C-02 Light Oil Recovery Column Analysis Report

Analysis Period: 2025-09-03 00:00:00 to 2025-09-30 00:00:00

Report Generated: 2025-10-15 17:30:47

# 1. Executive Summary

The \*\*Reboiler Heat Duty (IQR Cleaned)\*\* averaged -596.51 kW. The \*\*Condenser Heat Duty (IQR Cleaned)\*\* averaged 341.53 kW. The C-02 column had a material balance error of 94.27%. The column operated with a stable \*\*Reflux Ratio (IQR Median)\*\* of \*\*58.22\*\*. The central 50% of operation fell between 51.61 and 65.20. The naphthalene loss in the C-01 column was calculated to be 3.17%, which is \*\*above the acceptable limit\*\*. Naphthalene concentration in the C-02 top product was found to be 8.00%.

# 2. Key Performance Indicators (KPIs)

All values are averages over the analysis period. Averages for Reflux Ratio and Heat Duties are calculated using the robust Median from the IQR method.

• \*\*C-00 Overall Material Balance Error (%)\*\*: 4.64 %

• \*\*Naphthalene Loss in C-01 (%)\*\*: 3.17 %

• \*\*C-02 Overall Material Balance Error (%)\*\*: 94.27 %

• \*\*Average Differential Pressure\*\*: 209.91 mmHg

• \*\*Maximum Differential Pressure\*\*: 396.44 mmHg

• \*\*Average Reboiler Heat Duty\*\*: -596.51 kW

• \*\*Average Condenser Heat Duty\*\*: 341.53 kW

• \*\*Average Reflux Ratio (IQR Median)\*\*: 58.22

• \*\*Reboiler Temp (TI-72B)\*\*: 236.57 degC

• \*\*Naphthalene in C-02 Top Product (%)\*\*: 8.00 %

# 3. Data Integrity and Outlier Analysis

## 3.1 Standard Outlier Capping ($\pm 3\sigma$)

Data for general process tags (flows, temperatures, DP) were capped to the $3\sigma$ limit.

• \*\*FT\_01\*\*: 1099 outlier data points were capped.

• \*\*FT\_02\*\*: 32 outlier data points were capped.

• \*\*FT\_03\*\*: 1656 outlier data points were capped.

• \*\*FT\_06\*\*: 1682 outlier data points were capped.

• \*\*TI\_72B\*\*: 892 outlier data points were capped.

• \*\*TI\_13\*\*: 875 outlier data points were capped.

## 3.2 Robust Average Calculation (IQR Method)

Outliers in critical metrics (Reflux Ratio and Heat Duties) were filtered using the Interquartile Range ($1.5 imes IQR$) method. The table below shows the Median (robust average) and the central 50% operating range ($Q1$ to $Q3$).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Metric | Median (Robust Average) | Q1 (25th Percentile) | Q3 (75th Percentile) | Points Removed | % Removed |
| REFLUX\_RATIO | 58.22 | 51.61 | 65.20 | 2,599 | 6.83% |
| REBOILER\_HEAT\_DUTY | -596.51 (kW) | -629.36 (kW) | -535.04 (kW) | 7,009 | 18.41% |
| CONDENSER\_HEAT\_DUTY | 341.53 (kW) | 292.78 (kW) | 370.66 (kW) | 6,083 | 15.97% |

# 4. Material Balance Analysis

## 4.1 C-00 and C-01 Material Balance

• C-00 Overall Material Balance Error: 4.64%

• Naphthalene Loss in C-01: 3.17%

- ALERT: Naphthalene loss is above the 2% limit.

## 4.2 C-02 Material Balance

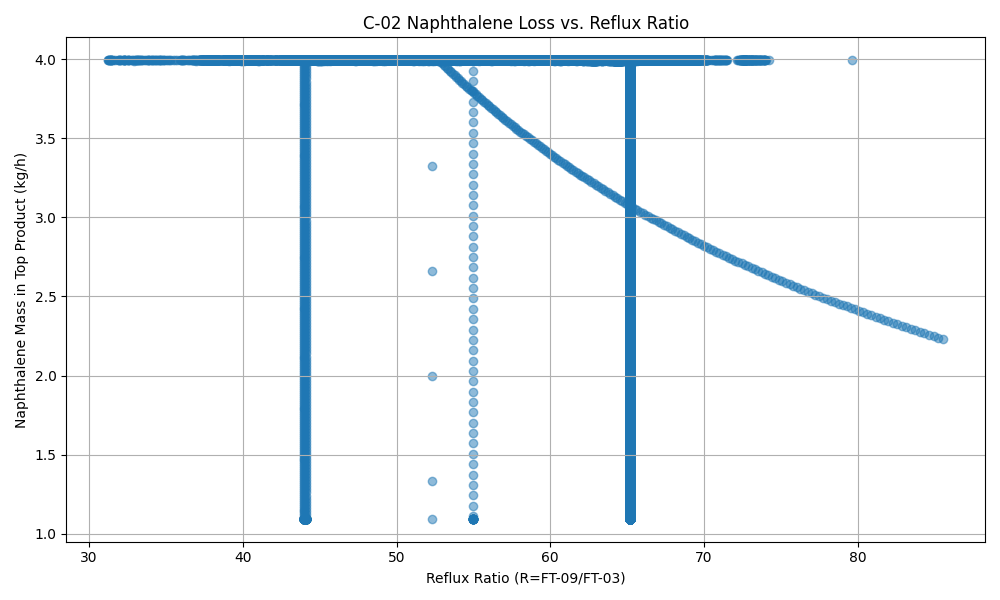
• C-02 Overall Material Balance Error: 94.27%

