421	0.000003421		
Design Data:	Pump efficiency: 0.7				
	Pressure increase: 5.8 psi				
	Flow rate: 377.0 gpm				
	Material of Construction: Carbon steel				
	Hydraulic horsepower: 1.27				
	Brake horsepower: 1.82				
Utilities:	1.36 kW				
Controls	None directly associated with this piece of equipment				

Table 22: E-100 Specification Sheet

Heat Exchanger					
Identification:	Item	Heater		Date:	*15 March, 2018*
	Item No.	E-100		By:	CP, QP, CF
	No. required	1			
Function:	To preheat methanol feed to E-101				
Operation:	Continuous				
Materials:	13	2			
Flow (gpm)	275	275			
DME mole%	0.0053	0.0053			
Methanol mole%	0.9586	0.9586			
Water mole%	0.036	0.036			
Design Data:	Area: 1917 ft^2			q: 63225288 Btu/h	
	LMDT: 290.86 R			Inner diameter: 0.0625 ft	
	hi: 352 Btu/ft^2*h*F			Outer diameter: 0.078 ft	
	ho: 352 Btu/ft^2*h*F			Correction factor: 0.9	
	Rfi: 0.000568 ft^2*h*F/Btu				
	Rfo: 0.000568 ft^2*h*F/Btu				
	kw: 31 Btu/ft*h*F				
	Overall heat transfer coefficient: 125.91 Btu/(ft^2*°F*h)				
Utilities:	1427 lb/m high pressure steam				
Controls	utilities stream is controlled by the outlet temperature				

Table 23: E-101 Specification Sheet

Heat Exchanger					
Identification:	Item	Heat Exchanger		Date:	*15 March, 2018*
	Item No.	E-101		By:	CP, QP, CF
	No. required	1			
Function:	To vaporize methanol feed to GBR-100				
Operation:	Continuous				
Materials:	2	3	4	5	
Flow (gpm)	275	275	292	292	
DME mole%	0.0053	0.0053	0.3991	0.3991	
Methanol mole%	0.9586	0.9586	0.171	0.171	
Water mole%	0.036	0.036	0.4298	0.4298	
Design Data:	Area: 2050 ft^2			q: 9585312 Btu/h	
	LMDT: 229.17 R			Inner diameter: 0.0625 ft	
	hi: 53 Btu/ft^2*h*F			Outer diameter: 0.078 ft	
	ho: 53 Btu/ft^2*h*F			Correction factor: 0.9	
	Rfi: 0.000568 ft^2*h*F/Btu				
	Rfo: 0.000568 ft^2*h*F/Btu				
	kw: 31 Btu/ft*h*F				
	Overall heat transfer coefficient: 22.72 Btu/(ft^2*°F*h)				
Utilities:	N/A				
Controls	N/A				

Table 24: E-102 Specification Sheet

Heat Exchanger					
Identification:	Item	Cooler		Date:	*15 March, 2018*
	Item No.	E-102		By:	CP, QP, CF
	No. required	1			
Function:	To condense feed to P-102				
Operation:	Continuous				
Materials:	5	11			
Flow (gpm)	292	292			
DME mole%	0.3991	0.3991			
Methanol mole%	0.171	0.171			
Water mole%	0.4298	0.4298			
Design Data:	Area: 3000 ft^2			q: 63319725 Btu/h	
	LMDT: 186.18 R			Inner diameter: 0.0625 ft	
	hi: 352 Btu/ft^2*h*F			Outer diameter: 0.078 ft	
	ho: 352 Btu/ft^2*h*F			Correction factor: 0.9	
	Rfi: 0.000568 ft^2*h*F/Btu				
	Rfo: 0.000568 ft^2*h*F/Btu				
	kw: 31 Btu/ft*h*F				
	Overall heat transfer coefficient: 125.91 Btu/(ft^2*°F*h)				
Utilities:	3597 gpm cooling water				
Controls	utilities stream is controlled by the outlet temperature				

Table 25: E-104 Specification Sheet

Heat Exchanger					
Identification:	Item	Cooler		Date:	*15 March, 2018*
	Item No.	E-104		By:	CP, QP, CF
	No. required	1			
Function:	To condense feed to P-104				
Operation:	Continuous				
Materials:	12	17			
Flow (gpm)	379	379			
DME mole%	0.9993	0.9993			
Methanol mole%	0.0007	0.0007			
Water mole%	0	0			
Design Data:	Area: 12106 ft^2			q: 22370768 Btu/h	
	LMDT: 16.3 R			Inner diameter: 0.0625 ft	
	hi: 352 Btu/ft^2*h*F			Outer diameter: 0.078 ft	
	ho: 352 Btu/ft^2*h*F			Correction factor: 0.9	
	Rfi: 0.000568 ft^2*h*F/Btu				
	Rfo: 0.000568 ft^2*h*F/Btu				
	kw: 31 Btu/ft*h*F				
	Overall heat transfer coefficient: 125.91 Btu/(ft^2*°F*h)				
Utilities:	7416 gpm cooling water				
Controls	utilities stream is controlled by the outlet temperature				

Table 26: E-103 Specification Sheet

Heat Exchanger					
Identification:	Item	Cooler		Date:	*15 March, 2018*
	Item No.	E-103		By:	CP, QP, CF
	No. required	1			
Function:	To condense feed to P-103				
Operation:	Continuous				
Materials:	7	14			
Flow (gpm)	108	108			
DME mole%	0.0259	0.0259			
Methanol mole%	0.8187	0.8187			
Water mole%	0.1554	0.1554			
Design Data:	Area: 1689 ft^2			q: 23410158 Btu/h	
	LMDT: 122.27 R			Inner diameter: 0.0625 ft	
	hi: 352 Btu/ft^2*h*F			Outer diameter: 0.078 ft	
	ho: 352 Btu/ft^2*h*F			Correction factor: 0.9	
	Rfi: 0.000568 ft^2*h*F/Btu				
	Rfo: 0.000568 ft^2*h*F/Btu				
	kw: 31 Btu/ft*h*F				
	Overall heat transfer coefficient: 125.91 Btu/(ft^2*°F*h)				
Utilities:	1325 gpm cooling water				
Controls	utilities stream is controlled by the outlet temperature				

Table 27: R-100 Specification Sheet

Heat Exchanger					
Identification:	Item	Kettle Reboiler		Date:	*15 March, 2018*
	Item No.	R-100		By:	CP, QP, CF
	No. required	1			
Function:	To boil bottoms product back into T-100				
Operation:	Continuous				
Materials:	6	to reboiler	boilup		
Flow (gpm)	104	222.3	118.3		
DME mole%	0.0086	0.0328	0.0618		
Methanol mole%	0.2819	0.4094	0.5619		
Water mole%	0.7095	0.5578	0.3763		
Design Data:	Area: 1126 ft^2			q: 25656344 Btu/h	
	LMDT: 201.01 R			Inner diameter: 0.0625 ft	
	hi: 352 Btu/ft^2*h*F			Outer diameter: 0.078 ft	
	ho:352 Btu/ft^2*h*F			Correction factor: 0.9	
	Rfi: 0.000568 ft^2*h*F/Btu				
	Rfo: 0.000568 ft^2*h*F/Btu				
	kw: 31 Btu/ft*h*F				
	Overall heat transfer coefficient: 125.91 Btu/(ft^2*°F*h)				
Utilities:	579.1 lb/m high pressure steam				
Controls	N/A				

Table 28: R-101 Specification Sheet

Heat Exchanger					
Identification:	Item	Kettle Reboiler		Date:	*15 March, 2018*
	Item No.	R-101		By:	CP, QP, CF
	No. required	1			
Function:	To boil bottoms product back into T-101				
Operation:	Continuous				
Materials:	8	to reboiler	boilup		
Flow (gpm)	50.3	102.4	52.1		
DME mole%	0	0	0		
Methanol mole%	0.0043	0.0132	0.0219		
Water mole%	0.9957	0.9868	0.9781		
Design Data:	Area: 1382 ft^2			q: 22168522 Btu/h	
	LMDT: 141.47 R			Inner diameter: 0.0625 ft	
	hi: 352 Btu/ft^2*h*F			Outer diameter: 0.078 ft	
	ho: 352 Btu/ft^2*h*F			Correction factor: 0.9	
	Rfi: 0.000568 ft^2*h*F/Btu				
	Rfo: 0.000568 ft^2*h*F/Btu				
	kw: 31 Btu/ft*h*F				
	Overall heat transfer coefficient: 125.91 Btu/(ft^2*°F*h)				
Utilities:	500.3 lb/m high pressure steam				
Controls	N/A				

Equipment Cost Summary

The cost of each piece of equipment was estimated via methods provided by Turton et al (4). The first step in this method for all equipment was the calculation of the "vanilla" purchase cost. This value is determined by two parameters. One is a set of constant values specific to each type of equipment, and the other is a dimension of the specific piece of equipment. For heat exchangers, area is the dimension used. Brake horsepower is used for pumps and volume is used for both distillation columns and reactors. Next, factors such as construction materials and design pressure (calculated by adding 50 psi to the operating pressure) were taken into account, which resulted in the calculation of a more accurate purchase cost.

Column cost estimates

Both columns were costed as vertical vessels. The diameter values were taken from Aspen HYSYS, and the vertical height was calculated by multiplying the number of trays by the tray spacing and adding 11 feet to account for the space above the first stage and below the last stage. The volume was then solved for, which enabled the team to synthesize a vanilla cost for the item. Carbon steel was selected for the material of construction, which meant that no additional cost was added. The design pressures were 171 psi and 179 psi in T-100 and T-101, respectively. The price of the trays was also accounted for in the column price. 24 of the 26 trays were costed as sieve trays, while the last two in T-100 were costed as bubble cap trays. Both were costed with carbon steel as the material of construction. The estimated costs associated with purchasing the equipment needed for this design can be found in Table 30 below.

Heat exchanger cost estimates

All heat exchangers were costed based on the surface area required for heat transfer. Each was designed to be constructed out of carbon steel, and the pressures of the inlet streams were used to calculated design pressure.

Pump cost estimates

All pump cost estimates were calculated based on the brake horsepower (in kilowatts) required by the pump. All pumps were constructed from carbon steel, and the pressure of the outlet

stream was used to calculate the required design pressure. Note that all pumps were spared since they are relatively cheap and must be available in order for the system to function. Thus, the purchased price value for each pump in Table 29 represents the cost of two such pumps.

Reactor cost estimate

As described in the reaction section of Equipment List and Unit Descriptions, the kinetics of the methanol reaction with the zeolite catalyst were utilized to determine the amount of catalyst required for the desired production of DME. This amount of catalyst was then used to estimate the volume of the reactor. Carbon steel was once again chosen as the material of design, and the pressure inside the reactor was used to calculate the design pressure.

Table 29: Purchase, bare module, and total module costs for all required equipment.

Item	Number used	Purchased Cost (C_p)
Pump 100	2	$ 16,000
Pump 101	2	$ 8,000
Pump 102	2	$ 8,000
Pump 103	2	$ 8,000
Pump 104	2	$ 8,000
Pump 105	2	$ 8,000
E-101	1	$ 36,000
Cooler 102	1	$ 46,000
Cooler 103	1	$ 33,000
Cooler 104	1	$ 167,000
Heater 100	1	$ 36,000
Reboiler (T-100)	1	$ 27,000
Reboiler (T-101)	1	$ 30,000
Dist. Tower 1	1	$ 43,000
Dist. Tower 2	1	$ 30,000
Reactor	1	$ 33,000
Trays (sieve)	24	$ 3,000
Trays (bubble cap)	2	$ 1,000
Total		$ 535,000
Escalated Total		$ 764,000

Fixed-Capital Investment Summary

Once the purchased cost of each piece of equipment was ascertained, the costs associated with installing the equipment were calculated. This was done via Equation 9 using B values gathered from Table A.4 created by Turton et al (4). Total module cost was also determined to account for contingencies (15% of bare module cost) and fees (3% of bare module cost), as shown by Equation 10. Values for calculated bare and total module costs can be found in Table 30.

$$C_{BM} = C_p^0 * (B_1 + (B_2 * F_m * F_p)) \quad \textit{Equation 9}$$

$$C_{TM} = C_{BM} + (0.15 * C_{BM}) + (0.03 * C_{BM}) \quad \textit{Equation 10}$$

Table 30: Purchase, bare module, and total module costs for all required equipment (2)

Item	Bare Module Cost (C_{BM})	Total Module Cost (C_{TM})
Pump 100	$ 42,000	$ 49,000
Pump 101	$ 19,000	$ 23,000
Pump 102	$ 20,000	$ 23,000
Pump 103	$ 19,000	$ 23,000
Pump 104	$ 20,000	$ 24,000
Pump 105	$ 20,000	$ 24,000
E-101	$ 117,000	$ 138,000
Cooler 102	$ 150,000	$ 177,000
Cooler 103	$ 106,000	$ 126,000
Cooler 104	$ 537,000	$ 633,000
Heater 100	$ 114,000	$ 135,000
Reboiler (T-100)	$ 87,000	$ 103,000
Reboiler (T-101)	$ 96,000	$ 113,000
Dist. Tower 1	$ 121,000	$ 142,000
Dist. Tower 2	$ 88,000	$ 104,000
Reactor	$ 131,000	$ 155,000
Trays (sieve)	$ 3,000	$ 3,000
Trays (bubble cap)	$ 1,000	$ 1,000
Total	$ 1,688,000	$ 1,992,000
Escalated Total	$ 2,411,000	$ 2,845,000

Controls System

A basic controls strategy was devised to better ensure our purity requirements were met, and that the process was being conducted in a safe manner. The controls system begins with a feed flow sensor that adjusts the inlet flowrate for the turndown flow stream entering T-100. This prevents the trays in T-100 from weeping when the tower is operating at less than full capacity. Following the feed flow rate sensor is a valve which is controlled by the outlet temperature of the stream after it passes through E-100 and E-101. Altering this flow rate after it has been merged with the recycle streams allows for the stream to achieve its desired temperature before entering GBR-100. The flow out of GBR-100 is controlled by the pressure inside the reactor, and as the pressure changes the flow rate of the outlet stream is adjusted to a rate that keeps the reactor operating safely. After the stream leaves the reactor and passes through the heat exchanger it enters the cooler in order to be condensed. An outlet temperature sensor has been placed on the cooler that controls the flow of cooling water through the reactor to ensure that the stream is fully condensed before it enters the pump going to T-100. T-100 has control systems at both of its outlet points. The columns overhead pressure is used to control the overhead flow rate leaving the column, and the level in the reboiler is used to control the bottoms flowrate out of the column. The columns overhead vapor stream then passes through E-104 where a temperature sensor is used to control the flow rate of cooling water making sure that the stream fully condenses. After passing through the pump the stream is then sent to either the final product outlet stream or T-100 reflux stream. The split is determined by a ratio control loop. The column's bottoms flow is pumped to T-101. T-101 is controlled in the same manner as T-100. The waste water outlet flow rate is controlled by monitoring the liquid level in the reboiler, and the columns overhead flowrate is controlled by the overhead pressure. The overhead flowrate then passes through E-103 where a temperature sensor is used to control the flow rate of cooling water to ensure that the stream fully condenses. After passing through the subsequent pump the stream is split between the columns reflux stream and the processes methanol recycle stream. In the same manner as column T-100 the split is determined by a ratio control loop.

The process also has concentration indicators installed at the top and bottom of both towers to ensure that the desired purities are being met.

Environment, Health, and Safety

Safety

A safe, healthy work environment is a basic requirement for any company. One way to ensure this environment is maintained is by following the rules and regulations laid out by the Occupational Health and Safety Administration (8). An essential part of guaranteeing the success of this process is causing all employees to receive the proper training and education they need to work safely.

While employers are responsible for providing a safe work environment, employees must help to maintain and positively contribute to this environment. Avoiding accidents can be accomplished by ensuring that the employees are well trained, and are not taking any egregious risks in their work due to incompetence or ignorance. Workers also need to maintain a healthy awareness of their surroundings, so as to be able to notice anything that may become a safety concern before it can do so. The ability to properly respond to these concerns is also necessary. Employees must be able to quickly and efficiently execute the training they received in order to respond to these issues. They also need to able to easily locate any equipment or carry out any contingency plans. In this section of the report dangers specific to the process of producing dimethyl ether through the dehydration of methanol will be documented. More information about these chemicals can be found on the material safety data sheets provided by the company.

There are two areas that need to be addressed involving the process environment. The first area is that a closed system needs to be maintained for the process. Any leaks could cause delays in production and endanger workers. Throughout the majority of the process the mixture is maintained in a liquid state. If one is exposed to dimethyl ether in its liquid form they can quickly develop frostbite because the DME will quickly vaporize and pull the heat from the body parts in contact with it (9). The second area that needs to be addressed is the ventilation of the system. Dimethyl ether can displace air leading to suffocation, and methanol is corrosive to the respiratory tract (9,10). Both of these are dire situations for employees that can be prevented or mitigated through proper ventilation of the process environment.

Caution is also necessary during the execution of this process to ensure that the pressure and temperature levels throughout the system do not exceed acceptable bounds. The reaction that is occurring in the reactor is an exothermic reaction. If this reaction is not properly monitored

there is a danger that it could become a runaway reaction, and cause catastrophic damage. Therefore, the reactor has a few safety considerations that need to be addressed. A cooling jacket needs to be placed around the reactor to ensure that the reactors temperature does not exceed its safe operating limits. A relief valve also needs to be included in the design of the reactor. This valve will serve as a failsafe should the cooling jacket fail to control the reaction. The relief valve will allow the reactor contents to flow into a safe outlet to prevent pressure build up, or top rapidly drop the temperature in the reactor if necessary. For reasons such as this the control systems need to be properly monitored. Further, any panel alarms need to be responded to in a timely fashion. Both methanol and dimethyl ether are classified as highly flammable and explosive materials by the National Institute for Occupational Safety and Health (8,9). In order to prevent them from causing fires in the plants ignition sources need to be kept away from the process area. However, should they be ignited then steps need to be taken to ensure workers safety and minimize damage to the plant. The plant should be evacuated. Firefighting personnel should also be alerted to the fact that methanol should not be extinguished using a water jet. Using a dry chemical or carbon dioxide to extinguish the fire is necessary. Neither of these methods will react negatively with any dimethyl ether in the fire. To exercise caution all fires in the plant should be doused under the assumption that there is some methanol in the fires fuel.

Health

As stated in the safety section methanol can be corrosive to the respiratory tract, and poses other health risk upon exposure. Any employee exposed to methanol fumes should get a physical to ensure that no lasting damage was imparted to their lungs.

Environment

Employees need to be aware of any spill or leaks of the materials used in this process. They cannot be allowed to contaminate the environment surrounding the plant. Spills should be handled by approaching them from upwind to avoid contact with any vapors produced. Once in proximity of the spill it should be absorbed using proper materials and then disposed of safely.

This process uses a number of coolers. The cooling water system used by this system needs to be properly cared for through regular maintenance. This regular maintenance can prevent corrosion, fouling, and microbial growth. Corrosion and fouling can be mediated by adding certain

chemicals to the water. Frequent testing can also identify microbial growth in the water before it becomes a major problem. Microbial growth can promote fouling in the cooling water system, and it can also facilitate the spreading of disease within the plant. Legionella can grow in cooling water and if left unchecked can cause an outbreak of Legionnaires' disease amongst the employees (11). Prevent the spread of such diseases is a vital part of the safe operation of a plant.

The Clean Water Act laid out specifications for cooling water intake structures which are regulated by the EPA. To prevent wildlife from being pulled into the system screens had to be placed at the systems inlet. Even though these screens can prevent wildlife from being pulled in it can still be trapped against these screens, causing harm to them and to the process. These problems can be prevented by regularly checking the inlets for obstructions. Doing this can help minimize the effect the plants cooling water inlets have on the environment (12). However, the plants cooling water outlets can also have an adverse effect on the area surrounding the plant. The chemicals and heat that get added to the water as it travels through the plant can place undue stress on the environment if they are released without any treatment. In order to prevent the cooling water from negatively impacting the environment, as much of it as possible is recycled. The amount that cannot be recycled is treated before it is safely disposed.

Economic Analysis

Estimation of Operating Expenses and Revenue

The primary costs of operating this plant are those of purchasing utilities and raw materials. The only raw materials needed in this process are methanol and lubricant. The cost of purchasing and shipping methanol is given by Methanex, and flow rate data specified in Aspen HYSYS is used to determine the annual cost. The lubricant cost was provided in the project statement, and it has the same shipping cost as that of methanol. Note that all yearly amounts account for a service factor of 0.95. The calculations associated with the purchase and shipping of methanol and lubricant can be found in Table 31.

Table 31: Data and costs of purchasing methanol and lubricant

Methanol	Purchase price	1.49	$/gal
	Shipping price	0.02	$/gal
	Flow rate	7,584	barrel/day
	Yearly amount	110,449,584	gal/year
	Cost	**$166,779,000**	**$/year**
Lubricant	Purchase price	1.65	$/lb
	Shipping price	0.02	$/gal
	Concentration	900	ppm
	DME flow	60,430	lb/hr
	Lubricant flow rate	54.41	lb/hr
	specific gravity	0.898	
	density	56.0	lb/ft^3
	Volume flow rate	7.26	gal/hr
	Yearly amount	452,800	lb/yr
	Yearly amount	60,443	gal/yr
	Cost	**$748,000**	**$/year**

Utility requirements, addressed in the Energy Balance and Utility Requirements section, were also costed to account for operating costs of the plant. Each pump's power requirement was added together, multiplied by the number of hours in a day, the number of days in a year, and the

service factor (0.95) to calculate the number of kilowatt hours needed per year. This value was multiplied by a cost of $0.07/kilowatt hour to determine the total cost of power for the process per year. For this design, 199,637 kilowatt hours were required, which results in an annual expense of $1,618,000. The catalyst was also treated as a utility. Its cost was estimated by multiplying the weight required for the reactor by the price per unit weight, and then dividing by the average lifespan of the catalyst (in this case 10.5 months). Steam mass flow rates in the kettle reboilers and E-100 were converted to mass flow per year, and multiplied by a known cost of $29.97/1000kg (4). Total amounts of required cooling water were calculated, and the units were converted to gallons per year. The average cost of cooling water in the United States was found (13), from which the total price of cooling water could be ascertained. A summary of utility prices can be found in Table 32.

Table 32: Utility costs for each piece of equipment and utility type

Equipment	Catalyst ($/yr)	Steam(kg/yr)	Electric (kW)	Cooling Water (gpm)	
Pump 100	-	-	19.94	-	
Pump 101	-	-	0.58	-	
Pump 102	-	-	1.23	-	
Pump 103	-	-	0.60	-	
Pump 104	-	-	1.36	-	
Pump 105	-	-	0.28	-	
Cooler 102	-	-	-	3,597	
Cooler 103	-	-	-	1,325	
Cooler 104	-	-	-	7,416	
Heater 100	-	324,000,000	-	-	
Reboiler (D1)	-	131,000,000	-	-	
Reboiler (D2)	-	114,000,000	-	-	
Reactor	305,000				
Totals		569,000,000	24.0	12,338	
Totals Yearly		569,000,000	200,000	6,160,000,000	
Cost $/unit		$29.97/1000kg	$0.07/kWh	$0.0002131/gal	Total Cost/Yr
Total Costs	$ 305,000	$ 17,053,000	$ 1,618,000	$ 1,313,000	$ 20,289,000

Revenue values are determined by the price of the DME and the yearly production. Production rates are calculated by Aspen HYSYS, and converted to yearly amounts via unit conversions and multiplication by the service factor. Selling price of the DME was chosen such that it would be less than the price average price of diesel, in order to increase the attractiveness of purchasing DME for consumers with diesel engines. The breakeven cost of DME is $1.88 per

gallon, and the average price of diesel in since 2007 is $3.13 per gallon (14). This team selected an estimated selling price of $2.40 per gallon, so as to produce a significant profit while still appealing to consumer's desire for cheaper commodities.

DCFROR Analysis

Discounted Flow Rate or Return analysis was used to assess the economic attractiveness of this project. Revenues, capital costs, operating costs, taxes, and depreciation were all taken into account for this analysis. For depreciation of equipment employed at the plant, a 15-year MACRS rate was used. This was done because the plant equipment is similar to that used in a natural gas plant, for which 15-year MACRS is utilized (15). Taxes were estimated to be 40% of taxable income. As designated in the business objectives of the problem statement, a hurdle rate of 8% was used, and the plant was given a 20 year plant life. As mentioned earlier, this plant will break even if the DME is sold at $1.88 per gallon. A detailed cash flow table can be found in Appendix I.

Sensitivity Analysis

A sensitivity analysis was performed to determine if the project posed any threat of becoming economically undesirable should costs or revenues fluctuate. For this sensitivity analysis, revenue, capital costs, utility costs, and raw material costs were the parameters varied in order to ascertain the stability of the project. The results can be found in Figure 2 below. Note that the DCFROR dips below the hurdle rate of 8% when the revenue costs decrease or the raw material costs increase sufficiently. This would normally be of concern, yet in this case the economic risk is mitigated by the fact that a conservative selling price for DME was selected. It could very easily be sold for a price of $2.75/gal, which would eliminate the risk of the DCFROR dipping below the hurdle rate.

Figure 2: Tornado chart for process NPV

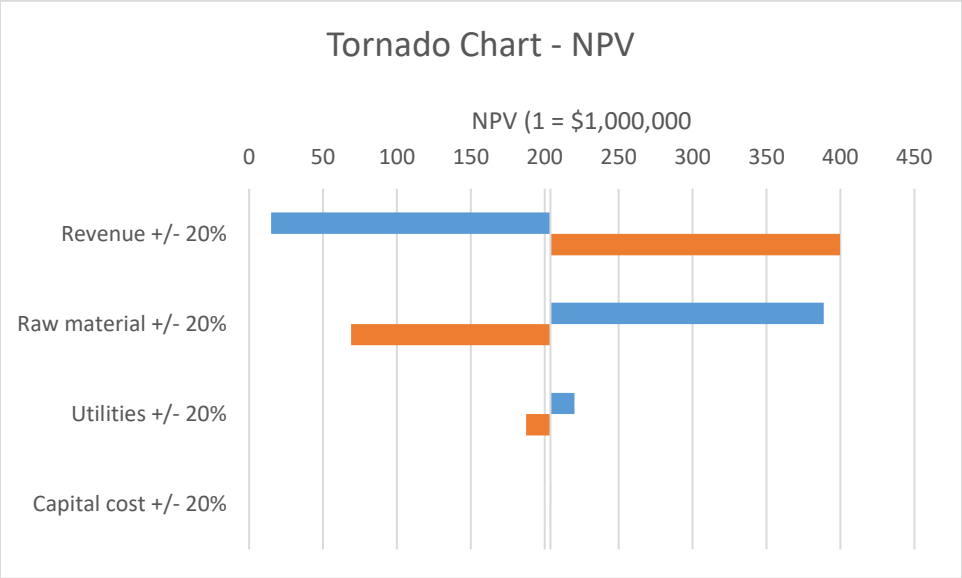
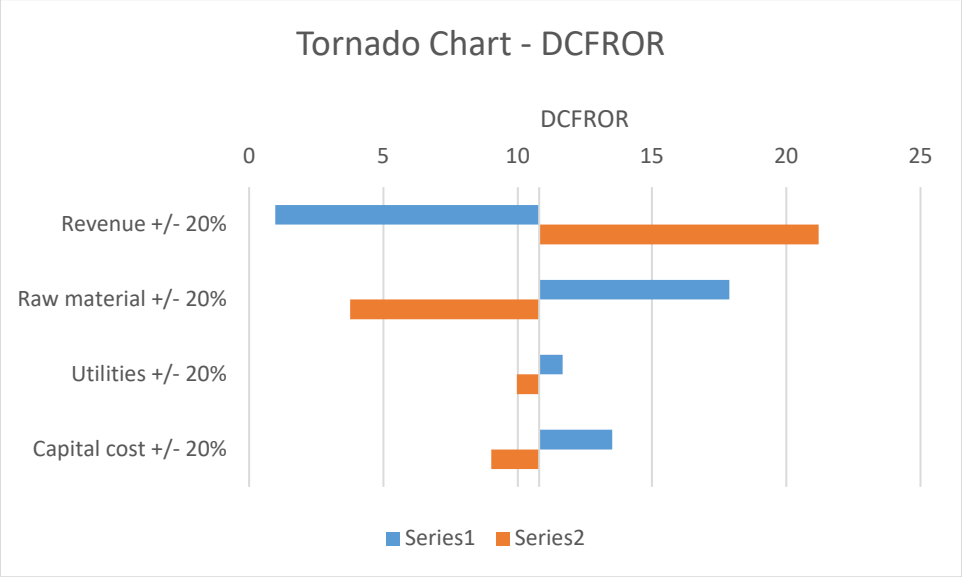


Figure 3: Tornado chart for process DCFROR



Conclusions

This team was able to synthesize a design capable of producing dimethyl ether for use as a fuel alternative for diesel engines.

To accomplish this, the use of seven heat exchangers, six pumps, two distillation columns, and one reactor are required. Of the heat exchangers, two are kettle reboilers that, along with heater E-100, use high pressure steam to impart energy to the process streams. Three others were coolers that condensed process streams with cooling water, and the last utilized the outlet stream of the reactor to heat the reactors feed stream. All heat exchangers other than the kettle reboilers are modeled as shell and tube heat exchangers. It costs a total of $18,300,000 per year to operate all of the heat exchangers due to steam and cooling water requirements, and it will cost 2,000,000 to manufacture and install them. All pumps are spared and designed as single stage centrifugal pumps, requiring in total 24.0 kW of power to operate, costing $1,600,000 per year to operate. In all, the pumps will cost $240,000 to manufacture and install. Most pumps were utilized to move material from one piece of equipment to another, although P-100 is implemented for the sake of increasing the operating pressure of the reaction, distillation, and heating processes. The distillation columns will have a capital cost and installing cost of $350,000, and the 26 trays necessary for their operation will cost $6,800. A packed bed reactor is also required to convert methanol to DME, which will cost $220,000 to manufacture and install, and which will have to be filled with gamma alumina catalyst approximately every 10.5 months, costing around $310,000 each year.

Recommendations

After conducting both a technical and an economic analysis it was determined that the project should be pursued.

While synthesizing this project there were a few areas this team believed should be addressed in order to make this design more accurate or complete. First, tray efficiencies were assumed to be 80% based on heuristics, but could have been tested. This would have allowed for a more conservative column estimate in achieving the desired purity. Modelling the heat exchangers throughout the system with more realistic pressure drops would lead to a more accurate cost estimate for the heat exchangers and pumps since the pumps would consequentially be required to impart a larger pressure change. Larger pumps could have been used in the process to better ensure that the fluids in the process are capable of reaching their intended destinations since energy losses and changes in elevation in the pipes were not accounted for in this design. It is also recommended that expert advice be sought to determine the best selling price of DME to ensure that DME is favored over diesel at the pump. Additionally, a more in depth control system could have been designed, and the control system could have been costed as well.

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Appendix I – Cash Flow Chart (2018-2039)

End of Year	11	12	13	14	15	16	17	18	19	20
Products (gal/year)	$ 99,599,010	$ 99,599,010	$ 99,599,010	$ 99,599,010	$ 99,599,010	$ 99,599,010	$ 99,599,010	$ 99,599,010	$ 99,599,010	$ 99,599,010
x Sales Price ($/gal)	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2
Sales Revenue	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000
+ Salvage value										
- Royalties (basis)										
Net Revenue	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000
- Raw Material Costs	$ (166,779,000)	$ (166,779,000)	$ (166,779,000)	$ (166,779,000)	$ (166,779,000)	$ (166,779,000)	$ (166,779,000)	$ (166,779,000)	$ (166,779,000)	$ (166,779,000)
- Other Op Costs	$ (20,289,000)	$ (20,289,000)	$ (20,289,000)	$ (20,289,000)	$ (20,289,000)	$ (20,289,000)	$ (20,289,000)	$ (20,289,000)	$ (20,289,000)	$ (20,289,000)
- Depreciation	$ (142,485)	$ (142,244)	$ (142,485)	$ (142,244)	$ (142,485)	$ (71,122)				
- Amorization										
- Depletion										
- Loss Forward										
- Writeoff										
Taxable Income	$ 51,827,515	$ 51,827,756	$ 51,827,515	$ 51,827,756	$ 51,827,515	$ 51,898,878	$ 51,970,000	$ 51,970,000	$ 51,970,000	$ 51,970,000
- Tax @ 40%	$ 20,731,006	$ 20,731,102	$ 20,731,006	$ 20,731,102	$ 20,731,006	$ 20,759,551	$ 20,788,000	$ 20,788,000	$ 20,788,000	$ 20,788,000
Net Income	$ 31,096,509	$ 31,096,654	$ 31,096,509	$ 31,096,654	$ 31,096,509	$ 31,139,327	$ 31,182,000	$ 31,182,000	$ 31,182,000	$ 31,182,000
+ Depreciation	$ 142,485	$ 142,244	$ 142,485	$ 142,244	$ 142,485	$ 71,122	$ -	$ -	$ -	$ -
+ Amorization	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
+ Depletion	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
+ Loss Forward	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
+ Writeoff	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
- Working Captial										
- Fixed Capital										
Cash Flow	$ 31,238,994	$ 31,238,898	$ 31,238,994	$ 31,238,898	$ 31,238,994	$ 31,210,449	$ 31,182,000	$ 31,182,000	$ 31,182,000	$ 31,182,000
Discount Factor	0.429	0.397	0.368	0.340	0.315	0.292	0.270	0.2502490	0.2317121	0.2145482
Discounted Cash Flow	$ 13,397,869	$ 12,405,396	$ 11,486,513	$ 10,635,628	$ 9,847,834	$ 9,110,032	$ 8,427,526	$ 7,803,265	$ 7,225,246	$ 6,690,042

End of Year	11	12	13	14	15	16	17	18	19	20
Products (gal/year)	$ 99,599,010	$ 99,599,010	$ 99,599,010	$ 99,599,010	$ 99,599,010	$ 99,599,010	$ 99,599,010	$ 99,599,010	$ 99,599,010	$ 99,599,010
x Sales Price ($/gal)	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2
Sales Revenue	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000
+ Salvage value										
- Royalties (basis)										
Net Revenue	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000	$ 239,038,000
- Raw Material Costs	$ (166,779,000)	$ (166,779,000)	$ (166,779,000)	$ (166,779,000)	$ (166,779,000)	$ (166,779,000)	$ (166,779,000)	$ (166,779,000)	$ (166,779,000)	$ (166,779,000)
- Other Op Costs	$ (20,289,000)	$ (20,289,000)	$ (20,289,000)	$ (20,289,000)	$ (20,289,000)	$ (20,289,000)	$ (20,289,000)	$ (20,289,000)	$ (20,289,000)	$ (20,289,000)
- Depreciation	$ (142,485)	$ (142,244)	$ (142,485)	$ (142,244)	$ (142,485)	$ (71,122)				
- Amorization										
- Depletion										
- Loss Forward										
- Writeoff										
Taxable Income	$ 51,827,515	$ 51,827,756	$ 51,827,515	$ 51,827,756	$ 51,827,515	$ 51,898,878	$ 51,970,000	$ 51,970,000	$ 51,970,000	$ 51,970,000
- Tax @ 40%	$ 20,731,006	$ 20,731,102	$ 20,731,006	$ 20,731,102	$ 20,731,006	$ 20,759,551	$ 20,788,000	$ 20,788,000	$ 20,788,000	$ 20,788,000
Net Income	$ 31,096,509	$ 31,096,654	$ 31,096,509	$ 31,096,654	$ 31,096,509	$ 31,139,327	$ 31,182,000	$ 31,182,000	$ 31,182,000	$ 31,182,000
+ Depreciation	$ 142,485	$ 142,244	$ 142,485	$ 142,244	$ 142,485	$ 71,122	$ -	$ -	$ -	$ -
+ Amorization	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
+ Depletion	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
+ Loss Forward	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
+ Writeoff	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
- Working Captial										
- Fixed Capital										
Cash Flow	$ 31,238,994	$ 31,238,898	$ 31,238,994	$ 31,238,898	$ 31,238,994	$ 31,210,449	$ 31,182,000	$ 31,182,000	$ 31,182,000	$ 31,182,000
Discount Factor	0.429	0.397	0.368	0.340	0.315	0.292	0.270	0.2502490	0.2317121	0.2145482
Discounted Cash Flow	$ 13,397,869	$ 12,405,396	$ 11,486,513	$ 10,635,628	$ 9,847,834	$ 9,110,032	$ 8,427,526	$ 7,803,265	$ 7,225,246	$ 6,690,042

Appendix II – Sizing and Costing Sheets

Macrs depreciation chart:

Macrs			
Cap Cost	15yr	Depreciation	Year
$ 2,411,000	0.05	-$ 120,550	1
	0.095	-$ 229,045	2
	0.0855	-$ 206,141	3
	0.077	-$ 185,647	4
	0.0693	-$ 167,082	5
	0.0623	-$ 150,205	6
	0.059	-$ 142,249	7
	0.059	-$ 142,249	8
	0.0591	-$ 142,490	9
	0.059	-$ 142,249	10
	0.0591	-$ 142,490	11
	0.059	-$ 142,249	12
	0.0591	-$ 142,490	13
	0.059	-$ 142,249	14
	0.0591	-$ 142,490	15
	0.0295	-$ 71,125	16
	Total	$ (2,411,000)	

