LY Series Pyrolysis Gasoline Hydrogenation Catalysts

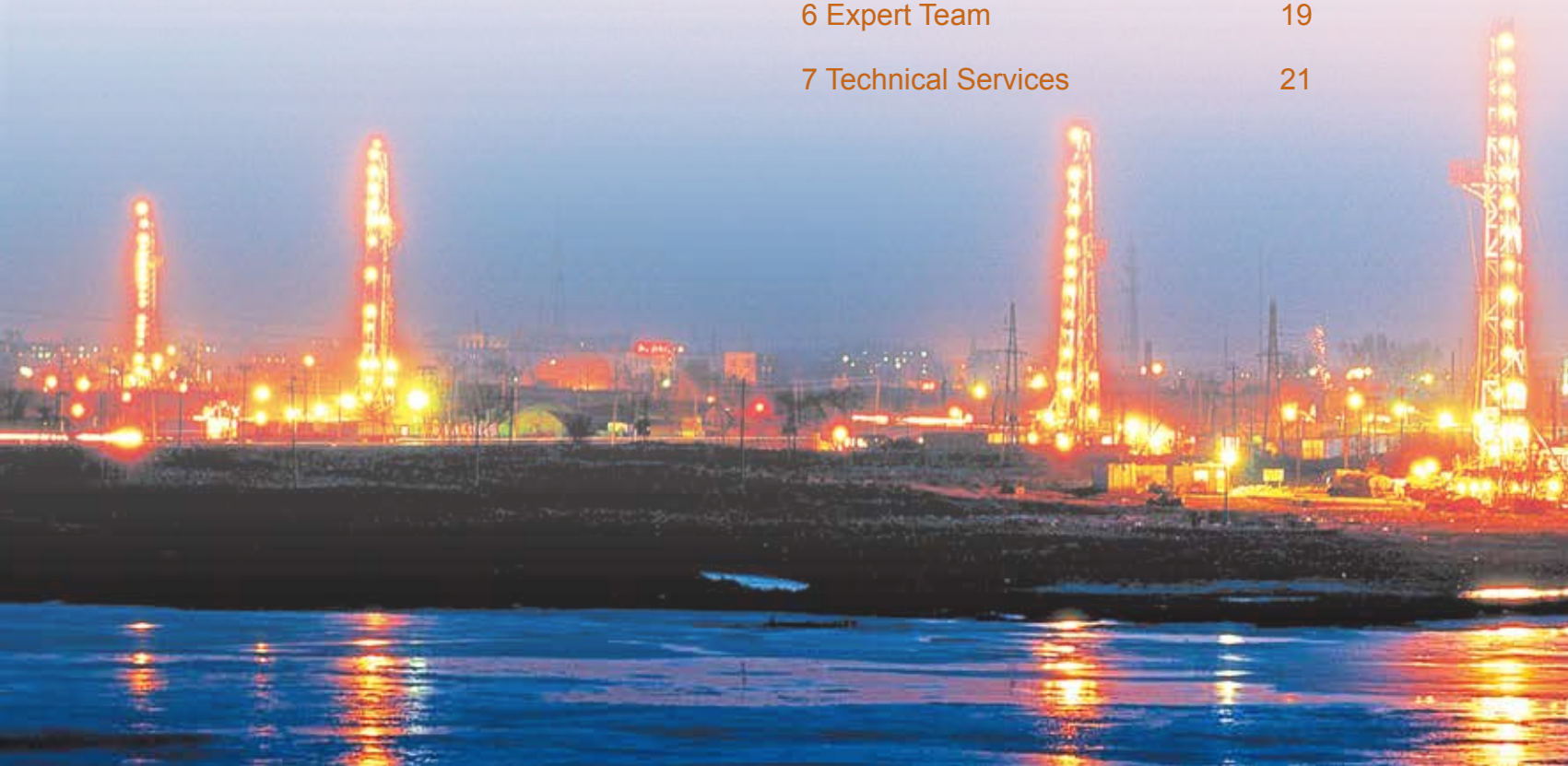
Science & Technology Management Department, CNPC

2015

CHINA NATIONAL PETROLEUM CORPORATION

Walk with the Industry and Promote the Development of Pyrolysis Gasoline Hydrogenation Catalysts!

Contents



China National Petroleum Corporation (CNPC) is a state-authorized investment agency and a state holding company. On July 1998, with the implementation of the Institutional reform of the State Council, CNPC was reorgnized to become an integrated oil company of cross-regions, cross-industries and cross-countries, it adopts modern enterprise system to realize the integrations of upstream and downstream operations, internal and external trade, production and marketing. CNPC's business covers six main sectors: oil and gas operations, petroleum engineering service, petroleum engineering construction, petroleum equipment manufacturing, financial services and new energy development. In 2014 CNPC produced 113.67 million tons of crude oil and 95.46 billion cubic meters of natural gas, while crude processing volume reached 150.2 million tons. The total revenue of RMB 2,730 billion with a profit of RMB173.4 billion had been achieved the same year.

CNPC was ranked 3th among the world's largest 50 oil companies and 4th in Fortune Global 500 in 2014.

CNPC strictly follows by the combined strategies of increasing resource capacity, expanding market shares and consolidating the international role, and persists in regarding technical innovation as a key framework to advance technological progress. To develop its core businesses, focuses will be placed on the solutions of key bottleneck technologies and key proprietary technologies. Thanks to continuously improving of the technical innovation system, optimizing the configuration of technological resources and strengthening the construction of strong talent teams, CNPC’s technological creativity has been considerably upgraded. Consequently, a large number of technologies have been developed independently, with its own intellectual property.

