أرامكو السعودية
saudi aramco

Saudi Aramco Increases Refinery Capacity by 100,000 Barrels/Day Using Plant Digital Twin

aspentech | Case Study

100 MBD projected increase in the refinery's processing capacity

CHALLENGE

Convert low-value fuel oil produced in a semi-conversion refinery into high-value products.

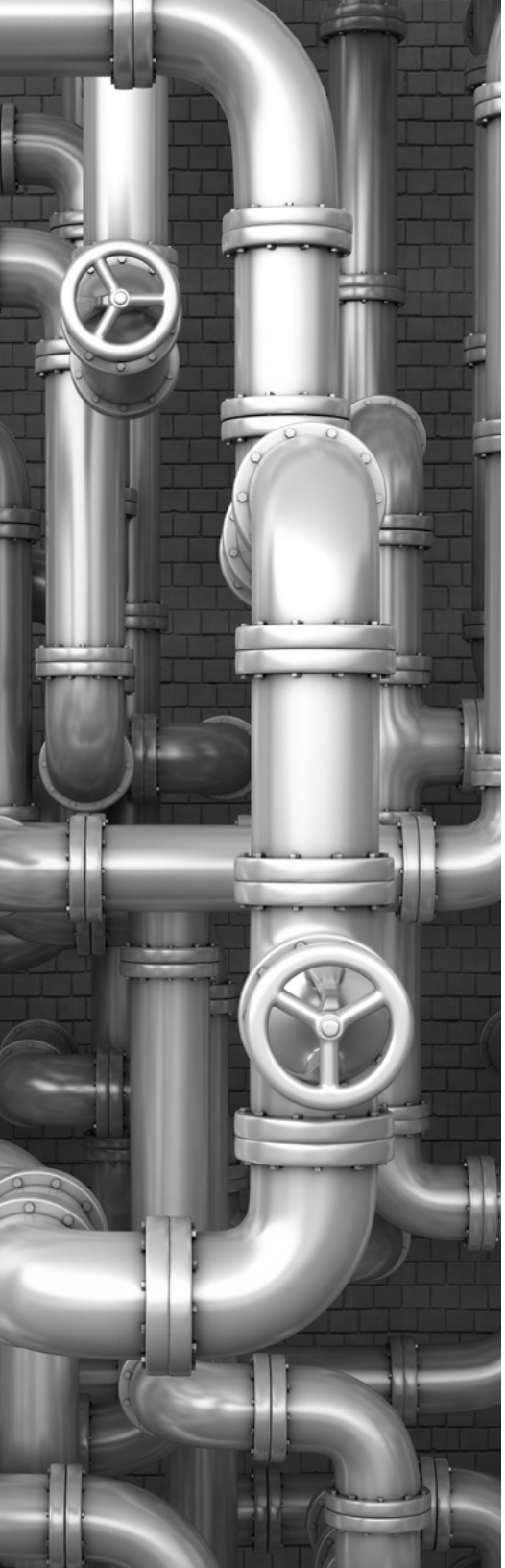
SOLUTION

Used Aspen HYSYS® to analyze feasibility of refinery reconfiguration plans by developing plant digital twins of hydrocracker, crude distillation unit (CDU), vacuum distillation unit (VDU) and other units.

BENEFITS

The Reconfiguration plan projected a 100 MBD increase in refinery capacity. Using Aspen HYSYS helped:

- Evaluate refinery reconfigurations
- De-bottleneck existing CDU/VDU processes for new conditions
- Develop conceptual design for new reactor processes
- Achieve overall heat and material, sulfur, hydrogen and utilities balances



Saudi Aramco is the state-owned oil company of the Kingdom of Saudi Arabia, founded in 1933. The company focuses on hydrocarbons exploration, production, refining, distribution, shipping and marketing crude oil to customers worldwide. Saudi Aramco has a refining capacity of 5.4 million barrels per day from their operations around the globe.