Sizing pumps:

Pump-100			
Q(bbl/day)	9370		
Q (gpm)	274.925		From fig 13-37, for product
Delt. P (psi)	100.1		Pump efficiency ~
Head (ft)			0.6
Hyd hp	16.0466429		
Brake hp	26.7444048	19.9433026	kW

Pump-101			
Q(bbl/day)	3505		
Q (gpm)	104.0375		From fig 13-37, for product
Delt. P (psi)	5.8		Pump efficiency ~
Head (ft)			0.45
Hyd hp	0.35184694		
Brake hp	0.78188209	0.58304947	kW

Pump-102			
Q(bbl/day)	9953		
Q (gpm)	291.958333		From fig 13-37, for product
Delt. P (psi)	5.8		Pump efficiency ~
Head (ft)			0.6
Hyd hp	0.98738095		
Brake hp	1.64563492	1.22714996	kW

Pump-103			
Q(bbl/day)	3565		
Q (gpm)	107.479167		From fig 13-37, for product
Delt. P (psi)	5.8		Pump efficiency ~
Head (ft)			0.45
Hyd hp	0.36348639		
Brake hp	0.80774754	0.60233734	kW

Pump-104			
Q(bbl/day)	12990		
Q (gpm)	376.71		From fig 13-37, for product
Delt. P (psi)	5.8		Pump efficiency ~
Head (ft)			0.7
Hyd hp	1.27400466		
Brake hp	1.82000666	1.35717897	kW

Pump-105			
Q(bbl/day)	1725		
Q (gpm)	50.025		From fig 13-37, for product
Delt. P (psi)	5.8		Pump efficiency ~
Head (ft)			0.45
Hyd hp	0.16918076		
Brake hp	0.37595724	0.28035131	kW

Costing Pumps:

Costing P-100								
				K1	3.3892	C1	0
				K2	0.0536	C2	0
				K3	0.1538	C3	0
Reported valued NOT Escalated	$Cp^0 = 10^{(K1+(K2*\log(A'o))+(k3*(\log(A'o))^2))}$					Fm	1.55
	5233					Fp	1
	$Cp = Cp^0 * Fm * Fp$					B1	1.89
	8110					B2	1.35
	$Cbm = Cp^0*(B1+(B2*Fm*Fp))$					Pressure	17.9517241
	20838						

Costing P-101								
				K1	3.3892	C1	0
				K2	0.0536	C2	0
				K3	0.1538	C3	0
Reported valued NOT Escalated	$Cp^0 = 10^{(K1+(K2*\log(A'o))+(k3*(\log(A'o))^2))}$					Fm	1.55
	2427					Fp	1
	$Cp = Cp^0 * Fm * Fp$					B1	1.89
	3762					B2	1.35
	$Cbm = Cp^0*(B1+(B2*Fm*Fp))$					Pressure	17.9517241
	9666						

Costing P-102								
				K1	3.3892	C1	0
				K2	0.0536	C2	0
				K3	0.1538	C3	0
Reported valued NOT Escalated	$Cp^0 = 10^{(K1+(K2*\log(A'o))+(k3*(\log(A'o))^2))}$					Fm	1.55
	2484					Fp	1
	$Cp = Cp^0 * Fm * Fp$					B1	1.89
	3850					B2	1.35
	$Cbm = Cp^0*(B1+(B2*Fm*Fp))$					Pressure	17.9517241
	9893						

Costing P-103								
				K1	3.3892	C1	0
				K2	0.0536	C2	0
				K3	0.1538	C3	0
Reported valued NOT Escalated	$Cp^0 = 10^{(K1+(K2*\log(A'o))+(k3*(\log(A'o))^2))}$					Fm	1.55
	2426					Fp	1
	$Cp = Cp^0 * Fm * Fp$					B1	1.89
	3760					B2	1.35
	$Cbm = Cp^0*(B1+(B2*Fm*Fp))$					Pressure	17.9517241
	9661						

Costing P-104								
				K1	3.3892	C1	0
				K2	0.0536	C2	0
				K3	0.1538	C3	0
Reported valued NOT Escalated	$Cp^0 = 10^{(K1+(K2*\log(A'o))+(k3*(\log(A'o))^2))}$					Fm	1.55
	2506					Fp	1
	$Cp = Cp^0 * Fm * Fp$					B1	1.89
	3885					B2	1.35
	$Cbm = Cp^0*(B1+(B2*Fm*Fp))$					Pressure	17.9517241
	9981						

Costing P-105								
				K1	3.3892	C1	0
				K2	0.0536	C2	0
				K3	0.1538	C3	0
Reported valued NOT Escalated	$Cp^0 = 10^{(K1+(K2*\log(A'o))+(k3*(\log(A'o))^2))}$					Fm	1.55
	2550					Fp	1
	$Cp = Cp^0 * Fm * Fp$					B1	1.89
	3952					B2	1.35
	$Cbm = Cp^0*(B1+(B2*Fm*Fp))$					Pressure	17.9517241
	10155						

Sizing Heat Exchangers:

E-101								
	ΔT (hot)	q = (mass flow) * ΔH				Delt H (J/g)	H1 (kJ/kg)	H2 (kJ/kg)
	93.50	2809294	(W)			203	-6039	-6242
		9585313	(Btu/h)					
						°C		K
						367.2	T.hi.	640.35
						273.7	T.ho.	546.85
	Ao = q/(Uo*MTD)					135.7	T.ci.	408.85
						250	T.co.	523.15
	191	(m^2)					T.hi.-T.co.	117.2
	2050	(ft^2)					T.ho.-T.ci.	138
						Stream flow (hot)		
LMTD ={(T.hi. -T.co.)-(T.ho. - T.ci.)} / ln ((T.hi. -T.co.)/(T.ho. - T.ci.))						kg/hr	49820	
127.3						g/s	13838.8889	
MTD = LMTD * F		U = [(do/hi*di)+(Rfi*do/di)+(do*ln(do/di)/2*Kw)+Rfo+(1/ho)]^-1						
	114.6		128.7					
Fouling								
F (T.ho.>T.co.)	0.9			Rfi (m^2*K/W)	0.0001			
				Rfo (m^2*K/W)	0.0001			
				Kw	54			
				hi (W/m^2)	300			
				ho (W/m^2)	300			
				do (m)				
				di (m)				

E-102

	ΔT (hot)	q = (mass flow) * ΔH				Delt H (J/g)	H1 (kJ/kg)	H2 (kJ/kg)
	209.0	18557950	(W)			1341	-6242	-7583
		63319725.4	(Btu/h)					
	mass flow water (mol/s)		Cp water (J/mol*K)		T(K)/1000	°C		K
	12589.1		75.8686773		0.29982	271.8	T.hi.	544.95
	3597.4	(gpm)				62.76	T.ho.	335.91
	Ao = q/(Uo*MTD)					26.67	T.ci.	299.82
						46.1	T.co.	319.25
	278.8	(m^2)					T.hi.-T.co.	225.7
	3000	(ft^2)					T.ho.-T.ci.	36.09
						kg/hr	49820	
LMTD ={(T.hi. -T.co.)-(T.ho. - T.ci.)} / ln ((T.hi. -T.co.)/(T.ho. - T.ci.))						g/s	13839	
103.431674								
MTD = LMTD * F		U = [(do/hi*di)+(Rfi*do/di)+(do*ln(do/di)/2*Kw)+Rfo+(1/ho)]^-1						
93.08850663		714.967581						
Fouling				Rfi (m^2*K/W)		0.0001		
F (T.ho.>T.co.)	0.9			Rfo (m^2*K/W)		0.0001		
				Kw		54		
				hi (W/m^2)		2000		
				ho (W/m^2)		2000		
				do (m)	0.0238			
				di (m)	0.01905			

E-104

	ΔT (hot)	q = (mass flow) * ΔH				Delta H	H1 (kJ/kg)	H2 (kJ/kg)
	1.0	6556497.22	(W)			409	-3981	-4390
		22370768.5	(Btu/h)					
	mass flow water (mol/s)		Cp water (J/mol*K)		T(K)/1000			
	25951.7		75.8686773		0.29982	°C		K
	7415.8	(gpm)				37.94	T.hi.	311.09
	Ao = q/(Uo*MTD)					36.94	T.ho.	310.09
						26.67	T.ci.	299.82
	1125.3	(m^2)				30	T.co.	303.15
	12106	(ft^2)					T.hi.-T.co.	7.94
							T.ho.-T.ci.	10.27
LMTD ={(T.hi. -T.co.)-(T.ho. - T.ci.)} / ln ((T.hi. -T.co.)/(T.ho. - T.ci.))								
9.055							kg/hr	57710
							g/s	16031
MTD = LMTD * F		U = [(do/hi*di)+(Rfi*do/di)+(do*ln(do/di)/2*Kw)+Rfo+(1/ho)]^-1						
8.150		715						
Fouling				Rfi (m^2*K/W)	0.0001			
F (T.ho.>T.co.)	0.9			Rfo (m^2*K/W)	0.0001			
				Kw	54			
				hi (W/m^2)	2000			
				ho (W/m^2)	2000			
				do (m)	0.0238			
				di (m)	0.01905			

E-103

	ΔT (hot)	q = (mass flow) * ΔH				Delt H	H1 (kJ/kg)	H2 (kJ/kg)
	60.0	6861125	(W)			1257	-6678	-7935
		23410158.5	(Btu/h)					
	mass flow water (mol/s)		Cp water (J/mol*K)		T.ci.(K)/1000	°C		K
	4637.6		75.8695522		0.29975	136.3	T.hi.	409.45
	1325.2	(gpm)				76.26	T.ho.	349.41
	Ao = q/(Uo*MTD)			A'o = Ao*F1*F2*F3)		26.6	T.ci.	299.75
				0.0	(m^2)	46.1	T.co.	319.25
	157.0	(m^2)					T.hi.-T.co.	90.2
	1689	(ft^2)					T.ho.-T.ci.	49.66
						kg/hr	19650	
LMTD ={(T.hi. -T.co.)-(T.ho. - T.ci.)} / ln ((T.hi. -T.co.)/(T.ho. - T.ci.))						g/s	5458	
67.92558011								
MTD = LMTD * F		U = [(do/hi*di)+(Rfi*do/di)+(do*ln(do/di)/2*Kw)+Rfo+(1/ho)]^-1						
61.1330221		714.967581						
Fouling				Rfi (m^2*K/W)	0.0001			
F (T.ho.>T.co.)	0.9			Rfo (m^2*K/W)	0.0001			
				kw (W/m*K)	54			
				hi (W/m^2)	2000			
				ho (W/m^2)	2000			
				do (m)	0.0238			
				di (m)	0.01905			

E-100

	ΔT (cold)	q = (mass flow) * ΔH				Delt H	H1	H2
	100.0	18530272	(W)			1339	-7581	-6242
		63225289	(Btu/h)					
	Steam flow	=q/Theoretical work	h(fg) (J/kg)			°C		K
	10.8	(kg/s)	1714100			254	T.hi.	527.15
	323873829.7	kg/year				250	T.ho.	523.15
	Ao = q/(Uo*MTD)					35.66	T.ci.	308.81
						135.7	T.co.	408.85
	178.2	(m^2)					T.hi.-T.co.	118.3
	1917	(ft^2)					T.ho.-T.ci.	214.34
						Kg/h	49820	
LMTD ={(T.hi. -T.co.)-(T.ho. - T.ci.)} / ln ((T.hi. -T.co.)/(T.ho. - T.ci.))						g/s	13839	
	161.5910715							
MTD = LMTD * F	J = [(do/hi*di)+(Rfi*do/di)+(do*ln(do/di)/2*Kw)+Rfo+(1/ho)]^-1							
145.4319644	714.967581							
Fouling				Rfi (m^2*K/W)	0.0001			
F (T.ho.>T.co.)	0.9			Rfo (m^2*K/W)	0.0001			
				Kw	54			
				hi (W/m^2)	2000			
				ho (W/m^2)	2000			
				do (m)	0.0238			
				di (m)	0.01905			

Reboiler for T-100

	ΔT (hot)	q = (mass flow) * ΔH				Duty (kJ/hr)		
	4.0	7519444	(W)			27070000		
		25656344	(Btu/h)					
	Steam flow	=q/hfg	h(fg) (J/kg)			°C		K
	4.4	(kg/s)	1714100			254	T.hi.	527.15
	131425552.8	kg/year				250	T.ho.	523.15
	Ao = q/(Uo*MTD)					135.2	T.ci.	408.35
						145.4	T.co.	418.55
	104.6	(m^2)					T.hi.-T.co.	108.6
	1126	(ft^2)					T.ho.-T.ci.	114.8
LMTD ={(T.hi. -T.co.)-(T.ho. - T.ci.)} / ln ((T.hi. -T.co.)/(T.ho. - T.ci.))								
111.671316								
MTD = LMTD * F		U = [(do/hi*di)+(Rfi*do/di)+(do*ln(do/di)/2*Kw)+Rfo+(1/ho)]^-1						
100.504184		714.967581						
Fouling				Rfi (m^2*K/W)	0.0001			
F (T.ho.>T.co	0.9			Rfo (m^2*K/W)	0.0001			
				Kw	54			
				hi (W/m^2)	2000			
				ho (W/m^2)	2000			
				do (m)	0.0238			
				di (m)	0.01905			

	Reboiler for T-101							
	ΔT (hot)	q = (mass flow) * ΔH				Duty		
	4.0	6497222.22	(W)			23390000		
T(K)/1000		22168522.2	(Btu/h)					
0.44585	Steam flow	=q/Theoretic	h(fg) (J/kg)			℃		K
	3.8	(kg/s)	1714100			254	T.hi.	527.15
	113559057.2	kg/year				250	T.ho.	523.15
	Ao = q/(Uo*MTD)			A'o = Ao*F1*F2*F3)		172.7	T.ci.	445.85
				0.0	(m^2)	174.1	T.co.	447.25
	128.5	(m^2)					T.hi.-T.co.	79.9
	1382	(ft^2)					T.ho.-T.ci.	77.3
LMTD ={(T.hi. -T.co.)-(T.ho. - T.ci.)} / ln ((T.hi. -T.co.)/(T.ho. - T.ci.))								
78.5928324								
MTD = LMTD * F		U = [(do/hi*di)+(Rfi*do/di)+(do*ln(do/di)/2*Kw)+Rfo+(1/ho)]^-1						
70.7335491		714.967581						
Fouling				Rfi (m^2*K/W)	0.0001			
F (T.ho.>T.co	0.9			Rfo (m^2*K/W)	0.0001			
				Kw	54			
				hi (W/m^2)	2000			
				ho (W/m^2)	2000			
				do (m)	0.0238			
				di (m)	0.01905			

Costing Heat Exchangers

Costing E-101								
				K1	4.8306	C1	0.03881
				K2	-0.8509	C2	-0.11272
				K3	0.3187	C3	0.08183
Reported valued NOT Escalated	Cp^0 = 10^(K1+(K2*log(A'o))+(k3*(log(A'o))^2))					Fm	1
	35259					Fp	1.02017
	Cp = Cp^0 *Fm*Fp					B1	1.63
	35970					B2	1.66
	Cbm = Cp^0*(B1+(B2*Fm*Fp))					Pressure shell	10.337931
	117183						

Costing E-102								
				K1	4.8306	C1	0.03881
				K2	-0.8509	C2	-0.11272
				K3	0.3187	C3	0.08183
Reported valued NOT Escalated	Cp^0 = 10^(K1+(K2*log(A'o))+(k3*(log(A'o))^2))					Fm	1
	45247.2					Fp	1.02
	Cp = Cp^0 *Fm*Fp					B1	1.63
	46160					B2	1.66
	Cbm = Cp^0*(B1+(B2*Fm*Fp))					Pressure shell (psi)	10.337931
	150378						

Costing E-104								
				K1	4.8306	C1		0.03881
				K2	-0.8509	C2		-0.11272
				K3	0.3187	C3		0.08183
Reported valued NOT Escalated	Cp^0 = 10^(K1+(K2*log(A'o))+(k3*(log(A'o))^2))					Fm		1
	159011.6					Fp		1.05142
	Cp = Cp^0 *Fm*Fp					B1		1.63
	167188					B2		1.66
	Cbm = Cp^0*(B1+(B2*Fm*Fp))							
	536721							

Costing E-103				K1	4.8306	C1	0.03881
				K2	-0.8509	C2	-0.11272
				K3	0.3187	C3	0.08183
Reported valued NOT Escalated	$Cp^0 = 10^{(K1+(K2*\log(A'o))+(k3*(\log(A'o))^2))}$					Fm	1
	31538.1					Fp	1.05142
	$Cp = Cp^0 * Fm * Fp$					B1	1.63
	33160					B2	1.66
	$Cbm = Cp^0*(B1+(B2*Fm*Fp))$					Pressure shell	11.137931
	106452						

Costing E-100				K1	4.8306	C1	0.03881
				K2	-0.8509	C2	-0.11272
				K3	0.3187	C3	0.08183
Reported valued NOT Escalated	$Cp^0 = 10^{(K1+(K2*\log(A'o))+(k3*(\log(A'o))^2))}$					Fm	1
	33887.5					Fp	1.05142
	$Cp = Cp^0 * Fm * Fp$					B1	1.63
	35630					B2	1.66
	$Cbm = Cp^0*(B1+(B2*Fm*Fp))$					Pressure shell	15.88275862
	114382						

Costing Reboiler for T-100				K1	4.8306	C1	0.03881
				K2	-0.8509	C2	-0.11272
				K3	0.3187	C3	0.08183
Reported valued NOT Escalated	$Cp^0 = 10^{(K1+(K2*\log(A'o))+(k3*(\log(A'o))^2))}$					Fm	1
	25827.4					Fp	1.05142
	$Cp = Cp^0 * Fm * Fp$					B1	1.63
	27155					B2	1.66
	$Cbm = Cp^0*(B1+(B2*Fm*Fp))$					Pressure shel	15.88275862
	87177						

Costing Reboiler for T-101				K1	4.8306	C1	0.03881
				K2	-0.8509	C2	-0.11272
				K3	0.3187	C3	0.08183
Reported valued NOT Escalated	$Cp^0 = 10^{(K1+(K2*\log(A'o))+(k3*(\log(A'o))^2))}$					Fm	1
	28411.9					Fp	1.05142
	$Cp = Cp^0 *Fm*Fp$					B1	1.63
	29873					B2	1.66
	$Cbm = Cp^0*(B1+(B2*Fm*Fp))$					Pressure shel	15.88275862
	95900						

Column Sizing and Costing

				Column Info-->	DME	Lin m	L inft		P psia + S	--> P barg	Tray Spacing (ft)			
						11.3	37		171	10.8	2			
			Chart				From Hysys				.3-520m2			
Distillation Column	Cp =Cpo*Fm*Fp	Cpo	Fm (CS)	Fp formula	Cbm=Cpo*Fbm	P barg safety	Diam-m	K1	K2	K3	Volume	Fbm	B1	B2
	$ 42,536	$ 19,164	1	2.2	$ 120,533	10.8	1.55	3.4974	0.4485	0.1074	21.3	6.3	2.25	1.82
Trays-sieve(.07-12.3)	Cp =Cpo*Fm*Fp	Cpo	Fm (CS)	Fp formula	Cbm=Cpo*Fbm	P barg safety	Area-m^2	K1	K2	K3	Size factor	Fbm		
11	$ 216	$ 216	1	1.0	$ 216	Volume	1.9	2.9949	0.4465	0.3961	0.2	1.0		
Trays-valve(0.7-10.5)														
2	$ 558	$ 558	1	1.0	$ 558		1.9	3.3322	0.4838	0.3434	0.2	1.0		

				Column Info-->	WW	Lin m	L inft		P psia + S	--> P barg	Tray Spacing (ft)			
						11.3	37		179	11.3	2			
			Chart				From Hysus				.3-520m2			
Distillation Column	Cp =Cpo*Fm*Fp	Cpo	Fm (CS)	Fp formula	Cbm=Cpo*Fbm	P barg safety	Diam-m	K1	K2	K3	Volume	Fbm	B1	B2
	$ 29,933	$ 14,889	1	2.0	$ 87,980	11.3	1.30	3.4974	0.4485	0.1074	15.0	5.9	2.25	1.82
Trays-sieve(.07-12.3)	Cp =Cpo*Fm*Fp	Cpo	Fm (CS)	Fp formula	Cbm=Cpo*Fbm	P barg safety	Area-m^2	K1	K2	K3	Size factor	Fbm		
13	$ 123	$ 123	1	1.0	$ 123	Volume	1.3	2.9949	0.4465	0.3961	0.1	1.0		
Trays-valve(0.7-10.5)														
0	$ 315	$ 315	1	1.0	$ 315		1.3	3.3322	0.4838	0.3434	0.1	1.0		

Reactor Sizing and Costing

-ra (kmol/((m^3)*h)	44.5
inlet mol conc.	0.96
outlet mol conc.	0.17
Molar flow (kmol/h)	1576
Fao (kmol/h)	1511
Fa (kmol/h)	269
X (percent conversion)	0.82
V=Fao$\int_0^X \frac{dx}{-ra}$ (m^3)	27.8
Density (kg/m^3)	882
Mass (kg)	24520
Mass (lb)	53943
price ($4.65/lb)	250836
Avg. Price ($4.95/lb)	267018
Price ($5.25/lb)	283201
Avg. Price/Year (9mon life)	356025
Avg. Price/Year (10.5mon life)	305164
Avg. Price/Year (12mon life)	267018
Volume of reactor (m^3)	38.9
Costing size (m^3)	40.0
Pressure+S (psi)	165
Pressure (barg)	10.4

Reactor	Cp =Cpo*Fm*Fp	Cpo	Fm (CS)	Fp formula	Cbm=Cpo*Fbm
	$ 32,742	$32,742	1	1.0	$ 130,969
P barg safety	K1	K2	K3	Volume	Fbm
10.4	3.3496	0.7235	0.0025	40.0	4.0

Appendix III – Misc.

Polymath Report

POLYMATH Report
Explicit Equations

Calculated values of explicit variables

	Variable	Value
1	A	1.21E+06
2	e	2.71828
3	Ea	80.48
4	Kp	5.846006
5	P_MeOH	135.09
6	R	0.008314
7	Rate_MeOH	-44.48976
8	T	640.35

Explicit equations

1 P_MeOH = .171*790
2 A = 1.21*10^6
3 Ea = 80.48
4 R = 8.314*10^-3
5 e = 2.71828
6 T = 273.15 + 367.2
7 Rate_MeOH = -A*(e^(-Ea/(R*T))) * P_MeOH
8 Kp = e ^(-9.76 + (3200/T) + (1.07*ln(T)) - (6.57*(10^-4)*T) + (4.9*(10^-8)*(T^2)) + (6050/(T^2)))

Appendix IV – Aspen HYSYS report

See Following pages for Aspen HYSYS report

****
INPUT SUMMARY
****

FLUID PACKAGE: Basis-1

Property Package Type: Nrtl
Component List - 1: diM-Ether /Methanol /H2O /

Reaction Set: Set-1

Reaction 'Rxn-1':
Reactants: Methanol, Stoich Coeff -2 / diM-Ether, Stoich Coeff 1 / H2O, Stoich Coeff 1 /

Basis Data: Basis = Activity / Phase = VapourPhase /

FLOWSHEET: Main

Fluid Package: Basis-1

STREAM: Meth feed (Material Stream)
Temperature = 25 C
Pressure = 100 kPa
Mass Flow = 40000 kg/h
Composition Basis (In Mass Fractions):diM-Ether = 0/ Methanol = 0.997182655/ H2O = 0.00281734517/

UNIT OPERATION: E-100 (Heater)
Feed Stream = meth feed 2 high P
Product Stream = meth feed 3
Energy Stream = heater 1
Pressure Drop = 0 kPa
Delta Temp = 100 C

UNIT OPERATION: E-101 (Heat Exchanger)
TubeInletStream = meth feed 3
TubeOutletStream = reactor feed
ShellInletStream = reactor out
ShellOutletStream = D1 feed
TEMAType2 = F
TubeOuterDiameter = 20 mm
TubeInnerDiameter = 16 mm
TubeThickness = FEMPTY mm
HCurveName = meth feed 3-reactor feed
HCurveName = reactor out-D1 feed
ShellPressureDrop = 0 kPa
TubePressureDrop = 0 kPa

STREAM: meth feed 3 (Material Stream)

STREAM: heater 1 (Energy Stream)

STREAM: reactor feed (Material Stream)
Temperature = 250 C

STREAM: reactor out (Material Stream)

STREAM: D1 feed (Material Stream)

UNIT OPERATION: T-100 (Reboiled Absorber)
TwoLiquidCheck = 2 Liquid Check
TargetType = 0
Phase = Liquid
ShowEffDiagFlag = True
Specification Name = Boilup RatioSpecConvergedStatus = InactiveSpecification Value = 10Specification Name = Comp FractionSpecConvergedStatus = YesSpecification Value = 0.9995

UNIT OPERATION: T-101 (Reboiled Absorber)
TwoLiquidCheck = 2 Liquid Check
ShowEffDiagFlag = True
Specification Name = Ovhd Prod RateSpecConvergedStatus = YesSpecification Value = 650 kgmole/hSpecification Name = Boilup RatioSpecConvergedStatus = InactiveSpecification Value = 4

STREAM: Meth H2O (Material Stream)

STREAM: reboiler 1 (Energy Stream)

STREAM: Meth Recycle (Material Stream)

STREAM: Waste Water (Material Stream)

STREAM: Reboiler 2 (Energy Stream)

UNIT OPERATION: MIX-100 (Mixer)
Feed Stream = Meth feed
Feed Stream = meth to rctr 2
Product Stream = meth feed 2

STREAM: meth feed 2 (Material Stream)

UNIT OPERATION: GBR-100 (Gibbs Reactor)
Feed Stream = reactor feed
Vapour Product = reactor out
Liquid Product = Purge
Reaction Set=Set-1
ReactorType = Specify Equilibrium Reactions

STREAM: Purge (Material Stream)

STREAM: D1 feed cooled (Material Stream)

UNIT OPERATION: E-102 (Cooler)
Feed Stream = D1 feed
Product Stream = D1 feed cooled
Energy Stream = cooler1
Pressure Drop = 0 kPa
Delta Temp = -200 C

STREAM: cooler1 (Energy Stream)

STREAM: DME outlet (Material Stream)

STREAM: meth feed 2 high P (Material Stream)

UNIT OPERATION: P-100 (Pump)
  Feed Stream = meth feed 2
  Product Stream = meth feed 2 high P
  Energy Stream = Pump1
  DeltaP = 690 kPa
  AdiabaticEfficiency = 75 %

STREAM: Pump1 (Energy Stream)

UNIT OPERATION: RCY-1 (Recycle)
  Inlet Stream = DME reflux 1
  Output Stream = DME reflux

UNIT OPERATION: E-103 (Cooler)
  Feed Stream = Meth Recycle
  Product Stream = Cooled meth recycle
  Energy Stream = Cooler3
  Pressure Drop = 0 kPa
  Delta Temp = -60 C

STREAM: Cooled meth recycle (Material Stream)

STREAM: Cooler3 (Energy Stream)

UNIT OPERATION: TEE-100 (Tee)
  Feed Stream = CMR2
  Product Stream = meth to rctrProduct Stream = meth to tower

STREAM: meth to rctr (Material Stream)

STREAM: meth to tower (Material Stream)

UNIT OPERATION: E-104 (Cooler)
  Feed Stream = DME outlet
  Product Stream = DME out2
  Energy Stream = cooler2
  Pressure Drop = 0 kPa
  Delta Temp = -1 C

STREAM: DME out2 (Material Stream)

STREAM: cooler2 (Energy Stream)

UNIT OPERATION: TEE-101 (Tee)
  Feed Stream = DME out3
  Product Stream = DME productProduct Stream = DME reflux 1

STREAM: DME reflux (Material Stream)
  Temperature = 36.9812967 C
  Pressure = 860 kPa
  Molar Flow = 631.577199 kgmole/h
  Composition Basis (In Mole Fractions):diM-Ether = 0.999279652/ Methanol = 0.000716868145/ H2O = 3.48018063e-006/

STREAM: DME product (Material Stream)

STREAM: DME reflux 1 (Material Stream)

UNIT OPERATION: ADJ-1 (Adjust)
  Target Object = DME out2
  Adjusted Object = E-104
  Target Variable = Vapour Fraction
  AdjustedVarDescription = Delta T
  StepSize = 3.5 C
  Tolerance = 0.001
  TargetVariable = 0

STREAM: METH reflux (Material Stream)
  Temperature = 76.2885619 C
  Pressure = 910 kPa
  Molar Flow = 325.035811 kgmole/h
  Composition Basis (In Mole Fractions):diM-Ether = 0.026406083/ Methanol = 0.81774417/ H2O = 0.155849747/

UNIT OPERATION: ADJ-2 (Adjust)
  Target Object = Cooled meth recycle
  Adjusted Object = E-103
  Target Variable = Vapour Fraction
  AdjustedVarDescription = Delta T
  StepSize = 10 C
  Tolerance = 0.01
  TargetVariable = 0

UNIT OPERATION: RCY-2 (Recycle)
  Inlet Stream = meth to tower
  Output Stream = METH reflux

STREAM: meth to rctr 2 (Material Stream)
  Temperature = 76.282758 C
  Pressure = 910 kPa
  Molar Flow = 325.012129 kgmole/h
  Composition Basis (In Mole Fractions):diM-Ether = 0.0258869747/ Methanol = 0.818695161/ H2O = 0.155417864/

UNIT OPERATION: ADJ-3 (Adjust)
  Target Object = meth feed 2
  Adjusted Object = E-103
  Target Variable = Vapour Fraction
  AdjustedVarDescription = Delta T
  StepSize = 10 C
  Tolerance = 0.001
  TargetVariable = 0

UNIT OPERATION: RCY-3 (Recycle)
  Inlet Stream = meth to rctr
  Output Stream = meth to rctr 2

UNIT OPERATION: ADJ-4 (Adjust)
  Target Object = reactor feed
  Adjusted Object = E-100

Target Variable = Temperature
AdjustedVarDescription = Delta T
StepSize = 10 C
Tolerance = 0.1 C
TargetVariable = 250 C

STREAM: Meth H2O Pumped (Material Stream)

UNIT OPERATION: P-101 (Pump)
Feed Stream = Meth H2O
Product Stream = Meth H2O Pumped
Energy Stream = pumper
DeltaP = 40 kPa
AdiabaticEfficiency = 75 %

STREAM: pumper (Energy Stream)

UNIT OPERATION: P-102 (Pump)
Feed Stream = D1 feed cooled
Product Stream = D1 feed pumped
Energy Stream = pumper2
DeltaP = 40 kPa
AdiabaticEfficiency = 75 %

STREAM: D1 feed pumped (Material Stream)

STREAM: pumper2 (Energy Stream)

UNIT OPERATION: P-103 (Pump)
Feed Stream = Cooled meth recycle
Product Stream = CMR2
Energy Stream = pumper3
DeltaP = 40 kPa
AdiabaticEfficiency = 75 %

STREAM: CMR2 (Material Stream)

STREAM: pumper3 (Energy Stream)

UNIT OPERATION: P-104 (Pump)
Feed Stream = DME out2
Product Stream = DME out3
Energy Stream = pumper4
DeltaP = 40 kPa
AdiabaticEfficiency = 75 %

STREAM: pumper4 (Energy Stream)

STREAM: DME out3 (Material Stream)

UNIT OPERATION: P-105 (Pump)
Feed Stream = Waste Water
Product Stream = WWT
Energy Stream = Pumper5
DeltaP = 40 kPa
AdiabaticEfficiency = 75 %

STREAM: Pumper5 (Energy Stream)

STREAM: WWT (Material Stream)

UNIT OPERATION: TEE-102 (Tee)
Feed Stream = D1 feed pumped
Product Stream = normal opProduct Stream = turn down

STREAM: normal op (Material Stream)

STREAM: turn down (Material Stream)

FLOWSHEET: COL1 (OWNER: T-100)

Fluid Package: Basis-1

UNIT OPERATION: Main Tower (Tower)
StageNumber = 9 (Feed)/ StageNumber = 4 (Feed)/
NumberOfColumnStages = 10
TrayActiveArea = 1.26393875 m2
WHtSpeced = 1
RateHoldup = 0.0883572188
StgNumber = 0
StgNumber = 1
StgNumber = 2
StgNumber = 3
StgNumber = 4
StgNumber = 5
StgNumber = 6
StgNumber = 7
StgNumber = 8
StgNumber = 9
HasTPSAROption = True

UNIT OPERATION: Reboiler (Reboiler)
Feed Stream = To Reboiler @COL1
Vapour Product = Boilup @COL1
Liquid Product = Meth H2O @COL1
Energy Stream = reboiler 1 @COL1
Volume = 2 m3
HeatExchanger = Duty
ViewVapourPhase = False
ViewLightLiqPhase = False
ViewHeavyLiqPhase = False

STREAM: To Reboiler (Material Stream)

STREAM: Boilup (Material Stream)

STREAM: Meth H2O (Material Stream)

STREAM: reboiler 1 (Energy Stream)

STREAM: DME reflux (Material Stream)

STREAM: DME outlet (Material Stream)

STREAM: normal op (Material Stream)

STREAM: turn down (Material Stream)

FLOWSHEET: COL2 (OWNER: T-101)

Fluid Package: Basis-1

UNIT OPERATION: Main Tower (Tower)
StageNumber = 6 (Feed)/ NumberOfColumnStages = 10
WHtSpeced = 1
RateHoldup = 0.0883572188
StgNumber = 0
StgNumber = 1
StgNumber = 2
StgNumber = 3
StgNumber = 4
StgNumber = 5
StgNumber = 6
StgNumber = 7
StgNumber = 8
StgNumber = 9
HasTPSAROption = True

UNIT OPERATION: Reboiler (Reboiler)
Feed Stream = To Reboiler @COL2
Vapour Product = Boilup @COL2
Liquid Product = Waste Water @COL2
Energy Stream = Reboiler 2 @COL2
Volume = 2 m3
HeatExchanger = Duty
ViewVapourPhase = False
ViewLightLiqPhase = False
ViewHeavyLiqPhase = False

STREAM: Meth Recycle (Material Stream)

STREAM: To Reboiler (Material Stream)

STREAM: Boilup (Material Stream)

STREAM: Waste Water (Material Stream)

STREAM: Reboiler 2 (Energy Stream)

STREAM: METH reflux (Material Stream)

STREAM: Meth H2O Pumped (Material Stream)

##
OUTPUT SUMMARY
##

OKLAHOMA STATE UNIVERSIT Case Name: version final hopefully internals working.hsc
Bedford, MA
USA Unit Set: SI

Date/Time: Mon Mar 12 20:03:19 2018

Basis-1 (Fluid Package): Component List

Fluid Package: Basis-1

COMPONENT LIST

Component List - 1 [HYSYS Databanks]

COMPONENT	TYPE	MOLECULAR WEIGHT	BOILING PT (C)	IDEAL LIQ DENSITY (kg/m3)	CRITICAL TEMP (C)
diM-Ether	Pure	46.07	-24.85	670.3	126.9
Methanol	Pure	32.04	64.65	795.7	239.4
H2O	Pure	18.02	100.0	998.0	374.1

(Continued..) Component List - 1 [HYSYS Databanks]

COMPONENT	CRITICAL PRES (kPa)	CRITICAL VOL (m3/kgmole)	ACENTRICITY	HEAT OF FORM (kJ/kgmole)
diM-Ether	5320	0.1780	0.2000	-1.842e+005
Methanol	7376	0.1270	0.5570	-2.013e+005
H2O	2.212e+004	5.710e-002	0.3440	-2.418e+005

Case (Simulation Case): Mass and Energy Balance, Utility Balance, Process CO2 Emissions

---

Simulation Case: Case

OVERALL MASS BALANCE

In Stream	Count	Mass Flow (kg/h)	Out Stream	Count	Mass Flow (kg/h)
Meth feed	Yes	4.000e+004	Purge	Yes	0.0000
			DME product	Yes	2.885e+004
			WWT	Yes	1.139e+004

Total In MassFlow (kg/h) 4.000e+004 Total Out MassFlow (kg/h) 4.024e+004
Mass Imbalance (kg/h) 238.1 Rel Mass Imbalance Pct (%) 0.60

OVERALL ENERGY BALANCE

InStream	Count	Energy Flow (kJ/h)	OutStream	Count	Energy Flow (kJ/h)
heater 1	Yes	6.671e+07	Purge	Yes	0.000e-01
reboiler 1	Yes	2.707e+07	cooler1	Yes	6.679e+07
Reboiler 2	Yes	2.339e+07	Cooler3	Yes	2.470e+07
Meth feed	Yes	-2.998e+08	cooler2	Yes	2.364e+07
Pump1	Yes	5.895e+04	DME product	Yes	-1.267e+08
pumper	Yes	1.438e+03	WWT	Yes	-1.721e+08
pumper2	Yes	3.908e+03			
pumper3	Yes	1.411e+03			
pumper4	Yes	5.257e+03			
Pumper5	Yes	6.914e+02			

Total In EnergyFlow (kJ/h) -1.826e+008 Total Out EnergyFlow (kJ/h) -1.836e+008

Energy Imbalance (kJ/h) -1.050e+006 Rel Energy Imbalance Pct (%) 0.57
OVERALL UTILITY BALANCE

