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INTERNATIONAL Fertilizer

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AFA Fertilizer Forum, Cairo

Sulphur: the fourth crop nutrient

State of the nitrogen market

Potash demand returns

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JANUARY-FEBRUARY 2017

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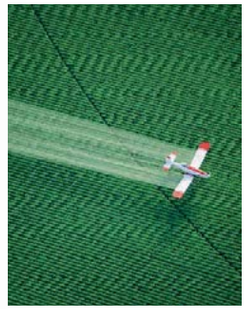

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Future leaders

Potash outlook

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Thinking about tomorrow

> **The fertilizer industry has been confronted by weak global nutrient demand, soft economic prospects, depressed crop prices, rising competition and volatile energy prices.**

What will 2017 have in store for the fertilizer industry? That's the apt and timely subject of one of our main features this January/February (see p15). It also encapsulates the general theme of what is *Fertilizer International*'s first issue of the year.

The last 12 months have certainly been a period that many will be happy to leave behind. As the International Fertilizer Industry (IFA) recently noted: "In 2016, the fertilizer industry has been confronted by weak global nutrient demand, soft economic prospects, depressed crop prices, rising competition and volatile energy prices. Fertilizer prices dropped to their lowest levels during the past five years, severely straining producer earnings."

The industry's reaction to this downbeat prognosis has been sensible, if a little predictable: cost reductions, production curtailments, plant closures, mergers and acquisitions; these have all dominated the fertilizer agenda over the last year.

And looking ahead, IFA, in its recently-published short-term outlook, singled-out Brexit, Turkey's attempted coup and the surprise outcome of the US presidential election as three factors likely to ratchet-up uncertainty during 2017 and beyond.

Delve a little deeper, though, and it's not all doom and gloom. For one thing, the market for fertilizers continues to expand, meaning the cake is getting bigger for everyone. The latest evidence suggests that, after a firm rebound in 2016/17, global fertilizer demand will still grow moderately in 2017/18. Predicted demand growth of 1.6% this year and into next offers some reassurance, even if it represents little more than "back-to-average" expansion.

Some encouraging green shoots of recovery also appear in our potash market outlook (*Phosphates & Potash Insight* section, p49) and the nitrogen market review (p25) this issue.

World potash output is expected to rebound during 2017 and grow for the first time in three years. As PotashCorp's CEO Jochen Tilk commented recently: "After a difficult year in 2016, there are clearly signs that things are picking up." The Mosaic Company is also predicting a "constructive" 2017 outlook for the potash market built on "solid farm demand worldwide, a rebound in global shipments and restructured operations". Potash recovery is also being driven by rising demand in the six major consuming countries in Asia and the Americas. All of these developments are positive signs of a potash market coming back into balance.

Nitrogen market dynamics have also shifted recently, as the long-predicted rationalisation of China's urea industry finally appears to be underway. Certainly, the one-fifth fall in Chinese urea exports – a major correction – was arguably the stand-out nitrogen market development last year. The jury remains out, though, on whether this signals a permanent reduction in China's ability to export urea.

The overall profitability of the nitrogen industry has also been improving, as falling production costs continue to outweigh sliding revenues. Setting aside downside risks, and the fact that margins may be eroded this year, a reasonably firm urea market in 2017 with a base case price of $250/t is foreseen by some analysts. A nitrogen price recovery this year would be widely-welcomed and another cause for cheer, even if the usual caveats and health warnings apply.

The longer-term success of the fertilizer industry ultimately depends on the ability of the sector to attract and retain highly-talented individuals and offer them rewarding careers. IFA and its member companies are well aware of this and have responded by launching the Young Professionals initiative. BCInsight and *Fertilizer International* are keen to support IFA's efforts. We have therefore shared some candid and valuable career advice from three of the industry's leading executives, Chuck Magro, Alexa Hergenröther and Dmitry Konyaev, in the current issue (p29).

Chuck, Alexa and Dmitry all took time out from IFA's busy Moscow conference last May to sit down and share insights with 130 industry young professionals. IFA president, Dr Abdul Rahman Jawahery, and its director general, Charlotte Hebebrand, were also on-hand lending their support. For anyone present at this event, the altruism and generosity shown by those at the top of the industry was striking.

IFA and the sector's business leaders are clearly thinking about tomorrow – as should we all. ■

S. Inglesfield

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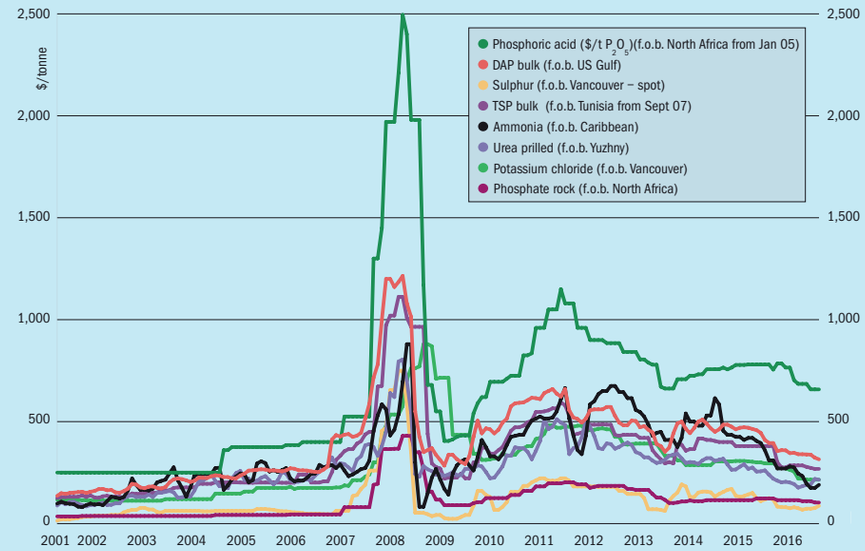
Market outlook

Historical price trends $/tonne



Source: BCInsight

Market insight courtesy of Integer Research

AMMONIA

Prices surged upwards from mid-November to late December due to shorter supply. This was linked to plant shutdowns globally and gas curtailments in Trinidad. These supply restrictions boosted the Yuzhny benchmark to $215/t f.o.b in late December, after it trailed below $170/t f.o.b through much of the fourth quarter. Several producers switched from selling ammonia to urea in response to weak ammonia prices, including Algeria's Sofert and Russia's TogliattiAzot. The US Tampa contract price remained weak compared to other international benchmarks, although it increased marginally to $225/t cfr in December. Incitec Pivot's newly-commissioned US ammonia plant at Waggaman produced 65,000 metric tonnes between mid-October and late November.

UREA

The urea market continued to firm in the fourth quarter of 2016. The Yuzhny urea price rebounded to $218/t in mid-December, up around $30/t on October. Strong demand in the US and Europe and limited availability in Yuzhny supported these price gains. Market fundamentals remained largely unchanged, though, with China's role as a swing supplier remaining the key influence. Rising Chinese coal costs caused the Chinese urea export price floor to rise in October and November. Looking ahead, however, urea prices are expected to face downward pressure as coal prices nudged lower in late November after the Chinese government backtracked on its coal policy.

PHOSPHATE

The global phosphate market remained subdued in November and December with import demand in key regions below expectations. There was limited DAP business to India with domestic stocks satisfying most needs. Major benchmarks for finished phosphates fell in November, with Chinese DAP priced at $310-320/t f.o.b. North African DAP was slightly higher at $327/t f.o.b., reflecting more buoyant demand and improved netbacks there. Phosphate demand also emerged in Pakistan and Bangladesh with several large volumes of Chinese product being shipped to South Asia. Finished phosphate prices did improve marginally in December. This was largely attributable to higher floor prices linked to a rebound in the costs of sulphur and ammonia.

POTASH

Baltic MOP prices stayed level at $218/t f.o.b. from mid-July through to December 2016, while average Vancouver MOP prices have remained at $230/t f.o.b. following increases in early September. Average Brazil MOP prices increased by $10/t in mid-October to reach $238/t cfr, although a small $2/t price erosion has since taken place.

Buyer sentiment in the potash industry is more positive than at this point last year. This is mainly because this year's Chinese contract negotiations are expected to conclude earlier, with contract discussions between Chinese buyers and potash suppliers for 2017 shipments expected to commence shortly. However, no decisions are anticipated before late January.

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Almost all major potash markets are due to post year-on-year decreases in 2016 imports compared to the previous year, with China and the US being particularly disappointing. 2016 US MOP imports, for example, were down 20% to 6.9 million tonnes for the year to October. The market was, however, buoyed by strong Brazilian demand for much of 2016. Brazil's imports totalled eight million tonnes for the year to November, a year-on-year increase of 6%.

SULPHUR

Sulphur prices moved upwards in late November and December as market sentiment continued to improve on the back of higher commodity prices and a slight boost in buying activity. Prices for Middle East December shipments have been in the high $80s/t to low $90s/t f.o.b. An improved supply/demand balance and some upticks in freight costs provided producers with an incentive to push up prices. However, challenging market conditions remain, contrary to this improvement in pricing, with downward pressure coming from both the processed phosphates market and seasonal fundamentals. On the consumption side, limited spot sulphur demand has been reported in key markets, with FACT and IFFCO in India both saying they have no requirements for sulphur in the near term.

Market price summary $/tonne – Early-January 2017

Nitrogen	Ammonia	Urea	Ammonium Sulphate	Phosphates	DAP	TSP	Phosphoric Acid
f.o.b. Caribbean	215	n.m.	f.o.b. E. Europe 80-90	f.o.b. US Gulf	315	n.m.	n.m.
f.o.b. Yuzhny	280-290	223-226	-	f.o.b. N. Africa	330-350	260-270	505-810
f.o.b. Middle East	208-220	235-265**	-	cfr India	320-325	-	580*
Potash	KCl Standard	K_2SO_4	**Sulphuric Acid**		**Sulphur**		
f.o.b. Vancouver	190-240	-	cfr US Gulf	30-40	f.o.b. Vancouver	83-90	
f.o.b. Middle East	185-240	-			f.o.b. Arab Gulf	87-92	
f.o.b. Western Europe	-	€440-460			cfr North Africa	67-78	
f.o.b. FSU	180-230				cfr India	105-110+	

Prices are on a bulk, spot basis, unless otherwise stated. (= contract ** = granular). Phosphoric acid is in terms of $/t P_2O_5 for merchant-grade (54% P_2O_5) product. Sulphur prices are for dry material. (+ Quotes for product ex-Arab Gulf)*

MARKET DRIVERS

- **Ammonia:** Further substantial ammonia price recovery in January and February is unlikely as fundamentals continue to look weak. Recent short-term supply shortages look set to end and additional capacity in the US and South America will add to ammonia market over-supply. The Yuzhny price is expected to commence the year trading in the range $190-210/t f.o.b. A seasonal uptick in ammonia demand is expected from February onwards ahead of the spring application period in North America and Europe, although its impact on prices is likely to be limited.
- **Urea:** Market fundamentals should improve in January due to limited availability in Yuzhny and the onset of seasonal demand for spring application. Supply from Yuzhnyy could be severely curtailed if OPZ fails to agree a new gas supply contract to replace the one which finished at the end of last year. There are expectations that US and European spring demand could boost global urea price levels. Further support will be provided if India makes an early return to the market. Such factors are expected to lead to a modest uptick in urea prices to $215-225/t early in 2017.
- **Phosphate:** The lack of DAP exports to India during 2016 has weighed heavily on the market. Due to sufficient stocks, Indian DAP import activity is expected to be limited until April when buying commences for the Kharif season. Some DAP demand will emerge from Africa, Oceania and parts of Asia in coming months, although this is unlikely to be sufficient to counter excess market supply.