## 4.3 Component-wise Balance

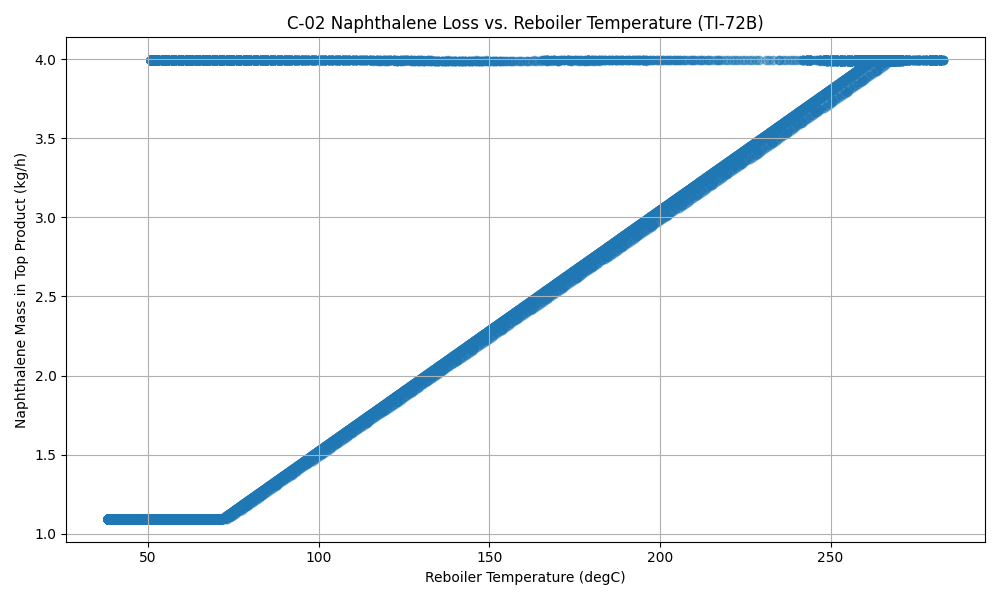
Detailed component balance requires lab data on all input/output streams.

# 5. Performance Plots

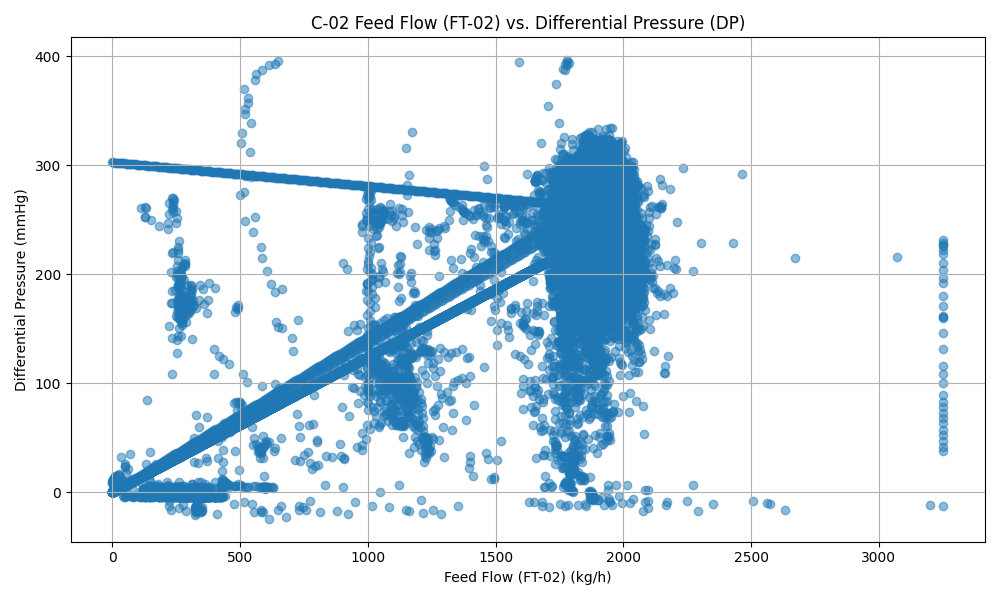
## 5.1 Naphthalene in Top Product vs. Reflux Ratio



