



Indian Refinery Reduces Energy Consumption Using Real-Time Digital Twin

BPCL cut energy
consumption
100MT*/day
saving over
\$1M USD/year

*MT= Metric Tons

Project's initial
investment
**Paid back in
<6 months**

CHALLENGE

BPCL Mumbai Refinery had set a goal to reduce its overall energy consumption by 37% by 2030. To help meet this aggressive energy reduction goal, BPCL wanted to reduce steam consumption in a major steam-consuming process unit.

SOLUTION

BPCL deployed an Aspen HYSYS®-based online digital twin of the amine regeneration unit (ARU) supporting the Aspen DMC3™-based (APC) system.

VALUE CREATED

- Reduced steam usage by 100MT/day, a cost savings of over \$1M USD/year
- Project was paid back in less than six months
- Provided a completely automated process for optimizing operation
- Ensured steady operation of the process unit and eliminated fluctuation for downstream units

Overview

The Bharat Petroleum Mumbai Refinery (BPCL - MR) is one of the most versatile refineries in India and excels in all aspects like quality, technology, energy, human relations, safety, environmental friendliness and operating cost. BPCL contributes to over 15% of overall refining capacity in India with the Mumbai Refinery having a capacity of 12 MMTPA. The Mumbai Refinery had undergone several changes in configurations and is continually modernizing. It processes over 94 types of crude oil with an API range from 37 to 39.8, has a Lubes refinery, Hydrocracker and 2 FCC Units, and is the lowest SOx-emitting refinery in India.





Challenge: Reduce Steam and Overall Energy Consumption

BPCL Mumbai Refinery had set a challenge to reduce its overall energy consumption by 37% by the year 2030. One of the main energy savings opportunities identified was to optimize steam consumption because significant energy was required for steam production. The Amine Regeneration Unit (ARU) in the refinery was a major consumer of steam. This unit uses steam to remove sulfur contained in the amines that come out of the amine treating units. The refinery typically consumed about 0.12 MT of steam per MT of amines. The steam requirement varied with different crude oil feedstocks and sulfur content. When processing high sulfur crude, the steam consumption increased and for low sulfur crude the steam consumption decreased. The challenge for the refinery was to continually optimize its steam consumption in the face of large variations in the sulfur content in its feedstock.

Digital Twin and APC Play Critical Role in ARU Steam Reduction

The refinery addressed the steam usage challenge by deploying an Aspen HYSYS-based real-time digital twin of the ARU supporting the Aspen DMC3 advanced process control (APC) system deployed on the three ARUs in the refinery. The digital twin, along with APC, reduced steam consumption by successfully maintaining the lean amine loading rate near the maximum permissible limit, the column bottom temperature and column reflux-feed ratio near the minimum possible value, and lower column pressure.

The lean amine loading rate was a critical operational variable that needed to be monitored and controlled, as it varied with the change in the sulfur content of the crude oil processed. However, unlike other variables, the change in sulfur content could not be directly measured at the refinery site. This is where the online digital twin played a key role. The digital twin, on a real-time basis, calculated the lean amine loading rate every hour and helped update the APC inferential system, significantly improving the accuracy of the APC inferential predictions, resulting in a significant reduction of steam consumption.

Empowering Operations Personnel

The digital twin comprised of rigorous simulation of the three ARU built in Aspen HYSYS. Easy to read web-based dashboards built using aspenONE Process Explorer™ enabled operations personnel, who were not very familiar with Aspen HYSYS, to easily access and act on the insights from the digital twin. The Aspen HYSYS simulation model, behind the digital twin, communicated back and forth with the Aspen InfoPlus.21® plant data

historian, using Aspen OnLine®, both for deriving operations data required to calibrate the simulation model to reflect actual plant conditions as well as writing back calculated variables into the data historian. The solution leveraged built-in features of Aspen OnLine that automated the data conditioning and cleansing of operations data from the plant data historian.

