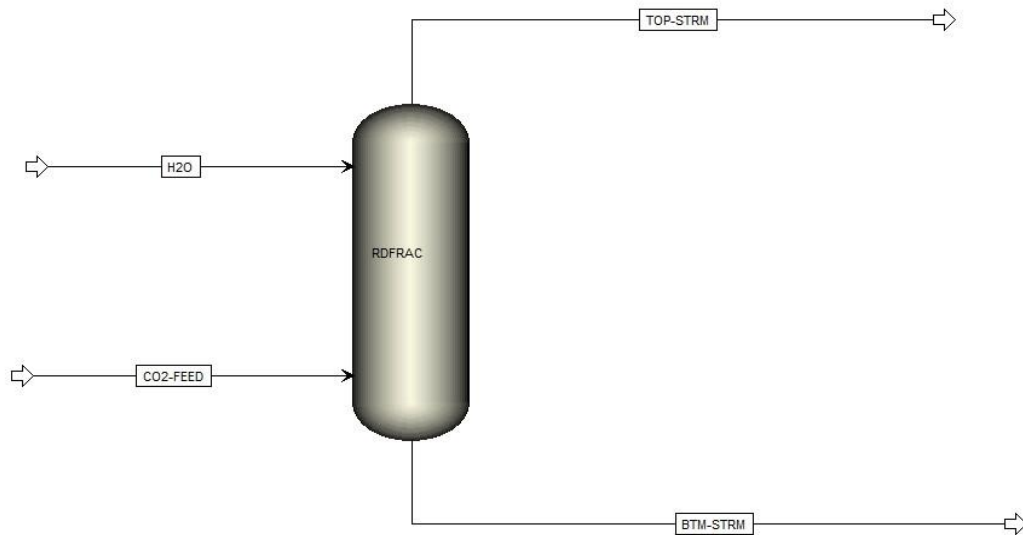


# ASSIGNMENT-03

## ROLL NO-234107206

### Main Flowsheet



### CO<sub>2</sub>-Feed Specification

☒ Mixed ☐ CI Solid ☐ NC Solid ☐ Flash Options ☐ EO Options ☐ Costing ☐ Comments

Specifications

Flash Type: **Temperature** **Pressure**

State variables

Temperature: **40** **C**

Pressure: **10** **bar**

Vapor fraction:

Total flow basis: **Mass**

Total flow rate: **100** **kg/hr**

Solvent:

Reference Temperature

Volume flow reference temperature:  **C**

Component concentration reference temperature:  **C**

Composition

**Mass-Frac**

Component	Value
ETHYLENE	
ACETI-01	<b>0.006</b>
WATER	
CARBO-01	<b>0.982</b>
NITROGEN	<b>0.012</b>
OXYGEN	
Total	<b>1</b>

☐ Component Attributes

☐ Particle Size Distribution

## H<sub>2</sub>O Specification

✓ Mixed | CI Solid | NC Solid | Flash Options | EO Options | Costing | Comments

^ Specifications

Flash Type: **Temperature** | **Pressure**

State variables

Temperature: 25 C

Pressure: 10 bar

Vapor fraction:

Total flow basis: **Mass**

Total flow rate: 150 kg/hr

Solvent:

Reference Temperature

Volume flow reference temperature: C

Component concentration reference temperature: C

Composition: **Mass-Frac**

Component	Value
ETHYLENE	
ACETI-01	
WATER	1
CARBO-01	
NITROGEN	
OXYGEN	

Total: 1

Component Attributes

Particle Size Distribution

## RedFrac Configuration

✓ Configuration | ✓ Streams | ✓ Pressure | Condenser | Reboiler | 3-Phase | Comments

