PJSC SIE NEFTEHIM



NEW ISOMERIZATION PROJECTS UNDER PJSC SIE NEFTEHIM TECHNOLOGIES

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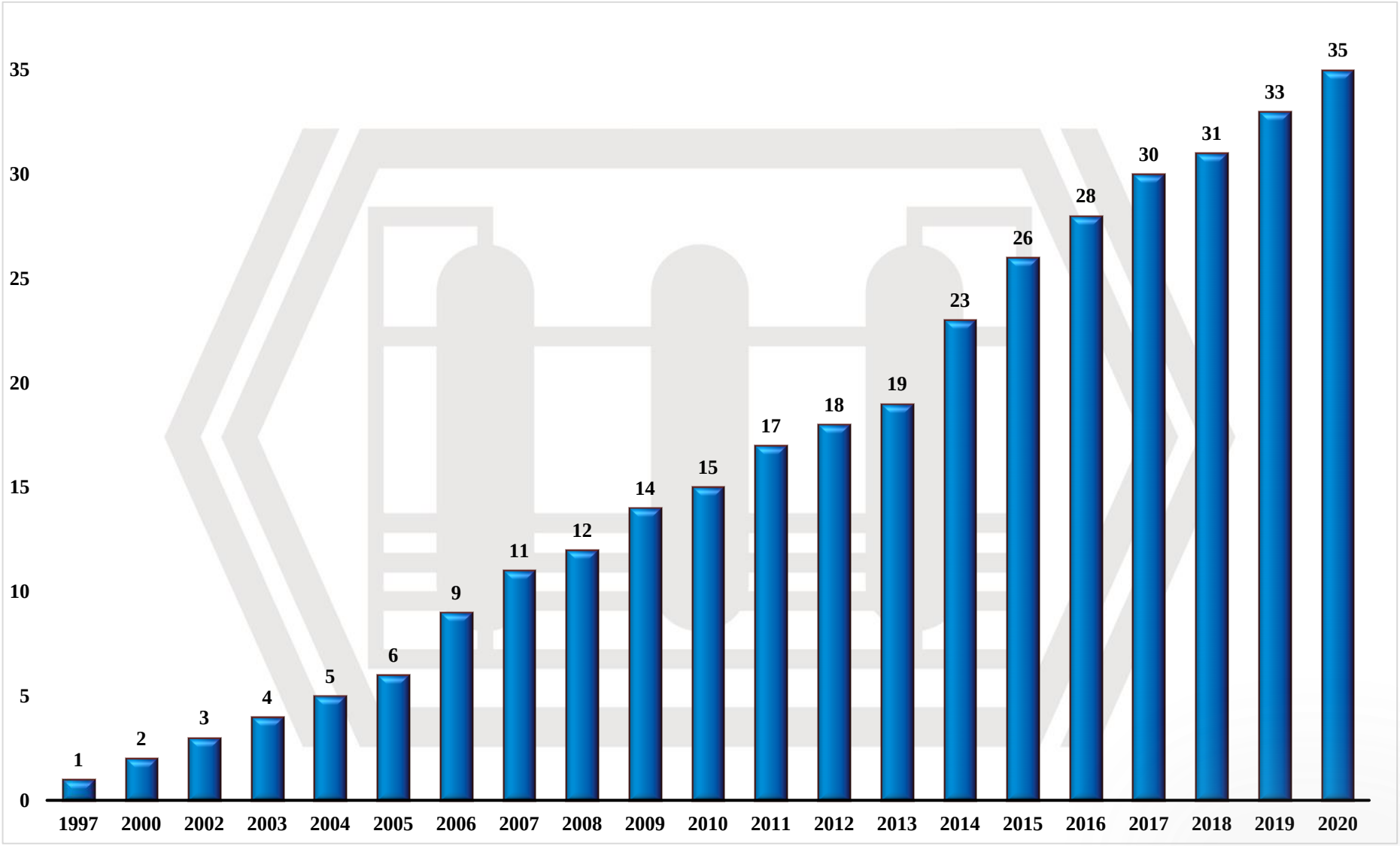
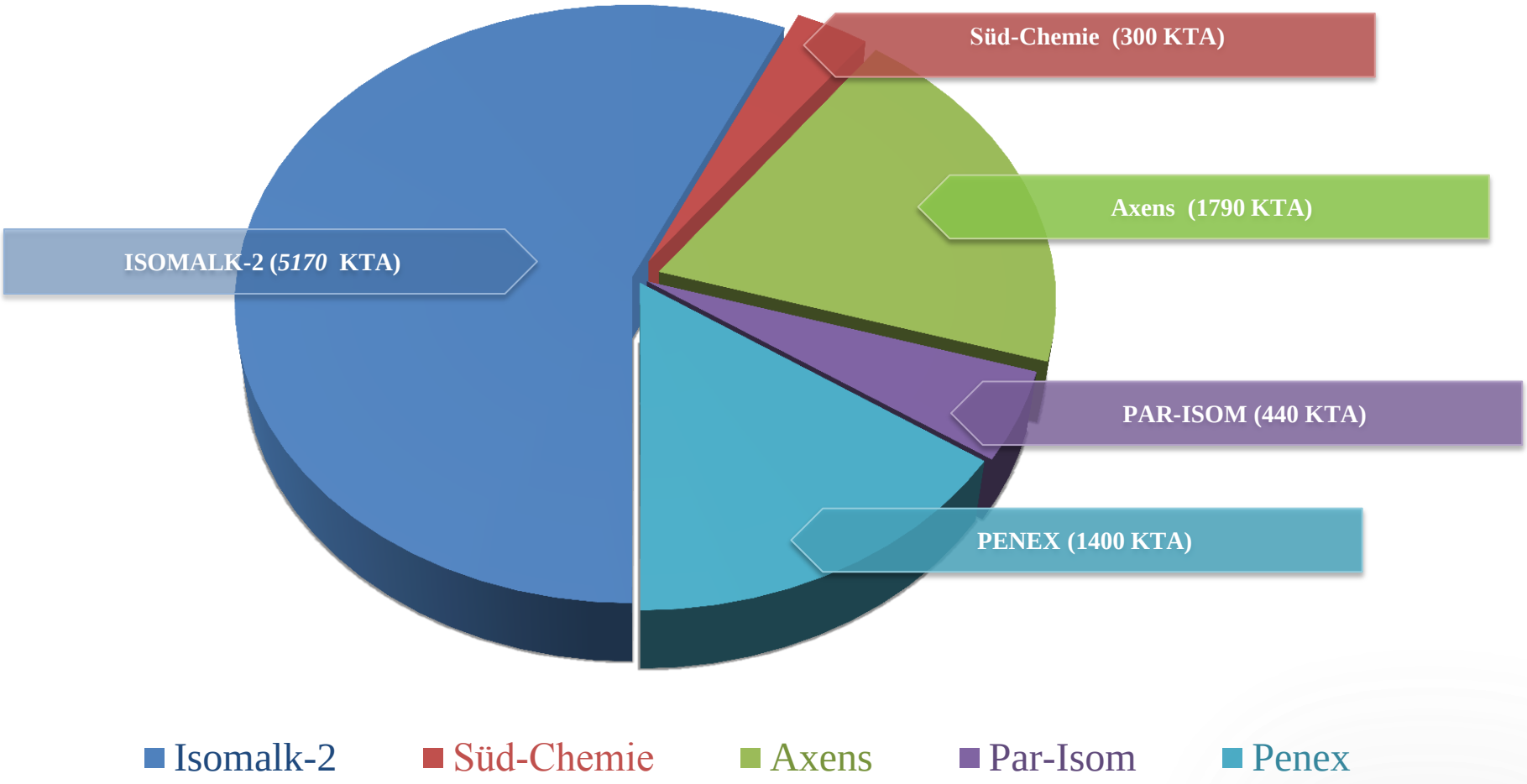
General Director

