In a market considered mature and risk averse, ABB – with a 40 percent market share, the world's leading provider of olefins technology – has unveiled a family of breakthrough solutions. Together, they lead to significantly lower capital costs, reduced energy needs and vastly increased operating margins for olefins plant operators.

New ethylene technologies

Olefins plant operators are today facing diminishing margins and uncertainties in feedstock pricing and availability as well as in product valuation. The chemical complexes in which olefins – such as ethylene and propylene – are produced cost upwards of US$ 500 million and include over 350 major pieces of equipment. Not surprisingly, the industry is constantly on the lookout for solutions with the ability to both lower first-time costs and improve operating margins. ABB's response has been to develop new ethylene technology that can:

- Reduce the capital cost of the ethylene plant by 15 % through the elimination of over 85 pieces of equipment.
- Reduce the energy required for the process by 12 %, thereby reducing greenhouse gas emissions by that amount.
- Change the process chemistry by upgrading lower-value byproducts to higher value-added products, and so increase the operating margin by as much as 30 %.

These solutions are a combination of several distinct innovations:

- *SRT X, a redesign of the cracking heater:* Cracking heaters represent approximately 30 % of the capital cost of an olefins plant. Using computational fluid dynamics (CFD), the energy density of this reaction system can be increased by 30 %, for a 10% reduction in capital cost.
- *CDHydro® technology for front-end hydrogenation, representing a change in process chemistry:* CDHydro technolo-

Construction site for the semi-commercial demonstration plants for CDHydro technology for front-end ethylene and Automet processes. Tianjin Petrochemical Complex, Tianjin, China.

gy for front-end ethylene introduces a new unit into the olefins plant flowsheet. Based upon the catalytic distillation technology of CDTECH®, the hydrogen in the cracking heater effluent is removed by chemical reaction rather than cryogenic fractionation. By incorporating CDHydro technology for front-end ethylene, capital costs can be reduced by over US$ 15 million and over 44 pieces of equipment can be eliminated.

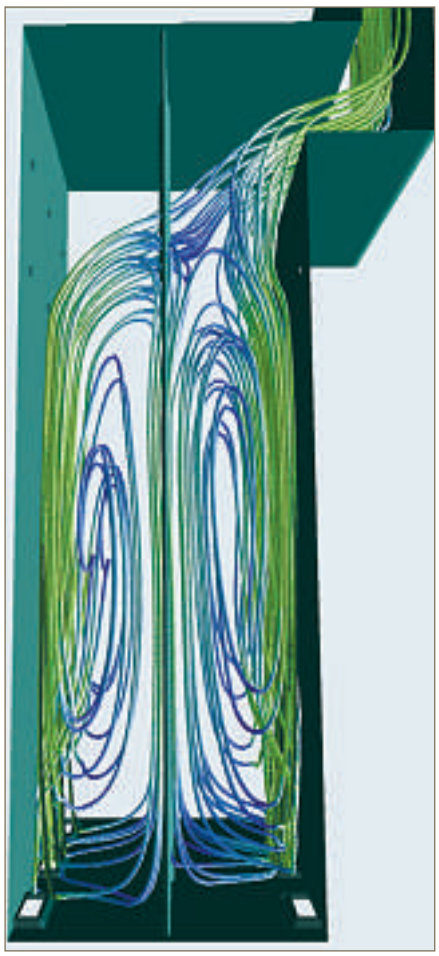
- *Two engineering advances having a substantial impact on product separation:* In olefins plants, considerable refrigeration is required to separate the low-boiling products. The conventional method comprises three separate refrigeration systems, ranging in temperature level from +20 °C to –140 °C. ABB has developed binary and tertiary refrigeration systems that combine these services into either two (binary) or one (tertiary) system. This allows a substantial saving in rotating equipment, an area normally absorbing 20% of the capital investment in the plant.
- *Introduction of new process chemistry – OCT and Automet:* This enables the plant operator to upgrade lower-valued byproducts into higher-valued products, including 1-hexene, a valuable alpha olefin used as a co-monomer in polyethylene.

Commercialization

After ABB had identified these innovations and developed basic data, a technology cooperation agreement was signed which serves as the vehicle for commercialization of all aspects of the new technology. Sinopec (China Petroleum and Chemical Corporation), the cooperation partner, is a publicly listed company with integrated upstream and downstream operations and a complete marketing network. Some elements of the new technology are already in the marketplace.

In December 2001, the Yanshan Petrochemical Company revamp incorporated binary refrigeration and CDHydro technology for methyl acetylene/propadiene hydrogenation (MAPD), a forerunner of the full CDHydro technology for the front-end ethylene concept. These two new technologies started up smoothly and the unit is operating at full capacity. The recently awarded Qilu ethylene plant expansion will incorporate the tertiary refrigeration system.

The expansion of another Far East olefins unit will include the tertiary refrigeration system and CDHydro technology for back-end ethylene, another of the catalytic distillation options for the C3/C4 acetylenes removal flowsheet.



By using CFD to study the aerodynamics, a modern ethylene cracking heater can be optimized for a substantial economic advantage.

The final elements of the new technology package will be demonstrated on a semi-commercial scale using feedstocks from the Sinopec Tianjin olefins plant. This demonstration facility will incorporate the new process chemistry elements of the new olefins technology. Construction of a CDHydro unit for front-end ethylene with the equivalent capacity of 2000 MTA ethylene and an Automet plant for 1-hexene production with a nominal capacity of 1500 MTA 1-hexene is expected to be completed by early 2003.

OCT and Automet

OCT and Automet are two processes that utilize metathesis chemistry to upgrade byproducts. This chemistry permits the rearrangement of the double bonds between olefins. Besides enabling the plant operator to upgrade lower-valued byproducts, metathesis chemistry also provides flexibility as a hedge against market uncertainty.

With OCT, a two percent feedstock reduction and a margin increase of up to US$ 45 million are possible for a typical olefins plant. Utilizing the Automet option, the gross margin of the entire ethylene plant can be increased by as much as 30 percent, or by over US$ 90 million per year

Olefins

Olefins are produced from a variety of feedstocks using a high-temperature thermal reaction to literally shatter the feed. This reaction occurs at temperatures exceeding 900°C in a series of cracking furnaces with a fired duty in the order of 250 MW. A wide variety of products are formed, from hydrogen to fuel oils. By controlling the reaction conditions, light olefins such as ethylene (two carbons), propylene (three carbons) and butenes (four carbons) are maximized. In addition to the olefins, however, some undesirable molecules are also produced. These byproducts negatively impact the overall margins for the olefins plant unless they are further upgraded.