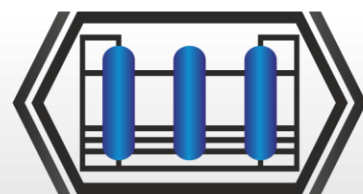


# ISOMERIZATION AND REFORMING

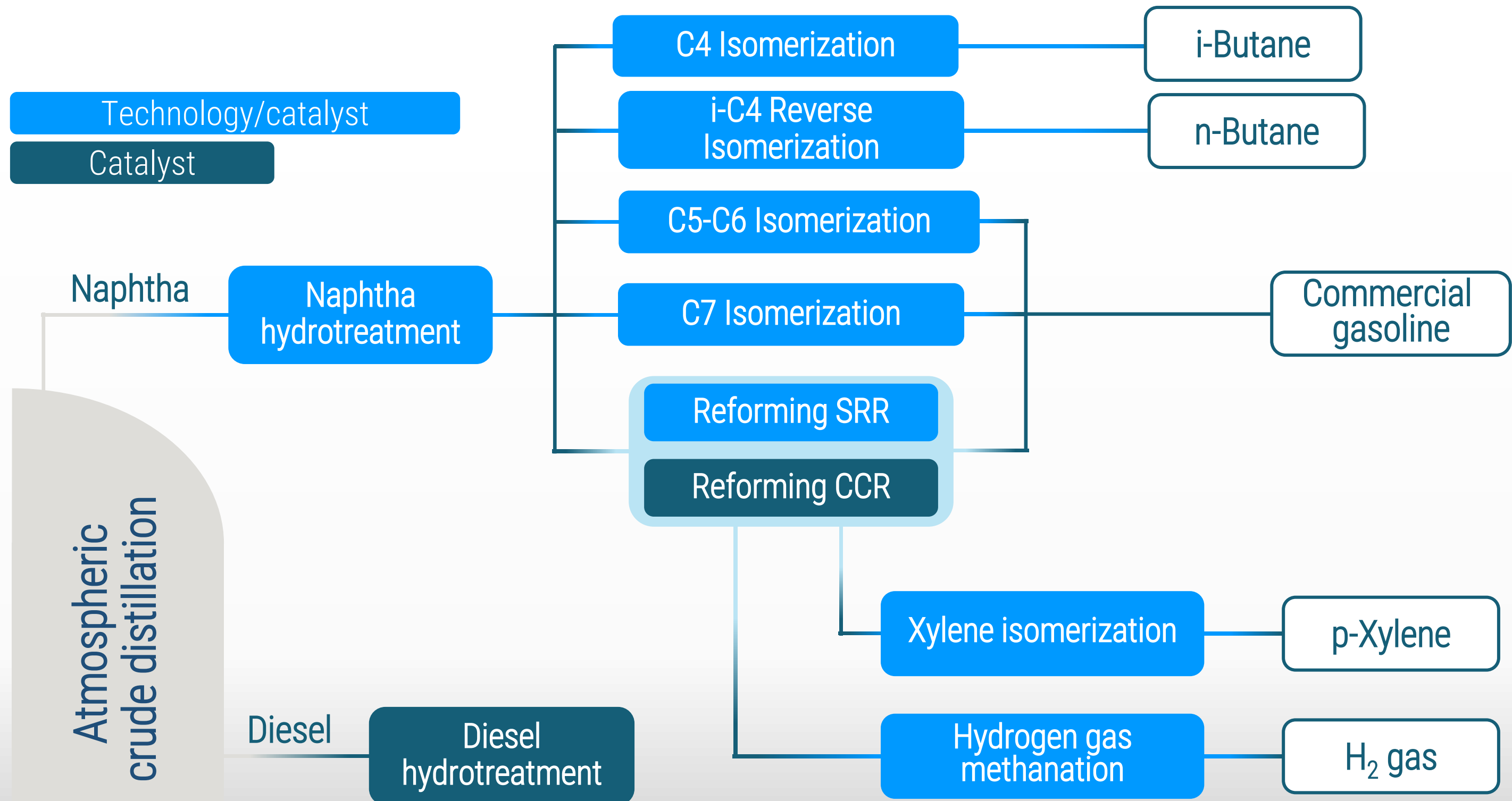
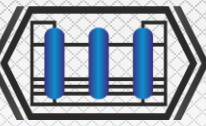
## MODERN TECHNOLOGIES