C_5-C_6 ISOMERIZATION UNITS COMMISSIONING TREND IN RUSSIA



SHARE OF DIFFERENT TECHNOLOGIES OF C_5-C_6 ISOMERATE PRODUCTION IN RUSSIA

Overall isomerate production throughput ~ 9100 KTA



SPECIAL FEATURES OF DIFFERENT C_5-C_6 ISOMERIZATION TECHNOLOGIES

Technologies over zeolite catalysts	Technologies over chlorinated catalysts (UOP, Axens)	Technology over sulfated catalyst SI-2 (Isomalk-2, PJSC SIE Neftehim)
✘ Process temperature 250-280 °C, thermodynamically unfavorable for the process	✓ Process temperature 130-160 °C	✓ Process temperature 130-160 °C
✘ Isomerate once-through octane number 77-78	✓ Isomerate once-through octane number 82-84	✓ Isomerate once-through octane number 82-84
✘ High rectification costs in recycle operation	✘ Requirement of constant chlorine supply and HC gas treatment	✓ High stability and reliability of the catalyst ✓ 10 year run without regeneration has been achieved
	✘ High sensitivity to sulfur, nitrogen, and water traces	✓ Possibility to produce 92-93 RON isomerate

NEW ISOMALK-2 UNITS START-UP IN 2015

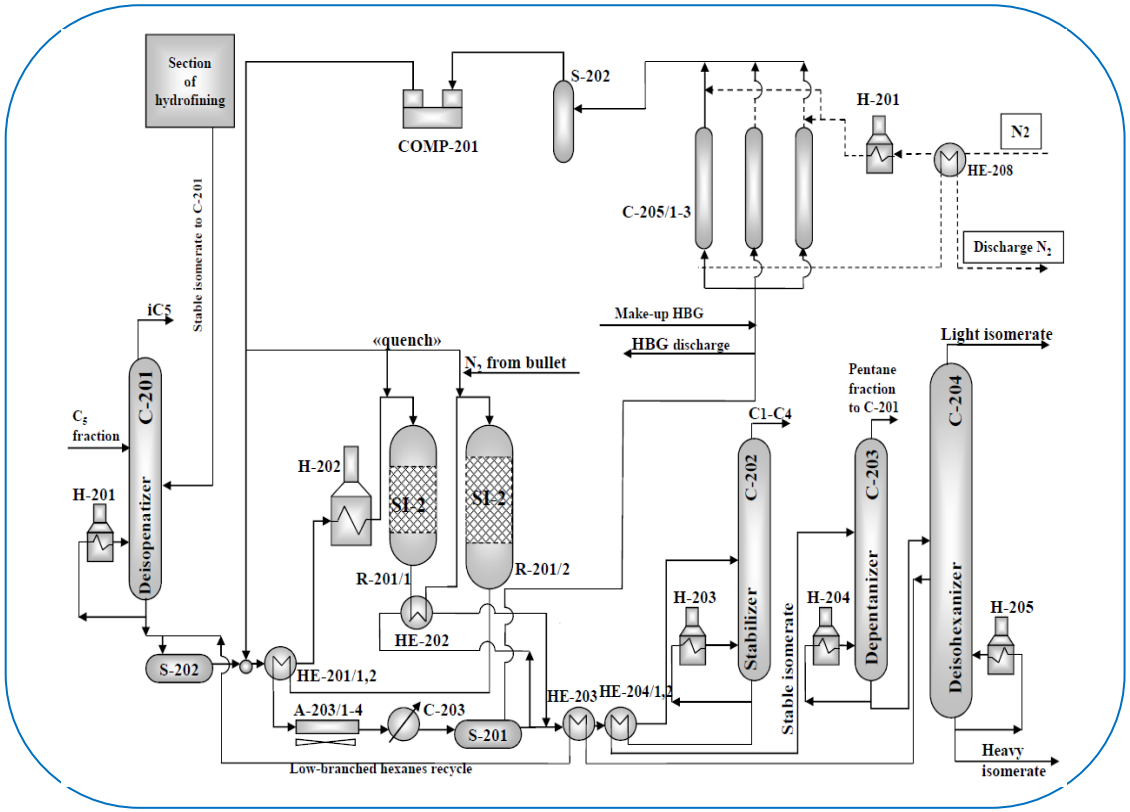
JSC Orsknefteorgsintez

- ✓ **Feed capacity – 300 KTA;**
- ✓ **n-C_5 and low-branched C_6 recycle;**
- ✓ **Isocomponent yield – 98.5-99.0 wt. %;**
- ✓ **Isomerate octane number 91.5-92.5;**
- ✓ **Guaranteed service life of the catalyst – 10 years;**
- ✓ **Guaranteed service cycle – 5 years.**

JSC RYAZAN OIL REFINING COMPANY

- ✓ **Unit feed capacity – 800 KTA;**
- ✓ **Feed Deisopentanizer and low-branched C_6 recycle;**
- ✓ **Isocomponent yield 98.5-99.0 wt. %;**
- ✓ **Isomerate octane number 89.5-90.0;**
- ✓ **Isopentane cut octane number 90.0-93.0;**
- ✓ **Guaranteed service life of the catalyst – 10 years;**
- ✓ **Guaranteed service cycle – 5 years.**