The LY series pyrolysis gasoline hydrogenation catalysts is one of representatives for major innovations of CNPC.

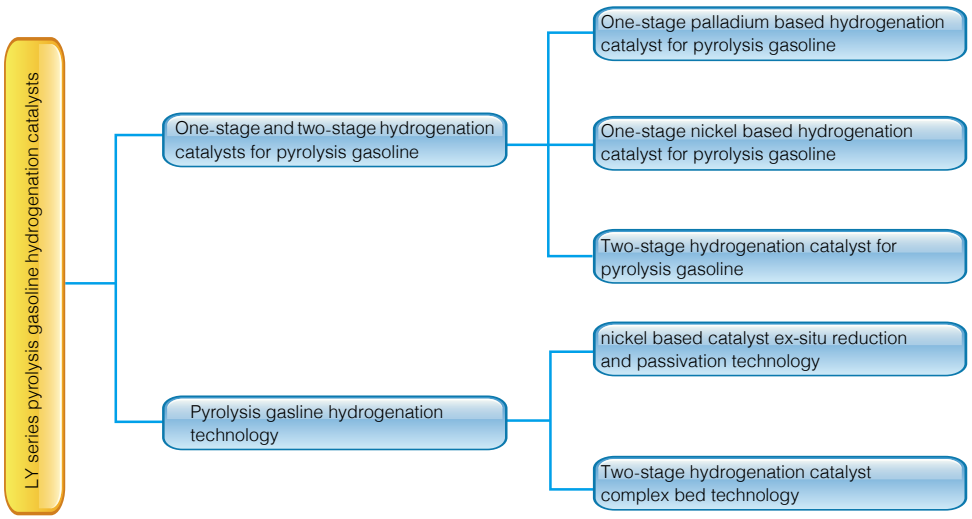
OFFERING ENERGY SOURCES, CREATING HARMONY

1 INTRODUCTION

Pyrolysis gasoline is the important byproduct of ethylene production by steam cracking, and the production capacity of pyrolysis gasoline accounts for about 50wt%~80wt% that of ethylene. After two-stage hydrogenation, pyrolysis gasoline can act as aromatics extraction feedstock. Pyrolysis gasoline hydrogenation: under the action of catalyst, carry out selective one-stage hydrogenation of dialkene with alkenyl aromatics to generate monoolefin and alkyl aromatics; then carry out two-stage hydrogenation to achieve hydrogenation saturation of monoolefin and remove sulfur impurities, thus producing the hydrogenation gasoline suitable for aromatics extraction.

The development of LY series pyrolysis gasoline hydrogenation catalysts begun in the 1960s. CNPC is the R&D organization which was firstly engaged in this field. Catalyst localization was firstly realized in the 1970s. R&D personnel keep on exploring and innovating taking the market demand as guide, and 3 types and 7 trademarks of catalysts with unique advantages in selectivity, resistance to impurity poisoning and stability have been formed, mainly including LY-9801D, LY-2008 and LY-9802. They cover multiple fields such as new catalytic material synthesis, catalyst preparation process development, catalyst product technology, hydrogenation reaction technology, etc. The domestic market share of one-stage hydrogenation catalysts is over 45%; the domestic market share of two-stage hydrogenation catalysts is over 75%.

CNPC has over 100 professional talents in R&D, production and after-sales service of pyrolysis gasoline catalysts and can provide various technical supports related to pyrolysis gasoline hydrogenation. CNPC has over 30 domestic invention patents in pyrolysis gasoline hydrogenation, the integral technology reaches international advanced level, and characteristic technologies and products have been successfully used in over 40 sets of domestic units.



2 CHARACTERISTIC TECHNOLOGIES

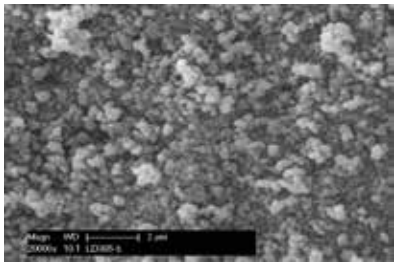
2.1 One-stage palladium based hydrogenation catalyst for pyrolysis gasoline—LY 9801D

One-stage palladium based hydrogenation catalyst for pyrolysis gasoline-LY 9801D has advantages such as high selectivity, high space velocity, high resistance to impurities, etc., and is applicable to one-stage selective hydrogenation of full distillates or intermediate distillates of pyrolysis gasoline.

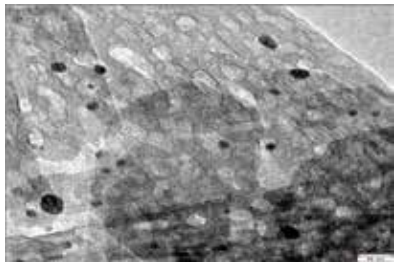
Typical physical and chemical property indexes	
Appearance	Light brown clover swath
Mass fraction of Pd (%)	0.280 ~ 0.350
OD (mm)	2.5 ~ 3.5
Bulk density (g/mL)	0.55 ~ 0.70
Radial crushing strength	⩾ 70

◆ High dispersion control technology for active component palladium

Improve the dispersivity of active component palladium on carrier surface and catalyst hydrogenation activity with the carrier morphology regulation and control technology.