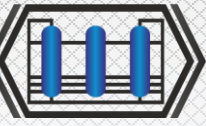
**SIE NEFTEHIM**

Timofey Karpenko  
Chief Technology Officer  
SIE Neftehim, LLC

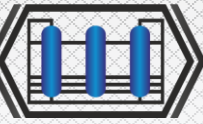
# TECHNOLOGIES AND CATALYSTS



# PROJECTS GEOGRAPHY



# REF SERIES CATALYST FOR FIXED BED REFORMERS

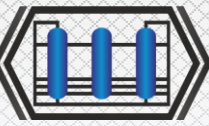


**REF-125**  
**REF-130**  
**REFUltra**

- RON increase up to 99
- Possible operation at low pressure
- Increase of cycle length up to 4 years
- High stability in severe operation

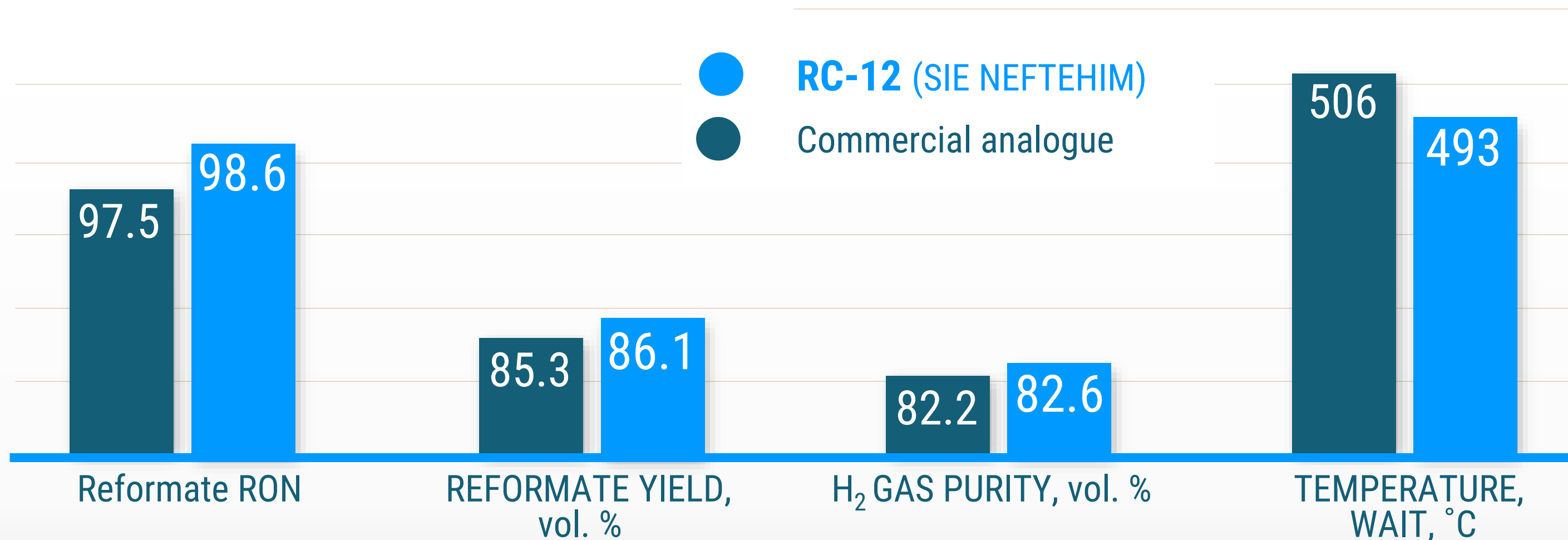
Commercial application in **17** units

# BENCHMARKING FIXED BED REFORMING CATALYSTS



	Conventional commercial catalyst	<b>REF<sup>Ultra</sup></b>	BENEFITS
RON	96-98	98-99	Ability to produce 99 RON reformat
Cycle length, years	2-3	3-4	High stability = Cycle length is 4 years
Reformat yield, wt. %	85-89	86-90	Enhanced reformat yield
Hydrogen yield, wt. %	2.3-2.6	2.3-2.7	High selectivity = Increase in H <sub>2</sub> yield

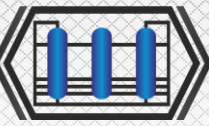
# COMMERCIAL EXPERIENCE OF CCR UNIT CONVERSION TO RC-12 CATALYST



**FULL CATALYST REPLACEMENT IN OPERATING CCR UNITS AND EXISTING CATALYST MAKE-UP**

# ISOMALK-2

## PENTANE-HEXANE CUTS ISOMERIZATION TECHNOLOGY



### OVER 15 YEARS OF COMMERCIAL EXPERIENCE

Over 30 references (Russia, USA, EU, China, India, Ukraine, Romania, Middle East countries), over 1,000,000 hours of SI-2 catalyst commercial operation in total