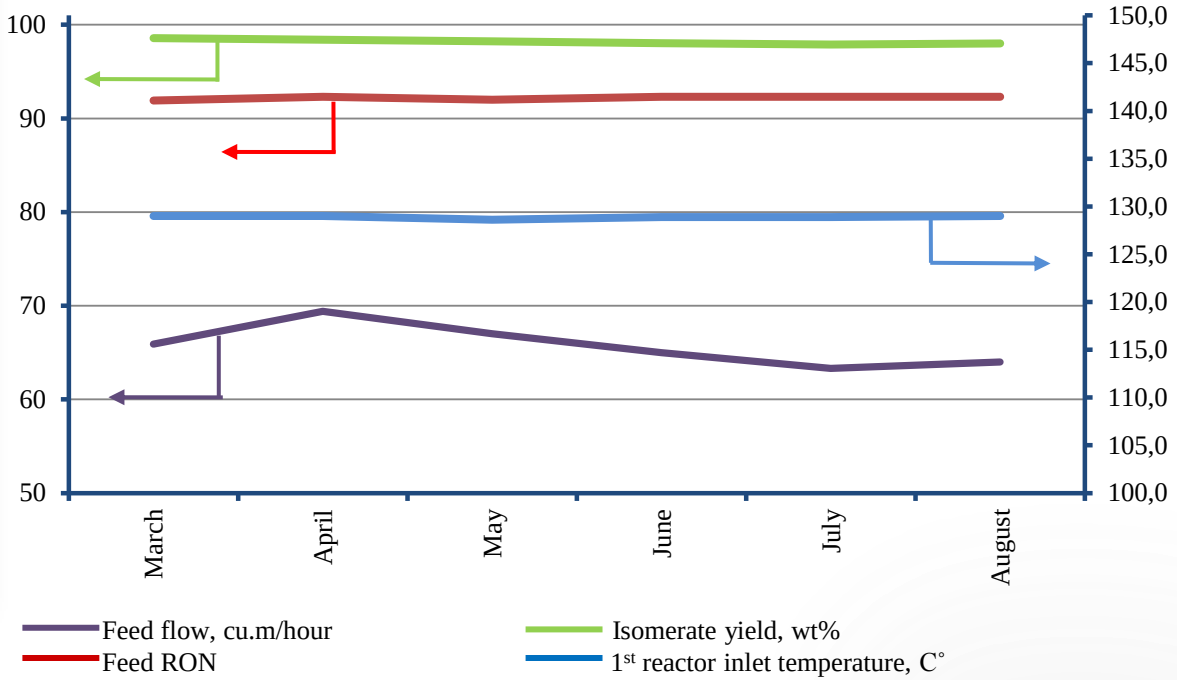
Main Process Flow Diagram



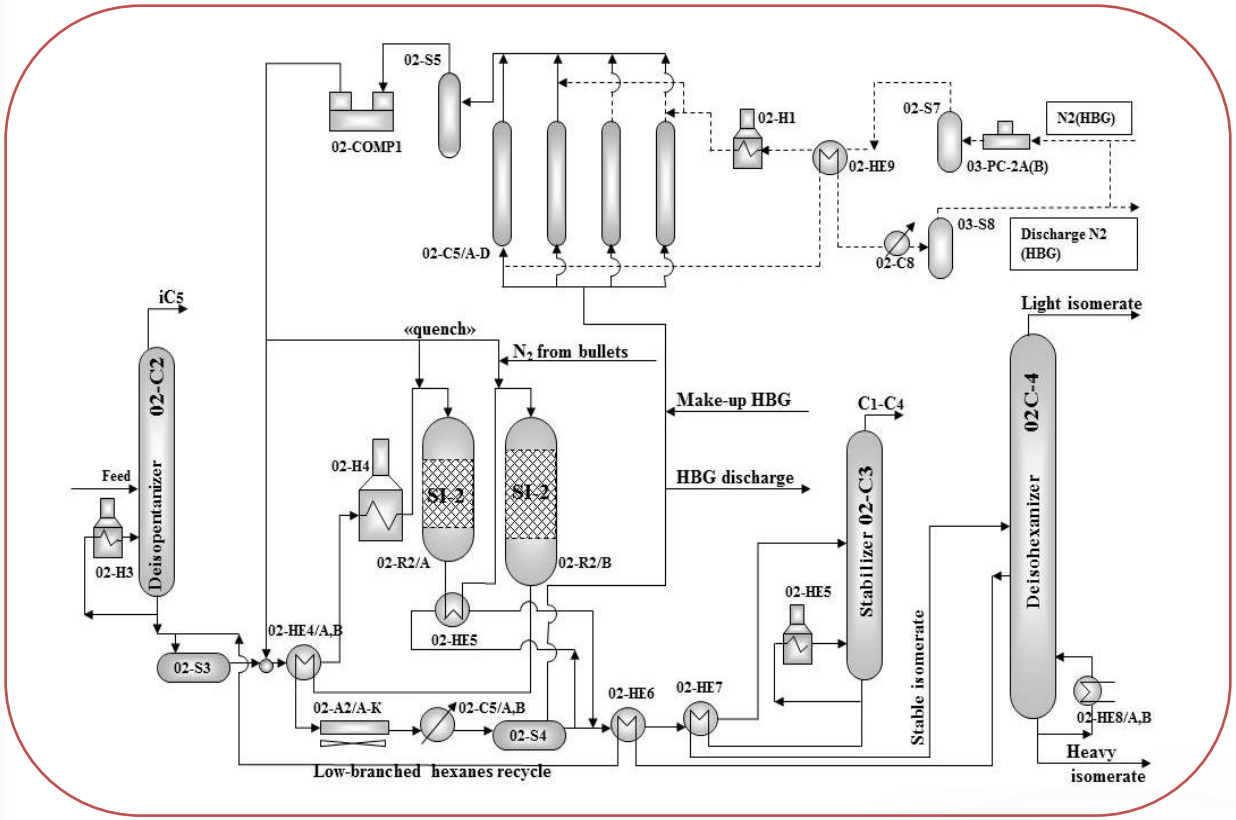
ISOMALK-2 UNIT OPERATING PERFORMANCES JSC ORSKNEFTEORGSINTEZ

Unit start-up	February 2015
Capacity, KTA	300
LHSV, h-1	2.0
Isocomponent octane number	91-92
Isocomponent yield, wt.%	97-98