  It is conceivable that higher raw materials costs and reduced Chinese availability could lead to higher prices early in 2017. However, the expected emergence of substantial low-cost Moroccan and Saudi Arabian tonnages will limit this upside, and most buyers seem to be content to wait on the sidelines through January and February.
- **Potash:** A tighter supply situation in the first quarter of 2017 should support prices. PotashCorp has announced another round of supply cuts, this time at its Cory potash operation, as well as inventory adjustments at the Allan and Lanigan plants. Elsewhere, an extensive maintenance programme planned by BPC will take out its production during the first quarter. Potash production from K+S in Germany also remains limited.

  Small increases in demand are currently forecast in all key MOP markets in 2017. China is expected to see a particularly strong demand uptick this year, as the country's buyers fill inventories depleted by delayed 2016 contract settlements. US sentiment is mixed, although many producers expect demand will increase as stocks are low. Indonesian demand is likely to be supported by improving palm oil prices and better weather conditions in 2017.
- **Sulphur:** In the absence of support from the processed phosphates sector, sulphur prices are unlikely to firm significantly beyond current levels. The Barzan project in the Middle East has been pushed back to the second half of the year. However, significant supply will be added in the first quarter when the Kashagan project and phase 20 & 21 of the South Pars project come online. Without significant support from the processed phosphates market, we see the potential for downward prices from the second quarter of 2017 onwards. The continued increase in sulphur supply in 2017 is expected to negatively impact global price benchmarks. However, the sulphur market outlook also hinges on whether the pricing of processed phosphates will improve this year.

Fertilizer Industry News

BRAZIL

Mosaic buys Vale Fertilizantes for $2.5bn

The Mosaic Company has agreed to buy Vale Fertilizantes, the fertilizer arm of Vale S.A., for $2.5 billion.

Vale could secure additional cash payments of up to $260 million from Mosaic over the next two years, subject to the financial performance of the sold business. The deal, announced on 19 December, will make Mosaic the leading fertilizer producer and distributor in Brazil, one of the world's largest agricultural economies.

The assets acquired from Vale will provide Mosaic with the capacity to produce 4.8 million tonnes of finished phosphates and 500,000 tonnes of potash in Brazil. They includes five Brazilian phosphate rock mines, four chemical and fertilizer production sites and one potash plant. Outside of Brazil, Mosaic will also acquire Vale's 40% interest in the Miski Mayo phosphate mine in Peru and its potash project at Kronau, Saskatchewan, as part of the deal. Mosaic has an additional option to buy Vale's Argentinian Rio Colorado potash project before closing the deal, although this is pending diligence checks.

Mosaic's agreement with Vale excludes the nitrogen and non-integrated phosphate business in Cubatão. The sale of these assets has previously being linked with Norway's Yara International.

"This acquisition provides Mosaic with a tremendous opportunity to capitalize on the fast-growing Brazilian agricultural market and from improving business conditions," said Joc O'Rourke, Mosaic's president and CEO.

Mosaic's expanded fertilizer business in Brazil will be led by Rick McLellan, currently the company's senior vice president, commercial.

"I am excited at the prospect of leading Mosaic's vastly expanding business in Brazil," said McLellan. "This will be an ideal time for us to grow in the region, with the strong Brazilian farm economy and growers across the country working to deliver higher crop yields."

Mosaic is funding the purchase with $1.25 billion in cash, which it plans to raise through a debt issue, and by issuing roughly 42.3 million shares to Vale, equivalent to a holding of about 11% in Mosaic. Vale will also have the right to appoint two directors to Mosaic's board on completion of the agreement.

Most of Vale's fertilizer assets and its distribution network in Brazil were originally acquired through the purchase of Fosfertil in 2010.

Mosaic's acquisition of Vale Fertilizantes is expected to close by the end of 2017, subject to regulatory approval and the closing conditions being met. Mosaic said in a conference call that it may eventually produce premium *MicroEssentials* products in Brazil.

Fire at Vale's Cubatão fertilizer plant

Fire broke out in part of Vale's Cubatão fertilizer complex in Sao Paulo state on 5 January, following reports of an explosion.

The fire is thought to have started on a conveyor belt at Vale's Cubatão Unit 2. This part of the complex produces ammonia, nitric acid, sulphuric acid, phosphoric acid, DAP/MAP and ammonium nitrate. The episode caused the release of ammonium nitrate and sulphuric acid into the atmosphere, according to initial fire department reports.

Thirteen fire-fighting vehicles were mobilised to deal with the accident. The complex was also shutdown to allow the evacuation of the site's workers and nearby businesses. Vale said the fire had been contained in a stament on 6 January. There were no casualties although two firefighters were ill temporarily.

UNITED STATES

Donaldsonville ammonia plant up and running

The newly-commissioned ammonia plant at CF's Donaldsonville, Louisiana, nitrogen complex is now operating consistently at its nameplate capacity of approximately 3,600 t/d. The plant, which started-up last September, had produced around 50,000 tonnes of ammonia by the end of 2016.

Donaldsonville's ammonia plant, alongside three similar-sized ammonia plants in Saudi Arabia, is the largest ammonia train by nameplate capacity in the world.

Its commissioning is symbolic as it marks the end of CF's capacity expansion at the site. Total ammonia capacity at Donaldsonville is now 4.3 million t/a, up from 3.1 million t/a previously. The Donaldsonville complex is now the largest nitrogen facility in the world and has the flexibility to switch production from merchant ammonia to upgraded products.

"The start-up of the new ammonia plant signals the completion of our Donaldsonville capacity expansion project," said Tony Will, president and CEO of CF Industries Holdings, Inc. "With all three new plants from the expansion running consistently at or above nameplate capacities, Donaldsonville's expanded asset base and unmatched logistics capabilities are ideally positioned to serve customers in North America and around the world, while strengthening our cash generation now and into the future."

Port Neal capacity expansion complete

CF Industries has also completed the capacity expansion projects at its Port Neal, Iowa, nitrogen complex in December, following the successful commissioning and start-up of the new ammonia and urea plants at the site.

The ammonia plant was operating at its nameplate capacity of approximately of 2,425 tons per day after entering production in late November. The urea plant at Port Neal was then commissioned in December. Both plants were taken offline subsequently to allow the replacement of parts. They were expected to resume production shortly, CF said on 28 December.

"CF's capacity expansion projects are complete," said Tony Will, president and CEO, CF Industries Holdings, Inc. "With projected returns significantly above our cost of capital, we have built the foundation for CF's growth and greatly increased our cash generation capability."

Total annual ammonia capacity at Port Neal is now 1.2 million tons, up from 380,000 tons previously. Most of the new ammonia capacity will be upgraded to urea. Total annual urea capacity at Port Neal is now 1.4 million tons, up from 50,000 tons previously. Total annual UAN capacity at the complex remains largely unchanged at 800,000 tons.

IFCo's Wever complex 98% complete

The Wever nitrogen complex in Iowa was 98% complete and started-up ammonia operations at the end of 2016.

The complex is owned and operated by

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Iowa Fertilizer Company (IFCo), a subsidiary of Netherlands-based OCI and is the first greenfield nitrogen facility to be built in the US in nearly 30 years.

"This is a significant moment for Iowa Fertilizer Company and more importantly for the customers we will serve throughout the United States," said Darrell Allman, IFCo's site operations director. "The start-up activities taking place underscore the tremendous progress that has been made at the plant in Wever and will help ensure the facility is operating correctly."

The $1.9 billion project will produce 1.5-2.0 million t/a of urea ammonium nitrate (UAN), granular urea, merchant ammonia and diesel exhaust fluid (DEF). The 725,000 t/a ammonia plant at the complex – the first of the site's units to be commissioned – will provide feedstock for all these products. IFCo expects to have storage capacity for 100,000 tonnes of ammonia, 120,000 tonnes of UAN, 40,000 tonnes of urea and 6,000 tonnes DEF at the Wever complex.

Platte River Equity buys Tiger-Sul Products

Platte River Equity has a acquired a controlling interest in Tiger-Sul Products, a leading global sulphur fertilizer supplier, from HJ Baker & Bro Inc.

HJ Baker, who have owned the company since 2005, will retain a minority stake in the company. Tiger-Sul's headquarters will remain in Shelton, Connecticut, and production will continue at its existing operations, namely Atmore, Alabama, Stockton, California, Irricana, Alberta and Shanghai, China.

"For more than 50 years, Tiger-Sul has been providing farmers around the globe with high quality sulphur-bentonite and micronutrient fertilizers, pushing the boundaries of innovation in the industry," Tiger-Sul chief executive Don Cherry, said. "Platte River has the resources and experience to help us accelerate the company's growth in the global market."

Waggaman plant handover complete

KBR Inc has handed over the new ammonia plant in Waggaman, Louisiana, to operators Dyno Nobel after successfully completing performance tests.

KBR was the EPC contractor for the project which uses the company's proprietary *Purifier* ammonia technology. KBR completed the project, from contract award to handover, in a record time of 42 months with no lost-time incidents over the five million man-hours this required.

Staff gather to celebrate the 125th anniversary of Lewis Pumps.

"We are proud of this ground-breaking project which showcases KBR's ammonia plant technology and EPC services," said David Zelinski, KBR president of onshore, engineering & construction for the Americas. "The completion of this project demonstrates KBR's world class project execution and customer service capabilities."

Lewis Pumps celebrates 125 years

Weir Minerals celebrated the 125th anniversary of Lewis Pumps, one of its oldest brands, at the end of 2016. The firm has a long-standing international reputation in the design and manufacture of pumps and valves for the sulphur, sulphuric acid and phosphoric acid industries.

Lewis Pumps began in 1891 as Chas S Lewis and Co, Inc, a family business supplying the beer pasteurisation and bottle cleaning industries. By 1906, the company had begun manufacturing pumps in-house, and went on to manufacture its first sulphuric acid pump in 1914 – a specialisation which has continued to the present day. The company manufactured its first sulphuric acid valve in 1975. It finally became part of the Weir Group in 1994.

"It is an honour to be celebrating 125 years of developing and manufacturing our Lewis pump range in this ever-changing industry. We have witnessed many challenges and opportunities throughout our history and continue to advance to meet the demands of our markets," said Bob Elliott, a divisional director at Weir Minerals.

CANADA

Colonsay resumes potash production

Mosaic has announced that its Colonsay potash mine in Saskatchewan will re-start production in mid-January, although the mine will not operate at full capacity initially.

Mosaic expects Colonsay to produce around 1.5 million tonnes in 2017, some 0.6 million t/a lower than its full capacity of 2.1 million t/a.

Mosaic idled Colonsay in July 2016 in reaction to lower prices and weak global demand for potash, while continuing production at its Esterhazy and Belle Plaine potash mines during this curtailment. All of the 330 workers temporarily laid-off at Colonsay last July have now returned to work.