### MAXIMUM EFFICIENCY

Isomerate production with more than 92 RON in the operating units.  
“Once-through” isomerate production with PIN 130+



### MAXIMUM STABILITY

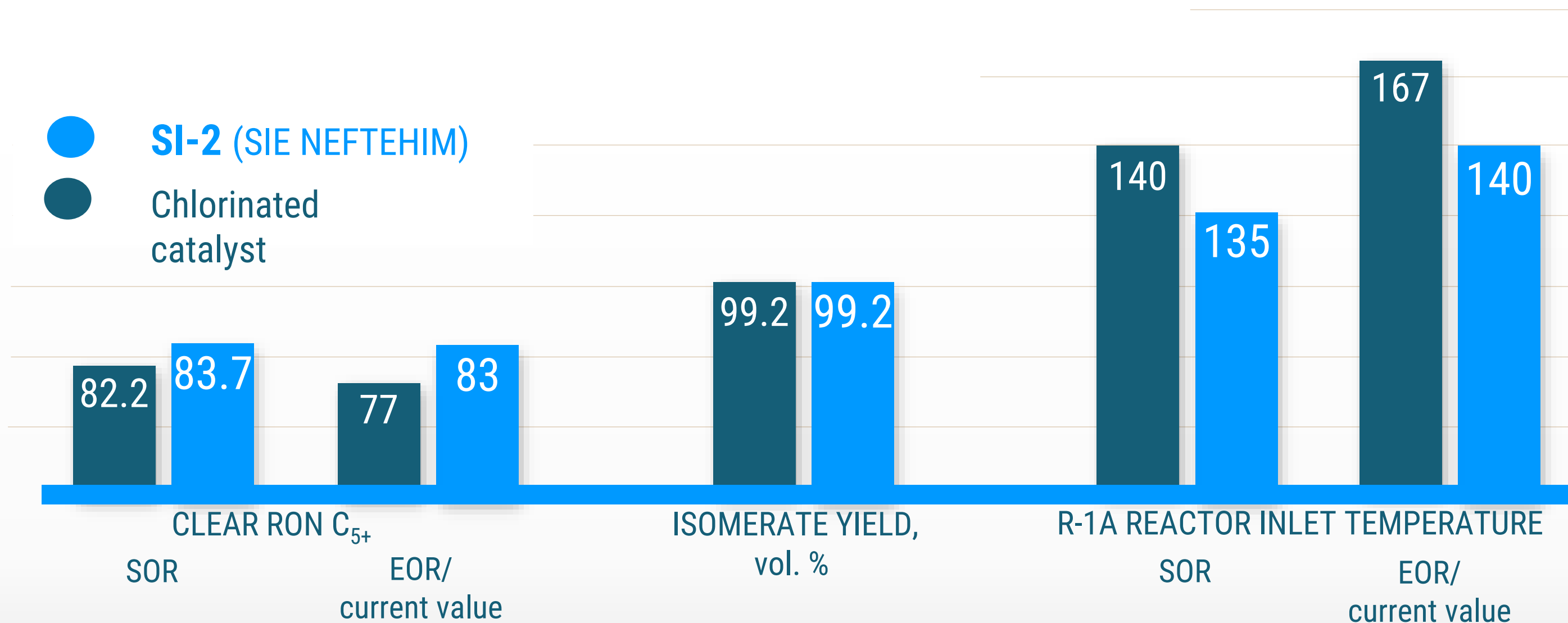
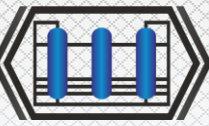
High tolerance of the catalyst to catalytic poisons, activity restoration after water breakthrough up to 100 ppm and sulfur up to 5 ppm.  
Actual catalyst service life in operating units is over 15 years



### MAXIMUM ENVIRONMENTAL SAFETY

No acid reagents and caustic wastes  
No corrosion fluids within the entire catalyst operating cycle

# ISOMERIZATION UNIT CONVERSION FROM CHLORINATED CATALYST TO SI-2 CATALYST



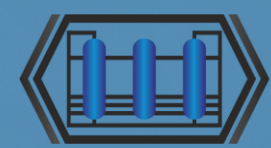
Tolerance to catalytic poisons,  
Expected catalyst service life > 10 years