Setup options

Calculation type: **Equilibrium**

Number of stages: 6 **Stage Wizard**

Condenser: **None**

Reboiler: **None**

Valid phases: **Vapor-Liquid**

Convergence: **Standard**

Operating specifications

Free water reflux ratio: 0 **Feed Basis**

## 1.NRTL Model

	Units	CO2-FEED	H2O	BTM-STRM	TOP-STRM
Phase			Liquid Phase	Liquid Phase	Vapor Phase
Temperature	C	40	25	28.1278	26.5082
Pressure	bar	10	10	10	10
Molar Vapor Fraction		0.999895	0	0	1
Molar Liquid Fraction		0.000104868	1	1	0
Molar Solid Fraction		0	0	0	0
Mass Vapor Fraction		0.999859	0	0	1
Mass Liquid Fraction		0.000140802	1	1	0
Mass Solid Fraction		0	0	0	0
Molar Enthalpy	cal/mol	-92132.6	-68262.2	-68421.4	-92050.1
Mass Enthalpy	cal/gm	-2104.45	-3789.13	-3757.82	-2110.57
Molar Entropy	cal/mol-K	-3.39797	-38.9652	-38.6662	-3.63132
Mass Entropy	cal/gm-K	-0.0776146	-2.1629	-2.12361	-0.0832606
Molar Density	mol/cc	0.000384118	0.055173	0.0545577	0.000401372
Mass Density	gm/cc	0.0168167	0.993957	0.993374	0.0175054
Enthalpy Flow	cal/sec	-58456.8	-157880	-159164	-57173.5
Average MW		43.78	18.0153	18.2078	43.6139
<b>+ Mole Flows</b>	<b>kmol/hr</b>	<b>2.28415</b>	<b>8.32627</b>	<b>8.37441</b>	<b>2.236</b>
<b>+ Mole Fractions</b>					
<b>+ Mass Flows</b>	<b>kg/hr</b>	<b>100</b>	<b>150</b>	<b>152.479</b>	<b>97.5208</b>
<b>- Mass Fractions</b>					
ETHYLENE		0	0	0	0
ACETI-01		0.006	0	0.00393496	3.00098e-22
WATER		0	1	0.98283	0.00142398
CARBO-01		0.982	0	0.0132318	0.986276
NITROGEN		0.012	0	3.22909e-06	0.0123
OXYGEN		0	0	0	0
Volume Flow	l/min	99.1079	2.5152	2.55827	92.8485

P = 10 bar

Bottom stream temperature = 28.1278 °C

Top stream temperature = 26.5082 °C

Mass flow rate of top stream = 97.5208 Kg/hr

Mass flow rate of bottom stream = 152.479 Kg/hr

Number of theoretical stage = 6

Composition of top stream = 3.00098\*10<sup>-22</sup>

Composition of bottom stream = 0.00393496

Reflux Ratio = 0

## 2.UNIQUAC Model

	Units	BTM-STRM	CO2-FEED	H2O	TOP-STRM
► <b>MIXED Substream</b>					
► Phase		Liquid Phase		Liquid Phase	Vapor Phase
► Temperature	C	28.2363	40	25	26.5206
► Pressure	bar	10	10	10	10
► Molar Vapor Fraction		0	0.999898	0	1
► Molar Liquid Fraction		1	0.000102256	1	0
► Molar Solid Fraction		0	0	0	0
► Mass Vapor Fraction		0	0.999863	0	1
► Mass Liquid Fraction		1	0.000137331	1	0
► Mass Solid Fraction		0	0	0	0
► Molar Enthalpy	cal/mol	-68422.1	-92132.6	-68262.2	-92049.8
► Mass Enthalpy	cal/gm	-3757.72	-2104.45	-3789.13	-2110.57
► Molar Entropy	cal/mol-K	-38.6634	-3.39792	-38.9652	-3.63094
► Mass Entropy	cal/gm-K	-2.12338	-0.0776136	-2.1629	-0.0832521
► Molar Density	mol/cc	0.0545505	0.000384117	0.055173	0.000401355
► Mass Density	gm/cc	0.99328	0.0168166	0.993957	0.0175046
► Enthalpy Flow	cal/sec	-159169	-58456.8	-157880	-57167.7
► Average MW		18.2084	43.78	18.0153	43.6138
► <b>✦ Mole Flows</b>	<b>kmol/hr</b>	<b>8.37463</b>	<b>2.28415</b>	<b>8.32627</b>	<b>2.23579</b>
► <b>✦ Mole Fractions</b>					
► <b>✦ Mass Flows</b>	<b>kg/hr</b>	<b>152.489</b>	<b>100</b>	<b>150</b>	<b>97.5112</b>
► <b>► Mass Fractions</b>					
► ETHYLENE		0	0	0	0
► ACETI-01		0.00393471	0.006	0	1.87332e-24
► WATER		0.982767	0	1	0.00142499
► NITROGEN		3.2425e-06	0.012	0	0.0123012
► CARBO-01		0.0132946	0.982	0	0.986274
► Volume Flow	l/min	2.55867	99.1082	2.5152	92.8434

