

ASIACHEM: 2010 China Coal Chemical Review

In 2010, the world oil price returned back to the interval between USD80-90/bbl, which further consolidating the cost competitiveness of coal derived chemicals. At the background of revived economy, global petrochemical market has been increasing warm up in past year, most Petrochemical products has significant growth of consumption and higher price in China market.

Better growth prospect of Petrochemical products also brought wider foreground for Coal based products, such as coal-to-liquid fuels (CTL), coal-to-olefins (CTO) and coal-to-mono ethylene glycol (CTMEG) etc. Coal-based synthetic natural gas (SNG) would also benefit from the demand growth and uprising price of Chinese natural gas market. Even traditional coal chemicals like ammonia, methanol, coke and calcium carbide also experienced a rebound of price and consumption; however the operating load rate for these products was yet depressed by the lasting overcapacity.

What achievements were obtained by the new coal chemical demonstrative projects? What's the update of national policies? And how about the breakthrough made by the Chinese coal chemical technologies researchers and developers? As a dedicated coal chemical consultancy, ASIACHEM would like to have a review on China coal chemical industry in the past year, and look forward the developing trend in future.

1. CTL demonstration realized long-term & steady operation

After started up successively in 2009, several Chinese CTL demonstration units realized long-term steady operation in 2010. Both the direct CTL (DCTL), developed by Shenhua Group and Synfuels' indirect CTL (ICTL) processes were adequately verified by demonstrative operation.

Up to December 2010, Shenhua DCTL unit had been cumulatively operated on coal-input for over 6200h with a 70%-plus operating rate. The unit was operated on design specification of all the main working parameters and outputted fully on-spec products.

Up to October 2010, Yitai CTL unit had kept under operation for cumulative 6612h and outputted 101118t of various oil products. From May 25th to October 31st, the unit was maintained 3816h of continuous operation under the load rate between 80%—110%. Another project also using Synfuels' ICTL technology, developed by Lu'an Group, realized stable production in this year, too.

At the same time, as CTL entered the stage of long period operation, CTL products also

found their way into the market. In February 2010, Inner Mongolia Yitai Refined Oil Marketing Co Ltd obtained license from MOFCOM for oil product wholesales. This is the third license granted to a Chinese CTL player, after Shenhua CTL & Chemical Co Ltd and Shenhua Ordos CTL Branch. Sales of CTL products are welcome on the market due to their premium quality.

Good performance of the F-T synfuel process of Chinese intellectual property right lent confidence to Chinese investors to build following CTL projects of mega size. Yitai CTL Company proposed a plan for 5.4Mt/a CTL plant located in Ordos. In October 2010, China Development Bank and Yitai Group signed up a finance package agreement in Beijing, involving CNY60bn of loan to support Yitai's CTL project as well as a branch railway for coal transportation. In November, Lu'an Group and Changzhi City of Shanxi Province jointly held a meeting to speed up the front-end preparations for Lu'an 5.4Mt/a CTL and chemical polygeneration project.

As for Sino-foreign joint venture, Shenhua Ningxia Coal-SASOL CTL project submitted application to NDRC in Q1 2010 and entered the stage of project audit by June this year. To cope with the probable carbon-reduction demand in future, SASOL proposed additional technical advancement and energy efficiency measures, to cut down emission form Ningxia CTL project.

With accumulation of operation data, production cost of CTL demonstration units was verified. Even lower cost is expected for future commercial plants of bigger capacity. The uprising trend of oil price on international market and the refined oil pricing mechanism regulated by Chinese authority may endow CTL production with even better profitability. As predicted by ASIACHEM, Chinese CTL investors will pay active efforts in preliminary works for mega size CTL projects starting from 2011 and may realize commissioning of such projects before the year of 2015.

2. CTO processes were proven by commercial demonstration

In 2010, China built three CTO demonstration units in succession and brought them into commissioning. In more details, Shenhua Baotou CTO project was completed in May and started up in August. Now the plant is kept under steady running state and expected to start business operation in January 2011. Another two CTO plants, both with PP as target product, by Datang (Duolun) and Shenghua Ningxia Coal respectively, also reached mechanical completion and are now on the way of whole process flow start up.

According to ASIACHEM, China will possess 1.58Mt/a of coal-to-polyolefin capacity by 2011 when the said three units are brought into business operation. The capacity will be composed of 300kt/a of PE and 1.26Mt/a of PP, as a sum accounting for about 7% of

Chinese total polyolefin production.