Unit operating performances since start-up in 2015

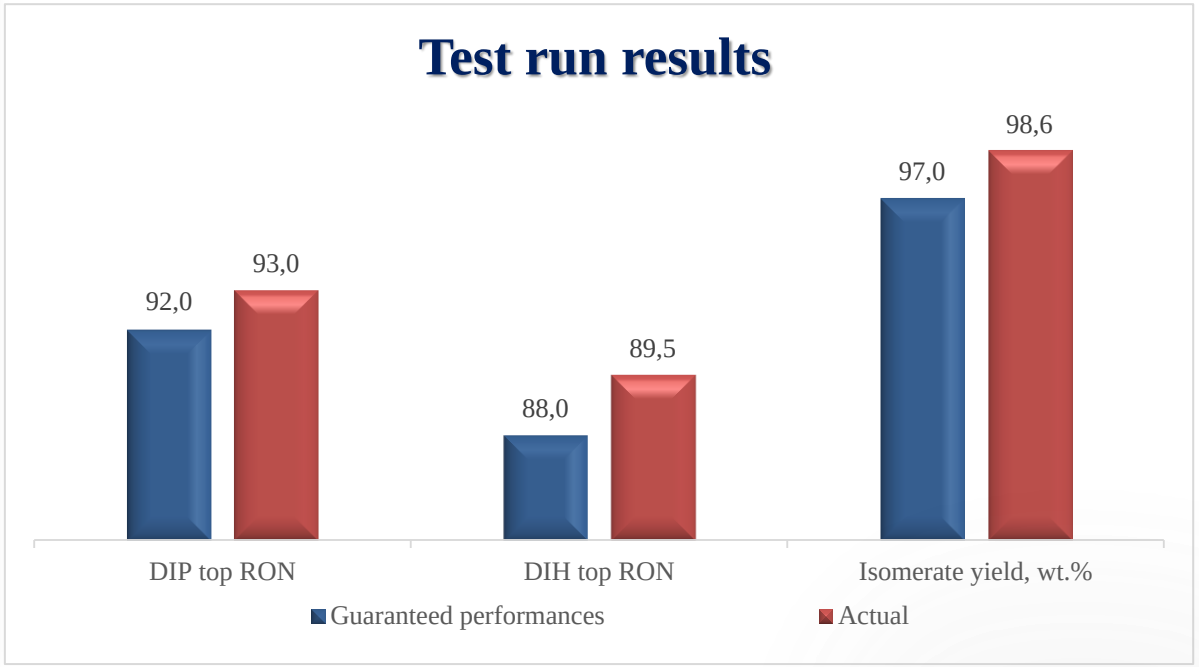


Main Process Flow Diagram



ISOMALK-2 UNIT OPERATING PERFORMANCES
JSC RYAZAN OIL REFINING COMPANY

