Taming 103 Crudes:
How BPCL Optimized CDU Operations With Online Process Simulation Models

aspentech | Case Study

Up to $6.25M USD/YR

Savings from improved CDU operations

> 200 product properties

Visible in real time

CHALLENGE

Managing 103 crude types, BPCL's Mumbai refinery faced major hurdles due to limited real-time visibility into product quality. Operators lacked timely data on critical parameters like CCR and metals, making it difficult to respond to crude variability, prevent column flooding or align operations with planning—ultimately constraining efficiency and profitability.

SOLUTION

BPCL deployed an online CDU simulation model built using Aspen HYSYS®, integrated with real-time plant data and BPMARRK crude assay predictions. Running hourly, the model delivers over 200 property predictions directly to DCS dashboards, enabling faster, data-driven decisions and improved process control.

VALUE CREATED

The real-time CDU simulation model has enabled BPCL to reduce emissions, minimize product giveaways and improve throughput—delivering estimated annual savings of $5M to $6.25M USD. Operators can now access over 200 property predictions hourly, enhancing decision-making, aligning planning with operations and streamlining workflows across the refinery.

Challenge

The BPCL Mumbai refinery faced a formidable operational challenge: it was processing an astonishing 103 different crude oils. This extreme variability demanded constant vigilance and adaptability from operators, who needed real-time insights into key parameters to optimize productivity, reduce energy consumption and minimize emissions.

However, the refinery lacked real-time visibility into critical KPIs—most notably, product quality. Measurements were available only once per day, which was far too infrequent for effective control. Advanced Process Control (APC) systems required more frequent sampling of crude distillation unit (CDU) product qualities, yet operators had access to only 15-20 product properties. Crucial parameters such as metals, Conradson carbon residue (CCR) and asphaltenes content were not measured. This created a significant blind spot, especially since CCR and asphaltenes levels in streams like vacuum gas oil (VGO) are vital for protecting catalysts used in downstream processes.

The CDUs were the first to feel the impact of crude quality shifts. For instance, lighter crudes often led to column flooding, reducing throughput. Yet operators had no real-time visibility into flooding conditions inside the column—nor any predictive tools to anticipate or mitigate such disruptions.

Another critical gap lay between the refinery's operating plan and its actual performance. Without real-time visibility into product cut points, adjustments could only be made once per day. This lag hindered responsiveness and left significant profit potential untapped.

Solution

To enhance operational efficiency and decision-making, the engineering team at the Mumbai refinery successfully developed and deployed an online process simulation model of the CDU using Aspen HYSYS. This comprehensive model also included key components such as the stabilizer column, crude drum, vacuum drum and pre-flash drum, ensuring a holistic representation of the CDU process.

The simulation model was seamlessly integrated with the refinery's data historian (Aspen InfoPlus.21®) via Aspen OnLine®. It was configured to run automatically every hour, enabling continuous calibration of the model with real-time plant data. The resulting property predictions from Aspen HYSYS were written back to the historian and made accessible to stakeholders through web-based dashboards built using aspenONE Process Explorer™. These dashboards were also displayed on the distributed control system (DCS) screens, providing panel engineers with timely and actionable insights.

Figure 1. Dashboards displayed on DCS screens.

