

## ASIACHEM: 2009 China Coal Chemical Review & Outlook

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Along with the reviving of China economic in 2009, both the price and consumption of traditional coal chemicals like ammonia, methanol, coke and carbide etc are rebounded. However the general operating load rate of these plants still low for the sake of inertia of capacity expansion. Most of the demonstration units of modern coal chemical like CTL (coal-to-liquid), CTO (coal-to-olefins), SNG (synthetic natural gas) and coal-based MEG (mono-ethylene glycol) are under construction or preparing for commission, part of them are expected to realize commercial operation in 2010.

What coal chemical policies updated in the past year? What new progresses in different fields were achieved? As a consultancy focusing on the coal-based energy & chemical industries, ASIACHEM would have a review on 2009 and an outlook on the nearing future.

### 1. China determined five demonstration orientations

In May 2009, China State Council issued the detailed draft of “PetroChemical Industry Stimulus Package”, which requests to proceed modern coal chemical demonstration in steadily and resolutely stop the blind development of traditional coal chemical projects. In next three years, no more approval for simple capacity expansion projects of traditional coal chemicals like coke and carbide etc will be approved, and the efforts shall be focused on 5 kinds of demonstration directions, there are CTL, CTO, coal-based DME, SNG and coal-based MEG.

In September 2009, State Council ratified the “Several Opinions on Repression of Overcapacity & Repeated Construction in Part of the Industries and Leading Healthy Industrial Development” prepared by the National Development & Reform Commission (NDRC), which requests to strictly implement the coal chemical industry policy, proceed modern coal chemical process demonstration steadily and will not arrange more new demonstration projects of modern coal chemical processes.

ASIACHEM considers that currently China capacities of coke, carbide route PVC, ammonia, methanol and DME etc are in severe surplus, while the demonstration units of CTL, CTO, SNG and coal-based MEG etc are still under construction or at the stage of trial operation. Therefore the policy trend is estimated to execute more strict constraints over the coal chemical fields of severe overcapacity, higher energy consumption and heavier pollution, and to reduce cost and improve competition ability by capacity up-scaling and replacement etc. For the processes of CTL, CTO, SNG and coal-based MEG etc, efforts in near future will be concentrated in major demonstration units and, after

successful industrial demonstration, their feasibility for popularization shall be judged based on the economic environment, market situation, resource conditions and cost competitiveness of these processes.

## **2. Methanol & DME downstream application need to be further developed**

China coal-based methanol industry was hit by severe impact from imported methanol in 2009, and became the overcapacity. According to data published by Ministry of Industry & Information Technology (MIIT), China aggregately imported 4.936Mt of methanol between Jan-Nov. 2009 36.2% more than the previous year, while the operating rate of methanol industry was only 42% and the price of methanol was fluctuating between CNY 1770~2030/t with the average in this period at the level of CNY1935/t or a drop of 42% in comparison with the price of a year ago. According to the data from ASIACHEM, between Jan. to Oct. 2009, China's apparent methanol consumption was 13.77Mt and might reach 16Mt for the whole year. As pushed by the internal market price and increasing domestic demand, methanol price rebounded strongly in December when the price on east China market once approached CNY2800/t, the price on north China market also leapt up around the level of CNY2500/t, showing a considerable profit margin for China methanol producers.

To protect domestic methanol enterprises, Ministry of Finance adjusted up the tariff refund rate for methanol export from 9% to 11% on April 1<sup>st</sup> 2009, and increased the refund rate to 13% starting from June 1<sup>st</sup> of the year. On June 24<sup>th</sup>, Ministry of Commerce started anti-dumping investigation against methanol imports from Saudi Arabia, Malaysia, Indonesia and New Zealand.

In addition, two national standards, for "Methanol as Motor Fuel" and "Motor-Use Methanol Gasoline (M85)" were enacted since November 1<sup>st</sup> and December 1<sup>st</sup> respectively. Publication of the two standards would lead normalized development of China methanol blended gasoline business.

