Two Great Organizations
United by a Catalyst

Colombia’s largest company, ECOPETROL, and the world leader in the catalyst market, Grace, have joined their talents and resources in an innovative research project. The result is a catalyst with international projections to increase diesel production; this is evidence of the success of strategic alliances in research, development and innovation and confirmation that ECOPETROL has world-class talent.

By developing a new catalyst in a joint project with Grace, ECOPETROL has scored very high.

The implications of this new technological product are related to:

i. The quantity and quality of the fuels produced in Colombia
ii. The national and international energy market
iii. ECOPETROL’s corporate strategy and international projections
iv. Current and future models for the undertakings in Research, Development and Innovation of the Colombian Petroleum Institute (ICP)

Within the national and global scale, the trend is that diesel consumption is growing at a faster pace than gasoline consumption. This phenomenon is evident in Latin America, Europe and the Asia-Pacific region. The price of diesel is now higher than gasoline in many markets.

The refining strategy in ECOPETROL is currently focused on gasoline, and crude processing is based on Fluid Catalytic Cracking (FCC). As is customary, these types of units (four in Barrancabermeja and one in Cartagena) are designed with gasoline as the main product. The FCC also produces a stream called Light Cycle Oil (LCO) with yields usually in the 15-18% range. The LCO has a distillation range similar to diesel, and a small portion of this stream (between 4-5%) is eventually used for diesel production.
The Colombian market for diesel is growing rapidly, and it is necessary to find options to increase the availability of this product. Since the FCC technology is the main technology for processing crudes in ECOPETROL, it was logical to find alternatives for increasing diesel yields from this process.

There are many alternatives for obtaining more LCO from an FCC, which include unit severity optimization, changes in the equipment’s internal design, changes in the catalyst or a combination of these options. The engineers at the ICP concluded that it was necessary to develop a suitable solution within the existing refinery infrastructure, while the Master Plans for the Reconversion of the ECOPETROL Refineries take place. After analyzing these options, they concluded that the appropriate solution was an innovation in the FCC catalyst.

The catalyst that is used in the FCC is silica and alumina-based, which accelerates the process reactions and increases the yields of the more valuable products.

The Best Option

At this point the question was: What would be the most appropriate mechanism to seek this innovation? There were three routes: (1) ECOPETROL would absorb all of the expenses and would perform all of the Research and Development work; (2) Wait for an outside company to manufacture the catalyst that was required; or (3) Form an alliance with a specialized company.

Each option had its advantages and disadvantages. After evaluating aspects like time available, internal capacity, extrapolation of the laboratory results to commercial production (scalability), development costs and success probability, it was concluded that the best decision was to create an alliance for this research.

After considering various proposals, the partner chosen was W. R. Grace, a company that was founded in 1854 in Peru by an American business man, and is presently a world leader in products based on silica and alumina oxides.

ECOPETROL found Grace to be the appropriate partner, since its researchers were thinking along the same path. The company supplies 35-40% of the FCC catalyst to the worldwide market, and has vast experience in specialty chemicals since its Research and Development team is one of the best in the world. Yet similar reasons were recognized by the American company, as Rubén Cruz, Grace RT General Manager, Latin America, explains: “In ICP we found incredible human capacity, knowledge, laboratory facilities and the desire to cooperate and to improve. It was exactly what we were looking for. It was very easy for us to make the decision. ICP is the partner with which we will associate to develop new technologies and new catalysts”. Cruz considers Colombia as a “leader” in the operation of catalytic units in Latin America and “probably the world”.

At Work

The challenge that the team from both organizations faced was to develop a catalyst that improved the LCO yield without affecting conversion, while minimizing the loss in gasoline. It was a major challenge, since there were no reports in the literature that revealed similar results, nor catalysts with this performance. It was necessary to complete an exploratory phase in the laboratory. During this stage, over 50 different formulations were evaluated in reactors using catalyst samples whose size varied between 5 and 8 grams. This work took almost a year and a half.

There were months of constant contact, data revisions, laboratory testing, verification of the requirements of ECOPETROL’s units and travelling of employees from both organizations to each other’s Research Facilities (Piedecuesta, Colombia and Baltimore, MD, USA) to assure good advancement on the project. The team was formed of five people from ICP, including the group leader and laboratory technicians, with the constant follow up from personnel at the management level, and a similar team from Grace.

After the initial process, the best two options were selected. Simultaneously, ICP developed process changes in the pilot plant that, which, in compliance with terms of the agreement, ECOPETROL patented as its own products. It deals with actions or mechanisms that lead to controlling many variables, including temperature, flow and feed treatment that allow optimizing the final result.

Afterward, the best formulations were tested in the pilot plant. The facilities and the procedures that were developed at ICP were used for catalyst evaluation and selection.

At this point it was necessary to perform two experimental cycles in the pilot plant, since the first formulations revealed high coke yields. The adjustments were agreed by both teams and a new group of samples was prepared.

From these, one catalyst with a very high potential was chosen. The new catalyst increased LCO yield by 4% without lowering conversion with only a slight loss in gasoline. The LCO obtained with this catalyst is of better quality than that generated from a conventional catalyst. This means that greater quantities of LCO can be added to the diesel pool (between 5 and 7%).

The results allow increasing the profitability of the refining process. At the same time, it generates an alternative to address, at least partially, the increasing demand for diesel without having to wait for the construction of new facilities.

The Future

The results obtained so far are very positive and both companies are working to convert this development into a commercial reality. “It is the first technology that has substantially improved the product yield...
and quality. We are very proud to arrive at something that has tried to be achieved for the past 15 or 20 years, and now we have finally arrived at this point,” said Cruz.

Once the final tests have been completed, the catalyst would be commercialized worldwide. This not only meets the specific needs of ECOPETROL, its potential includes Latin America, Europe and the Asia-Pacific Region.

The product is a concrete result. It is also a success story for strategic alliances in the development of innovative technologies. In ECOPETROL’s vision for 2020, the company will be characterized as one of the 30 leading companies in the petroleum industry, known for, among other reasons, its international positioning and its innovation.

In the future, ICP is considering an expansion strategy in three areas: fundamental research leveraged from specialized centers and universities, cooperation with organizations that are leaders for specific solutions, and the drive to create technology-based companies in order to license technologies created by ECOPETROL.

The joint work with Grace demonstrates the advantages of cooperative work. "For example, Grace, which has a strength in catalyst, teamed up with us to develop a new catalyst to improve diesel production. Through agreements, where we both win, we look for solutions for ECOPETROL, with a moderate risk in research" explains Néstor Fernando Saavedra, ICP Director. To innovate is not only to invent something: it is to apply creative schemes to put technology at the service of society. That is what it means to be world-class.

Grace Introduces TITAN™

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No more concerns for the elevated NOx, hydrogen, dry gas or coke created by use of traditional equilibrium catalysts, because TITAN™ contains no nickel, no vanadium and no additives. With the benefit of Grace Davison’s unique, environmentally friendly manufacturing process, TITAN™ can be offered with no rare earth surcharge. Only Grace Davison has the logistics capability to provide blends of TITAN™ with any combination of fresh catalysts, equilibrium catalysts and additives and TITAN™s performance is backed by the support of our Grace Davison world-class Technical Service team. So if you’re looking for quality, consistency and reliability, try the unique catalyst only offered by Grace Davison: TITAN™.

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