Mosaic's CEO and president Joc O'Rourke signalled in November that Colonsay was likely to resume operations early in the new year.

TURKEY

Government mulls fertilizer production phase-out

Turkish prime minister Binali Yildirim has suggested the country may phase-out production of chemical fertilizers altogether to prevent them from falling into the hands of terrorists, according to local media reports.

Turkey moved to ban the import and sale of nitrate fertilizers as an anti-terrorism measure last June. The ban covers ammonium nitrate, calcium ammonium nitrate and potassium nitrate products.

Yildirim flagged-up a possible switch from mineral to organic fertilizers for agronomic as well as security reasons. But it is unclear whether his suggestion covers just currently-banned nitrate fertilizers or encompasses all mineral fertilizers – or how such a move would affect Turkey's sizable domestic fertilizer industry. In addition to its currently-idle ammonium nitrate capacity, Turkey produces substantial volumes of ammonia, urea, mono- and diammonium phosphates, ammonium sulphate, triple superphosphate and NPKs.

ETHIOPIA

OCP signs fertilizer complex deal

Morocco's OCP Group has agreed to build a large-scale fertilizer complex in Ethiopia under a $2.4 billion partnership deal signed with the Ethiopian ministry of public enterprise.

The proposed Dire Dawa Fertilizer Complex will produce potash and nitrogen fertilizers using local mineral and natural gas resources. It will also consume OCP-supplied phosphoric acid.

An initial investment of $2.4 billion could see 2.5 million t/a of fertilizers produced by 2022, according to OCP. This would make Ethiopia self-sufficient in fertilizers and create additional volumes for export. Construction is expected to begin next year and last for three years, according to analysts CRU, with banks funding 60% of the project and the two partners financing the remainder. A subsequent investment of $1.3 billion will increase total production to 3.8 million t/a by 2025. Tonnage capacities for specific products have not been provided at this stage.

"This game-changing partnership is based on a common vision between Morocco and Ethiopia for sustainable agricultural development across Africa and reinforces economic ties between the two countries," OCP said in a statement.

In a related move, subsidiary company OCP Africa recently unveiled plans to set up 10 new distribution centres in African towns by 2020. The new centres, called "houses of the farmer", should eventually provide agricultural products and services for a total of one million farming families across the continent. The first two centres will be opened in Morocco and Nigeria in the near future and then rolled-out to other West and East African countries.

Africa is one of the world's fastest growing regions for fertilizer demand, although land application rates remain low by international standards.

SAUDI ARABIA

Ma'aden plans third phosphate project

Ma'aden has confirmed plans to develop a third phosphate fertilizer project in Saudi Arabia at an estimated cost of SAR 24 billion ($6.4 billion).

The new project could add an extra three million t/a to Saudi phosphate capacity by 2024, Ma'aden said in a statement, although final go-ahead will depend on the outcome of feasibility studies and the granting of necessary consents.

The news of a possible third phosphates project emerged after Saudi Arabia's King Salman attended an official inauguration at Ma'aden's Ras Al Khair site on 29 November.

The start-up of Ma'aden's Wa'ad Al Shamal phosphate fertilizer complex, meanwhile, is imminent. Around SAR 28 billion ($7.5 billion) has been invested in Wa'ad Al Shamal to date. The project is jointly owned by Ma'aden, Sabic and Mosaic and will eventually have the capacity to produce three million t/a of DAP, MAP and compound fertilizers.

Wa'ad Al Shamal began producing ammonia in September and is expected to reach

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full production capacity by 2019. Ma'aden CEO, Khalid al-Mudaifer, updated *Reuters* on the project's timetable last November. "Construction will be completed by the end of this year and, starting next year, we will begin production ramp up on a staggered basis to reach full capacity," said al-Mudaifer.

K+S buys 30% of Al-Biariq

Germany's K+S has bought a 30% stake in the Saudi Arabian SOP manufacturer Al-Biariq for Fertilizer Plant Co, Ltd.

K+S confirmed in a statement in December that it had paid "a high single-digit million US dollars figure" for its share of Al-Biariq. The German potash producer has an option to buy a further 30% in Al-Biariq within two years of closing the current deal.

Al-Biariq currently produces 20,000 t/a of SOP, although this is set to double to 40,000 t/a in the near future, according to K+S. The part-purchase will see K+S take control of the future distribution and marketing of Al-Biariq fertilizers.

"In line with our management agenda, we are further strengthening the specialty business in the Potash and Magnesium Products business unit through this investment and can offer an even broader product portfolio in the future," said Norbert Steiner, K+S chairman.

The 30% purchase of Al-Biariq should be completed during the second quarter of the year.

K+S's Hattorf production site, Germany.

TUNISIA

Phosphate production resumes

Tunisia's prime minister Youssef El-Shahed confirmed that phosphate production in the country resumed in November.

"We believe that the economy is reviving and we see glimpses of growth returning as phosphate production resumes and tourism starts to pick up. Also, the procedures taken by the government will help growth return," *Bloomberg* reported El-Shahed as saying.

Tunisian producer GCT also said that its Gafsa plant had been producing DAP in November and was now receiving stable phosphate rock deliveries.

GERMANY

K+S resumes Hattorf production

K+S resumed potash production at the Hattorf site of its Werra complex in Germany, the company confirmed on 2 January. All sites at Werra are now operating at full capacity following an improvement in water flow in the nearby Werra River.

K+S has also secured a new permit from Kassel regional council allowing it to continue to dispose of the saline wastewater generated by potash production at Werra using deep-well injection. The permit grants permission to dispose of 1.5 million cubic metres of wastewater between 2017 and 2021.

RUSSIA

Acron may postpone Talitsky project

Russia's Acron may postpone its Talitsky potash project in the Perm region until price levels recover, according to comments made to *Bloomberg* by its chairman Alexander Popov.

Acron announced in November 2015 that it was seeking Chinese, Indian and Arabian investors for the planned $1.6 billion project, but has yet to make a final decision on its go-ahead. Last year, a group of Indian investors shelved their plans for a 30% investment stake in Talitsky due to doubts over its valuation.

Talitsky is due to enter production in 2021, under Acron's current timetable, and is expected to reach full capacity of two million t/a by 2023.

"With Talitsky not due to be completed until after 2020, it would not be surprising if Acron decided to postpone the greenfield potash project," commented analysts CRU. "Still, other global capacity additions over the next five year are likely to add pressure to potash prices, jeopardising the chances of the recovery that Acron is hoping for."

TAJIKISTAN

Sarband complex revamp starts second phase

The second phase of the revamp and expansion at the Sarband nitrogen complex owned by OJSC Azot/Tajik Azot has begun. The project will increase urea production at the complex to 500,000 t/a.

Sarband has 110,000 t/a of ammonia and 180,000 t/a of urea capacity and was originally built in the 1960s. The complex was subsequently bought by Ukrainian fertilizer magnate Dmitry Firtash in 2002 and became part of Group DF/Ostchem. However, the complex ceased operations in 2008 due to a lack of natural gas feedstock. The plant was subsequently renationalised in 2014 after Firtash was placed under investigation for corruption.

Half of the company was eventually sold to China's Henan Zhongya Holding Group, who have invested $360 million in a wholesale revamp of the complex and overseen its conversion to coal gasification. The first stage of the expansion will take urea production to 320,000 t/a when it is completed in 2018. The recently-started second phase expansion to 500,000 t/a is expected to finish in 2019. ■

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People

Grupa Azoty selected **Wojciech Wardacki** as its new president on 16 December and at the same time removed the previous president, Mariusz Bober, who had been in office for less than 10 months. Mr Wardacki previously served as the president of Zakłady Chemiczne Zachem and was a board member of Ciech. He has been president of Grupa Azoty Zakłady Chemiczne Police since April. He was also once a member of the Sejm, the lower house of the Polish Parliament. "My mission is to complete the integration of the group, comprising four companies, while ensuring that they remain independent, and to enhance the group's market position," said Wardacki.

Mr Zhang Wei became the new president of Sinochem Group in November, following a meeting of the company's leadership team. He was also made a board member and deputy secretary of the party leadership committee of Sinochem Group.

Ma'aden's president and CEO **Khalid Al Mudaifer** has been appointed to the board of the International Fertilizer Association (IFA). "For many years the IFA has been the voice of the global fertilizer industry," said Khalid Al-Mudaifer. "We have been growing our relationship with IFA for a number of years now, while continuing to establish our own credentials in the global phosphate fertilizer market." Mr Al-Mudaifer has been president and CEO of Ma'aden since 2011 and has several decades of experience as a mining sector executive. He steered the early development of the Ma'aden Phosphate Company and the master planning of Ras Al Khair industrial city for Ma'aden.

The chairman of Abu Qir Fertilizer Company **Saad AbulMaaty** has been made chairman of the Arab Fertilizer Association (AFA). Mr AbulMaaty said he would put all his experience and expertise at the disposal of the AFA and would strive to make the Arab fertiliser industry the most innovative and competitive globally.

Dr Ralph Jäger, the personnel director of K+S KALI and a management board member left the company at the end of November. The supervisory board and Dr Jäger agreed not to extend his current term of office, which was due to expire on 30 June this year. The board expressed their thanks and appreciation for his work and wished Dr Jäger all the best for the future. The company's management board will now consist of two members until further notice. **Dr Rainer Gerling**, who has been responsible for production and technology since January 2016, has taken on the position of personnel director and has responsibility for human resources. **Alexa Hergenröther**, who has been responsible for marketing and sales since June 2014, has taken over responsibility for finance & controlling, structure & organisation and compliance, in addition to her current duties.

Ryan Bartlett has joined North America's Compass Minerals as its vice president for innovation and product development. He will be responsible for building a world-class research and development (R&D) team within the company's plant nutrient division. "Dr Bartlett's disciplined approach to product development and advancing scientific projects will be of exceptional benefit to Compass Minerals," said Brad Griffith, senior vice president for plant nutrition. "Ryan's background in agriculture and product development will allow us to maximise our newly expanded portfolio to create value for our farmer-customers." Dr Bartlett joins Compass Minerals after a nine year stint at Monsanto where he was responsible for the development of a global commercial field testing and innovation strategy for the company.

Mark Sopp will join Houston-headquarted KBR Inc as its Chief Financial Officer (CFO) on the retirement of it current CFO, Brian Ferraioli. Mark previously served as CFO and executive vice president for Leidos Holdings from 2005 to 2015. Prior to this, he held various executive positions with Titan Corp, another firm involved in government contracting and commercial business. "We look forward to Mark joining KBR," said Stuart Bradie, KBR president and CEO. "Along with his extensive financial and capital markets expertise, Mark's long-time experience in the government contracting sector, including knowledge of the government services investment community, will be immensely helpful as KBR expands our Government Services segment to achieve better balance between our government and hydrocarbons businesses."

Bradie also paid tribute to Brian Ferraioli: "We greatly appreciate Brian's fiscal leadership during his time at KBR. He has made many significant contributions, overseeing all the financial affairs of the company, helping strengthen our financial management and reduce our overall cost structure, and his sage advice has been a great help to me personally. We thank Brian for his service to the company and we wish him the very best in his well-deserved retirement."