ASIACHEM estimated that China's methanol output and apparent consumption will further grow in 2010. Although the obsession of import and overcapacity may continue, methanol producers possessing of coal resource and advance coal based methanol plants of mega capacity will occupy advantageous position in competition. Coking gas-to-methanol process, though of cost advantage, is vulnerable as the steady supply of coking gas is subjected to the impact from variable coke market. On the other hand, profit margin for methanol plants based on outsourced natural gas will be further compressed and these enterprises are forced to seek the chance for shifting the feed from gas to coal.

Chinese DME industry was suffering from the flat demand and lower pricing in the whole year of 2009. According to the data from ASIACHEM, China's DME output and

consumption both were around the level of 2Mt, with the operating rate across the industry depressed under 30%.

One reason for the flat demand was the absence of DME blended LPG standard, the consumers were not in confidence of the LPG product blended with DME of the lower heat value. In addition motor use of DME did not achieve popular applications. Reasons for the pricing-up difficulty are firstly, the deep drop of LPG price in H1 2009 (once even lower than the cost price of DME), as a LPG substitute DME could not be priced higher than LPG price. Secondly, although the rapid increase of LPG since August had resulted the price rebound of DME product, significant overcapacity and severe competition finally obstructed the further pricing-up.

In December 2009, the first standards package of China DME automobile industry were published after approved by MIIT, filling up the blank of DME auto standards. The package includes three standards, will be enacted since April 1<sup>st</sup> 2010 and play a guiding role to normalize and promote the development and application of Chinese DME automobiles. The "Market Entry Regulations for New Energy Automobile Manufacturing Enterprise & Product" published earlier in June 2009 by MIIT had explicitly included DME auto in the sector of New Energy automobiles.

ASIACHEM also estimated that the output of China DME industry and apparent consumption of DME market will keep growing in 2010 but the growth rate will be affected by the popular use of natural gas. DME use dominated regions are rural areas and small towns in east and south China out of the reach by gas pipelines. Besides, motor use as a diesel substitute will become a new growth point of DME industry.

### **3 China self-developed CTL processes were proven by industrial pilots**

There are series of China CTL projects started up in sequence in 2009. Both the direct CTL process of Shenhua Group and indirect CTL process self-developed by Synfuels China were proven by industrial pilots.

Shenhua Ordos 1.08 Mt/a direct CTL project was started up with success in January 2009, which was followed by the second trial operation started in Q3 2009. Up to last December, the project had output around 100kt of gasoline, diesel and other oil products in total. The first naphtha cargo train loaded with 2.3kt of naphtha oil left the plant on October 18<sup>th</sup> heading to Tianji. Another 180kt/a ferrous catalyst slurry bed indirect CTL unit under Shenhua CTL Chemical Company also obtained success in commissioning. And Shenhua Group also has got the business license for wholesale of refined oil product.

According to the data from ASIACHEM, China has 1.68Mt/a of CTL capacity in total by the end of 2009. In addition to Shenhua 1.08 Mt/a direct CTL project, other three industrial

test units using Synfuels China indirect CTL process were started up in the past year in succession. Yitai 160kt/a CTL project were commissioned with success in March and entered commercial operation in September 2009. Up to Q4 2009, the project had produced more than 12kt of oil products in total. Yitai CTL Company and Inner Mongolia Petrochemical Industry Test & Inspection Institute jointly prepared the enterprise standards of “F-T Synthesized Diesel” and “F-T Synthesized Naphtha”, filling up the blank of Chinese CTL product standard.

The 160kt/a CTL unit owned by Shanxi Lu’an Group produced on-spec diesel and naphtha products in August. An ammonia/urea plant attached to the CTL unit also output on-spec products in December. Another unit included in the package project, a CTL off-gas utilization & IGCC power plant, started construction in last September and was scheduled to start up by the end of 2010.

Shenhua 180kt/a ferrous catalyst slurry bed indirect CTL unit was also started up by the end of 2009 successfully.

Jincheng Coal Group (Jinmei Group) 100kt/a methanol-to-gasoline (MTG) project was started up in June 2009. The “ash smelting fluidized bed pulverized coal gasification process” used on the 300kt/a coal-based methanol project attached to the MTG unit was also proven successful in Q3 2009 by a trial operation.