No corrosion and caustic wastes in the unit

IN 2019, SIE NEFTEHIM COMPLETED STUDIES AND DEVELOPED  
**THE CATALYST MODIFICATION - SI-2B  
FOR DROP-IN REPLACEMENT OF CHLORINATED CATALYST**





# ISOMALK -2

Company

**JSC Gazpromneft – Omsk Refinery**

Year of commissioning

**2010**

Production configuration

**DIP+DP+DIH**

**11**

years of successful operation  
of SI-2 catalyst  
without regeneration

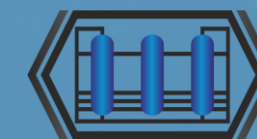


Capacity

**800**

KTA





SIE NEFTEHIM

# ISOMALK-2

Company

**Bharat Petroleum  
Corporation Limited (BPCL)**

Year of commissioning

**2017**

Production configuration

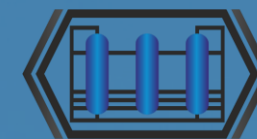
**Once-through/DIH**

**4** years of successful operation  
of SI-2 catalyst

Capacity

**680**  
KTA





SIE NEFTEHIM

# ISOMALK-2

Company

**Dongying Lianhe  
Petrochemical Ltd.**

Year of commissioning

**2020**

Production configuration

**DIP+DIH**

Grassroot isomerization unit

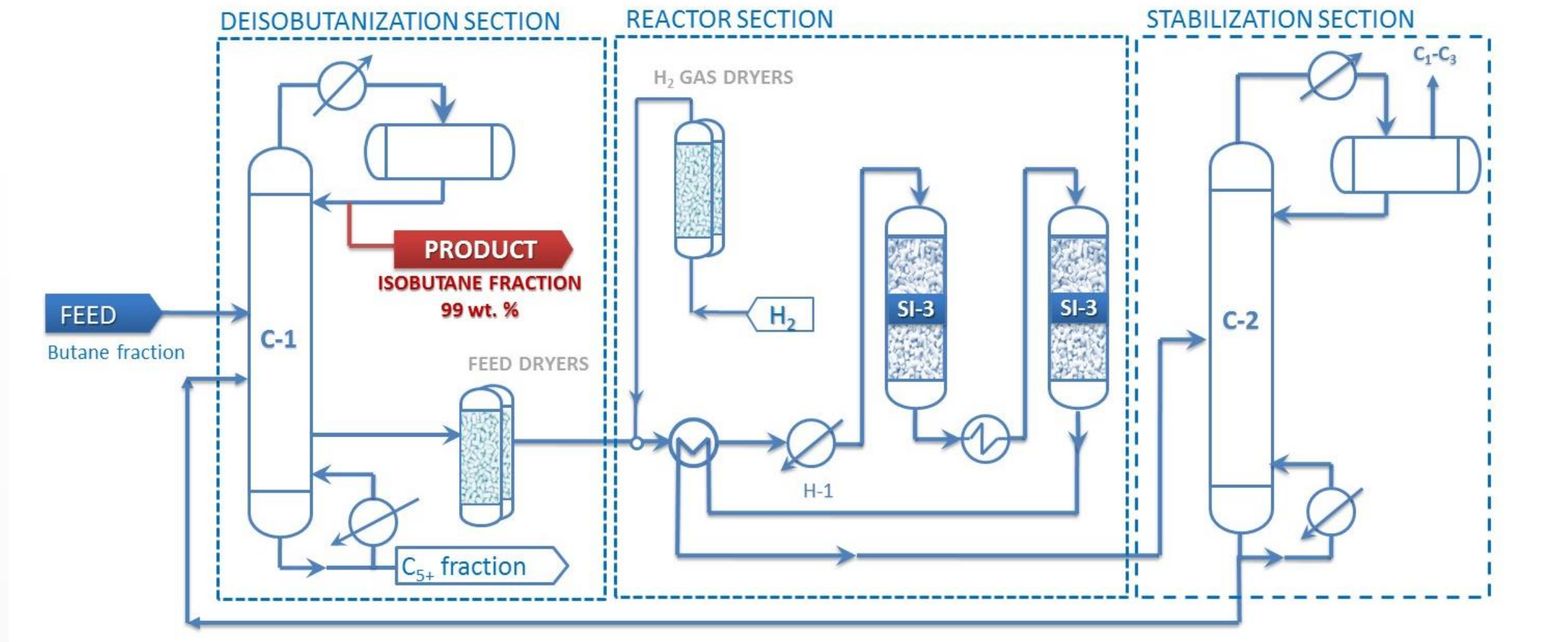
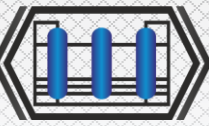
Capacity

**450**  
KTA



# ISOMALK-3

## N-BUTANE ISOMERIZATION TECHNOLOGY



2015

First commercial unit 200 KTA

2019

4 operating commercial units

2021...