MTO (methanol-to-olefins) process has been proven by the success of coal-to-polyolefin projects. Encouraged by the successful demonstration, a number of enterprises in China's coast regions are planning to take the advantages of good logistic conditions and the adjacency to consuming market and invest in MTO projects based on outsourced methanol. Ningbo Heyuan, Dalian Dahua Fujia, Zhejiang Xingxing New Energy Technology, Jiangsu Shenghong Group and Chia Tai Energy Chemical all announced like plans. A 1.8Mt/a methanol to 600kt/a olefins project proposed by Ningbo Heyuan has secured financial support from bank consortium and started construction. The project is scheduled to be on-stream by 2012.

Shenhua Group and Dow Chemical also pushed their JV CTO project forward in 2010. At beginning of 2010, the project received approval from National Energy Administration to start preliminary works. The parties announced in November that the project application report was submitted to Chinese Government. Also in November 2010, TOTAL Group and China Power Investment Group signed up a cooperation framework agreement in Paris, France, stating the parties shall lead feasibility study for a world-class CTO project to be built in Inner Mongolia. The project will introduce a combined methanol-to-olefins and olefin cracking process (MTO/OCP), may greatly improve the ethylene and propylene yields of MTO technology.

Sinopec also showed concentrated interest in CTO process. After the successful pilot test of self-developed SMTO process, Sinopec started construction of a 600kt/a demonstration project this year in Zhingyuan Petrochemical, Puyang, Henan Province. The company also plans future construction of commercial CTO plants in Guizhou, Henan, Anhui, and Shanxi Provinces.

Currently there are more than 20 CTO (and/or MTO) projects under planning in China, with over 10Mt/a totalized capacity. ASIACHEM considers that, abundance of Chinese coal resource and cost advantage of CTO process will eventually change the feed material structure of Chinese olefin production, and which even will also impact the naphtha-originated polyolefin industry which is typical in China and also in Northeast Asia (Japan, South Korea, Taiwan).

3. SNG industry was focusing concerns on price reform and pipeline construction

In 2010, Chinese SNG projects were staying at construction stage and the fastest one, phase I of Datang Chifeng 4bnNm³/a SNG project is expected to be complete in 2011.

In June 2010, NDRC issued the "Notification on Issues Related to Normalized

Development of SNG Industry”, explicitly stating that SNG projects have to be approved exclusively by NDRC. By the end of 2010, only four SNG projects, with capacities totalized up to 15.1bnNm³/a, obtained approval from NDRC, and they are Datang Chifeng (Inner Mongolia) 4bnNm³/a SNG project, Datang Fuxin (Liaoning) 4bnNm³/a SNG project, Huineng Ordos (Inner Mongolia) 1.6bnNm³/a SNG project and Qinghua Yili (Xinjiang) 5.5bnNm³/a SNG project respectively.

SNG industry will be benefit, though indirectly, from the price reform of natural gas on Chinese market. Price of domestic produced natural gas has been increased by CNY0.23/m³ since May 31st 2010. Profit margin of SNG projects will be greatly improved if they can catch up with the pace of pricing up.

Potential SNG producers were concerning very much on the channel of product distribution. If compromise can be reached on the amount and price for piping network entrance, to enter the gas net of PetroChina would become a preferable option. Some producers are planning LNG facility to sell SNG by shipment of LNG tank trucks. In Q4 2010, the government of Xinjiang Autonomous Region and Sinopec/Zhejiang Province signed a framework agreement to build a gas pipeline from Xinjiang to Zhejiang dedicated to SNG use. Completion of this pipeline will deliver a new choice for the distribution of product from a dozen of Xinjiang SNG projects now under planning or construction stage.

According to the forecast of ASIACHEM, China may furnish 30bnNm³/a SNG capacity by the year of 2015, and supply to 12% of the consumption at the time. Demonstration and commercial operation of SNG process will provide a relative cheap and secured gas supply, also a stronger back-up for our country to negotiate the price of natural gas imported from international market.

4. CTMEG became a new investment focus

Rapid development of Chinese polyester industry in recent years greatly spurred the demand on main raw materials, PTA (refined phthalic acid) and MEG. The big gap between MEG supply and demand and the best profit expectancy made CTMEG a new focus of the developing coal chemical industry.

Tongliao GEM CTMEG project used a process developed by Fujian Institute of Research on Structure of Matter, Chinese Academy of Sciences (FJIRSM-CAS), got through the whole process in December 2009. The owner then re-streamed up the product strips and added a 100kt/a oxalic acid (OA) section to the plant. On-spec OA product was took off the production line in May 2010. Separately in March 2010, Henan Coal & Chemical Industry Group (HCCIG) signed exclusive cooperation agreements with Danhua Technology and others, to build five CTMEG units, each of 200kt/a capacity, in Mengjin of

Luoyang, Yongcheng of Shangqiu, Huojia of Xinxiang, Puyang and Anyang (all in Henan Province) respectively. The total 1Mt/a MEG capacity, composed from these pioneer plants, is expected to be on-line within the next two years.

