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# Aspen-Hysys Simulation of a Condensate Fractionation Plant

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## Abstract

*The steady state simulation of condensate fractionation plant was carried out using Hysys 3.2 Process Simulator. The condensate is the byproduct, produced by processing of natural gas which contains mostly $C_2$ to $C_{16}$ complex carbon chain. In this simulation, using atmospheric distillation (fractionation) has the volumetric flow rates of three products like Petrol (Motor Sprit or MS), Kerosene and Diesel are 50%, 25% and 25% respectively on basis of the condensate feed to the plant. This unit models a condensate processing facility consisting of a pre-heating train used to heat up the liquid condensates, an atmospheric distillation column to fractionate the condensates into its straight run products, stripper, heat exchangers, buffer tanks and oil transferring systems. Preheated condensate (from a preheat train) is fed to the fractionator, where vapor-liquid separation done and specialized products are produced from different zone. A furnace was used to heat the oils at desired level. A comprehensive study has done between the simulated data and the plant's operating data.*

***Keywords:*** *Simulation, Design data, Hysys, Condensate fractionation, Heat exchanger.*

## 1. Introduction

Petroleum refineries have advanced periodically with the passage of time. Refinery operations for the creation of products such as Naphtha, Diesel, Kerosene and Gasoline have grown complex affecting the refinery profit. Limitations such as safety and environmental regulations, for maintaining plants to run at cleaner processes, are some constraints to achieve such profits [1]. Crude oil trapped in different reservoirs of the world of a specific field hold unique characteristics from one another on a physical and chemical basis [2]. Refineries fractionate these barrels of crude by their boiling points in order to obtain high value products such as gasoline, diesel, jet fuel, heating oil, fuel oil, lubricants, asphalt, coke, wax, and chemical feed stocks [3].

Many studies have been published related to crude distillation unit (CDU) study with reference to refinery planning and scheduling [4, 5], estimation of product properties [6, 7] and process control, modeling, simulation and optimization [8, 9]. Optimization of a crude distillation unit using a binary feed was carried out on the basis of the gross profit instead of the costs inferred by energy and raw materials [8]. An atmospheric distillation unit subjected to transient behavior due to changes in the operating conditions can be improved by a suitable control strategy to obtain better operations [10]. An expert system was designed for a CDU to predict the product flow and temperature values by minimizing the model output error by genetic algorithm frame work and maximizing the oil production subjected to control parameters [9].

The crude oil distillation unit (CDU) is the first processing unit in virtually all petroleum refineries. The CDU distills the incoming crude oil into various fractions of different boiling ranges, each of them are then processed further in the other refinery processing units. The CDU is often referred to as the atmospheric distillation unit because it operates at slightly above atmospheric pressure [11].

Varieties of products are obtained from fractionation of natural gas condensate. Heavy parts of it are used as diesel whereas the lighter parts are divided into different fractions for different uses. Distillation column is used for the separation of different fraction of condensate. One distillation column is sufficient for producing three products – two solvents and diesel. If any design change for the column is to be suggested, a new column cannot be built because it will require a lot of money. To evaluate different designs, simulators have become very handy. Several soft-wares have been developed for the petroleum industries. ASPEN™ HYSYS is one of the software which is widely accepted and used for refinery simulation. ASPEN™ HYSYS performs the oil distillation calculation through detail plate by plate calculation. This calculation includes generating pseudo-

components from the ASTM D86 data and generating properties from them. ASPEN HYSYS contains an oil manager which organizes the data for the pseudo-components separately [12, 13].
The purpose of this paper is to present the work developed at a typical condensate fractionation plant in Bangladesh. The work was done by HYSYS as a simulation tool. The challenge here was to model a complete process unit in order to allow the optimization of the operation.

