Enhancement of high quality motor gasoline production.

Under what conditions C7-cut isomerization is required?

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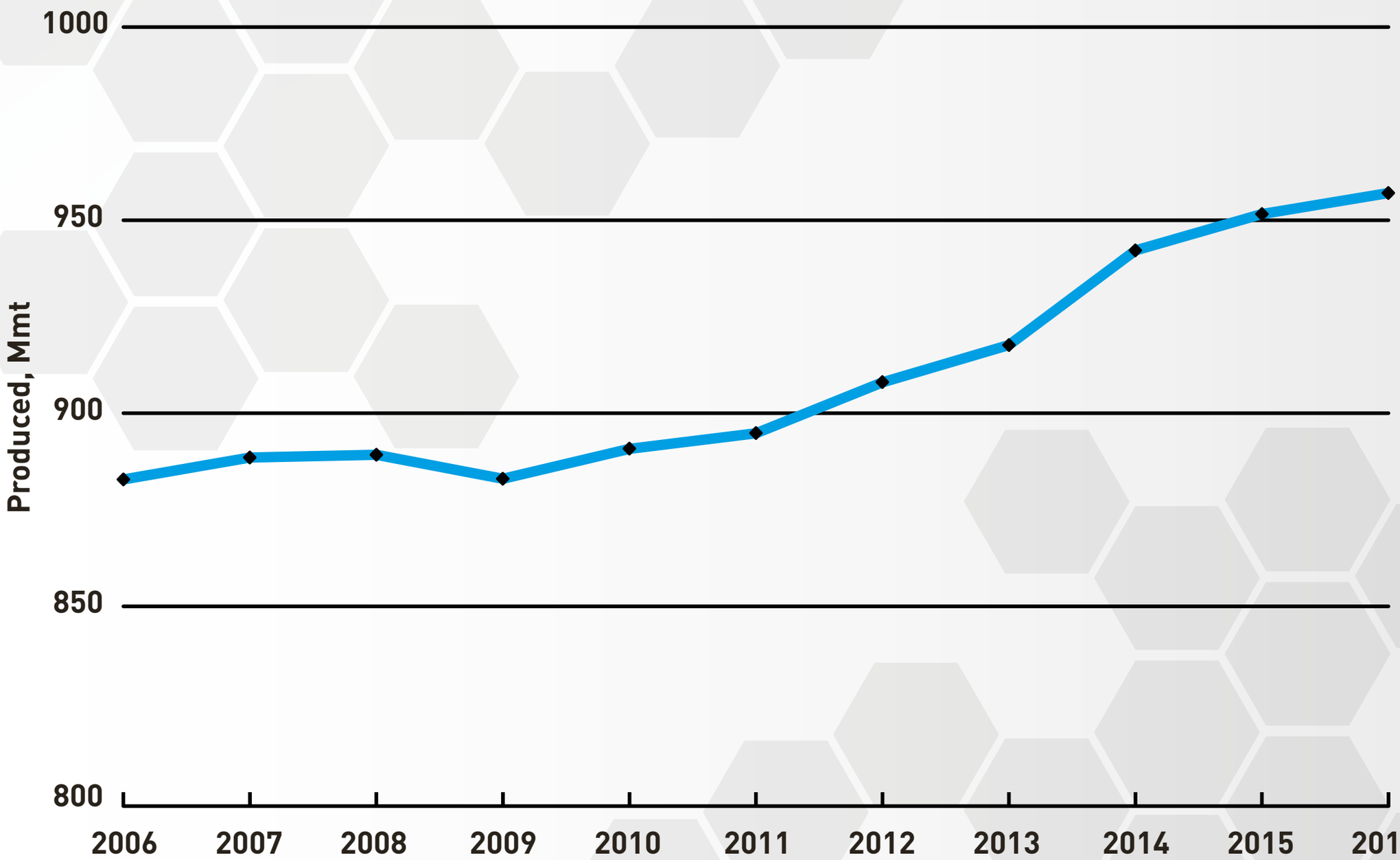
World trend of motor gasoline production