Start-up of the 5<sup>th</sup> unit  
New projects



SIE NEFTEHIM

# ISOMALK-3

Company

**Shandong Sincier  
Petrochemical Co., Ltd**

Year of commissioning

**2015**

Production configuration

**DIB + ISOM REACTOR**

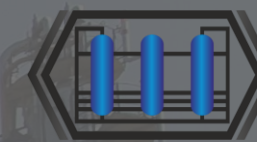
Capacity

**200**

KTA

**6** years of successful operation  
of SI-3 catalyst





SIE NEFTEHIM

# ISOMALK-3

Company

**Sinopec Jinling  
Petrochemicals Co., Ltd**

Year of commissioning

**2019**

Production configuration

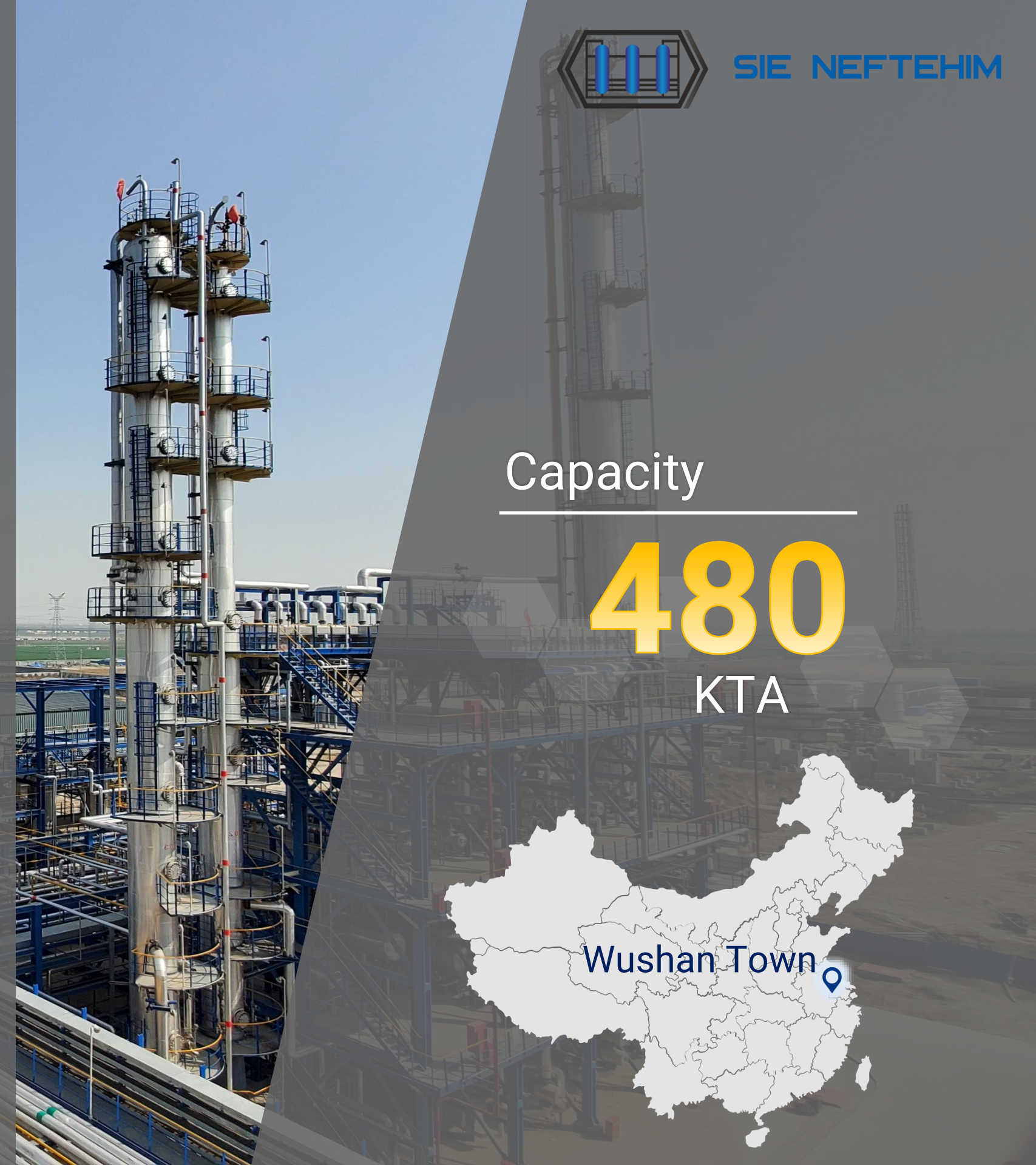
