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South Korea - Fuel Quality Progress

Despite limited domestic energy resources and thus dependent on imports to meet most of its energy consumption needs, South Korea has developed a complex refining industry and implemented some of the most stringent fuel quality standards in the Asia-Pacific region. In fact, these standards are among the strictest around the world, as indicated by its first place ranking for gasoline benzene limits (see adjoining article in this issue). South Korea's progress on fuel quality paralleled air quality improvement programs developed while its economic prosperity also expanded dramatically over the past three decades.

INSIDE THIS ISSUE

South Korea has a population of roughly 50 million people and estimate nominal Gross Domestic Product (GDP) of US$930 billion, making it the fourth-largest economy in the Asian region. The country is the fifth-largest net importer of crude oil, according to the International Energy Agency, and a significant importer of liquefied natural gas (LNG). Oil makes up about 50% of South Korea's total energy consumption, followed by coal (24%), nuclear power (14%) and natural gas (12%). Economic recovery in South Korea, following the severe global recession the past two years, is rapidly returning to pre-recession output. Export of produced goods has recovered across all major markets. Government efforts to shore up the banking system seem to have succeeded and access to global financial markets regained.

South Korea has no domestic crude oil production and is fully dependent on imports for crude oil-based transpiration fuels. These imports, however exceed consumption needs, as the country re-exports about a quarter of its gross oil imports as refined petroleum products. During the 1990s, expansions of South Korea's refineries allowed for this net increased output and for improvements in fuel qualities. Upstream oil development is managed by the state-owned Korea National Oil Company (KNOC). About 95% of the refining and products markets are comprised of five major companies, namely SK Energy, GS Caltex Oil Corporation, S-Oil Corporation, Hyundai Oil Refinery, and SK Inchon Oil Refinery. These companies, along with independents and importers, aim to attain a systematic and economically sound development of the petroleum industry.

The Clean Air Preservation Act grants authority to the Ministry of Environment (MOE) to set fuel quality standards related to environmental performance and goals in South Korea. The Petroleum and Petroleum Alternative Fuel Business Act also gives authority for setting technical fuel properties under the Petroleum Product Quality Standards. Fuel quality standards are developed with stakeholder inputs, including refiners, fuel blenders, and auto manufacturers, and are coordinated with the Korean Institute of Petroleum Management.

Existing gasoline grades include RON 91 regular and RON 94 premium fuel. The current sulphur limit for gasoline of 10 ppm max was implemented at the start of 2009, and is among the lowest standards in the world. Along with the strict benzene limit mentioned earlier, gasoline aromatics content is limited to 24 vol.%, concurrent with an olefins limit of 16 vol.%. These gasoline specifications are also considered as very strict, on par with those of the European Union. At present, the specifications also include a minimum oxygen content level of 0.5 wt.% during the summer and 1 wt.% level during the winter. The maximum oxygen content level is set at 2.3 wt.%. Ether-based oxygen- *(Continued on p4)*

FEATURE

Revised Ranking on Top 100 Countries - Gasoline Benzene Standards

An updated ranking of the top 100 countries based on gasoline benzene content standards was recently released by the International Fuel Quality Center (IFQC). South Korea made the top of the list with the earliest nationwide implementation of the lowest benzene limit at 0.7 vol.% since January 2009. This limit is down from 1 vol.%. previously determined for South Korea. The country has been at the forefront in the Asia-Pacific region in adopting clean-fuel standards over the past decade. Columbia, last year's first place holder, is now listed in the second position based on implementation date of its benzene standard, followed by Canada, both of which have 1 vol. % benzene limits in place.

Benzene is found naturally in crude oil, and thus passes into refined products, including transportation fuels. Benzene is a product of catalytic reforming that produces higher octane gasoline streams. It is emitted into the air as a result of fuel combustion (for example, auto engines), and is also from other industrial emissions sources. Benzene has adverse impacts on human health – the U.S. Environmental Protection Agency (EPA) classifies benzene as a Group A – known human carcinogen, which based on exposure level can effect bone marrow and red blood cells production.