Besides, feasibility study report of the joint venture indirect CTL project between Shenhua Ningxia Coal Group and SASOL passed a pre-assessment in November. The environment impact report of the project was also finalized and a public announcement on environment assessment for the project was displayed on-line in December.

Shaanxi Yulin 1Mt/a indirect CTL project of Yankuang Group passed environment assessment organized by the Ministry of Environment Protection. So far all the 23 supportive documents necessary for the project are submitted to relevant authority, and now is waiting for final approval.

ASIACHEM estimated that the construction of China CTL demonstration units will consequently enter the stage of commercial operation in 2010. Profitability, product profile and quality specifications of both direct and indirect CTL processes will be assessed.

#### **4 Steady progression of CTO projects construction**

To lead the healthy development of CTO (coal-to-olefins) industry, MIIT proceeded a nationwide CTO capacity deployment planning study and, based on the study conclusion, the CTO industry development plan will be proposed in coordination with the development of related coal, petrochemical and electric power industries.

Three major CTO projects owned by Datang Duolun, Shenhua Baotou and Shenhua Ningxia Coal respectively achieved steady progression in the year of 2009.

Starting from June 2009, the coal drying, coal gasification, methanol and PP units of Datang Duolun CTO project reached mechanical completion in succession. Air separation unit started commissioning in Q3 2009 and the No.2 PP line produced on-spec product by the first trial operation in November.

The three units, coal gasification, syn-gas cleaning and methanol of Shenhua Baotou CTO project reached mechanical completion in December 2009. According to the original schedule, the project shall output on-spec product by October 2010. MIIT has organized Shenhua CTO project coordination & supervision team and, with reference to the experiences obtained from success of Shenhua direct CTL project commissioning, prepared "Shenhua CTO Project Coordination & Supervision Working Scheme".

Shenhua Ningxia Coal CTO project also accomplished most of the construction. The MTP (methanol-to-propylene) unit and coal gasification unit will start up in April and July 2010 respectively.

All the three CTO projects as above described are expected to be on-stream in 2010. The core processing technologies of gasification and MTO (methanol-to-olefins) etc will be verified during the commissioning. According to ASIACHEM estimated, China total CTO capacity may approach 1.7Mt/a by the end of 2010.

China CTO industry also attracted interests from the top foreign investors.

When interview media in September 2009, an officer of TOTAL Petrochemical disclosed the year of 2010 would become a critical period for TOTAL's coal chemical business in China. TOTAL will chose appropriate time to start the formal feasibility study of a CTO project to be located in China, as well as the following application for approval procedures in this year, and strive for completion of the company's first mega size CTO commercial project in China before or around the year of 2015.

In November 2009, Shenhua and Dow Chemical laid corner stone for their JV Yulin coal-based cyclic economy project in Shenmu County, Yulin City of Shaanxi Province. With the backup of abundant coal and salt resources of local area and CNY10bn investment allocated for phase I construction, the project will start from a super size coal-based methanol unit and via the MTO processing route to produce ethylene, propylene and fine chemicals, as well as PVC, ethylene glycol, acrylic esters and other downstream products.

In addition, Chinese MTO processes of self owned intellectual property right also achieved breakthrough in the past year. In August, the fluidized bed methanol-to-propylene (FMTP) process jointly developed by China National Chemical Engineering Group Corporation, Tsinghua University and Anhui Huaihua Group got through the process flow of the whole system, and kept a continuous and steady operation of 470h in October. Based on this process, a project of 1.7Mt/a MTP capacity is planned by Huaihua Group, and the environment impact report of the project passed audit in February 2009.

According to the data from ASIACHEM, the number of China CTO projects, either under construction or at the preliminary planning stage, had exceeded 30 by the end of 2009. A NDRC officer announced at a press conference held in December 2009 that the capacity of CTO projects proposed by different Chinese provinces had totalized up to 20Mt/a. ASIACHEM estimated that, before the economic feasibility and technical viability of CTO process are verified by the three demonstration units, China will not probably approve more new CTO project. It is advisable to keep CTO projects and petrochemical based olefin projects under general planning to avoid repeated construction in the same regions. Besides, since most of Chinese PE and PP capacities are concentrated in lower end grades while the supply of upper end products is yet not self contained, spread of China CTO end product profile shall try extend toward the upper end.

