FÁBRICA CARIOCA
DE CATALISADORES

ISOZOOM

Additive for maximum octane barrel and C4´s generation

The refinery gasoline pool octane is determined by the aggregated performance of several process units. The conditions and operation strategies are of utmost importance, but many refiners do not owe an operating window for generating significant octane increases based exclusively on these kinds of movements.

Working to boost the refiner's flexibility, the Fábrica Carioca de Catalisadores S.A., along with the Petrobras and Ketjen research centers, developed the ISOZOOM additive, a catalytic solution based on the increased yield in better quality cracked naphtha in the FCC unit for the maximization of gasoline production in a refinery.

How octane is increased

To meet the demand for higher octane gasoline, the refiners can choose as strategy the use of ZSM-5-based additives (Figure 1). The small-diameter pore system of this zeolite allows the inlet of only linear compounds in the range of naphtha and LCO which are cracked inside the crystal, producing high octane species.

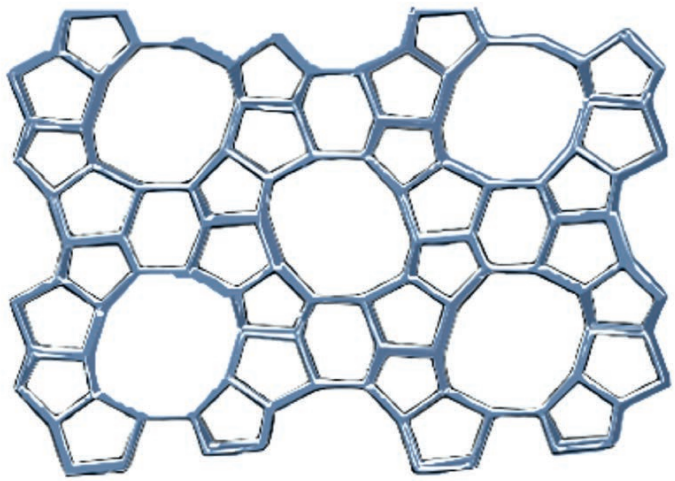

Figure 1: ZSM-5 zeolite porous structure.

These reactions consume the olefins and C_7 to C_{10} linear paraffins in the naphtha boiling range for producing chiefly light C_3 and C_4 olefins that make up LPG. Thus, the increased LPG yield is obtained at the expense of naphtha production loss. This effect is a benefit for the refiners who provide propene to the market; for others, however, this can be a nuisance by surcharging the gas compressor and LPG treating units operation.

The ISOZOOM additive was developed to meet the needs of the customers aiming at boosting octane at minimum cracked naphtha production loss and lower wet gas production, securing the refiner more flexibility and providing optimization of yields and product quality to increase the refinery profitability.

The ISOZOOM differential

What makes the ISOZOOM additive different from the ZSM-5-based additives are its formulation and manufacturing technology, enabling a more selective reaction mechanism for isomerization relative to cracking.

ISOZOOM does not crack nor creates aromatic compounds, but increases their concentration in the cracked naphtha by consuming the linear species. In this additive the zeolite has more accessible, stronger and more apart active sites, so the olefins that are formed in the naphtha range are consumed before undergoing hydrogen transfer and becoming low -octane paraffins. These properties favor the formation and preservation of branched compounds, resulting in improvement of the gasoline octane.

The naphtha boiling range long chain olefins are low-octane. ISOZOOM selectively cracks these olefins into propene and butenes, concentrating the branched and aromatic molecules in the cracked naphtha, increasing its octane.

Figures 2 and 3 compare the PIANO analysis (paraffins, iso-paraffins, aromatics, naphthenics, iso-olefins and olefins) of the gasoline obtained with an ISOZOOM-

containing catalyst system and another one obtained with a conventional additive. Figure 2 demonstrates that the gasoline obtained with ISOZOOM has more branched, unsaturated and naphthenic molecules (the linear paraffins were not shown) that contribute to the octane and are translated into a higher gasoline volume when compared to the conventional additives.

