

### Q1. DSTWU Model

Properties asked in the question:

Minimum reflux ratio	4.16625675	
Actual reflux ratio	4.87540192	
Minimum number of stages	15.2726594	
Number of actual stages	30	
Feed stage	18.7187939	
Number of actual stages above feed	17.7187939	
Reboiler heating required	0.270781464	Gcal/hr
Condenser cooling required	0.696507688	Gcal/hr
Distillate temperature	-103.067749	C
Bottom temperature	-87.847458	C
Distillate to feed fraction	0.399	

Streams:

Heat and Material Balance Table				
Stream ID		FEED	DISTLT	BOTTOMS
Temperature	C	23.9	-103.1	-87.8
Pressure	bar	1.034	1.034	1.034
Vapor Frac		1.000	0.000	0.000
Mole Flow	kmol/hr	90.718	36.197	54.522
Mass Flow	kg/hr	2654.721	1015.562	1639.158
Volume Flow	cum/hr	2151.037	1.789	3.016
Enthalpy	Gcal/hr	-0.637	0.291	-1.354
Mole Flow	kmol/hr			
ETHANE		54.431	0.054	54.377
ETHYLENE		36.287	36.142	0.145
Mole Frac				
ETHANE		0.600	0.002	0.997
ETHYLENE		0.400	0.998	0.003

## Q2. RadFrac Model

(a) Streams:

Heat and Material Balance Table				
Stream ID		FEED	BOTTOM	TOPPROD
Temperature	C	23.9	-87.8	-103.1
Pressure	bar	1.034	1.034	1.034
Vapor Frac		1.000	0.000	0.000
Mole Flow	kmol/hr	90.718	54.522	36.197
Mass Flow	kg/hr	2654.721	1639.183	1015.537
Volume Flow	cum/hr	2151.037	3.016	1.789
Enthalpy	Gcal/hr	-0.637	-1.354	0.292
Mole Flow	kmol/hr			
ETHANE		54.431	54.389	0.042
ETHYLENE		36.287	0.133	36.155
Mole Frac				
ETHANE		0.600	0.998	0.001
ETHYLENE		0.400	0.002	0.999

(b) Comparison between Mole fractions on the basis of type of Column used: (Q1 vs Q2)

Mole Fraction in <b>Distillate</b>	Using <b>DSTWU</b>	Using <b>RadFrac</b>
ETHANE	0.002	0.001
ETHYLENE	0.998	0.999
Mole Fraction in <b>Bottoms</b>		
ETHANE	0.997	0.998
ETHYLENE	0.003	0.002

Discrepancy in product compositions obtained from RadFrac and DSTWU: Yes, certain minor deviations do exist. Reason – DSTWU uses relatively less rigorous and simpler calculations, like using Gilliland's, Winn's, Underwood's correlations for calculating stages and reflux ratios. Constant molar overflow and constant relative volatility are assumed, similar to McCabe Thiele method. It is more suited to performing calculations for simpler, binary systems. RadFrac column on the other hand is far more rigorous and uses a more advanced technique which relies less on correlations and more on actual calculations. (similar to the Ponchon Savarit method). Hence, the discrepancies exist.

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