Carrier SEM photo



Catalyst TEM photo

Comparison of LY-9801D catalyst with imported catalyst in 1000 hours hydrogenation performance

Item	Diolefin	Bromine number	Diolefin hydrogenation selectivity	Catalyst sulfur deposition rate	Catalyst carbon deposition rate
LY-9801D	1.90	35.17	31.31	0.07	7.4
Imported catalyst	2.02	26.00	28.20	0.10	9.5

Under the same process conditions, the diolefin hydrogenation selectivity of LY-9801D catalyst is 11% higher than that of the imported catalyst, and both the sulfur deposition rate and carbon deposition rate are reduced greatly.

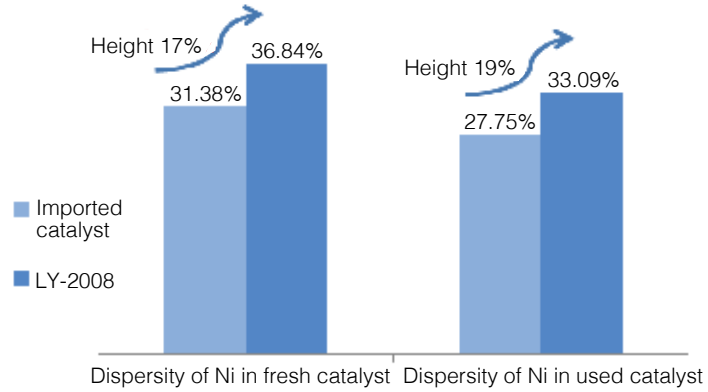
2.2 One-stage nickel based hydrogenation catalyst for pyrolysis gasoline—LY-2008

One-stage nickel based hydrogenation catalyst for pyrolysis gasoline—LY-2008 has excellent low temperature hydrogenation activity and good stability and is applicable to one-stage selective hydrogenation of full distillates or intermediate distillates of pyrolysis gasoline.

Typical physical and chemical property indexes	
Appearance	Black clover swath
Mass fraction of Ni (%)	12.5 ~ 14.5
OD (mm)	1.8 ~ 2.2
Bulk density (g/mL)	0.65 ~ 0.85
Radial crushing strength	⩾ 70

◆ High dispersion control technology for active component nickel

The dispersity of the active component Ni in LY-2008 catalyst before and after use is better than that in the imported catalyst, thus solving the technical problem on low utilization ratio of active component.



Comparison of LY-2008 catalyst with imported catalyst in 1000 hours hydrogenation performance

Item	Diolefin	Bromine number	As adhesion amount	Benzene loss rate	Diolefin hydrogenation selectivity	Inlet temperature	
						Initial period	Late period
LY-2008	1.49	42.76	31	0.9	46.56	35	85
Imported catalyst	1.72	36.50	49	1.1	36.77	45	95

Under the same process conditions, the inlet temperature of LY-2008 catalyst is 10℃ lower than that of the imported catalyst, and the benzene hydrogenation loss rate of LY-2008 catalyst is 0.2% lower than that of the imported catalyst.

2.3 Two-stage hydrogenation catalyst for pyrolysis gasoline—LY-9802

Two-stage hydrogenation catalyst for pyrolysis gasoline—LY-9802 has advantages such as good hydrogenation selectivity, low benzene hydrogenation loss rate, good resistance to coking, etc. The catalyst is applicable to two-stage hydrogenation of full distillates or intermediate distillates of pyrolysis gasoline. The lowest sulfur content of the product can be reduced to <0.2μg/g, and the aromatics hydrogenation rate is <0.5%(m/m).

Typical physical and chemical property indexes	
Appearance	Blue clover swath
Mass fraction of MoO_3 (%)	14.0 ~ 18.0
OD (mm)	1.0 ~ 2.0
Bulk density (g/mL)	0.65 ~ 0.75
Radial crushing strength	⩾ 70

◆ Catalyst surface acidity control technology

Regulate and control catalyst surface acidity, prohibit the forming of strong acid center and eliminate protonic acid. The technical problem on easy coking of catalyst has been solved.

Item	Weak acid quantity/μ mol.g^{-1}		Strong acid quantity/μ mol.g^{-1}	
	L acid	B acid	L acid	B acid
Imported catalyst	248.12	6.22	122.54	2.61
LY-9802	230.29	6.22	62.55	Not detected out

Long-period stability test of LY-9802 catalyst and imported catalyst

Item	Sulfur content of product/μg.g^{-1}	Bromine number of product/gBr.100g^{-1}	Benzene hydrogenation loss rate/%	Differential pressure after 500h/MPa	Differential pressure after 600h/MPa
LY-9802	<0.2	<0.5	0.5	Not Obvious	0.20
Imported catalyst	<0.2	<0.5	1.0	0.23	Shutdown due to over large differential pressure

Under the same process conditions, the anti-coking performance of LY-9802 catalyst is improved by 20%, the benzene hydrogenation loss rate is reduced by 50%, and the running period is prolonged.

2.4 Nickel based catalyst ex-situ pretreatment technology

Carry out reduction and passivation of the catalyst with the ex-situ pretreatment technology. After pretreatment, the catalyst has good activity and can guarantee appropriate selectivity.