P = 10 bar

Bottom stream temperature = 28.2363 °C

Top stream temperature = 26.5206 °C

Mass flow rate of top stream = 97.5112 Kg/hr

Mass flow rate of bottom stream = 152.489 Kg/hr

Number of theoretical stage = 6

Composition of top stream =  $1.87332 \times 10^{-24}$

Composition of bottom stream = 0.00393471

Reflux ratio = 0

### 3.SRK Model

	Units	BTM-SRTM	CO2-FEED	H2O	TOP-STRM
▶ <b>MIXED Substream</b>					
▶ Phase		Liquid Phase		Liquid Phase	Vapor Phase
▶ Temperature	C	26.4531	40	25	24.9976
▶ Pressure	bar	10	10	10	10
▶ Molar Vapor Fraction		0	0.999454	0	1
▶ Molar Liquid Fraction		1	0.000545599	1	0
▶ Molar Solid Fraction		0	0	0	0
▶ Mass Vapor Fraction		0	0.999273	0	1
▶ Mass Liquid Fraction		1	0.000727474	1	0
▶ Mass Solid Fraction		0	0	0	0
▶ Molar Enthalpy	cal/mol	-68995.6	-92227.2	-68989.4	-92243.1
▶ Mass Enthalpy	cal/gm	-3821.19	-2106.61	-3829.49	-2112.08
▶ Molar Entropy	cal/mol-K	-38.8875	-3.61632	-38.9853	-3.98124
▶ Mass Entropy	cal/gm-K	-2.15371	-0.0826022	-2.16401	-0.0911581
▶ Molar Density	mol/cc	0.0531886	0.00040138	0.053357	0.000424783
▶ Mass Density	gm/cc	0.960376	0.0175724	0.961241	0.018552
▶ Enthalpy Flow	cal/sec	-159650	-58516.9	-159562	-58429.3
▶ Average MW		18.0561	43.78	18.0153	43.6741
▶ <b>+ Mole Flows</b>	<b>kmol/hr</b>	<b>8.33007</b>	<b>2.28415</b>	<b>8.32627</b>	<b>2.28034</b>
▶ <b>+ Mole Fractions</b>					
▶ <b>+ Mass Flows</b>	<b>kg/hr</b>	<b>150.408</b>	<b>100</b>	<b>150</b>	<b>99.5917</b>
▶ <b>- Mass Fractions</b>					
▶ ETHYLENE		0	0	0	0
▶ ACETI-01		0.00200026	0.006	0	0.0030037
▶ NITROGEN		2.07915e-08	0.012	0	0.0120492
▶ WATER		0.996547	0	1	0.00111542
▶ CARBO-01		0.00145264	0.982	0	0.983832
▶ Volume Flow	l/min	2.61023	94.8456	2.6008	89.4707

P = 10 bar

Bottom stream temperature = 26.4531 °C

Top stream temperature = 24.9976 °C

Mass flow rate of top stream = 99.5917 Kg/hr

Mass flow rate of bottom stream = 150.408 Kg/hr

Number of theoretical stage = 6

Composition of top stream = 0.0030037

Composition of bottom stream = 0.00200026

Reflux ratio = 0

Model	Number of stages	Top stream composition ( mass fraction of acetic acid )	Bottom stream composition ( mass fraction of acetic acid )	Top stream mass flow of acetic acid	Bottom stream mass flow of acetic acid
NRTL	6	$3.00098 \times 10^{-22}$	0.00393496	$2.926 \times 10^{-20}$	0.6
UNIQUAC	6	$1.87332 \times 10^{-24}$	0.00393471	$1.826 \times 10^{-22}$	0.6
SRK	6	0.0030037	0.00200026	0.299144	0.300856

### Conclusion:

From observation of above table we get that UNIQUAC model is the best amongst all of three , because it is giving highest production of acetic acid than other two while the SRK model is giving least acetic acid production