Utility Name Usage Info Energy Flow Mass Flow Cost

Hot Utility Summary Cold Utility Summary

Utility Flow --- Utility Flow ---
Utility Cost --- Utility Cost ---
Carbon Emiss. --- Carbon Emiss. ---
Carbon Fees --- Carbon Fees ---
PROCESS CO2 EMISSIONS

Inlet Stream Count IFPP (1995) IFPP (2007) EPA (2009)
(kg/h) (kg/h) (kg/h)
Meth feed Yes 0.000e-01 0.000e-01 0.000e-01
Total from Inlets --- --- ---
Total Carbon Fees from Inlets (Cost/hr) --- --- ---
Outlet Stream Count IFPP (1995) IFPP (2007) EPA (2009)
(kg/h) (kg/h) (kg/h)
Purge Yes 0.000e-01 0.000e-01 0.000e-01
DME product Yes 0.000e-01 2.884e+04 0.000e-01
WWT Yes 0.000e-01 1.156e-02 0.000e-01
Total from Outlets --- 2.884e+04 ---
Total Carbon Fees from Outlets (Cost/hr) --- 0.000e-01 ---

Meth feed (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments
---
Material Stream: Meth feed Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

OVERALL LIQUID PH.
Vapour / Phase Fraction 0.0000 1.0000
Temperature: (C) 25.00 25.00
Pressure: (kPa) 100.0 100.0
Molar Flow (kgmole/h) 1251 1251
Mass Flow (kg/h) 4.000e+004 4.000e+004
Std Ideal Liq VolFlow (m3/h) 50.24 50.24
Molar Enthalpy (kJ/kgmole) -2.397e+05 -2.397e+05
Molar Entropy (kJ/kgmole-C) 4.664e+01 4.664e+01
Heat Flow (kJ/h) -2.998e+08 -2.998e+08
Liq VolFlow @Std Cond (m3/h) 50.20 50.20
COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
Methanol 1245 0.9950 3.989e+004 0.9972 50.13 0.9978
H2O 6.256 0.0050 112.7 0.0028 0.1129 0.0022
Total 1251 1.0000 4.000e+004 1.0000 50.24 1.0000
Liquid Phase Phase Fraction 1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
Methanol 1245 0.9950 3.989e+004 0.9972 50.13 0.9978
H2O 6.256 0.0050 112.7 0.0028 0.1129 0.0022
Total 1251 1.0000 4.000e+004 1.0000 50.24 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether --- --- ---
Methanol 0.0000 0.0000 ---
H2O 0.0000 0.0000 ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Mixer: MIX-100
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

---
meth feed 3 (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments
---
Material Stream: meth feed 3 Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

OVERALL VAPOUR PH.
Vapour / Phase Fraction 1.0000 1.0000
Temperature: (C) 135.7 135.7
Pressure: (kPa) 790.0 790.0
Molar Flow (kgmole/h) 1576 1576
Mass Flow (kg/h) 4.982e+004 4.982e+004
Std Ideal Liq VolFlow (m3/h) 62.45 62.45
Molar Enthalpy (kJ/kgmole) -1.973e+05 -1.973e+05
Molar Entropy (kJ/kgmole-C) 1.735e+02 1.735e+02

Heat Flow (kJ/h) -3.110e+08 -3.110e+08
Liq VolFlow @Std Cond (m3/h) 62.39 62.39
COMPOSITION

Overall Phase Vapour Fraction
1.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS
FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 8.414 0.0053 387.6 0.0078 0.5783
0.0093
Methanol 1511 0.9586 4.841e+004 0.9717 60.84
0.9743
H2O 56.77 0.0360 1023 0.0205 1.025
0.0164
Total 1576 1.0000 4.982e+004 1.0000 62.45
1.0000
Vapour Phase Phase Fraction
1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS
FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 8.414 0.0053 387.6 0.0078 0.5783
0.0093
Methanol 1511 0.9586 4.841e+004 0.9717 60.84
0.9743
H2O 56.77 0.0360 1023 0.0205 1.025
0.0164
Total 1576 1.0000 4.982e+004 1.0000 62.45
1.0000
K VALUE

COMPONENTS MIXED LIGHT
HEAVY
diM-Ether --- --- ---
Methanol --- --- ---
H2O --- --- ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL
CONNECTION
Heat Exchanger: E-101 Heater: E-100
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

---
reactor feed (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments
---
Material Stream: reactor feed Fluid Package:
Basis-1

Property Package: NRTL -
Ideal
CONDITIONS

OVERALL VAPOUR PH.
Vapour / Phase Fraction 1.0000 1.0000
Temperature: (C) 250.0 250.0
Pressure: (kPa) 790.0 790.0
Molar Flow (kgmole/h) 1576 1576
Mass Flow (kg/h) 4.982e+004 4.982e+004
Std Ideal Liq VolFlow (m3/h) 62.45 62.45
Molar Enthalpy (kJ/kgmole) -1.909e+05 -1.909e+05
Molar Entropy (kJ/kgmole-C) 1.873e+02 1.873e+02
Heat Flow (kJ/h) -3.009e+08 -3.009e+08
Liq VolFlow @Std Cond (m3/h) 62.39 62.39
COMPOSITION

Overall Phase Vapour Fraction
1.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS
FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 8.414 0.0053 387.6 0.0078 0.5783
0.0093
Methanol 1511 0.9586 4.841e+004 0.9717 60.84
0.9743
H2O 56.77 0.0360 1023 0.0205 1.025
0.0164
Total 1576 1.0000 4.982e+004 1.0000 62.45
1.0000
Vapour Phase Phase Fraction
1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS
FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 8.414 0.0053 387.6 0.0078 0.5783
0.0093
Methanol 1511 0.9586 4.841e+004 0.9717 60.84
0.9743
H2O 56.77 0.0360 1023 0.0205 1.025
0.0164
Total 1576 1.0000 4.982e+004 1.0000 62.45
1.0000
K VALUE

COMPONENTS MIXED LIGHT
HEAVY
diM-Ether --- --- ---
Methanol --- --- ---
H2O --- --- ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL
CONNECTION
Gibbs Reactor: GBR-100 Heat Exchanger: E-101 Adjust:
ADJ-4
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

---
reactor out (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments
---

Material Stream: reactor out Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

	OVERALL	VAPOUR PH.	LIQUID PH.	AQUEOUS PH.
Vapour / Phase Fraction	1.0000	1.0000	0.0000	0.0000
Temperature: (C)	367.2	367.2	367.2	367.2
Pressure: (kPa)	790.0	790.0	790.0	790.0
Molar Flow (kgmole/h)	1576	1576	0.0000	0.0000
Mass Flow (kg/h)	4.982e+004	4.982e+004	0.0000	0.0000
Std Ideal Liq VolFlow (m3/h)	66.32	66.32	0.0000	0.0000
Molar Enthalpy (kJ/kgmole)	-1.909e+05	-1.909e+05	-2.286e+05	-2.286e+05
Molar Entropy (kJ/kgmole-C)	2.008e+02	2.008e+02	1.341e+02	1.341e+02
Heat Flow (kJ/h)	-3.009e+08	-3.009e+08	0.000e-01	0.000e-01
Liq VolFlow @Std Cond (m3/h)	66.51	66.51	0.0000	0.0000

COMPOSITION

Overall Phase Vapour Fraction 1.0000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	629.1	0.3991	2.898e+004	0.5817	43.24	0.6519
Methanol	269.6	0.1710	8637	0.1734	10.85	0.1637
H2O	677.5	0.4298	1.220e+004	0.2450	12.23	0.1844
Total	1576	1.0000	4.982e+004	1.0000	66.32	1.0000

Vapour Phase Phase Fraction 1.000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	629.1	0.3991	2.898e+004	0.5817	43.24	0.6519
Methanol	269.6	0.1710	8637	0.1734	10.85	0.1637
H2O	677.5	0.4298	1.220e+004	0.2450	12.23	0.1844
Total	1576	1.0000	4.982e+004	1.0000	66.32	1.0000

Liquid Phase Phase Fraction 0.0000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	0.0000	0.2147	0.0000	0.3882	0.0000	0.4728
Methanol	0.0000	0.1028	0.0000	0.1292	0.0000	0.1325
H2O	0.0000	0.6825	0.0000	0.4825	0.0000	0.3947
Total	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000

Aqueous Phase Phase Fraction 0.0000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	0.0000	0.2147	0.0000	0.3882	0.0000	0.4728
Methanol	0.0000	0.1028	0.0000	0.1292	0.0000	0.1325
H2O	0.0000	0.6825	0.0000	0.4825	0.0000	0.3947
Total	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000

K VALUE

COMPONENTS	MIXED	LIGHT	HEAVY
diM-Ether	1.859	1.859	1.859
Methanol	1.665	1.665	1.665
H2O	0.6298	0.6298	0.6298

UNIT OPERATIONS

FEED TO	PRODUCT FROM	LOGICAL CONNECTION
Heat Exchanger: E-101	Gibbs Reactor: GBR-100	

UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

D1 feed (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

---

Material Stream: D1 feed Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

	OVERALL	VAPOUR PH.
Vapour / Phase Fraction	1.0000	1.0000
Temperature: (C)	273.7	273.7
Pressure: (kPa)	790.0	790.0
Molar Flow (kgmole/h)	1576	1576
Mass Flow (kg/h)	4.982e+004	4.982e+004
Std Ideal Liq VolFlow (m3/h)	66.32	66.32
Molar Enthalpy (kJ/kgmole)	-1.973e+05	-1.973e+05
Molar Entropy (kJ/kgmole-C)	1.898e+02	1.898e+02
Heat Flow (kJ/h)	-3.110e+08	-3.110e+08
Liq VolFlow @Std Cond (m3/h)	66.51	66.51

COMPOSITION

Overall Phase Vapour Fraction
1.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 629.1 0.3991 2.898e+004 0.5817 43.24 0.6519
Methanol 269.6 0.1710 8637 0.1734 10.85 0.1637
H2O 677.5 0.4298 1.220e+004 0.2450 12.23 0.1844
Total 1576 1.0000 4.982e+004 1.0000 66.32 1.0000
Vapour Phase Phase Fraction
1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 629.1 0.3991 2.898e+004 0.5817 43.24 0.6519
Methanol 269.6 0.1710 8637 0.1734 10.85 0.1637
H2O 677.5 0.4298 1.220e+004 0.2450 12.23 0.1844
Total 1576 1.0000 4.982e+004 1.0000 66.32 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether --- --- ---
Methanol --- --- ---
H2O --- --- ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Cooler: E-102 Heat Exchanger: E-101
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

Meth H2O (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

---

Material Stream: Meth H2O Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

OVERALL AQUEOUS PH.
Vapour / Phase Fraction 0.0000 1.0000
Temperature: (C) 145.4 145.4
Pressure: (kPa) 840.0 840.0
Molar Flow (kgmole/h) 954.8 954.8
Mass Flow (kg/h) 2.121e+004 2.121e+004
Std Ideal Liq VolFlow (m3/h) 23.63 23.63
Molar Enthalpy (kJ/kgmole) -2.605e+05 -2.605e+05
Molar Entropy (kJ/kgmole-C) 6.933e+01 6.933e+01
Heat Flow (kJ/h) -2.487e+08 -2.487e+08
Liq VolFlow @Std Cond (m3/h) 23.31 23.31
COMPOSITION

Overall Phase Vapour Fraction
0.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 8.247 0.0086 379.9 0.0179 0.5668 0.0240
Methanol 269.1 0.2819 8623 0.4066 10.84 0.4585
H2O 677.5 0.7095 1.220e+004 0.5755 12.23 0.5175
Total 954.8 1.0000 2.121e+004 1.0000 23.63 1.0000
Aqueous Phase Phase Fraction
1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 8.247 0.0086 379.9 0.0179 0.5668 0.0240
Methanol 269.1 0.2819 8623 0.4066 10.84 0.4585
H2O 677.5 0.7095 1.220e+004 0.5755 12.23 0.5175
Total 954.8 1.0000 2.121e+004 1.0000 23.63 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether 0.0000 --- 0.0000
Methanol 0.0000 --- 0.0000
H2O 0.0000 --- 0.0000
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Pump: P-101 Reboiled Absorber: T-100
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

Meth Recycle (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

---

Material Stream: Meth Recycle Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

OVERALL VAPOUR PH.
Vapour / Phase Fraction 1.0000 1.0000
Temperature: (C) 136.3 136.3
Pressure: (kPa) 870.0 870.0
Molar Flow (kgmole/h) 650.0 650.0
Mass Flow (kg/h) 1.965e+004 1.965e+004
Std Ideal Liq VolFlow (m3/h) 24.41 24.41
Molar Enthalpy (kJ/kgmole) -2.018e+05 -2.018e+05
Molar Entropy (kJ/kgmole-C) 1.712e+02 1.712e+02
Heat Flow (kJ/h) -1.312e+08 -1.312e+08
Liq VolFlow @Std Cond (m3/h) 24.36 24.36
COMPOSITION

Overall Phase Vapour Fraction 1.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 16.83 0.0259 775.3 0.0395 1.157 0.0474
Methanol 532.2 0.8187 1.705e+004 0.8679 21.43 0.8779
H2O 101.0 0.1554 1820 0.0926 1.823 0.0747
Total 650.0 1.0000 1.965e+004 1.0000 24.41 1.0000
Vapour Phase Phase Fraction 1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 16.83 0.0259 775.3 0.0395 1.157 0.0474
Methanol 532.2 0.8187 1.705e+004 0.8679 21.43 0.8779
H2O 101.0 0.1554 1820 0.0926 1.823 0.0747
Total 650.0 1.0000 1.965e+004 1.0000 24.41 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether --- --- ---
Methanol --- --- ---
H2O --- --- ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Cooler: E-103 Reboiled Absorber: T-101
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

Waste Water (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments
---
Material Stream: Waste Water Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

OVERALL AQUEOUS PH.
Vapour / Phase Fraction 0.0000 1.0000
Temperature: (C) 174.1 174.1
Pressure: (kPa) 890.0 890.0
Molar Flow (kgmole/h) 629.8 629.8
Mass Flow (kg/h) 1.139e+004 1.139e+004
Std Ideal Liq VolFlow (m3/h) 11.43 11.43
Molar Enthalpy (kJ/kgmole) -2.733e+05 -2.733e+05
Molar Entropy (kJ/kgmole-C) 3.825e+01 3.825e+01
Heat Flow (kJ/h) -1.721e+08 -1.721e+08
Liq VolFlow @Std Cond (m3/h) 11.24 11.24
COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 2.510e-004 0.0000 1.156e-002 0.0000 1.725e-005 0.0000
Methanol 2.733 0.0043 87.56 0.0077 0.1100 0.0096
H2O 627.1 0.9957 1.130e+004 0.9923 11.32 0.9904
Total 629.8 1.0000 1.139e+004 1.0000 11.43 1.0000
Aqueous Phase Phase Fraction 1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 2.510e-004 0.0000 1.156e-002 0.0000 1.725e-005 0.0000
Methanol 2.733 0.0043 87.56 0.0077 0.1100 0.0096
H2O 627.1 0.9957 1.130e+004 0.9923 11.32 0.9904
Total 629.8 1.0000 1.139e+004 1.0000 11.43 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether 0.0000 --- 0.0000
Methanol 0.0000 --- 0.0000
H2O 0.0000 --- 0.0000
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Pump: P-105 Reboiled Absorber: T-101 UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

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meth feed 2 (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

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Material Stream: meth feed 2 Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

	OVERALL	LIQUID PH.
Vapour / Phase Fraction	0.0000	1.0000
Temperature: (C)	35.34	35.34
Pressure: (kPa)	100.0	100.0
Molar Flow (kgmole/h)	1576	1576
Mass Flow (kg/h)	4.982e+004	4.982e+004
Std Ideal Liq VolFlow (m3/h)	62.45	62.45
Molar Enthalpy (kJ/kgmole)	-2.397e+05	-2.397e+05
Molar Entropy (kJ/kgmole-C)	5.513e+01	5.513e+01
Heat Flow (kJ/h)	-3.778e+08	-3.778e+08
Liq VolFlow @Std Cond (m3/h)	62.39	62.39

COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	8.414	0.0053	387.6	0.0078	0.5783	0.0093
Methanol	1511	0.9586	4.841e+004	0.9717	60.84	0.9743
H2O	56.77	0.0360	1023	0.0205	1.025	0.0164
Total	1576	1.0000	4.982e+004	1.0000	62.45	1.0000

Liquid Phase Phase Fraction 1.000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	8.414	0.0053	387.6	0.0078	0.5783	0.0093
Methanol	1511	0.9586	4.841e+004	0.9717	60.84	0.9743
H2O	56.77	0.0360	1023	0.0205	1.025	0.0164
Total	1576	1.0000	4.982e+004	1.0000	62.45	1.0000

K VALUE

COMPONENTS	MIXED	LIGHT	HEAVY
diM-Ether	0.0000	0.0000	---
Methanol	0.0000	0.0000	---
H2O	0.0000	0.0000	---

UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Pump: P-100 Mixer: MIX-100 Adjust: ADJ-3 UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

Purge (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

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Material Stream: Purge Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

	OVERALL	VAPOUR PH.	LIQUID PH.	AQUEOUS PH.
Vapour / Phase Fraction	0.0000	0.0000	0.5000	0.5000
Temperature: (C)	367.2	367.2	367.2	367.2
Pressure: (kPa)	790.0	790.0	790.0	790.0
Molar Flow (kgmole/h)	0.0000	0.0000	0.0000	0.0000
Mass Flow (kg/h)	0.0000	0.0000	0.0000	0.0000
Std Ideal Liq VolFlow (m3/h)	0.0000	0.0000	0.0000	0.0000
Molar Enthalpy (kJ/kgmole)	-2.286e+05	-1.909e+05	-2.286e+05	-2.286e+05
Molar Entropy (kJ/kgmole-C)	1.341e+02	2.008e+02	1.341e+02	1.341e+02
Heat Flow (kJ/h)	0.000e-01	0.000e-01	0.000e-01	0.000e-01
Liq VolFlow @Std Cond (m3/h)	0.0000	0.0000	0.0000	0.0000

COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	0.0000	0.2147	0.0000	0.3882	0.0000	0.4728
Methanol	0.0000	0.1028	0.0000	0.1292	0.0000	0.1325
H2O	0.0000	0.6825	0.0000	0.4825	0.0000	0.3947
Total	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000

Vapour Phase Phase Fraction
0.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 0.0000 0.3991 0.0000 0.5817 0.0000 0.6519
Methanol 0.0000 0.1710 0.0000 0.1734 0.0000 0.1637
H2O 0.0000 0.4298 0.0000 0.2450 0.0000 0.1844
Total 0.0000 1.0000 0.0000 1.0000 0.0000 1.0000
Liquid Phase Phase Fraction
0.5000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 0.0000 0.2147 0.0000 0.3882 0.0000 0.4728
Methanol 0.0000 0.1028 0.0000 0.1292 0.0000 0.1325
H2O 0.0000 0.6825 0.0000 0.4825 0.0000 0.3947
Total 0.0000 1.0000 0.0000 1.0000 0.0000 1.0000
Aqueous Phase Phase Fraction
0.5000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 0.0000 0.2147 0.0000 0.3882 0.0000 0.4728
Methanol 0.0000 0.1028 0.0000 0.1292 0.0000 0.1325
H2O 0.0000 0.6825 0.0000 0.4825 0.0000 0.3947
Total 0.0000 1.0000 0.0000 1.0000 0.0000 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether 1.859 1.859 1.859
Methanol 1.665 1.665 1.665
H2O 0.6298 0.6298 0.6298
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Gibbs Reactor: GBR-100
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

D1 feed cooled (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

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Material Stream: D1 feed cooled Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

OVERALL LIQUID PH.
Vapour / Phase Fraction 0.0000 1.0000
Temperature: (C) 73.68 73.68
Pressure: (kPa) 790.0 790.0
Molar Flow (kgmole/h) 1576 1576
Mass Flow (kg/h) 4.982e+004 4.982e+004
Std Ideal Liq VolFlow (m3/h) 66.32 66.32
Molar Enthalpy (kJ/kgmole) -2.397e+05 -2.397e+05
Molar Entropy (kJ/kgmole-C) 1.024e+02 1.024e+02
Heat Flow (kJ/h) -3.778e+08 -3.778e+08
Liq VolFlow @Std Cond (m3/h) 66.51 66.51
COMPOSITION

Overall Phase Vapour Fraction
0.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 629.1 0.3991 2.898e+004 0.5817 43.24 0.6519
Methanol 269.6 0.1710 8637 0.1734 10.85 0.1637
H2O 677.5 0.4298 1.220e+004 0.2450 12.23 0.1844
Total 1576 1.0000 4.982e+004 1.0000 66.32 1.0000
Liquid Phase Phase Fraction
1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 629.1 0.3991 2.898e+004 0.5817 43.24 0.6519
Methanol 269.6 0.1710 8637 0.1734 10.85 0.1637
H2O 677.5 0.4298 1.220e+004 0.2450 12.23 0.1844
Total 1576 1.0000 4.982e+004 1.0000 66.32 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether 0.0000 0.0000 ---
Methanol 0.0000 0.0000 ---
H2O 0.0000 0.0000 ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Pump: P-102 Cooler: E-102
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

DME outlet (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

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Material Stream: DME outlet Fluid Package: Basis-1

Property Package: NRTL - Ideal

CONDITIONS

	OVERALL	VAPOUR PH.
Vapour / Phase Fraction	1.0000	1.0000
Temperature: (C)	37.94	37.94
Pressure: (kPa)	820.0	820.0
Molar Flow (kgmole/h)	1253	1253
Mass Flow (kg/h)	5.771e+004	5.771e+004
Std Ideal Liq VolFlow (m3/h)	86.08	86.08
Molar Enthalpy (kJ/kgmole)	-1.833e+05	-1.833e+05
Molar Entropy (kJ/kgmole-C)	1.797e+02	1.797e+02
Heat Flow (kJ/h)	-2.297e+08	-2.297e+08
Liq VolFlow @Std Cond (m3/h)	93.38	93.38

COMPOSITION

Overall Phase Vapour Fraction 1.0000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	1252	0.9993	5.768e+004	0.9995	86.05	0.9996
Methanol	0.8981	0.0007	28.78	0.0005	3.616e-002	0.0004
H2O	4.286e-003	0.0000	7.722e-002	0.0000	7.737e-005	0.0000
Total	1253	1.0000	5.771e+004	1.0000	86.08	1.0000

Vapour Phase Phase Fraction 1.000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	1252	0.9993	5.768e+004	0.9995	86.05	0.9996
Methanol	0.8981	0.0007	28.78	0.0005	3.616e-002	0.0004
H2O	4.286e-003	0.0000	7.722e-002	0.0000	7.737e-005	0.0000
Total	1253	1.0000	5.771e+004	1.0000	86.08	1.0000

K VALUE

COMPONENTS	MIXED	LIGHT	HEAVY
diM-Ether	---	---	---
Methanol	---	---	---
H2O	---	---	---

UNIT OPERATIONS

FEED TO	PRODUCT FROM	LOGICAL CONNECTION
Cooler: E-104	Reboiled Absorber: T-100	

UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

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meth feed 2 high P (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

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Material Stream: meth feed 2 high P Fluid Package: Basis-1

Property Package: NRTL - Ideal

CONDITIONS

	OVERALL	LIQUID PH.
Vapour / Phase Fraction	0.0000	1.0000
Temperature: (C)	35.66	35.66
Pressure: (kPa)	790.0	790.0
Molar Flow (kgmole/h)	1576	1576
Mass Flow (kg/h)	4.982e+004	4.982e+004
Std Ideal Liq VolFlow (m3/h)	62.45	62.45
Molar Enthalpy (kJ/kgmole)	-2.397e+05	-2.397e+05
Molar Entropy (kJ/kgmole-C)	7.194e+01	7.194e+01
Heat Flow (kJ/h)	-3.777e+08	-3.777e+08
Liq VolFlow @Std Cond (m3/h)	62.39	62.39

COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	8.414	0.0053	387.6	0.0078	0.5783	0.0093
Methanol	1511	0.9586	4.841e+004	0.9717	60.84	0.9743
H2O	56.77	0.0360	1023	0.0205	1.025	0.0164
Total	1576	1.0000	4.982e+004	1.0000	62.45	1.0000

Liquid Phase Phase Fraction 1.000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	8.414	0.0053	387.6	0.0078	0.5783	0.0093
Methanol	1511	0.9586	4.841e+004	0.9717	60.84	0.9743
H2O	56.77	0.0360	1023	0.0205	1.025	0.0164

Total 1576 1.0000 4.982e+004 1.0000 62.45 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether 0.0000 0.0000 ---
Methanol 0.0000 0.0000 ---
H2O 0.0000 0.0000 ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Heater: E-100 Pump: P-100
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

Cooled meth recycle (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

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Material Stream: Cooled meth recycle Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

OVERALL LIQUID PH.
Vapour / Phase Fraction 0.0000 1.0000
Temperature: (C) 76.26 76.26
Pressure: (kPa) 870.0 870.0
Molar Flow (kgmole/h) 650.0 650.0
Mass Flow (kg/h) 1.965e+004 1.965e+004
Std Ideal Liq VolFlow (m3/h) 24.41 24.41
Molar Enthalpy (kJ/kgmole) -2.398e+05 -2.398e+05
Molar Entropy (kJ/kgmole-C) 9.489e+01 9.489e+01
Heat Flow (kJ/h) -1.559e+08 -1.559e+08
Liq VolFlow @Std Cond (m3/h) 24.36 24.36
COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 16.83 0.0259 775.3 0.0395 1.157 0.0474
Methanol 532.2 0.8187 1.705e+004 0.8679 21.43 0.8779
H2O 101.0 0.1554 1820 0.0926 1.823 0.0747
Total 650.0 1.0000 1.965e+004 1.0000 24.41 1.0000
Liquid Phase Phase Fraction 1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 16.83 0.0259 775.3 0.0395 1.157 0.0474
Methanol 532.2 0.8187 1.705e+004 0.8679 21.43 0.8779
H2O 101.0 0.1554 1820 0.0926 1.823 0.0747
Total 650.0 1.0000 1.965e+004 1.0000 24.41 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether 0.0000 0.0000 ---
Methanol 0.0000 0.0000 ---
H2O 0.0000 0.0000 ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Pump: P-103 Cooler: E-103 Adjust: ADJ-2
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

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meth to rctr (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

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Material Stream: meth to rctr Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

OVERALL LIQUID PH.
Vapour / Phase Fraction 0.0000 1.0000
Temperature: (C) 76.28 76.28
Pressure: (kPa) 910.0 910.0
Molar Flow (kgmole/h) 325.0 325.0
Mass Flow (kg/h) 9823 9823
Std Ideal Liq VolFlow (m3/h) 12.20 12.20
Molar Enthalpy (kJ/kgmole) -2.398e+05 -2.398e+05
Molar Entropy (kJ/kgmole-C) 9.521e+01 9.521e+01
Heat Flow (kJ/h) -7.794e+07 -7.794e+07
Liq VolFlow @Std Cond (m3/h) 12.18 12.18
COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 8.415 0.0259 387.7 0.0395 0.5783 0.0474
Methanol 266.1 0.8187 8526 0.8679 10.71 0.8779
H2O 50.50 0.1554 909.8 0.0926 0.9116 0.0747

Total 325.0 1.0000 9823 1.0000 12.20 1.0000
Liquid Phase Phase Fraction 1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 8.415 0.0259 387.7 0.0395 0.5783 0.0474
Methanol 266.1 0.8187 8526 0.8679 10.71 0.8779
H2O 50.50 0.1554 909.8 0.0926 0.9116 0.0747
Total 325.0 1.0000 9823 1.0000 12.20 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether 0.0000 0.0000 ---
Methanol 0.0000 0.0000 ---
H2O 0.0000 0.0000 ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Recycle: RCY-3 Tee: TEE-100
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

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meth to tower (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

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Material Stream: meth to tower Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

OVERALL LIQUID PH.
Vapour / Phase Fraction 0.0000 1.0000
Temperature: (C) 76.28 76.28
Pressure: (kPa) 910.0 910.0
Molar Flow (kgmole/h) 325.0 325.0
Mass Flow (kg/h) 9823 9823
Std Ideal Liq VolFlow (m3/h) 12.20 12.20
Molar Enthalpy (kJ/kgmole) -2.398e+05 -2.398e+05
Molar Entropy (kJ/kgmole-C) 9.521e+01 9.521e+01
Heat Flow (kJ/h) -7.794e+07 -7.794e+07
Liq VolFlow @Std Cond (m3/h) 12.18 12.18
COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 8.415 0.0259 387.7 0.0395 0.5783 0.0474
Methanol 266.1 0.8187 8526 0.8679 10.71 0.8779
H2O 50.50 0.1554 909.8 0.0926 0.9116 0.0747
Total 325.0 1.0000 9823 1.0000 12.20 1.0000
Liquid Phase Phase Fraction 1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 8.415 0.0259 387.7 0.0395 0.5783 0.0474
Methanol 266.1 0.8187 8526 0.8679 10.71 0.8779
H2O 50.50 0.1554 909.8 0.0926 0.9116 0.0747
Total 325.0 1.0000 9823 1.0000 12.20 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether 0.0000 0.0000 ---
Methanol 0.0000 0.0000 ---
H2O 0.0000 0.0000 ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Recycle: RCY-2 Tee: TEE-100
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

DME out2 (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

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Material Stream: DME out2 Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

OVERALL LIQUID PH.
Vapour / Phase Fraction 0.0000 1.0000
Temperature: (C) 36.94 36.94
Pressure: (kPa) 820.0 820.0
Molar Flow (kgmole/h) 1253 1253
Mass Flow (kg/h) 5.771e+004 5.771e+004
Std Ideal Liq VolFlow (m3/h) 86.08 86.08
Molar Enthalpy (kJ/kgmole) -2.022e+05 -2.022e+05
Molar Entropy (kJ/kgmole-C) 1.536e+02 1.536e+02
Heat Flow (kJ/h) -2.533e+08 -2.533e+08
Liq VolFlow @Std Cond (m3/h) 93.38 93.38

COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 1252 0.9993 5.768e+004 0.9995 86.05 0.9996
Methanol 0.8981 0.0007 28.78 0.0005 3.616e-002 0.0004
H2O 4.286e-003 0.0000 7.722e-002 0.0000 7.737e-005 0.0000
Total 1253 1.0000 5.771e+004 1.0000 86.08 1.0000
Liquid Phase Phase Fraction 1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 1252 0.9993 5.768e+004 0.9995 86.05 0.9996
Methanol 0.8981 0.0007 28.78 0.0005 3.616e-002 0.0004
H2O 4.286e-003 0.0000 7.722e-002 0.0000 7.737e-005 0.0000
Total 1253 1.0000 5.771e+004 1.0000 86.08 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether 0.0000 0.0000 ---
Methanol 0.0000 0.0000 ---
H2O 0.0000 0.0000 ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Pump: P-104 Cooler: E-104 Adjust: ADJ-1
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

DME reflux (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

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Material Stream: DME reflux Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

OVERALL LIQUID PH.
Vapour / Phase Fraction 0.0000 1.0000
Temperature: (C) 36.98 36.98
Pressure: (kPa) 860.0 860.0
Molar Flow (kgmole/h) 631.6 631.6
Mass Flow (kg/h) 2.909e+004 2.909e+004
Std Ideal Liq VolFlow (m3/h) 43.39 43.39
Molar Enthalpy (kJ/kgmole) -2.022e+05 -2.022e+05
Molar Entropy (kJ/kgmole-C) 1.540e+02 1.540e+02
Heat Flow (kJ/h) -1.277e+08 -1.277e+08
Liq VolFlow @Std Cond (m3/h) 47.07 47.07
COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 631.1 0.9993 2.908e+004 0.9995 43.38 0.9996
Methanol 0.4528 0.0007 14.51 0.0005 1.823e-002 0.0004
H2O 2.198e-003 0.0000 3.960e-002 0.0000 3.968e-005 0.0000
Total 631.6 1.0000 2.909e+004 1.0000 43.39 1.0000
Liquid Phase Phase Fraction 1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 631.1 0.9993 2.908e+004 0.9995 43.38 0.9996
Methanol 0.4528 0.0007 14.51 0.0005 1.823e-002 0.0004
H2O 2.198e-003 0.0000 3.960e-002 0.0000 3.968e-005 0.0000
Total 631.6 1.0000 2.909e+004 1.0000 43.39 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether 0.0000 0.0000 ---
Methanol 0.0000 0.0000 ---
H2O 0.0000 0.0000 ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Reboiled Absorber: T-100 Recycle: RCY-1
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

DME product (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

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Material Stream: DME product Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

	OVERALL	LIQUID PH.
Vapour / Phase Fraction	0.0000	1.0000
Temperature: (C)	36.98	36.98
Pressure: (kPa)	860.0	860.0
Molar Flow (kgmole/h)	626.4	626.4
Mass Flow (kg/h)	2.885e+004	2.885e+004
Std Ideal Liq VolFlow (m3/h)	43.04	43.04
Molar Enthalpy (kJ/kgmole)	-2.022e+05	-2.022e+05
Molar Entropy (kJ/kgmole-C)	1.540e+02	1.540e+02
Heat Flow (kJ/h)	-1.267e+08	-1.267e+08
Liq VolFlow @Std Cond (m3/h)	46.69	46.69

COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	626.0	0.9993	2.884e+004	0.9995	43.02	0.9996
Methanol	0.4490	0.0007	14.39	0.0005	1.808e-002	0.0004
H2O	2.143e-003	0.0000	3.861e-002	0.0000	3.869e-005	0.0000
Total	626.4	1.0000	2.885e+004	1.0000	43.04	1.0000

Liquid Phase Phase Fraction 1.000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	626.0	0.9993	2.884e+004	0.9995	43.02	0.9996
Methanol	0.4490	0.0007	14.39	0.0005	1.808e-002	0.0004
H2O	2.143e-003	0.0000	3.861e-002	0.0000	3.869e-005	0.0000
Total	626.4	1.0000	2.885e+004	1.0000	43.04	1.0000

K VALUE

COMPONENTS	MIXED	LIGHT	HEAVY
diM-Ether	0.0000	0.0000	---
Methanol	0.0000	0.0000	---
H2O	0.0000	0.0000	---

UNIT OPERATIONS

FEED TO	PRODUCT FROM	LOGICAL CONNECTION
Tee: TEE-101		

UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

DME reflux 1 (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

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Material Stream: DME reflux 1 Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

	OVERALL	LIQUID PH.
Vapour / Phase Fraction	0.0000	1.0000
Temperature: (C)	36.98	36.98
Pressure: (kPa)	860.0	860.0
Molar Flow (kgmole/h)	626.4	626.4
Mass Flow (kg/h)	2.885e+004	2.885e+004
Std Ideal Liq VolFlow (m3/h)	43.04	43.04
Molar Enthalpy (kJ/kgmole)	-2.022e+05	-2.022e+05
Molar Entropy (kJ/kgmole-C)	1.540e+02	1.540e+02
Heat Flow (kJ/h)	-1.267e+08	-1.267e+08
Liq VolFlow @Std Cond (m3/h)	46.69	46.69

COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	626.0	0.9993	2.884e+004	0.9995	43.02	0.9996
Methanol	0.4490	0.0007	14.39	0.0005	1.808e-002	0.0004
H2O	2.143e-003	0.0000	3.861e-002	0.0000	3.869e-005	0.0000
Total	626.4	1.0000	2.885e+004	1.0000	43.04	1.0000

Liquid Phase Phase Fraction 1.000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	626.0	0.9993	2.884e+004	0.9995	43.02	0.9996
Methanol	0.4490	0.0007	14.39	0.0005	1.808e-002	0.0004
H2O	2.143e-003	0.0000	3.861e-002	0.0000	3.869e-005	0.0000
Total	626.4	1.0000	2.885e+004	1.0000	43.04	1.0000

K VALUE

COMPONENTS	MIXED	LIGHT	HEAVY
diM-Ether	0.0000	0.0000	---
Methanol	0.0000	0.0000	---
H2O	0.0000	0.0000	---

UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Recycle: RCY-1 Tee: TEE-101
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

METH reflux (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

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Material Stream: METH reflux Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

	OVERALL	LIQUID PH.
Vapour / Phase Fraction	0.0000	1.0000
Temperature: (C)	76.29	76.29
Pressure: (kPa)	910.0	910.0
Molar Flow (kgmole/h)	325.0	325.0
Mass Flow (kg/h)	9825	9825
Std Ideal Liq VolFlow (m3/h)	12.21	12.21
Molar Enthalpy (kJ/kgmole)	-2.398e+05	-2.398e+05
Molar Entropy (kJ/kgmole-C)	9.524e+01	9.524e+01
Heat Flow (kJ/h)	-7.795e+07	-7.795e+07
Liq VolFlow @Std Cond (m3/h)	12.18	12.18

COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	8.583	0.0264	395.4	0.0402	0.5899	0.0483
Methanol	265.8	0.8177	8517	0.8669	10.70	0.8768
H2O	50.66	0.1558	912.6	0.0929	0.9144	0.0749
Total	325.0	1.0000	9825	1.0000	12.21	1.0000