Calendar 2017

FEBRUARY

27-30

IFA Global Safety Summit,
AMMAN, Jordan
Contact: IFA Conference Service
Tel: +33 1 53 93 05 25
Email: conference@fertilizer.org
Web: www.fertilizer.org

MARCH

13-15

Phosphates 2017, TAMPA, Florida
Contact: CRU Events
Tel: +44 20 7903 2444
Email: conferences@crugroup.com
Web: www.crugroup.com

MAY

8-10

SYMPHOS 2017, 4th International Symposium on Innovation in the Phosphate Industry, BEN GUERIR CITY, Morocco
Contact: SYMPHOS Technical Committee
Tel: +212 5 23 39 80 10
Email: symposiumocp@ocpgroup.ma
info@symphos.com
Web: www.symphos.com

22-24

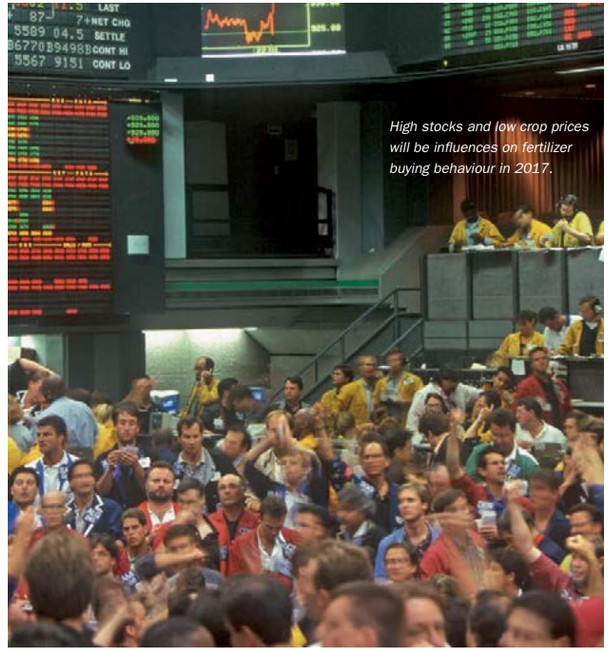
85th IFA Annual Conference,
MARRAKECH, Morocco
Contact: IFA Conference Service
28 rue Marbeuf,
75008 Paris, France.
Tel: +33 1 53 93 05 25
Email: conference@fertilizer.org
Web: www.fertilizer.org

JUNE

9-10

41st AIChE Annual Clearwater Conference 2016, CLEARWATER, Florida
Email: chair@aiche-cf.org
Web: www.aiche-cf.org

After a firm rebound in 2016/17, global fertilizer demand is set to moderate and slip back to average growth in 2017/18. On the upside, nutrients are more affordable than they were 12 months ago with fertilizer-to-grain price ratios currently close to a seven-year low. On the downside, global economic growth remains sluggish and political uncertainties abound. In agriculture, high stock levels are also expected to continue to weigh on cereal and oilseed prices.



High stocks and low crop prices will be influences on fertilizer buying behaviour in 2017.

What will 2017 have in store?

The past 12 months have presented the fertilizer industry with a blizzard of challenges and uncertainties, as the International Fertilizer Association (IFA) recently noted[1]:

"In 2016 the fertilizer industry has been confronted by weak global nutrient demand, soft economic prospects, depressed crop prices, rising competition and volatile energy prices. Fertilizer prices dropped to their lowest levels during the past five years, severely straining producer earnings."

The industry has reacted to these poor market conditions with cost reductions, production curtailments, plant closures, consolidations and mergers. Yet, as IFA also reports: "Fertilizer production and import levels have remained unexpectedly resilient, and in some cases have even reached record amounts."

Uncertain geopolitics

2016 has also been a year of profound political upheaval. The UK, Europe's second largest economy and the fifth largest globally, unexpectedly voted to leave the European Union in June. Later that summer, on Europe's eastern flank, Turkey detained thousands of its citizens and declared a state of emergency following a surprise coup attempt in which 300 people died. In November, on the other side of the Atlantic, Washington outsider Donald Trump was elected 45th president of the United States in one of the greatest political upsets of modern times.

IFA singled-out these three events in its latest short-term fertilizer outlook, mainly because of their hard-to-predict political and economic consequences[1]. Indeed, Turkey's ban on the sale and imports of nitrate fertilizers means the country's crackdown and unrest has already had a direct impact on the fertilizer market.

Complex demand drivers

Fertilizer demand is influenced by a range of factors, some of which are harder to predict than others. In the short-term, the main drivers of demand include:

- Farm economics and the macroeconomic conditions
- Crop prices and fertilizer-to-crop price ratios
- Crop mix, growing areas and crop yields
- Soil nutrient levels and nutrient replenishment
- Policy, regulation and fertilizer subsidies
- Sustainability, nutrient management and recycling

The importance of these factors varies from country-to-country and region-to-region. Adding to the complexity, these primary drivers are in turn influenced by a host of secondary and tertiary considerations.

A deterioration in **macroeconomic conditions**, by triggering slowdowns or contractions in global, regional and national growth, is detrimental to overall economic

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Table 1: **Global fertilizer demand forecast, million tonnes nutrients**

Nutrient	2017/18f (million tonnes)	2016/17f (million tonnes)	2015/16e (million tonnes)	2014/15 (million tonnes)	2013/14 (million tonnes)
N	113.0 (+1.3%)	111.6 (+2.4%)	109.0	110.1	109.2
P_2O_5	43.5 (+1.5%)	42.8 (+1.6%)	42.1	41.6	41.2
K_2O	34.1 (+2.6%)	33.2 (+1.8%)	32.6	32.4	31.2
Total	**190.6 (+1.6%)**	**187.6 (+2.1%)**	**183.8**	**184.1**	**181.6**

e: estimate, f: forecast *Source: IFA (November 2016)*

demand and also affects agricultural markets. **Farm economics** and attendant issues such as credit availability and barter ratios have a more direct impact on the ability of farmers to purchase fertilizers, as was seen in Brazil in 2015 (*Fertilizer International* 472, p30).

Crop prices and fertilizer-to-crop price ratios are also key controls on crop nutrient demand as they play a critical role in determining farm buying power and fertilizer affordability. Crop prices in turn are driven by **agricultural production, inventory levels and demand**. Analysts therefore pay particularly close attention to the prices of cereals, oilseeds, cotton, sugar and palm oil, the main fertilizer-consuming crop types. The **biofuels market** is also an important driver of fertilizer demand due to the large-scale cultivation of maize and sugarcane for ethanol and oilseed rape (canola) for biodiesel (*Fertilizer International* 474, p22). Crop failures due to extreme weather events such as the 2015/16 **El Niño** (*Fertilizer International* 475, p38) can also affect fertilizer demand in the short-term.

Commodities and currencies recover

The International Monetary Fund (IMF) is currently forecasting 3.1% growth in global GDP for 2016, a downgrade on its earlier forecasts due to faltering growth in the advanced economies during the second half of last year. More encouragingly, growth in the world economy is expected to accelerate to 3.4% this year. The emergence of Brazil, Nigeria and Russia from recession in 2017 is expected to offset a predicted slowdown in China's economy

Overall growth of the advanced economies is set to move up to 1.8% this year, on the back of a strengthening North American recovery. However, the economic repercussions and uncertainty created by 'Brexit' are expected to place the Eurozone countries and the UK on a lower growth path in 2017.

Commodity prices have shown signs of recovery in the last 12 months after the price falls of 2014 and 2015. After crashing to an 11-year low of less than $35 a barrel in January 2016 (*Fertilizer International* 470, p18), the oil price (Brent crude) has since recovered to $57/bbl, a year-on-year increase of almost two-thirds. The currencies of the main commodity-exporting countries such as Russia and Brazil, in a reversal of the major devaluations seen in 2015, have generally appreciated in 2016, mirroring the rebound in commodity prices.

High stocks to keep crop prices low

Agricultural commodity prices are also on the mend, although the picture is mixed and weakness remains. The FAO's Food Price Index fell to its lowest level in six years in 2015, reflecting the price weakness of a range of agricultural commodities. The last 12 months has been markedly different, though, with the index rallying to 171 points in November 2016, an almost uninterrupted year-on-year rise of 10%.

Cereal prices did weaken last year, however, due to a strengthening dollar and ample supplies. The FAO Cereal Price Index averaged 141.4 points in November 2016, down 7.9% year-on-year. The FAO Vegetable Oil Price Index, in contrast, rose to 175.6 last November, its highest level since August 2014. This strong rebound was primarily driven by strengthening palm oil prices supported by supply tightness and anticipated demand from the biodiesel sector.

Rabobank expects that record-high stock levels will keep global food prices low in 2017. The storage of staples such as wheat, corn and soybeans in record volumes will weigh on prices this year in its view. The Trump presidency could also bring with it currency uncertainty and volatile food prices, the bank reports, while elections in Germany and France add further unpredictability.

Rabobank also highlights the uncertainty and price risks created by China's huge stocks of key crops. The country is thought to hold 60% of global cotton supplies and over half of world corn, 40% of wheat and 21% of soybean reserves. This makes global prices of cotton, sugar, corn, soybeans and vegetable oil vulnerable, should China decide to sell some of these reserves, according to the bank.

Stefan Vogel, Rabobank's head of agri-commodity markets, said: "After three years of declining prices and extreme weather wrecking crops in many important agricultural regions, 2017 looks set to bring some much-needed stability to food prices. Nevertheless, record global stock levels mean prices are likely to remain stubbornly low.

"Yet the most striking wildcard in this is China. Given its massive share of global agri-commodity imports, it exerts a colossal influence on world food prices. And with huge stocks of many of the most important commodities – including corn, wheat and soybeans – any decision by China's policymakers to begin selling down these reserves would have a profound effect on world markets."

Fertilizer demand

IFA's latest fertilizer demand forecast for 2016/17 is broadly in line with its previous predictions (*Fertilizer International* 470, p18). It now expects world nutrient demand to rise by 2.1% to 187.6 million tonnes in 2016/17[2]. This largely positive prospect reflects the rebound in sugar, vegetable oil, cotton and dairy prices and the return to average weather conditions following the strong 2015/16 El Niño (*Fertilizer International* 475, p38).

Looking further ahead, IFA foresees a slight slowdown of demand growth over the next year or so. It currently predicts a 1.6% year-on-year rise in world fertilizer demand in 2017/18 to 190.6 million tonnes, a growth rate it describes as "back to average" (Table 1). In IFA's view, demand prospects for the coming year will be shaped by:

- Slightly tighter agricultural commodity markets
- Better economic prospects in the US, Brazil and Russia, helping offset a slowdown in China
- Growing political and policy uncertainties in some important fertilizer-consuming markets

The outlook for individual nutrients going forwards is as follows:

- Potash demand to grow most rapidly (+2.6%) in 2017/18 driven by strong market requirements in China, India, Brazil and Indonesia
- Modest phosphate demand growth (+1.5%) mainly driven by higher market needs in India, Brazil and Argentina
- A significant fall-back in nitrogen demand growth (+1.3%) to the medium-term average, with India solely responsible for half of the year-on-year increase in demand

Demand prospects in 2017/18 will be strongest in India, Brazil, Argentina, Indonesia and China, driven by the following:

- **India:** Incentives remain for growing more food, assuming no major change to fertilizer subsidies
- **Brazil/Argentina:** Improving economic and policy context
- **Indonesia:** Demand driven by oil palm and rice
- **China:** K showing strong demand growth with stable/declining N and P demand
- **Rest-of-world:** large potential in markets such as Africa and Ukraine

Global supply, sales and trade

Fertilizer supply looks set to outstrip demand this year, "2017 will also bring its own set of challenges, with a 3-4% growth in global supply against a 2-3% increase in demand," notes IFA[3].

