A golden anniversary in Qatar

The Sulphur Institute celebrated its 50th anniversary in Qatar with a record attendance at the Ritz Carlton Hotel, Doha, from April 11th-14th 2010.

The symposium was inaugurated by His Excellency **Abdullah bin Hamad Al Attiyah**, deputy premier and minister of energy and industry for Qatar, who spoke to additional commissioning of various projects in Qatar. "Sulphur production will increase significantly from this year's 1.2 to 2.5 million tons per annum by 2015," stated the deputy premier and minister in his opening remarks.

Catherine Randazzo, TSI president and CEO, added: "despite continued increases in sulphur demand for China, ore leaching, and coming expansion with newer applications, such as sulphur fertilizers, sulphur asphalt and sulphur concrete, challenges in various aspects of the industry will continue. TSI is committed to working with the industry through these future challenges, remaining the industry's single voice on a host of matters, including advocacy, environmental, health and safety, transportation regulations and logistics."

Hermann H. Wittje, TSI chair and director for raw materials at Mosaic called on all aspects of the industry to make sure they are active in TSI. Wittje affirmed, "TSI has expanded its membership to include producers, consumers, and traders, as well as those in service applications, and on a global basis, to address items impacting the entire industry."

Market papers

The global economic outlook was presented by **Marios Maratheftis** of Standard Chartered Bank. While a depression had been averted by the policy response of policy makers worldwide, he said, and the US was showing some stronger economic numbers, its economy had taken a massive hit in 2009. Normally the consumer drives the US economy, but here things do not look as positive, as spending is constrained by tight credit, falling house prices and unemployment, and there are concerns that the government fiscal stimulus will not be able to continue at its current rate. Credit growth is still falling and the banking sector is not working effectively. As a result the money supply is still in effect falling and 'quantitative easing' may need to restart toward the end of the year.

He also turned his attention to Greece, where 7% of government debt must be refinanced in 2Q 2010. The eurozone cannot afford to let Greece default, but in the absence of tax harmonisation or political union there is no fiscal policy tool available to the EU. Nevertheless, in other regions growth continues in India and China, oil prices are good and the Gulf region should see strong growth. He predicted that oil prices would remain above $85/bl for the rest of 2010.

John Westwood of Douglas-Westwood Ltd looked at those global oil and gas prospects. Population growth is driving

energy demand growth. From 1965 to 2008 population had increased by 95%, oil demand by 55% and energy demand by 190%, and this was set to continue. There are now a billion cars worldwide and China and India are 'motorising'.

On the oil side national oil companies now control 80% of oil reserves, and exploration and production spending by national oil companies has now reached 55% of the total. For private oil companies 8/10 have already passed peak production. Oil supplies will probably come to limit demand going forward as we reach a peak in production at some stage in the near future. Russian oil fields are in decline, and production is moving to new fields closer to the Arctic and Eastern Siberia. The more inhospitable region will lead to more expensive production.

For gas, production is soaring, with the Middle East and Latin America the major growth regions. The Middle East in particular is exporting more LNG, but unconventional gas production is also growing in the US. Europe still faces supply issues, and without the use of more natural gas UK electricity demand is forecast to exceed supply by 2017. Gas prices will continue to rise.

Luc Maene, head of the International Fertilizer Industry Association, gave a thought-provoking paper on fertilizer consumption. With the world population at 6.5 billion, food production, albeit at record levels, is only just keeping pace with rising consumption. Although cereal production had tripled from 1960 to 2010, it needed to double again by 2050, said Mr Maene. Stocks are still critically low, and many people in the world continue to go hungry. There is a need to increase agricultural productivity even if consumers have to return to a more 'basic' diet, with less meat.

Looking at the most recent years, fertilizer consumption had dropped by 5% during the 2008/9 growing season – less so on the nitrogen side, only 1.6% – but much more on the phosphate and potash side. While this year it should grow by 1.6% and next season 2.6%, this is still not enough for global food security. Most global nitrogen use (about 50%) goes towards the three main cereal crops of wheat, maize and rice, but fruit and vegetables are also taking an increasing share. Fertilizer production is close to the threshold of maximum efficiency, but there is plenty of room for improvement in its use, and short term improvements in productivity are likely to come from here – longer term improvements from genetic modification of crops may be more modest and involve trade-offs.