Liquid Phase Phase Fraction 1.000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	8.583	0.0264	395.4	0.0402	0.5899	0.0483
Methanol	265.8	0.8177	8517	0.8669	10.70	0.8768
H2O	50.66	0.1558	912.6	0.0929	0.9144	0.0749
Total	325.0	1.0000	9825	1.0000	12.21	1.0000

K VALUE

COMPONENTS	MIXED	LIGHT	HEAVY
diM-Ether	0.0000	0.0000	---
Methanol	0.0000	0.0000	---
H2O	0.0000	0.0000	---

UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Reboiled Absorber: T-101 Recycle: RCY-2
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

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meth to rctr 2 (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

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Material Stream: meth to rctr 2 Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

	OVERALL	LIQUID PH.
Vapour / Phase Fraction	0.0000	1.0000
Temperature: (C)	76.28	76.28
Pressure: (kPa)	910.0	910.0
Molar Flow (kgmole/h)	325.0	325.0
Mass Flow (kg/h)	9823	9823
Std Ideal Liq VolFlow (m3/h)	12.20	12.20
Molar Enthalpy (kJ/kgmole)	-2.398e+05	-2.398e+05
Molar Entropy (kJ/kgmole-C)	9.521e+01	9.521e+01
Heat Flow (kJ/h)	-7.795e+07	-7.795e+07
Liq VolFlow @Std Cond (m3/h)	12.18	12.18

COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	8.414	0.0259	387.6	0.0395	0.5783	0.0474
Methanol	266.1	0.8187	8526	0.8679	10.71	0.8779
H2O	50.51	0.1554	910.0	0.0926	0.9118	0.0747
Total	325.0	1.0000	9823	1.0000	12.20	1.0000

Liquid Phase Phase Fraction 1.000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	8.414	0.0259	387.6	0.0395	0.5783	0.0474

Methanol 266.1 0.8187 8526 0.8679 10.71 0.8779
H2O 50.51 0.1554 910.0 0.0926 0.9118 0.0747
Total 325.0 1.0000 9823 1.0000 12.20 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether 0.0000 0.0000 ---
Methanol 0.0000 0.0000 ---
H2O 0.0000 0.0000 ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Mixer: MIX-100 Recycle: RCY-3
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

Meth H2O Pumped (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments
---
Material Stream: Meth H2O Pumped Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

OVERALL AQUEOUS PH.
Vapour / Phase Fraction 0.0000 1.0000
Temperature: (C) 145.4 145.4
Pressure: (kPa) 880.0 880.0
Molar Flow (kgmole/h) 954.8 954.8
Mass Flow (kg/h) 2.121e+004 2.121e+004
Std Ideal Liq VolFlow (m3/h) 23.63 23.63
Molar Enthalpy (kJ/kgmole) -2.605e+05 -2.605e+05
Molar Entropy (kJ/kgmole-C) 6.944e+01 6.944e+01
Heat Flow (kJ/h) -2.487e+08 -2.487e+08
Liq VolFlow @Std Cond (m3/h) 23.31 23.31
COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 8.247 0.0086 379.9 0.0179 0.5668 0.0240
Methanol 269.1 0.2819 8623 0.4066 10.84 0.4585
H2O 677.5 0.7095 1.220e+004 0.5755 12.23 0.5175
Total 954.8 1.0000 2.121e+004 1.0000 23.63 1.0000

Aqueous Phase Phase Fraction 1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 8.247 0.0086 379.9 0.0179 0.5668 0.0240
Methanol 269.1 0.2819 8623 0.4066 10.84 0.4585
H2O 677.5 0.7095 1.220e+004 0.5755 12.23 0.5175
Total 954.8 1.0000 2.121e+004 1.0000 23.63 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether 0.0000 --- 0.0000
Methanol 0.0000 --- 0.0000
H2O 0.0000 --- 0.0000
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Reboiled Absorber: T-101 Pump: P-101
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

D1 feed pumped (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments
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Material Stream: D1 feed pumped Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

OVERALL LIQUID PH.
Vapour / Phase Fraction 0.0000 1.0000
Temperature: (C) 73.70 73.70
Pressure: (kPa) 830.0 830.0
Molar Flow (kgmole/h) 1576 1576
Mass Flow (kg/h) 4.982e+004 4.982e+004
Std Ideal Liq VolFlow (m3/h) 66.32 66.32
Molar Enthalpy (kJ/kgmole) -2.397e+05 -2.397e+05
Molar Entropy (kJ/kgmole-C) 1.026e+02 1.026e+02
Heat Flow (kJ/h) -3.778e+08 -3.778e+08
Liq VolFlow @Std Cond (m3/h) 66.51 66.51
COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)

diM-Ether 629.1 0.3991 2.898e+004 0.5817 43.24 0.6519
Methanol 269.6 0.1710 8637 0.1734 10.85 0.1637
H2O 677.5 0.4298 1.220e+004 0.2450 12.23 0.1844
Total 1576 1.0000 4.982e+004 1.0000 66.32 1.0000
Liquid Phase Phase Fraction 1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 629.1 0.3991 2.898e+004 0.5817 43.24 0.6519
Methanol 269.6 0.1710 8637 0.1734 10.85 0.1637
H2O 677.5 0.4298 1.220e+004 0.2450 12.23 0.1844
Total 1576 1.0000 4.982e+004 1.0000 66.32 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether 0.0000 0.0000 ---
Methanol 0.0000 0.0000 ---
H2O 0.0000 0.0000 ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Tee: TEE-102 Pump: P-102
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

CMR2 (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

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Material Stream: CMR2 Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

OVERALL LIQUID PH.
Vapour / Phase Fraction 0.0000 1.0000
Temperature: (C) 76.28 76.28
Pressure: (kPa) 910.0 910.0
Molar Flow (kgmole/h) 650.0 650.0
Mass Flow (kg/h) 1.965e+004 1.965e+004
Std Ideal Liq VolFlow (m3/h) 24.41 24.41
Molar Enthalpy (kJ/kgmole) -2.398e+05 -2.398e+05
Molar Entropy (kJ/kgmole-C) 9.521e+01 9.521e+01
Heat Flow (kJ/h) -1.559e+08 -1.559e+08
Liq VolFlow @Std Cond (m3/h) 24.36 24.36
COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 16.83 0.0259 775.3 0.0395 1.157 0.0474
Methanol 532.2 0.8187 1.705e+004 0.8679 21.43 0.8779
H2O 101.0 0.1554 1820 0.0926 1.823 0.0747
Total 650.0 1.0000 1.965e+004 1.0000 24.41 1.0000
Liquid Phase Phase Fraction 1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 16.83 0.0259 775.3 0.0395 1.157 0.0474
Methanol 532.2 0.8187 1.705e+004 0.8679 21.43 0.8779
H2O 101.0 0.1554 1820 0.0926 1.823 0.0747
Total 650.0 1.0000 1.965e+004 1.0000 24.41 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether 0.0000 0.0000 ---
Methanol 0.0000 0.0000 ---
H2O 0.0000 0.0000 ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Tee: TEE-100 Pump: P-103
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

DME out3 (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

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Material Stream: DME out3 Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

OVERALL LIQUID PH.
Vapour / Phase Fraction 0.0000 1.0000
Temperature: (C) 36.98 36.98
Pressure: (kPa) 860.0 860.0
Molar Flow (kgmole/h) 1253 1253

Mass Flow (kg/h) 5.771e+004 5.771e+004
Std Ideal Liq VolFlow (m3/h) 86.08 86.08
Molar Enthalpy (kJ/kgmole) -2.022e+05 -2.022e+05
Molar Entropy (kJ/kgmole-C) 1.540e+02 1.540e+02
Heat Flow (kJ/h) -2.533e+08 -2.533e+08
Liq VolFlow @Std Cond (m3/h) 93.38 93.38
COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 1252 0.9993 5.768e+004 0.9995 86.05 0.9996
Methanol 0.8981 0.0007 28.78 0.0005 3.616e-002 0.0004
H2O 4.286e-003 0.0000 7.722e-002 0.0000 7.737e-005 0.0000
Total 1253 1.0000 5.771e+004 1.0000 86.08 1.0000
Liquid Phase Phase Fraction 1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 1252 0.9993 5.768e+004 0.9995 86.05 0.9996
Methanol 0.8981 0.0007 28.78 0.0005 3.616e-002 0.0004
H2O 4.286e-003 0.0000 7.722e-002 0.0000 7.737e-005 0.0000
Total 1253 1.0000 5.771e+004 1.0000 86.08 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether 0.0000 0.0000 ---
Methanol 0.0000 0.0000 ---
H2O 0.0000 0.0000 ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Tee: TEE-101 Pump: P-104
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

WWT (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

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Material Stream: WWT Fluid Package: Basis-1

Property Package: NRTL - Ideal

CONDITIONS

OVERALL AQUEOUS PH.
Vapour / Phase Fraction 0.0000 1.0000
Temperature: (C) 174.1 174.1
Pressure: (kPa) 930.0 930.0
Molar Flow (kgmole/h) 629.8 629.8
Mass Flow (kg/h) 1.139e+004 1.139e+004
Std Ideal Liq VolFlow (m3/h) 11.43 11.43
Molar Enthalpy (kJ/kgmole) -2.733e+05 -2.733e+05
Molar Entropy (kJ/kgmole-C) 3.825e+01 3.825e+01
Heat Flow (kJ/h) -1.721e+08 -1.721e+08
Liq VolFlow @Std Cond (m3/h) 11.24 11.24
COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 2.510e-004 0.0000 1.156e-002 0.0000 1.725e-005 0.0000
Methanol 2.733 0.0043 87.56 0.0077 0.1100 0.0096
H2O 627.1 0.9957 1.130e+004 0.9923 11.32 0.9904
Total 629.8 1.0000 1.139e+004 1.0000 11.43 1.0000
Aqueous Phase Phase Fraction 1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 2.510e-004 0.0000 1.156e-002 0.0000 1.725e-005 0.0000
Methanol 2.733 0.0043 87.56 0.0077 0.1100 0.0096
H2O 627.1 0.9957 1.130e+004 0.9923 11.32 0.9904
Total 629.8 1.0000 1.139e+004 1.0000 11.43 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether 0.0000 --- 0.0000
Methanol 0.0000 --- 0.0000
H2O 0.0000 --- 0.0000
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Pump: P-105
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

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normal op (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

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Material Stream: normal op Fluid Package: Basis-1

Property Package: NRTL - Ideal

CONDITIONS

	OVERALL	LIQUID PH.
Vapour / Phase Fraction	0.0000	1.0000
Temperature: (C)	73.70	73.70
Pressure: (kPa)	830.0	830.0
Molar Flow (kgmole/h)	788.1	788.1
Mass Flow (kg/h)	2.491e+004	2.491e+004
Std Ideal Liq VolFlow (m3/h)	33.16	33.16
Molar Enthalpy (kJ/kgmole)	-2.397e+05	-2.397e+05
Molar Entropy (kJ/kgmole-C)	1.026e+02	1.026e+02
Heat Flow (kJ/h)	-1.889e+08	-1.889e+08
Liq VolFlow @Std Cond (m3/h)	33.26	33.26

COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	314.6	0.3991	1.449e+004	0.5817	21.62	0.6519
Methanol	134.8	0.1710	4319	0.1734	5.427	0.1637
H2O	338.7	0.4298	6102	0.2450	6.115	0.1844
Total	788.1	1.0000	2.491e+004	1.0000	33.16	1.0000

Liquid Phase Phase Fraction 1.000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	314.6	0.3991	1.449e+004	0.5817	21.62	0.6519
Methanol	134.8	0.1710	4319	0.1734	5.427	0.1637
H2O	338.7	0.4298	6102	0.2450	6.115	0.1844
Total	788.1	1.0000	2.491e+004	1.0000	33.16	1.0000

K VALUE

COMPONENTS	MIXED	LIGHT	HEAVY
diM-Ether	0.0000	0.0000	---
Methanol	0.0000	0.0000	---
H2O	0.0000	0.0000	---

UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Reboiled Absorber: T-100 Tee: TEE-102
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

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turn down (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

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Material Stream: turn down Fluid Package: Basis-1

Property Package: NRTL - Ideal

CONDITIONS

	OVERALL	LIQUID PH.
Vapour / Phase Fraction	0.0000	1.0000
Temperature: (C)	73.70	73.70
Pressure: (kPa)	830.0	830.0
Molar Flow (kgmole/h)	788.1	788.1
Mass Flow (kg/h)	2.491e+004	2.491e+004
Std Ideal Liq VolFlow (m3/h)	33.16	33.16
Molar Enthalpy (kJ/kgmole)	-2.397e+05	-2.397e+05
Molar Entropy (kJ/kgmole-C)	1.026e+02	1.026e+02
Heat Flow (kJ/h)	-1.889e+08	-1.889e+08
Liq VolFlow @Std Cond (m3/h)	33.26	33.26

COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	314.6	0.3991	1.449e+004	0.5817	21.62	0.6519
Methanol	134.8	0.1710	4319	0.1734	5.427	0.1637
H2O	338.7	0.4298	6102	0.2450	6.115	0.1844
Total	788.1	1.0000	2.491e+004	1.0000	33.16	1.0000

Liquid Phase Phase Fraction 1.000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	314.6	0.3991	1.449e+004	0.5817	21.62	0.6519
Methanol	134.8	0.1710	4319	0.1734	5.427	0.1637
H2O	338.7	0.4298	6102	0.2450	6.115	0.1844
Total	788.1	1.0000	2.491e+004	1.0000	33.16	1.0000

K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether 0.0000 0.0000 ---
Methanol 0.0000 0.0000 ---
H2O 0.0000 0.0000 ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Reboiled Absorber: T-100 Tee: TEE-102
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

E-100 (Heater): Design, Rating, Profiles, Tables

Heater: E-100

CONNECTIONS

Inlet Stream

STREAM NAME FROM UNIT OPERATION
meth feed 2 high P P-100 Pump
Outlet Stream

STREAM NAME TO UNIT OPERATION
meth feed 3 E-101 Heat Exchanger
Energy Stream

STREAM NAME FROM UNIT OPERATION
heater 1
PARAMETERS

Pressure Drop: 0.0000 kPa Duty: 6.671e+007 kJ/h
Volume: 0.1000 m3
Function: Not Selected Zones: 1
User Variables

RATING

NOZZLE PARAMETERS

Base Elevation Relative to Ground Level 0.0000 m

	meth feed 2 high P	meth feed 3
Diameter (m)	5.000e-002	5.000e-002
Elevation (Base) (m)	0.0000	0.0000
Elevation (Ground) (m)	0.0000	0.0000

PERFORMANCE PROFILES

Zone	Pressure (kPa)	Temperature (C)	Vapour Fraction	Enthalpy (kJ/kgmole)
Inlet	790.00	35.66	0.0000	-239657.87
0	790.00	135.66	1.0000	-197332.55

PERFORMANCE TABLE

Overall Phase

Temperature (C)	Pressure (kPa)	Heat Flow (kJ/h)	Enthalpy (kJ/kgmole)
35.66	790.00	0.00	-239657.87
45.66	790.00	1822522.87	-238501.53
55.66	790.00	3663562.60	-237333.44
65.66	790.00	5525463.73	-236152.12
75.66	790.00	7410938.23	-234955.84
85.66	790.00	9323138.06	-233742.61
95.66	790.00	11265774.73	-232510.06
105.66	790.00	13243344.37	-231255.35
115.66	790.00	15261719.39	-229974.75
125.66	790.00	17332646.11	-228660.81
135.66	790.00	66709614.10	-197332.55

Vapour Fraction	Vap Phase Mass Frac	Heat of Vap (kJ/kgmole)
0.0000	0.0000	---
0.0000	0.0000	---
0.0000	0.0000	---
0.0000	0.0000	---
0.0000	0.0000	---
0.0000	0.0000	---
0.0000	0.0000	---
0.0000	0.0000	---
0.0000	0.0000	---
0.0000	0.0000	---
1.0000	1.0000	---

Vapour Phase

Mass Flow (kg/h)	Molecular Wt	Density (kg/m3)	Mass Sp Heat (kJ/kg-C)	Viscosity (cP)	Thermal Cond (W/m-K)
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---
49823.49	31.61	7.35	1.65	0.01	0.02

Std Gas Flow (STD_m3/h)	Z Factor	Pseudo Pc (kPa)	Pseudo Tc (C)	Pseudo Zc	Pseudo Omega
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---
37266.37	1.00	7896.50	243.70	0.25	0.55

Light Liquid Phase

Mass Flow (kg/h)	Density (kg/m3)	Mass Sp Heat (kJ/kg-C)	Viscosity (cP)	Thermal Cond (W/m-K)	Surface Tens (dyne/cm)

49823.49	777.61	3.64	0.47	0.19	29.32
49823.49	766.97	3.68	0.41	0.18	27.74
49823.49	756.10	3.72	0.37	0.18	26.17
49823.49	744.98	3.76	0.33	0.17	24.61
49823.49	733.56	3.81	0.29	0.17	23.06
49823.49	721.82	3.87	0.26	0.16	21.52
49823.49	709.71	3.93	0.23	0.16	20.00
49823.49	697.17	4.01	0.21	0.15	18.50
49823.49	684.12	4.10	0.19	0.15	17.01
49823.49	670.49	4.24	0.17	0.14	15.54

Molecular Wt	Sp Gravity	Pseudo Pc (kPa)	Pseudo Tc (C)	Pseudo Zc	Pseudo Omega
31.61	0.78	7896.50	243.70	0.25	0.55
31.61	0.77	7896.50	243.70	0.25	0.55
31.61	0.76	7896.50	243.70	0.25	0.55
31.61	0.74	7896.50	243.70	0.25	0.55
31.61	0.73	7896.50	243.70	0.25	0.55
31.61	0.72	7896.50	243.70	0.25	0.55
31.61	0.71	7896.50	243.70	0.25	0.55
31.61	0.70	7896.50	243.70	0.25	0.55
31.61	0.68	7896.50	243.70	0.25	0.55
31.61	0.67	7896.50	243.70	0.25	0.55

Heavy Liquid Phase

Mass Flow (kg/h)	Density (kg/m3)	Mass Sp Heat (kJ/kg-C)	Viscosity (cP)	Thermal Cond (W/m-K)	Surface Tens (dyne/cm)

Molecular Wt	Sp Gravity	Pseudo Pc (kPa)	Pseudo Tc (C)	Pseudo Zc	Pseudo Omega

Mixed Liquid Phase

Mass Flow (kg/h)	Density (kg/m3)	Mass Sp Heat (kJ/kg-C)	Viscosity (cP)	Thermal Cond (W/m-K)	Surface Tens (dyne/cm)

49823.49	777.61	3.64	0.47	0.19	29.32
49823.49	766.97	3.68	0.41	0.18	27.74
49823.49	756.10	3.72	0.37	0.18	26.17
49823.49	744.98	3.76	0.33	0.17	24.61
49823.49	733.56	3.81	0.29	0.17	23.06
49823.49	721.82	3.87	0.26	0.16	21.52
49823.49	709.71	3.93	0.23	0.16	20.00
49823.49	697.17	4.01	0.21	0.15	18.50
49823.49	684.12	4.10	0.19	0.15	17.01
49823.49	670.49	4.24	0.17	0.14	15.54

Molecular Wt	Sp Gravity	Pseudo Pc (kPa)	Pseudo Tc (C)	Pseudo Zc	Pseudo Omega
31.61	0.78	7896.50	243.70	0.25	0.55
31.61	0.77	7896.50	243.70	0.25	0.55
31.61	0.76	7896.50	243.70	0.25	0.55
31.61	0.74	7896.50	243.70	0.25	0.55
31.61	0.73	7896.50	243.70	0.25	0.55
31.61	0.72	7896.50	243.70	0.25	0.55
31.61	0.71	7896.50	243.70	0.25	0.55
31.61	0.70	7896.50	243.70	0.25	0.55
31.61	0.68	7896.50	243.70	0.25	0.55
31.61	0.67	7896.50	243.70	0.25	0.55

E-101 (Heat Exchanger): Design, Rating, Details, Tables, HTFS Results, Exchanger Design and Rating

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Heat Exchanger: E-101

CONNECTIONS

Tube Side		Shell Side	
Inlet	Outlet	Inlet	Outlet
Name meth feed 3		Name reactor feed	Name reactor out
Name D1 feed			
From Op. E-100	To Op. GBR-100	From Op. GBR-100	To Op. E-102
Op. Type Heater		Op. Type Gibbs Reactor	Op. Type Gibbs Reactor Op. Type Cooler
Temp 135.66 C		Temp 250.00 C	Temp 367.22 C Temp 273.68 C

PARAMETERS

Heat Exchanger Model: Simple End Point

Tube Side DeltaP: 0.0000 kPa Shell Side DeltaP: 0.0000 kPa Passes: ---
UA: 7.969e+004 kJ/C-h Tolerance: 1.0000e-04

Tube Side Data		Shell Side Data	
Heat Transfer Coeff	---	Heat Transfer Coeff	---
Tube Pressure Drop	0.00 kPa	Shell Pressure Drop	0.00 kPa
Fouling	0.00000 C-h-m2/kJ	Fouling	0.00000 C-h-m2/kJ
Tube Length	6.00 m	Shell Passes	2
Tube O.D.	20.00 mm	Shell Series	1

Tube Thickness 2.0000 mm Shell Parallel 1
Tube Pitch 50.0000 mm Baffle Type Single
Orientation Horizontal Baffle Cut(%Area) 20.00
Passes Per Shell 2 Baffle Orientation Horizontal
Tubes Per Shell 160 Spacing 800.0000 mm
Layout Angle Triangular (30 degrees) Diameter 739.0488 mm
TEMA Type A F L Area 60.32 m2
SPECS

	Spec Value	Curr Value	Rel Error	Active	Estimate
E-101 Heat Balance	0.0000 kJ/h	1.637e-009 kJ/h	1.613e-016	On	Off
E-101 UA	---	7.969e+004 kJ/C-h	---	On	Off

Detailed Specifications

E-101 Heat Balance
Type: Duty Pass: Error Spec Value: 0.0000 kJ/h
E-101 UA
Type: UA Pass: Overall Spec Value: ---
User Variables

RATING

Sizing

Overall Data
Configuration
# of Shells in Series 1 Tube Passes per Shell 2 Elevation (Base) 0.0000 m
# of Shells in Parallel 1 Exchange Orientation Horizontal
First Tube Pass Flow Direction Counter
TEMA Type: A F L
Calculated Information
Shell HT Coeff --- Tube HT Coeff ---
Overall U 1321 kJ/h-m2-C Overall UA 7.969e+004 kJ/C-h
Shell DP 0.0000 kPa Tube DP 0.0000 kPa
Shell Vol per Shell 2.272 m3 Tube Vol per Shell 0.1930 m3
HT Area per Shell 60.32 m2
Shell Data
Shell and Tube Bundle
Shell Diameter 739.0 Tube Pitch 50.00 Shell Fouling 0.0000
(mm) (mm) (C-h-m2/kJ)
# of Tubes per Shell 160 Tube Layout Angle Triangular (30 degrees)
Shell Baffles
Shell Baffle Type Single Shell Baffle Orientation Horizontal
Baffle Cut (%Area) 20.00 Baffle Spacing 800.0 mm
Tube Data
Dimensions
OD 20.00 ID 16.00 Tube Thickness 2.000 Tube Length 6.000
(mm) (mm) (mm) (m)
Tube Properties

Tube Fouling 0.0000 Thermal Cond. 45.00 Wall Cp --- Wall Density ---
(C-h-m2/kJ) (W/m-K) (kJ/kg-C) (kg/m3)
Nozzle Parameters

Base Elevation Relative to Ground Level 0.0000 m

	meth feed 3	reactor out	reactor feed
Diameter (m)	5.000e-002	5.000e-002	5.000e-002
Elevation (Base) (m)	0.0000	0.0000	0.0000
Elevation (Ground) (m)	0.0000	0.0000	0.0000
Elevation (% of Height) (%)	0.00	0.00	0.00

	D1 feed
Diameter (m)	5.000e-002
Elevation (Base) (m)	0.0000
Elevation (Ground) (m)	0.0000
Elevation (% of Height) (%)	0.00

DETAILS

Overall/Detailed Performance

Duty: 1.015e+07 kJ/h UA Curv. Error: 0.00e-01 kJ/C-h
Heat Leak: 0.000e-01 kJ/h Hot Pinch Temp: 367.2 C
Heat Loss: 0.000e-01 kJ/h Cold Pinch Temp: 250.0 C
UA: 7.969e+04 kJ/C-h Ft Factor: ---
Min. Approach: 117.2 C Uncorrected Lmtd: 127.3 C
Lmtd: 127.3 C
TABLES

Shell Side - Overall Phase

Temperature (C)	Pressure (kPa)	Heat Flow (kJ/h)	Enthalpy (kJ/kgmole)	UA (kJ/C-h)	Molar Vap Frac	Mass Vap Frac	Heat of Vap. (kJ/kgmole)
273.68	790.00	0.00	-197332.55	0.00	1.0000	1.0000	---
367.22	790.00	10147733.23	-190894.10	0.00	1.0000	1.0000	---

Shell Side - Vapour Phase

Mass Flow (kg/h)	Molecular Wt	Density (kg/m3)	Mass Sp Heat (kJ/kg-C)	Viscosity (cP)	Thermal Cond (W/m-K)
49823.68	31.61	5.49	2.09	0.02	0.04
49823.68	31.61	4.69	2.27	0.02	0.05

Std Gas Flow (STD_m3/h)	Z Factor	Pseudo Pc (kPa)	Pseudo Tc (C)	Pseudo Zc	Pseudo Omega
37266.37	1.00	12892.78	252.40	0.26	0.32
37266.37	1.00	12892.78	252.40	0.26	0.32

Shell Side - Light Liquid Phase

Mass Flow (kg/h)	Density (kg/m3)	Mass Sp Heat (kJ/kg-C)	Viscosity (cP)	Thermal Cond (W/m-K)	Surface Tens (dyne/cm)
---	---	---	---	---	---
0.00	1415.59	8.62	0.14	0.18	0.56

Molecular Wt Sp Gravity Pseudo Pc Pseudo Tc Pseudo Zc Pseudo Omega
(kPa) (C)
--- --- --- --- --- ---
25.48 1.42 16997.50 307.20 0.26 0.33
Shell Side - Heavy Liquid Phase

Mass Flow Density Mass Sp Heat Viscosity Thermal Cond Surface Tens
(kg/h) (kg/m3) (kJ/kg-C) (cP) (W/m-K) (dyne/cm)
--- --- --- --- --- ---
0.00 1415.59 8.62 0.14 0.18 0.56
Molecular Wt Sp Gravity Pseudo Pc Pseudo Tc Pseudo Zc Pseudo Omega
(kPa) (C)
--- --- --- --- --- ---
25.48 1.42 16997.50 307.20 0.26 0.33
Shell Side - Mixed Liquid

Mass Flow Density Mass Sp Heat Viscosity Thermal Cond Surface Tens
(kg/h) (kg/m3) (kJ/kg-C) (cP) (W/m-K) (dyne/cm)
--- --- --- --- --- ---
0.00 1415.59 8.62 0.14 0.18 ---
Molecular Wt Sp Gravity Pseudo Pc Pseudo Tc Pseudo Zc Pseudo Omega
(kPa) (C)
--- --- --- --- --- ---
25.48 1.42 16997.50 307.20 0.26 0.33
Tube Side - Overall Phase

Temperature Pressure Heat Flow Enthalpy
(C) (kPa) (kJ/h) (kJ/kgmole)
135.66 790.00 0.00 -197332.55
250.00 790.00 10147733.23 -190894.10
UA Molar Vap Frac Mass Vap Frac Heat of Vap.
(kJ/C-h) (kJ/kgmole)
0.00 1.0000 1.0000 ---
0.00 1.0000 1.0000 ---
Tube Side - Vapour Phase

Mass Flow Molecular Wt Density Mass Sp Heat Viscosity Thermal Cond
(kg/h) (kg/m3) (kJ/kg-C) (cP) (W/m-K)
49823.49 31.61 7.35 1.65 0.01 0.02
49823.49 31.61 5.74 1.91 0.01 0.03
Std Gas Flow Z Factor Pseudo Pc Pseudo Tc Pseudo Zc Pseudo Omega
(STD_m3/h) (kPa) (C)
37266.37 1.00 7896.50 243.70 0.25 0.55
37266.37 1.00 7896.50 243.70 0.25 0.55
Tube Side - Light Liquid Phase

Mass Flow Density Mass Sp Heat Viscosity Thermal Cond Surface Tens
(kg/h) (kg/m3) (kJ/kg-C) (cP) (W/m-K) (dyne/cm)
--- --- --- --- --- ---
--- --- --- --- --- ---

Molecular Wt Sp Gravity Pseudo Pc Pseudo Tc Pseudo Zc Pseudo Omega
(kPa) (C)
--- --- --- --- --- ---
--- --- --- --- --- ---
Tube Side - Heavy Liquid Phase

Mass Flow Density Mass Sp Heat Viscosity Thermal Cond Surface Tens
(kg/h) (kg/m3) (kJ/kg-C) (cP) (W/m-K) (dyne/cm)
--- --- --- --- --- ---
--- --- --- --- --- ---
Molecular Wt Sp Gravity Pseudo Pc Pseudo Tc Pseudo Zc Pseudo Omega
(kPa) (C)
--- --- --- --- --- ---
--- --- --- --- --- ---
Tube Side - Mixed Liquid

Mass Flow Density Mass Sp Heat Viscosity Thermal Cond Surface Tens
(kg/h) (kg/m3) (kJ/kg-C) (cP) (W/m-K) (dyne/cm)
--- --- --- --- --- ---
--- --- --- --- --- ---
Molecular Wt Sp Gravity Pseudo Pc Pseudo Tc Pseudo Zc Pseudo Omega
(kPa) (C)
--- --- --- --- --- ---
--- --- --- --- --- ---
HTFS

Exchanger Design and Rating

T-100 (Reboiled Absorber): Design, Parameters, Side Ops, Internals, Rating, Performance, Flowsheet, Tray Tables
---
Reboiled Absorber: T-100

CONNECTIONS

Inlet Stream
STREAM NAME Stage FROM UNIT OPERATION
reboiler 1 Reboiler
DME reflux 1__Main Tower RCY-1 Recycle
normal op 4__Main Tower TEE-102 Tee
turn down 9__Main Tower TEE-102 Tee
Outlet Stream
STREAM NAME Stage TO UNIT OPERATION
Meth H2O Reboiler P-101 Pump
DME outlet 1__Main Tower E-104 Cooler
MONITOR

Specifications Summary
Specified Value Current Value Wt. Error
Btms Prod Rate --- 954.8 kgmole/h ---
Boilup Ratio 10.00 0.8359 9.164

Comp Fraction 0.9995 0.9995 -6.811e-005
Wt. Tol. Abs. Tol. Active Estimate Used
Btms Prod Rate 1.000e-002 1.000 kgmole/h Off On Off
Boilup Ratio 1.000e-002 1.000e-002 Off On Off
Comp Fraction 1.000e-002 1.000e-003 On On On
SPECS

Column Specification Parameters
Btms Prod Rate

Fix/Rang: Fixed Prim/Alter: Primary Lower Bnd: ---
Upper Bnd: ---
Stream: Meth H2O @COL1 Flow Basis: Molar
Boilup Ratio

Fix/Rang: Fixed Prim/Alter: Primary Lower Bnd: ---
Upper Bnd: ---
Stage: Reboiler Basis: Molar
Comp Fraction

Fix/Rang: Fixed Prim/Alter: Primary Lower Bnd: ---
Upper Bnd: ---
Stage: Flow Basis: Mass Fraction Phase: Liquid
Components: diM-Ether
SUBCOOLING

Degrees of Subcooling
Subcool to
User Variables

PROFILES

General Parameters
Sub-Flow Sheet: T-100 (COL1) Number of Stages: 10
Profile Estimates

	Temperature (C)	Net Liquid (kgmole/h)	Net Vapour (kgmole/h)
1__Main Tower	58.00	593.6	1253
2__Main Tower	45.03	444.8	1215
3__Main Tower	70.77	320.4	1066
4__Main Tower	94.16	1058	941.7
5__Main Tower	108.8	1041	891.7
6__Main Tower	115.7	1037	874.1
7__Main Tower	118.5	1035	869.9
8__Main Tower	119.8	1030	867.9
9__Main Tower	121.3	1785	863.7
10__Main Tower	135.2	1753	830.3
Reboiler	114.0	954.8	798.2

EFFICIENCIES

Stage Efficiencies

Stages	Overall	diM-Ether	Methanol	H2O
1__Main Tower	1.000	1.000	1.000	1.000
2__Main Tower	1.000	1.000	1.000	1.000
3__Main Tower	1.000	1.000	1.000	1.000
4__Main Tower	1.000	1.000	1.000	1.000
5__Main Tower	1.000	1.000	1.000	1.000
6__Main Tower	1.000	1.000	1.000	1.000
7__Main Tower	1.000	1.000	1.000	1.000
8__Main Tower	1.000	1.000	1.000	1.000
9__Main Tower	1.000	1.000	1.000	1.000
10__Main Tower	1.000	1.000	1.000	1.000
Reboiler	1.000	1.000	1.000	1.000

SOLVER

Column Solving Algorithm: HYSIM Inside-Out
Solving Options Acceleration Parameters
Maximum Iterations: 10000 Accelerate K Value & H Model Parameters: Off
Equilibrium Error Tolerance: 1.000e-05
Heat/Spec Error Tolerance: 5.000e-004
Save Solutions as Initial Estimate: On
Super Critical Handling Model: Simple K
Trace Level: Low
Init from Ideal K's: Off Damping Parameters
Initial Estimate Generator Parameters Azeotrope Check: Off
Iterative IEG (Good for Chemicals): Off Fixed Damping Factor: 1

SIDE STRIPPERS

SIDE RECTIFIERS

PUMP AROUNDS

VAP BYPASSES

ACTIVE INTERNAL OPTION: Internals-1@Main Tower@COL1

Name	Start Stage	End Stage	Mode	Internals Type	Tray / Packing Number of Passes	Packing Vendor	Packing Material	Packing Tray Spacing / Section Dimension (m)	Packed Height (m)	Diameter (m)
CS-1	1__Main Tower	8__Main Tower	Interactive	Sizing Trayed Sieve	1	---	---	---	0.6096	1.550
CS-2	9__Main Tower	10__Main Tower	Interactive	Sizing Trayed Bubble Cap	1	---	---	---	0.6096	1.550

SETUP

Section Name	CS-1	CS-2
Section Start	1__Main Tower	9__Main Tower
Section End	8__Main Tower	10__Main Tower
Internals	Trayed	Trayed
Internals Type	Sieve	Bubble Cap
Diameter (m)	1.550	1.550
Tray Spacing / Section Packed Height (m)	0.6096	0.6096
Number Of Passes	1	1
Maximum Acceptable Pressure Drop (kPa)	2.500	2.500
Maximum Percent Downcomer Backup	100.00 %	100.00 %
Maximum Percent Jet Flood	100.00 %	100.00 %
Percent Jet Flood For Design	80.00 %	80.00 %
Maximum Percent Liquid Entrainment	10.00 %	10.00 %
Minimum Weir Loading (m3/h-m)	4.471	4.471

Maximum Weir Loading (m3/h-m) 117.4 117.4
Minimum Downcomer Area / Total Tray Area 0.1000 0.1000
Override Downcomer Froth Density No No
Froth Density --- ---
Weep Method Hsieh Hsieh
Default Jet Flood Calculation Method GLITSCH6 GLITSCH6
Maximum Downcomer Loading Method Glitsch Glitsch
% Approach to Maximum Capacity --- ---
Design Capacity Factor --- ---
Capacity Factor at Flooding --- ---
System Foaming Factor 1.000 1.000
Aeration Factor Multipler 1.000 1.000
Minimum Liquid Flow Rate --- ---
Pressure Drop at Flood per Unit Packed Height --- ---
Allowable Pressure Drop per Unit Packed Height --- ---
Minimum Pressure Drop per Unit Packed Height --- ---
Number of Curves --- ---
Warning Status (% to Limit) 10.00 % 10.00 %
Pressure Drop Calculation Method --- ---
Mode Interactive Sizing Interactive Sizing
Status Needs Calculating Needs Calculating
GEOMETRY DETAILS