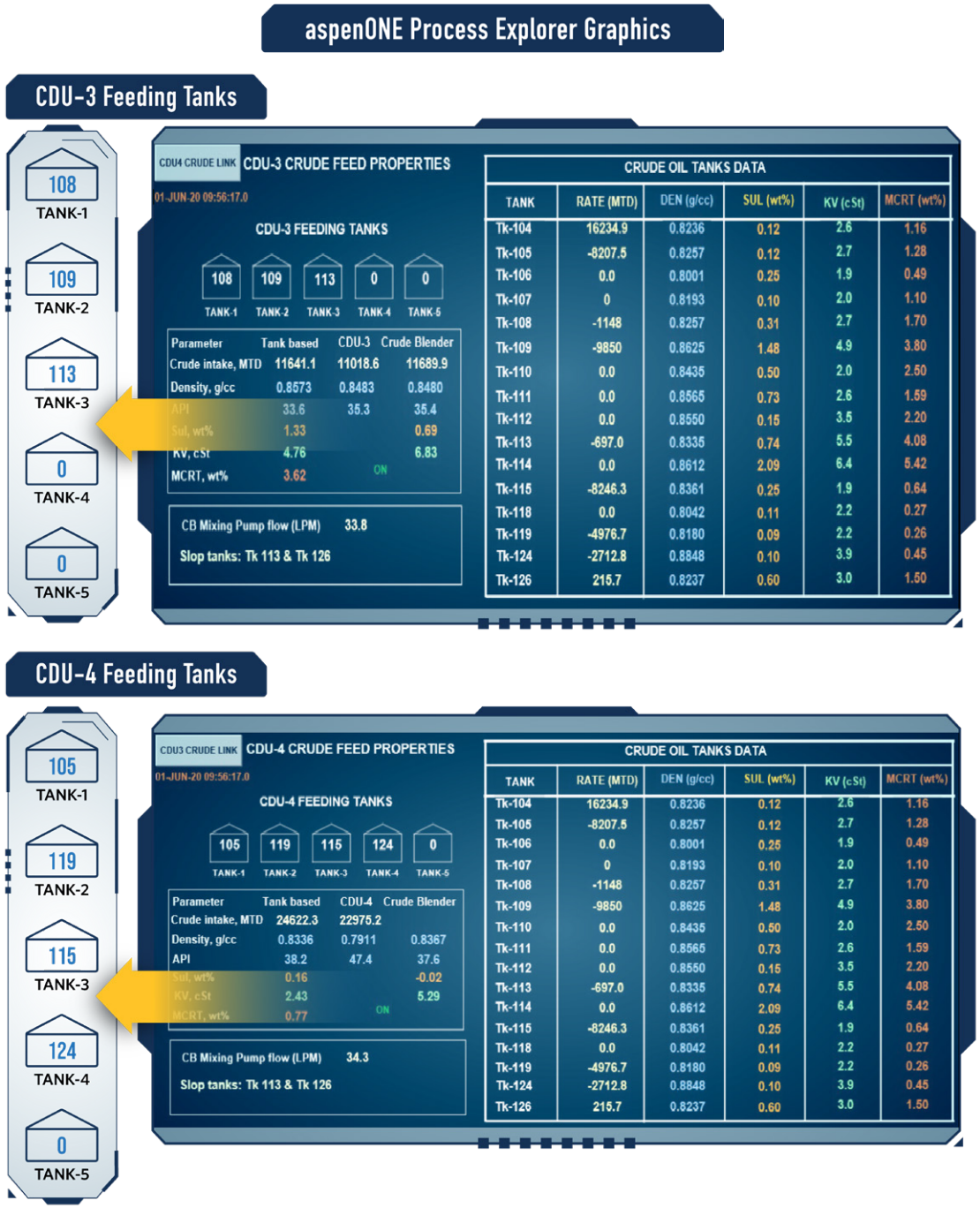

Figure 2. aspenONE Process Explorer dashboards.

The solution also used BPCL's proprietary BPMARRK technology—developed, patented and commercialized in-house—which predicts the characteristics of crude blends. The built-in integration between Aspen HYSYS and BPMARRK allowed assay data from BPMARRK to be directly incorporated into the simulation model, improving the accuracy of property predictions and enabling better crude management.

This solution has empowered BPCL refinery with enhanced visibility, improved process control and more informed operational decisions.

Value Created

The implementation of the online CDU simulation model has significantly enhanced the BPCL refinery's ability to make timely and informed decisions. With access to real-time insights, the refinery team has been able to minimize product giveaways and optimize product qualities more effectively. These insights have also enabled precise adjustments to reboiler steam and temperature settings, contributing to emission reductions and resulting in estimated annual savings of $0.63 million to $1 million USD from steam optimization alone.

Operational efficiency has improved further with the ability to visualize internal column behavior in real time. This has allowed operators to proactively identify and mitigate issues such as column flooding, leading to increased throughput. For instance, a DCS operator can now independently assess the impact of increasing lighter crude feed through the column to make confident, data-driven decisions.

Before the solution was implemented, product quality results were available only once a day and limited to 15 to 20 property predictions. Now, stakeholders have access to over 200 property predictions every hour, including live estimates of CCR and metal content in process streams. These predictions are displayed directly on DCS screens, making them easily accessible to panel engineers and other decision-makers.

The integration of real-time cut point and crude assay data into the Aspen PIMS™ planning model has enabled hourly updates, replacing the previous daily update cycle. This has improved alignment between planning and actual operations. In the area of APC, the solution has automated the communication of set point targets to the APC systems built using Aspen DMC3™. Previously, DCS operators manually set upper and lower limits based on experience. Now, these targets are automatically and accurately transmitted, freeing up operator time for higher-value tasks.

The refinery expects to realize $2.5 million to $3.75 million USD per year in savings from process optimization alone. The total estimated annual benefit from the solution is between $5 million and $6.25 million.

Beyond these tangible gains, the refinery has also benefited from a reduction in laboratory sampling and the replacement of certain online analyzers, further streamlining operations and reducing costs.

Conclusion

Faced with the complexity of processing 103 different crude oils, BPCL's Mumbai refinery overcame significant operational blind spots by deploying a cutting-edge online CDU simulation model. This initiative addressed critical gaps in real-time visibility, product quality monitoring, and responsiveness to crude variability—challenges that previously limited throughput, increased energy consumption and risked catalyst degradation.

By deploying an online process simulation model of the CDU in Aspen HYSYS, the refinery established a robust solution that delivers over 200 property predictions every hour, including key parameters like CCR and metal content. These insights are now directly accessible on DCS screens, empowering operators to make confident, data-driven decisions in real time.

The solution has delivered measurable impact:

- $0.63M–$1M USD/year in steam optimization savings through precise reboiler control
- $2.5M–$3.75M USD/year from broader process optimization
- $5M–$6.25M/year in total estimated annual benefits

Beyond financial gains, the refinery has improved planning alignment, reduced lab sampling, replaced certain online analyzers and freed up operator time for higher-value tasks. Most importantly, it has built a foundation for continuous improvement and operational agility—positioning BPCL as a leader in digital transformation within the refining sector.

About Aspen Technology

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