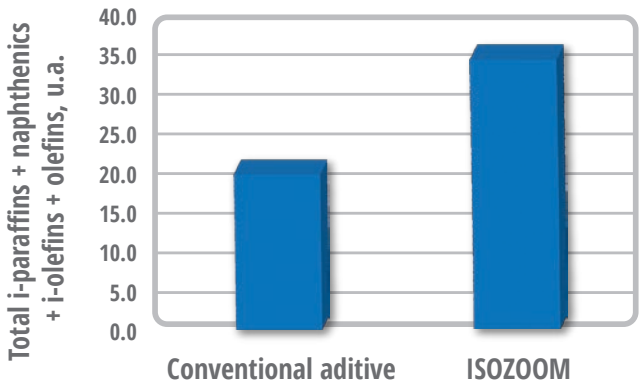

Figure 2: PIANIO of the gasoline obtained with ISOZOOM compared with a conventional additive.

On the other hand, the gasoline resulting from the use of the conventional additive is more aromatic than that obtained with ISOZOOM, because of the deeper degree of the cracking reactions (Figure 3).

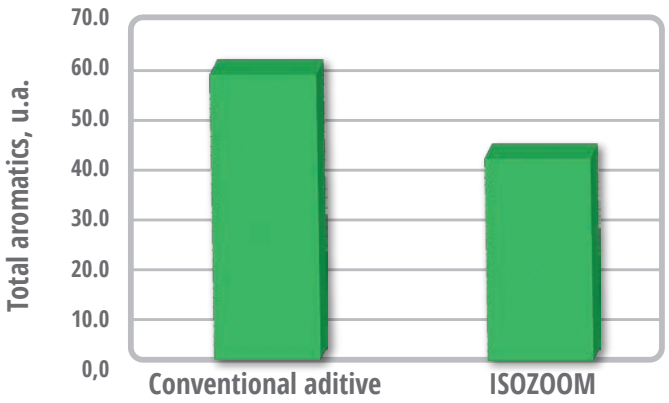

Figure 3: PIANIO of the gasoline obtained with ISOZOOM compared with a conventional additive – total aromatics.

The prevalence of the isomerization mechanism over olefin cracking provides an additional advantage: when these molecules are hydrogenated in the HDS unit, they are transformed into branched paraffins, therefore preserving the gasoline octane.

ISOZOOM: proven success for the gasoline octane boosting

An industrial test demonstrated the effectiveness of the ISOZOOM additive to boost the gasoline octane as compared to a catalyst system without additive. Table 1 lists the increase of 1.2 points of MON, chiefly caused by the higher aromatics concentration in the gasoline boiling range.

A further evaluation has shown that for the same yield in cracked naphtha, the ISOZOOM additive leads to octane gains when compared to conventional additives,

	Delta (ISOZOOM - base)
Conversion, w/w%	+ 0.8
Delta coke	- 0.002
LPG w/w%	+ 1.8
Naphtha, w/w %	- 1.6
RON	+ 0.1
MON	+ 1.2
Olefins (%)	- 2.2
Aromatics (%)	+ 5.0

Table 1: ISOZOOM effect compared with a system without additive.

as seen in Figure 4. This provides the refiner a larger operating margin so he may now add a higher amount of naphtha DD to the gasoline pool, increasing the gasoline production and, consequently, his profitability.

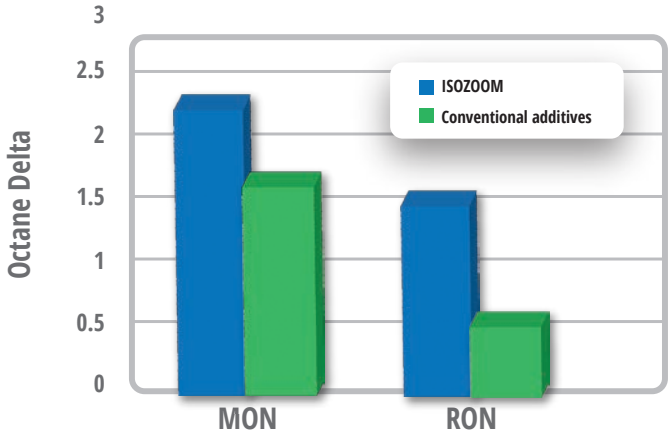

Figure 4: Octane gains with ISOZOOM compared with conventional additives for the same yield in cracked naphtha (source: lab studies).