Aside from Tongliao Golden Coal, other Chinese enterprises and/or research agencies also were working hard in the area of CTMEG R&D.

Wuhuan Engineering, Hubei Provincial Research Institute of Chemistry and Hebi Baoma Group jointly started construction of a coal-to-syngas-to-MEG pilot base, of 300t/a size, in January 2010.

Shanghai Huayi Group developed a 1500t/a CTMEG pilot project. Construction of the pilot unit is now on the way in the site of Shanghai Coking, Wujing, Shanghai, startup is scheduled in 2011.

By cooperating with Shanghai Pujing Chemical Technology Co Ltd and using a process technology developed by East China University of Science & Technology (ECUST), Anhui Huaihua Group built a syngas-to-MEG test unit of 1000t/a size on a site of its own. In Q4 2010, the unit got through the whole process flow and kept 1 month of steady operation and obtained MEG product of polyester grade conforming to the specification of GB/T 4649-2008.

Additional nearly 20 CTMEG projects were proposed and under planning stage, with capacities totalized up to almost 4Mt/a. Once the process is proven a success by commercial demonstrations, CTMEG will impact on the raw material structure of Chinese MEG production.

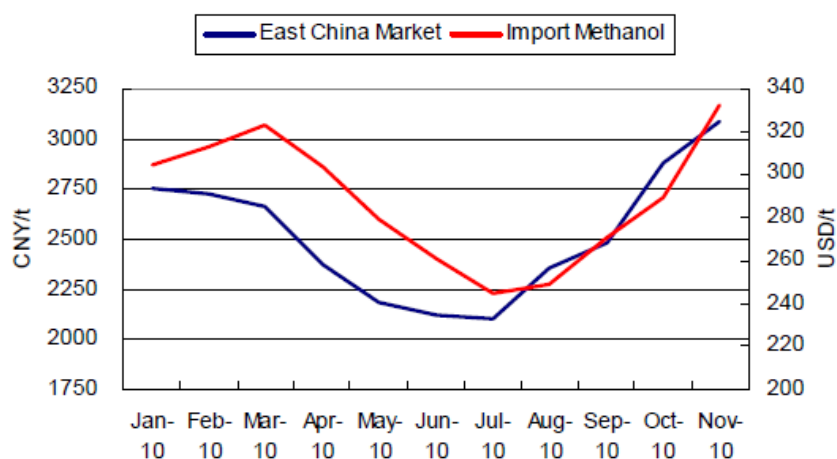
5. Methanol rebound, but DME remained in weakness

Chinese methanol industry was still impacted by the surplus of existing capacity and rush-in import, nonetheless the output increased by large to meet the revived demand. According to data from ASIACHEM, Chinese methanol output from Jan to Nov 2010 cumulated to 14.29Mt, a jump of 41% above the level of same period last year. But suffered from the huge existing capacity, the industry was still working under an operating rate of 50%. In the reported period, methanol import was 4.7Mt, and apparent consumption was 18.98Mt, showing a 5% down and a 26% up respectively comparing to one year ago.

Talking on the market trend, Chinese methanol market is fluctuant in 2010. It trapped in a down channel for the first half year especially from Feb to Jun, when the price in east China had once hit the yearly lowest of CNY2000/t, In H2 2010, the price of domestic

produced methanol was pulled up by the price of natural gas as main raw, imported product also shared the benefit of price hiking. Starting from October as part of domestic methanol plants were shut down because of extension of the energy conservation & emission reduction regulations, the balance inclined towards the side of demand and thus supported a new up-turn of pricing. Methanol price in east China market returned back at the level of CNY3000/t by December 2010.

In 2009, Chinese MOFCOM launched antidumping investigation against imported methanol, which is finally settled after one and a half year. MOFCOM published an announcement on December 23rd 2010, accusing the dumping of methanol imported from Indonesian, Malaysian and New Zealand producers causing substantial damage to their Chinese counterparts. Exporters of these countries shall be levied of 8.9%-37.5% punishing tariff to their export towards China, with in a 5-year period starting from December 24th 2010. However MOFCOM added that considering particularity of the case and approved by the State Council Tariff Rate Rule Committee, the said antidumping measure will be temporarily suspended, waiting for proper time point to exercise.