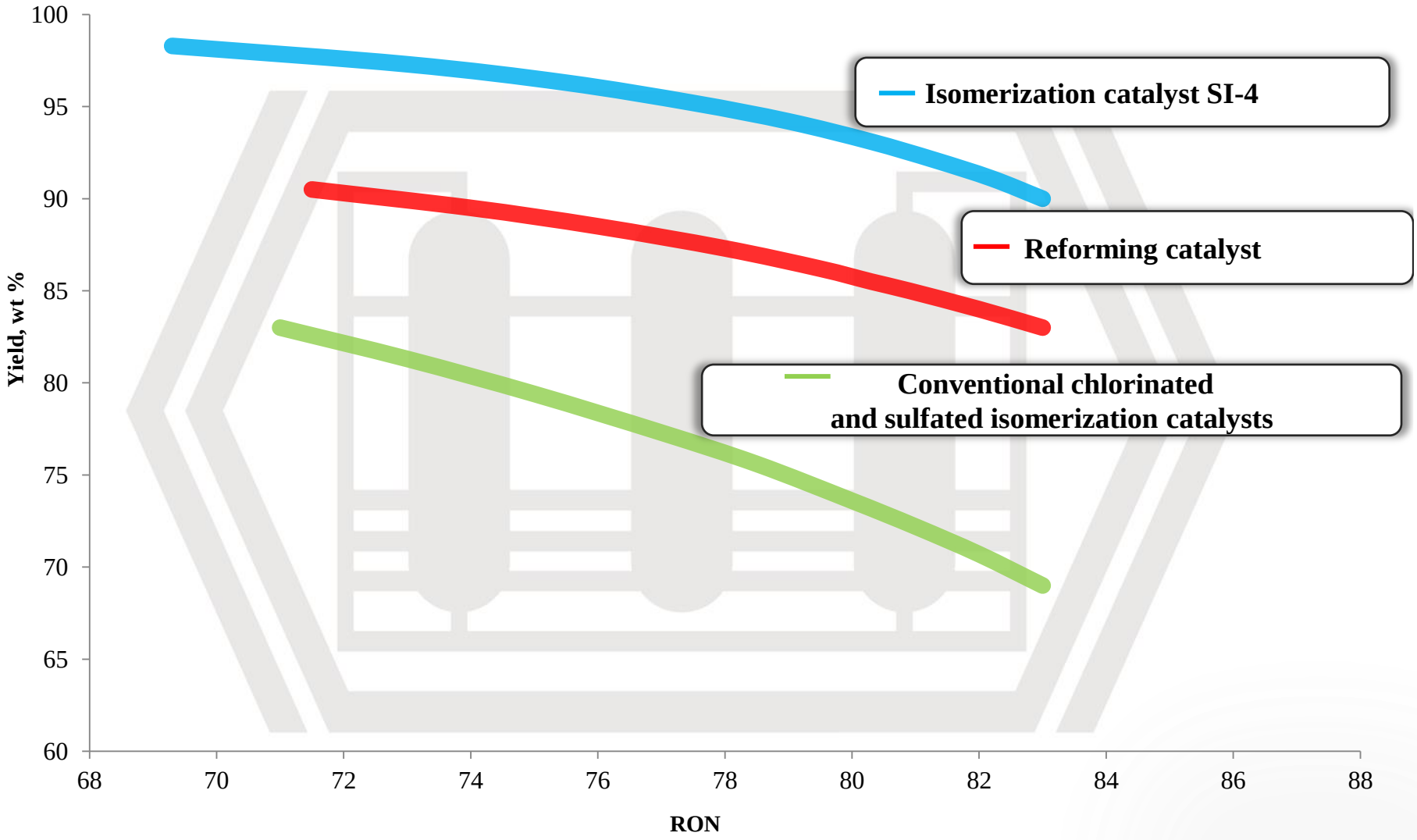
Unit start-up	May, 2015
Capacity, KTA	800
LHSV, h-1	2.5
Isocomponent octane number	89-90
Isocomponent yield, wt.%	98-99