Controlling the benzene level in gasoline is the most direct way to limit evaporative and exhaust emissions of benzene from vehicles. Although measures to reduce benzene levels in gasoline have not been as intensive as for some other fuel components, like sulphur content, further control of benzene levels has become more prevalent as emissions standards tighten around the globe. IFQC found that in most of the countries included in the ranking, actual gasoline fuel quality is typically lower than the legislated or regulatory control level.

European countries ranked high - Luxembourg in fourth place, Belgium in fifth and nine others tied for sixth – with maximum allowable benzene limits of 1 vol.% (survey data demonstrated actual range being 0.5 vol.% to 0.7 vol. %). Several Asian countries – Hong Kong, Japan, and Taiwan – ranked similarly high with 1 vol.% benzene limits since 2000.

The United States ranked 73rd primarily due to the rankings being based on national maximum allowable standards. In the U.S., the national benzene standard has not been updated since 1997. The state of California, as a stand-alone entry, would be ranked in first place based on its average benzene limit of 0.7 vol.%. implemented prior to 2008. Under the Mobile Source Air Toxics Rule (MSAT) phase 2 rule, the U.S. is currently implementing standards to reduce benzene levels in gasoline to an annual average of 0.62 vol.%, with a cap of 1.3 vol. %, beginning in 2011. Reformulated gasoline (RFG) in the U.S. now has a lower benzene annual average limit set at 0.95 vol.%.

Some notable shifts in the ranking include China moving up to 48th place based on stricter benzene limit implemented starting in 2010. Several South American countries, including Paraguay, Ecuador, Venezuela, and Peru, have improved or entered the rankings with improved fuel standards. Table 1 lists the top 25 countries in the IFQC ranking.

The updated rankings demonstrate the key role that government, refining and automakers have played in reducing benzene content in gasoline. Recognizing the concern about airborne toxics in major urban centres is resulting in continued and steady progress to improve fuel quality in many countries.

Countries in this ranking were placed based on the order of criteria for maximum allowable limits in national standards, limits in local and/or regional standards (such as specifications for cities and states), and by year of implementation of the standards. The IFQC focused on legislated or regulatory limits established, however, to further specify the rankings of countries with the same legislated/regulated limits, in some cases the market levels or additional criteria were applied based on available data. The full 100 rankings can be obtained by contacting IFQC at http://www.ifqc.org/

Table 1 – Top 25 Countries Ranked by Gasoline Benzene Limits

Rank	Country	Benzene Limit (vol.%)	Implementation Date
1	South Korea	0.7	2009
2	Columbia	0.9	1999
3	Canada	1	1999
4	Luxembourg	1	2000
5	Belgium	1	2000
6	Austria, Denmark, Finland, France, Germany, Netherlands, Spain, Sweden, United Kingdom	1	2000
15	Ireland, Portugal	1	2000
17	Greece, Italy	1	2000
19	Hong Kong, Iceland, Japan, Liechtenstein, Norway, Switzerland, Taiwan	1	2000

Source: International Fuel Quality Center, Hart Energy Consulting (Houston, Texas, USA)

Hong Kong Hosts DeWitt Asia Methanol & MTBE/Fuels Conferences

Returning after a one-year absence due to the economic downturn, the 2010 Asia Methanol and MTBE/Fuels Conference organised by DeWitt & Company was held recently at Kowloon, Hong Kong. This conference presents global and Asian region perspectives on methanol and MTBE markets, including overviews of supply and demand dynamics and in-depth focus on key issues affecting the industry. Industry experts presented on market trends in Asia, Europe and the Americas, new technology advances for production, downstream product outlooks and ongoing projects for meeting regional supplies. Some highlights from this well attended program are as follows.

