


1	 Company Name Not Available Bedford, MA USA	Case Name: SIMULATION FINAL.hsc
2		Unit Set: SI-user1
3		Date/Time: Sun Jun 26 21:29:37 2022
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Mixer: MIX-100

CONDITIONS

Name	FEED	RECYCLE	mixed
Vapour	1.0000	1.0000	1.0000
Temperature (C)	40.0000 *	46.0998 *	44.4298
Pressure (kPa)	4000.0000 *	4000.0000 *	4000.0000
Molar Flow (kgmole/h)	79.9078	261.8846 *	341.7924
Mass Flow (kg/h)	1000.0000 *	1533.3812	2533.3812
Std Ideal Liq Vol Flow (m3/h)	2.7947	8.1278	10.9225
Molar Enthalpy (kJ/kgmole)	-9.806e+004	-3.510e+004	-4.982e+004
Molar Entropy (kJ/kgmole-C)	110.7	101.6	103.9
Heat Flow (kJ/h)	-7.8358e+06	-9.1929e+06	-1.7029e+07

PROPERTIES

Name	FEED	RECYCLE	mixed
Molecular Weight	12.51	5.855	7.412
Molar Density (kgmole/m3)	1.515	1.474	1.483
Mass Density (kg/m3)	18.96	8.630	10.99
Act. Volume Flow (m3/h)	52.74	177.7	230.4
Mass Enthalpy (kJ/kg)	-7836	-5995	-6722
Mass Entropy (kJ/kg-C)	8.842	17.35	14.02
Heat Capacity (kJ/kgmole-C)	32.04	29.89	30.37
Mass Heat Capacity (kJ/kg-C)	2.560	5.106	4.098
LHV Molar Basis (Std) (kJ/gmole)	181.5	222.4	212.8
HHV Molar Basis (Std) (kJ/gmole)	212.2	260.0	248.8
HHV Mass Basis (Std) (kJ/kg)	1.696e+004	4.441e+004	3.357e+004
CO2 Loading	---	---	---
CO2 Apparent Mole Conc. (kgmole/m3)	---	---	---
CO2 Apparent Wt. Conc. (kgmol/kg)	---	---	---
LHV Mass Basis (Std) (kJ/kg)	1.450e+004	3.798e+004	2.871e+004
Phase Fraction [Vol. Basis]	1.000	1.000	1.000
Phase Fraction [Mass Basis]	1.000	1.000	1.000
Phase Fraction [Act. Vol. Basis]	1.000	1.000	1.000
Mass Exergy (kJ/kg)	731.3	1569	1239
Partial Pressure of CO2 (kPa)	1000	349.6	501.6
Cost Based on Flow (Cost/s)	0.0000	0.0000	0.0000
Act. Gas Flow (ACT_m3/h)	52.74	177.7	230.4
Avg. Liq. Density (kgmole/m3)	28.59	32.22	31.29
Specific Heat (kJ/kgmole-C)	32.04	29.89	30.37
Std. Gas Flow (STD_m3/h)	1889	6192	8081
Std. Ideal Liq. Mass Density (kg/m3)	357.8	188.7	231.9
Act. Liq. Flow (m3/s)	---	---	---
Z Factor	1.014	1.022	1.021
Watson K	13.41	21.21	18.15
User Property	---	---	---
Partial Pressure of H2S (kPa)	0.0000	0.0000	0.0000
Cp/(Cp - R)	1.350	1.385	1.377
Cp/Cv	1.391	1.399	1.396
Heat of Vap. (kJ/gmole)	12.50	11.00	11.09
Kinematic Viscosity (cSt)	0.6272	1.148	0.9305
Liq. Mass Density (Std. Cond) (kg/m3)	0.5291	0.2475	0.3133
Liq. Vol. Flow (Std. Cond) (m3/h)	1890	6196	8086
Liquid Fraction	0.0000	0.0000	0.0000
Molar Volume (m3/kgmole)	0.6600	0.6785	0.6742
Mass Heat of Vap. (kJ/kg)	998.6	1879	1496
Phase Fraction [Molar Basis]	1.0000	1.0000	1.0000
Surface Tension (dyne/cm)	---	---	---
Thermal Conductivity (W/m-K)	0.1050	0.1497	0.1373
Viscosity (cP)	1.189e-002	9.908e-003	1.023e-002
Cv (Semi-Ideal) (kJ/kgmole-C)	23.73	21.58	22.06

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Mixer: MIX-100 (continued)

PROPERTIES

Name	FEED	RECYCLE	mixed		
Mass Cv (Semi-Ideal) (kJ/kg-C)	1.896	3.686	2.976		
Cv (kJ/kgmole-C)	23.04	21.36	21.75		
Mass Cv (kJ/kg-C)	1.841	3.648	2.935		
Cv (Ent. Method) (kJ/kgmole-C)	---	---	---		
Mass Cv (Ent. Method) (kJ/kg-C)	---	---	---		
Cp/Cv (Ent. Method)	---	---	---		
Reid VP at 37.8 C (kPa)	---	---	---		
True VP at 37.8 C (kPa)	---	---	---		
Liq. Vol. Flow - Sum(Std. Cond) (m3/h)	1890	6196	8086		
Viscosity Index	-71.52	-23.63	-31.87		


Tank: methanol storage

CONDITIONS

Name	final product	shipping	vent		
Vapour	0.0007	0.0000	1.0000		
Temperature (C)	43.3948	42.0592	42.0592		
Pressure (kPa)	950.0000	200.0000	200.0000		
Molar Flow (kgmole/h)	19.9674	19.7027	0.2647		
Mass Flow (kg/h)	639.5488	629.1109	10.4379		
Std Ideal Liq Vol Flow (m3/h)	0.8017	0.7885	0.0131		
Molar Enthalpy (kJ/kgmole)	-2.446e+005	-2.434e+005	-3.371e+005		
Molar Entropy (kJ/kgmole-C)	25.11	23.42	165.4		
Heat Flow (kJ/h)	-4.8849e+06	-4.7957e+06	-8.9225e+04		

PROPERTIES

Name	final product	shipping	vent		
Molecular Weight	32.03	31.93	39.43		
Molar Density (kgmole/m3)	23.14	24.21	7.717e-002		
Mass Density (kg/m3)	741.1	773.1	3.043		
Act. Volume Flow (m3/h)	0.8630	0.8138	3.430		
Mass Enthalpy (kJ/kg)	-7638	-7623	-8548		
Mass Entropy (kJ/kg-C)	0.7838	0.7334	4.194		
Heat Capacity (kJ/kgmole-C)	119.2	119.5	39.76		
Mass Heat Capacity (kJ/kg-C)	3.721	3.743	1.008		
LHV Molar Basis (Std) (kJ/gmole)	612.5	619.1	120.8		
HHV Molar Basis (Std) (kJ/gmole)	692.0	699.4	137.0		
HHV Mass Basis (Std) (kJ/kg)	2.160e+004	2.190e+004	3473		
CO2 Loading	---	---	---		
CO2 Apparent Mole Conc. (kgmole/m3)	0.5056	0.2852	---		
CO2 Apparent Wt. Conc. (kgmol/kg)	6.822e-004	3.689e-004	---		
LHV Mass Basis (Std) (kJ/kg)	1.912e+004	1.939e+004	3063		
Phase Fraction [Vol. Basis]	6.227e-004	---	1.000		
Phase Fraction [Mass Basis]	3.420e-004	0.0000	1.000		
Phase Fraction [Act. Vol. Basis]	4.345e-002	0.0000	1.000		
Mass Exergy (kJ/kg)	4.468	1.977	43.09		
Partial Pressure of CO2 (kPa)	293.3	0.0000	154.3		
Cost Based on Flow (Cost/s)	0.0000	0.0000	0.0000		
Act. Gas Flow (ACT_m3/h)	3.750e-002	---	3.430		
Avg. Liq. Density (kgmole/m3)	24.91	24.99	20.15		
Specific Heat (kJ/kgmole-C)	119.2	119.5	39.76		
Std. Gas Flow (STD_m3/h)	472.1	465.9	6.258		
Std. Ideal Liq. Mass Density (kg/m3)	797.8	797.8	794.7		
Act. Liq. Flow (m3/s)	2.293e-004	2.260e-004	---		
Z Factor	---	---	---		
Watson K	10.57	10.60	8.990		

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Tank: methanol storage (continued)