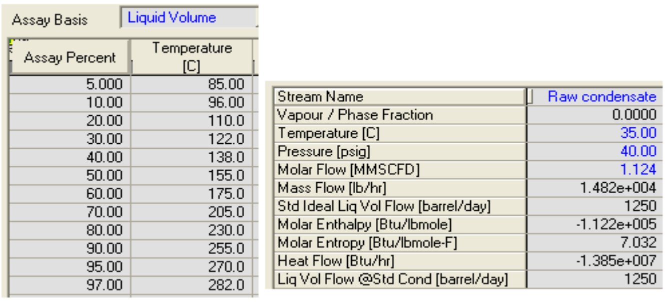
## 2. Design basis

True Boiling Point (TBP) analysis was done for the raw condensate in laboratory which is one of the base inputs for this simulation study. The condensate feed rate was 1250 Barrel/day (BPD) as a basis. A fractionation column was used to produce two solvents as top and side product and diesel as the bottom product. The industrial data was regenerated in the simulation environment. The package and method used for this work is listed below:

**Table 1**. Design basis for simulation by HYSYS

| | |
|---|---|
| Fluid Package | Peng-Robinson |
| Method of Simulation | Pseudo-component generation and plate by plate calculation |
| Properties generation | HYSYS properties |

Fluid package was selected to be Peng-Robinson (Table 1). The main reason behind this, it is widely used for refinery simulation as it can handle the hypothetical pseudo-components. The method of simulation for HYSYS is pseudo-component generation and plate by plate calculation from the 'True Boiling Point' or 'ASTM D86' input data. For this simulation, ASTM D86 input data were available from the refinery laboratory. The HYSYS solver uses different numerical methods for simulation and the selected method for the simulation was HYSIM Inside-Out which is suitable for most cases. From properties generation, two databases can be used for ASPEN HYSYS 3.2 – HYSYS properties and ASPEN properties. But as they are exclusive, HYSYS properties were used for property generation of the streams. The ASTM D86 data obtained from the refinery for condensate that were used as input for the oil manager in HYSYS are shown in Fig. 1.



Assay Basis: Liquid Volume

| Assay Percent | Temperature [C] |
|---|---|
| 5.000 | 85.00 |
| 10.00 | 96.00 |
| 20.00 | 110.0 |
| 30.00 | 122.0 |
| 40.00 | 138.0 |
| 50.00 | 155.0 |
| 60.00 | 175.0 |
| 70.00 | 205.0 |
| 80.00 | 230.0 |
| 90.00 | 255.0 |
| 95.00 | 270.0 |
| 97.00 | 282.0 |

| Stream Name | Raw condensate |
|---|---|
| Vapour / Phase Fraction | 0.0000 |
| Temperature [C] | 35.00 |
| Pressure [psig] | 40.00 |
| Molar Flow [MMSCFD] | 1.124 |
| Mass Flow [lb/hr] | 1.482e+004 |
| Std Ideal Liq Vol Flow [barrel/day] | 1250 |
| Molar Enthalpy [Btu/lbmole] | -1.122e+005 |
| Molar Entropy [Btu/lbmole-F] | 7.032 |
| Heat Flow [Btu/hr] | -1.385e+007 |
| Liq Vol Flow @Std Cond [barrel/day] | 1250 |

**Fig. 1.** Input data for oil manager and basis for simulation

## 3. Simulation of condensate fractionation plant

The condensate fractionation unit is first processed in the refinery and is composed by the following equipment: Three pre-heater (heat exchangers), one main distillation column and one kerosene stripper. The objective of the present works was to validate the model, checking all the settings and calibrations, to verify the answer of the model to real operating conditions.
The actual distillation column was a traditional distillation column which has a reboiler at the bottom and a condenser at the top. The column was simulated in HYSYS 3.2 to regenerate the data. The simulation model can be seen in Fig. 2. Among the three products, MS was the top product and it was the lightest of all. It would be used as thinner for paints. Kerosene was the side draw from the column. It was composed of mostly medium heavy oil components. Diesel was the bottom product of the column and heaviest of all.
Condensate comes from gas fields and stored in condensate storage tanks (Fig. 2). Then it (stream: raw condensate) fed to feed pre-heaters in fractionation area. At first feed pre-heater condensate pre-heated by kerosene products and then it (stream: condensate1) goes to another feed-preheater E-101 and heated up by diesel products. Then finally it pre-heated by heat transfer oil (thermal oil) coming from thermal oil heater to enrich with sufficient temperature before fed into fractionation column (stream: condensate).