Reduce treatment condition limitation by reaction unit;

The commencement time is shortened by 50%. During commencement control, the bed temperature rise doesn't exceed 50, thus improving the safety and operability of unit commencement;

The catalyst selectivity is improved by 3%~6%.

Commencement process flow	Reduction		Passivation		Commissioning
	Temperature/°C	Time/h	Material	Time/h	Bed temperature rise/°C
Ex-situ treatment	150~200	20~30	Naphtha	4~6	<50
In-situ treatment	400~450	85~100	Naphtha + sulfide	10~14	>100

2.5 Two-stage pyrolysis gasoline hydrogenation catalyst complex bed technology

The combined catalyst of LY-9802 with LY-9702 is used to realize the complex bed technology in a reactor. This can effectively improve the hydrogenation desulphurization performance of catalyst at low temperature, ensure catalyst service life and increase triphen yield; especially for the hydrogenation feedstock with low sulfur content and high alkene content, the catalyst still has very good hydrogenation performance.

LY-9702 catalyst involves mainly hydrogenation and secondarily desulphurization; LY-9802 catalyst involves mainly desulphurization and secondarily hydrogenation. By combining the hydrogenation advantage of LY-9702 with the desulphurization advantage of LY-9802 perfectly, low sulfur content feedstock can be effectively processed, thus solving the problem on easy deactivation during application of hydrofining catalyst in low sulfur feedstock and prolong the regeneration cycle of catalyst.

With the technology, Guangzhou Petrochemical first regeneration cycle is 39 months. The sulfur content of Dushanzi Petrochemical feedstock is <40μg/g, and the catalyst can still run stably continuously.

3 TYPICAL CASES

Application of LY-9801D catalyst in Shanghai Petrochemical 700kt/a complete pyrolysis gasoline hydrogenation unit for ethylene

Shanghai Petrochemical Co. is a holding subsidiary of SINOPEC. Located in Jinshan District, Shanghai City, Shanghai Petrochemical Co. is one of the largest integrated refining and chemical comprehensive petrochemical enterprises in China and has the ethylene production capacity of 700kt/a.

The previous ethylene production capacity of Shanghai Petrochemical Co. was 300kt/a. After unit modification in 2001, it reached 700kt/a. To save cost, the hydrogenation reactor was not adjusted, the catalyst load was increased, the reaction space speed was up to 3.5h^{-1}, and the catalyst used the LY series catalyst of CNPC all the time.

LY-9801D catalyst running data of Shanghai Petrochemical Co. in 2007—2010

Running state	Date	Time/ month	Inlet temperature/℃	Outlet temperature/℃	Diolefin avg. of feedstock (gL/100g)	Diolefin avg. of production (gL/100g)	Regeneration reason
Running period Ⅰ	2007.8 ~ 2008.11	14.5	43 ~ 47	66 ~ 80	18.64	0.93	In cooperation with compressor dry gas sealing system replacement
Running period Ⅱ	2008.11 ~ 2009.5	6	44 ~ 57	64 ~ 82	18.23	1.1	In cooperation with two-stage catalyst skimming
Running period Ⅲ	2009.5 ~ 2009.12	6.5	41 ~ 51	61 ~ 75	15.55	0.74	In cooperation with two-stage catalyst replacement
Running period Ⅳ	2009.12 ~ 2010.8	7.5	40 ~ 52	58 ~ 76	16.08	1.0	In cooperation with two-stage catalyst replacement

The running life was three years and the inlet temperature was stable. The temperature increase rate was slow and the highest temperature was increased to 57℃ , which is far too lower than the highest temperature 90℃ as permitted by the reactor. The bed temperature rise was stable, and the product diolefin yield was at a low level all the time, indicating that LY-9801D catalyst has good reaction effect and excellent hydrogenation performance.

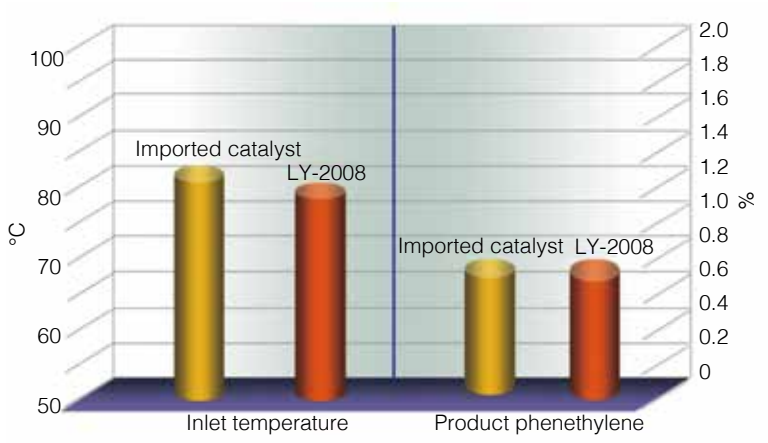
Application of LY-2008 catalyst in Dushanzi Petrochemical 220kt/a complete pyrolysis gasoline hydrogenation unit for ethylene

Dushanzi Petrochemical Co. is a holding subsidiary of CNPC. Located in Dushanzi District, Karamay City, Dushanzi Petrochemical Co., is one of birthplaces of China's petroleum industry and the first batch of "national environment-friendly enterprise". The total ethylene production capacity is 1220kt/a.