PROPERTIES

Name	final product	shipping	vent
User Property	---	---	---
Partial Pressure of H2S (kPa)	0.0000	0.0000	0.0000
Cp/(Cp - R)	1.075	1.075	1.264
Cp/Cv	1.006	1.360	1.282
Heat of Vap. (kJ/gmole)	78.72	41.58	42.42
Kinematic Viscosity (cSt)	---	0.5549	4.302
Liq. Mass Density (Std. Cond) (kg/m3)	804.3	801.8	799.8
Liq. Vol. Flow (Std. Cond) (m3/h)	0.7952	0.7846	1.305e-002
Liquid Fraction	0.9993	1.000	0.0000
Molar Volume (m3/kgmole)	4.322e-002	4.130e-002	12.96
Mass Heat of Vap. (kJ/kg)	2458	1302	1076
Phase Fraction [Molar Basis]	0.0007	0.0000	1.0000
Surface Tension (dyne/cm)	26.83	27.32	---
Thermal Conductivity (W/m-K)	---	0.1752	2.158e-002
Viscosity (cP)	---	0.4290	1.309e-002
Cv (Semi-Ideal) (kJ/kgmole-C)	110.9	111.2	31.45
Mass Cv (Semi-Ideal) (kJ/kg-C)	3.461	3.483	0.7975
Cv (kJ/kgmole-C)	118.5	87.89	31.01
Mass Cv (kJ/kg-C)	3.700	2.753	0.7865
Cv (Ent. Method) (kJ/kgmole-C)	---	77.99	---
Mass Cv (Ent. Method) (kJ/kg-C)	---	2.443	---
Cp/Cv (Ent. Method)	---	1.532	---
Reid VP at 37.8 C (kPa)	193.1	109.3	8172
True VP at 37.8 C (kPa)	1806	186.0	2.499e+004
Liq. Vol. Flow - Sum(Std. Cond) (m3/h)	1.115	0.7846	1.305e-002
Viscosity Index	-7.042	-6.347	-6.055


Heater: feed heater

CONDITIONS

Name	mixed	to reactor	heater duty
Vapour	1.0000	1.0000	---
Temperature (C)	44.4298	200.0000 *	---
Pressure (kPa)	4000.0000	3950.0000	---
Molar Flow (kgmole/h)	341.7924	341.7924	---
Mass Flow (kg/h)	2533.3812	2533.3812	---
Std Ideal Liq Vol Flow (m3/h)	10.9225	10.9225	---
Molar Enthalpy (kJ/kgmole)	-4.982e+004	-4.507e+004	---
Molar Entropy (kJ/kgmole-C)	103.9	116.2	---
Heat Flow (kJ/h)	-1.7029e+07	-1.5403e+07	1.6258e+06

PROPERTIES

Name	mixed	to reactor
Molecular Weight	7.412	7.412
Molar Density (kgmole/m3)	1.483	0.9882
Mass Density (kg/m3)	10.99	7.325
Act. Volume Flow (m3/h)	230.4	345.9
Mass Enthalpy (kJ/kg)	-6722	-6080
Mass Entropy (kJ/kg-C)	14.02	15.68
Heat Capacity (kJ/kgmole-C)	30.37	30.99
Mass Heat Capacity (kJ/kg-C)	4.098	4.181
LHV Molar Basis (Std) (kJ/gmole)	212.8	212.8
HHV Molar Basis (Std) (kJ/gmole)	248.8	248.8
HHV Mass Basis (Std) (kJ/kg)	3.357e+004	3.357e+004
CO2 Loading	---	---
CO2 Apparent Mole Conc. (kgmole/m3)	---	---

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Heater: feed heater (continued)


PROPERTIES

Name	mixed	to reactor		
CO2 Apparent Wt. Conc. (kgmol/kg)	---	---		
LHV Mass Basis (Std) (kJ/kg)	2.871e+004	2.871e+004		
Phase Fraction [Vol. Basis]	1.000	1.000		
Phase Fraction [Mass Basis]	1.000	1.000		
Phase Fraction [Act. Vol. Basis]	1.000	1.000		
Mass Exergy (kJ/kg)	1239	1386		
Partial Pressure of CO2 (kPa)	501.6	495.4		
Cost Based on Flow (Cost/s)	0.0000	0.0000		
Act. Gas Flow (ACT_m3/h)	230.4	345.9		
Avg. Liq. Density (kgmole/m3)	31.29	31.29		
Specific Heat (kJ/kgmole-C)	30.37	30.99		
Std. Gas Flow (STD_m3/h)	8081	8081		
Std. Ideal Liq. Mass Density (kg/m3)	231.9	231.9		
Act. Liq. Flow (m3/s)	---	---		
Z Factor	1.021	1.016		
Watson K	18.15	18.15		
User Property	---	---		
Partial Pressure of H2S (kPa)	0.0000	0.0000		
Cp/(Cp - R)	1.377	1.367		
Cp/Cv	1.396	1.365		
Heat of Vap. (kJ/gmole)	11.09	11.74		
Kinematic Viscosity (cSt)	0.9305	1.970		
Liq. Mass Density (Std. Cond) (kg/m3)	0.3133	0.3133		
Liq. Vol. Flow (Std. Cond) (m3/h)	8086	8086		
Liquid Fraction	0.0000	0.0000		
Molar Volume (m3/kgmole)	0.6742	1.012		
Mass Heat of Vap. (kJ/kg)	1496	1583		
Phase Fraction [Molar Basis]	1.0000	1.0000		
Surface Tension (dyne/cm)	---	---		
Thermal Conductivity (W/m-K)	0.1373	0.1857		
Viscosity (cP)	1.023e-002	1.443e-002		
Cv (Semi-Ideal) (kJ/kgmole-C)	22.06	22.67		
Mass Cv (Semi-Ideal) (kJ/kg-C)	2.976	3.059		
Cv (kJ/kgmole-C)	21.75	22.69		
Mass Cv (kJ/kg-C)	2.935	3.062		
Cv (Ent. Method) (kJ/kgmole-C)	---	---		
Mass Cv (Ent. Method) (kJ/kg-C)	---	---		
Cp/Cv (Ent. Method)	---	---		
Reid VP at 37.8 C (kPa)	---	---		
True VP at 37.8 C (kPa)	---	---		
Liq. Vol. Flow - Sum(Std. Cond) (m3/h)	8086	8086		
Viscosity Index	-31.87	-15.12		

Distillation: DISTILLATION

CONNECTIONS

Inlet Stream			
STREAM NAME	Stage	FROM UNIT OPERATION	
REBOILER DUTY	Reboiler		
liquid	5 Main Tower	Separator	separator
Outlet Stream			
STREAM NAME	Stage	TO UNIT OPERATION	
CONDENSER DUTY	Condenser		
METHANOL	Condenser	Heat Exchanger	Condenser
DUMMY	Condenser		
WATER	Reboiler		

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Distillation: DISTILLATION (continued)

MONITOR

Specifications Summary

	Specified Value	Current Value	Wt. Error			
13	Reflux Ratio	3.000 *	6.997	1.332		
14	Ovhd Vap Rate	19.73 kgmole/h *	19.97 kgmole/h	1.208e-002		
15	Distillate Rate	0.0000 kgmole/h *	3.996e-007 kgmole/h	-3.326e-008		
16	Reflux Rate	---	139.7 kgmole/h	---		
17	Btms Prod Rate	---	19.99 kgmole/h	---		
18	Comp Recovery	0.9700 *	0.9700	1.089e-005		
19	Comp Fraction	1.000e-002 *	9.999e-003	-3.677e-005		
	Wt. Tol.	Abs. Tol.	Active	Estimate	Used	
21	Reflux Ratio	1.000e-002	1.000e-002	Off	On	Off
22	Ovhd Vap Rate	1.000e-002	1.000 kgmole/h	Off	On	Off
23	Distillate Rate	1.000e-002	1.000 kgmole/h	On	On	On
24	Reflux Rate	1.000e-002	1.000 kgmole/h	Off	On	Off
25	Btms Prod Rate	1.000e-002	1.000 kgmole/h	Off	On	Off
26	Comp Recovery	1.000e-002	1.000e-003	On	On	On
27	Comp Fraction	1.000e-002	1.000e-003	On	On	On

SPECS

Column Specification Parameters

Reflux Ratio

33	Fix/Rang:	Fixed	Prim/Alter:	Primary	Lower Bnd:	---	Upper Bnd:	---
34	Stage:	Condenser	Flow Basis:	Molar	Liquid Spec:	---		

Ovhd Vap Rate

37	Fix/Rang:	Fixed	Prim/Alter:	Primary	Lower Bnd:	---	Upper Bnd:	---
38	Stream:	ETHANOL @COL1	Flow Basis:	Molar				

Distillate Rate

41	Fix/Rang:	Fixed	Prim/Alter:	Primary	Lower Bnd:	---	Upper Bnd:	---
42	Stream:	DUMMY @COL1	Flow Basis:	Molar				

Reflux Rate

45	Fix/Rang:	Fixed	Prim/Alter:	Primary	Lower Bnd:	---	Upper Bnd:	---
46	Stage:	Condenser	Flow Basis:	Molar	Liquid Spec:	---		