In fractionation column due to relative volatility of different components of condensate it's divided mainly in three portions. Heat transfer and mass transfer are played at different stages and try to get equilibrium conditions. At top get MS vapor at 130 °C to 135 °C with 10 to 11 psig, kerosene as a side product (stream- kerosene) produced at 190 °C to 200 °C with 11 psig, the rest portion diesel as a bottom product (stream- Diesel) produced at 275 °C to280 °C with 12 psig. MS vapors then goes to condenser, then (stream- petrol) more cooled by exchanging heat with cooling water at E-104. Then liquid MS goes to buffer tank V-100 and then the MS pumped by P-100 to product storage tank.
As a side product kerosene goes to kerosene stripper, and then from the bottom of the stripper it's pumped to the first pre-heater and E-103 to be cooled by exchanging heat with fed condensate and with cooling water accordingly. Then it goes to buffer tank (V-101) and finally pumped to kerosene storage tank.
The bottom product diesel is pumped to the heat exchangers E-101 and E-100 to be cooled by exchanging heat with condensate and with cooling water accordingly. Then it goes to buffer tank (V-102) and finally pumped to diesel storage tank.
A high boiling point heat transfer oil (Therminol VP-1) heated up in a heater and supplied to feed pre-heater (E-102), fractionator reboiler and kerosene reboiler to heat up condensate, diesel and kerosene accordingly. For better quality of the products by more fractions, in the fractionation column, reflux of certain amount of MS, kerosene and diesel was done.

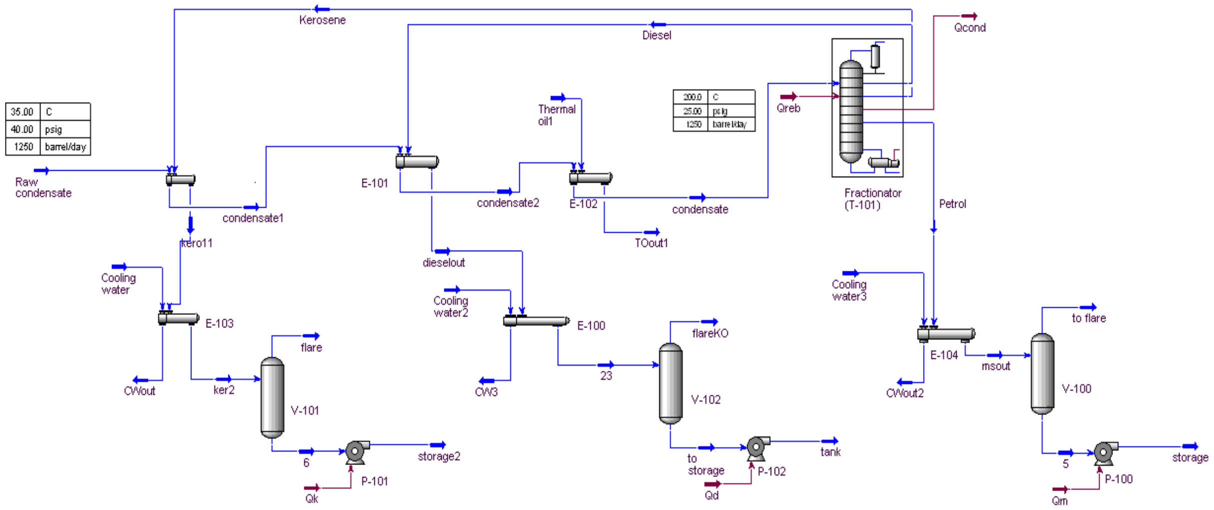



**Fig. 2.** Process simulation model for condensate fractionation plant.

The Heat and Material Balance (HMB) of the whole streams in the plant is shown in Fig. 3 as a result of the simulation.