IFA expects nearly 100 new ammonia, phosphoric acid and potash production units and expansion projects to come on-stream in 2016 and 2017, adding 19 million tonnes of additional nutrient capacity to world supply. A further 15 projects will also add to phosphate rock production capacity. Nearly two-thirds of this extra capacity (12 million tonnes) is scheduled to arrive this year, although the effective supply from this is likely to be considerably lower (nine million tonnes)[3].

Global urea capacity is projected to grow by 7% between 2015 and 2017 to 223 million tonnes. Some 3.4 million tonnes of this is due to be added in 2016, followed by a further 11.4 million tonnes in 2017. More than half of the 2015-2017 increase is expected to come from two countries, the US and Nigeria.

Phosphate fertilizer capacity is forecast to rise by 9% between 2015 and 2017 to 48.6 million tonnes P_2O_5. This is divided between a 0.5 million tonne addition in 2016 and a 3.3 million tonne P_2O_5 addition in 2017. More than four-fifths of the 2015-2017 phosphate capacity increase will come from Morocco (35%), Saudi Arabia, (31%) and China (16%).

THE YEAR AHEAD

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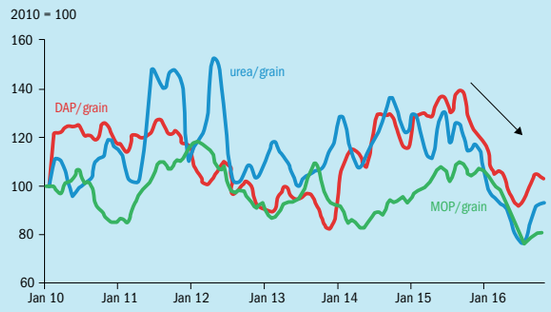
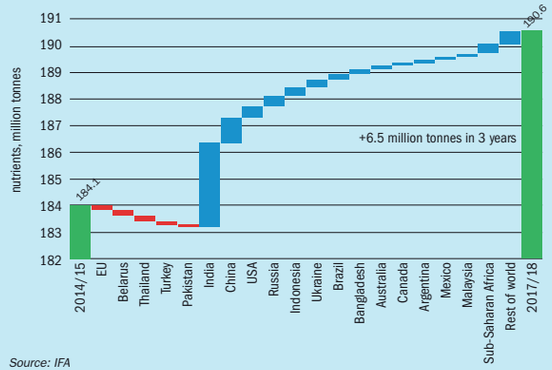
Fig 1: **Fertilizer-to-grain price ratios for urea, DAP and MOP**



Source: IFA

Fig 2: **Global demand growth, 2014/15 to 2017/18**



Source: IFA

2015-2017 potash capacity is set to rise by 9% (7.7 million tonnes) to 91.6 million tonnes MOP (muriate of potash) by the end of 2017. Around 95% of the net global increase is expected to come from PotashCorp (three million tonnes), K+S Legacy in Canada (two million tonnes), China (1.7 million tonnes) and Uralkali (0.9 million tonnes). Recent curtailments and ore depletion have, however, removed over four million tonnes from global potash supply, according to IFA[3].

Global sales and trade prospects for 2017 are broadly positive. For phosphate fertilizers, diammonium phosphate (DAP) sales (+8% to 39 million tonnes) and trade (+5% to 17-18 million tonnes) are set to grow markedly. More moderate growth, in contrast, is expected for world sales of urea (+2-3% to 183 million tonnes) and potash (+2-3% to 64-65 million tonnes). Some growth in world potash trade is anticipated (+2% to 48-49 million tonnes) while urea trade is expected to remain stable year-on-year (49 million tonnes)[3].

Synthesis

Global fertilizer demand is set to firmly rebound in 2016/17, after virtually no growth in 2015/16, and then moderate into 2017/18.

Fertilizers are more affordable than they were a year ago. Fertilizer-to-grain price ratios, for example, have fallen sharply since the middle of 2015 and are currently close to a seven-year low (Figure 1). The World Bank's fertilizer price index (2010 = 100) also fell by almost one-fifth in 2016, from 95 to 78, and is forecast to rise by just two points to 80 during 2017.

Global growth will remain sluggish and the economic outlook mixed. Russia and Brazil should both emerge from recession in 2017. Symbolically, China's economic growth rate will be eclipsed by the robust performance of India's economy. In agriculture, high stock levels are expected to continue to weigh on cereal and oilseed prices.

Global sales and trade in urea, potash and DAP should expand in 2017. Fertilizer supply growth is, however, forecast to outstrip demand this year. India, alongside China, Sub-Saharan Africa and Brazil, continues to play a vital role in driving the global expansion in fertilizer demand. The subcontinent is expected to account for almost one half of the 6.5 million tonne rise in nutrient demand between 2014/15 and 2017/18 (Figure 2).

Looking much further ahead, how long India will continue to drive world demand – and if and when it will follow China's lead in attempting to cap consumption – remains an open question. A number of developments on the horizon will also act to constrain global fertilizer demand. The EU's draft fertilizer regulation could eventually limit production and sales of high-cadmium phosphate rock, for example (*Fertilizer International* 474, p28). Policies on environmental stewardship, nutrient use efficiency and recycling are also being strengthened at national and international level (*Fertilizer International* 474, p32). This is exemplified by China's decision to limit fertilizer consumption to 1% annual growth up to 2020 with zero growth after this date.

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2. Heffer, P. et al., 2016. Short-Term Prospects for World Agriculture and Fertilizer Demand 2015/16 – 2017/18. IFA Strategic Forum, 26-28 November 2016, Dubai.
3. Prud'homme, M., 2016. Global Fertilizer Supply and Trade 2016 – 2017. *IFA Strategic Forum*, 26-28 November 2016, Dubai.

Sulphur: the fourth crop nutrient

Sulphur is becoming an increasingly important crop nutrient – thanks to lower sulphur emissions, the increasing prevalence of high-analysis fertilizers and rising cropping intensity. This is opening up opportunities for producers to capitalise on the value of sulphur by supplying sulphate and sulphur-enhanced fertilizers in ever larger volumes.

Soil sulphur deficiency, a relative rarity 20 years ago, is becoming more common. The reasons for this are threefold. Firstly, the deposition of sulphur dioxide emissions from the atmosphere used to guarantee that soils in many regions were automatically enriched and replenished with sulphur. This is no longer the case, however, as increasingly stringent environmental regulations and the introduction of low-sulphur fuel has sharply cut emissions. Secondly, improving crop yields are withdrawing ever larger amounts of sulphur from the field. Finally, farmers are continuing to switch to high-analysis products, containing little or no sulphur, at the expense of sulphur-rich, low-analysis products, a long-term consumption trend that has also put sulphur replenishment on a downward path.

The resulting depletion of soil sulphur means that its value as a plant nutrient is now receiving greater recognition. Sulphur has become increasingly valued by the farm sector in recent years, to the extent that some industry observers have started to call sulphur 'the fourth crop nutrient'.

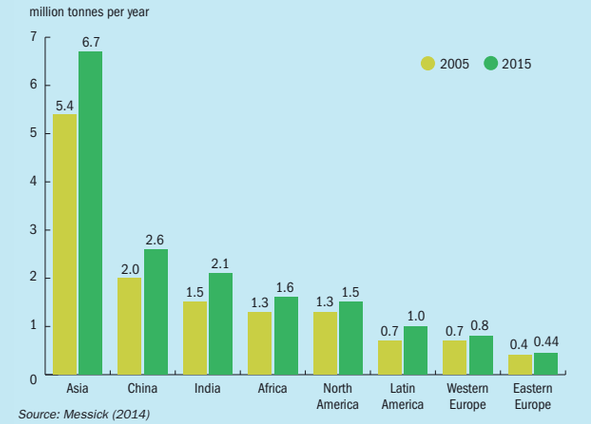
Growing sulphur deficit

Sulphur supplied through the application of traditional sulphate fertilizers currently stands at around 10.8 million tonnes globally, according to some calculations. Additionally, the worldwide use of sulphur-enhanced fertilizers, sulphur-bentonite and thiosulphates is likely to add a further 4.0 million tonnes to the supply of sulphur to crops.

Agricultural intensification and the shift to higher yielding and shorter season crops means nutrients are being extracted from soils, including sulphur, in ever larger amounts. Root vegetables, onions and brassica, especially rapeseed, also have a particularly high demand for sulphur. Pasture and other widely-grown crops such as cotton, coffee, and sugarcane also require moderately high sulphur applications.

These and other factors have helped push up the global crop requirement for sulphur over the last 25 years ago. TSI estimates that this has increased from around 15 million tonnes in 1992 to in excess of 20 million tonnes today[1]. Yet the amount of sulphur supplied to crops through fertilizer applications, in contrast, has remained at around 10 million tonnes annually over this period. The growing global deficit resulting from this application shortfall has created the market potential for an additional 10.6 million tonnes of sulphur, calculates TSI, mainly located in Asia and the Americas (Figure 1).

Fig 1: **Regional plant nutrient sulphur defecits**



Source: Messick (2014)

Back in its rightful place

Sulphur is present in all crops and plays an important metabolic role. It is essential for the formation of proteins, amino acids, vitamins and enzymes, and is involved in photosynthesis, energy metabolism and carbohydrate production. Sulphur also contributes to the flavour and aroma of crops such as onions and can therefore influence the quality of farm produce.

Importantly, sulphur does not act alone and works in tandem with nitrogen

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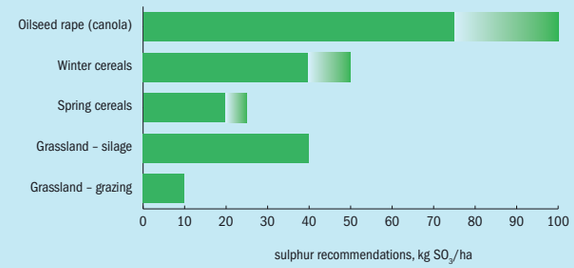
Fig 2: **General sulphur recommendations for crops**



Source: Yara

to enable the formation of amino acids during protein synthesis. Sulphur is also part of the plant enzyme required for nitrogen uptake. Because of this, sulphur and nitrogen are inseparable nutrients according to fertilizer producer Yara International:

"Many agronomists now consider sulphur to be the second most important nutrient after nitrogen. Certainly, sulphur is an essential nutrient, closely linked with nitrogen in biological processes with both elements forming an inseparable team. Previously, crop requirements were generally met from atmospheric deposition, so sulphur was confined to a secondary role. However, today it is back in its rightful place as an essential component of optimum nitrogen management."

In crop nutrition, sulphur plays a critical role in early crop establishment and improves resistance to environmental stress. Deficiency stunts early plant growth, leading to yield losses later on, and is exacerbated by the following conditions:

- Light and sandy soils with low soil organic matter
- Leaching conditions from high rainfall during winter
- Dry spring conditions resulting in low sulphate mobility
- Low temperatures slowing the mineralisation rate
- Low input of organic matter and mineral sulphur
- Low sulphur deposition due to remoteness from industry

Root vegetables, onions and brassica, especially rapeseed, are particularly sulphur hungry crops. Pasture and other widely-grown crops such as cotton, coffee, and sugarcane also require moderately high sulphur applications (Figure 2).