Common Geometry CS-1 CS-2
Section Start 1__Main Tower 9__Main Tower
Section End 8__Main Tower 10__Main Tower
Internals Sieve Bubble Cap
Section Diameter (m) 1.550 1.550
Foaming Factor 1.000 1.000
Over-Design Factor 1.000 1.000
Common Tray Geometry CS-1 CS-2
Number of Passes 1 1
Tray Spacing (m) 0.6096 0.6096
Picket Fence Weirs No No
Swept Back Weirs No No
Active Area Under Downcomer No No
Deck Thickness 10 Gauge 10 Gauge
Deck Thickness Value (mm) 3.404 3.404
Balance Downcomers Based On Maximum Downcomer Loading Maximum Downcomer Loading
Weir Modifications None None
Net Area (m2) 1.698 1.698
Cross-Sectional Area (m2) 1.887 1.887
Active Area (m2) 1.510 1.510
Downcomer Geometry CS-1 CS-2
Side Weir Height (mm) 50.80 50.80
Weir Length (m) --- ---
Downcomer Clearance (mm) 38.10 38.10
Downcomer Width - Top (mm) 242.5 242.5
Downcomer Width - Bottom (mm) 242.5 242.5
Downcomer Loading Top (m3/h-m2) 245.6 347.6
Weir Loading (m3/h-m) 41.14 58.24
Downcomer Area - Top (m2) 0.1887 0.1887
Downcomer Area - Bottom (m2) 0.1887 0.1887
Picketing Fraction --- ---
Center Weir Height (mm) --- ---
Weir Length (m) --- ---
Downcomer Clearance (mm) --- ---
Downcomer Width - Top (mm) --- ---
Downcomer Width - Bottom (mm) --- ---
Downcomer Loading Top (m3/h-m2) --- ---
Weir Loading (m3/h-m) --- ---
Downcomer Area - Top (m2) --- ---
Downcomer Area - Bottom (m2) --- ---
Picketing Fraction --- ---
Off Center Weir Height (mm) --- ---
Inside Weir Length (m) --- ---
Outside Weir Length (m) --- ---
Downcomer Clearance (mm) --- ---
Downcomer Width - Top (mm) --- ---
Downcomer Width - Bottom (mm) --- ---
Downcomer Loading Top (m3/h-m2) --- ---
Maximum Outside Weir Loading (m3/h-m) --- ---
Maximum Inside Weir Loading (m3/h-m) --- ---
Downcomer Area - Top (m2) --- ---
Downcomer Area - Bottom (m2) --- ---
Inside Picketing Fraction --- ---
Outside Picketing Fraction --- ---
Off-Center Downcomer Location (m) --- ---
Swept Back Weir Geometry CS-1 CS-2
Compatibility KG Tower KG Tower
A --- ---
B/Parallel Chord Segment --- ---
S/Swept-Back Weir --- ---
Swept-Back Weir Chord --- ---
Angled Chord Segment --- ---
Tray With Maximum Weir Loading 4 9
Maximum Weir Loading (m3/h-m) 41.14 58.24
Maximum Allowable Weir Loading in Section (m3/h-m) 117.4 117.4
Actual Side Weir Length (m) 1.126 1.126
Effective Side Weir Length (m) 1.126 1.126
Lost Area (%) 0.00 0.00
Sieve Geometry CS-1 CS-2
Hole Diameter (mm) 12.70 ---
Number of Holes 1191 ---
Hole Area to Active Area 0.1000 ---
Bubble Cap Geometry CS-1 CS-2
Cap Diameter --- 3 in (76.2 mm)
Skirt Height --- 1.0 in (25.4 mm)
Number of Caps --- 75
Number of Caps Per Active Area --- 50.00
Valve Geometry CS-1 CS-2
Tray Type --- ---
Valve Type --- ---
Valve Material --- ---
Leg Length --- ---
Valve Thickness --- ---
Number of Valves --- ---
Number of Valves per Active Area --- ---
Packing Geometry CS-1 CS-2
HETP (m) --- ---
Section Packed Height (m) --- ---
Packing Type --- ---
Packing Vendor --- ---
Packing Material --- ---
Packing Dimension --- ---
Packing Factor (m2/m3) --- ---
Packing Surface Area (m2/m3) --- ---

1st Stichlmair Constant --- ---
2nd Stichlmair Constant --- ---
3rd Stichlmair Constant --- ---
Void Fraction --- ---
RESULTS SUMMARY

Section Name CS-1 CS-2
Section Start 1__Main Tower 9__Main Tower
Section End 8__Main Tower 10__Main Tower
Internals Trayed Trayed
Diameter (m) 1.550 1.550
Number of Passes 1 1
Tray Spacing / Section Packed Height (m) 0.6096 0.6096
Total Height (m) 4.877 1.219
Total Pressure Drop (kPa) 57.03 23.78
Total Pressure Drop (Head Loss) (m) 879.6 331.1
Trays With Weeping None None
Maximum Percent Jet Flood (%) 92.91 59.70
Tray With Maximum Jet Flood 1__Main Tower 9__Main Tower
Maximum Percent Downcomer Backup (%) 46.67 70.66
Tray With Maximum Downcomer Backup 1__Main Tower 9__Main Tower
Maximum Downcomer Loading (m3/h-m2) 245.6 347.6
Tray With Maximum Downcomer Loading 4__Main Tower 9__Main Tower
Maximum Downcomer Loading Location Side Side
Maximum Weir Loading (m3/h-m) 41.14 58.24
Tray With Maximum Weir Loading 4__Main Tower 9__Main Tower
Maximum Weir Loading Location Side Side
Maximum Aerated Height Over Weir (mm) 141.6 114.0
Tray With Maximum Aerated Height Over Weir 1__Main Tower 9__Main Tower
Maximum % Approach To System Limit (%) 69.41 30.13
Tray With Maximum % Approach To System Limit 1__Main Tower 9__Main Tower
Maximum Cs Based On Bubbling Area (%) 0.1136 6.450e-002
Tray With Maximum Cs Based On Bubbling Area 1__Main Tower 9__Main Tower
Maximum % Capacity (Constant L/V) 92.91 59.70
Maximum Capacity Factor --- ---
Section Pressure Drop (kPa) 57.03 23.78
Average Pressure Drop Per Height (kPa/m) --- ---
Average Pressure Drop Per Height (Frictional) (mbar/m) --- ---
Maximum Stage Liquid Holdup (m3) --- ---
Maximum Liquid Superficial Velocity (m/s) --- ---
Surface Area (m2/m3) --- ---
Void Fraction --- ---
1st Stichlmair Constant --- ---
2nd Stichlmair Constant --- ---
3rd Stichlmair Constant --- ---
STAGE BY STAGE RESULTS: CS-1

State Conditions
Stages Liquid Temperature Vapor Temperature Liquid Mass Flow Vapor Mass Flow Liquid Volume Flow Vapor Volume Flow
(C) (C) (kg/h) (kg/h) (m3/s) (m3/s)
1__Main Tower 37.94 45.03 2.719e+004 5.580e+004 1.287e-002 1.086
2__Main Tower 45.03 70.77 1.924e+004 4.786e+004 8.851e-003 1.027
3__Main Tower 70.77 94.16 1.163e+004 4.024e+004 4.994e-003 0.9664
4__Main Tower 94.16 108.8 3.190e+004 3.561e+004 1.287e-002 0.9490
5__Main Tower 108.8 115.7 2.961e+004 3.332e+004 1.171e-002 0.9446
6__Main Tower 115.7 118.5 2.876e+004 3.247e+004 1.128e-002 0.9442
7__Main Tower 118.5 119.8 2.840e+004 3.210e+004 1.109e-002 0.9427
8__Main Tower 119.8 121.3 2.801e+004 3.171e+004 1.089e-002 0.9392
Physical Conditions
Stages Liquid Molecular Weight Vapor Molecular Weight Liquid Mass Density Vapor Mass Density Liquid Viscosity Vapor Viscosity Surface Tension
(kg/m3) (kg/m3) (cP) (cP) (dyne/cm)
1__Main Tower 45.80 45.93 586.8 14.28 8.172e-002 9.582e-003 10.32
2__Main Tower 43.25 44.89 603.8 12.94 0.1009 1.010e-002 12.90
3__Main Tower 36.29 42.73 646.7 11.57 0.1475 1.044e-002 20.64
4__Main Tower 30.14 39.93 688.4 10.42 0.1623 1.030e-002 30.71
5__Main Tower 28.45 38.12 702.5 9.798 0.1668 1.014e-002 30.93
6__Main Tower 27.75 37.32 708.6 9.552 0.1659 1.007e-002 30.86
7__Main Tower 27.45 36.99 711.3 9.459 0.1653 1.007e-002 30.91
8__Main Tower 27.18 36.72 714.1 9.379 0.1646 1.013e-002 31.33
Hydraulic Results
Stages Percent Jet Flood Dry Pressure Drop Total Pressure Drop Dry Pressure Drop (Head Loss) Total Pressure Drop (Head Loss)
(%) (mbar) (mbar) (mm) (mm)
1__Main Tower 92.91 6.811 9.173 118.4 159.4
2__Main Tower 80.34 5.525 7.834 93.31 132.3
3__Main Tower 66.91 4.372 6.724 68.93 106.0
4__Main Tower 66.10 3.798 6.935 56.26 102.7
5__Main Tower 62.63 3.538 6.686 51.35 97.06
6__Main Tower 61.34 3.446 6.599 49.59 94.97
7__Main Tower 60.75 3.402 6.560 48.77 94.04
8__Main Tower 60.07 3.348 6.516 47.80 93.05
Stages Downcomer Backup (Aerated) Downcomer Backup (Unaerated) Percent Downcomer Backup (Aerated) Percent Downcomer Backup (Unaerated)

(m) (m) (%) (%)
1__Main Tower 0.3082 0.1827 46.67 27.66
2__Main Tower 0.2497 0.1488 37.81 22.53
3__Main Tower 0.1980 0.1191 29.99 18.04
4__Main Tower 0.2317 0.1401 35.09 21.21
5__Main Tower 0.2191 0.1326 33.18 20.08
6__Main Tower 0.2145 0.1299 32.49 19.67
7__Main Tower 0.2126 0.1287 32.19 19.49
8__Main Tower 0.2105 0.1275 31.87 19.30
Stages Mass Rate / Column Area Volume Rate / Column Area Fs (Net Area) Fs (Bubble Area) Cs (Net Area)
(kg/s-m2) (m3/h-m2) (sqrt(Pa)) (sqrt(Pa))
(m/s)
1__Main Tower 4.002 24.56 2.416 2.718
0.1010
2__Main Tower 2.832 16.89 2.176 2.448
8.951e-002
3__Main Tower 1.712 9.528 1.935 2.177
7.680e-002
4__Main Tower 4.696 24.56 1.804 2.030
6.928e-002
5__Main Tower 4.359 22.34 1.741 1.959
6.615e-002
6__Main Tower 4.234 21.51 1.718 1.933
6.499e-002
7__Main Tower 4.180 21.16 1.707 1.921
6.444e-002
8__Main Tower 4.123 20.78 1.694 1.905
6.380e-002
Stages Cs (Bubble Area) Approach to System Limit Height Over Weir (Aerated) Height Over Weir (Unaerated)
(m/s) (%) (m) (m)
1__Main Tower 0.1136 69.41 0.1416
2.528e-002
2__Main Tower 0.1007 58.14 9.324e-002
1.748e-002
3__Main Tower 8.640e-002 44.67 5.686e-002
1.137e-002
4__Main Tower 7.794e-002 36.94 0.1186
2.477e-002
5__Main Tower 7.442e-002 35.27 0.1062
2.268e-002
6__Main Tower 7.312e-002 34.69 0.1019
2.195e-002
7__Main Tower 7.250e-002 34.40 0.1000
2.164e-002
8__Main Tower 7.177e-002 33.96 9.802e-002
2.133e-002
Side Downcomer Results
Stages Volume Residence Time Velocity From Top Velocity from Bottom Exit Velocity
(m3) (seconds) (m/s) (m/s) (m/s)
1__Main Tower 3.447e-002 2.678 6.821e-002 6.821e-002 0.3000
2__Main Tower 2.808e-002 3.173 4.691e-002 4.691e-002 0.2063
3__Main Tower 2.248e-002 4.501 2.647e-002 2.647e-002 0.1164
4__Main Tower 2.643e-002 2.054 6.822e-002 6.822e-002 0.3000
5__Main Tower 2.502e-002 2.137 6.206e-002 6.206e-002 0.2729
6__Main Tower 2.451e-002 2.174 5.976e-002 5.976e-002 0.2628
7__Main Tower 2.429e-002 2.190 5.877e-002 5.877e-002 0.2584
8__Main Tower 2.405e-002 2.208 5.773e-002 5.773e-002 0.2539
STAGE BY STAGE RESULTS: CS-2

State Conditions
Stages Liquid Temperature Vapor Temperature Liquid Mass Flow Vapor Mass Flow Liquid Volume Flow Vapor Volume Flow
(C) (C) (kg/h) (kg/h) (m3/s) (m3/s)
9__Main Tower 121.3 135.2 4.735e+004 2.615e+004 1.822e-002 0.9322
10__Main Tower 135.2 145.4 4.326e+004 2.205e+004 1.614e-002 0.9184
Physical Conditions
Stages Liquid Molecular Weight Vapor Molecular Weight Liquid Mass Density Vapor Mass Density Liquid Viscosity Vapor Viscosity Surface Tension
(kg/m3) (kg/m3) (cP) (cP)
(dyne/cm)
9__Main Tower 26.53 31.49 721.9 7.790 0.1630 9.674e-003 32.85
10__Main Tower 24.68 27.63 744.7 6.670 0.1595 9.732e-003 34.10
Hydraulic Results
Stages Percent Jet Flood Dry Pressure Drop Total Pressure Drop Dry Pressure Drop (Head Loss) Total Pressure Drop (Head Loss)
(%) (mbar) (mbar) (mm) (mm)
9__Main Tower 59.70 7.914 12.49 111.8
176.5
10__Main Tower 53.27 6.954 11.29 95.22
154.6
Stages Downcomer Backup (Aerated) Downcomer Backup (Unaerated) Percent Downcomer Backup (Aerated) Percent Downcomer Backup (Unaerated)
(m) (m) (%) (%)
9__Main Tower 0.4667 0.2828 70.66 42.82
10__Main Tower 0.4151 0.2518 62.86
38.13
Stages Mass Rate / Column Area Volume Rate / Column Area Fs (Net Area) Fs (Bubble Area) Cs (Net Area)
(kg/s-m2) (m3/h-m2) (sqrt(Pa)) (sqrt(Pa))
(m/s)
9__Main Tower 6.971 34.76 1.532 1.724
5.734e-002
10__Main Tower 6.369 30.78 1.397 1.571
5.141e-002
Stages Cs (Bubble Area) Approach to System Limit Height Over Weir (Aerated) Height Over Weir (Unaerated)
(m/s) (%) (m) (m)
9__Main Tower 6.450e-002 30.13 0.1140
3.510e-002
10__Main Tower 5.784e-002 26.80 9.561e-002
3.172e-002
Side Downcomer Results
Stages Volume Residence Time Velocity From Top Velocity from Bottom Exit Velocity
(m3) (seconds) (m/s) (m/s) (m/s)

9__Main Tower 5.336e-002 2.928 9.657e-002 9.657e-002 0.4246
10__Main Tower 4.752e-002 2.945 8.551e-002 8.551e-002 0.3760
RATING

Tray Sections

Tray Section Main Tower @COL1
Tray Diameter (m) 1.500
Weir Height (m) 5.000e-002
Weir Length (m) 1.200
Tray Space (m) 0.5000
Tray Volume (m3) 0.8836
Disable Heat Loss Calculations No
Heat Model None
Rating Calculations No
Tray Hold Up (m3) 8.836e-002
Vessels

Vessel Reboiler @COL1
Diameter (m) 1.193
Length (m) 1.789
Volume (m3) 2.000
Orientation Horizontal
Vessel has a Boot No
Boot Diameter (m) ---
Boot Length (m) ---
Hold Up (m3) 1.000
Other Equipment In Column Flowsheet

Pressure Profile

	Pressure (kPa)	Pressure Drop (kPa)
1__Main Tower	820.0 kPa	2.222 kPa
2__Main Tower	822.2 kPa	2.222 kPa
3__Main Tower	824.4 kPa	2.222 kPa
4__Main Tower	826.7 kPa	2.222 kPa
5__Main Tower	828.9 kPa	2.222 kPa
6__Main Tower	831.1 kPa	2.222 kPa
7__Main Tower	833.3 kPa	2.222 kPa
8__Main Tower	835.6 kPa	2.222 kPa
9__Main Tower	837.8 kPa	2.222 kPa
10__Main Tower	840.0 kPa	---
Reboiler	840.0 kPa	0.0000 kPa

Pressure Solving Options

Pressure Tolerance 1.000e-004 Pressure Drop Tolerance 1.000e-004
Damping Factor 1.000 Max Press Iterations 100
SUMMARY

Flow Basis: Molar The composition option is selected
Feed Composition

	DME reflux	normal op	turn down
Flow Rate (kgmole/h)	631.5772	788.0580	788.0580
	---	---	---
diM-Ether	0.9993	0.3991	0.3991
Methanol	0.0007	0.1710	0.1710
H2O	0.0000	0.4298	0.4298

Flow Basis: Molar The composition option is selected
Feed Flows

	DME reflux	normal op	turn down
Flow Rate (kgmole/h)	631.5772	788.0580	788.0580
	---	---	---
diM-Ether (kgmole/h)	631.1222	314.5502	314.5502
Methanol (kgmole/h)	0.4528	134.7802	134.7802
H2O (kgmole/h)	0.0022	338.7276	338.7276

Products
Flow Basis: Molar The composition option is selected
Product Compositions

	DME outlet	Meth H2O
Flow Rate (kgmole/h)	1.252878e+03	954.8151
	---	---
diM-Ether	0.9993	0.0086
Methanol	0.0007	0.2819
H2O	0.0000	0.7095

Flow Basis: Molar The composition option is selected
Product Flows

	DME outlet	Meth H2O
Flow Rate (kgmole/h)	1.252878e+03	954.8151
	---	---
diM-Ether (kgmole/h)	1.251976e+03	8.2470
Methanol (kgmole/h)	0.8981	269.1150
H2O (kgmole/h)	0.0043	677.4530

Flow Basis: Molar The composition option is selected
Product Recoveries

	DME outlet	Meth H2O
Flow Rate (kgmole/h)	1.252878e+03	954.8151
	---	---
diM-Ether (%)	99.3456	0.6544
Methanol (%)	0.3326	99.6674
H2O (%)	0.0006	99.9994

COLUMN PROFILES

Reflux Ratio: 0.4738 Reboil Ratio: 0.8359 The Flows Option is Selected Flow Basis: Molar
Column Profiles Flows

	Temp (C)	Pres (kPa)	Net Liq (kgmole/h)	Net Vap (kgmole/h)	Net Feed (kgmole/h)	Net Draws	Duty (kJ/h)
1__Main Tower	37.9	820.0	593.6	---	631.6	1253	---
2__Main Tower	45.0	822.2	444.8	1215	---	---	---
3__Main Tower	70.8	824.4	320.4	1066	---	---	---
4__Main Tower	94.2	826.7	1058	941.7	788.1	---	---
5__Main Tower	108.8	828.9	1041	891.7	---	---	---
6__Main Tower	115.7	831.1	1037	874.1	---	---	---

7__Main Tower 118.5 833.3 1035 869.9 --- ---

8__Main Tower 119.8 835.6 1030 867.9 --- ---

9__Main Tower 121.3 837.8 1785 863.7 788.1 ---

10__Main Tower 135.2 840.0 1753 830.3 --- ---

Reboiler 145.4 840.0 --- 798.2 --- 954.8
2.71e+007
Column Profiles Energy
Temperature Liq Enthalpy Vap Enthalpy Heat
Loss
(C) (kJ/kgmole) (kJ/kgmole) (kJ/h)
1__Main Tower 37.94 -2.028e+005 -1.833e+005 -
--
2__Main Tower 45.03 -2.086e+005 -1.830e+005 -
--
3__Main Tower 70.77 -2.246e+005 -1.827e+005 -
--
4__Main Tower 94.16 -2.408e+005 -1.847e+005 -
--
5__Main Tower 108.8 -2.438e+005 -1.883e+005 -
--
6__Main Tower 115.7 -2.450e+005 -1.909e+005 -
--
7__Main Tower 118.5 -2.456e+005 -1.921e+005 -
--
8__Main Tower 119.8 -2.463e+005 -1.926e+005 -
--
9__Main Tower 121.3 -2.484e+005 -1.932e+005 -
--
10__Main Tower 135.2 -2.529e+005 -2.019e+005 -
--
Reboiler 145.4 -2.605e+005 -2.099e+005 ---
FEEDS / PRODUCTS

Flow Basis: Molar
Stream Type Duty State Flows Enthalpy
Temp
(kJ/h) (kgmole/h) (kJ/kgmole)
(C)
1__Main Tower DME reflux Feed --- Liquid 632
-2.0e+005 36.98
DME outlet Draw --- Vapour 1.25e+003 -
1.8e+005 37.94
2__Main Tower
3__Main Tower
4__Main Tower normal op Feed --- Liquid 788
-2.4e+005 73.70
5__Main Tower
6__Main Tower
7__Main Tower
8__Main Tower
9__Main Tower turn down Feed --- Liquid 788
-2.4e+005 73.70
10__Main Tower
Reboiler reboiler 1 Energy 2.7e+007 --- ---

Meth H2O Draw --- Liquid 955 -
2.6e+005 145.35

PERFORMANCE SUMMARY FOR INTERNAL
OPTION: Internals-1@Main Tower@COL1

Number Of Stages 10
Total Height (m) 6.096
Total Head Loss (mm) 1211
Total Pressure Drop (mbar) 80.81
Number Of Sections 2
Number Of Diameters 1
Pressure Drop Across Sump (kPa) ---
Section Start End Height Diameter Internals Tray or
Packing Section Pressure Drop Approach To Flood
Limiting
(m) (m) Type Type (mbar) (%) Stage
CS-1 1__Main Tower 8__Main Tower 0.6096 1.550
Trayed Sieve 57.03 92.91
CS-2 9__Main Tower 10__Main Tower 0.6096 1.550
Trayed Bubble Cap 23.78 59.70
SETUP

Sub-Flowsheet
Internal Feed Stream External Feed Stream Transfer
Basis
reboiler 1 reboiler 1 None Req'd
DME reflux DME reflux P-H Flash
normal op normal op P-H Flash
turn down turn down P-H Flash
Internal Prod Stream External Prod Stream Transfer
Basis
Meth H2O Meth H2O P-H Flash
DME outlet DME outlet P-H Flash

VARIABLES

Column Flowsheet Vars Available as Parameters
Data Source Variable Component
Description

COMPONENT MAPS

Feed Streams
Feed Name In to SubFlowSheet Out of
SubFlowSheet
reboiler 1
DME reflux
normal op

Product Stream
Product Name In to SubFlowSheet Out of
SubFlowSheet
Meth H2O

TRAY by TRAY PROPERTIES TABLES

Column Temperature / Pressure Profile

Column Stage	Temperature (C)	Pressure (kPa)
1__Main Tower	37.94	820.0
2__Main Tower	45.03	822.2
3__Main Tower	70.77	824.4
4__Main Tower	94.16	826.7

5__Main Tower 108.8 828.9
6__Main Tower 115.7 831.1
7__Main Tower 118.5 833.3
8__Main Tower 119.8 835.6
9__Main Tower 121.3 837.8
10__Main Tower 135.2 840.0
Reboiler 145.4 840.0
Column Flow Profile

Options Selected
Molar flow is selected Net is selected as flow basis
Tray Number Vapour Bulk Liquid
(kgmole/h) (kgmole/h)
1__Main Tower 1253 593.6
2__Main Tower 1215 444.8
3__Main Tower 1066 320.4
4__Main Tower 941.7 1058
5__Main Tower 891.7 1041
6__Main Tower 874.1 1037
7__Main Tower 869.9 1035
8__Main Tower 867.9 1030
9__Main Tower 863.7 1785
10__Main Tower 830.3 1753
Reboiler 798.2 954.8
Column Properties Profile

Options Selected
Mass basis is selected
Stage Surf Tens Mol Wt Dens Visc Therm Con Heat Cap
L-Liq L-Liq L-Liq L-Liq L-Liq
(dyne/cm) (kg/m3) (cP) (W/m-K) (kJ/kg-C)
1__Main Tower 10.3 45.8 587 8.17e-002 0.126 2.53
2__Main Tower 12.9 43.3 604 0.101 0.132 2.73
3__Main Tower 20.6 36.3 647 0.147 0.169 3.31
4__Main Tower 30.7 30.1 688 0.162 0.265 3.78
5__Main Tower 30.9 28.5 702 0.167 0.279 4.10
6__Main Tower 30.9 27.7 709 0.166 0.285 4.29
7__Main Tower 30.9 27.4 711 0.165 0.289 4.38
8__Main Tower 31.3 27.2 714 0.165 0.295 4.44
9__Main Tower 32.9 26.5 722 0.163 0.317 4.54
10__Main Tower 34.1 24.7 745 0.159 0.360 4.14
Reboiler 38.4 22.2 786 0.150 0.458 4.31

Column Composition Profile

Options Selected
Fraction is selected as the composition basis Net is selected as flow basis
Molar basis is selected
Stage diM-Ether Methanol H2O
L-Liq L-Liq L-Liq
1__Main Tower 0.9814 0.0182 0.0004
2__Main Tower 0.8151 0.1690 0.0159
3__Main Tower 0.4351 0.4325 0.1324
4__Main Tower 0.2534 0.3576 0.3890
5__Main Tower 0.1586 0.4268 0.4146
6__Main Tower 0.1191 0.4554 0.4254
7__Main Tower 0.1048 0.4627 0.4325
8__Main Tower 0.0996 0.4541 0.4463
9__Main Tower 0.0967 0.4134 0.4899
10__Main Tower 0.0328 0.4094 0.5578
Reboiler 0.0086 0.2819 0.7095
Heavy/Light Key Component Ratios

Options Selected
Molar basis is selected
Key Components

Light Key Chosen Heavy Key Chosen
diM-Ether On diM-Ether Off
Methanol On Methanol Off
H2O On H2O Off
Stage Light Liq
1__Main Tower ---
2__Main Tower ---
3__Main Tower ---
4__Main Tower ---
5__Main Tower ---
6__Main Tower ---
7__Main Tower ---
8__Main Tower ---
9__Main Tower ---
10__Main Tower ---
Reboiler ---
Column K-Values Profile

Tray Number diM-Ether Methanol H2O
1__Main Tower 1.018 3.934e-002 8.161e-003
2__Main Tower 1.215 5.484e-002 1.302e-002
3__Main Tower 2.120 0.1640 5.001e-002
4__Main Tower 3.186 0.4129 0.1158
5__Main Tower 4.061 0.6415 0.1976
6__Main Tower 4.527 0.7784 0.2494
7__Main Tower 4.715 0.8392 0.2719
8__Main Tower 4.798 0.8740 0.2807
9__Main Tower 4.898 0.9342 0.2863
10__Main Tower 6.029 1.379 0.4256
Reboiler 7.150 1.994 0.5304

T-101 (Reboiled Absorber): Design, Parameters, Side Ops, Internals, Rating, Performance, Flowsheet, Tray Tables
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Reboiled Absorber: T-101

CONNECTIONS

Inlet Stream
STREAM NAME Stage FROM UNIT OPERATION
Reboiler 2 Reboiler
METH reflux 1__Main Tower RCY-2 Recycle

Meth H2O Pumped 6__Main Tower P-101 Pump Outlet Stream
STREAM NAME Stage TO UNIT OPERATION
Meth Recycle 1__Main Tower E-103 Cooler
Waste Water Reboiler P-105 Pump
MONITOR

Specifications Summary
Specified Value Current Value Wt. Error
Ovhd Prod Rate 650.0 kgmole/h 650.0 kgmole/h 1.080e-005
Btms Prod Rate --- 629.8 kgmole/h ---
Boilup Ratio 4.000 1.013 2.987
Wt. Tol. Abs. Tol. Active Estimate Used
Ovhd Prod Rate 1.000e-002 1.000 kgmole/h On On On
Btms Prod Rate 1.000e-002 1.000 kgmole/h Off On Off
Boilup Ratio 1.000e-002 1.000e-002 Off On Off
SPECS

Column Specification Parameters
Ovhd Prod Rate

Fix/Rang: Fixed Prim/Alter: Primary Lower Bnd: ---
Upper Bnd: ---
Stream: Meth Recycle @COL2 Flow Basis: Molar
Btms Prod Rate

Fix/Rang: Fixed Prim/Alter: Primary Lower Bnd: ---
Upper Bnd: ---
Stream: Waste Water @COL2 Flow Basis: Molar
Boilup Ratio

Fix/Rang: Fixed Prim/Alter: Primary Lower Bnd: ---
Upper Bnd: ---
Stage: Reboiler Basis: Molar
SUBCOOLING

Degrees of Subcooling
Subcool to
User Variables

PROFILES

General Parameters
Sub-Flow Sheet: T-101 (COL2) Number of Stages: 10
Profile Estimates

	Temperature (C)	Net Liquid (kgmole/h)	Net Vapour (kgmole/h)
1__Main Tower	120.0	375.2	650.0
2__Main Tower	140.5	359.9	700.2
3__Main Tower	144.8	348.0	684.9
4__Main Tower	148.5	341.1	673.0
5__Main Tower	150.9	338.0	666.1
6__Main Tower	152.1	1286	662.9
7__Main Tower	157.5	1273	655.9
8__Main Tower	163.9	1267	643.3
9__Main Tower	169.4	1267	637.0
10__Main Tower	172.7	1268	636.7
Reboiler	160.0	629.8	638.0

EFFICIENCIES

Stage Efficiencies

Stages	Overall	diM-Ether	Methanol	H2O
1__Main Tower	1.000	1.000	1.000	1.000
2__Main Tower	1.000	1.000	1.000	1.000
3__Main Tower	1.000	1.000	1.000	1.000
4__Main Tower	1.000	1.000	1.000	1.000
5__Main Tower	1.000	1.000	1.000	1.000
6__Main Tower	1.000	1.000	1.000	1.000
7__Main Tower	1.000	1.000	1.000	1.000
8__Main Tower	1.000	1.000	1.000	1.000
9__Main Tower	1.000	1.000	1.000	1.000
10__Main Tower	1.000	1.000	1.000	1.000
Reboiler	1.000	1.000	1.000	1.000

SOLVER

Column Solving Algorithm: HYSIM Inside-Out
Solving Options Acceleration Parameters
Maximum Iterations: 10000 Accelerate K Value & H Model Parameters: Off
Equilibrium Error Tolerance: 1.000e-05
Heat/Spec Error Tolerance: 5.000e-004
Save Solutions as Initial Estimate: On
Super Critical Handling Model: Simple K
Trace Level: Low
Init from Ideal K's: Off Damping Parameters
Initial Estimate Generator Parameters Azeotrope Check: Off
Iterative IEG (Good for Chemicals): Off Fixed Damping Factor: 1

SIDE STRIPPERS

SIDE RECTIFIERS

PUMP AROUNDS

VAP BYPASSES

ACTIVE INTERNAL OPTION: Internals-1@Main Tower@COL2

Name	Start Stage	End Stage	Mode	Internals Type	Tray / Packing Number of Passes	Packing Vendor	Packing Material	Packing Section Dimension (m)	Tray Spacing / Packed Height (m)	Diameter (m)
CS-1	1__Main Tower	10__Main Tower	Interactive Sizing	Trayed	Sieve 1	---	---	---	0.6096	1.300

SETUP

Section Name CS-1
Section Start 1__Main Tower
Section End 10__Main Tower
Internals Trayed
Internals Type Sieve
Diameter (m) 1.300
Tray Spacing / Section Packed Height (m) 0.6096

Number Of Passes 1
Maximum Acceptable Pressure Drop (kPa) 2.500
Maximum Percent Downcomer Backup 100.00 %
Maximum Percent Jet Flood 100.00 %
Percent Jet Flood For Design 80.00 %
Maximum Percent Liquid Entrainment 10.00 %
Minimum Weir Loading (m3/h-m) 4.471
Maximum Weir Loading (m3/h-m) 117.4
Minimum Downcomer Area / Total Tray Area 0.1000
Override Downcomer Froth Density No
Froth Density ---
Weep Method Hsieh
Default Jet Flood Calculation Method GLITSCH6
Maximum Downcomer Loading Method Glitsch
% Approach to Maximum Capacity ---
Design Capacity Factor ---
Capacity Factor at Flooding ---
System Foaming Factor 1.000
Aeration Factor Multipler 1.000
Minimum Liquid Flow Rate ---
Pressure Drop at Flood per Unit Packed Height ---
Allowable Pressure Drop per Unit Packed Height ---
Minimum Pressure Drop per Unit Packed Height ---
Number of Curves ---
Warning Status (% to Limit) 10.00 %
Pressure Drop Calculation Method ---
Mode Interactive Sizing
Status Needs Calculating
GEOMETRY DETAILS

Common Geometry CS-1
Section Start 1__Main Tower
Section End 10__Main Tower
Internals Sieve
Section Diameter (m) 1.300
Foaming Factor 1.000
Over-Design Factor 1.000
Common Tray Geometry CS-1
Number of Passes 1
Tray Spacing (m) 0.6096
Picket Fence Weirs No
Swept Back Weirs No
Active Area Under Downcomer No
Deck Thickness 10 Gauge
Deck Thickness Value (mm) 3.404
Balance Downcomers Based On Maximum Downcomer Loading
Weir Modifications None
Net Area (m2) 1.195
Cross-Sectional Area (m2) 1.327
Active Area (m2) 1.062
Downcomer Geometry CS-1
Side Weir Height (mm) 50.80
Weir Length (m) ---
Downcomer Clearance (mm) 38.10
Downcomer Width - Top (mm) 203.4
Downcomer Width - Bottom (mm) 203.4
Downcomer Loading Top (m3/h-m2) 111.9
Weir Loading (m3/h-m) 35.75
Downcomer Area - Top (m2) 0.1327
Downcomer Area - Bottom (m2) 0.1327
Picketing Fraction ---
Center Weir Height (mm) ---
Weir Length (m) ---
Downcomer Clearance (mm) ---
Downcomer Width - Top (mm) ---
Downcomer Width - Bottom (mm) ---
Downcomer Loading Top (m3/h-m2) ---
Weir Loading (m3/h-m) ---
Downcomer Area - Top (m2) ---
Downcomer Area - Bottom (m2) ---
Picketing Fraction ---
Off Center Weir Height (mm) ---
Inside Weir Length (m) ---
Outside Weir Length (m) ---
Downcomer Clearance (mm) ---
Downcomer Width - Top (mm) ---
Downcomer Width - Bottom (mm) ---
Downcomer Loading Top (m3/h-m2) ---
Maximum Outside Weir Loading (m3/h-m) ---
Maximum Inside Weir Loading (m3/h-m) ---
Downcomer Area - Top (m2) ---
Downcomer Area - Bottom (m2) ---
Inside Picketing Fraction ---
Outside Picketing Fraction ---
Off-Center Downcomer Location (m) ---
Swept Back Weir Geometry CS-1
Compatibility KG Tower
A ---
B/Parallel Chord Segment ---
S/Swept-Back Weir ---
Swept-Back Weir Chord ---
Angled Chord Segment ---
Tray With Maximum Weir Loading 6
Maximum Weir Loading (m3/h-m) 35.75
Maximum Allowable Weir Loading in Section (m3/h-m) 117.4
Actual Side Weir Length (m) 0.9446
Effective Side Weir Length (m) 0.9446
Lost Area (%) 0.00
Sieve Geometry CS-1
Hole Diameter (mm) 12.70
Number of Holes 838
Hole Area to Active Area 0.1000
Bubble Cap Geometry CS-1
Cap Diameter ---
Skirt Height ---
Number of Caps ---
Number of Caps Per Active Area ---
Valve Geometry CS-1
Tray Type ---
Valve Type ---
Valve Material ---
Leg Length ---
Valve Thickness ---
Number of Valves ---
Number of Valves per Active Area ---
Packing Geometry CS-1
HETP (m) ---
Section Packed Height (m) ---
Packing Type ---
Packing Vendor ---
Packing Material ---
Packing Dimension ---

Packing Factor (m2/m3) ---
Packing Surface Area (m2/m3) ---
1st Stichlmair Constant ---
2nd Stichlmair Constant ---
3rd Stichlmair Constant ---
Void Fraction ---
RESULTS SUMMARY

Section Name CS-1
Section Start 1__Main Tower
Section End 10__Main Tower
Internals Trayed
Diameter (m) 1.300
Number of Passes 1
Tray Spacing / Section Packed Height (m) 0.6096
Total Height (m) 6.096
Total Pressure Drop (kPa) 59.42
Total Pressure Drop (Head Loss) (m) 760.0
Trays With Weeping None
Maximum Percent Jet Flood (%) 57.46
Tray With Maximum Jet Flood 1__Main Tower
Maximum Percent Downcomer Backup (%) 30.61
Tray With Maximum Downcomer Backup 6__Main Tower
Maximum Downcomer Loading (m3/h-m2) 254.4
Tray With Maximum Downcomer Loading 6__Main Tower
Maximum Downcomer Loading Location Side
Maximum Weir Loading (m3/h-m) 35.75
Tray With Maximum Weir Loading 6__Main Tower
Maximum Weir Loading Location Side
Maximum Aerated Height Over Weir (mm) 99.71
Tray With Maximum Aerated Height Over Weir 6__Main Tower
Maximum % Approach To System Limit (%) 36.75
Tray With Maximum % Approach To System Limit 1__Main Tower
Maximum Cs Based On Bubbling Area (%) 7.425e-002
Tray With Maximum Cs Based On Bubbling Area 1__Main Tower
Maximum % Capacity (Constant L/V) 57.46
Maximum Capacity Factor ---
Section Pressure Drop (kPa) 59.42
Average Pressure Drop Per Height (kPa/m) ---
Average Pressure Drop Per Height (Frictional) (mbar/m) ---
Maximum Stage Liquid Holdup (m3) ---
Maximum Liquid Superficial Velocity (m/s) ---
Surface Area (m2/m3) ---
Void Fraction ---
1st Stichlmair Constant ---
2nd Stichlmair Constant ---
3rd Stichlmair Constant ---
STAGE BY STAGE RESULTS: CS-1

