

Success Story

APC Project for 1 Million Ton (per year) Ethylene Cracking Unit

SINOPEC SABIC (TIANJIN) Petrochemical Company Limited

Location: Tianjin Binhai District, China
Order date: August 2014
Completion: February 2016
Industry: Petrochemical



Overview

SINOPEC SABIC (TianJin) Petrochemical Company Limited is a large-scale petrochemical enterprise jointly established by China Petroleum and Chemical Corporation and Saudi Basic Industrial Investment Co., Ltd., with a 50:50 share ratio. Established on October 20, 2009, the company operates an integrated refinery and petrochemical complex in Tianjin Binhai District that covers an area of 1.72 square kilometers. It was officially put into commercial operation on May 11, 2010. As of 2014, the total investment was 29.4 billion yuan and the registered capital was 9.8 billion yuan.

This complex now has 9 sets of advanced, world-class process facilities with an annual output of 1 million tons of ethylene, 650,000 tons of pyrolysis gasoline, 4 million tons of ethylene oxide, and 36 million tons of ethylene glycol. It has excellent infrastructure and auxiliary facilities, and can produce 21 types of chemicals, 5 types of functional chemicals, and 3 types of polymer products (28 models).

At the beginning of the construction of the SINOPEC SABIC complex, Yokogawa successfully installed the CENTUM CS 3000 production control system, Exaquantum plant information management system, plant asset management system (PRM), and more than 40,000 HART field devices, which have been operating smoothly.

For the advanced process control (APC) project, Yokogawa was responsible for providing consulting, design, and engineering implementation services for a 1 million ton (per year) ethylene plant, as part of which it supplied APC hardware and software as well as online analytical instruments. Commencing work on this project in August 2014, Yokogawa completed commissioning of the separation unit in June 2015, and commissioning of the cracking furnace unit in October 2015. After three months of trial operation, the calibration of the full-process APC system was completed in February 2016.

Challenges

Following the startup of the 1 million tons (per year) ethylene cracker at the SINOPEC SABIC complex,

progress was gradually made in meeting the design requirements for various process indicators. However, operator workload remained high and the automation of devices needed to be improved. The cracking furnace's oxygen content control was not a closed-loop, devices had not been optimized for the cracking furnace COT, and there was room for improvement in reducing product loss and energy consumption in the separation section. In order to improve the automation and operation of the equipment, and thereby gain comprehensive benefits from its use, SINOPEC SABIC urgently needed to implement advanced process control.

Customer's Expectations

- Stabilize cracking severity, P/E fluctuation to be controlled within +/-0.05
- Saving fuel gas in cracking furnace
- Stabilize the operation of the demethanization column, reducing the standard variance for ethylene content at the top of the tower over 40%, reducing ethylene loss over 0.02%
- Stabilize the operation of the propylene splitter, reduce the standard variance for propylene content at the bottom of the tower over 40%, and reduce the loss of propylene over 0.3%
- Reduce H₂/C₂H₂ hydrogen alkyne ratio for the C₂ hydrogenation reactor over 4%
- Stabilize the operation of the C₅ column, reduce the standard variance for the bottom temperature over 30%, and save medium pressure steam over 3%
- The standard variance for all controlled variables to be reduced by more than 30%
- APC controller usage rate is not to be less than 95%

Solutions

The APC project for the 1 million ton (per year) ethylene cracking unit included on-line analysis of cracking raw materials, real-time optimization of cracking severity, and advanced control of main production equipment, from furnace area to separation section.

Yokogawa, as the contractor for the project, provided an integrated and comprehensive solution. The solution included an on-line analysis system for cracking raw materials and calculation of cracking severity as well as advanced control related software, hardware, and engineering services. During the project, Yokogawa completed the supply, integration, and commissioning of the on-line analysis system to ensure that the measurement results of the analyzer were transmitted to SPYRO software for real-time calculation. At the same time, Yokogawa developed an SPYRO data interface and put it into use successfully. Yokogawa's APC controller provided multivariable control for 11 cracking furnaces, 4 hydrogenation reactors, and 13 distillation columns. The control level of the devices was improved and the workload of operators reduced, and the cracking depth could be optimized in real time.

The Results Achieved

After all the APC systems were put on line, the device working conditions were compared with those before APC implementation, and the following results were achieved:

- P/E standard variance control range was 0.0045.
- The yield of diene increased by 0.39%.
- Fuel gas consumption decreased by 0.87%.
- The standard variance of ethylene content at the top of the demethanizer was reduced by 60.66%, and the ethylene loss was reduced by 0.05%.
- The standard variance of propylene content at the bottom of propylene distillation column decreased by 74.18% and propylene content decreased by 0.35%.
- The H₂/C₂H₂ ratio of C₂ hydrogenation reactor was reduced by 7.42%.
- The standard deviation of bottom temperature of C₅ tower was reduced by 33.02%, and the consumption of medium pressure steam was reduced by 6.32%.
- Standard variance of all controlled variables decreased by 54.66%.
- Controller usage rate is above 95%.

Customer Satisfaction

"We are very satisfied with the reliability of Yokogawa system and products," said Li Wenzhi, a professional engineer of ethylene cracking unit of Sinopec SABIC (Tianjin) Co., Ltd. After the completion of APC project of ethylene cracking unit, the automation degree of the company's plant has been greatly improved. The operation of cracking furnace is visible, controllable, and optimized. The most valuable thing is that it realizes real-time optimal control of cracking severity, which is rare in China. At the same time, the fuel gas consumption, steam consumption, and product loss have been improved. Our plant receives economic benefits of more than 22 million yuan annually. It is expected that cooperation with Yokogawa on real time optimization projects will continue in the near future.



For more Information and Contact

[Control System](#) (EN)

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[Yokogawa Electric \(China\) Co., Ltd.](#)

Address: 3F TowerD Cartelo Crocodile Building, No.568 West Tianshan Road, Shanghai 200335, China

Phone: 021-62396262 / Fax: 021-62387866

[YOKOGAWA ELECTRIC CORPORATION](#)

World Headquarters