**DIB + ISOM REACTOR**

**2** years of successful operation  
of SI-3 catalyst

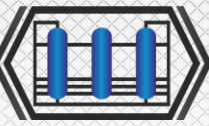
Capacity

**480**

KTA



# ISOMALK-4 HEPTANE HYDROCARBONS (70-105°C CUT) ISOMERIZATION TECHNOLOGY



## C<sub>7</sub> HYDROCARBON PROCESSING

Isomerization

Reforming

Distribution of 70-105°C cut between these units results in the performance deterioration

Low conversion

Low aromatization

High cracking

High cracking

### ISOMALK-4

Selectivity 95%

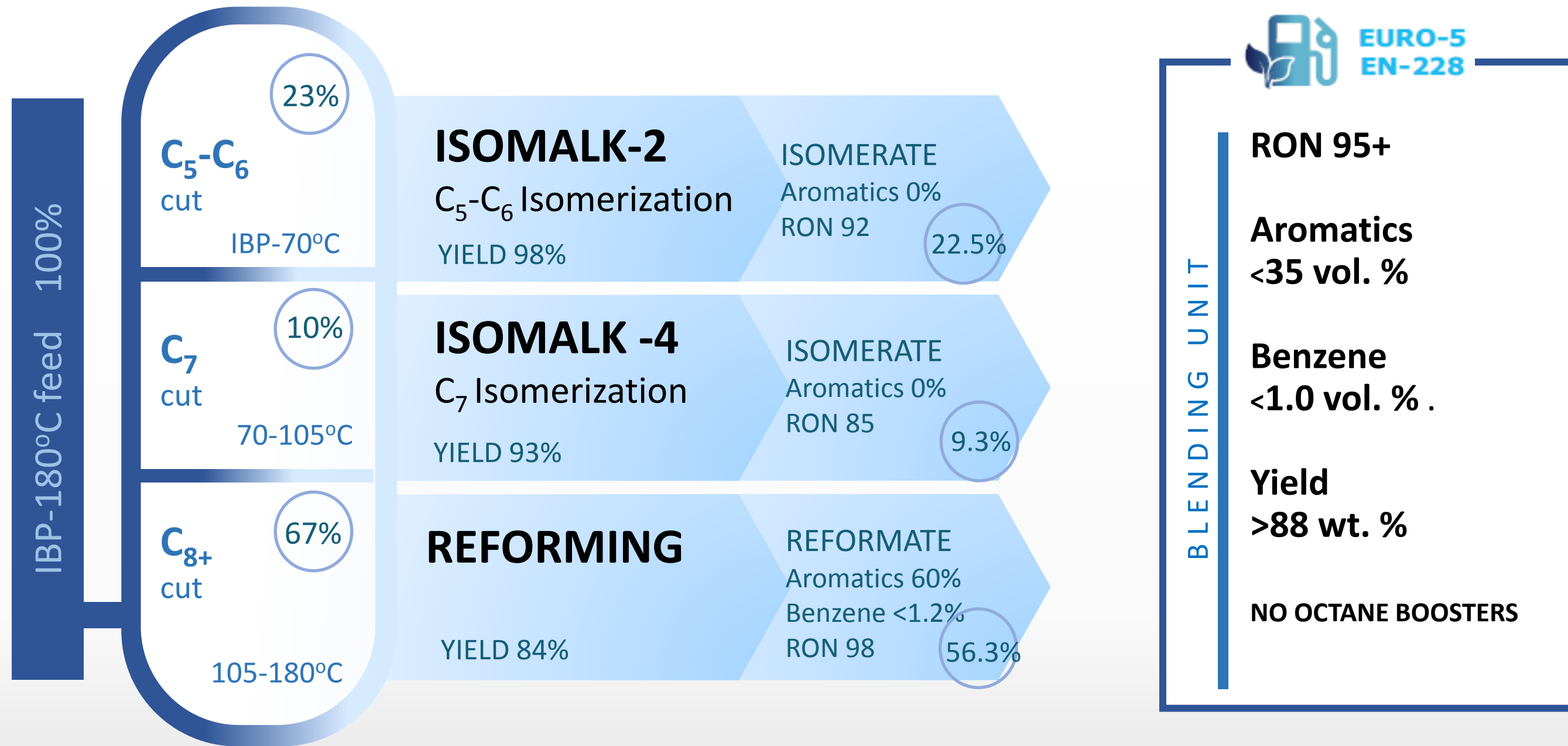
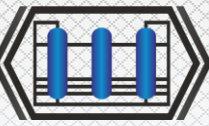
Yield 93-95%