Btms Prod Rate

49	Fix/Rang:	Fixed	Prim/Alter:	Primary	Lower Bnd:	---	Upper Bnd:	---
50	Stream:	WATER @COL1	Flow Basis:	Molar				

Comp Recovery

53	Fix/Rang:	Fixed	Prim/Alter:	Primary	Lower Bnd:	---	Upper Bnd:	---
54	Draw:	ETHANOL @COL1	Flow Basis:	Molar				
55	Components:	Methanol						

Comp Fraction


58	Fix/Rang:	Fixed	Prim/Alter:	Primary	Lower Bnd:	---	Upper Bnd:	---
59	Stage:		Flow Basis:	Mass Fraction	Phase:	Liquid		
60	Components:	H2O						

SUBCOOLING

63		Condenser	
64	Degrees of Subcooling		---
65	Subcool to		---

User Variables

PROFILES

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Distillation: DISTILLATION (continued)

PROFILES

General Parameters

Sub-Flow Sheet:	DISTILLATION (COL1)	Number of Stages:	10
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Profile Estimates

	Temperature (C)	Net Liquid (kgmole/h)	Net Vapour (kgmole/h)
Condenser	139.0 *	59.19 *	19.73 *
1 Main Tower	140.5 *	58.95 *	78.92 *
2 Main Tower	141.5 *	58.48 *	78.68 *
3 Main Tower	142.8 *	57.90 *	78.21 *
4 Main Tower	144.3 *	57.20 *	77.63 *
5 Main Tower	146.2 *	111.1 *	76.93 *
6 Main Tower	146.9 *	110.8 *	90.86 *
7 Main Tower	147.8 *	110.2 *	90.60 *
8 Main Tower	149.4 *	108.9 *	89.92 *
9 Main Tower	152.5 *	106.5 *	88.64 *
10 Main Tower	158.6 *	102.6 *	86.26 *
Reboiler	169.3 *	20.23 *	82.41 *

EFFICIENCIES

Stage Efficiencies

Stages	Overall	CO2	Hydrogen	Methanol	H2O
Condenser	1.000	1.000	1.000	1.000	1.000
1 Main Tower	1.000	1.000	1.000	1.000	1.000
2 Main Tower	1.000	1.000	1.000	1.000	1.000
3 Main Tower	1.000	1.000	1.000	1.000	1.000
4 Main Tower	1.000	1.000	1.000	1.000	1.000
5 Main Tower	1.000	1.000	1.000	1.000	1.000
6 Main Tower	1.000	1.000	1.000	1.000	1.000
7 Main Tower	1.000	1.000	1.000	1.000	1.000
8 Main Tower	1.000	1.000	1.000	1.000	1.000
9 Main Tower	1.000	1.000	1.000	1.000	1.000
10 Main Tower	1.000	1.000	1.000	1.000	1.000
Reboiler	1.000	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		

Damping Parameters


Initial Estimate Generator Parameters

Azeotrope Check:	Off
Iterative IEG (Good for Chemicals):	Off
Fixed Damping Factor:	1

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)	0.5500	*	
Tray Volume (m3)	0.9719		
Disable Heat Loss Calculations	No		

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Distillation: DISTILLATION (continued)

9	Heat Model	None	
10	Rating Calculations	No	
11	Tray Hold Up (m3)	8.836e-002	

Vessels

14	Vessel	Condenser @COL1	Reboiler @COL1
15	Diameter (m)	1.193	1.193
16	Length (m)	1.789	1.789
17	Volume (m3)	2.000 *	2.000 *
18	Orientation	Horizontal	Horizontal
19	Vessel has a Boot	No	No
20	Boot Diameter (m)	---	---
21	Boot Length (m)	---	---
22	Hold Up (m3)	1.000	1.000

Other Equipment In Column Flowsheet

23			
24			

Pressure Profile


28		Pressure (kPa)	Pressure Drop (kPa)
29	Condenser	1000 kPa *	0.0000 kPa
30	1 Main Tower	1000 kPa	1.667 kPa
31	2 Main Tower	1002 kPa	1.667 kPa
32	3 Main Tower	1003 kPa	1.667 kPa
33	4 Main Tower	1005 kPa	1.667 kPa
34	5 Main Tower	1007 kPa	1.667 kPa
35	6 Main Tower	1008 kPa	1.667 kPa
36	7 Main Tower	1010 kPa	1.667 kPa
37	8 Main Tower	1012 kPa	1.667 kPa
38	9 Main Tower	1013 kPa	1.667 kPa
39	10 Main Tower	1015 kPa	---
40	Reboiler	1015 kPa *	0.0000 kPa

Pressure Solving Options

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

CONDITIONS


47	Name	liquid	WATER	METHANOL	DUMMY
48	Vapour	0.0000	0.0000	1.0000	0.0000
49	Temperature (C)	40.0000	174.3316	138.2059	138.2059
50	Pressure (kPa)	3800.0000	1015.0000	1000.0000	1000.0000
51	Molar Flow (kgmole/h)	39.9578	19.9904	19.9674	0.0000
52	Mass Flow (kg/h)	1007.9845	368.4357	639.5488	0.0000
53	Std Ideal Liq Vol Flow (m3/h)	1.1757	0.3740	0.8017	0.0000
54	Molar Enthalpy (kJ/kgmole)	-2.640e+005	-2.725e+005	-2.019e+005	-2.298e+005
55	Molar Entropy (kJ/kgmole-C)	44.59	86.85	133.5	57.04
56	Heat Flow (kJ/h)	-1.0550e+07	-5.4480e+06	-4.0308e+06	-9.1809e-02
57	Name	REBOILER DUTY	CONDENSER DUTY		
58	Vapour	---	---		
59	Temperature (C)	---	---		
60	Pressure (kPa)	---	---		
61	Molar Flow (kgmole/h)	---	---		
62	Mass Flow (kg/h)	---	---		
63	Std Ideal Liq Vol Flow (m3/h)	---	---		
64	Molar Enthalpy (kJ/kgmole)	---	---		
65	Molar Entropy (kJ/kgmole-C)	---	---		
66	Heat Flow (kJ/h)	5.4444e+06	4.3734e+06		

1	 Company Name Not Available Bedford, MA USA	Case Name:	SIMULATION FINAL.hsc
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Distillation: DISTILLATION (continued)

PROPERTIES

Name	liquid	WATER	METHANOL	DUMMY
Molar Weight	25.23	18.43	32.03	31.61
Molar Density (kgmole/m3)	33.61	46.93	0.3276	20.68
Mass Density (kg/m3)	847.9	865.0	10.49	653.8
Act. Volume Flow (m3/h)	1.189	0.4259	60.94	1.932e-008
Mass Enthalpy (kJ/kg)	-1.047e+004	-1.479e+004	-6303	-7268
Mass Entropy (kJ/kg-C)	1.767	4.712	4.168	1.804
Heat Capacity (kJ/kgmole-C)	101.5	88.30	58.71	144.1
Mass Heat Capacity (kJ/kg-C)	4.022	4.791	1.833	4.559
LHV Molar Basis (Std) (kJ/gmole)	315.5	18.90	612.5	617.6
HHV Molar Basis (Std) (kJ/gmole)	376.4	61.13	692.0	698.3
HHV Mass Basis (Std) (kJ/kg)	1.492e+004	3317	2.160e+004	2.209e+004
CO2 Loading	---	---	---	---
CO2 Apparent Mole Conc. (kgmole/m3)	0.3670	5.181e-015	---	1.747e-002
CO2 Apparent Wt. Conc. (kgmol/kg)	4.329e-004	5.990e-018	---	2.673e-005
LHV Mass Basis (Std) (kJ/kg)	1.251e+004	1026	1.912e+004	1.954e+004
Phase Fraction [Vol. Basis]	---	0.0000	1.000	0.0000
Phase Fraction [Mass Basis]	0.0000	0.0000	1.000	0.0000
Phase Fraction [Act. Vol. Basis]	0.0000	0.0000	1.000	0.0000
Mass Exergy (kJ/kg)	8.221	130.6	331.1	73.08
Partial Pressure of CO2 (kPa)	0.0000	0.0000	21.85	0.0000
Cost Based on Flow (Cost/s)	0.0000	0.0000	0.0000	0.0000
Act. Gas Flow (ACT_m3/h)	---	---	60.94	---
Avg. Liq. Density (kgmole/m3)	33.99	53.45	24.91	25.26
Specific Heat (kJ/kgmole-C)	101.5	88.30	58.71	144.1
Std. Gas Flow (STD_m3/h)	944.8	472.7	472.1	9.447e-006
Std. Ideal Liq. Mass Density (kg/m3)	857.4	985.1	797.8	798.6
Act. Liq. Flow (m3/s)	3.302e-004	1.183e-004	---	5.367e-012
Z Factor	---	5.813e-003	0.8924	1.414e-002
Watson K	10.57	10.63	10.57	10.62
User Property	---	---	---	---
Partial Pressure of H2S (kPa)	0.0000	0.0000	0.0000	0.0000
Cp/(Cp - R)	1.089	1.104	1.165	1.061
Cp/Cv	1.187	1.195	1.307	1.379
Heat of Vap. (kJ/gmole)	28.30	36.71	78.67	31.30
Kinematic Viscosity (cSt)	0.6280	0.1048	0.8446	0.2311
Liq. Mass Density (Std. Cond) (kg/m3)	868.9	1002	804.3	799.6
Liq. Vol. Flow (Std. Cond) (m3/h)	1.160	0.3678	0.7952	1.580e-008
Liquid Fraction	1.000	1.000	0.0000	1.000
Molar Volume (m3/kgmole)	2.975e-002	2.131e-002	3.052	4.836e-002
Mass Heat of Vap. (kJ/kg)	1122	1992	2456	990.1
Phase Fraction [Molar Basis]	0.0000	0.0000	1.0000	0.0000
Surface Tension (dyne/cm)	47.80	42.44	---	13.60
Thermal Conductivity (W/m-K)	0.3484	0.6549	2.341e-002	0.1372
Viscosity (cP)	0.5325	9.063e-002	8.863e-003	0.1511
Cv (Semi-Ideal) (kJ/kgmole-C)	93.16	79.98	50.39	135.8
Mass Cv (Semi-Ideal) (kJ/kg-C)	3.693	4.340	1.573	4.296
Cv (kJ/kgmole-C)	85.50	73.88	44.91	104.5
Mass Cv (kJ/kg-C)	3.389	4.008	1.402	3.307
Cv (Ent. Method) (kJ/kgmole-C)	80.99	---	---	---
Mass Cv (Ent. Method) (kJ/kg-C)	3.210	---	---	---
Cp/Cv (Ent. Method)	1.253	---	---	---
Reid VP at 37.8 C (kPa)	188.2	26.85	193.1	32.86
True VP at 37.8 C (kPa)	3931	9.153	1806	40.95
Liq. Vol. Flow - Sum(Std. Cond) (m3/h)	1.160	0.3678	0.7952	1.580e-008
Viscosity Index	-4.027	---	-43.84	-39.71