Mr Dave McCaskill, vice president with DeWitt & Company, provided opening remarks and the initial market overview presentation on the Global Methanol Industry. He examined the complexity inherent within the industry and generally reviewed supply/demand and pricing history, core derivatives and uses, capacity growth, and drivers to methanol's future. This presentation was followed by Miss Heng Lee Shir, DeWitt & Company, who spoke about specific market conditions for Asia, and Mr Wolfgang Seuser, DeWitt & company, who talked about the European markets. Other presentations were given on methanol technologies and projects for the region. The first day sessions were followed by an industry representative roundtable that discussed recent conditions and trends in the methanol industry and responded to questions from conference attendees.

At the second day of the conference, Miss Heng provided an "Asian MTBE Market Overview" and noted the continued stability in supply and demand for the region as the economic recovery expands.

Mr Clarence Woo, executive director for the Asian Clean Fuels Association, spoke on "A New Era for MTBE Industry in Asia & Middle East." He summarized regional fuel developments over the past decade, then focused on how governments in Asia and the Middle East utilized sound technical and scientific data and evaluations to make positive policy decisions on clean fuels and MTBE to their benefit. In looking at the big picture, the Asian and Middle East regions are the fastest growing with respect to vehicle use and transport fuel demands. Mr Woo summarized the outlook for Asian and Middle East fuel quality, as illustrated in Figure 1. He concluded that fundamentals support continued opportunities in these regions and that cooperation is essential to market growth.

Mr Wolfgang Seuser, vice president with DeWitt & Company, continue the theme of complexity in his presentation on the European market and the bewildering fuel scenario that exists. He summarized the numerous changes to the European Union (EU) fuel and energy directives, and the challenges to meeting mandates particularly for biofuels. He also examined tax policy and changes in vehicle and fuels use for the region.

Ms Soong Siew Li, with Ecofuel SpA, presented on behalf of Mr Guiseppe Stringa, also with Ecofuel SpA, a detailed paper on "The Role of Ethers in the Improvement of Gasoline Quality in the EU. The paper highlighted the importance of ethers for octane replacement as lead phase-out took place, followed by sulphur and benzene level reductions to lower emissions. She noted the similar path being taken in the Asian region for fuel quality improvements. She further indicated the expansion of the product barrel with oxygenates blending. Ms Soong also summarized the next phase of fuel changes within the EU to address greenhouse gases emissions.

Mr David McCaskill of DeWitt & Company, presented on behalf of Ms Maura Brianti with Saipem SpA, about the flexibility of its etherification technology and product quality characteristics. He reviewed recent projects in the Asian region and noted the importance of deploying technologies that meet the industry's needs.

The conference concluded with an industry roundtable discussion about fuels and oxygenates. This two-day forum gave participants a thorough examination of the current methanol/oxygenates industries, and the outlook for global and regional issues and developments.

Figure 1 – Fuel Quality Outlook for Asia and Middle East Regions

Source: C. Woo, Asian Clean Fuels Association, 2010 DeWitt Asia Methanol & MTBE/fuels Conference, April 2010

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(continued from p1) ates are the main products blended to meet these specifications. Table 1 presents some of South Korea's current gasoline standards.

Prior to the global recession, average growth in vehicle registration was about 13%, and over 17 million vehicles are on the roads today in South Korea. Passenger cars dominate the auto industry with over 74% of the market, followed by trucks at 19% and transport buses at just over 6%. Gasoline engines are the main drive systems in the passenger car fleet.

Table 1 – South Korea Current Select Gasoline Standards

Specification Name	Standard	Test Method
RON, min	91/94(1)	KS M 2039
Sulphur, ppm, max	10	KS M 2027
Lead, g/l, max	0.0013	KS M 2402
Benzene, vol.%, max	0.7	ASTM D6296
Aromatics, vol.%, max	24(2)	ASTM D1319
Olefins, vol.%, max	18(2)	ASTM D1319
RVP @ 37.8°C, kPa, max	60(3)	KS M ISO 3007
Oxygen, wt.%, min	0.5 (s) / 1 (w)	KS M 2408, ASTM D4815
Oxygen, wt.%, max	2.3	KS M 2408, ASTM D4815
Oxygenates		
Methanol, vol.%, max	(4)	KS M 2408, ASTM D4815
Distillation		
T_{10}, °C, max	70	KS M ISO 3405
T_{50}, °C, max	125	KS M ISO 3405
T_{90}, °C, max	170	KS M ISO 3405
FBP, °C, max	225	KS M ISO 3405

(1) Two grades – Regular (91) and Premium (94)

(2) Either aromatics 24 vol.% max and olefins 16 vol.%, or aromatics 21 vol.% max and olefins 19 vol.% max.

