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# THE PROCESS OF PENEX COMPANY UOP

***DZMITRY YUKHNO, DZMITRY SIARHUTA, SERAFIMA PAKROUSKAYA***
**Polotsk State University, Belarus**

*This article deals with the process of low temperature isomerization in the light part of gasoline cut, as one of the ways of improvement of the commercial gasoline quality.*

The evolution of engine-building, the improvement of its construction, the reinforcement of ecological requirements have made it essential to use better quality benzene. Right in this article we will try to describe the process of obtaining ecologically pure components of the commercial gasoline.

The most suitable isomers, needed for the improvement of starting qualities of benzene, are ethyl-methyl ethane and caproyl hydride. These isomers can be obtained from straight-run gasoline fractions. These fractions are characterized by the low disquisitive octane level, which usually fluctuates from 60 to 70. This fraction, which is used to constitute 10 per cents of the gasoline blending fleet in the USA and even more in Europe, was just added into benzene without any farther refinement, not taking into account the removing of alkyl hydrosulphide.

But it has been shown that one must invert paraffin hydrocarbons $C_5$ and $C_6$ of normal pattern into the correspond branched isomers, in order to improve their disquisitive octane level. One of the variants of such an improvement is the suggested UOP process Penex, where highly active low temperature hydroisomerization catalyst (industrial aluminum platinum catalyst, promoted chlorine) is employed [1]. The platinum catalyst with aluminium oxide when employed into $Al_2O_3$ 7 – 10 per cents of haloid, has very high acid activity that is why the process of isomerization is successfully carried out under 100 – 130 ° C [2].

Since the fraction which takes up 10 per cents of gasoline distillation is responsible for the starting process, the strategic implementation of Penex process appears in evidence. That is – the purification of the benzene quality with intent to improve the benzene starting process by means of improving knock characteristics of gasoline light particle(the increase of octane number). The startability is characterized by: the pressure of startup steam and the octane level. During the isomerization process these two factors are regulated simultaneously: the improvement of theoctane leveldue to the migration of methyl group(s) and due to the lowering of the isomerizate boiling temperature. That results in better evaporation and, accordingly, in the increase of prime steams pressure. The main characteristics of octane hydrocarbons and their isomers are shown in Table 1.

Table 1. The main characteristics of the octane hydrocarbons $C_5$–$C_7$

| Hydrocarbons | Octane number (MON) | Octane number (RON) |
|---|---|---|
| n–$C_5$ | 61,9 | 61,7 |
| i–$C_5$ | 90,3 | 92,3 |
| n–$C_6$ | 26 | 24,8 |
| 2–methylpentane | 73,5 | 73,4 |
| 3–methylpentane | 74,3 | 74,5 |
| 2,3–dimethylbutane | 94,3 | 101,7 |
| n–$C_7$ | 0 | 0 |

One can see from the Table 1 that it is highly efficient to use hydrocarbons upto$C_7$. The products of isomerization have low sensibility (the common difference between the researched and the engine octane levels). And this is highly important for the operational qualities of the commercial gasoline. It is also seen from the Table 1 that caproyl hydride should be well recycled.

The reactions of the paraffine hydrocarbon's isomerization are balanced:

$$n - C_5H_{12} \underset{}{\overset{t}{\rightleftharpoons}} i - C_5H_{12}$$

They are carried out almost without any changes in its volume, that is why the thermodynamic equilibrium depends only on the temperature; low temperatures contribute to the formation of the isoparaffin hydrocarbons. The thermal effect of the isomerization reaction is not rather big – from 2 to 20 kJ/moth and changes very little during the temperature vibrations. The reaction's mechanisms are carbocationic [3].

The reactions act in attendance to the hydrogen in the fixed layer of the catalyst under the operating conditions, contributing to the isomerization and preventing hydrogen cracking. These operation conditions are far not tough, as evidenced by the moderate operating pressure, low temperature and high partial pressure of the hydrogen [1].

On the Table 2 you can see the operating conditions of "Penex".

Table 2. The operating conditions of "Penex"

| Conditions | Range |
|---|---|
| *t*, °C | 120–180 |
| *P*, MPa | 3–4 |
| Contentof $H_2$inhydrogen-rich recycle gas, %w. | ≥ 95 |
| Content ofbenzol inraw material, % mass. | 1–5 |

One of the important characteristics of raw material is the content of benzol in it. The content should usually not exceed 5 per cent, as benzol is hydrogenated easily, respectively, it raises the operating temperature and lowers considerably theoctane number of the isomerizate (seeTable 1).

In summary: The process of low temperature of isomerization "Penex" allows getting a high quality component of the commercial grade fuel, which meets ecological requirements as well as the usage conditions, as the main component of the commercial gasoline in modern engines.

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