Real-Time Refinery-Wide Emissions Insights:

HPCL Real-Time Emissions Monitoring

aspentech | Case Study

2040 Net Zero Emissions

On Target

$50,000-100,000 USD

Annual Savings Per Furnace

CHALLENGE

HPCL was expanding the capacity of its Visakh Refinery from 8.3 MMTPA to 15 MMTPA—and had to do so without increasing the current sulfur oxide (SOx) emissions levels.

SOLUTION

To get real-time insights into SOx emissions, HPCL built and deployed an online comprehensive refinery simulation model using Aspen HYSYS®, integrated with the live plant data historian, Aspen InfoPlus.21®.

VALUE CREATED

- Real-time emission data enabled the refinery to increase efficiency, reduce fuel sulfur quantity and target emission-control technologies.
- Oxygen content optimization led to annual savings of approximately $50,000-100,000 USD per furnace and also contributed to lower NOx emissions.
- The online simulation model streamlined the estimating of emissions, saving approximately 550 man-hours per year.

Challenge

Hindustan Petroleum Corporation Limited (HPCL) is a refining company in India, owned by the Oil and Natural Gas Corporation (ONGC), which is a government entity. They own two refineries, Mumbai Refinery and Visakh Refinery.

HPCL's Visakh Refinery recently expanded its capacity from 8.3 MMTPA to 15 MMTPA. Despite this expansion, the allowed sulfur oxide (SOx) emissions levels could not be increased. Therefore, operators needed solutions to closely monitor SOx emissions to anticipate and mitigate any increases due to the higher refinery throughput.

The refinery also needed to monitor real-time CO_2 emissions to achieve its net-zero emissions target by 2040.

Additionally, the online analyzers for emissions measurement, connected to all stacks in the refinery, were linked in real-time to state and federal pollution control regulators. It was crucial for the refinery to have a way to verify the accuracy of these online analyzers.

Conventional Microsoft Excel-based calculations for estimating emissions were time-consuming and insufficient for determining the impact of instantaneous changes in fuel quality.

Solution

The refinery team addressed emission-monitoring challenges by developing and deploying an online comprehensive refinery simulation model using Aspen HYSYS, integrated with the live plant data historian, Aspen InfoPlus.21. This model encompassed 23 heaters, six boilers, two sets of FCC regenerators, three sets of Claus reactors and four sets of HRSGs, all within a single Aspen HYSYS flowsheet.

The online simulation model provided refinery operators with real-time insights into load-based emissions of SOx, nitrogen oxides (NOx) and CO_2, as well as flow, composition and dispersion coefficients for flue gas and odor threshold compounds. This model offered unparalleled insights