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Distillation: DISTILLATION (continued)

SUMMARY

11	Flow Basis:	Molar	The composition option is selected
----	-------------	-------	------------------------------------

Feed Composition

	liquid		
13			
14	Flow Rate (kgmole/h)	39.9578	
15		---	
16	CO2	0.0109	
17	Hydrogen	0.0004	
18	Methanol	0.4943	
19	H2O	0.4944	

20	Flow Basis:	Molar	The composition option is selected
----	-------------	-------	------------------------------------

Feed Flows

	liquid		
22			
23	Flow Rate (kgmole/h)	39.9578	
24		---	
25	CO2 (kgmole/h)	0.4363	
26	Hydrogen (kgmole/h)	0.0162	
27	Methanol (kgmole/h)	19.7520	
28	H2O (kgmole/h)	19.7533	

Products

30	Flow Basis:	Molar	The composition option is selected
----	-------------	-------	------------------------------------

Product Compositions

	METHANOL	DUMMY	WATER
32			
33	Flow Rate (kgmole/h)	19.9674	19.9904
34		---	---
35	CO2	0.0219	0.0000
36	Hydrogen	0.0008	0.0000
37	Methanol	0.9596	0.0296
38	H2O	0.0178	0.9704

39	Flow Basis:	Molar	The composition option is selected
----	-------------	-------	------------------------------------

Product Flows

	METHANOL	DUMMY	WATER
41			
42	Flow Rate (kgmole/h)	19.9674 *	19.9904 *
43		---	---
44	CO2 (kgmole/h)	0.4363 *	0.0000 *
45	Hydrogen (kgmole/h)	0.0162 *	0.0000 *
46	Methanol (kgmole/h)	19.1599 *	0.5921 *
47	H2O (kgmole/h)	0.3550 *	19.3983 *

48	Flow Basis:	Molar	The composition option is selected
----	-------------	-------	------------------------------------

Product Recoveries


	METHANOL	DUMMY	WATER
50			
51	Flow Rate (kgmole/h)	19.9674	19.9904
52		---	---
53	CO2 (%)	100.0000	0.0000
54	Hydrogen (%)	100.0000	0.0000
55	Methanol (%)	97.0021	2.9979
56	H2O (%)	1.7971	98.2029

COLUMN PROFILES

59	Reflux Ratio: 6.997	Reboil Ratio: 7.504	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)
61							
62							
63	Condenser	138.2	1000	139.7	---	19.97	4.37e+006 *
64	1_Main Tower	139.4	1000	139.7	159.7	---	---
65	2_Main Tower	140.1	1002	139.0	159.6	---	---
66	3_Main Tower	141.0	1003	138.0	159.0	---	---
67	4_Main Tower	142.3	1005	136.6	158.0	---	---
68	5_Main Tower	144.2	1007	190.2	156.5	39.96	---

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Distillation: DISTILLATION (continued)

COLUMN PROFILES

	Temp (C)	Pres (kPa)	Net Liq (kgmole/h)	Net Vap (kgmole/h)	Net Feed (kgmole/h)	Net Draws (kgmole/h)	Duty (kJ/h)
13	6_Main Tower	145.1	1008	189.1	170.2	---	---
14	7_Main Tower	146.6	1010	187.1	169.2	---	---
15	8_Main Tower	149.2	1012	183.5	167.1	---	---
16	9_Main Tower	153.9	1013	177.4	163.5	---	---
17	10_Main Tower	162.7	1015	170.0	157.4	---	---
18	Reboiler	174.3	1015	---	150.0	---	19.99
							5.44e+006 *

Column Profiles Energy

	Temperature (C)	Liq Enthalpy (kJ/kgmole)	Vap Enthalpy (kJ/kgmole)	Heat Loss (kJ/h)
22	Condenser	138.2	-2.298e+005	-2.019e+005
23	1_Main Tower	139.4	-2.304e+005	-1.989e+005
24	2_Main Tower	140.1	-2.317e+005	-1.995e+005
25	3_Main Tower	141.0	-2.336e+005	-2.004e+005
26	4_Main Tower	142.3	-2.363e+005	-2.019e+005
27	5_Main Tower	144.2	-2.401e+005	-2.040e+005
28	6_Main Tower	145.1	-2.417e+005	-2.044e+005
29	7_Main Tower	146.6	-2.445e+005	-2.059e+005
30	8_Main Tower	149.2	-2.492e+005	-2.085e+005
31	9_Main Tower	153.9	-2.572e+005	-2.131e+005
32	10_Main Tower	162.7	-2.675e+005	-2.206e+005
33	Reboiler	174.3	-2.725e+005	-2.306e+005


FEEDS / PRODUCTS

Flow Basis:		Molar		State	Flows (kgmole/h)	Enthalpy (kJ/kgmole)	Temp (C)
37							
38							
39							
40	CONDENSER DUTY	Energy	4.4e+006 *		---	---	---
41	METHANOL	Draw	---	Vapour	20.0 *	-2.0e+005 *	138.2 *
42	DUMMY	Draw	---	Liquid	4.00e-007 *	-2.3e+005 *	138.2 *
43							
44							
45							
46	liquid	Feed	---	Liquid	40.0 *	-2.6e+005 *	40.00 *
47							
48							
49							
50							
51							
52	REBOILER DUTY	Energy	5.4e+006 *		---	---	---
53	WATER	Draw	---	Liquid	20.0 *	-2.7e+005 *	174.33 *

Heat Exchanger: Condenser

CONDITIONS


Name	METHANOL	to condenser	final product	water return
59				
60	Vapour	1.0000	0.0000	0.0000
61	Temperature (C)	138.2059	30.0293	43.3948
62	Pressure (kPa)	1000.0000	600.0000 *	950.0000
63	Molar Flow (kgmole/h)	19.9674	712.7850	19.9674
64	Mass Flow (kg/h)	639.5488	12840.8933	639.5488
65	Std Ideal Liq Vol Flow (m3/h)	0.8017	12.8668	0.8017
66	Molar Enthalpy (kJ/kgmole)	-2.019e+005	-2.859e+005	-2.446e+005
67	Molar Entropy (kJ/kgmole-C)	133.5	54.63	25.11
68	Heat Flow (kJ/h)	-4.0308e+06	-2.0382e+08	-4.8849e+06

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Heat Exchanger: Condenser (continued)