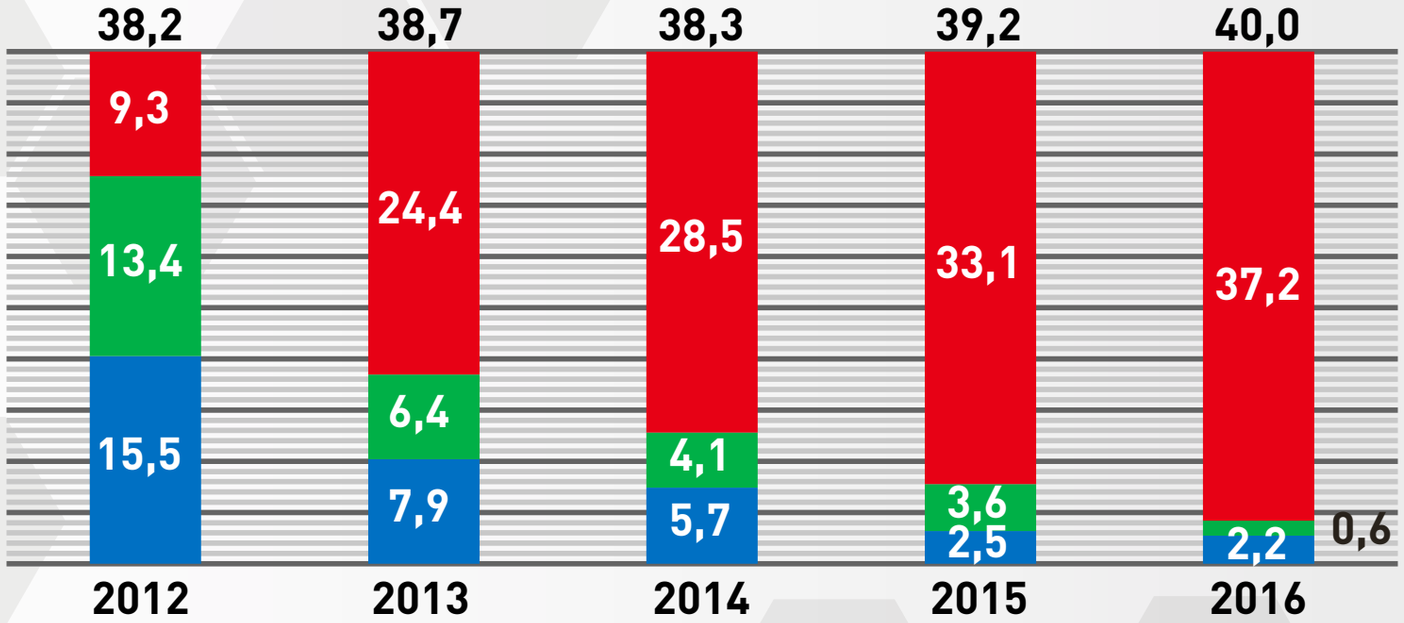


Russian oil processing industry performances in 2012-2016

Motor gasoline production, MMt

2015-2016 Dynamics

K5 +4.1 MMt (+12.4%)