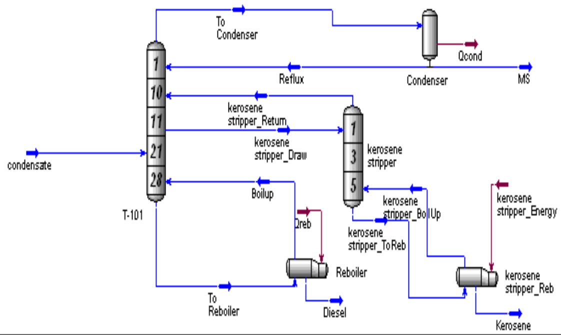
| Streams | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | condensate | Petrol | Diesel | Kerosene | Raw condensate | condensate1 | kero11 | condensate2 | dieselout | Thermal oil1 |
| Vapour Fraction | | 0.6845 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Temperature | C | 200.0 | 35.00 | 280.9 | 200.8 | 35.00 | 60.00 | 123.2 | 125.0 | 64.30 | 316.0 |
| Pressure | psig | 25.00 | 10.00 | 12.00 | 10.74 | 40.00 | 35.00 | 5.741 | 30.00 | 7.000 | 100.0 |
| Molar Flow | MMSCFD | 1.124 | 0.6925 | 0.1870 | 0.2443 | 1.124 | 1.124 | 0.2443 | 1.124 | 0.1870 | 10.80 |
| Mass Flow | lb/hr | 1.482e+004 | 7055 | 3983 | 3785 | 1.482e+004 | 1.482e+004 | 3785 | 1.482e+004 | 3983 | 1.968e+005 |
| Std Ideal Liq Vol Flow | barrel/day | 1250 | 625.0 | 312.5 | 312.5 | 1250 | 1250 | 312.5 | 1250 | 312.5 | 1.271e+004 |
| Heat Flow | Btu/hr | -1.041e+007 | -6.629e+006 | -2.713e+006 | -2.928e+006 | -1.385e+007 | -1.354e+007 | -3.235e+006 | -1.265e+007 | -3.601e+006 | 3.231e+007 |
| Molar Enthalpy | Btu/lbmole | -8.437e+004 | -8.718e+004 | -1.321e+005 | -1.091e+005 | -1.122e+005 | -1.097e+005 | -1.206e+005 | -1.025e+005 | -1.754e+005 | 2.725e+004 |
| | | TOout1 | CWout | Cooling water | ker2 | 23 | Cooling water2 | CW3 | msout | Cooling water3 | CWout2 |
| Vapour Fraction | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Temperature | C | 304.0 | 35.00 | 30.00 | 35.00 | 35.00 | 30.00 | 35.00 | 35.00 | 30.00 | 35.00 |
| Pressure | psig | 95.00 | 55.00 | 60.00 | 0.7407 | 2.000 | 60.00 | 55.00 | 5.000 | 60.00 | 55.00 |
| Molar Flow | MMSCFD | 10.80 | 16.06 | 16.06 | 0.2443 | 0.1870 | 5.148 | 5.148 | 0.6925 | 5.117e-003 | 5.117e-003 |
| Mass Flow | lb/hr | 1.968e+005 | 3.176e+004 | 3.176e+004 | 3785 | 3983 | 1.018e+004 | 1.018e+004 | 7055 | 10.12 | 10.12 |
| Std Ideal Liq Vol Flow | barrel/day | 1.271e+004 | 2179 | 2179 | 312.5 | 312.5 | 698.8 | 698.8 | 625.0 | 0.6945 | 0.6945 |
| Heat Flow | Btu/hr | 3.007e+007 | -2.157e+008 | -2.160e+008 | -3.529e+006 | -3.695e+006 | -6.927e+007 | -6.918e+007 | -6.630e+006 | -6.885e+004 | -6.875e+004 |
| Molar Enthalpy | Btu/lbmole | 2.536e+004 | -1.224e+005 | -1.225e+005 | -1.315e+005 | -1.800e+005 | -1.225e+005 | -1.224e+005 | -8.718e+004 | -1.225e+005 | -1.224e+005 |
| | | to flare | 5 | storage | flare | 6 | storage2 | flareKO | to storage | tank | Qcond |
| Vapour Fraction | | 1.0000 | 0.0000 | 0.0000 | 1.0000 | 0.0000 | 0.0000 | 1.0000 | 0.0000 | 0.0000 | <empty> |
| Temperature | C | 35.00 | 35.00 | 35.11 | 35.00 | 35.00 | 35.09 | 35.00 | 35.00 | 35.07 | <empty> |
| Pressure | psig | 5.000 | 5.000 | 40.00 | 0.7407 | 0.7407 | 35.74 | 2.000 | 2.000 | 37.00 | <empty> |
| Molar Flow | MMSCFD | 0.0000 | 0.6925 | 0.6925 | 0.0000 | 0.2443 | 0.2443 | 0.0000 | 0.1870 | 0.1870 | <empty> |
| Mass Flow | lb/hr | 0.0000 | 7055 | 7055 | 0.0000 | 3785 | 3785 | 0.0000 | 3983 | 3983 | <empty> |
| Std Ideal Liq Vol Flow | barrel/day | 0.0000 | 625.0 | 625.0 | 0.0000 | 312.5 | 312.5 | 0.0000 | 312.5 | 312.5 | <empty> |
| Heat Flow | Btu/hr | 0.0000 | -6.630e+006 | -6.628e+006 | 0.0000 | -3.529e+006 | -3.528e+006 | 0.0000 | -3.695e+006 | -3.695e+006 | 4.618e+006 |
| Molar Enthalpy | Btu/lbmole | -5.718e+004 | -8.718e+004 | -8.717e+004 | -9.906e+004 | -1.315e+005 | -1.315e+005 | -1.370e+005 | -1.800e+005 | -1.800e+005 | <empty> |