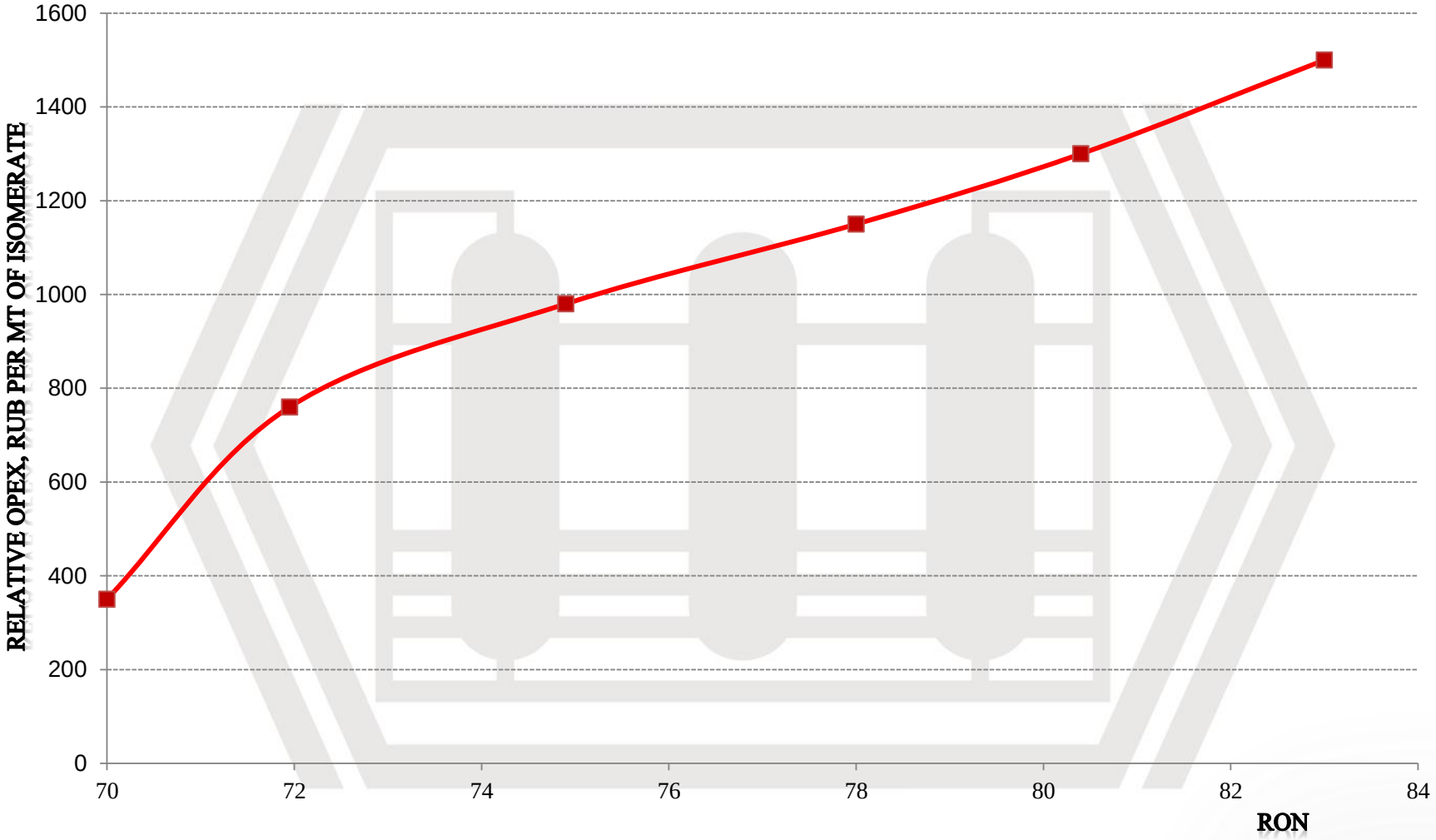
MAIN DIRECTIONS OF FURTHER ISOMERIZATION PROCESS DEVELOPMENT

- ✓ Increase of C_6 – hydrocarbons share in pentane-hexane cut up to 70-75%
- ✓ Increase of C_5-C_6 cut octane number up to 92-93
- ✓ Improvement of operation reliability. Increase of the unit run without catalyst regeneration up to 10 years
- ✓ Conversion of C_7-cut (70-105 °C) from reforming to isomerization

70-105 °C CUT ISOMERIZATION VS. REFORMING



Correlation between 70-105 °C cut isomerization OPEX and isomerate octane number



REFINERY CONDITIONS INDICATING THE NECESSITY OF INTRODUCING C_7 CUT ISOMERIZATION

1. **Lack of high-octane non-aromatic autocomponents for production of EURO-4, EURO-5 and eventually EURO-6 motor gasoline**

2. **Reforming units' overload with feed and high content of benzene precursors in the feed**