Pressing issues at the moment include micronutrient deficiencies, especially of zinc, while looking to the longer term future we may see a choice between greenhouse gas reduction in the fertilizer industry and food security. Fertilizer represents 2-3% of global greenhouse gas emissions, but Luc argued that this is outweighed by other concerns – agriculture as a whole accounts for around 10-12%, and deforestation to clear new areas for cultivation represents up to 15%. On the other hand, 48% of the world's population is only alive due to the effect of fertilizer, especially synthetic nitrogen.

Sulphur markets

Mike Kitto of British Sulphur Consultants gave his customary overview of the sulphur market. Sulphur demand was week in 2009 compared to 2008 in most importing markets, he said, down 3.5 million t/a in the six largest, but China had more than made up for that with an additional 3.8 million t/a of demand. Sulphur demand began to improve in 4Q 2009 due to firming phosphate prices, but supply is tight out of the Middle East due to OPEC quotas on oil production and project delays. Coupled with Canadian exports declining more rapidly than expected, the effect has been to increase sulphur prices to more than $200/t. However, the market fundamentals remain bearish. There is an additional 12.6 million t/a of Middle East production to come onstream from 2009-19; the region needs more non-associated gas to cope with rising local gas demand since associated gas is crimped by OPEC oil quotas. Availability of export sulphur will more than double in the Gulf to 2019.

In North America sulphur recovery at US refineries will add 2.5 million t/a of production, but sulphur production in Alberta is falling quickly. Oil sands production is rising but not enough to offset this. In the FSU, sulphur production from natural gas is relatively stable, although Kashagan will add 3,800 t/d in 2012. Sulphur recovery is capped here – the rest will be reinjected. There are new sour gas plans in Turkmenistan and Uzbekistan, but at Tengiz the gas will also most likely be reinjected.

Meanwhile in China, sulphur production is increasing due to sour gas production in Sichuan, by around 4.5 million t/a to 2019. Refineries will add another 1.2 million t/a to this. Imports should fall slowly to 2012, but rising demand will lead to increasing imports thereafter.

Sulphuric acid consumption for ore leaching is 15 million t/a, and on-purpose acid production is increasing. Copper will add 1million t/a of sulphur demand, nickel 4 million and even uranium 0.5-1.0 million t/a. The sulphur balance shows the largest surpluses in about 2012, and declining thereafter. However, Mike noted that sulphur

Ras Laffan Common Sulphur Facility

Delegates were taken around the common sulphur facility at the massive Ras Laffan site in the north of Qatar. The facility handles sulphur from gas processing for a variety of plants, including the massive Qatargas LNG facility, which runs 7 LNG trains which will have a total capacity of 42 million t/a by the end of 2010.

The common sulphur facility currently processes 3,000 t/d of sulphur – 1,000 of it brought by road and 2,000 t/d fed from the granulators via a molten sulphur pipeline. The pipeline uses skin effect heat tracing with fibreoptic monitoring, and there are two pipelines each with 100% capacity so that there are no interruptions of the sulphur flow to the granulators. There are 13 Enersul granulators with a nominal capacity of 10,000 t/d, at a configuration of 11 operating, 1 on standby and 1 down for maintenance. The granulators and the truck unloading station feed into a huge sulphur storage area with two stacker-reclaimers. The 200,000 tonne sulphur storage shed can accommodate four Boeing 747s! There is also emergency blocking capacity at the site of 6 sulphur blocks with a total potential storage of 3.8 million tonnes.

The loading berths next to the storage area can handle vessels of 40-60,000 dwt capacity, and there are two shiploaders. Molten sulphur began flowing in August 2009, and granulation started in November. The first ship was loaded in February 2010. At the time of the visit in April, five ships had been loaded with a total of 117,000 tonnes of sulphur.

speculators, especially in China, seemed to have added a new component to the market.

Next **Saad al Kuwari** of Tasweeq ran through the long list of Qatari projects that will be generating more sulphur over the coming years – RasGas, Qatargas, Dolphin, Oryx, Pearl, and the new refineries. Qatar's sulphur exports have gone from 300,000 t/a in 2000 to 800,000 t/a in 2009, 1.2 million t/a in 2010, and will reach 2.5 million t/a in 2015, mostly aimed at India and China, but also South Africa and Southeast Asia.