**Fig. 3(a).** Heat and Material balances for process streams

| | | Qreb | Qm | Qk | Qd | Reflux | To Condenser | Boilup | To Reboiler | MS | Diesel |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Vapour Fraction | | <empty> | <empty> | <empty> | <empty> | 0.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0000 |
| Temperature | C | <empty> | <empty> | <empty> | <empty> | 35.00 | 119.3 | 280.9 | 272.4 | 35.00 | 280.9 |
| Pressure | psig | <empty> | <empty> | <empty> | <empty> | 10.00 | 10.00 | 12.00 | 12.00 | 10.00 | 12.00 |
| Molar Flow | MMSCFD | <empty> | <empty> | <empty> | <empty> | 1.385 | 2.078 | 1.004 | 1.191 | 0.6925 | 0.1870 |
| Mass Flow | lb/hr | <empty> | <empty> | <empty> | <empty> | 1.411e+004 | 2.117e+004 | 2.030e+004 | 2.428e+004 | 7055 | 3983 |
| Std Ideal Liq Vol Flow | barrel/day | <empty> | <empty> | <empty> | <empty> | 1250 | 1875 | 1606 | 1918 | 625.0 | 312.5 |
| Heat Flow | Btu/hr | 2.392e+006 | 1309 | 651.4 | 650.9 | -1.326e+007 | -1.527e+007 | -1.167e+007 | -1.678e+007 | -6.629e+006 | -2.713e+006 |
| Molar Enthalpy | Btu/lbmole | <empty> | <empty> | <empty> | <empty> | -8.718e+004 | -6.694e+004 | -1.059e+005 | -1.283e+005 | -8.718e+004 | -1.321e+005 |
| | | condensate | kerosene stripper_Draw | kerosene stripper_Return | Kerosene | kerosene stripper_BoilUp | kerosene stripper_ToReb | Qcond | Qreb | kerosene stripper_Energy | |
| Vapour Fraction | | 0.6845 | 0.0000 | 1.0000 | 0.0000 | 1.0000 | 0.0000 | <empty> | <empty> | <empty> | |
| Temperature | C | 200.0 | 180.7 | 184.6 | 200.8 | 200.8 | 195.3 | <empty> | <empty> | <empty> | |
| Pressure | psig | 25.00 | 10.74 | 10.74 | 10.74 | 10.74 | 10.74 | <empty> | <empty> | <empty> | |
| Molar Flow | MMSCFD | 1.124 | 0.4066 | 0.1623 | 0.2443 | 0.1833 | 0.4276 | <empty> | <empty> | <empty> | |
| Mass Flow | lb/hr | 1.482e+004 | 5975 | 2190 | 3785 | 2690 | 6475 | <empty> | <empty> | <empty> | |
| Std Ideal Liq Vol Flow | barrel/day | 1250 | 497.4 | 184.9 | 312.5 | 224.1 | 536.6 | <empty> | <empty> | <empty> | |
| Heat Flow | Btu/hr | -1.041e+007 | -4.754e+006 | -1.460e+006 | -2.928e+006 | -1.754e+006 | -5.049e+006 | 4.618e+006 | 2.392e+006 | 3.666e+005 | |
| Molar Enthalpy | Btu/lbmole | -8.437e+004 | -1.065e+005 | -8.195e+004 | -1.091e+005 | -8.718e+004 | -1.075e+005 | <empty> | <empty> | <empty> | |