RON 85-87

### SI-4

Oxide catalyst

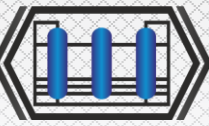
# PROSPECTIVE PRODUCTION DESIGN FOR EURO-5 GASOLINE PRODUCTION



- Production of additional non-aromatic component
- Increase in reformate yield in the reforming unit
- Benzene reduction in reformate until 1.0-1.5 wt. % due to reforming feed upgrading

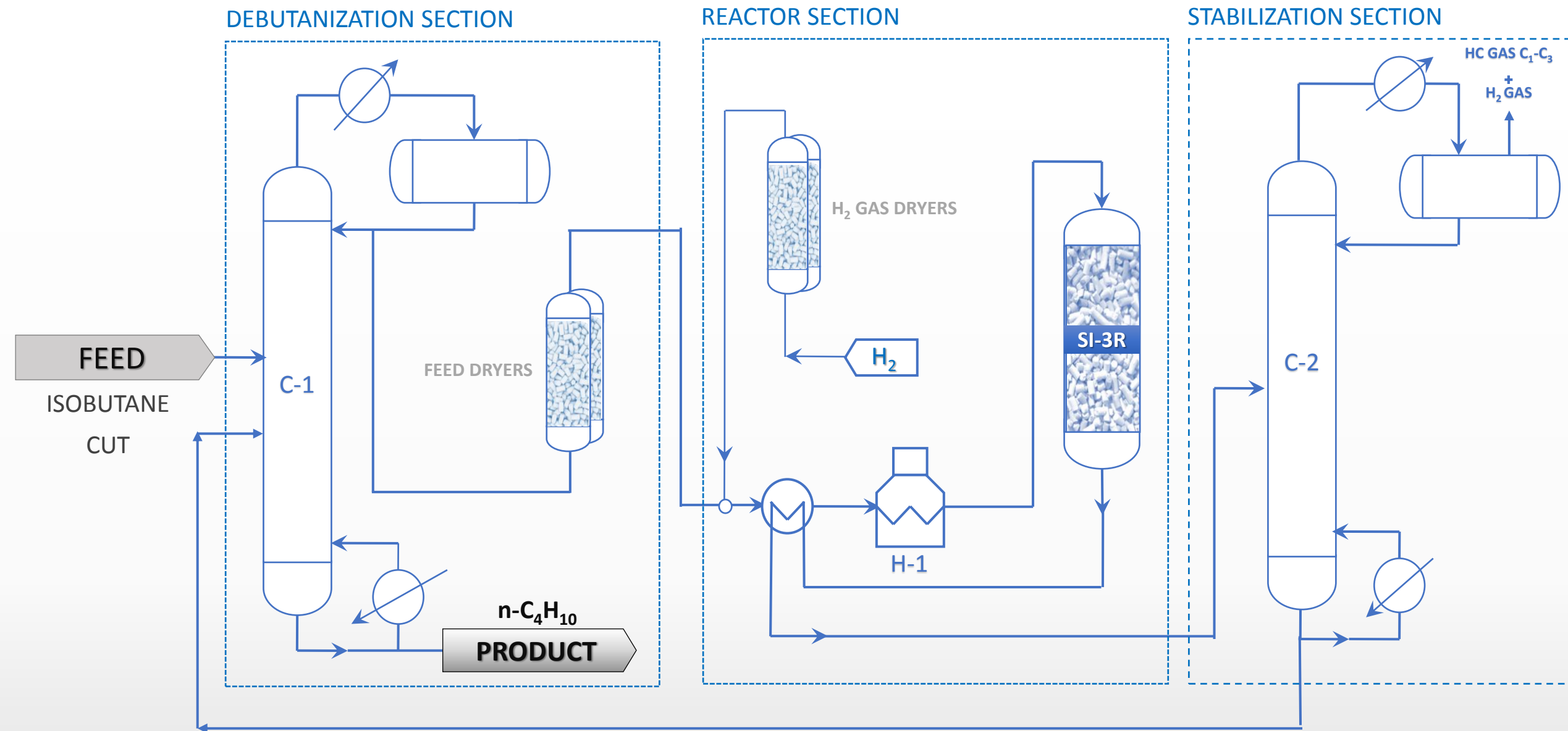


# ISOMALK-3R



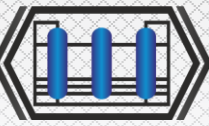
## BUTANE REVERSE ISOMERIZATION TECHNOLOGY