(3) June – August – 60 kPa; October – March – 96 kPa

(4) Methanol 0.1 wt.%

Source: International Fuel Quality Center, SK Ministry of Environment

Upcoming Conferences & Events

Asia Oil & Gas Conference
6-8 June,
Kuala Lumpur, Malaysia

2010 Middle East Petrochemicals Conference
7-9 June
Abu Dhabi, UAE

Asia MTBE & Gasoline Additives Summit 2010
23-25 June, Chengdu, China

Downstream Asia 2010
27-29 October
Singapore

Petrotech 2010 – International Oil & Gas Conference
31 October – 3 November
New Delhi

Because of urban air quality concerns, the government since 2004 has conducted the Special Measures for Metropolitan Air Quality Improvement program. The goal of this program is to improve air quality in South Korea within 10 years to comparable levels measured in advanced countries. Some of the special measures have included low-emission vehicles incentives, advanced diesel engine technology, early retirement of older vehicles, and improved fuel quality standards. Vehicle emissions regulations have also be tightened as Euro-V equivalent standards were applied beginning January 2009. Further, vehicle emissions warranty periods were expanded to 16,000 kilometres over 10 years.

Economic expansion, industrial activities and increasing vehicle numbers pose significant air quality challenges for South Korea. In particular, particulate matter (PM) levels in the air remain high in large cities, although improvements are being seen as programs get implemented. The MOE sets air quality standards for six major pollutants, including PM10, carbon monoxide, sulphur dioxide, nitrous oxides, ozone (smog), and lead. Various air pollution abatement policies, like fuel quality standards to lower sulphur content, are beginning to result in air quality improvements.

South Korea is presently working on plans to finalize this September an emissions trading scheme covering most of its carbon emissions. The plan being considered will establish a trading market in 2012 and set emissions reductions for industry. The trading system will allow companies to set a market price for carbon and other emissions. South Korea has targeted a 2020 emissions reduction goal that is 30% below the projected level if no actions were taken to control carbon releases. The government continues its dialogue in the international arena on carbon emissions limits.

As South Korea's economic engine returns to full strength and output growth levels resume, the strong fuel quality specifications and clean vehicle emissions standards become even more important to combat air quality impacts. The progress on these standards demonstrated by South Korea presents a guide for other countries in the Asia region for their clean fuel and vehicles programs.

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Fuels Industry Updates

GLOBAL MTBE MARKET TO EXCEED 14 MILLION TONS BY 2015

A new report was released earlier this month by Global Industry Analysts, Inc. (GIA), which projects that the world market for Methyl Tert-Butyl Ether (MTBE) will exceed 14 million tons by the year 2015. The analysis found that developing regions, including Asia and Middle East, are expanding the blending of the clean-burning, high octane gasoline component. This increase is counter-balancing the declining use in North America and Europe. GIA estimates that global capacity utilization rate for MTBE is about 75%.

The study analyzed data and sales for regions including Europe, China, Middle East, and Rest of World. Currently, the Middle East represents the global leader in MTBE consumption accounting for about 30% of the global demand in 2009. China is quickly emerging as a fast-growing market over the period of 2006 to 2015. The rising demand in developing countries in the Asia region is primarily being driven by need to reduce emissions causing air pollution. According to GIA, MTBE acts as an "important additive for cleaner emissions and improved fuel quality." Declining consumption in Western Europe is being counter-acted by increased export to Arab Gulf, South American and Africa. The GIA report, titled "Methyl Tert-Butyl Ether: A Global Strategic Business Report," provides a review of market trends, competitive scenario, and recent industry activities.