PROPERTIES

Name	METHANOL	to condenser	final product	water return	
Molecular Weight	32.03	18.02	32.03	18.02	
Molar Density (kgmole/m3)	0.3276	55.71	23.14	55.08	
Mass Density (kg/m3)	10.49	1004	741.1	992.2	
Act. Volume Flow (m3/h)	60.94	12.79	0.8630	12.94	
Mass Enthalpy (kJ/kg)	-6303	-1.587e+004	-7638	-1.581e+004	
Mass Entropy (kJ/kg-C)	4.168	3.032	0.7838	3.247	
Heat Capacity (kJ/kgmole-C)	58.71	79.89	119.2	79.89	
Mass Heat Capacity (kJ/kg-C)	1.833	4.435	3.721	4.435	
LHV Molar Basis (Std) (kJ/gmole)	612.5	0.0000	612.5	0.0000	
HHV Molar Basis (Std) (kJ/gmole)	692.0	41.01	692.0	41.01	
HHV Mass Basis (Std) (kJ/kg)	2.160e+004	2276	2.160e+004	2276	
CO2 Loading	---	---	---	---	
CO2 Apparent Mole Conc. (kgmole/m3)	---	0.0000	0.5056	0.0000	
CO2 Apparent Wt. Conc. (kgmol/kg)	---	0.0000	6.822e-004	0.0000	
LHV Mass Basis (Std) (kJ/kg)	1.912e+004	0.0000	1.912e+004	0.0000	
Phase Fraction [Vol. Basis]	1.000	0.0000	6.227e-004	0.0000	
Phase Fraction [Mass Basis]	1.000	0.0000	3.420e-004	0.0000	
Phase Fraction [Act. Vol. Basis]	1.000	0.0000	4.345e-002	0.0000	
Mass Exergy (kJ/kg)	331.1	0.8466	4.468	3.454	
Partial Pressure of CO2 (kPa)	21.85	0.0000	293.3	0.0000	
Cost Based on Flow (Cost/s)	0.0000	0.0000	0.0000	0.0000	
Act. Gas Flow (ACT_m3/h)	60.94	---	3.750e-002	---	
Avg. Liq. Density (kgmole/m3)	24.91	55.40	24.91	55.40	
Specific Heat (kJ/kgmole-C)	58.71	79.89	119.2	79.89	
Std. Gas Flow (STD_m3/h)	472.1	1.685e+004	472.1	1.685e+004	
Std. Ideal Liq. Mass Density (kg/m3)	797.8	998.0	797.8	998.0	
Act. Liq. Flow (m3/s)	---	3.554e-003	2.293e-004	3.595e-003	
Z Factor	0.8924	4.272e-003	---	3.775e-003	
Watson K	10.57	---	10.57	---	
User Property	---	---	---	---	
Partial Pressure of H2S (kPa)	0.0000	0.0000	0.0000	0.0000	
Cp/(Cp - R)	1.165	1.116	1.075	1.116	
Cp/Cv	1.307	1.145	1.006	1.153	
Heat of Vap. (kJ/gmole)	78.67	37.87	78.72	38.07	
Kinematic Viscosity (cSt)	0.8446	0.7938	---	0.5981	
Liq. Mass Density (Std. Cond) (kg/m3)	804.3	1015	804.3	1015	
Liq. Vol. Flow (Std. Cond) (m3/h)	0.7952	12.65	0.7952	12.65	
Liquid Fraction	0.0000	1.000	0.9993	1.000	
Molar Volume (m3/kgmole)	3.052	1.795e-002	4.322e-002	1.816e-002	
Mass Heat of Vap. (kJ/kg)	2456	2102	2458	2113	
Phase Fraction [Molar Basis]	1.0000	0.0000	0.0007	0.0000	
Surface Tension (dyne/cm)	---	71.23	26.83	68.61	
Thermal Conductivity (W/m-K)	2.341e-002	0.6183	---	0.6376	
Viscosity (cP)	8.863e-003	0.7967	---	0.5934	
Cv (Semi-Ideal) (kJ/kgmole-C)	50.39	71.58	110.9	71.58	
Mass Cv (Semi-Ideal) (kJ/kg-C)	1.573	3.973	3.461	3.973	
Cv (kJ/kgmole-C)	44.91	69.76	118.5	69.28	
Mass Cv (kJ/kg-C)	1.402	3.872	3.700	3.846	
Cv (Ent. Method) (kJ/kgmole-C)	---	---	---	---	
Mass Cv (Ent. Method) (kJ/kg-C)	---	---	---	---	
Cp/Cv (Ent. Method)	---	---	---	---	
Reid VP at 37.8 C (kPa)	193.1	---	193.1	---	
True VP at 37.8 C (kPa)	1806	---	1806	---	
Liq. Vol. Flow - Sum(Std. Cond) (m3/h)	0.7952	12.65	1.115	12.65	
Viscosity Index	-43.84	-0.1204	-7.042	-4.917	

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Cont. Stirred Tank Reactor: REACTOR

CONNECTIONS

Inlet Stream Connections

Stream Name	From Unit Operation
to reactor	Heater feed heater

Outlet Stream Connections

Stream Name	To Unit Operation
from reactor	Cooler: product cooler
dummy liquid	

Energy Stream Connections

Stream Name	From Unit Operation
reactor cooling	

PARAMETERS

Physical Parameters		Optional Heat Transfer	
Delta P	Vessel Volume	Duty	Energy Stream
100.0 kPa *	3.142 m3	-1.151e+006 kJ/h	reactor cooling

User Variables

REACTION DETAILS

Reaction: Rxn-1

Component	Mole Weight	Stoichiometric Coeff.
CO2	44.01	-1 *
Hydrogen	2.016	-3 *
Methanol	32.04	1 *
H2O	18.02	1 *

REACTION RESULTS FOR : Set-1

Extents

	Act. % Conv.	Base Comp.	Rxn Extent
Rxn-1	46.09	CO2	5.487e-003

Balance

	Total Inflow	Total Rxn	Total Outflow
CO2	1.191e-002	-5.487e-003	6.419e-003
Hydrogen	8.258e-002	-1.646e-002	6.611e-002
Methanol	3.540e-004	5.487e-003	5.841e-003
H2O	1.059e-004	5.487e-003	5.593e-003


RATING

Sizing

Cylinder	Vertical	Reactor has a Boot:	No
Volume 3.142 m3	Diameter 2.000 m *	Height	1.000 *

Nozzles

Base Elevation Relative to Ground Level	0.0000 m *	Diameter	2.000 m *	Height	1.000 *
	to reactor	from reactor	dummy liquid		
Diameter (m)	5.000e-002	5.000e-002	5.000e-002		
Elevation (Base) (m)	0.5000	1.000	0.0000		
Elevation (Ground) (m)	0.5000	1.000	0.0000		
Elevation (% of Height) (%)	50.00	100.00	0.00		

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Cont. Stirred Tank Reactor: REACTOR (continued)

CONDITIONS

Name	to reactor	dummy liquid	from reactor	reactor cooling
Vapour	1.0000	0.0000	1.0000	---
Temperature (C)	200.0000 *	200.0000	200.0000 *	---
Pressure (kPa)	3950.0000	3850.0000	3850.0000	---
Molar Flow (kgmole/h)	341.7924	0.0000	302.2850	---
Mass Flow (kg/h)	2533.3812	0.0000	2533.3674	---
Std Ideal Liq Vol Flow (m3/h)	10.9225	0.0000	9.3111	---
Molar Enthalpy (kJ/kgmole)	-4.507e+004	-2.514e+005	-5.476e+004	---
Molar Entropy (kJ/kgmole-C)	116.2	93.70	121.4	---
Heat Flow (kJ/h)	-1.5403e+07	0.0000e-01	-1.6554e+07	-1.1508e+06