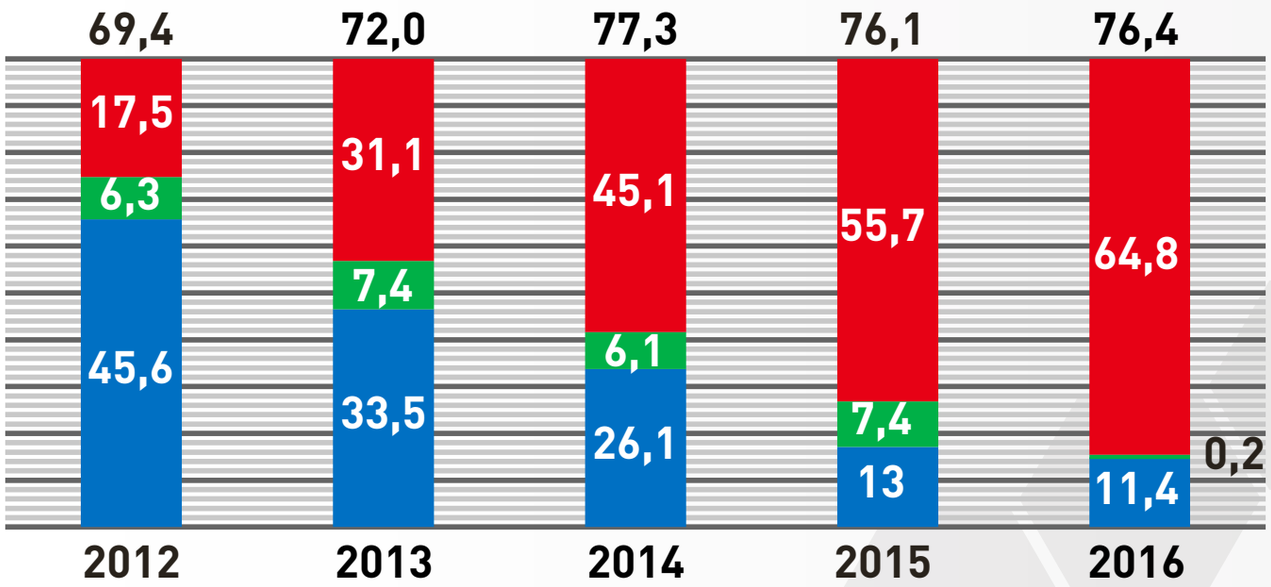


■ K3 and lower
■ K4 ■ K5

Diesel oil production, MMt

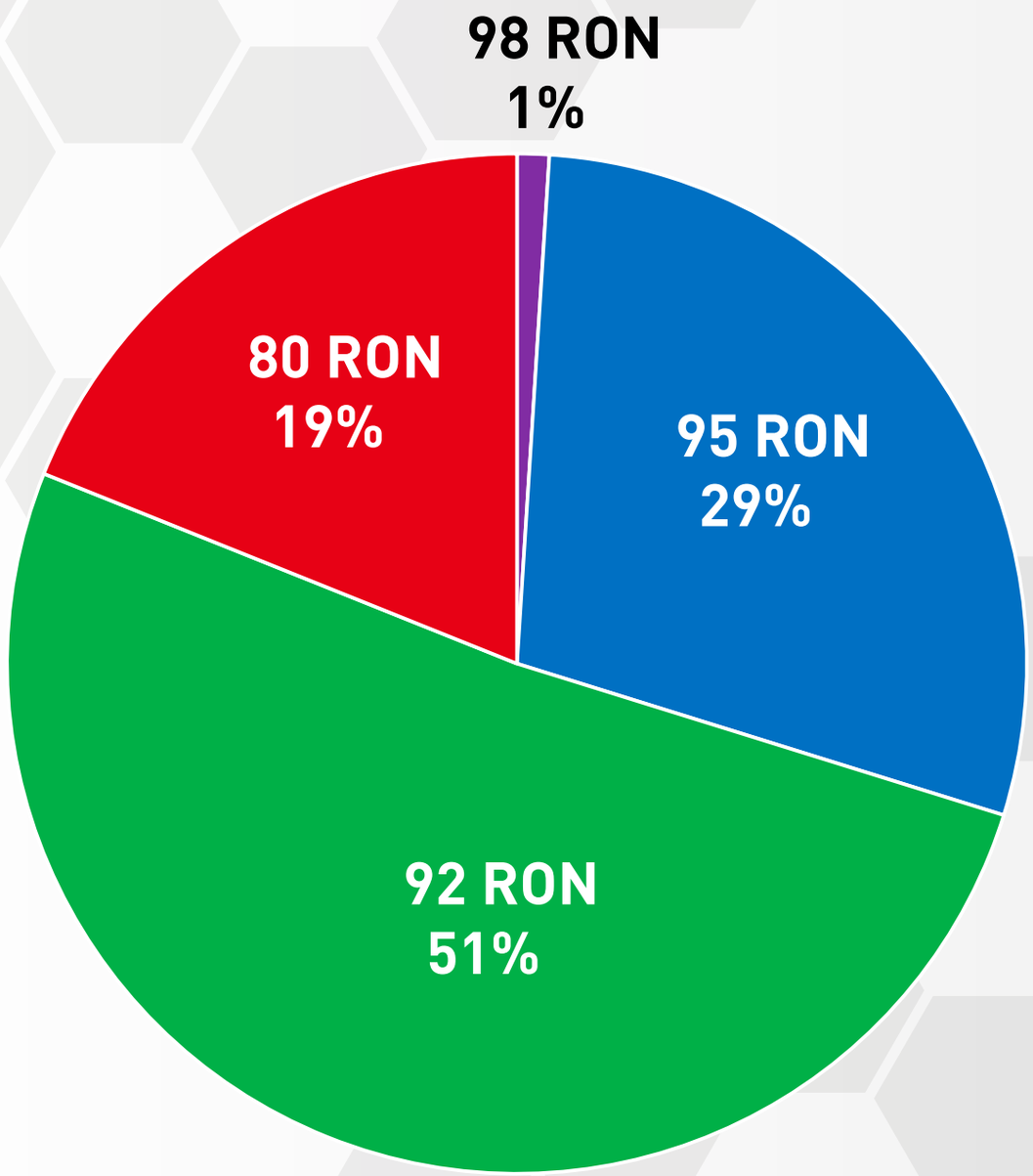
2015-2016 Dynamics

K5 +9.1 MMt (+16.3%)