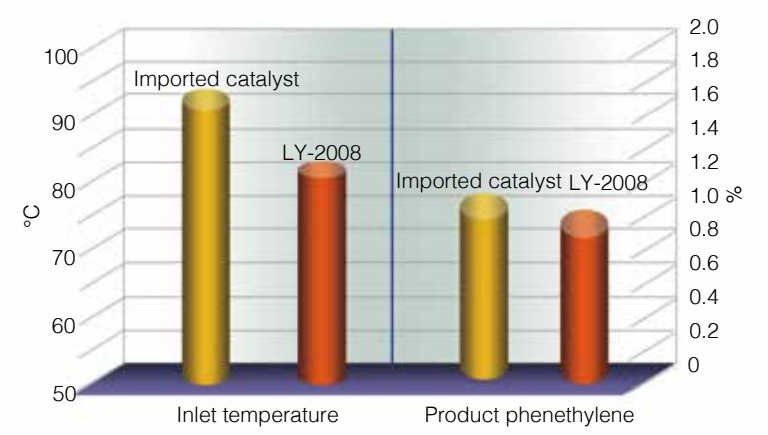
Since 2008, Dushanzi Petrochemical 220kt/a complete one-stage pyrolysis gasoline hydrogenation unit for ethylene has used LY-2008 catalyst of CNPC all the time. The hydrogenation effect of the catalyst is good, and the comprehensive performance of the catalyst is better than that of imported catalyst.

Feedstock oil properties (C5~C9)

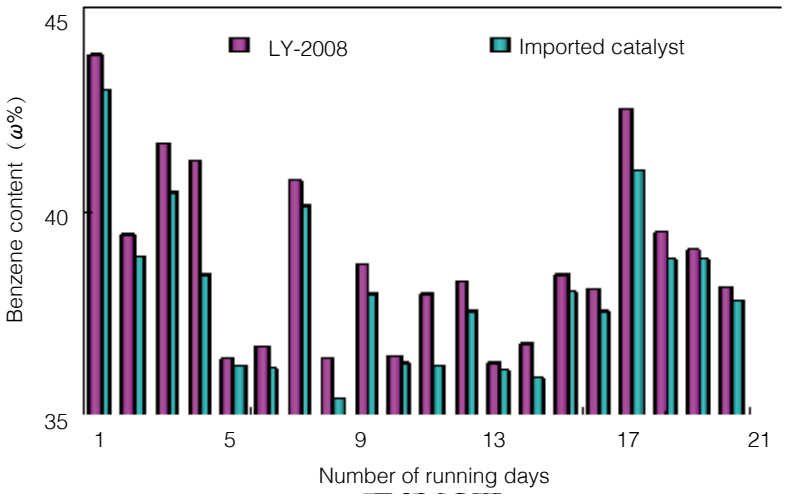
Item	Density (g/mL)	Distillation range (℃)	Bromine number (gBr/100g)	Diolefin (gL/100g)	Phenethylene (m%)	Collid (mg/100mL)	Sulfur (ug/g)	As (ng/g)
Value	0.82~0.84	41~177	72.8~91.2	30.5~34.1	4.06~5.97	7~14	30~40	71~130



Operation comparison in case of 100% feed load



Operation comparison in case of 130% feed load



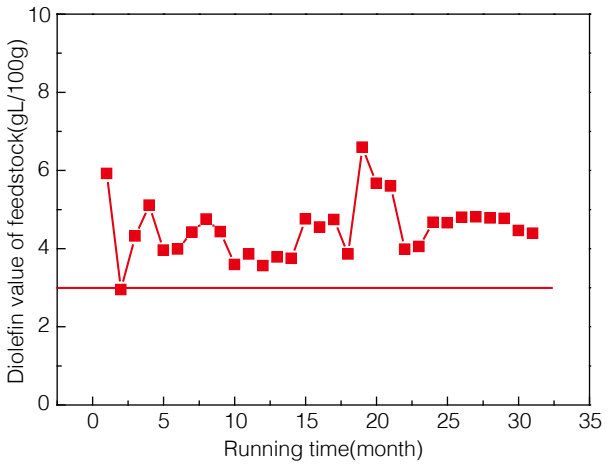
Comparison of product benzene content in the calibration period

The hydrogenation activity of LY-2008 catalyst is equivalent to that of imported catalyst, and the benzene hydrogenation loss rate of LY-2008 catalyst is about 20% lower than that of imported catalyst. Under the condition of bad hydrogenation feedstock, LY-2008 catalyst shows good resistance to coking and impurities and good hydrogenation stability, and running period I of LY-2008 catalyst is 4 months longer than that of imported catalyst.

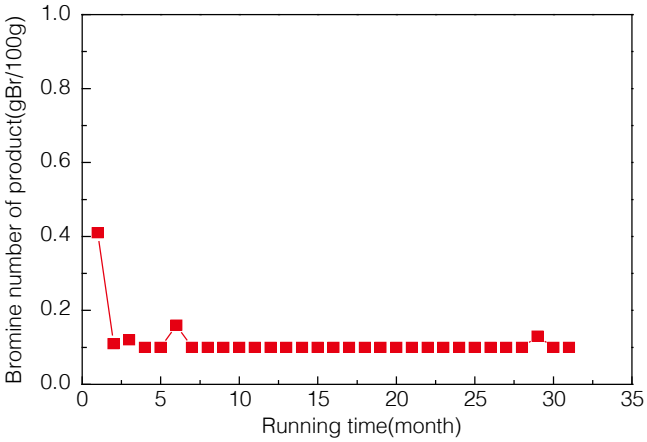
Application of LY-9802 catalyst in Fujian Refining & Petrochemical 800kt/a complete pyrolysis gasoline hydrogenation unit for ethylene

Fujian Refining & Petrochemical Co. is a large Sino-foreign joint venture petrochemical enterprise by FPCL, ExxonMobil and Saudi Aramco with their equity ratio being 50%:25%:25% and has 800kt/a ethylene production capacity. LY-9802 catalyst was used as the first loading catalyst for the new pyrolysis gasoline hydrogenation unit of the company in 2009 and was loaded and used again in 2013.