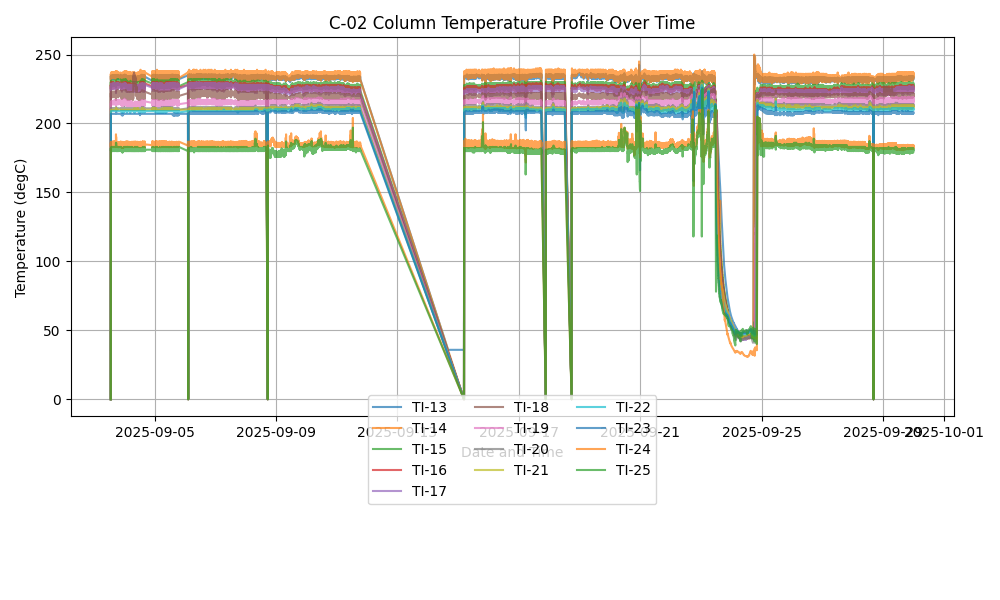
## 5.2 Naphthalene in Top Product vs. Reboiler Temperature



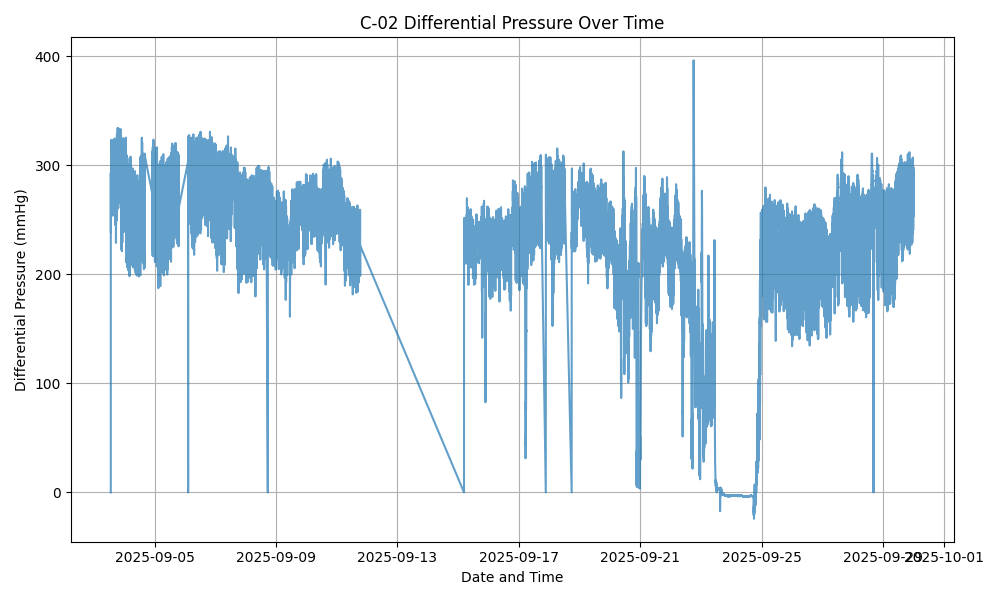
## 5.3 Feed vs. Differential Pressure



## 5.4 Temperature Profile



## 5.5 Differential Pressure (DP)



## 5.6 Daily Trends