**Fig. 3(b).** Heat and Material balances for process streams

The fractionation column environment (Fig. 4) is to install and define the streams and operations contained in a column sub-flowsheet. There contains tray section, condensers, reboilers, side strippers, heat exchangers, pumps. HYSYS contains a number of pre-built column sub-flowsheet template that quickly install a column of a typical type and then customize it's as required within its column environment [14]. In the column the condensate feed tray number was 21, kerosene withdrawn from 11 and kerosene reflux to column was 10. Diesel and MS were withdrawn from bottom and top of the column respectively and both were refluxed again to the column. Column (T-101) environment is given below with it's process flow diagram containing heat and mass balances.




| Material Streams | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Reflux | To Condenser | Boilup | To Reboiler | MS | Diesel | condensate | kerosene stripper_Draw | kerosene stripper_Return | Kerosene | kerosene stripper_BoilUp | kerosene stripper_ToReb |
| Vapour Fraction | | 0.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0000 | 0.6845 | 0.0000 | 1.0000 | 0.0000 | 1.0000 | 0.0000 |
| Temperature | C | 35.00 | 119.3 | 280.9 | 272.4 | 35.00 | 280.9 | 200.0 | 180.7 | 184.6 | 200.8 | 200.8 | 195.3 |
| Pressure | psig | 10.00 | 10.00 | 12.00 | 12.00 | 10.00 | 12.00 | 25.00 | 10.74 | 10.74 | 10.74 | 10.74 | 10.74 |
| Molar Flow | MMSCFD | 1.385 | 2.078 | 1.004 | 1.191 | 0.6925 | 0.1870 | 1.124 | 0.4066 | 0.1623 | 0.2443 | 0.1833 | 0.4276 |
| Mass Flow | lb/hr | 1.411e+004 | 2.117e+004 | 2.030e+004 | 2.428e+004 | 7055 | 3983 | 1.482e+004 | 5975 | 2190 | 3785 | 2690 | 6475 |
| Liquid Volume Flow | barrel/day | 1250 | 1875 | 1606 | 1918 | 625.0 | 312.5 | 1250 | 497.4 | 184.9 | 312.5 | 224.1 | 536.6 |
| Heat Flow | Btu/hr | -1.326e+007 | -1.527e+007 | -1.167e+007 | -1.678e+007 | -6.629e+006 | -2.713e+006 | -1.041e+007 | -4.754e+006 | -1.460e+006 | -2.928e+006 | -1.754e+006 | -5.049e+006 |

**Fig. 4.** Process Flow Diagram (PFD) of the Fractionator

The column converges quickly with the good estimate provided from the shortcut model (Fig. 5). The column profiles can be checked by selecting the ''Performance'' tab in the column environment and then selecting ''Plots'' from the menu on the left and ''Composition'' from the list of possible plots. To size the trays in Hysys, must activate the tray sizing utility (from the Tools menu via Tools/Utilities/Tray Sizing). When bubble cap trays are selected withthe default spacing of 24 in (2 ft.) and the other default parameters. The column diameter is found to be 4.921 ft. The data on column size, number of trays, reboiler, and condenser duty can then be extracted from the simulation and put into a cost model or spreadsheet to carry out optimization of the total annual cost of production.

