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SIE NEFTEHIM: Aiming the challenges of the future

Based in the south Russia Krasnodar innovative chemical technology company - Scientific Industrial Enterprise (SIE) Neftehim LLC is one of Russia's hundred most competent companies in its field. The company presents ISOPLAT, new efficient technology for the environmentally friendly high-octane gasoline components production with ultra-low aromatics and benzene. OILMARKET magazine met with the SIE NEFTEHIM President and CEO, Alexander Nikitovich Shakun.

The development of fuel markets in the modern world often poses the most unexpected challenges for technology developers.

Since the Euro1 standard was introduced in the countries of the European Economic Union in 1992, many countries of the world and even individual regional states in large countries, such as California in the United States, have joined the challenging and sometimes exhausting race to get ahead of clean motor fuels and gasoline in particular.

Some countries were not in a hurry to join the race for environmentally friendly fuels, but subsequently picked up such a pace that they were the first to launch Euro6, with tightly limited emissions of automobile engines, like Japan, which advanced from Euro1 to Euro6 in 2000-2009.

Other "slow starters" made a successful transition, despite the huge volumes of their markets, as was the case with Russia, India and China.

Over the span of the first two decades of the 21st century hundreds of refineries around the world, invested billions of dollars in the production of environmentally friendly fuels that determine the quality of emissions, and technologists often had to solve very complicated puzzles, predicting the petroleum or diesel fuels domination in the further development of the transportation and refining industry. In 2010-s, the increasingly dynamic development of the electromobile transport made these challenges even more complicated.

It should be noted here that, despite very dynamic progress with electric vehicles and the development of renewable energy, which will give more than 70% increase in energy supply by 2040, according to BP's authoritative review Energy Outlook 2040 for 2019, the demand for transport fuels by 2040 will increase from 56mn b/d (2.8bn t of oil equivalent per year) to 61mn b/d. (3.05bn toe/yr).

This increase in the production of fuels - 2mn b/d (or 100mn t of oil equivalent per year) will be accounted for by road transport — automobiles, trucks, as well as dynamically growing in Asia two and three-wheeled vehicles, as well as 3mn b/d (or 150mn toe/yr) for aviation and maritime transport.

Trillions of dollars will be required to produce these fuels, according to the BP Energy Outlook 2040 study for 2019.



Pictured: The President of the Krasnodar company Scientific Industrial Enterprise Neftehm Alexander Nikitovich Shakun

OILMARKET: I would like to immediately emphasize the importance of the further development of technologies for the crude output and motor fuels production in the coming decades so that the illusion of “quick and painless” switch from cars with combustion engines to electric cars today will not mislead anyone.

And now the first question - how do you see the key trends in the Eurasian markets in the production of environmentally friendly modern fuels for internal combustion engines?

ALEXANDER SHAKUN: In the context of the fact that many refineries in Russia, Kazakhstan and other countries of the Eurasian region, as well as in India and China have already completed quite expensive refinery upgrading projects for the production of environmentally friendly fuels, and investments in the coming years will be mainly directed in crude output, the market needs low-cost and, at the same time, effective solutions for the production of high-quality components of high-octane gasoline with a low content of aromatics.

Further development of gasoline consumption in environmental context, primarily aims to reduce the content of aromatic hydrocarbons, benzene and other harmful substances:

- 1) a decrease in the share of aromatic hydrocarbons to less than 25% vol.,
- 2) a decrease in the share of benzene to less than 0.8% vol.,
- 3) reducing the proportion of olefins to 4-10% vol.,
- 4) reduction in the share of MTBE to less than 7% vol.,
- 5) reducing the proportion of total sulfur to less than 10mg/kg.

It is important to emphasize the special urgency of reducing the share of aromatic components and benzene, which is crucially important for the engine emissions to meet Euro5 and Euro6 standards.

Regional trends in the environmentally friendly motor fuels markets are shown in Table 1.

Table 1 Tightening environmental requirements for modern automotive gasoline			
	EN 228(EU)	EPA-E10 (U.S.A.)	JIS K 2202(Japan)

Aromatics, % vol.	≤ 35	21 -25	-
Olefins,% vol.	≤ 18	4-10	-
Benzene,% vol.	≤ 1	0.6 -0.8	≤ 1
MTBE,% vol.	≤ 22	none	≤ 7
Ethanol,% vol.	≤ 10	9.6 -10	≤ 3
Sulfur, ppm mass.	≤ 10	8 -11	≤ 10

OILMARKET: *Isomalk-2, Isomalk-3 processes, developed by SIE NEFTEHIM, are very well known not only in Russian and the post-Soviet market, but also abroad - in Eastern Europe, India and China - everywhere where high-octane gasoline blends will be very relevant for decades and more for the cars as well as for the 2–3 wheeled vehicles. The Isomalk-2 process is the most large-scale solution for the production of environmentally friendly gasoline components in Russia since the beginning of the 21st century, which is ahead of all foreign licensors combined in the total volumes of isomerate production. Please tell us what's prompted your company to develop a new process for producing high-octane gasoline components?*

ALEXANDER SHAKUN: For refiners it is important not only to limit aromatics in gasoline, but also to reduce the operating costs of its production, to increase the yield of the target product.

