PERP Program

December 2000

Chem Systems' Process Evaluation/Research Planning program has published a new report, ***Extending the Methane Value Chain (99/00S9)***.

Abundant natural gas resources are becoming available in many remote locations around the world. The drive to monetize these resources by governments and industry has intensified in recent years. LNG technology provides one method for transporting the otherwise stranded gas to market, but the capital intensive infrastructure requirement can be cost prohibitive. Emerging gas-to-liquids technologies may play a significant role in the utilization of remote natural gas, however, they have yet to be commercially proven.

Recent process improvements in methane reforming to produce synthesis gas (syngas) and so-called mega-scale production technologies for methanol could provide an effective means for monetizing remote natural gas.

Currently, acetic acid and formaldehyde are the two key derivatives of methanol. In addition, the current methane value chain also includes syngas to ammonia/urea, methane to acetylene, hydrogen cyanide, carbon disulfide, halogenated derivatives, etc.

Although a C_1-based chemical industry is not a new concept, (sky-rocketing oil prices in the late 1970s and early 1980s caused a flurry of research into C_1-based process chemistry) improved synthesis gas and methanol economics are renewing interest in the C_1-based petrochemical process technology. Extending the methane value chain involves production of petrochemical feedstocks from natural gas now made from olefins via conventional routes. As such, natural gas will play an ever increasing role as a global hydrocarbon resource.

Improved methanol economics will first translate to better economics for its immediate derivatives - acetic acid and formaldehyde. Low-cost methanol will benefit the current state-of-the-art methanol carbonylation processes for producing acetic acid such as Celanese's Acid Optimization process and BP's iridium catalyzed process (CATIVA process). The resulting low-cost acetic acid will in turn benefit the manufacturing of vinyl acetate by acetoxylation with ethylene. Other derivatives of acetic acid might also be considered.

Similarly, improved methanol economics will result in a low-cost production of formaldehyde which, in turn, could become a potential feedstock for ethylene glycol via a previously used process by DuPont (abandoned in 1968).

Another area that has attracted special attention recently is the technologies for converting methanol to olefins (MTO). UOP/Norsk Hydro ASA have made good progress in MTO technology development. Although MTO is not yet competitive with conventional petroleum-based sources of olefins, low-cost methanol will help improve the viability of the MTO process and allow the basic petrochemical building blocks -- ethylene and propylene -- to be produced from methane.

The objective of this study is to revisit, under the context of low cost stranded methane and improved methanol economics, some previously developed but abandoned, and some improved C_1-based technologies and processes. Some of these processes have been previously deemed to be "a technical success but economic failure" under a very different set of economic conditions and environment.

The figure below depicts the potential extension of the methane value chain and the routes for petrochemical feedstocks from methane via syngas/methanol as described above.

EXTENDING THE METHANE VALUE CHAIN