State Conditions
Stages Liquid Temperature Vapor Temperature Liquid Mass Flow Vapor Mass Flow Liquid Volume Flow Vapor Volume Flow
(C) (C) (kg/h) (kg/h) (m3/s) (m3/s)
1__Main Tower 136.3 140.5 1.041e+004 2.023e+004 4.127e-003 0.7669
2__Main Tower 140.5 144.8 9163 1.898e+004 3.487e-003 0.7560
3__Main Tower 144.8 148.5 8166 1.799e+004 2.980e-003 0.7475
4__Main Tower 148.5 150.9 7554 1.738e+004 2.672e-003 0.7422
5__Main Tower 150.9 152.1 7253 1.708e+004 2.521e-003 0.7390
6__Main Tower 152.1 157.5 2.720e+004 1.582e+004 9.381e-003 0.7385
7__Main Tower 157.5 163.9 2.556e+004 1.417e+004 8.561e-003 0.7333
8__Main Tower 163.9 169.4 2.420e+004 1.281e+004 7.884e-003 0.7334
9__Main Tower 169.4 172.7 2.342e+004 1.204e+004 7.498e-003 0.7366
10__Main Tower 172.7 174.1 2.307e+004 1.169e+004 7.325e-003 0.7405
Physical Conditions
Stages Liquid Molecular Weight Vapor Molecular Weight Liquid Mass Density Vapor Mass Density Liquid Viscosity Vapor Viscosity Surface Tension
(kg/m3) (kg/m3) (cP) (cP) (dyne/cm)
1__Main Tower 27.75 28.90 700.7 7.329 0.1622 9.159e-003 24.67
2__Main Tower 25.46 27.72 730.0 6.976 0.1600 9.432e-003 30.24
3__Main Tower 23.47 26.73 761.3 6.685 0.1547 9.673e-003 34.94
4__Main Tower 22.15 26.09 785.4 6.503 0.1480 9.832e-003 37.85
5__Main Tower 21.46 25.76 799.1 6.418 0.1429 9.916e-003 39.24
6__Main Tower 21.15 24.11 805.4 5.949 0.1401 1.024e-002 39.82
7__Main Tower 20.08 22.03 829.3 5.369 0.1298 1.070e-002 41.63
8__Main Tower 19.10 20.12 852.6 4.853 8.994e-002 1.108e-002 42.89
9__Main Tower 18.49 18.91 867.7 4.539 9.042e-002 1.128e-002 43.33
10__Main Tower 18.20 18.32 875.1 4.385 9.027e-002 1.135e-002 43.39
Hydraulic Results
Stages Percent Jet Flood Dry Pressure Drop Total Pressure Drop Dry Pressure Drop (Head Loss) Total Pressure Drop (Head Loss)
(%) (mbar) (mbar) (mm) (mm)
1__Main Tower 57.46 3.525 5.984 51.30 87.09
2__Main Tower 53.75 3.260 5.838 45.54 81.54
3__Main Tower 50.62 3.055 5.752 40.92 77.04
4__Main Tower 48.61 2.930 5.717 38.04 74.22
5__Main Tower 47.58 2.867 5.704 36.58 72.79
6__Main Tower 51.32 2.653 6.322 33.59 80.05
7__Main Tower 47.50 2.361 6.147 29.04 75.58

8__Main Tower 44.36 2.135 6.029 25.53 72.11
9__Main Tower 42.60 2.014 5.975 23.67 70.21
10__Main Tower 41.86 1.967 5.955 22.92 69.39

Stages Downcomer Backup (Aerated) Downcomer Backup (Unaerated) Percent Downcomer Backup (Aerated) Percent Downcomer Backup (Unaerated)
(m) (m) (%) (%)
1__Main Tower 0.1778 0.1076 26.92 16.29
2__Main Tower 0.1686 0.1022 25.52 15.47
3__Main Tower 0.1614 9.797e-002 24.44 14.83
4__Main Tower 0.1571 9.541e-002 23.79 14.45
5__Main Tower 0.1549 9.414e-002 23.46 14.25
6__Main Tower 0.2021 0.1228 30.61 18.60
7__Main Tower 0.1935 0.1176 29.30 17.81
8__Main Tower 0.1870 0.1137 28.32 17.21
9__Main Tower 0.1835 0.1116 27.79 16.90
10__Main Tower 0.1820 0.1107 27.56 16.76

Stages Mass Rate / Column Area Volume Rate / Column Area Fs (Net Area) Fs (Bubble Area) Cs (Net Area)
(kg/s-m2) (m3/h-m2) (sqrt(Pa)) (sqrt(Pa)) (m/s)
1__Main Tower 2.179 11.19 1.738 1.955 6.600e-002
2__Main Tower 1.917 9.456 1.671 1.880 6.216e-002
3__Main Tower 1.709 8.082 1.618 1.820 5.890e-002
4__Main Tower 1.581 7.246 1.584 1.782 5.677e-002
5__Main Tower 1.518 6.838 1.567 1.763 5.567e-002
6__Main Tower 5.692 25.44 1.508 1.696 5.333e-002
7__Main Tower 5.349 23.22 1.422 1.600 4.955e-002
8__Main Tower 5.064 21.38 1.352 1.522 4.645e-002
9__Main Tower 4.902 20.34 1.314 1.478 4.472e-002
10__Main Tower 4.829 19.87 1.298 1.460 4.399e-002

Stages Cs (Bubble Area) Approach to System Limit Height Over Weir (Aerated) Height Over Weir (Unaerated)
(m/s) (%) (m) (m)
1__Main Tower 7.425e-002 36.75 5.461e-002 1.168e-002
2__Main Tower 6.993e-002 33.13 4.724e-002 1.037e-002
3__Main Tower 6.626e-002 30.50 4.145e-002 9.301e-003
4__Main Tower 6.387e-002 28.99 3.792e-002 8.633e-003
5__Main Tower 6.263e-002 28.27 3.618e-002 8.300e-003
6__Main Tower 5.999e-002 27.08 9.971e-002 2.350e-002
7__Main Tower 5.575e-002 24.97 8.796e-002 2.162e-002
8__Main Tower 5.226e-002 23.31 7.932e-002 2.022e-002
9__Main Tower 5.030e-002 22.43 7.473e-002 1.946e-002
10__Main Tower 4.949e-002 22.08 7.278e-002 1.912e-002

Side Downcomer Results

Stages Volume Residence Time Velocity From Top Velocity from Bottom Exit Velocity
(m3) (seconds) (m/s) (m/s) (m/s)
1__Main Tower 1.428e-002 3.460 3.109e-002 3.109e-002 0.1147
2__Main Tower 1.356e-002 3.890 2.627e-002 2.627e-002 9.688e-002
3__Main Tower 1.300e-002 4.364 2.245e-002 2.245e-002 8.280e-002
4__Main Tower 1.266e-002 4.740 2.013e-002 2.013e-002 7.424e-002
5__Main Tower 1.249e-002 4.956 1.900e-002 1.900e-002 7.006e-002
6__Main Tower 1.630e-002 1.738 7.068e-002 7.068e-002 0.2607
7__Main Tower 1.561e-002 1.823 6.450e-002 6.450e-002 0.2379
8__Main Tower 1.509e-002 1.914 5.940e-002 5.940e-002 0.2191
9__Main Tower 1.481e-002 1.975 5.649e-002 5.649e-002 0.2083
10__Main Tower 1.469e-002 2.006 5.518e-002 5.518e-002 0.2035

RATING

Tray Sections

Tray Section Main Tower @COL2
Tray Diameter (m) 1.500
Weir Height (m) 5.000e-002
Weir Length (m) 1.200
Tray Space (m) 0.5000
Tray Volume (m3) 0.8836
Disable Heat Loss Calculations No
Heat Model None
Rating Calculations No
Tray Hold Up (m3) 8.836e-002

Vessels

Vessel Reboiler @COL2
Diameter (m) 1.193
Length (m) 1.789
Volume (m3) 2.000
Orientation Horizontal
Vessel has a Boot No
Boot Diameter (m) ---
Boot Length (m) ---
Hold Up (m3) 1.000

Other Equipment In Column Flowsheet

Pressure Profile

	Pressure (kPa)	Pressure Drop (kPa)
1__Main Tower	870.0 kPa	2.222 kPa
2__Main Tower	872.2 kPa	2.222 kPa
3__Main Tower	874.4 kPa	2.222 kPa
4__Main Tower	876.7 kPa	2.222 kPa
5__Main Tower	878.9 kPa	2.222 kPa
6__Main Tower	881.1 kPa	2.222 kPa
7__Main Tower	883.3 kPa	2.222 kPa
8__Main Tower	885.6 kPa	2.222 kPa
9__Main Tower	887.8 kPa	2.222 kPa
10__Main Tower	890.0 kPa	---
Reboiler	890.0 kPa	0.0000 kPa

Pressure Solving Options

Pressure Tolerance 1.000e-004 Pressure Drop Tolerance 1.000e-004
Damping Factor 1.000 Max Press Iterations 100
SUMMARY

Flow Basis: Molar The composition option is selected
Feed Composition

	METH reflux	Meth H2O Pumped
Flow Rate (kgmole/h)	325.0358	954.8151
	---	---
diM-Ether	0.0264	0.0086
Methanol	0.8177	0.2819
H2O	0.1558	0.7095

Flow Basis: Molar The composition option is selected
Feed Flows

	METH reflux	Meth H2O Pumped
Flow Rate (kgmole/h)	325.0358	954.8151
	---	---
diM-Ether (kgmole/h)	8.5829	8.2470
Methanol (kgmole/h)	265.7961	269.1150
H2O (kgmole/h)	50.6567	677.4530

Products
Flow Basis: Molar The composition option is selected
Product Compositions

	Meth Recycle	Waste Water
Flow Rate (kgmole/h)	650.0070	629.8439
	---	---
diM-Ether	0.0259	0.0000
Methanol	0.8187	0.0043
H2O	0.1554	0.9957

Flow Basis: Molar The composition option is selected
Product Flows

	Meth Recycle	Waste Water
Flow Rate (kgmole/h)	650.0070	629.8439
	---	---
diM-Ether (kgmole/h)	16.8297	0.0003
Methanol (kgmole/h)	532.1784	2.7328
H2O (kgmole/h)	100.9990	627.1108

Flow Basis: Molar The composition option is selected
Product Recoveries

	Meth Recycle	Waste Water
Flow Rate (kgmole/h)	650.0070	629.8439
	---	---
diM-Ether (%)	99.9985	0.0015
Methanol (%)	99.4891	0.5109
H2O (%)	13.8714	86.1286

COLUMN PROFILES

Reflux Ratio: 0.5772 Reboil Ratio: 1.013 The Flows Option is Selected Flow Basis: Molar
Column Profiles Flows

	Temp (C)	Pres (kPa)	Net Liq (kgmole/h)	Net Vap (kgmole/h)	Net Feed (kgmole/h)	Net Draws (kgmole/h)	Duty (kJ/h)
1__Main Tower	136.3	870.0	375.2	---	325.0	650.0	---
2__Main Tower	140.5	872.2	359.9	700.2	---	---	---
3__Main Tower	144.8	874.4	348.0	684.9	---	---	---
4__Main Tower	148.5	876.7	341.1	673.0	---	---	---
5__Main Tower	150.9	878.9	338.0	666.1	---	---	---
6__Main Tower	152.1	881.1	1286	662.9	954.8	---	---
7__Main Tower	157.5	883.3	1273	655.9	---	---	---
8__Main Tower	163.9	885.6	1267	643.3	---	---	---
9__Main Tower	169.4	887.8	1267	637.0	---	---	---
10__Main Tower	172.7	890.0	1268	636.7	---	---	---
Reboiler	174.1	890.0	---	638.0	---	629.8	2.34e+007

Column Profiles Energy

	Temperature (C)	Liq Enthalpy (kJ/kgmole)	Vap Enthalpy (kJ/kgmole)	Heat Loss (kJ/h)
1__Main Tower	136.3	-2.413e+005	-2.018e+005	---
2__Main Tower	140.5	-2.491e+005	-2.053e+005	---
3__Main Tower	144.8	-2.559e+005	-2.086e+005	---
4__Main Tower	148.5	-2.603e+005	-2.114e+005	---
5__Main Tower	150.9	-2.626e+005	-2.133e+005	---
6__Main Tower	152.1	-2.636e+005	-2.142e+005	---
7__Main Tower	157.5	-2.671e+005	-2.188e+005	---
8__Main Tower	163.9	-2.702e+005	-2.248e+005	---
9__Main Tower	169.4	-2.721e+005	-2.305e+005	---
10__Main Tower	172.7	-2.729e+005	-2.341e+005	---
Reboiler	174.1	-2.733e+005	-2.359e+005	---

FEEDS / PRODUCTS

Flow Basis: Molar
Stream Type Duty State Flows Enthalpy Temp
(kJ/h) (kgmole/h) (kJ/kgmole) (C)
1__Main Tower METH reflux Feed --- Liquid 325 -2.4e+005 76.29
Meth Recycle Draw --- Vapour 650 -2.0e+005 136.26
2__Main Tower
3__Main Tower
4__Main Tower
5__Main Tower
6__Main Tower Meth H2O Pumped Feed --- Liquid 955 -2.6e+005 145.36
7__Main Tower
8__Main Tower
9__Main Tower
10__Main Tower
Reboiler Reboiler 2 Energy 2.3e+007 --- --- ---
Waste Water Draw --- Liquid 630 -2.7e+005 174.14
PERFORMANCE SUMMARY FOR INTERNAL OPTION: Internals-1@Main Tower@COL2

Number Of Stages 10
Total Height (m) 6.096
Total Head Loss (mm) 760.0
Total Pressure Drop (mbar) 59.42
Number Of Sections 1
Number Of Diameters 1
Pressure Drop Across Sump (kPa) ---
Section Start End Height Diameter Internals Tray or Packing Section Pressure Drop Approach To Flood Limiting
(m) (m) Type Type (mbar) (%) Stage
CS-1 1__Main Tower 10__Main Tower 0.6096 1.300 Trayed Sieve 59.42 57.46
SETUP

Sub-Flowsheet
Internal Feed Stream External Feed Stream Transfer Basis
Reboiler 2 Reboiler 2 None Req'd
METH reflux METH reflux P-H Flash
Meth H2O Pumped Meth H2O Pumped P-H Flash
Internal Prod Stream External Prod Stream Transfer Basis
Meth Recycle Meth Recycle P-H Flash
Waste Water Waste Water P-H Flash

VARIABLES

Column Flowsheet Vars Available as Parameters
Data Source Variable Component Description

COMPONENT MAPS

Feed Streams
Feed Name In to SubFlowSheet Out of SubFlowSheet
Reboiler 2
METH reflux

Product Stream
Product Name In to SubFlowSheet Out of SubFlowSheet
Meth Recycle

TRAY by TRAY PROPERTIES TABLES

Column Temperature / Pressure Profile

Column Stage	Temperature (C)	Pressure (kPa)
1__Main Tower	136.3	870.0
2__Main Tower	140.5	872.2
3__Main Tower	144.8	874.4
4__Main Tower	148.5	876.7
5__Main Tower	150.9	878.9
6__Main Tower	152.1	881.1
7__Main Tower	157.5	883.3
8__Main Tower	163.9	885.6
9__Main Tower	169.4	887.8
10__Main Tower	172.7	890.0
Reboiler	174.1	890.0

Column Flow Profile

Options Selected
Molar flow is selected Net is selected as flow basis

Tray Number	Vapour (kgmole/h)	Bulk Liquid (kgmole/h)
1__Main Tower	650.0	375.2
2__Main Tower	700.2	359.9
3__Main Tower	684.9	348.0
4__Main Tower	673.0	341.1
5__Main Tower	666.1	338.0
6__Main Tower	662.9	1286
7__Main Tower	655.9	1273
8__Main Tower	643.3	1267
9__Main Tower	637.0	1267
10__Main Tower	636.7	1268
Reboiler	638.0	629.8

Column Properties Profile

Options Selected
Mass basis is selected

Stage	Surf Tens L-Liq (dyne/cm)	Mol Wt L-Liq	Dens L-Liq (kg/m3)	Visc L-Liq (cP)	Therm Con L-Liq (W/m-K)	Heat Cap L-Liq (kJ/kg-C)
1__Main Tower	24.7	27.7	701	0.162	0.241	4.28
2__Main Tower	30.2	25.5	730	0.160	0.318	4.32
3__Main Tower	34.9	23.5	761	0.155	0.397	4.35
4__Main Tower	37.8	22.1	785	0.148	0.457	4.36

5__Main Tower 39.2 21.5 799 0.143 0.490
4.37
6__Main Tower 39.8 21.2 805 0.140 0.506
4.38
7__Main Tower 41.6 20.1 829 0.130 0.562
4.40
8__Main Tower 42.9 19.1 853 8.99e-002 0.617
4.41
9__Main Tower 43.3 18.5 868 9.04e-002 0.653
4.41
10__Main Tower 43.4 18.2 875 9.03e-002 0.671
4.40
Reboiler 43.4 18.1 878 9.01e-002 0.679 4.40

Column Composition Profile

Options Selected
Fraction is selected as the composition basis Net is selected as flow basis
Molar basis is selected
Stage diM-Ether Methanol H2O
L-Liq L-Liq L-Liq
1__Main Tower 0.0043 0.6853 0.3105
2__Main Tower 0.0022 0.5260 0.4718
3__Main Tower 0.0020 0.3846 0.6134
4__Main Tower 0.0019 0.2907 0.7074
5__Main Tower 0.0018 0.2421 0.7561
6__Main Tower 0.0017 0.2204 0.7779
7__Main Tower 0.0004 0.1461 0.8535
8__Main Tower 0.0001 0.0773 0.9226
9__Main Tower 0.0000 0.0341 0.9659
10__Main Tower 0.0000 0.0132 0.9868
Reboiler 0.0000 0.0043 0.9957
Heavy/Light Key Component Ratios

Options Selected
Molar basis is selected
Key Components

Light Key Chosen Heavy Key Chosen
diM-Ether On diM-Ether Off
Methanol On Methanol Off
H2O On H2O Off
Stage Light Liq
1__Main Tower ---
2__Main Tower ---
3__Main Tower ---
4__Main Tower ---
5__Main Tower ---
6__Main Tower ---
7__Main Tower ---
8__Main Tower ---
9__Main Tower ---
10__Main Tower ---
Reboiler ---
Column K-Values Profile

Tray Number diM-Ether Methanol H2O
1__Main Tower 6.088 1.195 0.5005
2__Main Tower 6.280 1.422 0.5050
3__Main Tower 6.681 1.730 0.5240
4__Main Tower 7.159 2.045 0.5542
5__Main Tower 7.507 2.267 0.5791
6__Main Tower 7.688 2.384 0.5931
7__Main Tower 8.561 2.928 0.6664
8__Main Tower 9.739 3.685 0.7743
9__Main Tower 10.79 4.387 0.8804
10__Main Tower 11.42 4.826 0.9490
Reboiler 11.73 5.037 0.9824

MIX-100 (Mixer): Design, Rating

Mixer: MIX-100

CONNECTIONS

Inlet Stream

STREAM NAME FROM UNIT OPERATION
Meth feed
meth to rctr 2 RCY-3 Recycle
Outlet Stream

STREAM NAME TO UNIT OPERATION
meth feed 2 P-100 Pump
PARAMETERS

User Variables

NOZZLE PARAMETERS

Base Elevation Relative to Ground Level 0.0000 m
Meth feed meth to rctr 2 meth feed 2
Diameter (m) 5.000e-002 5.000e-002 5.000e-002
Elevation (Base) (m) 0.0000 0.0000 0.0000
Elevation (Ground) (m) 0.0000 0.0000 0.0000

GBR-100 (Gibbs Reactor): Design, Reactions, Rating

Gibbs Reactor: GBR-100

CONNECTIONS

Inlet Stream Connections

Stream Name From Unit Operation
reactor feed E-101 Heat Exchanger
Outlet Stream Connections

Stream Name To Unit Operation
reactor out Heat Exchanger: E-101
Purge
Energy Stream Connections

Stream Name From Unit Operation

PARAMETERS

Physical Parameters Optional Heat Transfer

Delta P Vessel Volume Duty Energy Stream
0.0000 kPa --- 0.0000 kJ/h
User Variables

REACTIONS OVERALL

REACTIONS SUMMARY: Set-1

Name % Conversion Base Equilibrium Rxn Extent Est. Extent
Component Constant
Rxn-1 --- Methanol --- --- ---
REACTOR COMPONENT SUMMARY

Components Total Inflow Total Reaction Total Outflow Gibbs Energy
--- --- --- ---
--- --- --- ---
--- --- --- ---
REACTION DETAILS

MOLE FLOW SPECIFICATIONS

Components Total Feed (kgmole/h) Total Prod (kgmole/h) Inerts Frac Spec (kgmole/h) Fixed Spec
diM-Ether 8.414 629.1 No --- ---
Methanol 1511 269.6 No --- ---
H2O 56.77 677.5 No --- ---
ATOM MATRIX DATA

C H O
diM-Ether 2.000 6.000 1.000
Methanol 1.000 4.000 1.000
H2O 0.0000 2.000 1.000
RATING

Sizing

Cylinder Vertical Reactor has a Boot: No
Volume --- Diameter --- Height ---
Nozzles

Base Elevation Relative to Ground Level 0.0000 m
Diameter --- Height ---
reactor feed reactor out Purge
Diameter (m) 5.000e-002 5.000e-002 5.000e-002
Elevation (Base) (m) 0.0000 0.0000 0.0000
Elevation (Ground) (m) 0.0000 0.0000 0.0000
Elevation (% of Height) (%) --- --- ---

E-102 (Cooler): Design, Rating, Profiles, Tables

Cooler: E-102

CONNECTIONS

Inlet Stream

STREAM NAME FROM UNIT OPERATION
D1 feed E-101 Heat Exchanger
Outlet Stream

STREAM NAME TO UNIT OPERATION
D1 feed cooled P-102 Pump
Energy Stream

STREAM NAME TO UNIT OPERATION
cooler1
PARAMETERS

Pressure Drop: 0.0000 kPa Duty: 6.679e+007 kJ/h
Volume: 0.1000 m3
Function: Not Selected Zones: 1
User Variables

NOZZLE PARAMETERS

Base Elevation Relative to Ground Level 0.0000 m
D1 feed D1 feed cooled
Diameter (m) 5.000e-002 5.000e-002
Elevation (Base) (m) 0.0000 0.0000
Elevation (Ground) (m) 0.0000 0.0000
PERFORMANCE PROFILES

Zone Pressure (kPa) Temperature (C) Vapour Fraction Enthalpy (kJ/kgmole)
Inlet 790.00 273.68 1.0000 -197332.55
0 790.00 73.68 0.0000 -239711.77
PERFORMANCE TABLE

Overall Phase

Temperature (C) Pressure (kPa) Heat Flow (kJ/h) Enthalpy (kJ/kgmole) Vapour Fraction Vap Phase Mass Frac Heat of Vap (kJ/kgmole)
273.68 790.00 0.00 -197332.55 1.0000 1.0000 ---
253.68 790.00 -2059884.08 -198639.49 1.0000 1.0000 ---
233.68 790.00 -4082298.63 -199922.65 1.0000 1.0000 ---
213.68 790.00 -6069185.46 -201183.27 1.0000 1.0000 ---
193.68 790.00 -8023937.68 -202423.50 1.0000 1.0000 ---
173.68 790.00 -9952207.16 -203646.94 1.0000 1.0000 ---
153.68 790.00 -11863163.69 -204859.38 1.0000 1.0000 ---
133.68 790.00 -26008256.71 -213834.03 0.7843 0.8538 ---
113.68 790.00 -44191586.56 -225370.83 0.4721 0.5914 ---
93.68 790.00 -55982057.93 -232851.54 0.2487 0.3386 ---
73.68 790.00 -66794563.84 -239711.77

0.0000 0.0000 ---

Vapour Phase

Mass Flow (kg/h)	Molecular Wt (kg/m3)	Density (kJ/kg-C)	Mass Sp Heat (cP)	Viscosity (W/m-K)	Thermal Cond
49823.68	31.61	5.49	2.09	0.02	0.04
49823.68	31.61	5.70	2.05	0.01	0.04
49823.68	31.61	5.93	2.01	0.01	0.04
49823.68	31.61	6.17	1.98	0.01	0.03
49823.68	31.61	6.43	1.95	0.01	0.03
49823.68	31.61	6.72	1.92	0.01	0.03
49823.68	31.61	7.04	1.91	0.01	0.03
42541.05	34.41	8.04	1.83	0.01	0.03
29465.49	39.60	9.73	1.71	0.01	0.02
16872.06	43.04	11.15	1.64	0.01	0.02
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Std Gas Flow (STD_m3/h)	Z Factor	Pseudo Pc (kPa)	Pseudo Tc (C)	Pseudo Zc	Pseudo Omega
37266.37	1.00	12892.78	252.40	0.26	0.32
37266.37	1.00	12892.78	252.40	0.26	0.32
37266.37	1.00	12892.78	252.40	0.26	0.32
37266.37	1.00	12892.78	252.40	0.26	0.32
37266.37	1.00	12892.78	252.40	0.26	0.32
37266.37	1.00	12892.78	252.40	0.26	0.32
37266.37	1.00	12892.78	252.40	0.26	0.32
29227.76	1.00	11090.89	227.48	0.27	0.31
17592.10	1.00	8123.26	181.99	0.27	0.28
9269.16	1.00	6528.65	152.51	0.27	0.24
---	---	---	---	---	---

Light Liquid Phase

Mass Flow (kg/h)	Density (kg/m3)	Mass Sp Heat (kJ/kg-C)	Viscosity (cP)	Thermal Cond (W/m-K)	Surface Tens (dyne/cm)
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49823.68	680.04	3.39	0.15	0.28	33.17

Molecular Wt	Sp Gravity	Pseudo Pc (kPa)	Pseudo Tc (C)	Pseudo Zc	Pseudo Omega
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31.61	0.68	12892.78	252.40	0.26	0.32

Heavy Liquid Phase

Mass Flow (kg/h)	Density (kg/m3)	Mass Sp Heat (kJ/kg-C)	Viscosity (cP)	Thermal Cond (W/m-K)	Surface Tens (dyne/cm)
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7282.63	807.87	3.92	0.14	0.53	44.41
20358.19	756.59	4.29	0.16	0.42	41.16
32951.62	714.98	3.79	0.16	0.34	37.48
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Molecular Wt	Sp Gravity	Pseudo Pc (kPa)	Pseudo Tc (C)	Pseudo Zc	Pseudo Omega
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21.42	0.81	19444.33	343.02	0.26	0.36
24.47	0.76	17157.53	315.37	0.26	0.36
27.83	0.71	14999.78	285.48	0.26	0.35
---	---	---	---	---	---

Mixed Liquid Phase

Mass Flow (kg/h)	Density (kg/m3)	Mass Sp Heat (kJ/kg-C)	Viscosity (cP)	Thermal Cond (W/m-K)	Surface Tens (dyne/cm)
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7282.63	807.87	3.92	0.14	0.53	44.41
20358.19	756.59	4.29	0.16	0.42	41.16
32951.62	714.98	3.79	0.16	0.34	37.48
49823.68	680.04	3.39	0.15	0.28	33.17

Molecular Wt	Sp Gravity	Pseudo Pc (kPa)	Pseudo Tc (C)	Pseudo Zc	Pseudo Omega
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21.42	0.81	19444.33	343.02	0.26	0.36
24.47	0.76	17157.53	315.37	0.26	0.36
27.83	0.71	14999.78	285.48	0.26	0.35
31.61	0.68	12892.78	252.40	0.26	0.32

E-103 (Cooler): Design, Rating, Profiles, Tables

Cooler: E-103

CONNECTIONS

Inlet Stream

STREAM NAME	FROM UNIT OPERATION
Meth Recycle	T-101 Reboiled Absorber

Outlet Stream

STREAM NAME	TO UNIT OPERATION
Cooled meth recycle	P-103 Pump

Energy Stream

STREAM NAME	TO UNIT OPERATION
Cooler3	

PARAMETERS

Pressure Drop: 0.0000 kPa Duty: 2.470e+007 kJ/h
Volume: 0.1000 m3
Function: Not Selected Zones: 1
User Variables

NOZZLE PARAMETERS

Base Elevation Relative to Ground Level 0.0000 m

	Meth Recycle	Cooled meth recycle
Diameter (m)	5.000e-002	5.000e-002
Elevation (Base) (m)	0.0000	0.0000
Elevation (Ground) (m)	0.0000	0.0000

PERFORMANCE PROFILES

Zone	Pressure (kPa)	Temperature (C)	Vapour Fraction	Enthalpy (kJ/kgmole)
Inlet	870.00	136.26	1.0000	-201833.38
0	870.00	76.26	0.0000	-239827.88

PERFORMANCE TABLE

Overall Phase

Temperature (C)	Pressure (kPa)	Heat Flow (kJ/h)	Enthalpy (kJ/kgmole)
136.26	870.00	0.00	-201833.38
130.26	870.00	-19288457.75	-231507.61
124.26	870.00	-20927755.57	-234029.58
118.26	870.00	-21427800.51	-234798.87
112.26	870.00	-21914380.61	-235547.45
106.26	870.00	-22392444.87	-236282.92
100.26	870.00	-22863705.28	-237007.93
94.26	870.00	-23329143.12	-237723.98
88.26	870.00	-23789446.27	-238432.13
82.26	870.00	-24245149.01	-239133.21
76.26	870.00	-24696690.78	-239827.88

Vapour Fraction	Vap Phase Mass Frac	Heat of Vap (kJ/kgmole)
1.0000	1.0000	---
0.0638	0.0689	---
0.0000	0.0000	---
0.0000	0.0000	---
0.0000	0.0000	---
0.0000	0.0000	---
0.0000	0.0000	---
0.0000	0.0000	---
0.0000	0.0000	---
0.0000	0.0000	---

Vapour Phase

Mass Flow (kg/h)	Molecular Wt	Density (kg/m3)	Mass Sp Heat (kJ/kg-C)	Viscosity (cP)	Thermal Cond (W/m-K)
19646.84	30.23	7.73	1.69	0.01	0.02
1352.90	32.61	8.46	1.66	0.01	0.02
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Std Gas Flow (STD_m3/h)	Z Factor	Pseudo Pc (kPa)	Pseudo Tc (C)	Pseudo Zc	Pseudo Omega
15369.05	1.00	9614.08	257.46	0.25	0.51
981.07	1.00	8249.42	236.59	0.25	0.50
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Light Liquid Phase

Mass Flow (kg/h)	Density (kg/m3)	Mass Sp Heat (kJ/kg-C)	Viscosity (cP)	Thermal Cond (W/m-K)	Surface Tens (dyne/cm)
---	---	---	---	---	---
18293.94	677.79	4.17	0.16	0.18	19.57
19646.84	683.26	4.35	0.17	0.18	20.17
19646.84	691.29	4.17	0.18	0.19	21.08
19646.84	699.11	4.09	0.20	0.19	21.99
19646.84	706.72	4.02	0.21	0.19	22.91
19646.84	714.16	3.97	0.22	0.19	23.84
19646.84	721.43	3.93	0.24	0.20	24.77
19646.84	728.55	3.88	0.25	0.20	25.70
19646.84	735.53	3.85	0.27	0.20	26.63
19646.84	742.38	3.81	0.29	0.21	27.57

Molecular Wt	Sp Gravity	Pseudo Pc (kPa)	Pseudo Tc (C)	Pseudo Zc	Pseudo Omega
---	---	---	---	---	---
30.06	0.68	9707.13	258.89	0.25	0.52
30.23	0.68	9614.08	257.46	0.25	0.51

30.23	0.69	9614.08	257.46	0.25	0.51
30.23	0.70	9614.08	257.46	0.25	0.51
30.23	0.71	9614.08	257.46	0.25	0.51
30.23	0.71	9614.08	257.46	0.25	0.51
30.23	0.72	9614.08	257.46	0.25	0.51
30.23	0.73	9614.08	257.46	0.25	0.51
30.23	0.74	9614.08	257.46	0.25	0.51
30.23	0.74	9614.08	257.46	0.25	0.51

Heavy Liquid Phase

Mass Flow (kg/h)	Density (kg/m3)	Mass Sp Heat (kJ/kg-C)	Viscosity (cP)	Thermal Cond (W/m-K)	Surface Tens (dyne/cm)
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Molecular Wt	Sp Gravity	Pseudo Pc (kPa)	Pseudo Tc (C)	Pseudo Zc	Pseudo Omega
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Mixed Liquid Phase

Mass Flow (kg/h)	Density (kg/m3)	Mass Sp Heat (kJ/kg-C)	Viscosity (cP)	Thermal Cond (W/m-K)	Surface Tens (dyne/cm)
---	---	---	---	---	---
18293.94	677.79	4.17	0.16	0.18	19.57
19646.84	683.26	4.35	0.17	0.18	20.17
19646.84	691.29	4.17	0.18	0.19	21.08
19646.84	699.11	4.09	0.20	0.19	21.99
19646.84	706.72	4.02	0.21	0.19	22.91
19646.84	714.16	3.97	0.22	0.19	23.84
19646.84	721.43	3.93	0.24	0.20	24.77
19646.84	728.55	3.88	0.25	0.20	25.70
19646.84	735.53	3.85	0.27	0.20	26.63
19646.84	742.38	3.81	0.29	0.21	27.57

Molecular Wt	Sp Gravity	Pseudo Pc (kPa)	Pseudo Tc (C)	Pseudo Zc	Pseudo Omega
---	---	---	---	---	---
30.06	0.68	9707.13	258.89	0.25	0.52
30.23	0.68	9614.08	257.46	0.25	0.51
30.23	0.69	9614.08	257.46	0.25	0.51
30.23	0.70	9614.08	257.46	0.25	0.51
30.23	0.71	9614.08	257.46	0.25	0.51
30.23	0.71	9614.08	257.46	0.25	0.51
30.23	0.72	9614.08	257.46	0.25	0.51
30.23	0.73	9614.08	257.46	0.25	0.51
30.23	0.74	9614.08	257.46	0.25	0.51
30.23	0.74	9614.08	257.46	0.25	0.51

E-104 (Cooler): Design, Rating, Profiles, Tables

Cooler: E-104

CONNECTIONS

Inlet Stream

STREAM NAME	FROM UNIT OPERATION
DME outlet	T-100 Reboiled Absorber

Outlet Stream

STREAM NAME	TO UNIT OPERATION
DME out2	P-104 Pump

Energy Stream

STREAM NAME	TO UNIT OPERATION
cooler2	

PARAMETERS

Pressure Drop: 0.0000 kPa Duty: 2.364e+007 kJ/h
Volume: 0.1000 m3
Function: Not Selected Zones: 1
User Variables

NOZZLE PARAMETERS

Base Elevation Relative to Ground Level 0.0000 m

	DME outlet	DME out2
Diameter (m)	5.000e-002	5.000e-002
Elevation (Base) (m)	0.0000	0.0000
Elevation (Ground) (m)	0.0000	0.0000

PERFORMANCE PROFILES

Zone	Pressure (kPa)	Temperature (C)	Vapour Fraction	Enthalpy (kJ/kgmole)
Inlet	820.00	37.94	1.0000	-183339.13
0	820.00	36.94	0.0000	-202207.96

PERFORMANCE TABLE

Overall Phase

Temperature (C)	Pressure (kPa)	Heat Flow (kJ/h)	Enthalpy (kJ/kgmole)
37.94	820.00	0.00	-183339.13
37.84	820.00	-167637.55	-183472.93
37.74	820.00	-403347.75	-183661.06
37.64	820.00	-755150.17	-183941.86
37.54	820.00	-1341529.14	-184409.88
37.44	820.00	-2533470.21	-185361.25

37.34	820.00	-6369657.75	-188423.15
37.24	820.00	-23596837.39	-202173.23
37.14	820.00	-23611347.29	-202184.81
37.04	820.00	-23625852.71	-202196.39
36.94	820.00	-23640353.63	-202207.96

Vapour Fraction	Vap Phase Mass Frac	Heat of Vap (kJ/kgmole)
1.0000	1.0000	---
0.9933	0.9934	---
0.9838	0.9838	---
0.9693	0.9694	---
0.9448	0.9449	---
0.8946	0.8947	---
0.7319	0.7321	---
0.0000	0.0000	---
0.0000	0.0000	---
0.0000	0.0000	---
0.0000	0.0000	---

Vapour Phase

Mass Flow (kg/h)	Molecular Wt	Density (kg/m3)	Mass Sp Heat (kJ/kg-C)	Viscosity (cP)	Thermal Cond (W/m-K)
57706.12	46.06	14.60	1.47	0.01	0.02
57322.93	46.06	14.61	1.47	0.01	0.02
56772.83	46.06	14.61	1.47	0.01	0.02
55937.86	46.06	14.62	1.47	0.01	0.02
54527.23	46.06	14.62	1.47	0.01	0.02
51630.51	46.07	14.63	1.47	0.01	0.02
42244.73	46.07	14.63	1.47	0.01	0.02
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---