EUROPEAN COURT SUPPORTS EU FUELS DIRECTIVE LIMIT ON MMT

The European Union's (EU) revised fuel quality directive sets a reduced limit of 6 milligrams per litre (mg/l) for MMT (methylcyclopentadienyl manganese tricarbonyl) in gasoline starting in 2011. Afton Chemical, the producer of MMT in Britain, challenged the limit in the High Court of England and Wales. The court sought a preliminary ruling on the legality of the limit from the European Court of Justice (ECJ). An advisor to the ECJ recently issued the opinion that the revised fuel quality directive does not violate or breach EU principles on equal treatment and proportionality.

In response to Afton Chemical's argument that other metallic additives are not as restricted, the advisor determined that "(d)ifferent scientific information warrants different precautionary measures" for setting the limits. With respect to proportionality, the advisor determined that the uncertainty over health risks from MMT use and exposures also justified the limit. On Afton's view that the revised fuel quality directive to require pump labelling for fuels containing MMT would be an effective ban, the advisor noted "(i)f the additives were more attractive, service stations would either pay the additional expense or do without fuels without additives."

INDIA TO COMPLETE EURO 3-EQUIVALENT STANDARDS BY OCTOBER

India's 13 major urban centers have basically completed by April the implementation to Euro 4-equivalent fuel standards with 50 ppm sulphur limits. The rest of the country is now expected to implement the move to Euro 3-equivalent standards (150 ppm sulphur limit) by October 2010, according to the Ministry of Petroleum and Natural Gas. The original timeline (April 1) for meeting that standard for the non-urban areas could not be met due to logistical issues in distributing the compliant fuel to all areas. The oil companies in India have collectively invested about Rs 36,000 crore (U.S. $8 billion) in refinery upgrades to meet the new standards. Media reports indicate that the refiners are planning to meet the new October deadline for providing the cleaner fuel for consumers.

SINOPEC PRODUCT EMPHASIS ON GASOLINE, NOT DIESEL, FOR 2010

Officials with the China Petroleum and Chemical Corp. (Sinopec) recently announced that the company will continue its refining shift to emphasize more output of gasoline and kero-jet fuel, rather than diesel fuel, in response to market signals. This shift had started last year as China's gasoline car fleet experienced substantial growth as economic recovery took hold. The company recently reported first-quarter 2010 profitability returning to the refinery operations, in part due increased gasoline and kero demands. Sinopec's gasoline output in 2009 was up about 16.1%, compared to 2008. The company also reports maximised refining throughput at near full capacity since the second quarter of last year. In addition, China's fuel quality standards are tightening for both for urban centres and national use in response to vehicle performance needs and consumer demands.

EU REACH UPDATE – CHEMICALS REGISTRATION LIST PUBLISHED

The European Chemicals Agency (ECHA) has published a list of 4,415 substances that it expects to be registered by the November 30, 2010 deadline in compliance with the European Union's REACH legislation. (REACH – Registration, Evaluation, Authorisation, and Restriction of Chemical Substances enacted June 2007 to improve protection of human health and the environment by requiring registration and data submissions by industry for chemicals used in the EU). The list was com-

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piled from information supplied by companies about their plans to register substances, and is primarily aimed at chemicals used in product manufacturing. The ECHA notes that companies using substances that are not currently on the list need to contact suppliers to find out if they plan to register.

The November 30 deadline applies to substances manufactured in, or imported into, the EU in annual volumes of 1,000 tonnes or more, or at lower volumes for certain substances predetermined to pose some toxic risk. Failure to register the chemical by the November 30th will make it illegal to manufacture or sell the non-registered substance in the EU. The ECHA list of substances identified for registration in 2010 is available at: http://echa.europa.eu/chem_data/list_registration_2010_en.asp