KPI Dashboards presented by the online digital twin solution

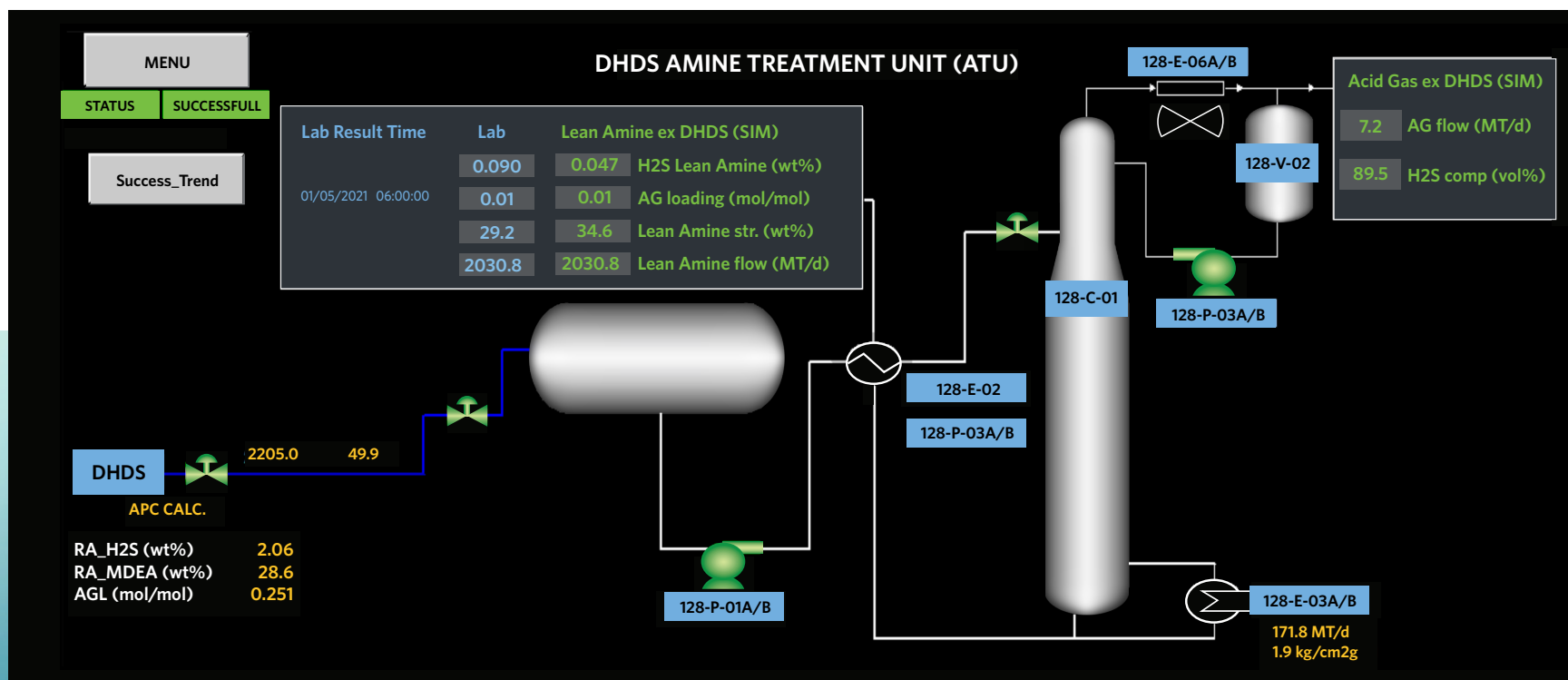


Figure 1. The AspenTech online digital twin solution for BPCL Mumbai Refinery.



Reduction in steam consumption after the implementation of the online digital twin solution with APC

Impressive Results for BPCL

The Mumbai Refinery further reduced its steam usage by decreasing the amount of amines used in the ARU and therefore the level of steam required. It achieved this by deploying Aspen DMC3 APC systems in six amine absorption units. The software automated the lean amine circulation to the absorber while maintaining the rich amine load rate near the maximum permissible limit.

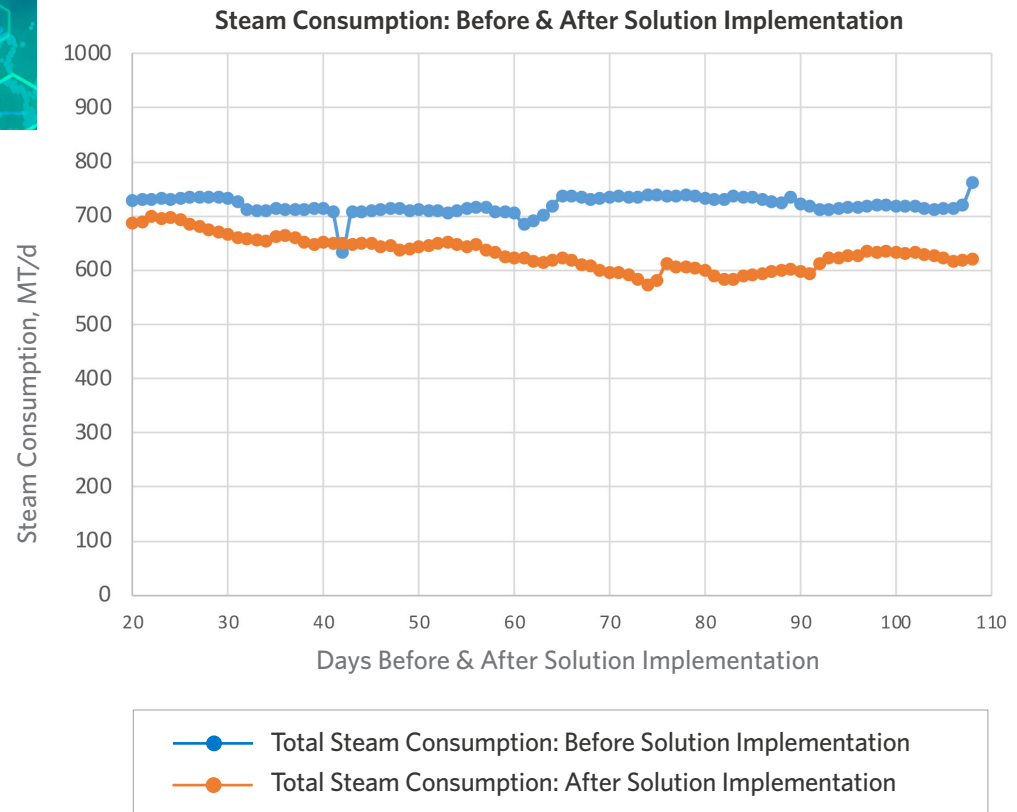


Figure 2. Steam consumption before and after the digital twin with APC implementation for BPCL.



Summary

As a result of the digital twin implementation, BPCL Mumbai Refinery reduced steam usage by 100 MT/day, a savings of over \$1M USD/year. In addition, the project's initial investment was paid back in less than six months. By automating the process, operators only had to set the minimum and maximum limits for the APC.

Most importantly, the digital twin solution enabled steady operation of the refinery's ARU, resulting in fewer fluctuations to the downstream sulfur recovery units (SRU) and tail gas treating units (TGTU). Given the success of the digital twin implementation, BPCL plans to deploy digital twins at other amine absorption units and refineries.





About Aspen Technology

Aspen Technology, Inc. (NASDAQ: AZPN) 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 capital-intensive industries can run their assets safer, greener, longer and faster to improve their operational excellence.

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