Std Gas Flow (STD_m3/h)	Z Factor	Pseudo Pc (kPa)	Pseudo Tc (C)	Pseudo Zc	Pseudo Omega
29623.60	1.00	5321.53	126.93	0.27	0.20
29425.95	1.00	5321.30	126.92	0.27	0.20
29142.63	1.00	5321.07	126.91	0.27	0.20
28713.10	1.00	5320.85	126.90	0.27	0.20
27988.11	1.00	5320.63	126.88	0.27	0.20
26500.42	1.00	5320.41	126.87	0.27	0.20
21682.28	1.00	5320.19	126.86	0.27	0.20
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---

Light Liquid Phase

Mass Flow (kg/h)	Density (kg/m3)	Mass Sp Heat (kJ/kg-C)	Viscosity (cP)	Thermal Cond (W/m-K)	Surface Tens (dyne/cm)
---	---	---	---	---	---
383.19	586.48	2.53	0.08	0.13	10.28
933.29	586.21	2.53	0.08	0.13	10.24
1768.26	585.94	2.53	0.08	0.13	10.20
3178.89	585.66	2.52	0.08	0.13	10.17
6075.62	585.39	2.52	0.08	0.13	10.13
15461.39	585.12	2.52	0.08	0.13	10.10
57706.12	585.00	2.51	0.08	0.13	10.08
57706.12	585.16	2.51	0.08	0.13	10.09
57706.12	585.31	2.51	0.08	0.13	10.11
57706.12	585.47	2.51	0.08	0.13	10.12

Molecular Wt	Sp Gravity	Pseudo Pc (kPa)	Pseudo Tc (C)	Pseudo Zc	Pseudo Omega
---	---	---	---	---	---
45.84	0.59	5356.26	128.68	0.27	0.21
45.88	0.59	5349.39	128.36	0.27	0.20
45.92	0.59	5343.07	128.05	0.27	0.20
45.96	0.59	5337.00	127.74	0.27	0.20
46.00	0.59	5331.06	127.43	0.27	0.20
46.03	0.59	5325.19	127.13	0.27	0.20
46.06	0.59	5321.53	126.93	0.27	0.20
46.06	0.59	5321.53	126.93	0.27	0.20
46.06	0.59	5321.53	126.93	0.27	0.20
46.06	0.59	5321.53	126.93	0.27	0.20

Heavy Liquid Phase

Mass Flow (kg/h)	Density (kg/m3)	Mass Sp Heat (kJ/kg-C)	Viscosity (cP)	Thermal Cond (W/m-K)	Surface Tens (dyne/cm)
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---
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---	---	---	---	---	---
---	---	---	---	---	---

Molecular Wt	Sp Gravity	Pseudo Pc (kPa)	Pseudo Tc (C)	Pseudo Zc	Pseudo Omega
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---
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---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---

Mixed Liquid Phase

Mass Flow (kg/h)	Density (kg/m3)	Mass Sp Heat (kJ/kg-C)	Viscosity (cP)	Thermal Cond (W/m-K)	Surface Tens (dyne/cm)
---	---	---	---	---	---
383.19	586.48	2.53	0.08	0.13	10.28
933.29	586.21	2.53	0.08	0.13	10.24
1768.26	585.94	2.53	0.08	0.13	10.20
3178.89	585.66	2.52	0.08	0.13	10.17
6075.62	585.39	2.52	0.08	0.13	10.13
15461.39	585.12	2.52	0.08	0.13	10.10
57706.12	585.00	2.51	0.08	0.13	10.08

57706.12 585.16 2.51 0.08 0.13 10.09
57706.12 585.31 2.51 0.08 0.13 10.11
57706.12 585.47 2.51 0.08 0.13 10.12

Molecular Wt	Sp Gravity	Pseudo Pc (kPa)	Pseudo Tc (C)	Pseudo Zc	Pseudo Omega
45.84	0.59	5356.26	128.68	0.27	0.21
45.88	0.59	5349.39	128.36	0.27	0.20
45.92	0.59	5343.07	128.05	0.27	0.20
45.96	0.59	5337.00	127.74	0.27	0.20
46.00	0.59	5331.06	127.43	0.27	0.20
46.03	0.59	5325.19	127.13	0.27	0.20
46.06	0.59	5321.53	126.93	0.27	0.20
46.06	0.59	5321.53	126.93	0.27	0.20
46.06	0.59	5321.53	126.93	0.27	0.20
46.06	0.59	5321.53	126.93	0.27	0.20

P-100 (Pump): Design, Rating, Performance

Pump: P-100

CONNECTIONS

Inlet Stream

Stream Name From Unit Operation
meth feed 2 MIX-100 Mixer
Outlet Stream

Stream Name To Unit Operation
meth feed 2 high P E-100 Heater
Energy Stream

Stream Name From Unit Operation
Pump1
PARAMETERS

Adiabatic Efficiency (%): 75.00 Delta P: 690.0 kPa
Duty: 16.38 kW
CURVES

Delta P: 690.0 kPa Duty: 16.38 kW
Coefficient A: 0.0000 Coefficient B: 0.0000 Coefficient C: 0.0000
Parameter Preferences Units for Delta P: m Flow Basis ActVolFlow Units for Flow: m3/h
User Variables

RATING

Head Offset: --- Efficiency Offset: ---
Characteristic Curves

Speed:
Flow Head Efficiency (%)
NPSH

NPSH Required --- NPSH Available 13.14 m Enable NPSH Curves: No
NPSH Curves

Nozzle Paramaters

Base Elevation Relative to Ground Level 0.0000 m

	meth feed 2	meth feed 2 high P
Diameter (m)	5.000e-002	5.000e-002
Elevation (Base) (m)	0.0000	0.0000
Elevation (Ground) (m)	0.0000	0.0000

Inertia

Rotational inertia (kg-m2) 0.5000 Radius of gyration (m) 0.1000 Mass (kg) 50.00 Friction loss factor (kg-m2/s) 5.000e-002
Start Up

Design Flow Typical Operating Capacity 10.00 m3/h
PERFORMANCE

Results

Total Head --- Velocity Head -7.869e-004 m
Total Fluid Head ---
Pressure Head 90.49 m Delta P excluding Static Head Results ---

---

P-101 (Pump): Design, Rating, Performance

Pump: P-101

CONNECTIONS

Inlet Stream

Stream Name From Unit Operation
Meth H2O T-100 Reboiled Absorber
Outlet Stream

Stream Name To Unit Operation
Meth H2O Pumped T-101 Reboiled Absorber
Energy Stream

Stream Name From Unit Operation
pumper
PARAMETERS

Adiabatic Efficiency (%): 75.00 Delta P: 40.00 kPa
Duty: 0.3996 kW
CURVES

Delta P: 40.00 kPa Duty: 0.3996 kW
Coefficient A: 0.0000 Coefficient B: 0.0000 Coefficient C: 0.0000
Parameter Preferences Units for Delta P: m Flow Basis ActVolFlow Units for Flow: m3/h
User Variables

RATING

Head Offset: --- Efficiency Offset: ---
Characteristic Curves

Speed:
Flow Head Efficiency (%)
NPSH

NPSH Required --- NPSH Available 0.7431 m Enable
NPSH Curves: No
NPSH Curves

Nozzle Paramaters

Base Elevation Relative to Ground Level 0.0000 m
Meth H2O Meth H2O Pumped
Diameter (m) 5.000e-002 5.000e-002
Elevation (Base) (m) 0.0000 0.0000
Elevation (Ground) (m) 0.0000 0.0000
Inertia

Rotational inertia (kg-m2) 0.5000 Radius of gyration (m) 0.1000 Mass (kg) 50.00 Friction loss factor (kg-m2/s) 5.000e-002
Start Up

Design Flow Typical Operating Capacity 10.00 m3/h
PERFORMANCE

Results

Total Head --- Velocity Head -5.837e-005 m
Total Fluid Head ---
Pressure Head 5.187 m Delta P excluding Static Head Results ---

---

P-102 (Pump): Design, Rating, Performance

Pump: P-102

CONNECTIONS

Inlet Stream

Stream Name From Unit Operation
D1 feed cooled E-102 Cooler
Outlet Stream

Stream Name To Unit Operation
D1 feed pumped TEE-102 Tee
Energy Stream

Stream Name From Unit Operation
pumper2
PARAMETERS

Adiabatic Efficiency (%): 75.00 Delta P: 40.00 kPa
Duty: 1.085 kW
CURVES

Delta P: 40.00 kPa Duty: 1.085 kW
Coefficient A: 0.0000 Coefficient B: 0.0000 Coefficient C: 0.0000
Parameter Preferences Units for Delta P: m Flow Basis ActVolFlow Units for Flow: m3/h

User Variables

RATING

Head Offset: --- Efficiency Offset: ---
Characteristic Curves

Speed:
Flow Head Efficiency (%)
NPSH

NPSH Required --- NPSH Available 7.521 m Enable
NPSH Curves: No
NPSH Curves

Nozzle Paramaters

Base Elevation Relative to Ground Level 0.0000 m
D1 feed cooled D1 feed pumped
Diameter (m) 5.000e-002 5.000e-002
Elevation (Base) (m) 0.0000 0.0000
Elevation (Ground) (m) 0.0000 0.0000
Inertia

Rotational inertia (kg-m2) 0.5000 Radius of gyration (m) 0.1000 Mass (kg) 50.00 Friction loss factor (kg-m2/s) 5.000e-002
Start Up

Design Flow Typical Operating Capacity 10.00 m3/h
PERFORMANCE

Results

Total Head --- Velocity Head 1.659e-004 m
Total Fluid Head ---
Pressure Head 5.998 m Delta P excluding Static Head Results ---

---

P-103 (Pump): Design, Rating, Performance

Pump: P-103

CONNECTIONS

Inlet Stream

Stream Name From Unit Operation
Cooled meth recycle E-103 Cooler
Outlet Stream

Stream Name To Unit Operation
CMR2 TEE-100 Tee
Energy Stream

Stream Name From Unit Operation
pumper3
PARAMETERS

Adiabatic Efficiency (%): 75.00 Delta P: 40.00 kPa
Duty: 0.3921 kW

CURVES

Delta P: 40.00 kPa Duty: 0.3921 kW
Coefficient A: 0.0000 Coefficient B: 0.0000 Coefficient C: 0.0000
Parameter Preferences Units for Delta P: m Flow Basis ActVolFlow Units for Flow: m3/h
User Variables

RATING

Head Offset: --- Efficiency Offset: ---
Characteristic Curves

Speed:
Flow Head Efficiency (%)
NPSH

NPSH Required --- NPSH Available 94.13 m Enable NPSH Curves: No
NPSH Curves

Nozzle Paramaters

Base Elevation Relative to Ground Level 0.0000 m

	Cooled meth recycle CMR2	
Diameter (m)	5.000e-002	5.000e-002
Elevation (Base) (m)	0.0000	0.0000
Elevation (Ground) (m)	0.0000	0.0000

Inertia

Rotational inertia (kg-m2) 0.5000 Radius of gyration (m) 0.1000 Mass (kg) 50.00 Friction loss factor (kg-m2/s) 5.000e-002
Start Up

Design Flow Typical Operating Capacity 10.00 m3/h
PERFORMANCE

Results

Total Head --- Velocity Head -4.134e-005 m
Total Fluid Head ---
Pressure Head 5.494 m Delta P excluding Static Head Results ---

---

P-104 (Pump): Design, Rating, Performance

Pump: P-104

CONNECTIONS

Inlet Stream

Stream Name	From Unit Operation
DME out2	E-104 Cooler

Outlet Stream

Stream Name	To Unit Operation
DME out3	TEE-101 Tee
Energy Stream	

Stream Name	From Unit Operation
pumper4	

PARAMETERS

Adiabatic Efficiency (%): 75.00 Delta P: 40.00 kPa
Duty: 1.460 kW
CURVES

Delta P: 40.00 kPa Duty: 1.460 kW
Coefficient A: 0.0000 Coefficient B: 0.0000 Coefficient C: 0.0000
Parameter Preferences Units for Delta P: m Flow Basis ActVolFlow Units for Flow: m3/h
User Variables

RATING

Head Offset: --- Efficiency Offset: ---
Characteristic Curves

Speed:
Flow Head Efficiency (%)
NPSH

NPSH Required --- NPSH Available 11.18 m Enable NPSH Curves: No
NPSH Curves

Nozzle Paramaters

Base Elevation Relative to Ground Level 0.0000 m

	DME out2	DME out3
Diameter (m)	5.000e-002	5.000e-002
Elevation (Base) (m)	0.0000	0.0000
Elevation (Ground) (m)	0.0000	0.0000

Inertia

Rotational inertia (kg-m2) 0.5000 Radius of gyration (m) 0.1000 Mass (kg) 50.00 Friction loss factor (kg-m2/s) 5.000e-002
Start Up

Design Flow Typical Operating Capacity 10.00 m3/h
PERFORMANCE

Results

Total Head --- Velocity Head -7.647e-004 m
Total Fluid Head ---
Pressure Head 6.967 m Delta P excluding Static Head Results ---

---

P-105 (Pump): Design, Rating, Performance

Pump: P-105

CONNECTIONS

Inlet Stream

Stream Name From Unit Operation
Waste Water T-101 Reboiled Absorber
Outlet Stream

Stream Name To Unit Operation
WWT
Energy Stream

Stream Name From Unit Operation
Pumper5
PARAMETERS

Adiabatic Efficiency (%): 75.00 Delta P: 40.00 kPa
Duty: 0.1921 kW
CURVES

Delta P: 40.00 kPa Duty: 0.1921 kW
Coefficient A: 0.0000 Coefficient B: 0.0000 Coefficient C: 0.0000
Parameter Preferences Units for Delta P: m Flow Basis ActVolFlow Units for Flow: m3/h
User Variables

RATING

Head Offset: --- Efficiency Offset: ---
Characteristic Curves

Speed:
Flow Head Efficiency (%)
NPSH

NPSH Required --- NPSH Available 0.1708 m Enable NPSH Curves: No
NPSH Curves

Nozzle Paramaters

Base Elevation Relative to Ground Level 0.0000 m

	Waste Water	WWT
Diameter (m)	5.000e-002	5.000e-002
Elevation (Base) (m)	0.0000	0.0000
Elevation (Ground) (m)	0.0000	0.0000

Inertia

Rotational inertia (kg-m2) 0.5000 Radius of gyration (m) 0.1000 Mass (kg) 50.00 Friction loss factor (kg-m2/s) 5.000e-002
Start Up

Design Flow Typical Operating Capacity 10.00 m3/h
PERFORMANCE

Results

Total Head --- Velocity Head -8.764e-006 m
Total Fluid Head ---
Pressure Head 4.644 m Delta P excluding Static Head Results ---

---
RCY-1 (Recycle): Design

Recycle: RCY-1

CONNECTIONS

Inlet Stream

Stream Name From Unit Operation
DME reflux 1 TEE-101 Tee
Outlet Stream

Stream Name To Unit Operation
DME reflux T-100 Reboiled Absorber
TOLERANCE

Vapour Fraction: 10.00 Temperature: 10.00 Pressure: 10.00
Flow: 10.00 Enthalpy: 10.00 Composition: 10.00
NUMERICAL

Acceleration Type: Wegstein Iteration Type: Nested
Maximum Iterations: 10 Iteration Count: 0
Wegstein Count: 3 Q Minimum: -20.00 Q Maximum: 0.0000
Iteration History

Iteration	Variable	Outlet Value	Inlet Value
0	Converged	---	---

User Variables

RCY-2 (Recycle): Design

Recycle: RCY-2

CONNECTIONS

Inlet Stream

Stream Name From Unit Operation
meth to tower TEE-100 Tee
Outlet Stream

Stream Name To Unit Operation
METH reflux T-101 Reboiled Absorber
TOLERANCE

Vapour Fraction: 10.00 Temperature: 10.00 Pressure: 10.00
Flow: 10.00 Enthalpy: 10.00 Composition: 10.00
NUMERICAL

Acceleration Type: Wegstein Iteration Type: Nested
Maximum Iterations: 10 Iteration Count: 0
Wegstein Count: 3 Q Minimum: -20.00 Q Maximum: 0.0000
Iteration History

Iteration	Variable	Outlet Value	Inlet Value
4	Converged	---	---

User Variables

RCY-3 (Recycle): Design

Recycle: RCY-3

CONNECTIONS

Inlet Stream

Stream Name From Unit Operation
meth to rctr TEE-100 Tee
Outlet Stream

Stream Name To Unit Operation
meth to rctr 2 MIX-100 Mixer
TOLERANCE

Vapour Fraction: 10.00 Temperature: 10.00 Pressure: 10.00
Flow: 10.00 Enthalpy: 10.00 Composition: 10.00
NUMERICAL

Acceleration Type: Wegstein Iteration Type: Nested
Maximum Iterations: 10 Iteration Count: 0
Wegstein Count: 3 Q Minimum: -20.00 Q Maximum: 0.0000
Iteration History

Iteration Variable Outlet Value Inlet Value
5 Converged --- ---
User Variables

TEE-100 (Tee): Design, Rating, Dynamcis

Tee: TEE-100

CONNECTIONS

Inlet Stream

STREAM NAME FROM UNIT OPERATION
CMR2 P-103 Pump
Outlet Stream

STREAM NAME TO UNIT OPERATION
meth to rctr RCY-3 Recycle
meth to tower RCY-2 Recycle
PARAMETERS

Flow Ratios Dynamic Valve Openings
meth to rctr 0.5000 50.00
meth to tower 0.5000 50.00

Valve Control: Multiple Stream
User Variables

RATING

Nozzle Parameters

Base Elevation Relative to Ground Level 0.0000 m

	CMR2	meth to rctr	meth to tower
Diameter (m)	5.000e-002	5.000e-002	5.000e-002
Elevation (Base) (m)	0.0000	0.0000	0.0000
Elevation (Ground) (m)	0.0000	0.0000	0.0000

DYNAMICS

Holdup Details

Phase	Accumulation (kgmole/h)	Moles (kgmole)	Volume (m3)
Vapour	0.0000	0.0000	0.0000
Liquid	0.0000	0.0000	0.0000
Aqueous	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0000

TEE-101 (Tee): Design, Rating, Dynamcis

Tee: TEE-101

CONNECTIONS

Inlet Stream

STREAM NAME FROM UNIT OPERATION
DME out3 P-104 Pump
Outlet Stream

STREAM NAME TO UNIT OPERATION
DME product
DME reflux 1 RCY-1 Recycle
PARAMETERS

Flow Ratios Dynamic Valve Openings
DME product 0.5000 50.00
DME reflux 1 0.5000 50.00

Valve Control: Multiple Stream
User Variables

RATING

Nozzle Parameters

Base Elevation Relative to Ground Level 0.0000 m

	DME out3	DME product	DME reflux 1
Diameter (m)	5.000e-002	5.000e-002	5.000e-002
Elevation (Base) (m)	0.0000	0.0000	0.0000
Elevation (Ground) (m)	0.0000	0.0000	0.0000

DYNAMICS

Holdup Details

Phase Accumulation Moles Volume

	(kgmole/h)	(kgmole)	(m3)
Vapour	0.0000	0.0000	0.0000
Liquid	0.0000	0.0000	0.0000
Aqueous	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0000

TEE-102 (Tee): Design, Rating, Dynamcis

Tee: TEE-102

CONNECTIONS

Inlet Stream

STREAM NAME	FROM UNIT OPERATION
D1 feed pumped	P-102 Pump

Outlet Stream

STREAM NAME	TO UNIT OPERATION
normal op	T-100 Reboiled Absorber
turn down	T-100 Reboiled Absorber

PARAMETERS

	Flow Ratios	Dynamic Valve Openings
normal op	0.5000	50.00
turn down	0.5000	50.00

Valve Control: Multiple Stream
User Variables

RATING

Nozzle Parameters

Base Elevation Relative to Ground Level 0.0000 m

	D1 feed pumped	normal op	turn down
Diameter (m)	5.000e-002	5.000e-002	5.000e-002
Elevation (Base) (m)	0.0000	0.0000	0.0000
Elevation (Ground) (m)	0.0000	0.0000	0.0000

DYNAMICS

Holdup Details

Phase	Accumulation (kgmole/h)	Moles (kgmole)	Volume (m3)
Vapour	0.0000	0.0000	0.0000
Liquid	0.0000	0.0000	0.0000
Aqueous	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0000

ADJ-1 (Adjust): Design

Adjust: ADJ-1

Adjusted Variable		Measured Variable	
OBJECT	VARIABLE	OBJECT	VARIABLE
E-104	Delta T	DME out2	Vapour Fraction

Solving Parameters

Source for Target Value: User Supplied Target Value: 0.0000
Solving Method: Secant Tolerance: 0.0010 Maximum Iterations: 10
Step Size: 3.500 C Minimum: --- Maximum: ---
User Variables

ADJ-2 (Adjust): Design

Adjust: ADJ-2

Adjusted Variable		Measured Variable	
OBJECT	VARIABLE	OBJECT	VARIABLE
E-103	Delta T	Cooled meth recycle	Vapour Fraction

Solving Parameters

Source for Target Value: User Supplied Target Value: 0.0000
Solving Method: Secant Tolerance: 0.0100 Maximum Iterations: 10
Step Size: 10.00 C Minimum: --- Maximum: ---
User Variables

ADJ-3 (Adjust): Design

Adjust: ADJ-3

Adjusted Variable		Measured Variable	
OBJECT	VARIABLE	OBJECT	VARIABLE
E-103	Delta T	meth feed 2	Vapour Fraction

Solving Parameters

Source for Target Value: User Supplied Target Value: 0.0000
Solving Method: Secant Tolerance: 0.0010 Maximum Iterations: 10
Step Size: 10.00 C Minimum: --- Maximum: ---
User Variables

ADJ-4 (Adjust): Design

Adjust: ADJ-4

Adjusted Variable		Measured Variable	

OBJECT VARIABLE OBJECT VARIABLE
E-100 Delta T reactor feed Temperature
Solving Parameters

Source for Target Value: User Supplied Target Value: 250.0 C
Solving Method: Secant Tolerance: 0.1000 C Maximum Iterations: 10
Step Size: 10.00 C Minimum: --- Maximum: ---
User Variables

To Reboiler @COL1 (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

---

Material Stream: To Reboiler @COL1 Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

	OVERALL	VAPOUR PH.	LIQUID PH.
Vapour / Phase Fraction	0.0000	0.0000	1.0000
Temperature: (C)	135.2	135.2	135.2
Pressure: (kPa)	840.0	840.0	840.0
Molar Flow (kgmole/h)	1753	0.0000	1753
Mass Flow (kg/h)	4.326e+004	0.0000	4.326e+004
Std Ideal Liq VolFlow (m3/h)	50.50	0.0000	50.50
Molar Enthalpy (kJ/kgmole)	-2.529e+05	-2.019e+05	-2.529e+05
Molar Entropy (kJ/kgmole-C)	8.519e+01	1.757e+02	8.519e+01
Heat Flow (kJ/h)	-4.434e+08	0.000e-01	-4.434e+08
Liq VolFlow @Std Cond (m3/h)	49.94	0.0000	49.94

COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	57.54	0.0328	2651	0.0613	3.955	0.0783
Methanol	717.6	0.4094	2.299e+004	0.5315	28.90	0.5722
H2O	977.8	0.5578	1.762e+004	0.4072	17.65	0.3495
Total	1753	1.0000	4.326e+004	1.0000	50.50	1.0000

Vapour Phase Phase Fraction 0.0000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	0.0000	0.1979	0.0000	0.2896	0.0000	0.3348
Methanol	0.0000	0.5647	0.0000	0.5746	0.0000	0.5597
H2O	0.0000	0.2374	0.0000	0.1358	0.0000	0.1055
Total	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000

Liquid Phase Phase Fraction 1.000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	57.54	0.0328	2651	0.0613	3.955	0.0783
Methanol	717.6	0.4094	2.299e+004	0.5315	28.90	0.5722
H2O	977.8	0.5578	1.762e+004	0.4072	17.65	0.3495
Total	1753	1.0000	4.326e+004	1.0000	50.50	1.0000

K VALUE

COMPONENTS	MIXED	LIGHT	HEAVY
diM-Ether	6.029	6.029	---
Methanol	1.379	1.379	---
H2O	0.4256	0.4256	---

UNIT OPERATIONS

FEED TO	PRODUCT FROM	LOGICAL CONNECTION
Reboiler: Reboiler @COL1	Tower: Main Tower @COL1	

UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

Boilup @COL1 (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

---

Material Stream: Boilup @COL1 Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

	OVERALL	VAPOUR PH.
Vapour / Phase Fraction	1.0000	1.0000
Temperature: (C)	145.4	145.4
Pressure: (kPa)	840.0	840.0
Molar Flow (kgmole/h)	798.2	798.2
Mass Flow (kg/h)	2.205e+004	2.205e+004
Std Ideal Liq VolFlow (m3/h)	26.87	26.87
Molar Enthalpy (kJ/kgmole)	-2.099e+05	-2.099e+05
Molar Entropy (kJ/kgmole-C)	1.647e+02	1.647e+02
Heat Flow (kJ/h)	-1.676e+08	-1.676e+08
Liq VolFlow @Std Cond (m3/h)	26.70	26.70

COMPOSITION

Overall Phase Vapour Fraction 1.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 49.29 0.0618 2271 0.1030 3.388 0.1261
Methanol 448.5 0.5619 1.437e+004 0.6517 18.06 0.6722
H2O 300.3 0.3763 5411 0.2453 5.422 0.2018
Total 798.2 1.0000 2.205e+004 1.0000 26.87 1.0000
Vapour Phase Phase Fraction 1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 49.29 0.0618 2271 0.1030 3.388 0.1261
Methanol 448.5 0.5619 1.437e+004 0.6517 18.06 0.6722
H2O 300.3 0.3763 5411 0.2453 5.422 0.2018
Total 798.2 1.0000 2.205e+004 1.0000 26.87 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether --- --- ---
Methanol --- --- ---
H2O --- --- ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Tower: Main Tower @COL1 Reboiler: Reboiler @COL1
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

Meth H2O @COL1 (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

---

Material Stream: Meth H2O @COL1 Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

OVERALL VAPOUR PH. LIQUID PH.
Vapour / Phase Fraction 0.0000 0.0000 1.0000
Temperature: (C) 145.4 145.4 145.4
Pressure: (kPa) 840.0 840.0 840.0
Molar Flow (kgmole/h) 954.8 0.0000 954.8
Mass Flow (kg/h) 2.121e+004 0.0000 2.121e+004
Std Ideal Liq VolFlow (m3/h) 23.63 0.0000 23.63
Molar Enthalpy (kJ/kgmole) -2.605e+05 -2.099e+05 -2.605e+05
Molar Entropy (kJ/kgmole-C) 6.933e+01 1.647e+02 6.933e+01
Heat Flow (kJ/h) -2.487e+08 0.000e-01 -2.487e+08
Liq VolFlow @Std Cond (m3/h) 23.31 0.0000 23.31
COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 8.247 0.0086 379.9 0.0179 0.5668 0.0240
Methanol 269.1 0.2819 8623 0.4066 10.84 0.4585
H2O 677.5 0.7095 1.220e+004 0.5755 12.23 0.5175
Total 954.8 1.0000 2.121e+004 1.0000 23.63 1.0000
Vapour Phase Phase Fraction 0.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 0.0000 0.0618 0.0000 0.1030 0.0000 0.1261
Methanol 0.0000 0.5619 0.0000 0.6517 0.0000 0.6722
H2O 0.0000 0.3763 0.0000 0.2453 0.0000 0.2018
Total 0.0000 1.0000 0.0000 1.0000 0.0000 1.0000
Liquid Phase Phase Fraction 1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 8.247 0.0086 379.9 0.0179 0.5668 0.0240
Methanol 269.1 0.2819 8623 0.4066 10.84 0.4585
H2O 677.5 0.7095 1.220e+004 0.5755 12.23 0.5175
Total 954.8 1.0000 2.121e+004 1.0000 23.63 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether 7.150 7.150 ---
Methanol 1.994 1.994 ---
H2O 0.5304 0.5304 ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Material Stream: Meth H2O Reboiler: Reboiler @COL1
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

DME reflux @COL1 (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

---

Material Stream: DME reflux @COL1 Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

	OVERALL	LIQUID PH.
Vapour / Phase Fraction	0.0000	1.0000
Temperature: (C)	36.98	36.98
Pressure: (kPa)	860.0	860.0
Molar Flow (kgmole/h)	631.6	631.6
Mass Flow (kg/h)	2.909e+004	2.909e+004
Std Ideal Liq VolFlow (m3/h)	43.39	43.39
Molar Enthalpy (kJ/kgmole)	-2.022e+05	-2.022e+05
Molar Entropy (kJ/kgmole-C)	1.540e+02	1.540e+02
Heat Flow (kJ/h)	-1.277e+08	-1.277e+08
Liq VolFlow @Std Cond (m3/h)	47.07	47.07

COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	631.1	0.9993	2.908e+004	0.9995	43.38	0.9996
Methanol	0.4528	0.0007	14.51	0.0005	1.823e-002	0.0004
H2O	2.198e-003	0.0000	3.960e-002	0.0000	3.968e-005	0.0000
Total	631.6	1.0000	2.909e+004	1.0000	43.39	1.0000

Liquid Phase Phase Fraction 1.000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	631.1	0.9993	2.908e+004	0.9995	43.38	0.9996
Methanol	0.4528	0.0007	14.51	0.0005	1.823e-002	0.0004
H2O	2.198e-003	0.0000	3.960e-002	0.0000	3.968e-005	0.0000
Total	631.6	1.0000	2.909e+004	1.0000	43.39	1.0000

K VALUE

COMPONENTS	MIXED	LIGHT	HEAVY
diM-Ether	0.0000	0.0000	---
Methanol	0.0000	0.0000	---
H2O	0.0000	0.0000	---

UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Tower: Main Tower @COL1 Material Stream: DME reflux
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

DME outlet @COL1 (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments

---

Material Stream: DME outlet @COL1 Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

	OVERALL	VAPOUR PH.
Vapour / Phase Fraction	1.0000	1.0000
Temperature: (C)	37.94	37.94
Pressure: (kPa)	820.0	820.0
Molar Flow (kgmole/h)	1253	1253
Mass Flow (kg/h)	5.771e+004	5.771e+004
Std Ideal Liq VolFlow (m3/h)	86.08	86.08
Molar Enthalpy (kJ/kgmole)	-1.833e+05	-1.833e+05
Molar Entropy (kJ/kgmole-C)	1.797e+02	1.797e+02
Heat Flow (kJ/h)	-2.297e+08	-2.297e+08
Liq VolFlow @Std Cond (m3/h)	93.38	93.38

COMPOSITION

Overall Phase Vapour Fraction 1.0000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	1252	0.9993	5.768e+004	0.9995	86.05	0.9996
Methanol	0.8981	0.0007	28.78	0.0005	3.616e-002	0.0004
H2O	4.286e-003	0.0000	7.722e-002	0.0000	7.737e-005	0.0000
Total	1253	1.0000	5.771e+004	1.0000	86.08	1.0000

Vapour Phase Phase Fraction 1.000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	1252	0.9993	5.768e+004	0.9995	86.05	0.9996

Methanol 0.8981 0.0007 28.78 0.0005 3.616e-002 0.0004
H2O 4.286e-003 0.0000 7.722e-002 0.0000 7.737e-005 0.0000
Total 1253 1.0000 5.771e+004 1.0000 86.08 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether --- --- ---
Methanol --- --- ---
H2O --- --- ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Material Stream: DME outlet Tower: Main Tower @COL1
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

---
normal op @COL1 (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments
---
Material Stream: normal op @COL1 Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

OVERALL LIQUID PH.
Vapour / Phase Fraction 0.0000 1.0000
Temperature: (C) 73.70 73.70
Pressure: (kPa) 830.0 830.0
Molar Flow (kgmole/h) 788.1 788.1
Mass Flow (kg/h) 2.491e+004 2.491e+004
Std Ideal Liq VolFlow (m3/h) 33.16 33.16
Molar Enthalpy (kJ/kgmole) -2.397e+05 -2.397e+05
Molar Entropy (kJ/kgmole-C) 1.026e+02 1.026e+02
Heat Flow (kJ/h) -1.889e+08 -1.889e+08
Liq VolFlow @Std Cond (m3/h) 33.26 33.26
COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 314.6 0.3991 1.449e+004 0.5817 21.62 0.6519
Methanol 134.8 0.1710 4319 0.1734 5.427 0.1637
H2O 338.7 0.4298 6102 0.2450 6.115 0.1844
Total 788.1 1.0000 2.491e+004 1.0000 33.16 1.0000

Liquid Phase Phase Fraction 1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 314.6 0.3991 1.449e+004 0.5817 21.62 0.6519
Methanol 134.8 0.1710 4319 0.1734 5.427 0.1637
H2O 338.7 0.4298 6102 0.2450 6.115 0.1844
Total 788.1 1.0000 2.491e+004 1.0000 33.16 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether 0.0000 0.0000 ---
Methanol 0.0000 0.0000 ---
H2O 0.0000 0.0000 ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Tower: Main Tower @COL1 Material Stream: normal op
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

---
turn down @COL1 (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments
---
Material Stream: turn down @COL1 Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

OVERALL LIQUID PH.
Vapour / Phase Fraction 0.0000 1.0000
Temperature: (C) 73.70 73.70
Pressure: (kPa) 830.0 830.0
Molar Flow (kgmole/h) 788.1 788.1
Mass Flow (kg/h) 2.491e+004 2.491e+004
Std Ideal Liq VolFlow (m3/h) 33.16 33.16
Molar Enthalpy (kJ/kgmole) -2.397e+05 -2.397e+05
Molar Entropy (kJ/kgmole-C) 1.026e+02 1.026e+02
Heat Flow (kJ/h) -1.889e+08 -1.889e+08
Liq VolFlow @Std Cond (m3/h) 33.26 33.26
COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)

diM-Ether 314.6 0.3991 1.449e+004 0.5817 21.62 0.6519
Methanol 134.8 0.1710 4319 0.1734 5.427 0.1637
H2O 338.7 0.4298 6102 0.2450 6.115 0.1844
Total 788.1 1.0000 2.491e+004 1.0000 33.16 1.0000
Liquid Phase Phase Fraction 1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 314.6 0.3991 1.449e+004 0.5817 21.62 0.6519
Methanol 134.8 0.1710 4319 0.1734 5.427 0.1637
H2O 338.7 0.4298 6102 0.2450 6.115 0.1844
Total 788.1 1.0000 2.491e+004 1.0000 33.16 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether 0.0000 0.0000 ---
Methanol 0.0000 0.0000 ---
H2O 0.0000 0.0000 ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Tower: Main Tower @COL1 Material Stream: turn down
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

Main Tower @COL1 (Tower): Design, Rating, Performance

Tower: Main Tower @COL1

Vapour Draws Summary

Name: Name: Name:
Tray Number
Temperature (C)
Pressure (kPa)
Mass Flow (kg/h)
Molar Flow (kgmole/h)
Ideal Liquid Volume Flow (m3/h)
Molar Enthalpy (kJ/kgmole)
Mass Enthalpy (kJ/kg)
Heat Flow (kJ/h)
Molecular Weight
Molar Entropy (kJ/kgmole-C)
Mass Entropy (kJ/kg-C)
Molar Density (kgmole/m3)
Mass Density (kg/m3)
Std Liq Mass Den (kg/m3)
Molar Heat Cap (kJ/kgmole-C)
Mass Heat Cap (kJ/kg-C)
Thermal Cond (W/m-K)
Viscosity (cP)
Surface Tension (dyne/cm) --- --- ---
Z Factor
Liquid Draws Summary

Name: Name: Name:
Tray Number
Temperature (C)
Pressure (kPa)
Mass Flow (kg/h)
Molar Flow (kgmole/h)
Ideal Liquid Volume Flow (m3/h)
Molar Enthalpy (kJ/kgmole)
Mass Enthalpy (kJ/kg)
Heat Flow (kJ/h)
Molecular Weight
Molar Entropy (kJ/kgmole-C)
Mass Entropy (kJ/kg-C)
Molar Density (kgmole/m3)
Mass Density (kg/m3)
Std Liq Mass Den (kg/m3)
Molar Heat Cap (kJ/kgmole-C)
Mass Heat Cap (kJ/kg-C)
Thermal Cond (W/m-K)
Viscosity (cP)
Surface Tension (dyne/cm)
Z Factor
Water Draws Summary

Name: Name: Name:
Tray Number
Temperature (C)
Pressure (kPa)
Mass Flow (kg/h)
Molar Flow (kgmole/h)
Water Volume Flow (m3/h)
Molar Enthalpy (kJ/kgmole)
Mass Enthalpy (kJ/kg)
Heat Flow (kJ/h)
Molecular Weight
Molar Entropy (kJ/kgmole-C)
Mass Entropy (kJ/kg-C)
Molar Density (kgmole/m3)
Mass Density (kg/m3)
Std Liq Mass Den (kg/m3)
Molar Heat Cap (kJ/kgmole-C)
Mass Heat Cap (kJ/kg-C)
Thermal Cond (W/m-K)
Viscosity (cP)
Surface Tension (dyne/cm)
Z Factor
User Variables

RATING

Sizing

Weir Height (m) 5.000e-002
Weir Length (m) 1.200
Tray Space (m) 0.5000
Tray Volume (m3) 0.8836
DC Volume (m3) 8.836e-002
Diameter (m) 1.500
Active Area (m2) 1.264
Flow Paths 1
Internal Type: Sieve
Nozzles