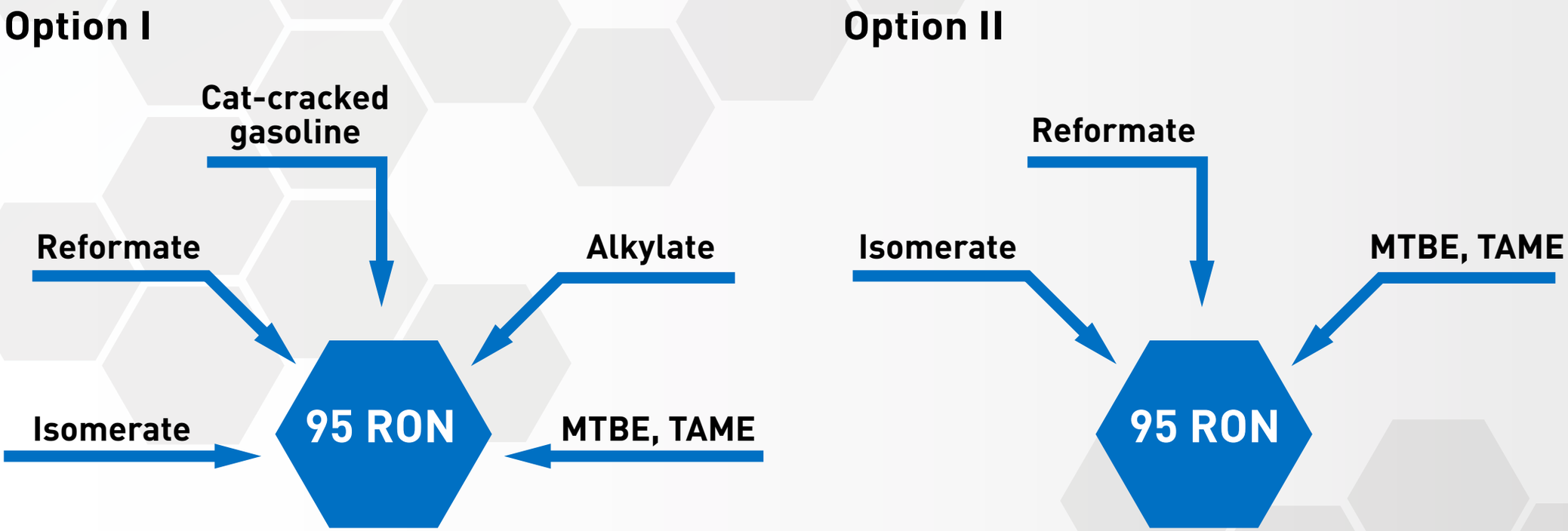


■ K3 and lower
■ K4 ■ K5

K5 environmental standard motor gasoline production in the first half of 2017 in the Russian Federation