### **5 Coal to SNG became a new hot point**

The tight natural gas (NG) supply resulted from the cold weather in Q4 2009 attracted more concern on the urgency of NG peaking facility construction and the development of diversified NG sources to secure the supply.

On December 27-28<sup>th</sup> 2009, the 2<sup>nd</sup> National Energy Work Conference, after set up of the State Energy Administration (SEA), was held in Beijing. Mr. Zhang Guobao, general director of SEA expressed on the conference that although China's NG output is expected to maintain a 8%-9%/a growth rate over the coming years, still a wide gap is to be filled up to meet the increasing demand. China shall pay more attention to the development of unconventional NG resources, such as shale gas, coal bed methane (CBM) and coal-based synthetic natural gas (SNG) etc.

Datang International SNG project to be built in Chifeng, Inner Mongolia, obtained official approval from NDRC in August 2009, and had accomplished CNY2bn of investment up to December last year. The first line under the project, of 1.3bnNm<sup>3</sup>/a SNG capacity, is scheduled to be complete by the end of 2010, followed by completion of the whole project in 2012.

Huineng SNG project, Inner Mongolia, obtained approval from NDRC in December 2009. This is the first NDRC approved SNG project invested by the private company.

Several other SNG projects also achieved new progresses in the past year. In February 2009, Shendong Tianlong Group 1.3bnNm<sup>3</sup>/a SNG project, to be built in Zhundong (East Zhunger), Xinjiang was registered by the local government of Xinjiang Autonomous Region. In April, Shenhua Group laid corner stone for its Ordos 2bnNm<sup>3</sup>/a SNG project. In early May 2009, Datang Group Fuxin 4bnNm<sup>3</sup>/a SNG project passed an environment impact audit organized by the Ministry of Environment Protection. In June, CNOOC and Datong Coal Group jointly announced the commencement of a 4bnNm<sup>3</sup>/a SNG project. In July, Xinwen Mineral 2bnNm<sup>3</sup>/a SNG project and Qinghua Group 1.3bnNm<sup>3</sup>/a SNG project both started construction in Yili, Xinjiang. In October, CNOOC and Ordos City signed a cooperation framework agreement to build SNG project in the city. In November, China Power Investment held inauguration ceremony for another SNG project located in Yili, Xinjiang.

As expected by ASIACHEM, China would have established 20bnNm<sup>3</sup>/a of SNG capacity by 2015, accounting for around 10% of the total consumption. SNG process demonstration and commercial operation will provide a relatively inexpensive and secured NG supply, and enhance the market power of Chinese players in NG import price negotiation.

ASIACHEM considers that the appropriate development of SNG projects and establishment of sufficient SNG capacity will become an effective way to secure NG supply. Construction of the West-to-East Pipelines and other gas pipeline systems has provided good infrastructure conditions for SNG product shipment. Reform of NG pricing mechanism may also help to increase the market competitiveness of SNG.

## **6 Breakthrough achieved in coal-based MEG technology**

Rapid development of China polyester industry in recent years greatly pulled up the demand on main feed materials, i.e. phthalic acid (PTA) and mono-ethylene glycol (MEG). However, great quantity of MEG were imported to meet the demand as the China MEG output did not show similar growth in the same period.

Coal-based MEG process opens up a new feed material source for MEG production. Industrial demonstration of the process was listed in the national petroleum & chemical industry stimulus program. In addition, higher market price of MEG would create brilliant foreground for profitability of the novel process and make it a new hot point in Chinese coal chemical industry.

In May 2009, WISON (holding) Group held an inauguration ceremony for its Ordos coal

chemical complex project. Phase I construction scope of the project, including 400kt/a coal-based methanol capacity and 300kt/a MEG capacity, was registered by the authority of Inner Mongolia Autonomous Region earlier in July 2008. Preliminary works for the project are now under smooth progression.