PROPERTIES

Name	to reactor	dummy liquid	from reactor	
Molecular Weight	7.412	22.49	8.381	
Molar Density (kgmole/m3)	0.9882	21.84	0.9684	
Mass Density (kg/m3)	7.325	491.2	8.116	
Act. Volume Flow (m3/h)	345.9	0.0000	312.2	
Mass Enthalpy (kJ/kg)	-6080	-1.118e+004	-6534	
Mass Entropy (kJ/kg-C)	15.68	4.167	14.48	
Heat Capacity (kJ/kgmole-C)	30.99	121.0	33.01	
Mass Heat Capacity (kJ/kg-C)	4.181	5.381	3.939	
LHV Molar Basis (Std) (kJ/gmole)	212.8	203.9	234.9	
HHV Molar Basis (Std) (kJ/gmole)	248.8	257.3	275.6	
HHV Mass Basis (Std) (kJ/kg)	3.357e+004	1.144e+004	3.289e+004	
CO2 Loading	---	---	---	
CO2 Apparent Mole Conc. (kgmole/m3)	---	---	---	
CO2 Apparent Wt. Conc. (kgmol/kg)	---	---	---	
LHV Mass Basis (Std) (kJ/kg)	2.871e+004	9067	2.803e+004	
Phase Fraction [Vol. Basis]	1.000	---	1.000	
Phase Fraction [Mass Basis]	1.000	0.0000	1.000	
Phase Fraction [Act. Vol. Basis]	1.000	---	1.000	
Mass Exergy (kJ/kg)	1386	194.8	1225	
Partial Pressure of CO2 (kPa)	495.4	0.0000	294.3	
Cost Based on Flow (Cost/s)	0.0000	0.0000	0.0000	
Act. Gas Flow (ACT_m3/h)	345.9	---	312.2	
Avg. Liq. Density (kgmole/m3)	31.29	---	32.47	
Specific Heat (kJ/kgmole-C)	30.99	121.0	33.01	
Std. Gas Flow (STD_m3/h)	8081	0.0000	7147	
Std. Ideal Liq. Mass Density (kg/m3)	231.9	878.7	272.1	
Act. Liq. Flow (m3/s)	---	0.0000	0.0000	
Z Factor	1.016	---	---	
Watson K	18.15	10.67	18.65	
User Property	---	---	---	
Partial Pressure of H2S (kPa)	0.0000	0.0000	0.0000	
Cp/(Cp - R)	1.367	1.074	1.337	
Cp/Cv	1.365	1.236	1.342	
Heat of Vap. (kJ/gmole)	11.74	75.09	21.98	
Kinematic Viscosity (cSt)	1.970	0.1267	1.708	
Liq. Mass Density (Std. Cond) (kg/m3)	0.3133	892.1	0.3545	
Liq. Vol. Flow (Std. Cond) (m3/h)	8086	0.0000	7146	
Liquid Fraction	0.0000	1.000	0.0000	
Molar Volume (m3/kgmole)	1.012	4.578e-002	1.033	
Mass Heat of Vap. (kJ/kg)	1583	3339	2623	
Phase Fraction [Molar Basis]	1.0000	0.0000	1.0000	
Surface Tension (dyne/cm)	---	26.26	---	
Thermal Conductivity (W/m-K)	0.1857	0.3827	0.1627	
Viscosity (cP)	1.443e-002	6.222e-002	1.386e-002	
Cv (Semi-Ideal) (kJ/kgmole-C)	22.67	112.7	24.70	

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Cont. Stirred Tank Reactor: REACTOR (continued)

PROPERTIES

Name	to reactor	dummy liquid	from reactor		
Mass Cv (Semi-Ideal) (kJ/kg-C)	3.059	5.011	2.947		
Cv (kJ/kgmole-C)	22.69	97.88	24.61		
Mass Cv (kJ/kg-C)	3.062	4.353	2.936		
Cv (Ent. Method) (kJ/kgmole-C)	---	---	---		
Mass Cv (Ent. Method) (kJ/kg-C)	---	---	---		
Cp/Cv (Ent. Method)	---	---	---		
Reid VP at 37.8 C (kPa)	---	978.3	---		
True VP at 37.8 C (kPa)	---	---	---		
Liq. Vol. Flow - Sum(Std. Cond) (m3/h)	8086	0.0000	7146		
Viscosity Index	-15.12	---	-17.26		

Recycle: RECYCLE

CONNECTIONS

Inlet Stream

Stream Name	From Unit Operation
to recycle	Compressor recycle compressor

Outlet Stream

Stream Name	To Unit Operation
RECYCLE	Mixer MIX-100

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

CONDITIONS

Name	to recycle	RECYCLE			
Vapour	1.0000	1.0000			
Temperature (C)	46.1019	46.0998 *			
Pressure (kPa)	4000.0000 *	4000.0000 *			
Molar Flow (kgmole/h)	262.3272	261.8846 *			
Mass Flow (kg/h)	1525.3829	1533.3812			
Std Ideal Liq Vol Flow (m3/h)	8.1354	8.1278			
Molar Enthalpy (kJ/kgmole)	-3.472e+004	-3.510e+004			
Molar Entropy (kJ/kgmole-C)	101.5	101.6			
Heat Flow (kJ/h)	-9.1091e+06	-9.1929e+06			

PROPERTIES

Name	to recycle	RECYCLE			
Molecular Weight	5.815	5.855			
Molar Density (kgmole/m3)	1.474	1.474			
Mass Density (kg/m3)	8.570	8.630			
Act. Volume Flow (m3/h)	178.0	177.7			

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Recycle: RECYCLE (continued)

PROPERTIES

Name	to recycle	RECYCLE		
12	Mass Enthalpy (kJ/kg)	-5972	-5995	
13	Mass Entropy (kJ/kg-C)	17.46	17.35	
14	Heat Capacity (kJ/kgmole-C)	29.88	29.89	
15	Mass Heat Capacity (kJ/kg-C)	5.139	5.106	
16	LHV Molar Basis (Std) (kJ/gmole)	222.6	222.4	
17	HHV Molar Basis (Std) (kJ/gmole)	260.3	260.0	
18	HHV Mass Basis (Std) (kJ/kg)	4.476e+004	4.441e+004	
19	CO2 Loading	---	---	
20	CO2 Apparent Mole Conc. (kgmole/m3)	---	---	
21	CO2 Apparent Wt. Conc. (kgmol/kg)	---	---	
22	LHV Mass Basis (Std) (kJ/kg)	3.828e+004	3.798e+004	
23	Phase Fraction [Vol. Basis]	1.000	1.000	
24	Phase Fraction [Mass Basis]	1.000	1.000	
25	Phase Fraction [Act. Vol. Basis]	1.000	1.000	
26	Mass Exergy (kJ/kg)	1580	1569	
27	Partial Pressure of CO2 (kPa)	345.7	349.6	
28	Cost Based on Flow (Cost/s)	0.0000	0.0000	
29	Act. Gas Flow (ACT_m3/h)	178.0	177.7	
30	Avg. Liq. Density (kgmole/m3)	32.25	32.22	
31	Specific Heat (kJ/kgmole-C)	29.88	29.89	
32	Std. Gas Flow (STD_m3/h)	6203	6192	
33	Std. Ideal Liq. Mass Density (kg/m3)	187.5	188.7	
34	Act. Liq. Flow (m3/s)	---	---	
35	Z Factor	1.022	1.022	
36	Watson K	21.31	21.21	
37	User Property	---	---	
38	Partial Pressure of H2S (kPa)	0.0000	0.0000	
39	Cp/(Cp - R)	1.386	1.385	
40	Cp/Cv	1.400	1.399	
41	Heat of Vap. (kJ/gmole)	10.99	11.00	
42	Kinematic Viscosity (cSt)	1.155	1.148	
43	Liq. Mass Density (Std. Cond) (kg/m3)	0.2458	0.2475	
44	Liq. Vol. Flow (Std. Cond) (m3/h)	6206	6196	
45	Liquid Fraction	0.0000	0.0000	
46	Molar Volume (m3/kgmole)	0.6785	0.6785	
47	Mass Heat of Vap. (kJ/kg)	1890	1879	
48	Phase Fraction [Molar Basis]	1.0000	1.0000	
49	Surface Tension (dyne/cm)	---	---	
50	Thermal Conductivity (W/m-K)	0.1500	0.1497	
51	Viscosity (cP)	9.900e-003	9.908e-003	
52	Cv (Semi-Ideal) (kJ/kgmole-C)	21.57	21.58	
53	Mass Cv (Semi-Ideal) (kJ/kg-C)	3.709	3.686	
54	Cv (kJ/kgmole-C)	21.35	21.36	
55	Mass Cv (kJ/kg-C)	3.672	3.648	
56	Cv (Ent. Method) (kJ/kgmole-C)	---	---	
57	Mass Cv (Ent. Method) (kJ/kg-C)	---	---	
58	Cp/Cv (Ent. Method)	---	---	
59	Reid VP at 37.8 C (kPa)	---	---	
60	True VP at 37.8 C (kPa)	---	---	
61	Liq. Vol. Flow - Sum(Std. Cond) (m3/h)	6206	6196	
62	Viscosity Index	-23.42	-23.63	

Compressor: recycle compressor

WORKSHEET

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Compressor: recycle compressor (continued)

Conditions

Name	Recycled	to recycle	recyl comp power
Vapour	1.0000	1.0000	---
Temperature (C)	40.0000	46.1019	---
Pressure (kPa)	3800.0000	4000.0000 *	---
Molar Flow (kgmole/h)	262.3272	262.3272	---
Mass Flow (kg/h)	1525.3829	1525.3829	---
Std Ideal Liq Vol Flow (m3/h)	8.1354	8.1354	---
Molar Enthalpy (kJ/kgmole)	-3.491e+004	-3.472e+004	---
Molar Entropy (kJ/kgmole-C)	101.4	101.5	---
Heat Flow (kJ/h)	-9.1572e+06	-9.1091e+06	4.8073e+04