Main arrangements of motor gasoline blending



Disadvantages

Option I	- High content of olefins and sulfur in cat-cracked gasoline - Limited amount of alkylate
Option II	- High content of aromatics due to high share of reformate

CHALLENGES OF REFINERY IN MOTOR GASOLINE PRODUCTION

1. Deterioration of fixed-bed reformer performances due to catalyst coking and out-of-schedule shutdowns caused by poisoning.
The share of fixed-bed reformers is still high

2. Out-of-schedule shutdowns of isomerization units due to highly-sensitive catalyst's poisoning and excessive corrosion

3. High share of reformate with increased aromatics content in motor gasoline production

Modern tasks of oil processing in production of high octane EURO-5 motor gasoline

- Increase of reforming catalysts' service cycle in fixed-bed reformers up to 3-4 years for "severe operation" with production of 97-99 RON reformate
- Enhancement of reformate yield in operating fixed-bed reformers up to 90-92% due to minimization of catalyst coking and pressure decrease
- Enhancement of CCR units operation due to improved catalyst selectivity and strength
- Increase of isomerization unit turnaround period up to 6 years
- Increase of period between regeneration for isomerization units up to 12 years
- Maximization of non-aromatic isomerate share by means of C_7-cut redistribution from reforming feed to isomerization feed
- Construction of n-butane isomerization units to obtain feed for alkylate and MTBE production

Recent modifications of reforming catalysts produced and supplied by SIE NEFTEHIM, LLC

BRAND	SERVICE	MODE	SERVICE CYCLE	SERVICE LIFE	REFORMATE YIELD
REF	Fixed-bed	Up to 100 RON	Up to 4 years	Not less than 8 years	Up to 90%
RC	CCR	Up to 110 RON	-	Not less than 8 years	Up to 92%

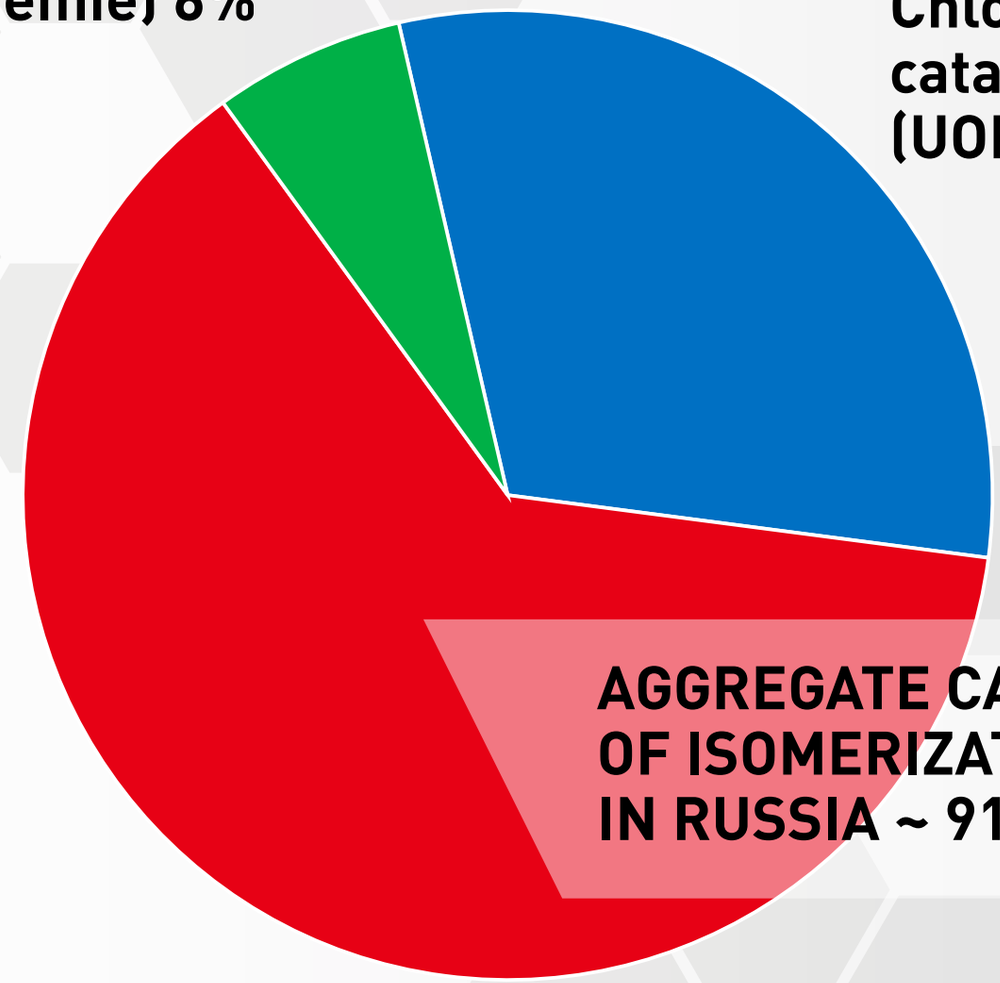
Factors, determining catalytic properties of reforming catalysts