The ISOPLAT process allows to increase the output of high-octane auto fuel components compared to traditional schemes, when C7 - hydrocarbons are distributed between the feedstock of the isomerization and reforming units.

This solution is suitable both for newly designed units and for already existing reforming plants, which is very important for refineries in Russia, producing K5 class gasoline under very tight state regulation.

This process is already at a very mature stage of development, the process and the catalysts have passed laboratory and pilot tests, the industrial production of catalysts has been mastered.



OILMARKET: *What is the main innovation of the process?*

ALEXANDER SHAKUN: In the world of oil refining, the well-known scheme for processing broad gasoline fractions (straight-run and secondary treatment) is widely used, which boils down to its separation into the IBP- (80) 70°C fraction and 80-180 (190)°C fraction. The light fraction undergoes isomerization, and the heavy fraction is reformed to obtain light non-aromatic isomerate and reformate with an aromatic content from 55 to 70% by volume.

The optimization of such a scheme in the last decade has been reduced to an increase in the yield of the product at the C5-C6 units — isomerization and reforming of the heavy fraction. Research and implementation of new catalytic systems is in progress. SIE Neftehim is one of the world leaders as a developer of isomerization catalysts and reforming catalysts for semi-regenerative reforming and reforming plants with continuous catalyst regeneration.

However, in order to further improve the efficiency of gasoline production by Euro5 standards and more stringent standards, it becomes obvious that it is necessary to embed a separate isomerization of the C7 hydrocarbons fraction (fr.70-105°C) into this scheme. Its distribution between the C5-C6 feedstock of isomerization and reforming leads to a non-selective transformation of C7-hydrocarbons, a decrease in the yield of the target product and an increase in the aromatic yield for the entire pool of the resulting auto fuel components.

We managed to develop a highly efficient C7 isomerization technology. ISOPLAT is another step in increasing the efficiency of introducing C7 isomerization fraction technology by combining the hydrogen circulation circuit of two separate units — C7 fraction isomerization and reforming the C8 fraction — EBP.

Ultimately, the ISOPLAT process allows to reduce the aromatic concentration in the auto fuel component, increasing its output and reducing operating costs.

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page 8

ISOMERIZATION is the main way to produce high-octane motor gasoline with low aromatics content according to the environmental standards Euro5 and Euro6.

Nowadays, there are only two low-temperature isomerization technologies that can compete in the world market: over highly-chlorinated alumina catalysts and over sulfated zirconia catalysts:

- Increasingly refiners give preference to zirconia isomerization catalysts as they are more reliable and more efficient in operation;
- Zirconia catalysts commercial field of application has been widened: from C5-C6 isomerization to C4 isomerization.

Application of non-chlorinated catalytic systems breaks new ground in C7-fraction isomerization.

page 11

In 2018 the TATNEFT's TANECO Oil Refining Complex in Nizhnekamsk launched the naphtha processing complex comprising Isomalk-2 isomerization unit for 420,000 t/yr.

Nail Maganov, General Director of TATNEFT pointed out that the Nizhnekamsk became the place for establishing oil processing facilities of the new technological generation providing for the maximum processing depth.

Commissioning of the complex is an important step making it possible to produce high-octane gasoline grade that corresponds to the Euro5 ecological class.

JSC TANECO light naphtha isomerization unit 1800 section has been built without using any foreign equipment. Unit start-up and commissioning with production of isomerate with more than 92 RON were completed in the shortest possible time. It is due in no small part to the supervision of the process Licensor and developer of the Basic Engineering Design - SIE Neftehim, LLC - at all process implementation stages. Licensor's skilled experts supervised the unit Detailed Engineering and construction, unit preparation for start-up, catalyst loading, commissioning and test run.

page 12

Omsk refinery is the largest among Russian and European analogues, and is in the top three of the world plants of the type with the highest capacity makes 800,000 t/yr. Isomalk-2 produces isomerate — a high-octane component of commercial gasoline with minimal content of sulfur and aromatics to produce Euro-5 compliant motor gasoline.