Higher-analysis, lower sulphur

Worldwide, much less sulphur has been added to soils through the application of fertilizers in recent decades. This is partly because the use of sulphur-containing products, mainly single superphosphate (SSP), ammonium sulphate (AS) and sulphate of potash (SOP), has either fallen or been outpaced by the rising consumption of higher-analysis alternatives such as urea, diammonium phosphate (DAP), monoammonium phosphate (MAP) and muriate of potash (MOP), which are largely sulphur-free. (Figure 3).

Traditional sulphate fertilizers

World demand for sulphur-containing fertilizers is more than 65 million tonnes at present, about 18% of the total global fertilizer market[2]. Consumption is greatest in Latin America (15.2 million tonnes), East Asia (14.0 million tonnes) and Southeast Asia and Oceania (10.3 million tonnes), with these three regions accounting for 60% of global demand for these products.

Two traditional sulphate fertilizers, ammonium sulphate and single superphosphate, together supply about four-fifths of market demand for sulphur-containing fertilizers. World demand for **single superphosphate (SSP)** is just over 33 million tonnes (5.4 million tonnes P_2O_5), making it the second largest-selling phosphate fertilizer on the market after diammonium phosphate (DAP). Consumption is concentrated in four main markets, China, Brazil, India and Australia, which collectively account for 85% of total global demand.

SSP is a low-analysis fertilizer with a nutrient content of around a fifth (18-22% P_2O_5). Because of this, it tends to be consumed in the country of origin, and export volumes have declined due to increasing competition from more economic high-analysis phosphates. SSP consumption has contracted by almost a third in the past twenty years, with a further fall of six million tonnes expected over the next decade.

In contrast, consumption of **ammonium sulphate (AS)** is on the rise even though its nitrogen content (21%) is much lower than urea (46%) and ammonium nitrate (33%). World supply has grown by almost two-thirds since 1995 to around 24 million tonnes currently, with much of this increase linked to the massive growth of 'involuntary' production capacity in China.

Consumption of AS is concentrated in the Americas (the US, Brazil, Mexico and Canada) and East and Southeast Asia (China, Indonesia, Vietnam and Malaysia). Turkey and Germany also offer sizeable markets for AS (*Fertilizer International* 469, p20). World consumption is forecast to continue to grow to 26.8 million tonnes by 2018 and then to 27.7 million tonnes by 2025.

The use of AS in NPK blends has become increasingly popular as awareness of sulphur deficiency in soils has become more widespread. The doubling in world oilseed rape (canola) production, from 36 million tonnes in 2001 to 71 million tonnes in 2013, is another factor that has helped drive-up AS demand. Oilseed rape is particularly sulphur-hungry, removing around 13.5 kilos of sulphur from the soil for each tonne of crop harvested.

Sulphate of potash (SOP) is valued as a chloride-free source of potash for lucrative cash crops such as tobacco, tree nuts and citrus fruits. World demand is around 6.1 million tonnes currently. China accounts for 55% of world consumption and has been responsible for much of the 2.1 million tonne expansion in SOP demand globally since 2007. North America and Europe are also sizable markets accounting for some 60% of demand outside of China. World SOP demand is predicted to grow by over one-fifth to 7.5 million tonnes by 2020, this expansion being led by an extra 1.1 million tonnes of demand in the Chinese market (*Fertilizer International* 475, p49).

Global demand for **sulphate of potash magnesia (SOPM)** is around 2.5 million

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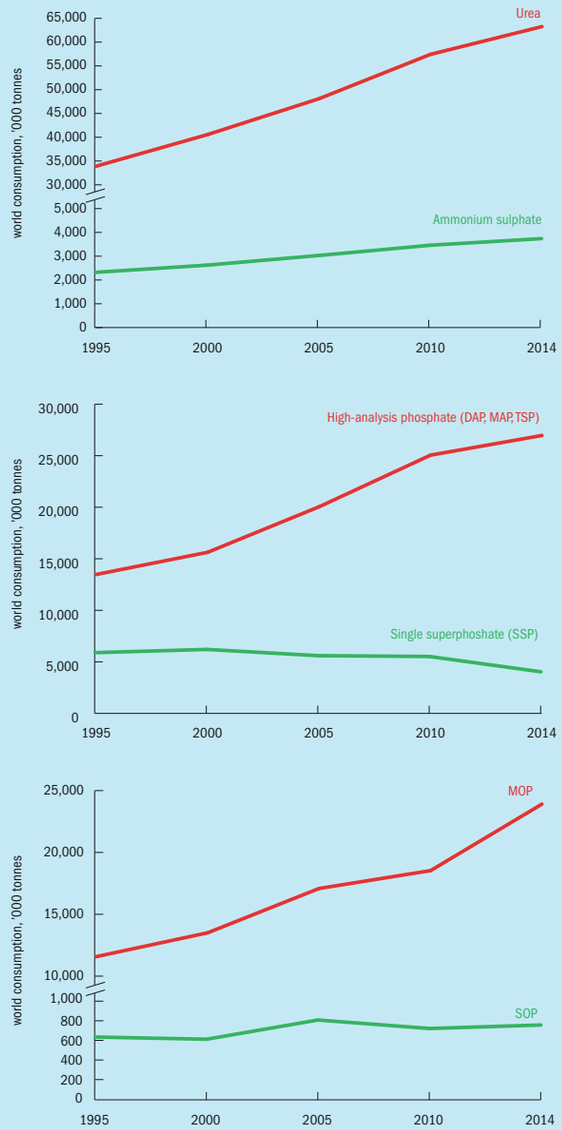
Fig 3: **Use of higher-analysis fertilizers (red) versus sulphur-containing products (green)**



Source: IFA

tonnes and has grown strongly in recent years. China has again led the way with a five-fold increase in consumption between 2005 and 2013, growing from around 300,000 tonnes to 1.5 million tonnes over this period. The market for SOPM, similar to SOP and SSP, is highly concentrated with just four countries, China, the US, Canada and Germany, accounting for the lion's share of consumption. Production is also concentrated in three countries, China, the US and Germany. Only half a million tonnes of SOPM, around 20% of total demand, is traded annually.

A number of **sulphate-containing NP and NPK fertilizers** are also available on the market. Production is concentrated in Europe and North America, although Chinese production has also grown significantly in recent years[1]. Ammonium phosphate sulphate, a fertilizer with a 60% ammonium sulphate and 40% MAP composition, is a commonly produced grade of NP+S fertilizer (16-20-0-14S). It is directly applied to forage crops in many countries, particularly legumes, and is also a popular choice of fertilizer for small grains and rapeseed (canola).

Sulphur-enhanced fertilizers

Fertilizer producers have reacted to the widening demand gap by developing sulphur-enhanced fertilizers (Figure 4). These typically use innovative technologies to incorporate elemental sulphur into high-analysis fertilizers, either within granules or as an external coating.

Introducing a liquid sulphur spray to Urea, TSP, MAP or DAP during drum or pan granulation, for example, results in N and P products with a 5-20% elemental sulphur content. Sulphur-enhanced fertilizers combine nutrient availability with high use-efficiency, and also have good storage and handling properties. Examples include:

- Sulphur-bentonite
- Sulphur-coated urea, MAP or TSP
- Fortified SSP
- Sulphur-enhanced DAP
- Sulphur-enhanced MAP enriched with sulphate

The market for sulphur-enhanced NP+S products is developing particularly quickly in the US, Brazil and Africa[3].

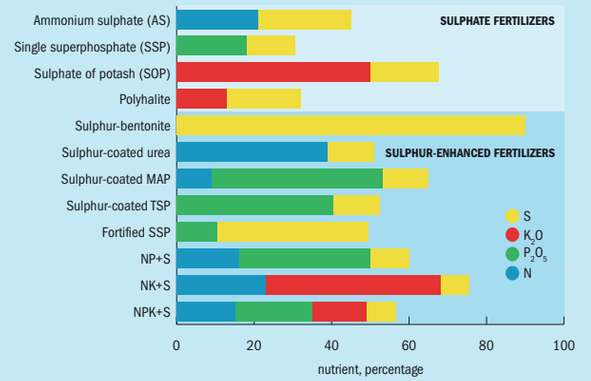
To be of value to crops as a nutrient, the elemental sulphur (S_8) present in these fertilizers firstly needs to be oxidised into plant-available sulphate by *thiobacillus* soil bacteria. This process requires the availability of oxygen and moisture and only occurs within a certain temperature range.

Fine elemental sulphur (40-150 microns) can be combined with 5-10% swelling clay to form **sulphur-bentonite** pastilles. The minor clay component promotes microbial conversion into sulphate early in the growing season by dispersing and releasing sulphur particles into the soil. This helps guarantee the supply of sulphur throughout the season and minimises leaching losses. Sulphur-bentonite is widely-used to treat sulphur deficiency in the US and India[2] and is suitable for blending as well as direct application.

Sulphur-enriched SSP is popular in countries such as New Zealand and can contain twice as much sulphur as ordinary SSP. Added elemental sulphur complements SSP's existing sulphate content and helps meet crop needs during the whole growing season by providing both immediate and reserve stores of sulphur. This makes it particularly suitable for applications in areas with high leaching losses.

Controlled release fertilizers (CRFs) can be produced by coating highly-soluble nutrients with relatively insoluble elemental sulphur. **Sulphur-coated urea (SCU)**, for example, combines 77-82% urea (36-38% N) with a 14-20% sulphur coating. SCU is suitable for multiple nitrogen applications on sandy soils under high rainfall or irrigation conditions. It is marketed as a CRF for grass forage, turf, sugarcane, pineapple, cranberries, strawberries and intermittently-flooded rice.

Fig 4: **Nutrient content of selected sulphate and sulphur-enhanced fertilizers**



Source: Till (2010), Lawson (2016), Sampson (2016)

Production growth and innovation

The last five to six years has seen the emergence of speciality NP+S products. These have established a strong market presence in India, Brazil and the US since the turn of the decade. Demand for NP+S fertilizers from Australia and Ethiopia is also on the increase[2].

The North American market for The **Mosaic** Company's successful and pioneering sulphur-enhanced MAP product range, *MicroEssentials*, broke through the one million t/a barrier at the end of 2013. These versatile premium fertilizers are now applied to around 11% of US farmland. They are suitable for both direct application and bulk blending and their increasing use is backed by 12 years of field data and more than 1,200 crop trials globally.

Mosaic has created and grown the market for *MicroEssentials* by marketing three key advantages:

- The all-in-one formula provides a more **uniform nutrient distribution** across the field compared to blended fertilizers
- Unique product chemistry **increases nutrient uptake** by lowering the pH around granules
- **Season-long sulphur** with sulphate being available to the plants immediately and elemental sulphur becoming available later in the growing season

The company offers three main formulations:

- *MicroEssentials SZ* with 12% N, 40% P, 10% S and 1% Zn (12-40-0 10S 1Zn)
- *MicroEssentials S15* with 13% N, 33% P and 15% S (13-33-0 15S)
- *MicroEssentials S10* with 12% N, 40% P and 10% S (12-40-0 10S)

The sulphur content in all three formulations is a 50:50 mix of elemental sulphur and sulphate.