- Physical and chemical properties of catalyst support
- Loading conditions for platinum, promoters, and modifiers
- Conditions of drying and calcination
- Activation conditions in a reforming unit
- Conditions of reformer feed preparation
- Management of all production and operation stages for reforming catalyst (scientific and technical support)

SHARE OF DIFFERENT ISOMERIZATION TECHNOLOGIES IN RUSSIA

Zeolite catalysts (Süd-Chemie) 6%

Chlorinated catalysts (UOP, Axens) 31%



Oxide sulfated catalysts (SIE Neftehim and UOP) 63%

AGGREGATE CAPACITY OF ISOMERIZATION UNITS IN RUSSIA ~ 9105 KTA

BENEFITS OF OXIDE SULFATED ISOMERIZATION CATALYSTS

- Long-term service life and service cycle
- Possible activity restoration via regeneration
- Tolerance to H2O and sulfur traces
- Low corrosiveness

- 12 years service life has been achieved over SI-2 catalyst
- 12 years service cycle without regeneration has been achieved over SI-2 catalyst
- Catalyst SI-2 totally restores its activity after removal of impurities from feed and hydrogen gas

Commercial introduction of n-butane isomerization process based on oxide sulfated catalyst

2015	200 KTA Isomalk-3 unit, Shandong Sincier Petrochemical Co., Ltd (China), a part of MTBE complex
2016- 2017	Construction and start-up of 2 new Isomalk-3 units in China
2017- ...	Technology promotion in different countries

Isomalk-3 unit, Shandong Sincier Petrochemical Co., Ltd

C_7-cut (70-105°c) isomerization process Isomalk-4

Octane number enhancement for 70-105°C straight run cut from 65 up to 85 numbers and complete hydrogenation of aromatics

Recovery of 70-105°C cut from reformer feed allows for increasing the reformate yield and octane

Involvement of 70-105°C cut isomerization into processing circuit allows for producing EURO-5 motor gasoline without addition of alkylate and cat-cracked gasoline

CONCLUSION

1. Efficiency improvement of high octane EURO-5 motor gasoline production requires enhancement of naphtha processing technologies in the following ways:

- **Creation of catalysts for fixed-bed units with long-term service cycle (up to 4 years) for «severe» operation (up to 99-100 octane numbers).**
- **Creation of CCR reforming catalysts with enhanced mechanical strength and selectivity.**
- **Further increase of pentane-hexane isomerization units' share based on oxide sulfated catalysts, providing unit service cycle up to 6 years and more.**
- **Construction of n-butane isomerization units to provide feed for alkylation and MTBE units. New technology Isomalk-3 providing stable unit operation has been introduced.**
- **Transfer of 70-105°C cut from reformers to isomerization units for refineries with limited alkylate amount. C_7-cut isomerization technology Isomalk-4 has been developed.**

2. All necessary technologies for production of EURO-5 motor gasoline are developed in Russia.

THANK YOU!

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