Item	Parameter
Catalyst loading amount (m^3)	31.8
Diolefin value of feedstock (gL/100g)	2.0~5.0
Running period I (month)	31
Continuous running period I (month)	50
Reactor inlet temperature (°C)	225~240
Feed rate (t/h)	33~48
Bromine number of hydrogenation product (gBr/100g)	<0.2
Sulfur content of hydrogenation product (μg/g)	<0.2



Diolefin value of two-stage feedstock for pyrolysis gasoline



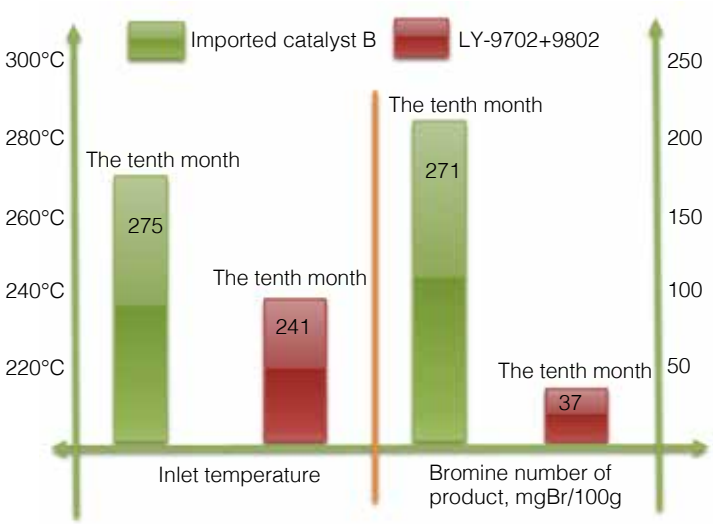
Bromine number of two-stage pyrolysis gasoline product

Due to insufficient hydrogenation depth of one-stage catalyst, the diolefin value of the hydrogenation product is 2.0~5.0gL/100g, which is far too higher than 1.0 gL/100g (required index).

Under the condition of over-standard diolefin value of feedstock, the hydrogenation process parameters of LY-9802 catalyst are stable, the product is acceptable, and the continuously stable running period is 50 months. This shows good low temperature hydrogenation desulphurization activity and high anti-coking stability.

Application of LY-9702+LY-9802 catalyst in Guangzhou Petrochemical 220kt/a complete pyrolysis gasoline hydrogenation unit for ethylene

Guangzhou Petrochemical Co. is a holding subsidiary of SINOPEC. Located in Huangpu District, Guangzhou City, Guangzhou Petrochemical Co. is one of the largest modern petrochemical enterprises in Southern China and has 220kt/a ethylene production capacity.



Operation comparison of the catalyst with the imported catalyst in the same period when being used in the tenth period

The two-stage hydrogenation catalyst for Guangzhou Petrochemical pyrolysis gasoline unit used an imported catalyst in the early commencement stage. Soon after commissioning, the performance of the catalyst was degraded.

The production specifications couldn't reach the requirements of the design, thus affecting product quality. The catalyst was changed into LY-9702+LY-9802 complex bed catalyst of CNPC in 2005, obtaining a satisfactory effect.

The inlet temperature was only 232 ℃ in the early commencement stage of the catalyst. After 39 months of continuous use, the catalyst was not regenerated. The service life of the catalyst is 15 months longer than that of the imported catalyst, and the triphen yield of the catalyst is 0.6% higher than that of the imported catalyst.