What to do with this sulphur is a perennial problem, and **Al Mulhall** of PotashCorp described the global phosphate outlook. Crop prices and farm revenues are gradually increasing and fertilizer is becoming more affordable again, and there is lots of new capacity coming onstream to 2012 at Ma'aden, as well as in Morocco, Brazil, Jordan and China. The phosphate market might be tight to 2011 but should go back to surplus in 2012.

China has been the biggest buyer of sulphur, and **Yang Qi** of the China Sulphuric Acid Industry Association spoke about phosphates and sulphuric acid there. The Chinese phosphate industry is recovering from the financial crisis and Sichuan earthquake and led by DAP production will this year exceed the record year of 2007, reaching over 13.7 million t/a. With strong demand from both the fertilizer and non-fertilizer industries, sulphuric acid production in China is growing rapidly, driven mostly by elemental sulphur based acid and smelter acid production. In 2010 China's sulphuric acid and phosphate fertilizer industries will be strengthened through adjustments in business structure as well as technological improvements.

Raza Soomar turned to the Indian situation, where the growth in phosphate fertilizer consumption has been phenomenal. There has been two-digit growth since 2003-4, apart from during 2008-9 due to the financial crisis. Nevertheless that year marked a record import year with DAP imports passing 6.2 million t/a. With no new planned capacity, India is set to import significant quantities for years, and the industry is being encouraged to enter overseas joint ventures to outsource phosphoric acid/rock production.

Legislation

Michael Corke of Purvin & Gertz looked at the options for sulphur in marine fuels in the light of the new International Maritime Organisation rules. Bunker fuel demand is increasing in spite of a dip due to the current recession and about 30% of refinery output goes to fuel oil. The question would be how this would be affected by having to achieve low sulphur emissions from 2020. Although much faith is put in scrubbing technology, Mr Corke said that it didn't really exist at the moment in spite of some promising development work. It is still unclear how it will work in practice, and this potentially throws the solution back onto refineries. Unfortunately, refineries are unlikely to invest in new sections until the price and demand justify the investment. Hydrotreating to low sulphur fuels is a potential option, but coking looked more likely. Either way, said Mr Corke, the bunker market is large enough that it is likely to shift price relationships in many other markets.

Michael Weiss of Lurgi/Air Liquide updated his presentation from last year on clean coal. The drop in the price of natural gas has put many coal-based projects that looked convincing before the recession onto the back burner. Many projects are now undecided, although there are still initiatives

in the US and India, and especially China. Mr Weiss looked at the potential sulphur production from a large scale coal to liquids project of 80,000 bbl/d. This would require 2,460 t/h of coal, and would produce 21 t/h of sulphur. China's CTL projects in Shenhua and Yankuang had the potential to produce 360,000 t/a of sulphur.

Sulphur uses

Mohammed al Methel of Aramco looked at sulphur extended asphalt and **Marwa al Ansary** of Shell sulphur concrete – these two papers are covered in much greater detail elsewhere in this issue.

Nickel leaching has held out the promise of large scale sulphur use for some time, though high pressure acid leaching (HPAL) has had a history of high project costs. **Simon Purkiss** of European Nickel reviewed the development of HPAL projects before turning to his own firm's heap leaching process which, he said, had a capital expenditure of $6/annual lb of nickel compared to $20-30/annual lb for HPAL. Sulphur use for HPAL runs at about 8-14t sulphur per tonne of nickel produced, while the figure is 15-20 tonnes S per tonne Ni for heap leaching. Taking into account likely HPAL projects and heap leach projects over the next few years, Mr Purkiss projected an annual demand of about 3.6 million t/a of sulphur by 2015.

Andrew Green of the International Zinc Association followed on from Luc Maene's presentation to look at using zinc sulphate as a fertilizer to correct zinc deficiencies in soils. Around 50% of all soils are reckoned to be zinc deficient, with India and China badly affected, leading to health problems worldwide and up to 450,000 infant deaths per year. Zinc sulphate is the most widely used fertilizer to correct these problems, and with a 14% sulphur content by weight it also has the side effect of correcting sulphur deficiencies which can limit plant growth. The International Zinc Association and Sulphur Institute are working partnership to promote zinc sulphate use worldwide.