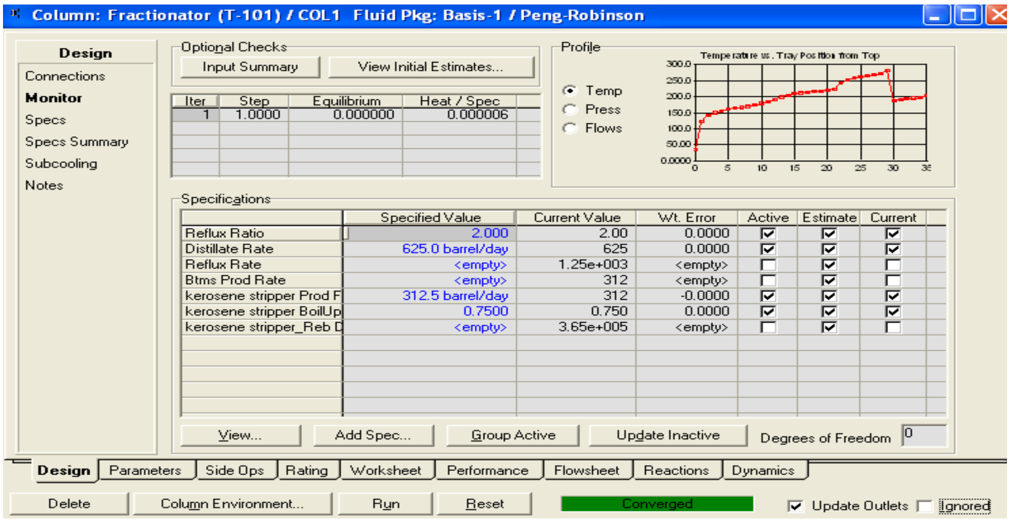
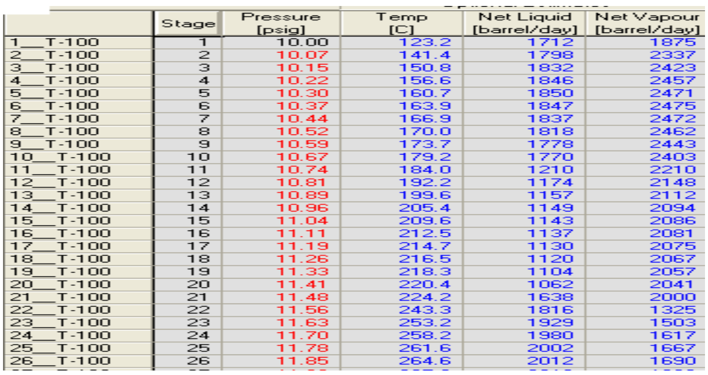



**Fig. 5.** Column specifications.

In this simulation 28 bubble cap trays were used in the main column for vapor-liquid equilibrium (Fig. 6). Bubble cap calculations are based on the method described in design of equilibrium stage processes by Bufford D. Smith [14]. Tray efficiency was used as 75%. Conditions on the trays like pressure, temperature, liquid and vapor flowrate are calculated for every tray which is given in the Fig.6