over **SI-3R** catalyst



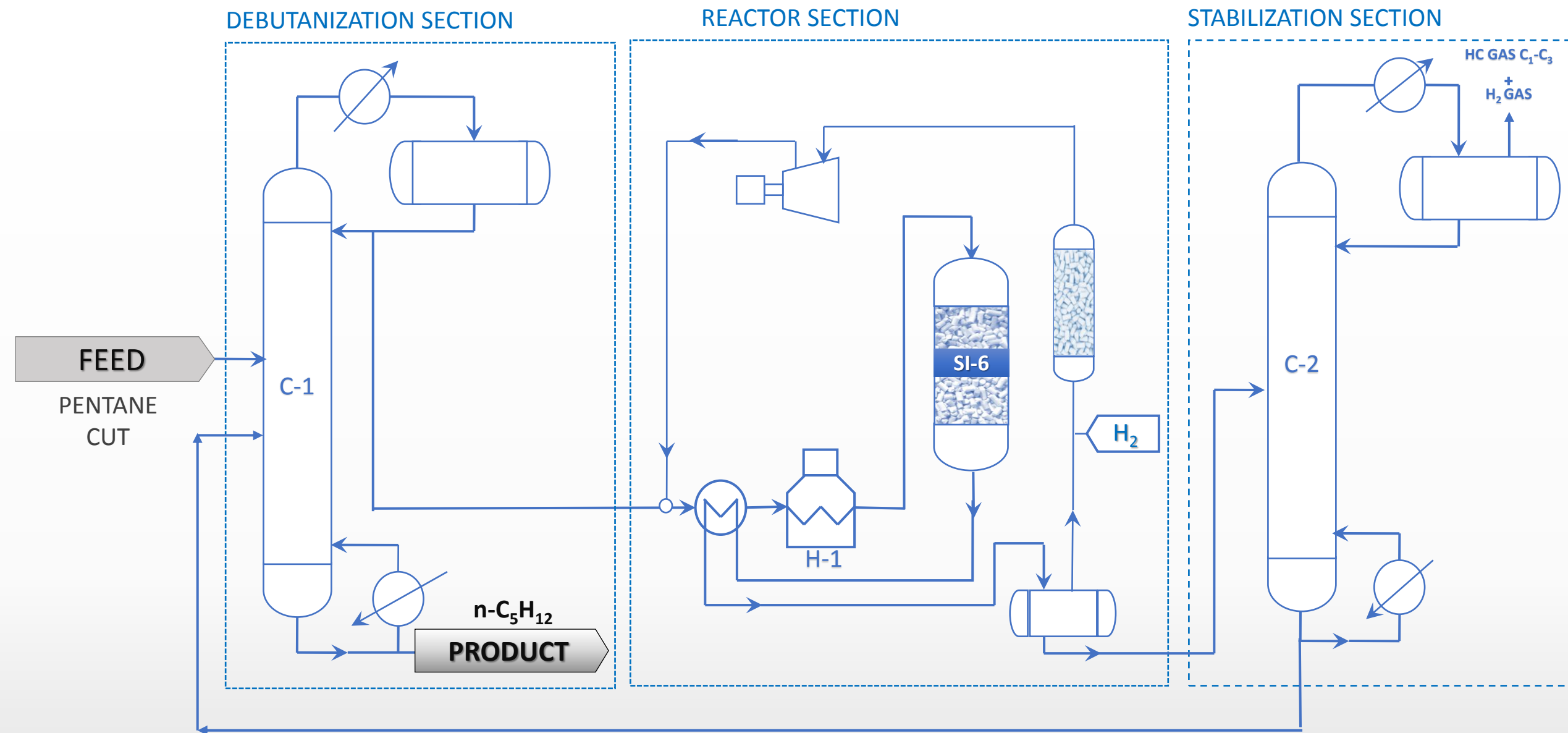
- High tolerance to catalytic poisons
- No reagents supply
- Product does not contain chlorine and other impurities
- Catalyst service life > 10 years

# ISOMALK-6R



## PENTANE REVERSE ISOMERIZATION TECHNOLOGY

over **SI-6** catalyst



- High tolerance to catalytic poisons
- High selectivity
- Catalyst service life > 8 years