performance schedule

No.	Application company	Application unit	Starting and ending time of application
1	FREP ★	800kt/a two-stage pyrolysis gasoline hydrogenation unit for ethylene	Up to now
2	Qilu Petrochemical	One-stage and two-stage pyrolysis gasoline hydrogenation unit for ethylene	Up to now
3	Maoming Petrochemical ★	One-stage and two-stage pyrolysis gasoline hydrogenation unit for ethylene	Up to now
	Maoming Petrochemical ▲	360kt/a one-stage and two-stage pyrolysis gasoline hydrogenation unit for ethylene	Up to now
4	Yangzi Petrochemical	450kt/a one-stage and two-stage pyrolysis gasoline hydrogenation unit for ethylene	Up to now
	Yangzi Petrochemical	450kt/a one-stage and two-stage pyrolysis gasoline hydrogenation unit for ethylene	
5	Shanghai Petrochemical	700kt/a one-stage and two-stage 2# pyrolysis gasoline hydrogenation unit for ethylene	Up to now
	Shanghai Petrochemical	700kt/a one-stage and two-stage 4# pyrolysis gasoline hydrogenation unit for ethylene	
6	Guangzhou Petrochemical ▲	220kt/a two-stage pyrolysis gasoline hydrogenation unit for ethylene	Up to now
7	Yanshan Petrochemical	710kt/a one-stage pyrolysis gasoline hydrogenation unit for ethylene	
8	Zhongyuan Petrochemical ▲	180kt/a one-stage pyrolysis gasoline hydrogenation unit for ethylene	
	Zhongyuan Petrochemical ▲	180kt/a two-stage pyrolysis gasoline hydrogenation unit for ethylene	
9	Jilin Petrochemical ▲	700kt/a two-stage pyrolysis gasoline hydrogenation unit for ethylene	Up to now
	Jilin Petrochemical	150kt/a one-stage and two-stage pyrolysis gasoline hydrogenation unit for ethylene	Up to now
10	Daqing Petrochemical ▲	600kt/a one-stage BG1 pyrolysis gasoline hydrogenation unit for ethylene	Up to now
	Daqing Petrochemical	270kt/a one-stage and two-stage pyrolysis gasoline hydrogenation unit for ethylene	
11	Shenyang Paraffin Wax Chemical Co. ★	120kt/a one-stage and two-stage catalytic pyrolysis gasoline hydrogenation unit	Up to now
12	Lanzhou Petrochemical Company ★	460kt/a one-stage and two-stage pyrolysis gasoline hydrogenation unit for ethylene	Up to now
	Lanzhou Petrochemical Company ★	240kt/a one-stage pyrolysis gasoline hydrogenation unit for ethylene	
	Lanzhou Petrochemical Company ★	240kt/a two-stage pyrolysis gasoline hydrogenation unit for ethylene	Up to now
13	Liaoning Huajin Tongda Chemicals Co., Ltd. ★	450kt/a two-stage pyrolysis gasoline hydrogenation unit for ethylene	Up to now
	Liaoning Huajin Tongda Chemicals Co., Ltd. ▲	110kt/a two-stage pyrolysis gasoline hydrogenation unit for ethylene	Up to now
14	Dushanzi Petrochemical ▲	220kt/a one-stage and two-stage pyrolysis gasoline hydrogenation unit for ethylene	Up to now
15	Liaoyang Petrochemical	200kt/a one-stage and two-stage pyrolysis gasoline hydrogenation unit for ethylene	Up to now
16	Fushun Ethylene ★	800kt/a one-stage and two-stage pyrolysis gasoline hydrogenation unit for ethylene	Up to now
	Fushun Ethylene ▲	140kt/a one-stage and two-stage pyrolysis gasoline hydrogenation unit for ethylene	Up to now
17	Sichuan Petrochemical ★	800kt/a one-stage and two-stage pyrolysis gasoline hydrogenation unit for ethylene	Up to now

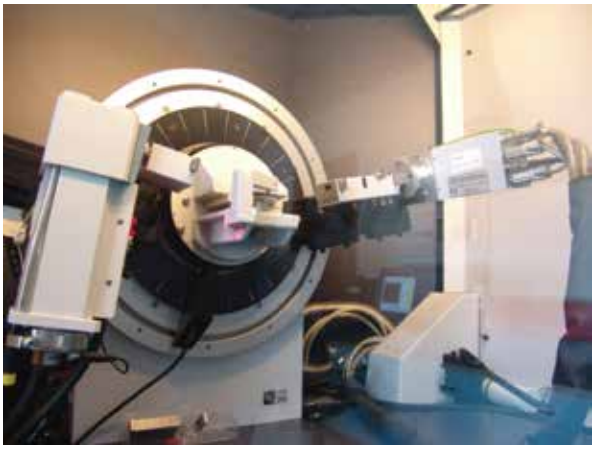
(Note: ★ means the first loading of catalyst for new units; ▲ means a substitute for imported catalyst.)

4 ANCILLARY EQUIPMENT

CNPC has set up laboratories involving pyrolysis gasoline hydrogenation catalyst characterization, oil product analysis and catalyst evaluation, totaling over 100 pieces (sets) of equipment.

4.1 Catalyst characterization

The main scientific research equipment includes: mercury injection apparatus manufactured by Thermo, full automatic chemical adsorption instrument and physical adsorption instrument manufactured by American Mike Co., X-ray diffractometer manufactured by American Bruker Co., atomic absorption spectrophotometer manufactured by Varian, etc. They are used to characterize catalyst property comprehensively.



4.2 Oil product analysis

The main scientific research equipment includes: gas chromatograph-mass spectrometer, gas chromatograph and sulfur form tester manufactured by Agilent, gas chromatograph and chemoluminescence sulfur and nitrogen analyzer manufactured by American Bruker Co., etc. They are used to analyze oil product property comprehensively.

Gas chromatograph

4.3 Catalyst evaluation

The main scientific research equipment includes: multi-channel catalyst evaluation unit, small scale evaluation unit and pilot evaluation unit manufactured by American HTE Co., etc. They are used to evaluate catalyst property.

Gas chromatograph-mass spectrometer

Catalyst pilot evaluation unit

Multi-channel catalyst evaluation unit

4.4 Chemical catalyst and new material evaluation and test base

CNPC has its own chemical catalyst evaluation and test base with complete facilities. The base is mainly used in synthesis of various new catalytic materials and preparation, production and scale-up study of modified catalysts and hydrogenation catalysts and has 500t annual comprehensive production capacity.

Ensure production depending upon scientific research, promote scientific research depending upon production, and form a virtuous cycle integrating production and research. Fully utilize the advantage of R&D and realize series production “acting according to actual circumstances, customizing” according to different requirements of users.