Properties

Name	Recycled	to recycle
Molecular Weight	5.815	5.815
Molar Density (kgmole/m3)	1.429	1.474
Mass Density (kg/m3)	8.308	8.570
Act. Volume Flow (m3/h)	183.6	178.0
Mass Enthalpy (kJ/kg)	-6003	-5972
Mass Entropy (kJ/kg-C)	17.44	17.46
Heat Capacity (kJ/kgmole-C)	29.85	29.88
Mass Heat Capacity (kJ/kg-C)	5.133	5.139
LHV Molar Basis (Std) (kJ/gmole)	222.6	222.6
HHV Molar Basis (Std) (kJ/gmole)	260.3	260.3
HHV Mass Basis (Std) (kJ/kg)	4.476e+004	4.476e+004
CO2 Loading	---	---
CO2 Apparent Mole Conc. (kgmole/m3)	---	---
CO2 Apparent Wt. Conc. (kgmol/kg)	---	---
LHV Mass Basis (Std) (kJ/kg)	3.828e+004	3.828e+004
Phase Fraction [Vol. Basis]	1.000	1.000
Phase Fraction [Mass Basis]	1.000	1.000
Phase Fraction [Act. Vol. Basis]	1.000	1.000
Mass Exergy (kJ/kg)	1556	1580
Partial Pressure of CO2 (kPa)	328.4	345.7
Cost Based on Flow (Cost/s)	0.0000	0.0000
Act. Gas Flow (ACT_m3/h)	183.6	178.0
Avg. Liq. Density (kgmole/m3)	32.25	32.25
Specific Heat (kJ/kgmole-C)	29.85	29.88
Std. Gas Flow (STD_m3/h)	6203	6203
Std. Ideal Liq. Mass Density (kg/m3)	187.5	187.5
Act. Liq. Flow (m3/s)	---	---
Z Factor	---	1.022
Watson K	21.31	21.31
User Property	---	---
Partial Pressure of H2S (kPa)	0.0000	0.0000
Cp/(Cp - R)	1.386	1.386
Cp/Cv	1.400	1.400
Heat of Vap. (kJ/gmole)	10.96	10.99
Kinematic Viscosity (cSt)	1.171	1.155
Liq. Mass Density (Std. Cond) (kg/m3)	0.2458	0.2458
Liq. Vol. Flow (Std. Cond) (m3/h)	6206	6206
Liquid Fraction	0.0000	0.0000
Molar Volume (m3/kgmole)	0.6999	0.6785
Mass Heat of Vap. (kJ/kg)	1885	1890
Phase Fraction [Molar Basis]	1.0000	1.0000
Surface Tension (dyne/cm)	---	---
Thermal Conductivity (W/m-K)	0.1477	0.1500
Viscosity (cP)	9.733e-003	9.900e-003
Cv (Semi-Ideal) (kJ/kgmole-C)	21.54	21.57

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Compressor: recycle compressor (continued)

Properties

Name	Recycled	to recycle		
Mass Cv (Semi-Ideal) (kJ/kg-C)	3.704	3.709		
Cv (kJ/kgmole-C)	21.31	21.35		
Mass Cv (kJ/kg-C)	3.666	3.672		
Cv (Ent. Method) (kJ/kgmole-C)	---	---		
Mass Cv (Ent. Method) (kJ/kg-C)	---	---		
Cp/Cv (Ent. Method)	---	---		
Reid VP at 37.8 C (kPa)	---	---		
True VP at 37.8 C (kPa)	---	---		
Liq. Vol. Flow - Sum(Std. Cond) (m3/h)	6206	6206		
Viscosity Index	-23.59	-23.42		


Separator: separator

CONDITIONS

Name	condensed mixture	liquid	vapour	
Vapour	0.8678	0.0000	1.0000	
Temperature (C)	40.0000 *	40.0000	40.0000	
Pressure (kPa)	3800.0000	3800.0000	3800.0000	
Molar Flow (kgmole/h)	302.2850	39.9578	262.3272	
Mass Flow (kg/h)	2533.3674	1007.9845	1525.3829	
Std Ideal Liq Vol Flow (m3/h)	9.3111	1.1757	8.1354	
Molar Enthalpy (kJ/kgmole)	-6.519e+004	-2.640e+005	-3.491e+004	
Molar Entropy (kJ/kgmole-C)	93.89	44.59	101.4	
Heat Flow (kJ/h)	-1.9707e+07	-1.0550e+07	-9.1572e+06	

PROPERTIES

Name	condensed mixture	liquid	vapour	
Molecular Weight	8.381	25.23	5.815	
Molar Density (kgmole/m3)	1.636	33.61	1.429	
Mass Density (kg/m3)	13.71	847.9	8.308	
Act. Volume Flow (m3/h)	184.8	1.189	183.6	
Mass Enthalpy (kJ/kg)	-7779	-1.047e+004	-6003	
Mass Entropy (kJ/kg-C)	11.20	1.767	17.44	
Heat Capacity (kJ/kgmole-C)	39.32	101.5	29.85	
Mass Heat Capacity (kJ/kg-C)	4.691	4.022	5.133	
LHV Molar Basis (Std) (kJ/gmole)	234.9	315.5	222.6	
HHV Molar Basis (Std) (kJ/gmole)	275.6	376.4	260.3	
HHV Mass Basis (Std) (kJ/kg)	3.289e+004	1.492e+004	4.476e+004	
CO2 Loading	---	---	---	
CO2 Apparent Mole Conc. (kgmole/m3)	---	0.3670	---	
CO2 Apparent Wt. Conc. (kgmol/kg)	---	4.329e-004	---	
LHV Mass Basis (Std) (kJ/kg)	2.803e+004	1.251e+004	3.828e+004	
Phase Fraction [Vol. Basis]	0.8737	---	1.000	
Phase Fraction [Mass Basis]	0.6021	0.0000	1.000	
Phase Fraction [Act. Vol. Basis]	0.9936	0.0000	1.000	
Mass Exergy (kJ/kg)	958.8	8.221	1556	
Partial Pressure of CO2 (kPa)	328.4	0.0000	328.4	
Cost Based on Flow (Cost/s)	0.0000	0.0000	0.0000	
Act. Gas Flow (ACT_m3/h)	183.6	---	183.6	
Avg. Liq. Density (kgmole/m3)	32.47	33.99	32.25	
Specific Heat (kJ/kgmole-C)	39.32	101.5	29.85	
Std. Gas Flow (STD_m3/h)	7147	944.8	6203	
Std. Ideal Liq. Mass Density (kg/m3)	272.1	857.4	187.5	
Act. Liq. Flow (m3/s)	3.302e-004	3.302e-004	---	
Z Factor	---	---	---	
Watson K	18.65	10.57	21.31	

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Separator: separator (continued)

PROPERTIES

Name	condensed mixture	liquid	vapour
User Property	---	---	---
Partial Pressure of H2S (kPa)	0.0000	0.0000	0.0000
Cp/(Cp - R)	1.268	1.089	1.386
Cp/Cv	1.233	1.187	1.400
Heat of Vap. (kJ/gmole)	21.98	28.30	10.96
Kinematic Viscosity (cSt)	---	0.6280	1.171
Liq. Mass Density (Std. Cond) (kg/m3)	0.3545	868.9	0.2458
Liq. Vol. Flow (Std. Cond) (m3/h)	7146	1.160	6206
Liquid Fraction	0.1322	1.000	0.0000
Molar Volume (m3/kgmole)	0.6113	2.975e-002	0.6999
Mass Heat of Vap. (kJ/kg)	2623	1122	1885
Phase Fraction [Molar Basis]	0.8678	0.0000	1.0000
Surface Tension (dyne/cm)	47.80	47.80	---
Thermal Conductivity (W/m-K)	---	0.3484	0.1477
Viscosity (cP)	---	0.5325	9.733e-003
Cv (Semi-Ideal) (kJ/kgmole-C)	31.00	93.16	21.54
Mass Cv (Semi-Ideal) (kJ/kg-C)	3.699	3.693	3.704
Cv (kJ/kgmole-C)	31.88	85.50	21.31
Mass Cv (kJ/kg-C)	3.804	3.389	3.666
Cv (Ent. Method) (kJ/kgmole-C)	---	80.99	---
Mass Cv (Ent. Method) (kJ/kg-C)	---	3.210	---
Cp/Cv (Ent. Method)	---	1.253	---
Reid VP at 37.8 C (kPa)	---	188.2	---
True VP at 37.8 C (kPa)	---	3931	---
Liq. Vol. Flow - Sum(Std. Cond) (m3/h)	6207	1.160	6206
Viscosity Index	-30.09	-4.027	-23.59


Pump: Water pump

CONDITIONS

Name	Water source	to condenser	Pump power
Vapour	0.0000	0.0000	---
Temperature (C)	30.0000 *	30.0293	---
Pressure (kPa)	150.0000 *	600.0000 *	---
Molar Flow (kgmole/h)	712.7850	712.7850	---
Mass Flow (kg/h)	12840.8933 *	12840.8933	---
Std Ideal Liq Vol Flow (m3/h)	12.8668	12.8668	---
Molar Enthalpy (kJ/kgmole)	-2.860e+005	-2.859e+005	---
Molar Entropy (kJ/kgmole-C)	54.63	54.63	---
Heat Flow (kJ/h)	-2.0382e+08	-2.0382e+08	7.6770e+03