2010 Pricing Trends of Domestic and Imported Methanol on East China Market

DME industry encountered more difficulties in 2010. In June 2010, General Administration of Quality Supervision & Inspection, State Administration for Industry & Commerce, State Administration of Working Safety and National Energy Administration decided to start a joint regulating and correcting action nationwide in the field of LPG business. Main target of the action is to check irregular blending of DME in LPG and trace the product distribution flow from DME producers. In fact such regulating and correcting actions were started even earlier by local authorities. Stagnant distribution caused the load rate of most Chinese DME producers dropping to the level below 20%.

Chinese national standard (GB) “Di-Methyl Ether (DME) for Town-Gas Use” was finally approved in September 2010 and shall be enacted since July 1st 2011. However it specifies DME mass fraction $\geq 99.0\%$ and methanol $< 1.0\%$ for the use as town gas, in

other words it requires the fuel to be burned in high purity and shipped in dedicated cylinder. This closes up the access for blended DME/LPG to achieve the support from GB standardization system.

Though Chinese methanol industry saw significant increase of both output and demand in 2010, the year's newly added 8.95Mt/a capacity has pushed the nation's total up to 38.4Mt/a and forced the industry to find new outlets. On the other end, stagnant growth of traditional methanol derivatives like formaldehyde and acetic acid etc, as well as the obstructed way for DME development also drove the industry to extend into new fields, such as methanol-to-olefins (MTO), methanol-to-aromatics (MTA) or like. Just to name a few, Huating Zhongxu, Yuanxing Energy etc have proposed MTO plans based on their existing methanol capacity; Huadian Group is planning to build MTA pilot and industrial plant of mega size in Yulin, Shaanxi, by using a fluidized bed MTA (FMTA) process licensed from Tsinghua University.

6. More emphases were focused on carbon emission reduction

Low-carbon economy has become a well concerned concept and all the relevant industries are paying more attentions on how to reduce the carbon dioxide emission from coal based power and chemical production by capture, sequestration and reuse.

In 2010, the first integrated gasification combined circulation (IGCC) project in Chinese power industry, also known as "GreenGen" developed by jointly Huaneng Group and domestic/foreign investors was pressed forward on the way of construction, a 250MW IGCC station as phase I of the project is expected to be complete in 2011, attached by a "GreenGen" laboratory.

Construction of the first carbon dioxide capture & sequestration (CCS) demonstration unit in Chinese coal chemical industry was started in June 2010. The project was designed to capture and sequester 100kt/a of carbon dioxide from Shenhua Ordos DCTL complex. Once the demonstration is proven successful, CCS plant of mega size shall be planned and built in foreseeable future.

Coal chemical industry generates great quantity of carbon dioxide emission, and the gas from some processes is of high concentration, can be captured on lower cost. To use the captured gas in enhancement of oil recovery (EOR) or other commercial applications, it may bring additional benefits, other than the carbon reduction target, to the enterprises. PetroChina and Sinopec are carrying on the research of CO₂-EOR.

In 2010, Sinopec built a 40kt/a CO₂ capture, purifying & EOR demonstration unit in the power plant of Victory Oil Field. A process study for 1Mt/a flue gas CO₂ capture &

purifying treatment is now on the way by Nanjing Chemical Research Institute under Sinopec. After completion of the mega size plant, it will become the world largest CCS unit. PetroChina also continues its own CO₂-EOR study in Changqing Oil Field, Shaanxi Province.

In general, 2010 was the year China achieving major progression in demonstration of novel coal chemical processes. CTL demonstration units realized long-term steady operation and verified cost data to lay good foundation for future commercial plant of mega size. Three major units were built to proven CTO process, and the successful performance of Shenhua Baotou project has proven the liability of MTO technology, and is for sure to promote MTO production based on outsourced methanol. Construction of SNG demonstration projects was also pressed forward and the industry paid close attention on the product distribution channels and pricing trend. Technology R&D of CTMEG process achieved eye-catching progresses and attracted interest from across the industry.

As novel coal chemical demonstrative projects going smoothly, the traditional coal chemicals are still in overcapacity and poor operating rate. However large plants based on modified processes will have bigger chance to survive competition while backward facilities of higher material and energy consumption shall be eliminated in the future. According to newly published "Methanol Industry 12-5 Development Program", China hopes to control its nationwide methanol capacity at the level of 50Mt/a and the number of producers below 150 by the year of 2015, which means an elimination of 3~5Mt/a out of date capacities.

Development of new coal chemical industry has made it practicable to supplement and/or partially substitute the traditional petrochemicals. On the other hand, the trend of oil price staying high on international market has greatly improved the profit outlook of novel coal chemical projects. ASIACHEM considers that to build a coal gasification based modern energy chemical system, and to realize clean coal conversion, as well as to take advantages of CO₂ capturing and cut down CO₂ emission, will be helpful to China make sure energy security and chemical supply, and realize the environment friendly and sustainable development.

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