| | Stage | Pressure [psig] | Temp [C] | Net Liquid [barrel/day] | Net Vapour [barrel/day] |
|---|---|---|---|---|---|
| 1__T-100 | 1 | 10.00 | 123.2 | 1712 | 1875 |
| 2__T-100 | 2 | 10.07 | 141.4 | 1798 | 2337 |
| 3__T-100 | 3 | 10.15 | 150.8 | 1832 | 2423 |
| 4__T-100 | 4 | 10.22 | 156.6 | 1846 | 2457 |
| 5__T-100 | 5 | 10.30 | 160.7 | 1850 | 2471 |
| 6__T-100 | 6 | 10.37 | 163.9 | 1847 | 2475 |
| 7__T-100 | 7 | 10.44 | 166.9 | 1837 | 2472 |
| 8__T-100 | 8 | 10.52 | 170.0 | 1818 | 2462 |
| 9__T-100 | 9 | 10.59 | 173.7 | 1778 | 2443 |
| 10__T-100 | 10 | 10.67 | 179.2 | 1770 | 2403 |
| 11__T-100 | 11 | 10.74 | 184.0 | 1210 | 2210 |
| 12__T-100 | 12 | 10.81 | 192.2 | 1174 | 2148 |
| 13__T-100 | 13 | 10.89 | 199.6 | 1157 | 2112 |
| 14__T-100 | 14 | 10.96 | 205.4 | 1149 | 2094 |
| 15__T-100 | 15 | 11.04 | 209.6 | 1143 | 2086 |
| 16__T-100 | 16 | 11.11 | 212.5 | 1137 | 2081 |
| 17__T-100 | 17 | 11.19 | 214.7 | 1130 | 2075 |
| 18__T-100 | 18 | 11.26 | 216.5 | 1120 | 2067 |
| 19__T-100 | 19 | 11.33 | 218.3 | 1104 | 2057 |
| 20__T-100 | 20 | 11.41 | 220.4 | 1062 | 2041 |
| 21__T-100 | 21 | 11.48 | 224.2 | 1638 | 2000 |
| 22__T-100 | 22 | 11.56 | 243.3 | 1816 | 1325 |
| 23__T-100 | 23 | 11.63 | 253.2 | 1929 | 1503 |
| 24__T-100 | 24 | 11.70 | 258.2 | 1980 | 1617 |
| 25__T-100 | 25 | 11.78 | 261.6 | 2002 | 1667 |
| 26__T-100 | 26 | 11.85 | 264.6 | 2012 | 1690 |

**Fig. 6.** Process conditions at different trays

## 4. Results and discussion

**Table 2.** Comparison between the real operation and the simulation.

| Parameters | Units | Simulation | Real |
|---|---|---|---|
| Column top temperature | $^oC$ | 123 | 130 |
| Column top pressure | psig | 10 | 11 |
| Column bottom temperature | $^oC$ | 270 | 275 |
| Column bottom pressure | psig | 12 | 12 |
| Column temperature at tray 11 | $^oC$ | 184 | 170 |
| Kerosene stripper temp. | $^oC$ | 200.8 | 195 |
| Kerosene stripper press. | psig | 10.74 | 11 |
| Column feed temp. | $^oC$ | 200 | 200 |
| Column feed press. | psig | 25 | 25 |
| MS product flowrate | BPD | 625 | 675 |
| Kerosene product flowrate | BPD | 312.5 | 275 |
| Diesel product flowrate | BPD | 312.5 | 300 |
| Products storage temp. | $^oC$ | 35 | 35 |

Fig. 3, Fig. 4 and Fig. 6 are the process simulation results. Table 2 is for the comparison between real plant's data and simulated data. Some major plant's operating data are compared with simulation results. The simulated volumetric flow rates with their corresponding temperatures for MS product, kerosene product and diesel product were 625 BPD, 312.5 BPD and 312.5 BPD but in real they are 675 BPD, 275 BPD and 300 BPD respectively. There was an increase in the real temperature for column top and column bottom whereas a decrease in the real temperature for kerosene stripper. The operating pressure remains almost same in both simulation result and plant data. Column feed condition was same for both cases.

## 5. Conclusion

Simulation software is a very good tool for the process industry, not only at the level of conceptual design but also during the entire lifecycle of the equipment, were it can be very useful for performance, debottlenecking and process studies. The study presents the simulation of a condensate fractionation plant. A Process Flow Diagram (PFD) was presented with heat and mass balances. The simulated results were compared with the real plant's data. Almost all the parameters matched with each other. This showed that the Column needed to be optimized in order to convert more of the atmospheric residue into other premium products like diesel, kerosene and petrol. The presented results have been obtained using the steady state version of the software, but all the simulations done in steady state can have an evolution to a dynamic simulation (for example to build process simulators for operator training or to study the behavior of the process units in transient conditions), or to a real time optimization system where, together with the advanced process control tools, can be very profitable in the optimization of the operation in real time.

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