PROPERTIES

Name	Water source	to condenser
Molecular Weight	18.02	18.02
Molar Density (kgmole/m3)	55.71	55.71
Mass Density (kg/m3)	1004	1004
Act. Volume Flow (m3/h)	12.80	12.79
Mass Enthalpy (kJ/kg)	-1.587e+004	-1.587e+004
Mass Entropy (kJ/kg-C)	3.032	3.032
Heat Capacity (kJ/kgmole-C)	79.90	79.89
Mass Heat Capacity (kJ/kg-C)	4.435	4.435
LHV Molar Basis (Std) (kJ/gmole)	0.0000	0.0000
HHV Molar Basis (Std) (kJ/gmole)	41.01	41.01
HHV Mass Basis (Std) (kJ/kg)	2276	2276
CO2 Loading	---	---
CO2 Apparent Mole Conc. (kgmole/m3)	0.0000	0.0000

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Pump: Water pump (continued)

PROPERTIES

Name	Water source	to condenser		
CO2 Apparent Wt. Conc. (kgmol/kg)	0.0000	0.0000		
LHV Mass Basis (Std) (kJ/kg)	0.0000	0.0000		
Phase Fraction [Vol. Basis]	0.0000	0.0000		
Phase Fraction [Mass Basis]	0.0000	0.0000		
Phase Fraction [Act. Vol. Basis]	0.0000	0.0000		
Mass Exergy (kJ/kg)	0.2484	0.8466		
Partial Pressure of CO2 (kPa)	0.0000	0.0000		
Cost Based on Flow (Cost/s)	0.0000	0.0000		
Act. Gas Flow (ACT_m3/h)	---	---		
Avg. Liq. Density (kgmole/m3)	55.40	55.40		
Specific Heat (kJ/kgmole-C)	79.90	79.89		
Std. Gas Flow (STD_m3/h)	1.685e+004	1.685e+004		
Std. Ideal Liq. Mass Density (kg/m3)	998.0	998.0		
Act. Liq. Flow (m3/s)	3.554e-003	3.554e-003		
Z Factor	1.068e-003	4.272e-003		
Watson K	---	---		
User Property	---	---		
Partial Pressure of H2S (kPa)	0.0000	0.0000		
Cp/(Cp - R)	1.116	1.116		
Cp/Cv	1.145	1.145		
Heat of Vap. (kJ/gmole)	40.43	37.87		
Kinematic Viscosity (cSt)	0.7944	0.7938		
Liq. Mass Density (Std. Cond) (kg/m3)	1015	1015		
Liq. Vol. Flow (Std. Cond) (m3/h)	12.65	12.65		
Liquid Fraction	1.000	1.000		
Molar Volume (m3/kgmole)	1.795e-002	1.795e-002		
Mass Heat of Vap. (kJ/kg)	2244	2102		
Phase Fraction [Molar Basis]	0.0000	0.0000		
Surface Tension (dyne/cm)	71.23	71.23		
Thermal Conductivity (W/m-K)	0.6182	0.6183		
Viscosity (cP)	0.7972	0.7967		
Cv (Semi-Ideal) (kJ/kgmole-C)	71.59	71.58		
Mass Cv (Semi-Ideal) (kJ/kg-C)	3.974	3.973		
Cv (kJ/kgmole-C)	69.76	69.76		
Mass Cv (kJ/kg-C)	3.872	3.872		
Cv (Ent. Method) (kJ/kgmole-C)	---	---		
Mass Cv (Ent. Method) (kJ/kg-C)	---	---		
Cp/Cv (Ent. Method)	---	---		
Reid VP at 37.8 C (kPa)	---	---		
True VP at 37.8 C (kPa)	---	---		
Liq. Vol. Flow - Sum(Std. Cond) (m3/h)	12.65	12.65		
Viscosity Index	-0.1088	-0.1204		


Adjust: Water T control

Adjusted Variable		Measured Variable	
OBJECT	VARIABLE	OBJECT	VARIABLE
Water source	Mass Flow	water return	Temperature

Solving Parameters

Source for Target Value:	User Supplied	Target Value:	45.00 C *
Solving Method:	Secant	Tolerance:	0.1000 C
Step Size:	9000 kg/h	Minimum:	---
		Maximum:	---

User Variables

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Cooler: product cooler

CONDITIONS

Name	from reactor	condensed mixture	Prod cooler duty
Vapour	1.0000	0.8678	---
Temperature (C)	200.0000 *	40.0000 *	---
Pressure (kPa)	3850.0000	3800.0000	---
Molar Flow (kgmole/h)	302.2850	302.2850	---
Mass Flow (kg/h)	2533.3674	2533.3674	---
Std Ideal Liq Vol Flow (m3/h)	9.3111	9.3111	---
Molar Enthalpy (kJ/kgmole)	-5.476e+004	-6.519e+004	---
Molar Entropy (kJ/kgmole-C)	121.4	93.89	---
Heat Flow (kJ/h)	-1.6554e+07	-1.9707e+07	3.1536e+06

PROPERTIES

Name	from reactor	condensed mixture		
Molecular Weight	8.381	8.381		
Molar Density (kgmole/m3)	0.9684	1.636		
Mass Density (kg/m3)	8.116	13.71		
Act. Volume Flow (m3/h)	312.2	184.8		
Mass Enthalpy (kJ/kg)	-6534	-7779		
Mass Entropy (kJ/kg-C)	14.48	11.20		
Heat Capacity (kJ/kgmole-C)	33.01	39.32		
Mass Heat Capacity (kJ/kg-C)	3.939	4.691		
LHV Molar Basis (Std) (kJ/gmole)	234.9	234.9		
HHV Molar Basis (Std) (kJ/gmole)	275.6	275.6		
HHV Mass Basis (Std) (kJ/kg)	3.289e+004	3.289e+004		
CO2 Loading	---	---		
CO2 Apparent Mole Conc. (kgmole/m3)	---	---		
CO2 Apparent Wt. Conc. (kgmol/kg)	---	---		
LHV Mass Basis (Std) (kJ/kg)	2.803e+004	2.803e+004		
Phase Fraction [Vol. Basis]	1.000	0.8737		
Phase Fraction [Mass Basis]	1.000	0.6021		
Phase Fraction [Act. Vol. Basis]	1.000	0.9936		
Mass Exergy (kJ/kg)	1225	958.8		
Partial Pressure of CO2 (kPa)	294.3	328.4		
Cost Based on Flow (Cost/s)	0.0000	0.0000		
Act. Gas Flow (ACT_m3/h)	312.2	183.6		
Avg. Liq. Density (kgmole/m3)	32.47	32.47		
Specific Heat (kJ/kgmole-C)	33.01	39.32		
Std. Gas Flow (STD_m3/h)	7147	7147		
Std. Ideal Liq. Mass Density (kg/m3)	272.1	272.1		
Act. Liq. Flow (m3/s)	0.0000	3.302e-004		
Z Factor	---	---		
Watson K	18.65	18.65		
User Property	---	---		
Partial Pressure of H2S (kPa)	0.0000	0.0000		
Cp/(Cp - R)	1.337	1.268		
Cp/Cv	1.342	1.233		
Heat of Vap. (kJ/gmole)	21.98	21.98		
Kinematic Viscosity (cSt)	1.708	---		
Liq. Mass Density (Std. Cond) (kg/m3)	0.3545	0.3545		
Liq. Vol. Flow (Std. Cond) (m3/h)	7146	7146		
Liquid Fraction	0.0000	0.1322		
Molar Volume (m3/kgmole)	1.033	0.6113		
Mass Heat of Vap. (kJ/kg)	2623	2623		
Phase Fraction [Molar Basis]	1.0000	0.8678		
Surface Tension (dyne/cm)	---	47.80		
Thermal Conductivity (W/m-K)	0.1627	---		
Viscosity (cP)	1.386e-002	---		
Cv (Semi-Ideal) (kJ/kgmole-C)	24.70	31.00		

1	 Company Name Not Available Bedford, MA USA	Case Name: SIMULATION FINAL.hsc
2		Unit Set: SI-user1
3		Date/Time: Sun Jun 26 21:29:37 2022
4		
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Cooler: product cooler (continued)

PROPERTIES

11	Name	from reactor	condensed mixture			
12	Mass Cv (Semi-Ideal) (kJ/kg-C)	2.947	3.699			
13	Cv (kJ/kgmole-C)	24.61	31.88			
14	Mass Cv (kJ/kg-C)	2.936	3.804			
15	Cv (Ent. Method) (kJ/kgmole-C)	---	---			
16	Mass Cv (Ent. Method) (kJ/kg-C)	---	---			
17	Cp/Cv (Ent. Method)	---	---			
18	Reid VP at 37.8 C (kPa)	---	---			
19	True VP at 37.8 C (kPa)	---	---			
20	Liq. Vol. Flow - Sum(Std. Cond) (m3/h)	7146	6207			
21	Viscosity Index	-17.26	-30.09			

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