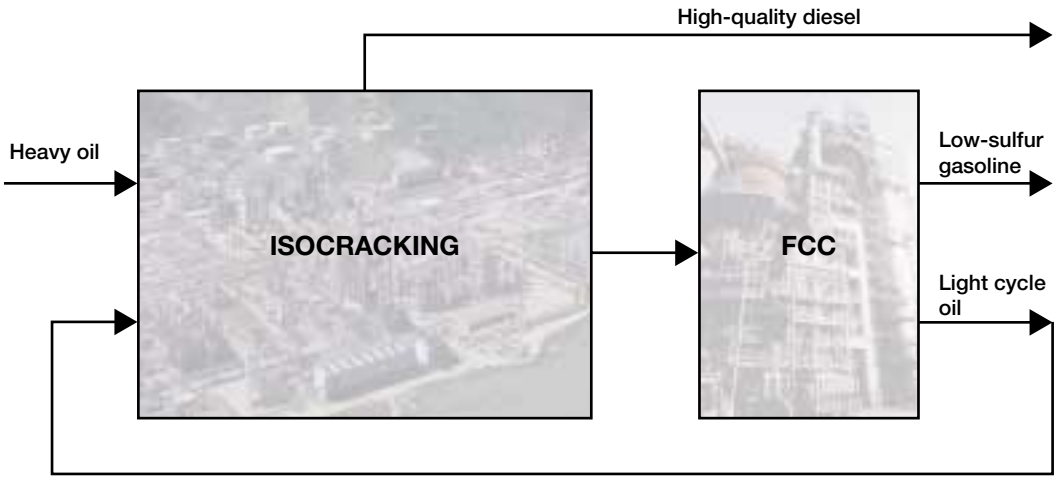
# Unique catalysts help crack the sulfur problem




Demand for diesel fuel is rising by three to four percent a year, and in the world's most pollution-prone countries – like China, India and Russia – demand is growing even faster.

But, as with all other types of fuel, the pressure is on to manufacture diesels that are cleaner and greener. Tough environmental legislation and penal tax systems aimed at controlling the use of the dirtiest fuels means that refiners and petrochemical companies are constantly searching for ways to produce the popular fuels in forms that hurt the environment less. Simultaneously, refiners are trying to improve low profit margins by processing the cheapest and consequently most sour crudes – those laden with contaminants.

ABB has formed a 50/50 joint venture with Chevron (Chevron Lummus Global) to exploit and license a Chevron technology that holds the key to cleaner diesel and to extract other, more valuable distillates from the refining process. The technology, a form of hydrocracking, is called Isocracking.

Hydrocracking is the refining process that converts high sulfur- and other contaminant-laden heavy molecules to smaller, cleaner compounds that are used in transportation fuels such as gasoline, aviation turbine fuel and diesel. It takes place in catalytic reactors in the presence of hydrogen and usually under relatively high pressure.

The process is extremely flexible and the refiner can modulate the production of gasoline and diesel to suit seasonal and market demand. What distinguishes Isocracking from other hydrocracking processes is its ability to produce higher yields of aviation turbine fuel and diesel starting from the same feed source while consuming the least amount of high-priced catalyst and hydrogen.

Isocracking is also the only significant licensed process to be supported by experience from operating refineries. Chevron operates seven hydrocrackers.

From an environmental standpoint, Isocracking has two important functions:

Firstly it produces high-quality diesel with low aromatics. Aromatics are the molecules in fuel that are difficult to burn in an internal-combustion engine. Some, like benzene, are carcinogenic.

High levels of unburned material in the fuel exit the exhaust pipes of trucks, vans, tractors and cars as highly polluting suspended particulate matter (SPM) in the fumes. Isocracking reduces the aromatics to very low levels.

Secondly, Isocracking converts harmful sulfur and nitrogen compounds in heavy oils to compounds that can be trapped and removed from the environment. There is virtually no $SO_x$ or $NO_x$ – gases that cause acid rain – emitted from the plant. The latest generation of diesel and gasoline engine systems requires an extremely low level of sulfur in diesel – providing additional motivation for the refiner to produce cleaner diesel.

The key benefit of the technology is that it allows refiners to use heavy oils – which would normally only be useful for fuel oils used in ships and power plants – to create far more valuable gasoline, aviation jet fuel and/or diesel efficiently and cost-effectively. In addition, Isocracking does not have the negative environmental impact of a process such as fluidized catalytic cracking (FCC), the most widely used heavy-oil conversion process in refineries.

The FCC unit has been used for decades to convert heavy oils to gasoline and a product called light cycle oil (LCO). Both these products are very high in sulfur content. The light cycle oil is laden with aromatics. In the past, LCO could be blended into the diesel pool with little or no treatment.

The refiner's dilemma is what to do with the FCC unit in today's stringent environment, where gasoline has to have less than 30 parts per million (ppm) of sulfur, and diesel very low aromatics and sulfur. A variation of Isocracking, called Mild Isocracking, is the answer.

A relatively low-severity Isocracking unit is included upstream of the FCC unit to trap most of the contaminants in the heavy oil. The process also produces a significant quantity of clean diesel. The cleaned heavy oil can now be fed to the FCC unit to produce clean fuels from which useful products can be more easily refined. This use of Isocracking has a huge potential in Western Europe and the United States.

Chevron has designed more than 50 Isocracking units in the last 35 years, but constant refinements to the process and development of cleverer catalysts in association with ABB ensure that demand for this type of refining process remains strong.

The process now has a family of some 25 different catalysts, used for producing everything from gasoline to distillates. The wide array of catalysts permits catalyst systems to be designed to meet the specific requirements of a particular refiner.

In the last year, important projects have been completed or launched around the world, including one in a refinery near the Taj Mahal in India to prevent pollution from destroying the marble of the famous monument.

Applications of mild hydrocracking are expected to be particularly sought after in Europe, where demand for ultra-low sulfur diesel is especially high. Underscoring the need is a recent project in Sweden which has called for the production of diesel with a sulfur content as low as 10 ppm.