Self adaptive real-time optimization of Fluid Catalytic Cracking Unit (FCCU) of refinery in Shandong Province

A 1.4 million ton/annual MIP-CGP FCCU online optimization system at a Shandong petrochemical plant has been in operation since November 2003.

Optimization objective: Economic benefits of the unit

Optimize variables:

- Temperature of the first reactor
- Second reactor catalyst storage capacity
- Pre lift dry gas flow rate
- Feed residuum ratio
- Feed temperature
- Termination agent flow rate
- Recycling oil ratio
- New catalyst addition flow rate

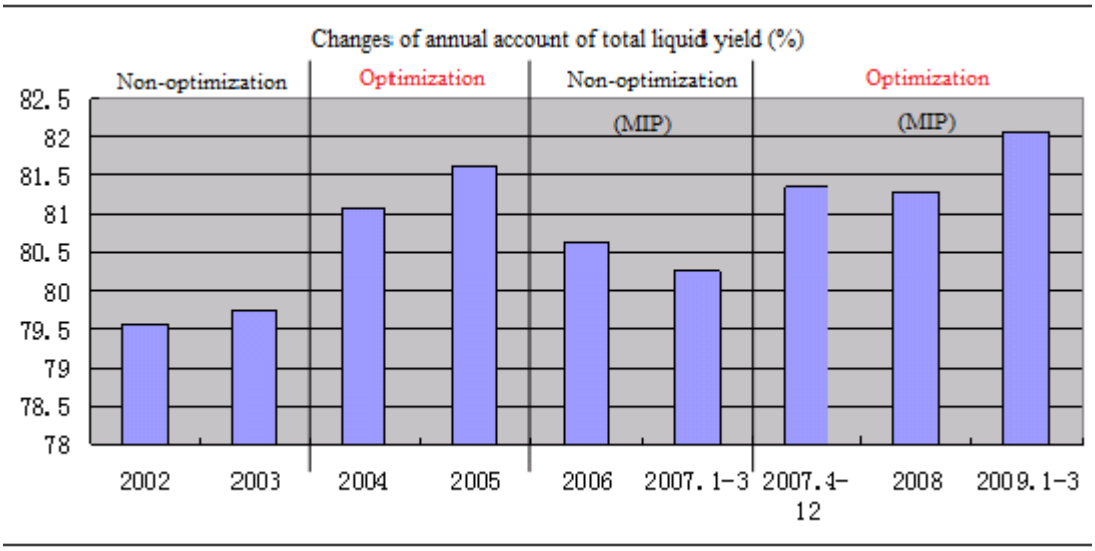
Automatically find the best match for these variables by adjusting them online

High value-added products: Total liquid yield%=LPG%+Gasoline%+Diesel%

Product statistical data for 4 months before and after optimization:

	Before optimization	After optimization	Increment of optimization
Dry gas yield (%)	4.55	4.23	-0.32
LPG yield (%)	22.07	22.43	0.36
Gasoline yield (%)	25.55	36.32	0.77
Diesel yield (%)	22.52	22.41	-0.11
Slurry yield (%)	6.79	6.02	-0.77
Total liquid yield (%)	80.14	81.16	1.02

Annual statistics results:



Note: This unit was renovated in 2006, increasing its annual processing capacity from 1 million tons to 1.4 million tons/annual, and was converted to the MIP-CGP process.

The entire factory was shut down for half a year in 2009 for acid oil adaptability renovation. It began construction on November 17, 2009. Due to process changes and issues with measuring instrument sampling, the optimized system was put into operation in January 2010. The raw materials for the modified FCCU have undergone significant changes. Therefore, we have examined the adaptability of the RTO system under the new raw materials, and compare and analyze the monthly accounts before and after optimization.

Comparison table of monthly ledger before and after Optimization after acid oil adaptability transformation:

	Before optimization December 2009	After optimization January-June 2010	Increment of optimization
Dry gas yield(%)	- (meter malfunction)	2.97	-
LPG yield (%)	21.45	19.55	-1.9
Gasoline yield (%)	37.79	38.16	0.43
Diesel yield (%)	27.21	30.88	3.67
Slurry yield (%)	4.93	3.08	-1.85
Total liquid yield (%)	86.45	88.73	1.29

Long term optimization effect, according to over 7 years of ledger statistics:

- 39 months before optimization (3 years and 3 months): total liquid yield 80.0%
- Real time optimization for 48 months (4 years): total liquid yield 81.37%

Total liquid yield increases 1.37% after optimization.

Over the past four years of optimization, it has produced more than 50000 tons of liquid hydrocarbons, gasoline, and diesel.