Tray Section Elevation Relative to Ground Level 0.0000 m

	HoldupRG	VtoAbove (m)	Diameter (m)	L toBelow (m)	Diameter (m)
1__Main Tower	4.500 m	---	---	0.0000 m	3.000e-003 m
2__Main Tower	4.000 m	0.5000 m	3.000e-003 m	0.0000 m	3.000e-003 m
3__Main Tower	3.500 m	0.5000 m	3.000e-003 m	0.0000 m	3.000e-003 m
4__Main Tower	3.000 m	0.5000 m	3.000e-003 m	0.0000 m	3.000e-003 m
5__Main Tower	2.500 m	0.5000 m	3.000e-003 m	0.0000 m	3.000e-003 m
6__Main Tower	2.000 m	0.5000 m	3.000e-003 m	0.0000 m	3.000e-003 m
7__Main Tower	1.500 m	0.5000 m	3.000e-003 m	0.0000 m	3.000e-003 m
8__Main Tower	1.000 m	0.5000 m	3.000e-003 m	0.0000 m	3.000e-003 m
9__Main Tower	0.5000 m	0.5000 m	3.000e-003 m	0.0000 m	3.000e-003 m
10__Main Tower	0.0000 m	0.5000 m	3.000e-003 m	---	---

	Feed Tray	Elevation RH (m)	Diameter (m)
DME reflux	1__Main Tower	0.3750 m	5.000e-002 m
normal op	4__Main Tower	0.3750 m	5.000e-002 m
turn down	9__Main Tower	0.3750 m	5.000e-002 m
Boilup	10__Main Tower	0.0000 m	5.000e-002 m

	Prod Tray	Elevation RH (m)	Diameter (m)
DME outlet	1__Main Tower	0.5000 m	5.000e-002 m
To Reboiler	10__Main Tower	0.0000 m	3.000e-003 m

Heat Loss

Efficiency

Overall Efficiency

Tray	Overall
1__Main Tower	1.000
2__Main Tower	1.000
3__Main Tower	1.000
4__Main Tower	1.000
5__Main Tower	1.000
6__Main Tower	1.000
7__Main Tower	1.000
8__Main Tower	1.000
9__Main Tower	1.000
10__Main Tower	1.000

Component Efficiency

Tray	diM-Ether	Methanol	H2O
1__Main Tower	1.000	1.000	1.000
2__Main Tower	1.000	1.000	1.000
3__Main Tower	1.000	1.000	1.000
4__Main Tower	1.000	1.000	1.000
5__Main Tower	1.000	1.000	1.000
6__Main Tower	1.000	1.000	1.000
7__Main Tower	1.000	1.000	1.000
8__Main Tower	1.000	1.000	1.000
9__Main Tower	1.000	1.000	1.000
10__Main Tower	1.000	1.000	1.000

Pressure Drop

	Pressure (kPa)	Pressure Drop (kPa)
1__Main Tower	820.0 kPa	2.222 kPa
2__Main Tower	822.2 kPa	2.222 kPa
3__Main Tower	824.4 kPa	2.222 kPa
4__Main Tower	826.7 kPa	2.222 kPa
5__Main Tower	828.9 kPa	2.222 kPa
6__Main Tower	831.1 kPa	2.222 kPa
7__Main Tower	833.3 kPa	2.222 kPa
8__Main Tower	835.6 kPa	2.222 kPa
9__Main Tower	837.8 kPa	2.222 kPa
10__Main Tower	840.0 kPa	---

Rating Enabled: No Top Tray Fixed For Update Tray
Section Pressure Drop 20.00 kPa
Vapour Mole Fractions

Tray Number	diM-Ether	Methanol	H2O
1__Main Tower	0.9993	0.0007	0.0000
2__Main Tower	0.9905	0.0093	0.0002
3__Main Tower	0.9224	0.0709	0.0066
4__Main Tower	0.8073	0.1476	0.0451
5__Main Tower	0.6443	0.2738	0.0819
6__Main Tower	0.5394	0.3545	0.1061
7__Main Tower	0.4941	0.3883	0.1176
8__Main Tower	0.4778	0.3969	0.1253
9__Main Tower	0.4735	0.3862	0.1403
10__Main Tower	0.1979	0.5647	0.2374

Liquid Mole Fractions

Tray Number	diM-Ether	Methanol	H2O
1__Main Tower	0.9814	0.0182	0.0004
2__Main Tower	0.8151	0.1690	0.0159
3__Main Tower	0.4351	0.4325	0.1324
4__Main Tower	0.2534	0.3576	0.3890
5__Main Tower	0.1586	0.4268	0.4146
6__Main Tower	0.1191	0.4554	0.4254
7__Main Tower	0.1048	0.4627	0.4325
8__Main Tower	0.0996	0.4541	0.4463
9__Main Tower	0.0967	0.4134	0.4899
10__Main Tower	0.0328	0.4094	0.5578

Vapour Mass Fractions

Tray Number	diM-Ether	Methanol	H2O
1__Main Tower	0.9995	0.0005	0.0000
2__Main Tower	0.9935	0.0065	0.0001
3__Main Tower	0.9467	0.0506	0.0027
4__Main Tower	0.8703	0.1107	0.0190

5__Main Tower 0.7433 0.2197 0.0370
6__Main Tower 0.6518 0.2980 0.0501
7__Main Tower 0.6099 0.3334 0.0567
8__Main Tower 0.5952 0.3438 0.0610
9__Main Tower 0.5941 0.3371 0.0688
10__Main Tower 0.2896 0.5746 0.1358
Liquid Mass Fractions

Tray Number diM-Ether Methanol H2O
1__Main Tower 0.9871 0.0127 0.0002
2__Main Tower 0.8682 0.1252 0.0066
3__Main Tower 0.5523 0.3819 0.0657
4__Main Tower 0.3873 0.3801 0.2325
5__Main Tower 0.2569 0.4806 0.2625
6__Main Tower 0.1978 0.5260 0.2762
7__Main Tower 0.1759 0.5402 0.2839
8__Main Tower 0.1688 0.5353 0.2958
9__Main Tower 0.1679 0.4994 0.3327
10__Main Tower 0.0613 0.5315 0.4072
Vapour LiqVolume Fractions

Tray Number diM-Ether Methanol H2O
1__Main Tower 0.9996 0.0004 0.0000
2__Main Tower 0.9945 0.0055 0.0001
3__Main Tower 0.9552 0.0430 0.0018
4__Main Tower 0.8914 0.0955 0.0131
5__Main Tower 0.7798 0.1942 0.0260
6__Main Tower 0.6960 0.2680 0.0360
7__Main Tower 0.6566 0.3023 0.0410
8__Main Tower 0.6429 0.3128 0.0443
9__Main Tower 0.6428 0.3072 0.0500
10__Main Tower 0.3348 0.5597 0.1055
Liquid LiqVolume Fractions

Tray Number diM-Ether Methanol H2O
1__Main Tower 0.9891 0.0108 0.0001
2__Main Tower 0.8876 0.1078 0.0045
3__Main Tower 0.6015 0.3504 0.0481
4__Main Tower 0.4484 0.3707 0.1808
5__Main Tower 0.3065 0.4831 0.2104
6__Main Tower 0.2394 0.5361 0.2245
7__Main Tower 0.2141 0.5539 0.2320
8__Main Tower 0.2063 0.5510 0.2428
9__Main Tower 0.2068 0.5180 0.2752
10__Main Tower 0.0783 0.5722 0.3495

Reboiler @COL1 (Reboiler): Design, Rating, Performance

Reboiler: Reboiler @COL1

CONNECTIONS

Inlet Name From Oper
To Reboiler @COL1 Tower: Main Tower @COL1
Outlet Name To Oper
Boilup @COL1 Tower: Main Tower @COL1
Meth H2O @COL1 Material Stream: Meth H2O

Energy Name To Oper
reboiler 1 @COL1 Reboiler: Reboiler @COL1
PARAMETERS

Vessel Volume: 2.000 m3 Pressure Drop: 0.0000 kPa Duty: 2.7071e+07 kJ/h
Level SP: 50.00 % Liquid Volume: 1.000 m3
RATING

Sizing

Cylinder Horizontal This reboiler has a Boot: No
Volume 2.000 m3 Diameter 1.193 m Length 1.789
Nozzles

Base Elevation Relative to Ground Level 0.0000 m
Diameter 1.193 m Length 1.789
To Reboiler @COL1 Boilup @COL1 Meth H2O @COL1
Diameter (m) 5.965e-002 5.965e-002 5.965e-002
Elevation (Base) (m) 1.193 1.193 0.0000
Elevation (Ground) (m) 1.193 1.193 0.0000
Elevation (% of Height) (%) 100.00 100.00 0.00
Options

PV Work Term Contribution (%) 100.00
PERFORMANCE TABLE

Overall Phase

Temperature Pressure Heat Flow Enthalpy
(C) (kPa) (kJ/h) (kJ/kgmole)
135.21 840.00 0.00 -252922.57
145.35 840.00 27071392.97 -237479.59
Vapour Fraction Vap Phase Mass Frac Heat of Vap (kJ/kgmole)
0.0000 0.0000 ---
0.4553 0.5098 ---
Vapour Phase

Mass Flow Molecular Wt Density Mass Sp Heat Viscosity Thermal Cond
(kg/h) (kg/m3) (kJ/kg-C) (cP) (W/m-K)
0.00 31.49 7.79 1.75 0.01 0.02
22053.58 27.63 6.67 1.84 0.01 0.03
Std Gas Flow Z Factor Pseudo Pc Pseudo Tc Pseudo Zc Pseudo Omega
(STD_m3/h) (kPa) (C)
0.00 1.00 10469.21 249.14 0.26 0.44
18872.39 1.00 12797.33 283.18 0.25 0.45
Light Liquid Phase

Mass Flow Density Mass Sp Heat Viscosity Thermal Cond Surface Tens
(kg/h) (kg/m3) (kJ/kg-C) (cP) (W/m-K) (dyne/cm)
43260.85 744.75 4.14 0.16 0.36 34.10
--- --- --- --- --- ---
Molecular Wt Sp Gravity Pseudo Pc Pseudo Tc Pseudo Zc Pseudo Omega

(kPa) (C)
24.68 0.74 15532.75 310.89 0.26 0.43
--- --- --- --- --- ---
Heavy Liquid Phase

Mass Flow Density Mass Sp Heat Viscosity Thermal Cond Surface Tens
(kg/h) (kg/m3) (kJ/kg-C) (cP) (W/m-K) (dyne/cm)
--- --- --- --- --- ---
21207.27 786.30 4.31 0.15 0.46 38.43
Molecular Wt Sp Gravity Pseudo Pc Pseudo Tc Pseudo Zc Pseudo Omega
(kPa) (C)
--- --- --- --- --- ---
22.21 0.79 17819.42 334.05 0.26 0.40
Mixed Liquid Phase

Mass Flow Density Mass Sp Heat Viscosity Thermal Cond Surface Tens
(kg/h) (kg/m3) (kJ/kg-C) (cP) (W/m-K) (dyne/cm)
43260.85 744.75 4.14 0.16 0.36 34.10
21207.27 786.30 4.31 0.15 0.46 38.43
Molecular Wt Sp Gravity Pseudo Pc Pseudo Tc Pseudo Zc Pseudo Omega
(kPa) (C)
24.68 0.74 15532.75 310.89 0.26 0.43
22.21 0.79 17819.42 334.05 0.26 0.40

Meth Recycle @COL2 (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments
---
Material Stream: Meth Recycle @COL2 Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

OVERALL VAPOUR PH.
Vapour / Phase Fraction 1.0000 1.0000
Temperature: (C) 136.3 136.3
Pressure: (kPa) 870.0 870.0
Molar Flow (kgmole/h) 650.0 650.0
Mass Flow (kg/h) 1.965e+004 1.965e+004
Std Ideal Liq VolFlow (m3/h) 24.41 24.41
Molar Enthalpy (kJ/kgmole) -2.018e+05 -2.018e+05
Molar Entropy (kJ/kgmole-C) 1.712e+02 1.712e+02
Heat Flow (kJ/h) -1.312e+08 -1.312e+08
Liq VolFlow @Std Cond (m3/h) 24.36 24.36
COMPOSITION

Overall Phase Vapour Fraction 1.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 16.83 0.0259 775.3 0.0395 1.157 0.0474
Methanol 532.2 0.8187 1.705e+004 0.8679 21.43 0.8779
H2O 101.0 0.1554 1820 0.0926 1.823 0.0747
Total 650.0 1.0000 1.965e+004 1.0000 24.41 1.0000
Vapour Phase Phase Fraction 1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 16.83 0.0259 775.3 0.0395 1.157 0.0474
Methanol 532.2 0.8187 1.705e+004 0.8679 21.43 0.8779
H2O 101.0 0.1554 1820 0.0926 1.823 0.0747
Total 650.0 1.0000 1.965e+004 1.0000 24.41 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether --- --- ---
Methanol --- --- ---
H2O --- --- ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Material Stream: Meth Recycle Tower: Main Tower @COL2
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

To Reboiler @COL2 (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments
---
Material Stream: To Reboiler @COL2 Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

OVERALL VAPOUR PH. LIQUID PH.
Vapour / Phase Fraction 0.0000 0.0000 1.0000
Temperature: (C) 172.7 172.7 172.7
Pressure: (kPa) 890.0 890.0 890.0
Molar Flow (kgmole/h) 1268 0.0000 1268
Mass Flow (kg/h) 2.307e+004 0.0000 2.307e+004
Std Ideal Liq VolFlow (m3/h) 23.26 0.0000 23.26
Molar Enthalpy (kJ/kgmole) -2.729e+05 -2.341e+05 -2.729e+05
Molar Entropy (kJ/kgmole-C) 3.936e+01 1.254e+02 3.936e+01
Heat Flow (kJ/h) -3.460e+08 0.000e-01 -3.460e+08

Liq VolFlow @Std Cond (m3/h) 22.87 0.0000 22.87
COMPOSITION

Overall Phase Vapour Fraction
0.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS
FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 3.233e-003 0.0000 0.1489 0.0000 2.222e-
004 0.0000
Methanol 16.68 0.0132 534.4 0.0232 0.6716
0.0289
H2O 1251 0.9868 2.254e+004 0.9768 22.59
0.9711
Total 1268 1.0000 2.307e+004 1.0000 23.26
1.0000
Vapour Phase Phase Fraction
0.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS
FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 0.0000 0.0000 0.0000 0.0001 0.0000
0.0001
Methanol 0.0000 0.0635 0.0000 0.1076 0.0000
0.1313
H2O 0.0000 0.9365 0.0000 0.8923 0.0000
0.8686
Total 0.0000 1.0000 0.0000 1.0000 0.0000
1.0000
Liquid Phase Phase Fraction
1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS
FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 3.233e-003 0.0000 0.1489 0.0000 2.222e-
004 0.0000
Methanol 16.68 0.0132 534.4 0.0232 0.6716
0.0289
H2O 1251 0.9868 2.254e+004 0.9768 22.59
0.9711
Total 1268 1.0000 2.307e+004 1.0000 23.26
1.0000
K VALUE

COMPONENTS MIXED LIGHT
HEAVY
diM-Ether 11.42 11.42 ---
Methanol 4.826 4.826 ---
H2O 0.9490 0.9490 ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL
CONNECTION
Reboiler: Reboiler @COL2 Tower: Main Tower @COL2
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

Boilup @COL2 (Material Stream): Conditions,
Composition, K Value, Package Properties, Attachments

Material Stream: Boilup @COL2 Fluid
Package: Basis-1

Property Package: NRTL -
Ideal
CONDITIONS

OVERALL VAPOUR PH.
Vapour / Phase Fraction 1.0000 1.0000
Temperature: (C) 174.1 174.1
Pressure: (kPa) 890.0 890.0
Molar Flow (kgmole/h) 638.0 638.0
Mass Flow (kg/h) 1.169e+004 1.169e+004
Std Ideal Liq VolFlow (m3/h) 11.83 11.83
Molar Enthalpy (kJ/kgmole) -2.359e+05 -2.359e+05
Molar Entropy (kJ/kgmole-C) 1.216e+02 1.216e+02
Heat Flow (kJ/h) -1.505e+08 -1.505e+08
Liq VolFlow @Std Cond (m3/h) 11.63 11.63
COMPOSITION

Overall Phase Vapour Fraction
1.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS
FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 2.982e-003 0.0000 0.1374 0.0000 2.049e-
004 0.0000
Methanol 13.94 0.0219 446.8 0.0382 0.5615
0.0475
H2O 624.1 0.9781 1.124e+004 0.9618 11.27
0.9525
Total 638.0 1.0000 1.169e+004 1.0000 11.83
1.0000
Vapour Phase Phase Fraction
1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS
FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 2.982e-003 0.0000 0.1374 0.0000 2.049e-
004 0.0000
Methanol 13.94 0.0219 446.8 0.0382 0.5615
0.0475
H2O 624.1 0.9781 1.124e+004 0.9618 11.27
0.9525
Total 638.0 1.0000 1.169e+004 1.0000 11.83
1.0000
K VALUE

COMPONENTS MIXED LIGHT
HEAVY
diM-Ether --- --- ---
Methanol --- --- ---
H2O --- --- ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Tower: Main Tower @COL2 Reboiler: Reboiler @COL2
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

Waste Water @COL2 (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments
---
Material Stream: Waste Water @COL2 Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

	OVERALL	VAPOUR PH.	LIQUID PH.
Vapour / Phase Fraction	0.0000	0.0000	1.0000
Temperature: (C)	174.1	174.1	174.1
Pressure: (kPa)	890.0	890.0	890.0
Molar Flow (kgmole/h)	629.8	0.0000	629.8
Mass Flow (kg/h)	1.139e+004	0.0000	1.139e+004
Std Ideal Liq VolFlow (m3/h)	11.43	0.0000	11.43
Molar Enthalpy (kJ/kgmole)	-2.733e+05	-2.359e+05	-2.733e+05
Molar Entropy (kJ/kgmole-C)	3.825e+01	1.216e+02	3.825e+01
Heat Flow (kJ/h)	-1.721e+08	0.000e-01	-1.721e+08
Liq VolFlow @Std Cond (m3/h)	11.24	0.0000	11.24

COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	2.510e-004	0.0000	1.156e-002	0.0000	1.725e-005	0.0000
Methanol	2.733	0.0043	87.56	0.0077	0.1100	0.0096
H2O	627.1	0.9957	1.130e+004	0.9923	11.32	0.9904
Total	629.8	1.0000	1.139e+004	1.0000	11.43	1.0000

Vapour Phase Phase Fraction 0.0000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Methanol	0.0000	0.0219	0.0000	0.0382	0.0000	0.0475
H2O	0.0000	0.9781	0.0000	0.9618	0.0000	0.9525
Total	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000

Liquid Phase Phase Fraction 1.000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC
diM-Ether	2.510e-004	0.0000	1.156e-002	0.0000	1.725e-005	0.0000
Methanol	2.733	0.0043	87.56	0.0077	0.1100	0.0096
H2O	627.1	0.9957	1.130e+004	0.9923	11.32	0.9904
Total	629.8	1.0000	1.139e+004	1.0000	11.43	1.0000

K VALUE

COMPONENTS	MIXED	LIGHT	HEAVY
diM-Ether	11.73	11.73	---
Methanol	5.037	5.037	---
H2O	0.9824	0.9824	---

UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Material Stream: Waste Water Reboiler: Reboiler @COL2
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

METH reflux @COL2 (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments
---
Material Stream: METH reflux @COL2 Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

	OVERALL	LIQUID PH.
Vapour / Phase Fraction	0.0000	1.0000
Temperature: (C)	76.29	76.29
Pressure: (kPa)	910.0	910.0
Molar Flow (kgmole/h)	325.0	325.0
Mass Flow (kg/h)	9825	9825
Std Ideal Liq VolFlow (m3/h)	12.21	12.21
Molar Enthalpy (kJ/kgmole)	-2.398e+05	-2.398e+05
Molar Entropy (kJ/kgmole-C)	9.524e+01	9.524e+01
Heat Flow (kJ/h)	-7.795e+07	-7.795e+07
Liq VolFlow @Std Cond (m3/h)	12.18	12.18

COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS	MOLE FLOW (kgmole/h)	MOLE FRAC	MASS FLOW (kg/h)	MASS FRAC	LIQVOL FLOW (m3/h)	LIQVOL FRAC

(kgmole/h) (kg/h) (m3/h)
diM-Ether 8.583 0.0264 395.4 0.0402 0.5899 0.0483
Methanol 265.8 0.8177 8517 0.8669 10.70 0.8768
H2O 50.66 0.1558 912.6 0.0929 0.9144 0.0749
Total 325.0 1.0000 9825 1.0000 12.21 1.0000
Liquid Phase Phase Fraction 1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 8.583 0.0264 395.4 0.0402 0.5899 0.0483
Methanol 265.8 0.8177 8517 0.8669 10.70 0.8768
H2O 50.66 0.1558 912.6 0.0929 0.9144 0.0749
Total 325.0 1.0000 9825 1.0000 12.21 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether 0.0000 0.0000 ---
Methanol 0.0000 0.0000 ---
H2O 0.0000 0.0000 ---
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Tower: Main Tower @COL2 Material Stream: METH reflux
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

Meth H2O Pumped @COL2 (Material Stream): Conditions, Composition, K Value, Package Properties, Attachments
---
Material Stream: Meth H2O Pumped @COL2 Fluid Package: Basis-1

Property Package: NRTL - Ideal
CONDITIONS

OVERALL AQUEOUS PH.
Vapour / Phase Fraction 0.0000 1.0000
Temperature: (C) 145.4 145.4
Pressure: (kPa) 880.0 880.0
Molar Flow (kgmole/h) 954.8 954.8
Mass Flow (kg/h) 2.121e+004 2.121e+004
Std Ideal Liq VolFlow (m3/h) 23.63 23.63
Molar Enthalpy (kJ/kgmole) -2.605e+05 -2.605e+05
Molar Entropy (kJ/kgmole-C) 6.944e+01 6.944e+01
Heat Flow (kJ/h) -2.487e+08 -2.487e+08
Liq VolFlow @Std Cond (m3/h) 23.31 23.31
COMPOSITION

Overall Phase Vapour Fraction 0.0000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 8.247 0.0086 379.9 0.0179 0.5668 0.0240
Methanol 269.1 0.2819 8623 0.4066 10.84 0.4585
H2O 677.5 0.7095 1.220e+004 0.5755 12.23 0.5175
Total 954.8 1.0000 2.121e+004 1.0000 23.63 1.0000
Aqueous Phase Phase Fraction 1.000

COMPONENTS MOLE FLOW MOLE FRAC MASS FLOW MASS FRAC LIQVOL FLOW LIQVOL FRAC
(kgmole/h) (kg/h) (m3/h)
diM-Ether 8.247 0.0086 379.9 0.0179 0.5668 0.0240
Methanol 269.1 0.2819 8623 0.4066 10.84 0.4585
H2O 677.5 0.7095 1.220e+004 0.5755 12.23 0.5175
Total 954.8 1.0000 2.121e+004 1.0000 23.63 1.0000
K VALUE

COMPONENTS MIXED LIGHT HEAVY
diM-Ether 0.0000 --- 0.0000
Methanol 0.0000 --- 0.0000
H2O 0.0000 --- 0.0000
UNIT OPERATIONS

FEED TO PRODUCT FROM LOGICAL CONNECTION
Tower: Main Tower @COL2 Material Stream: Meth H2O Pumped
UTILITIES

(No utilities reference this stream)
PROCESS UTILITY

Main Tower @COL2 (Tower): Design, Rating, Performance

Tower: Main Tower @COL2

Vapour Draws Summary

Name: Name: Name:
Tray Number
Temperature (C)

Pressure (kPa)
Mass Flow (kg/h)
Molar Flow (kgmole/h)
Ideal Liquid Volume Flow (m3/h)
Molar Enthalpy (kJ/kgmole)
Mass Enthalpy (kJ/kg)
Heat Flow (kJ/h)
Molecular Weight
Molar Entropy (kJ/kgmole-C)
Mass Entropy (kJ/kg-C)
Molar Density (kgmole/m3)
Mass Density (kg/m3)
Std Liq Mass Den (kg/m3)
Molar Heat Cap (kJ/kgmole-C)
Mass Heat Cap (kJ/kg-C)
Thermal Cond (W/m-K)
Viscosity (cP)
Surface Tension (dyne/cm) --- --- ---
Z Factor
Liquid Draws Summary

Name: Name: Name:
Tray Number
Temperature (C)
Pressure (kPa)
Mass Flow (kg/h)
Molar Flow (kgmole/h)
Ideal Liquid Volume Flow (m3/h)
Molar Enthalpy (kJ/kgmole)
Mass Enthalpy (kJ/kg)
Heat Flow (kJ/h)
Molecular Weight
Molar Entropy (kJ/kgmole-C)
Mass Entropy (kJ/kg-C)
Molar Density (kgmole/m3)
Mass Density (kg/m3)
Std Liq Mass Den (kg/m3)
Molar Heat Cap (kJ/kgmole-C)
Mass Heat Cap (kJ/kg-C)
Thermal Cond (W/m-K)
Viscosity (cP)
Surface Tension (dyne/cm)
Z Factor
Water Draws Summary

Name: Name: Name:
Tray Number
Temperature (C)
Pressure (kPa)
Mass Flow (kg/h)
Molar Flow (kgmole/h)
Water Volume Flow (m3/h)
Molar Enthalpy (kJ/kgmole)
Mass Enthalpy (kJ/kg)
Heat Flow (kJ/h)
Molecular Weight
Molar Entropy (kJ/kgmole-C)
Mass Entropy (kJ/kg-C)
Molar Density (kgmole/m3)
Mass Density (kg/m3)
Std Liq Mass Den (kg/m3)
Molar Heat Cap (kJ/kgmole-C)
Mass Heat Cap (kJ/kg-C)
Thermal Cond (W/m-K)
Viscosity (cP)
Surface Tension (dyne/cm)
Z Factor
User Variables

RATING

Sizing

Weir Height (m) 5.000e-002
Weir Length (m) 1.200
Tray Space (m) 0.5000
Tray Volume (m3) 0.8836
DC Volume (m3) 8.836e-002
Diameter (m) 1.500
Active Area (m2) 1.264
Flow Paths 1
Internal Type: Sieve
Nozzles

Tray Section Elevation Relative to Ground Level 0.0000 m
HoldupRG VtoAbove (m) Diameter (m) L toBelow (m) Diameter (m)
1__Main Tower 4.500 m --- --- 0.0000 m 3.000e-003 m
2__Main Tower 4.000 m 0.5000 m 3.000e-003 m 0.0000 m 3.000e-003 m
3__Main Tower 3.500 m 0.5000 m 3.000e-003 m 0.0000 m 3.000e-003 m
4__Main Tower 3.000 m 0.5000 m 3.000e-003 m 0.0000 m 3.000e-003 m
5__Main Tower 2.500 m 0.5000 m 3.000e-003 m 0.0000 m 3.000e-003 m
6__Main Tower 2.000 m 0.5000 m 3.000e-003 m 0.0000 m 3.000e-003 m
7__Main Tower 1.500 m 0.5000 m 3.000e-003 m 0.0000 m 3.000e-003 m
8__Main Tower 1.000 m 0.5000 m 3.000e-003 m 0.0000 m 3.000e-003 m
9__Main Tower 0.5000 m 0.5000 m 3.000e-003 m 0.0000 m 3.000e-003 m
10__Main Tower 0.0000 m 0.5000 m 3.000e-003 m --- ---

Feed Tray Elevation RH (m) Diameter (m)
METH reflux 1__Main Tower 0.3750 m 5.000e-002 m
Meth H2O Pumped 6__Main Tower 0.3750 m 5.000e-002 m
Boilup 10__Main Tower 0.0000 m 5.000e-002 m

Prod Tray Elevation RH (m) Diameter (m)
Meth Recycle 1__Main Tower 0.5000 m 5.000e-002 m
To Reboiler 10__Main Tower 0.0000 m 3.000e-003 m
Heat Loss

Efficiency

Overall Efficiency

Tray	Overall
1__Main Tower	1.000
2__Main Tower	1.000
3__Main Tower	1.000
4__Main Tower	1.000
5__Main Tower	1.000
6__Main Tower	1.000
7__Main Tower	1.000
8__Main Tower	1.000
9__Main Tower	1.000
10__Main Tower	1.000

Component Efficiency

Tray	diM-Ether	Methanol	H2O
1__Main Tower	1.000	1.000	1.000
2__Main Tower	1.000	1.000	1.000
3__Main Tower	1.000	1.000	1.000
4__Main Tower	1.000	1.000	1.000
5__Main Tower	1.000	1.000	1.000
6__Main Tower	1.000	1.000	1.000
7__Main Tower	1.000	1.000	1.000
8__Main Tower	1.000	1.000	1.000
9__Main Tower	1.000	1.000	1.000
10__Main Tower	1.000	1.000	1.000

Pressure Drop

	Pressure (kPa)	Pressure Drop (kPa)
1__Main Tower	870.0 kPa	2.222 kPa
2__Main Tower	872.2 kPa	2.222 kPa
3__Main Tower	874.4 kPa	2.222 kPa
4__Main Tower	876.7 kPa	2.222 kPa
5__Main Tower	878.9 kPa	2.222 kPa
6__Main Tower	881.1 kPa	2.222 kPa
7__Main Tower	883.3 kPa	2.222 kPa
8__Main Tower	885.6 kPa	2.222 kPa
9__Main Tower	887.8 kPa	2.222 kPa
10__Main Tower	890.0 kPa	---

Rating Enabled: No Top Tray Fixed For Update Tray
Section Pressure Drop 20.00 kPa
Vapour Mole Fractions

Tray Number	diM-Ether	Methanol	H2O
1__Main Tower	0.0259	0.8187	0.1554
2__Main Tower	0.0141	0.7477	0.2383
3__Main Tower	0.0132	0.6653	0.3215
4__Main Tower	0.0133	0.5947	0.3920
5__Main Tower	0.0133	0.5488	0.4379
6__Main Tower	0.0133	0.5252	0.4614
7__Main Tower	0.0034	0.4278	0.5688
8__Main Tower	0.0008	0.2849	0.7144
9__Main Tower	0.0002	0.1495	0.8504
10__Main Tower	0.0000	0.0635	0.9365

Liquid Mole Fractions

Tray Number	diM-Ether	Methanol	H2O
1__Main Tower	0.0043	0.6853	0.3105
2__Main Tower	0.0022	0.5260	0.4718
3__Main Tower	0.0020	0.3846	0.6134
4__Main Tower	0.0019	0.2907	0.7074
5__Main Tower	0.0018	0.2421	0.7561
6__Main Tower	0.0017	0.2204	0.7779
7__Main Tower	0.0004	0.1461	0.8535
8__Main Tower	0.0001	0.0773	0.9226
9__Main Tower	0.0000	0.0341	0.9659
10__Main Tower	0.0000	0.0132	0.9868

Vapour Mass Fractions

Tray Number	diM-Ether	Methanol	H2O
1__Main Tower	0.0395	0.8679	0.0926
2__Main Tower	0.0224	0.8290	0.1485
3__Main Tower	0.0220	0.7691	0.2089
4__Main Tower	0.0229	0.7129	0.2642
5__Main Tower	0.0235	0.6741	0.3024
6__Main Tower	0.0239	0.6534	0.3227
7__Main Tower	0.0065	0.5685	0.4250
8__Main Tower	0.0016	0.4143	0.5841
9__Main Tower	0.0004	0.2381	0.7616
10__Main Tower	0.0001	0.1076	0.8923

Liquid Mass Fractions

Tray Number	diM-Ether	Methanol	H2O
1__Main Tower	0.0071	0.7914	0.2016
2__Main Tower	0.0041	0.6620	0.3339
3__Main Tower	0.0039	0.5252	0.4710
4__Main Tower	0.0039	0.4207	0.5755
5__Main Tower	0.0038	0.3615	0.6347
6__Main Tower	0.0038	0.3338	0.6624
7__Main Tower	0.0009	0.2332	0.7659
8__Main Tower	0.0002	0.1297	0.8701
9__Main Tower	0.0000	0.0590	0.9409
10__Main Tower	0.0000	0.0232	0.9768

Vapour LiqVolume Fractions

Tray Number	diM-Ether	Methanol	H2O
1__Main Tower	0.0474	0.8779	0.0747
2__Main Tower	0.0273	0.8511	0.1216
3__Main Tower	0.0271	0.7997	0.1732
4__Main Tower	0.0286	0.7498	0.2216
5__Main Tower	0.0296	0.7147	0.2556
6__Main Tower	0.0302	0.6958	0.2740
7__Main Tower	0.0084	0.6213	0.3703
8__Main Tower	0.0022	0.4697	0.5281
9__Main Tower	0.0005	0.2815	0.7180
10__Main Tower	0.0001	0.1313	0.8686

Liquid LiqVolume Fractions

Tray Number	diM-Ether	Methanol	H2O
1__Main Tower	0.0087	0.8239	0.1673
2__Main Tower	0.0052	0.7095	0.2853
3__Main Tower	0.0051	0.5801	0.4148
4__Main Tower	0.0052	0.4758	0.5190
5__Main Tower	0.0052	0.4145	0.5803
6__Main Tower	0.0052	0.3852	0.6096
7__Main Tower	0.0013	0.2760	0.7228
8__Main Tower	0.0003	0.1574	0.8423
9__Main Tower	0.0001	0.0729	0.9270
10__Main Tower	0.0000	0.0289	0.9711

Reboiler @COL2 (Reboiler): Design, Rating, Performance

Reboiler: Reboiler @COL2

CONNECTIONS

Inlet Name From Oper
To Reboiler @COL2 Tower: Main Tower @COL2
Outlet Name To Oper
Boilup @COL2 Tower: Main Tower @COL2
Waste Water @COL2 Material Stream: Waste Water

Energy Name To Oper
Reboiler 2 @COL2 Reboiler: Reboiler @COL2
PARAMETERS

Vessel Volume: 2.000 m3 Pressure Drop: 0.0000 kPa Duty: 2.3390e+07 kJ/h
Level SP: 50.00 % Liquid Volume: 1.000 m3
RATING

Sizing

Cylinder Horizontal This reboiler has a Boot: No
Volume 2.000 m3 Diameter 1.193 m Length 1.789
Nozzles

Base Elevation Relative to Ground Level 0.0000 m
Diameter 1.193 m Length 1.789

	To Reboiler @COL2	Boilup @COL2	Waste Water @COL2
Diameter (m)	5.965e-002	5.965e-002	5.965e-002
Elevation (Base) (m)	1.193	1.193	0.0000
Elevation (Ground) (m)	1.193	1.193	0.0000
Elevation (% of Height) (%)	100.00	100.00	0.00

Options

PV Work Term Contribution (%) 100.00
PERFORMANCE TABLE

Overall Phase

Temperature (C)	Pressure (kPa)	Heat Flow (kJ/h)	Enthalpy (kJ/kgmole)
172.68	890.00	0.00	-272906.58
174.14	890.00	23390310.10	-254457.88

Vapour Fraction	Vap Phase Mass Frac	Heat of Vap (kJ/kgmole)
0.0000	0.0000	---
0.5032	0.5066	---

Vapour Phase

Mass Flow (kg/h)	Molecular Wt	Density (kg/m3)	Mass Sp Heat (kJ/kg-C)	Viscosity (cP)	Thermal Cond (W/m-K)
0.06	18.91	4.54	2.70	0.01	0.03
11689.54	18.32	4.38	2.81	0.01	0.03

Std Gas Flow (STD_m3/h)	Z Factor	Pseudo Pc (kPa)	Pseudo Tc (C)	Pseudo Zc	Pseudo Omega
0.07	1.00	21183.60	365.59	0.26	0.36
15085.45	1.00	21797.68	371.20	0.26	0.35

Light Liquid Phase

Mass Flow (kg/h)	Density (kg/m3)	Mass Sp Heat (kJ/kg-C)	Viscosity (cP)	Thermal Cond (W/m-K)	Surface Tens (dyne/cm)
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Molecular Wt	Sp Gravity	Pseudo Pc (kPa)	Pseudo Tc (C)	Pseudo Zc	Pseudo Omega
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Heavy Liquid Phase

Mass Flow (kg/h)	Density (kg/m3)	Mass Sp Heat (kJ/kg-C)	Viscosity (cP)	Thermal Cond (W/m-K)	Surface Tens (dyne/cm)
23074.52	875.09	4.40	0.09	0.67	43.39
11385.04	878.22	4.40	0.09	0.68	43.39

Molecular Wt	Sp Gravity	Pseudo Pc (kPa)	Pseudo Tc (C)	Pseudo Zc	Pseudo Omega
18.20	0.88	21926.02	372.38	0.26	0.35
18.08	0.88	22056.02	373.56	0.26	0.34

Mixed Liquid Phase

Mass Flow (kg/h)	Density (kg/m3)	Mass Sp Heat (kJ/kg-C)	Viscosity (cP)	Thermal Cond (W/m-K)	Surface Tens (dyne/cm)
23074.52	875.09	4.40	0.09	0.67	43.39
11385.04	878.22	4.40	0.09	0.68	43.39

Molecular Wt	Sp Gravity	Pseudo Pc (kPa)	Pseudo Tc (C)	Pseudo Zc	Pseudo Omega
18.20	0.88	21926.02	372.38	0.26	0.35
18.08	0.88	22056.02	373.56	0.26	0.34

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