In Figure 5 the octanes-barrel (MON-barrel) of the ISOZOOM-containing catalyst system are compared with a base case containing a conventional additive. The assessment was obtained in a ACE unit, with the respective e-cats.

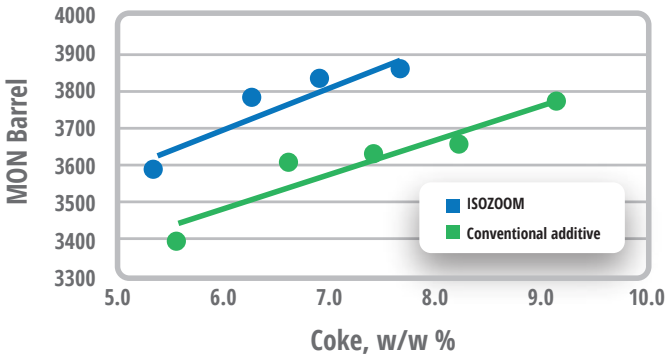

Figure 5: ISOZOOM octanes barrel production compared with a conventional additive.

LPG produced by ISOZOOM is more butane-rich, suitable for use as an alkylation feed

In a commercial comparison of ISOZOOM against a catalyst system without additives, it could be observed that, besides producing more propene than the base case, the LPG produced by ISOZOOM is richer in isobutane, which also renders it advantageous for use as alkylation feed.

Figure 6 demonstrates that the isobutane/propene ratio is higher for ISOZOOM than for the base case.

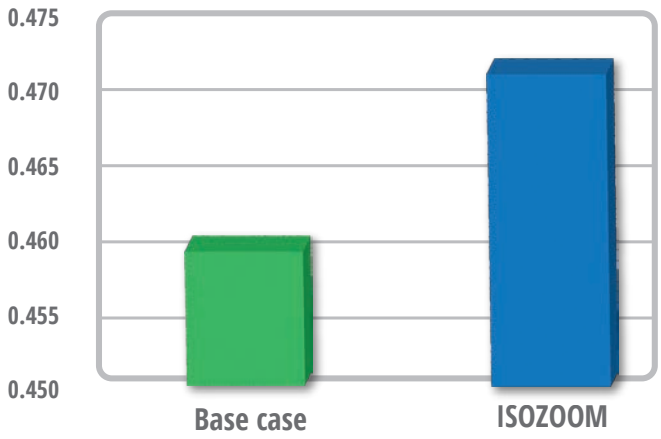

Figure 6: iC4/C3= ratio for LPG produced by ISOZOOM vs. base case.

When the refinery includes an alkylation unit, the isobutane and the butenes generated by ISOZOOM may be alkylated and integrated to the gasoline pool as high octane, low sulfur components. Besides, ISOZOOM favors the isomerization reactions of the naphtha boiling range molecules, yielding branched compounds that contribute to improving naphtha octane.

When the refinery goal is a high yield of high-octane gasoline, the choice should fall on **ISOZOOM**.

Benefits of ISOZOOM

The ISOZOOM additive provides the following advantages:

- Increased octane of the cracked naphtha, enabling the addition of higher amount of naphtha DD to the gasoline pool;
- Higher isoparaffins content in gasoline;
- Octane preservation when naphtha undergoes port-treatment for sulfur reduction (HDS);
- Olefins C4- and isobutane-rich LPG, suitable for alkylate production;
- Higher gasoline production and lower LPG production relative to ZSM-5-zeolite-based conventional additives.

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For more information, contact the FCC S.A. Technical Services team

ABOUT FCC S.A.

FCC S.A is a leading-edge technology company, with headquarters in Rio de Janeiro, comprising the Petrobras S.A. and Ketjen companies. Being the sole manufacturer of catalytic cracking catalysts and additives for petroleum refining in the South-American market, its consumer customers are the refineries of the Petrobras Systems, as well as the petroleum refineries of South-American countries.

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