The proprietary *Fusion* process used in the manufacture of *MicroEssentials* joins together nitrogen, phosphorus, sulphur and zinc to create a nutritionally-balanced granule capable of boosting crop yields by 3-7%, compared to conventional MAP or DAP. Mosaic's innovative fertilizer technology also provides nutrient use efficiency gains. *MicroEssentials SZ* formulations, for example, improve plant uptake of P by up to 30% and Zn uptake by up to 45% compared to a typical blend.

MicroEssentials accounted for 20% of Mosaic's phoshate product volume in 2015. North American producer JR Simplot has followed suit by introducing a new premium sulphur product *40 Rock* (40% P_2O_5 and 6.5% S) following the expansion of its Rock Springs, Wyoming plant in 2014.

One of Mosaic's key competitors, Morocco's **OCP Group**, will start producing its own range of highly-concentrated sulphur-enhanced fertilizers later this year using Shell Thiogro technology under license. This will allow the company to incorporate elemental sulphur into fertilizer products produced at its Jorf Lasfar site, including ammonium phosphates, NPKs and existing sulphur-containing products. The licencing deal with **Shell Sulphur Solutions** is an important long-term strategic move by OCP as it will add new and potentially highly-lucrative premium products to the company's existing fertilizer range.

Shell Sulphur Solutions also entered into a partnership with **Uhde Fertilizer Technology (UFT)** early last year. The deal between the two companies will allows Shell Thiogro's Urea-ES technology to be incorporated into UFT's proprietary fluid bed urea granulation process. This will enable some of the world's largest urea plants to produce sulphur-enhanced urea fertilizers in future, if there is a demand for this.

Unlike existing urea sulphur coating processes, Urea-ES technology evenly

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disperses an emulsion of tiny sulphur particles in urea melt prior to granulation. The microscopic size of the embedded sulphur particles (under 40 microns) helps promote oxidation during the crop season.

An innovative NIIK high-speed drum granulation unit for the production of sulphur-enhanced fertilizers is currently being commissioned by **Qafco** in Qatar. The 100 kg/hour capacity pilot-scale unit will trial the manufacture of urea-ammonium sulphate and sulphur-enriched and sulphur-coated urea.

Tiger-Sul Products, a Canadian subsidiary of Connecticut-based **HJ Baker & Bro, Inc**, is a leading and long-standing global sulphur-bentonite supplier. The firm is the world's largest producer of 90% sulphur pastille fertilizer, *Tiger 90CR*, a product that has been exported throughout South America, New Zealand, Australia, Europe, and China for over 20 years.

Additionally, Tigur-Sul sells the granular sulphate/sulphur fertilizer *Tiger 50CR* (50% S + 12% N) which combines 36% elemental sulphur and 60% ammonium sulphate with 4% bentonite. The combination of immediately-available sulphate and the slow-release sulphur make it an ideal product for colder Northern climates, according to Tiger-Sul.

Tiger-Sul also manufactures and markets Tiger Micronutrients, a range of premium sulphur-enhanced fertilizers. These combine *Tiger 90 CR* sulphur-bentonite with micronutrients using proprietary *Microsite Enhanced* technology. The range includes:

- *Tiger Zinc 18%* (65% S + 18% Zn)
- *Tiger Manganese 15%* (63% S + 15% Mn)
- *Tiger Copper 7%* (80% S + 7% Cu)
- *Tiger Copper 12%* (72% S + 12% Cu)
- *Tiger Iron 22%* (55% S + 22% Fe)

HJ Baker expanded into the Chinese market in 2014 by opening a sulphur-bentonite plant in Lianyungang, China. This manufactures *Tiger 90CR* and a zinc-enhanced micronutrient product to meet the country's growing demand for sulphur fertilizers. "China has a limited production of high sulphur containing fertilizers which has caused massive sulphur deficiencies in soils across the extensive farming regions of the country," explains Christopher Smith, HJ Baker's CEO. "In fact, The Sulphur Institute currently estimates that the annual deficit in China is now more than two million tons, the largest in the world."

HJ Baker also opened a new Canadian Tiger-Sul sulphur-bentonite production plant at Irricana, Alberta, at the end of 2014. The site is 46 miles north of the company's existing Calgary manufacturing plant and was opened following a two-year upgrade.

In 2015, HJ Baker launched *Tiger XP*, a new sulphur-bentonite product with a higher release rate which targets early-season sulphur deficiency in crops. This makes sulphur available to plants more rapidly by using a proprietary activator to speed up oxidation to sulphate. Platte River Equity recently bought a majority stake in Tiger-Sul Products, although HJ Baker will keep a minority interest in the firm.

In Europe, **Yara International** offers two ammonium nitrate/calcium sulphate fertilizers to growers:

- *YaraBela AXAN* (27% N + 9% SO_3), a compound granular nitrogen and sulphur fertilizer with an N:S ratio of 7.5:1 suitable for use on all crops
- *YaraBela SULPHAN* (24% N + 15% SO_3), a compound nitrogen and sulphur fertilizer with an N:S ratio of 4:1 that is particularly suitable for crops with a higher sulphur requirement

Sulphur-containing products make up seven of the eleven fertilizers manufactured by **CF** in the UK, including its successful *DoubleTop* and *SingleTop* lines:

- *SingleTop* 27N ($12SO_3$), an ammonium nitrate/calcium sulphate compound product for 'little and often' applications of N and S to cereals and grass throughout the season
- *DoubleTop* 27N ($30SO_3$), an ammonium nitrate/ammonium sulphate compound product for spring application to crops that have a high sulphur demand, including oilseed rape and winter cereals

Russia's **PhosAgro** increased its sulphur fertilizer production capabilities by launching a new 100,000 t/a capacity production line at its Metachem site in 2015. This will manufacture sulphur-containing phosphate-potash fertilizers specifically formulated for priority markets such as Brazil.

Fertigation, the application of nutrients via an irrigation system, is a niche but high-value agricultural market for sulphur. Thiosulphates, in particular, are widely-used as liquid sulphur fertilizers in the broad acre and speciality crop market in North America and Europe. Their use is also on the increase in Latin America.

Tessenderlo Kerley is a global leader in specialty liquid fertilizers and manufactures four main thiosulphate products:

- Ammonium thiosulphate, *Thio-Sul* (12% N + 26% S)
- Potassium thiosulphate, *KTS* (25% K + 17% S)
- Calcium thiosulphate, *CaTs* (6% Ca +10% S)
- Magnesium thiosulphate, *MagThio* (4% Mg + 10% S)

Thio-Sul is suitable for most irrigation systems and, along with nitrogen, delivers sulphur in both elemental and sulphate form. It also improves phosphorus uptake, and can be added to urea ammonium nitrate (UAN) as a nitrification inhibitor to reduce nitrogen losses. *KTS*, another of Tessenderlo Kerley's leading thiosulphate products, is marketed as a high-analysis potassium and sulphur fertilizer for fertigation. It is suitable for booster or starter formulations and can also be applied as a foliar fertilizer when crop demand for potassium is high.

Valued in its own right

Previously, the market value of traditional sulphur-containing fertilizers has mainly come from the other nutrients they contain. "Ammonium sulphate is marketed as a nitrogen fertilizer with some sulphur, SSP as a phosphate fertilizer with some sulphur and SOP as a potash fertilizer with some sulphur. Only gypsum is sold extensively on the basis of its sulphur content over the importance of the calcium it contains," comment analysts Fertecon.

Encouragingly, the market is starting to value sulphur in its own right, as soil depletion becomes more acute, crop demand increases and new products emerge. "Sulphur depletion in soils is becoming more of an issue, and the profile of sulphur as a nutrient is increasing," Fertecon reported in 2015. "The success Mosaic has had with its *MicroEssentials* products, which are phosphate-based and include both sulphur and sulphate, is testament to the changing perceptions of the need to incorporate more sulphur in fertilizers." ■

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The state of the nitrogen market


Laura Cross


Julia Belyaeva

Following a recent webinar by Integer Research, we discuss the key nitrogen market developments of the last 12 months with the firm's **Laura Cross** and **Julia Belyaeva**.

Nitrogen industry oversupply has been a dominant theme in 2016. Yet recent energy market developments have had an equally profound influence on the nitrogen sector by dramatically altering global production costs.

Laura Cross, nitrogen team leader at UK-based Integer Research, links these two drivers with urea prices in 2016: "Our short-term price forecast was that urea prices were likely to fall over the course of the year due to the prevailing oversupply and the low production costs of key marginal producers."

The one-fifth fall in Chinese urea exports was one of 2016's standout market developments in her view: "Chinese urea exports fell 22% year-on-year in the first nine months of 2016 as producers responded to weak global pricing."

Cross is pleased to report that this major market correction was foreseen by Integer Research.

"It's always nice when our expectations come to fruition. What's really important, though, is that this decrease in Chinese exports wasn't met with a direct or equal response in the international price. We're still in a period of quite weak urea prices. Only towards the end of 2016 did we see prices stabilise and increase – and even that has mostly been driven by seasonal demand import interest from India."

Market inherently oversupplied

While it exerts a strong influence outside its borders, Laura Cross is keen to stress that the current state of the market is not solely down to China.

> **"Recent nitrogen pricing has been a function of oversupply and, most critically, falling energy prices**

"The export volume correction in China has come from lower utilisation rates. But the nitrogen market remains inherently oversupplied. As much as China is important, we do have to come back to the global analysis.

"Yes, recent price developments are largely impacted by the product that comes out of China. But we also have to look at the expectations going forward for production costs and how that compares to other regions around the world."

Her Integer Research colleague, nitrogen analyst Julia Belyaeva, agrees that oversupply and falling energy prices, by affecting nitrogen pricing and company profits, are beginning to force a market correction.

"Recent nitrogen pricing has been a function of oversupply and, most critically, falling energy prices. This has resulted in the nitrogen price for some producers falling below the cash cost. And we've almost certainly begun to see a volume correction in urea exports from China and in nitrogen products from Ukraine and Central Europe too."

Prices falls over two years

Energy market rebalancing and attendant energy price falls emerged as major themes in 2016, explains Belyaeva.

"Nitrogen prices have fallen over the past two years largely as a result of new supply which has outweighed growth in demand. But – in addition to the market entering this supply-driven phase – there's been a significant shift in nitrogen production costs driven by a rebalancing of the energy market over the last 18 months.

"Energy prices have fallen significantly and this has fed through to marginal nitrogen-producing countries and regions, which are typically China in the urea market and Europe for ammonia and downstream products, including ammonium nitrate and calcium ammonium nitrate. So the nitrogen industry floor price has lowered as a result of falling energy prices – and this is why we are seeing low nitrogen prices currently."

Energy costs: losers and winners

Industry production costs have fallen particularly dramatically at the top end of the cost curve during the last 18 months. The highest global production cost for ammonia, for example, moved downwards from $526/t in 2014 to $377/t during the first half of 2016.

"The industry cost curve in 2016 is a lot flatter than it was in 2014," elaborates Belyaeva. "But, on closer inspection, we see something even more profound: critically, energy costs of some of the highest cost nitrogen producers have fallen more compared to the lowest cost producers."