3. **High content of C_7 hydrocarbons in pentane-hexane isomerization feed**

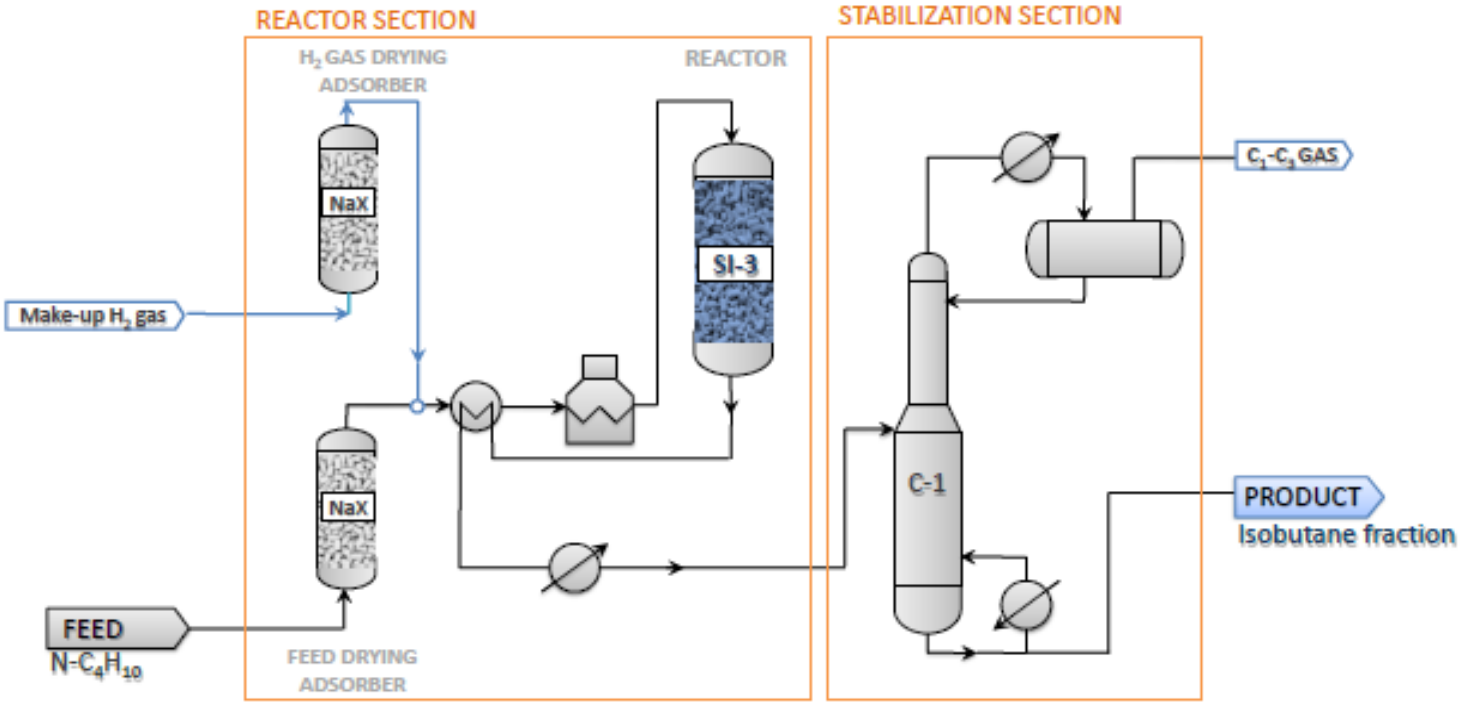
SIGNIFICANCE OF NEW N-BUTANE ISOMERIZATION UNITS' CONSTRUCTION

With the increase of oil refining depth, isobutane demand for alkylation processes will constantly extend

N-butane isomerization technology over chlorinated catalysts is widely used in the world refinery, however, it has a number of well-known disadvantages

PJSC SIE Neftehim created an alternative n-butane isomerization technology – Isomalk-3, which is designed to provide stable production of isobutane

PROCESS FLOW DIAGRAM OF N-BUTANE ISOMERIZATION TECHNOLOGY ISOMALK-3



Typical Isomalk-3 n-butane isomerization unit consists of the following sections:

- ***isomerization feed treatment and drying section –*** is designed for water removal from isomerization feed; this procedure is intended for catalyst protection from water, which inhibits catalyst activity;
- ***isomerization reactor section –*** is designed for proceeding isomerization reactions of normal butane into isobutane over active catalyst sites at the most favorable conditions for the main reaction;
- ***hydrogen gas dryers section –*** is designed for water removal from hydrogen gas, as well as from nitrogen during catalyst regeneration;
- ***stabilizer section*** – is designed for recovery of C_1-C_3 hydrocarbons and dissolved hydrogen from the obtained product.

MAIN PROCESS PARAMETERS OF ISOMALK-3 TECHNOLOGY

Parameter	Values
Temperature, ^{o}C	160-210
Pressure, MPag	1.5-2.0
LHSV, hour $^{-1}$	6.0-8.0
H_2:butane molar ratio	0.07-0.10
“Once-through” n-butane conversion, %	50-55
“Once-through” C_{3+}-hydrocarbons yield, wt. %	99
“Once-through” C_{4+}-hydrocarbons yield, wt. %	94-95
Total catalyst service life, years	8
Service cycle, years	3

CONCLUSION

- ✓ **Russian technologies for isocomponent production are as good as the best world analogues**
- ✓ **At the Russian refineries the problem of gasoline production according to EURO-5 standard was resolved. However, for production increase and commercial product cost reduction it is necessary to further increase production of high-octane non-aromatic autocomponents**
- ✓ **In connection with the trend for further reduction of aromatic components proportion in motor gasoline to 24% there is a need for construction of 70-150 °C cut isomerization and n-butane isomerization units**

THANK YOU FOR ATTENTION!

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