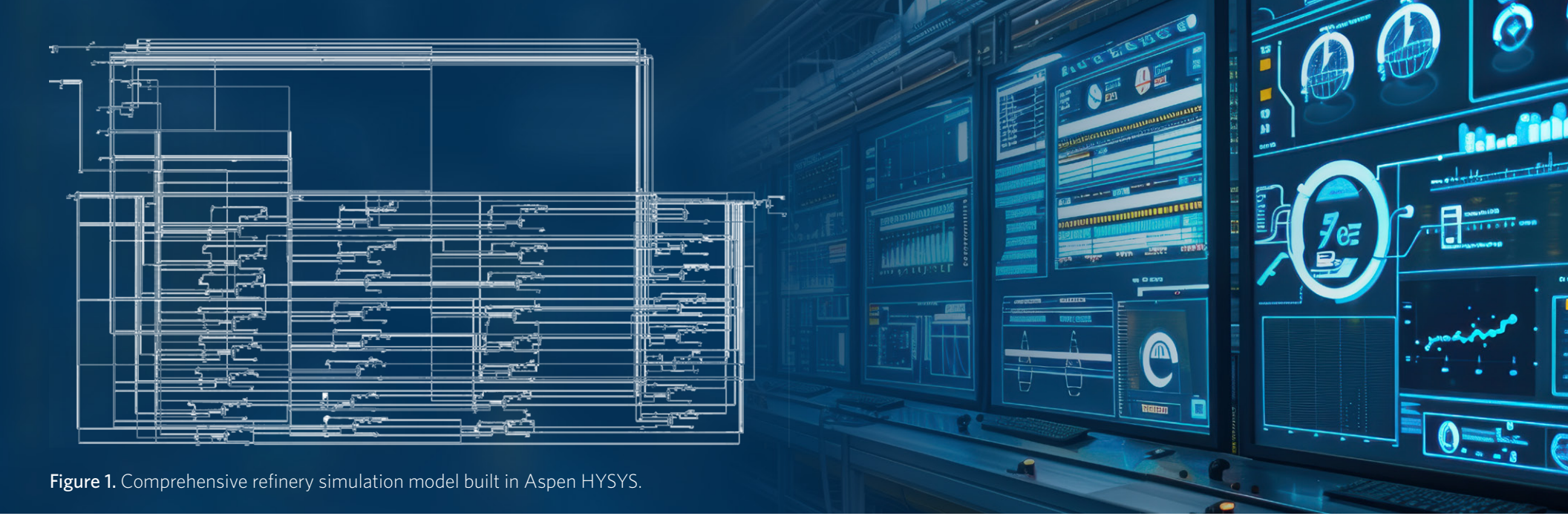

Figure 1. Comprehensive refinery simulation model built in Aspen HYSYS.

into emission profiles, including volatile organic compounds (VOCs) and NOx, across various processes and units within the refinery.

By continuously monitoring emissions in real time, the refinery ensured compliance with regulatory limits, thereby avoiding penalties for exceeding emission thresholds. The real-time emission monitoring system generated detailed reports on emission levels, trends, and compliance status, which were utilized for internal analysis and regulatory reporting requirements.

Real-time emission models can adapt to changing operating conditions, such as fluctuations in feedstock composition or variations in production rates. This flexibility has ensured that emission monitoring remains accurate and effective under diverse circumstances.

Value Created

The model demonstrated adaptability to changing operating conditions, such as fluctuations in feedstock composition or variations in production rates, ensuring accurate and effective emission monitoring under diverse circumstances.

Optimization of excess oxygen in the field resulted in maintaining the excess oxygen content as low as 1-2%, compared to earlier values of 3-5%. This optimization led to annual savings of approximately $50,000-100,000 USD per furnace. Additionally, the reduction in excess air minimized fuel energy wasted in heating inert nitrogen, thereby reducing NOx emissions.

Real-time emission data enabled the refinery to optimize processes for efficiency and cost-effectiveness. By identifying areas of high

emissions, measures were implemented to reduce fuel sulfur quantity and improve resource utilization. The access to real-time emission data provided valuable insights for the refinery's crude planners and economics team, informing decision-making processes related to maintenance scheduling, process unit throughput optimization and investment in emission-control technologies.

The model predicted oxygen content and other gaseous components in the flue gas based on stoichiometric ratios, which were verified with analyzer readings in the field. This real-time dynamic comparison facilitated the immediate identification and rectification of faulty analyzers, preventing erroneous exceedances recorded with statutory pollution regulators.

The introduction of this model eliminated the use of complex Microsoft Excel sheets for estimating emissions, resulting in a savings of approximately 550 man-hours per year

Conclusion

HPCL's Visakh Refinery has successfully expanded its capacity while maintaining stringent SOx emission levels, thanks to the deployment of an advanced online comprehensive refinery simulation model using Aspen HYSYS. This model has revolutionized emission monitoring by providing real-time insights into SOx, NOx and CO_2 emissions, as well as other critical parameters.

The real-time data enabled the refinery to ensure compliance with regulatory limits, optimize processes for efficiency and cost-effectiveness and achieve significant annual savings by reducing excess oxygen content. The model's adaptability to changing operating conditions and its ability to verify analyzer accuracy have further enhanced the refinery's emission control capabilities.

Overall, HPCL's innovative approach has set a benchmark for proactive emission management, contributing to their goal of net zero emissions by 2040 and demonstrating the value of real-time emission monitoring in modern refinery operations.

About Aspen Technology

Aspen Technology, now part of Emerson, is a global software leader helping industries at the forefront of the world's dual challenge meet the increasing demand for resources from a rapidly growing population in a profitable and sustainable manner. AspenTech solutions address complex environments where it is critical to optimize the asset design, operation and maintenance lifecycle Through our unique combination of deep domain expertise and innovation, customers in asset-intensive industries can run their assets safer, greener, longer and faster to improve their operational excellence.

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