In September 2009, a cooperation agreement was signed between Wuhuan Engineering, Hubei Provincial Chemistry Research Institute and Hebi Baoma Group, to jointly construct a coal-based MEG pilot unit. As specified in the agreement, with the back up delivered by Hebi Baoma Group from its existing chemical plants and utility infrastructures, the parties shall jointly develop a novel process of “coal-based syn-gas to MEG” and build 300~500t/a pilot, 10kt/a demonstration unit and 100 or 200kt/a commercial plant consequently.

In October 2009, Kailuan Group laid corner stone for a polygeneration cyclic economy project of “2 x 200kt/a MEG and 2 x 200kt/a coal tar hydrogenation”, located in Ordos, Inner Mongolia.

In November 2009, two 200kt/a coal-based MEG projects, jointly invested by Henan Coal & Chemical Industry Group and Tongliao GEM Coal Chemical Co Ltd, started construction in Mengjin County of Luoyang City and Yongcheng City, Shangqiu, Henan Province respectively. Capital investment for a 200kt/a project of the process is around CNY2.6bn and the construction schedule is 30 months.

In December 2009, the global first coal-based MEG demonstration unit, Tongliao GEM 200kt/a MEG commercial project got through the entire process flow and accomplished one week of trial operation. The project is expected to enter business operation in 2010.

ASIACHEM thinks that the rivals of China coal-based MEG industry include not only the domestic integrated petrochemical enterprises but also the MEG producers in Middle East based on inexpensive ethane or naphtha as feed material. China market demand on MEG will increase steadily, but the competition advantage of coal-based MEG process will depend on several major factors, including the production cost, the reliability of process and the stability of plant operation.

### **7 Lower carbon emission concerned by coal chemical industry**

The concept of low carbon economy is getting deeply implanted in people's mind, and how to cut down the emission of carbon dioxide from coal chemical production, for example by the way of capture, sequestration and reuse, is attracting more and more concerns from China coal conversion players.

In May 2009, the first demonstration unit of integrated gasification combined circulation

(IGCC) process in China's power industry, Huaneng GreenGen Project, obtained official approval from NDRC, and started construction in last July. The first 250MW class IGCC generator package under the project is expected to be online in H1 2011.

In July 2009, China's MOST, SEA and US DOE jointly announced to set up SINO-US Clean Energy Joint Research Center. Objective to organize the center is to promote joint studies in the field of clean energy processes, participated by Chinese and American scientists and engineers.

In August 2009, Huaneng Group and US Duke Energy signed a cooperation memorandum, declaring their efforts to cut down the emission of carbon dioxide and other greenhouse gases, by using New Energy technologies developed by the both countries, including CSS (carbon capture & sequestration), coal gasification and other clean coal processes.

In September 2009, Shenhua Group and West Virginia University of USA signed up a technology cooperation agreement on development of direct CTL and CCS processes. During FS stage, the parties will jointly establish an explorative demonstration unit with design capacity to capture and sequester 100kt/a of carbon dioxide in Ordos, Inner Mongolia. The unit will be included in the package of Shenhua Group's direct CTL demonstration complex located in Ordos, Inner Mongolia.

In general, the overcapacity in China's traditional coal chemical sectors did not change fundamentally, the industry still suffered from the low operating load. However the larger producers possessing updated process technology occupied dominant position in the competition. Along with the reviving of China economy, it is expected that the more competitive players in China's conventional coal chemical sectors will further consolidate their market shares in 2010, while the backward plants of higher material and utility consumption will be expelled from the market.

Demonstration units of modern coal chemical processes are going to enter the stage of commissioning or commercial operation successively in 2010. Their technology eligibility and product competition vitality will be testified in the course. In addition, the profitability of modern coal chemical projects will be significantly affected by the oil price. Once the oil price climbs the height of USD100/bbl again, it will bring up very bright prospect for these projects

Currently, China still consumed coal nearing 3 billion ton per year, and which accounts for 70% energy supply. In the eve before Copenhagen Conference, China Government made solemn commitment to reduce 40%~45% of carbon emission per unit GDP by the year of 2020 from the basis of 2005. Therefore, ASIACHEM advises that, to build a modern

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energy & chemical system based on coal gasification, and to realize clean & efficient coal utilization, shall become the strategy choice of China.

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