Biofuels have been a sector driving fertilizer demand growth, and **Chris de Brey** of the Sulphur Institute gave a round-up of biofuels developments. Despite the uncertainty prevailing in world financial and commodity markets, the sector has gained a foothold in several markets and is likely to continue to grow, with the evolution path varying by region and policy, economic and technological circumstances.

Sulphur logistics

Tom Valore of Agip KCO took a fascinating look at the logistics challenge for sulphur from the Caspian Sea region. The region produced 8.2 million t/a of sulphur in 2009, 5.9 million t/a from Russia and 2.3 million t/a from Kazakhstan, mostly from the Tengiz field. Most current production is solid formed. Local demand is limited, with 2-2.5 million t/a going to sulphuric acid for phosphate manufacture and 200,000 t/a going to ureanium leaching in Kazakhstan (although this will increase next year). The balance is exported, of which 4.5 million t/a is formed and the remaining 1-1.5 million t/a is crushed bulk sulphur from existing stockpiles.

The logistical challenges are formidable. Kazakhstan is 2,000 km across and has a rail transit time of 10-12 days. To China the distance is 6,000 km and can take 20-25 days by rail. Exports by sea take 7 days to travel the 2,500 km to the Black Sea and then up to 10-25 days by ship, depending on destination. There is limited capacity at the sulphur terminals, and a need for Black Sea infrastructure development. There is also a seagoing bottleneck at the Bosphorus which can add 10-12 days of delays to shipments. Sulphur blocks at Tengiz still account for 6-7 million tonnes, although this has been drawn down from the original 10 million tonnes. No new open storage is allowed by the Kazakh government so there are plans to make greater use of acid gas injection and development of alternative markets, as well as new storage technologies. At Kashagan, which will come onstream in 2012, the storage will be in sand with the sides and top of the block covered and full monitoring. Up to 6 blocks will be created with a total storage of 4 million tonnes.

We may come to the option of having to store sulphur underground, and **Roy Pickren Jr** of Crescent Technology gave a presentation on how this might work. Storage in underground caverns, especially salt caverns is low risk, economically attractive and environmentally advantageous. Mr Pickren said that a slurry of sulphur prills or granules could be used for depositing the material. Sulphur recovery from these caverns would be about 25% the cost of Frasch mining from natural deposits, as using prills allows the interstitial spaces to be conduits for superheated water, letting it permeate faster. However, Mr Pickren admitted that the technology had not yet been demonstrated on a large scale.

Presentations

The conference ended with a series of presentations. The presentation for best paper was given to Dr Marwa al Ansary for her engaging and interesting presentation on sulphur asphalt. Honourable mentions went to Tom Valore of Agip and Al Mulhall of PotashCorp.

It being the 50th anniversary of TSI, awards were also made to those who had given extensive service to the sulphur industry over the years. The awardees were:

James Cattano, Primary Resources, Bruce Coulbourn, ICEC Asia PTE Ltd., Terry Draycott, PRISM, Mike Kitto, British Sulphur Consultants, M.B. Lonikar , Abu Dhabi Gas Industries Ltd., Dhafar Lsloum , Saudi Aramco, Phillipe Molliere, Crescent Technology, Mas Nohara, Enersul LP, Piero Nulli, Esseco SRL, Siraj Rahmitula, Transfert FZCO, Don Roberts, ICEC Canada Limited, David Singleton, Crescent Technology, Swiss Singapore Overseas Ent PTE Ltd., Rajesh Somani, Swiss Singapore Overseas Ent PTE Ltd., Ralph Thawley, FMB Ltd., Dick van Meurs, ICEC Limited SA, Luxembourg Max-Michael Weiss, Lurgi GmbH, Dick Wilkinson, Brimrock US LLC, Janus Wiznewski, JWBS, Harold Weber, TSI, Donald Messick, TSI, Roy Pickren, Crescent Technology, and Omar Al Qatani, Saudi Aramco.