5 QUALIFICATION STANDARDS

Product standard of CNPC: Q/SY 142—2009 One-stage hydrogenation catalyst for pyrolysis gasoline(LY-9801D)

Product standard of RIPP: Q/SY SHY 0003—2012 One-stage selective nickel based hydrogenation catalyst for pyrolysis gasoline (LY-2008)

Product standard of RIPP: Q/SY SHY 0025—2013 Two-stage hydrogenation catalyst for pyrolysis gasoline (LY-9702)

Product standard of CNPC: Q/SY 143—2009 Two-stage hydrogenation catalyst for pyrolysis gasoline(LY-9802)

Typical patents

Patent name	Patent No.
1. Selective hydrogenation catalyst for pyrolysis gasoline	US6576586
2. A selective hydrogenation catalyst and the preparation thereof	US8211823B2
3. A selective hydrogenation catalyst for pyrolysis gasoline	MY-128461-A
4. A selective hydrogenation catalyst and the preparation thereof	SG161662
5. A selective nickel based hydrogenation catalyst and the preparation thereof	GB2467086
6. A selective nickel based hydrogenation catalyst and the preparation thereof	SG160867
7. A selective hydrogenation catalyst and the preparation thereof	JP 2011506068A
8. A selective nickel based hydrogenation catalyst and the preparation thereof	JP 5357170B2
9. A selective hydrogenation catalyst and the preparation thereof	MYPI 2010002160
10. Hydrofining catalyst	PCT/CN2010/000417
11. A hydrofining catalyst preparation method	PCT/CN2010/000418
12. A one-stage selective hydrogenation catalyst for pyrolysis gasoline	ZL91109503.9
13. Selective hydrogenation catalyst for pyrolysis gasoline	ZL00101797.7
14. A selective nickel based hydrogenation catalyst and its preparation method and application	ZL200610000172.4
15. A hydrofining catalyst and its preparation method and application	ZL200610064905.0
16. A selective nickel based hydrogenation catalyst and its preparation method	ZL200710176670.9
17. A selective hydrogenation catalyst and its preparation method	ZL200710179443.1
18. One-stage selective hydrogenation method for pyrolysis gasoline distillate	ZL200810102240.7
19. A selective hydrogenation method for full-distillate pyrolysis gasoline diolefin	ZL200810102242.6
20. A high dispersity nickel catalyst and its preparation method and application	ZL200910084540.1
21. A pretreatment method for nickel based hydrogenation catalyst	ZL200910079181.0
22. A pseudoboehmite containing amorphous silica-alumina and its preparation method	ZL201010106266.6
23. A hydrofining catalyst preparation method	ZL201010114295.7
24. Hydrofining catalyst	ZL201010114256.7
25. A hydrofining catalyst and its preparation method	ZL201110191280.5
26. A hydrofining catalyst and its preparation method	ZL201110191189.3
27. A selective hydrogenation catalyst and its preparation method	ZL201010106259.6
28. A reduction method for palladium based catalyst	201110133334.2
29. A hydrofining method for distillate oil	201110191247.2
30. A hydrofining method for medium-low distillate oil	201110191283.9
31. A selective diene hydrogenation catalyst and its preparation method	201110044513.9
32. A nickel based hydrogenation catalyst and its preparation method	201110267117.2
33. A nickel based hydrogenation catalyst and its preparation method, reduction method and regeneration method	201110267252.7
34. A selective hydrogenation method for gasoline	201210322247.6
35. A selective nickel based hydrogenation catalyst and its preparation method	201210322246.1
36. A pyrolysis gasoline hydrogenation catalyst and its preparation method	201310585233.8

Technology secrets

1.A forming preparation technology for specially-shaped alumina carrier
2.A catalyst preparation method for increasing the interaction between active components and additives
3.A recovery technology for noble metal palladium in spent catalyst
4.A preparation technology for high dispersity catalyst carrier with active components
5.A control technology for pseudoboehmite pore structure
6.A preparation technology for high dispersity catalyst with active components using immersion liquid
7.A preparation method for nickel based catalyst immersion liquid
8.A high-efficiency catalyst sulphurization method
9.A thermal activation treatment technology for increasing the yield of nickel based catalyst

6 EXPERT TEAM

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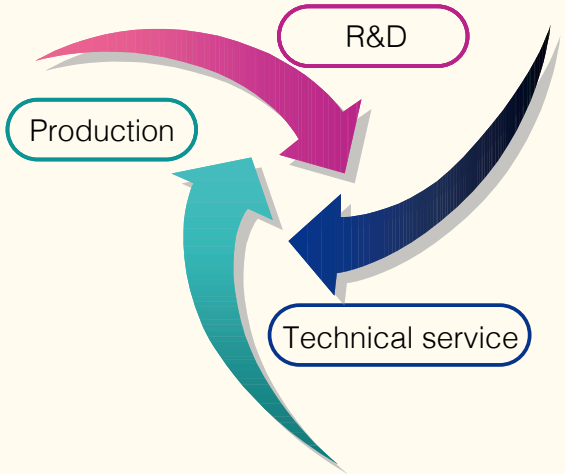
7 TECHNICAL SERVICES



The professional technical service team can provide you various pre-sales, in-sales and after-sales services and help you reach perfect combination of units, feedstocks and operating parameters with catalysts and realize maximum benefits as per the service mode “supply as needed”.

Comprehensive development of industrial production and technical services, and virtuous circulation on the basis of scientific development

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