Upgrading Bottom of the Barrel Products to Improve Margins

One of the customer's semi-conversion refineries was producing excessive fuel oil, limiting the facility's margin to a level lower than comparably sized refineries. Saudi Aramco decided to revamp the refinery to upgrade the bottom of the barrel products to create more value and improve the refinery's profit margins.

Revamping the Refinery

Out of the many alternatives available for upgrading heavy oil to high value products, Saudi Aramco chose residue hydrocracker technology, which also aligned with the company's objective to increase diesel production. The refinery unit already had enough hydrogen production to meet the requirements of the new hydrocracker.

The refinery was also considering changing the crude oil it was processing.

The refinery revamp plan included the following changes to the plant:

- Adding a new residue hydrocracker and a new VGO (vacuum gas oil) hydrocracker
- Adding two distillation columns: An atmospheric distillation column and a new vacuum distillation column to distill the LVGO (light vacuum gas oil) and HVGO (heavy vacuum gas oil). The existing distillation column of the visbreaker unit, which was expected to become redundant after the revamp, could be remodeled into the atmospheric distillation column.
- Modifying the existing CDU and VDU in light of the new crude oil.

As the next step in the project, Saudi Aramco engineers conducted a feasibility study of the proposed revamp work. They used Aspen HYSYS Petroleum Refining to debottleneck and develop design modifications for the existing CDU and VDU to accommodate the new crude oil.

They also simulated the operation of the new residue hydrocracker unit by developing a plant digital twin of the reactor using the hydrocracker model (kinetic reactor model) available in Aspen HYSYS Petroleum Refining, using data from the licensor. The Aspen HYSYS hydrocracker model includes component definitions as well as reaction pathways for the vacuum residue range.

Engineers used Aspen HYSYS to develop equipment sizing for the new units such as the vacuum residue hydrocracker and its associated downstream separator vessels.

Due to the tight project timeline, rather than using the rigorous refinery-wide model capabilities in Aspen HYSYS, Saudi Aramco leveraged a refinery-wide model they had already developed in Aspen PIMS™ to study the new refinery reconfiguration's operational feasibility. The team also used the Aspen PIMS model to optimize gasoline blending.

In addition, engineers generated the LP base and shift vector data to create the new reactor sub-model within the refinery-wide model by using the kinetic reactor model in Aspen HYSYS.

Although CAPEX estimates can be derived from HYSYS models, in this case the team used licensor data to make that estimate. Based on the information generated in the feasibility study, the customer conducted a net present value (NPV) analysis to study the financial viability of the project.

Increasing Capacity and Profit

The new reconfiguration plan projects a 100 MBD increase in the refinery's processing capacity, a substantial reduction in fuel oil production together with a significant boost in diesel production capacity.

- Aspen PIMS and Aspen HYSYS were used in tandem for the overall feasibility analysis of the refinery reconfiguration plan.
- Aspen HYSYS helped the team to debottleneck and suggest modifications for critical existing units such as the CDU and the VDU to perform in new operating conditions.
- Aspen HYSYS Petroleum Refining enabled development of a rigorous model of the new reactor unit, which generated data required for the respective reactor sub model in Aspen PIMS.
- Rigorous simulation of the different process units using Aspen HYSYS helped compute heat and material balance, sulfur balance and hydrogen balance.

aspentech | Technology That Loves Complexity

About Aspen Technology

Aspen Technology (AspenTech) is a leading software supplier for optimizing asset performance. Our products thrive in complex, industrial environments where it is critical to optimize the asset design, operation and maintenance lifecycle. AspenTech uniquely combines decades of process modeling expertise with machine learning. Our purpose-built software platform automates knowledge work and builds sustainable competitive advantage by delivering high returns over the entire asset lifecycle. As a result, companies in capital-intensive industries can maximize uptime and push the limits of performance, running their assets faster, safer, longer and greener.

Visit www.AspenTech.com to find out more.