There are large regional and country-to-country variations too. The largest cost reductions for urea have occurred in Central Europe and Ukraine, as well as in Chinese coal-based production, while

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MOPCO's nitrogen complex, Damietta, Egypt.

PHOTO: THYSSENKRUPP INDUSTRIAL SOLUTIONS

productions costs in the Middle East and North Africa (MENA), in contrast, have increased.

Belyaeva paints a complex picture.

"The key issue when it comes to energy and feedstock prices – the main drivers behind changing production costs and prices – is that natural gas and coal markets are very segmented across the regions. Even within one region, such as Europe, countries can have a very diverse range of energy pricing policies and mechanisms.

"For nitrogen capacity in Europe and Eurasia, energy costs have fallen across the region since 2014. On the other hand, energy costs have edged up in the MENA region compared to 2014. Whereas energy cost changes in Asia show more of a mixed picture."

Costs have generally risen in Gulf states and other countries which rely heavily on oil export revenues, and where the energy supplied to nitrogen producers has been state-subsidised. Gas prices in Saudi Arabia, for example, increased two-fold in 2016. A similar pattern of increasing nitrogen production costs is also observed in other MENA countries, including Egypt, Algeria and Qatar.

Natural gas based urea producers in China have also been hit by rising feedstock costs, points out Belyaeva: "The scarcity of natural gas resources recently led to the Chinese government removing natural gas subsidies to fertilizer producers last November – and this will idle some of the country's loss-making urea capacity."

China drives global urea falls

Falling energy costs, especially for natural gas based production in Europe and coal-based production in China, has had a profound influence on the nitrogen market globally.

"A fall in production costs in China for coal-based urea production has been the main driving factor behind the international fall in urea prices, given that Chinese coal-based urea capacity makes up such a large proportion of the global market," comments Belyaeva.

She adds: "There's also been a continuous fall in gas prices in Europe as well, largely due to gas market liberalisation. Producers, particularly in West Europe and Central Europe, have benefited from falling hub-based gas prices. Countries such as Lithuania, Poland, Ukraine, are shifting away from long-term indexed gas agreements with Russia towards hub-based spot gas purchases, or even LNG. This has really driven down the price of gas in Europe and made these producers more competitive."

Gas liberalisation

Gas pricing mechanisms play a key role in determining the cost of feedstock to nitrogen producers. According to Julia Belyaeva, feedstock prices have changed considerably over the last few years in response to two major gas market trends.

"Firstly, we find that state-regulated gas feedstock pricing is shifting away in favour of market-based gas feedstock pricing. In Russia, for example, gas pricing to nitrogen producers has typically been state-regulated, but recently we've seen increasing competition from independent gas producers.

"The second major trend we've noticed is that regional gas markets are becoming more liberalised. In Europe, alongside the long-term shift away from oil-indexed contracts towards hub-based purchases, we now have the prospect of US liquefied natural gas (LNG) arbitrage. This will further increase competition for gas in this region and push down gas feedstock prices to nitrogen producers."

NITROGEN MARKET REVIEW

Loss making plants and rationalisation

Chinese urea exports were down 25% during January-July 2016 and are expected to reach nine million tonnes for 2016 as a whole, a 4.7 million tonne year-on-year fall. Chinese urea prices bottomed soon after the Indian tender in July, setting an international floor price at $180/t.

Yet, even with coal prices at a record low, profit margins for Chinese producers remain thin, as Integer's Laura Cross explains:

"Based on local Chinese urea prices – meaning fertilizer and industrial products sold into domestic market – around 25% of Chinese capacity was unprofitable at the start of 2016. We also know that, in the last two years, Chinese urea plants haven't necessarily adhered to conventional production economics – so we're no longer looking at a straightforward relationship between the nitrogen price and a decision on whether to run these plants or not."

However, on an international price basis, a much higher proportion of Chinese plants, even the majority, were likely to be loss-making.

"If we take into account the margins that Chinese producers make when they're selling urea into the international market, the share of urea capacity that is loss making rises to much more than 25%," says Cross. "Indeed, if urea continues to be priced below $200/t – as it has done throughout 2016 – we enter a scenario where closer to two-thirds of all Chinese capacity is losing money on its urea production."

Taking account of the wider industrial economics in China, especially developments in the coal market, Integer Research concluded that a rationalisation of Chinese urea production was on the cards during 2016. Laura Cross explains their thinking:

"Because the vast majority of Chinese urea capacity is coal-based, we expected rationalisation to start in 2016. Falling utilisation rates and lower export volumes coming out of China would accompany that. Rationalisation would also start to rebalance the domestic Chinese market, based on where unprofitable plants are located, what their feedstocks are, as well as on their ability to reach ports and so influence the export market."

Turning point for Chinese urea exports?

The rebound in Chinese anthracite and bituminous coal prices in the third quarter of 2016, driven by tight supply and strong domestic demand, could have positive consequences for the urea market by limiting Chinese exports.

"The recent increases in bituminous and anthracite coal prices certainly makes the situation look positive, as it could lead to the belief that we've seen the turnaround in the coal market in China now," says Cross. "That in turn could lead us to conclude that Chinese urea productions costs are on the up – meaning we could expect to see fewer urea producers in China being able to hit the international market."

The jury is out on whether this coal price turnaround, and the consequent reduction in China's ability to export urea, will be sustained, mainly because it depends

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on difficult-to-predict Chinese government intervention and market manipulation.

Laura Cross makes a case for caution.

"Integer isn't confident about this. The research we've done doesn't conclude that a sustained turnaround in the urea export potential of China is a dead certainty. The market balance will probably continue to be partly controlled by the Chinese government, using a combination of production curtailments, incentives and subsidies on input costs. Government control of the currency also has a big impact as urea exports are effectively sold in dollars."

These positive interventions by the Chinese government have certainly gone some way towards improving nitrogen market sentiment in 2016, accepts Cross.

"At the beginning of this year, the Chinese government dealt with the structural overcapacity in coal production by implementing measures that shortened the market and drove up the price of coal. That, in turn, really started to squeeze coal-based nitrogen margins – and led to more operators idling their capacity by effectively raising the urea export price from China."

However, the fact remains that the Chinese National Development and Reform Commission (NDRC) could act to reverse these decisions in future. The profitability of the Chinese coal industry also provides scope for a fall-back in prices, according to Cross:

"There is room for price reduction in the Chinese coal industry as coal producers we sampled in 2015 were still making healthy margins. That tells us there is still room to manoeuvre down coal prices for the foreseeable future."

Looking ahead

In recent times, energy cost falls have generally outpaced nitrogen price drops, helping sustain and even improve the profitability of many nitrogen sector companies. Whether this will continue – and if not who will suffer and who will prosper in 2017 – is a big question, confirms Julia Belyaeva.

"On average, falls in production costs have outweighed falls in revenues and led to improved profitability for nitrogen producers. However, the reasons responsible for higher profits are increasingly fragmented, being based on regional- and country-level energy market developments and currency devaluations. Profitability of UAN producers in the US improved most significantly of all products worldwide, while AN gross margins fell relative to ammonia and urea due to weaker prices."

Because of this, margins for some nitrogen producers will come under pressure this year and into 2018 in Belyaeva's view.

"We expect a significant amount of Chinese natural-gas based urea capacity to be idled over the next few years. Similarly, Ukrainian producers are at great risk due to their internal gas security situation and ongoing negotiations with Russia for gas supplies. Central European producers are at risk too. If a rise in gas prices in Europe begins to outpace growth in nitrogen prices, the margins for this set of producers will be the first to be squeezed."

Belyaeva does, however, expect the markets for individual nitrogen products to play out differently over the next 18 months to two years.

"Firstly, Integer expects the ammonia market will remain weak into the first half of 2017 due to US capacity additions – we estimate around 600,000 t/a of additional merchant ammonia will have been added by 2016's end. We also believe the ammonia market will move towards a more balanced state by the end of the year, and forecast a price of around $250/t on average for 2017.

"The urea market, in contrast, will remain firmer than ammonia. Recent increases in Chinese coal feedstock prices, by affecting China's ability to decrease its urea export price, will remain a key driver of the urea price globally, as has been shown in recent months. We are forecasting around $225/t as our urea price base case for 2017. However, there could be a downside price of around $200/t, if coal prices in China were to fall again."

Significant shifts in global trade are also imminent, according to Laura Cross, due to changes in the supply-demand balance, especially in net importing regions such as North America.

"China is where we see quite as lot of the correction and re-routing of global trade playing out in the coming months and years. If we look at the global export destinations of Chinese product in the last few years, you can see that a lot of that export volume was ending up in Asian markets, but also in North America as well."

Summing up, Laura Cross concludes: "What's happening with supply-demand balances in other regions of the world, particularly the net importers, is going to have a substantial impact on where we see this global re-routing of the nitrogen trade playing out." ■

THE 2016 NITROGEN MARKET:

Key findings from Integer Research

- Saudi Arabia's fixed-gas price increased by $0.75/MMBtu to $1.50/MMBtu from 1 January 2016, causing the country to move up the global urea cost curve. Meanwhile, producers in Europe reaped the benefits of continued low hub-based gas prices, and bituminous and anthracite coal prices in China continued to fall albeit at slower rates.
- Although Ukraine's gas costs fell to $7.8/MMBtu on average in H1 2016 as it diversified away from Russian gas towards cheaper European imports, the country moved towards the top of the global cost curve given the relative decrease in gas costs in other regions.
- In China, natural gas based urea production moved further up the cost curve due to government restrictions on gas supply which resulted in higher fixed gas prices to nitrogen plants.
- The global range in ammonia ex-works production costs contracted by $70/t to $241/t in the first half of 2016 compared to 2015, as feedstock prices continued to decline globally, particularly in countries where gas prices are market-driven such as the US and Europe. This led to producers with regulated or fixed gas prices, such as in Saudi Arabia and Egypt, becoming comparatively less competitive.
- European producers have shown the largest fall in ex-works urea production costs compared to 2015, due to sustained low hub-based gas prices, while Saudi Arabia, Iran and Nigeria are among the countries that have experienced year-on-year increases in gas costs due to revised state regulated gas prices.
- Compared to the annual average gas price in 2015, Russia moved up the global nitrates cost curve in rouble terms, but remained cost competitive in US dollar terms due to continued devaluation of the rouble.
- Producers in West Europe moved further down the cost curve as a result of falling market based gas prices, and improved their profitability even more so due to the sustained price premium in Europe. ■

IFA president Dr Abdul Rahman Jawahery addresses the Future Fertilizer Leaders event. Seated (left to right) are IFA's Volker Andresen, Agrium's Chuck Magro, Uralchem's Dmitry Konyaev and Alexa Hergenröther from K+S.

Future fertilizer leaders

The International Fertilizer Association (IFA) held a successful Future Fertilizer Leaders event at its 2016 annual conference in Moscow. Industry leaders from Agrium, K+S and Uralchem reflected on their careers and offered valuable insights and candid advice to an audience of 130 young professionals. Executives from all three companies agreed that attracting talented young professionals is necessary to ensure the sector has the future leadership it will need to thrive in a rapidly-changing market.

Recruiting talented young people into the fertilizer industry, developing their abilities, rewarding their efforts and ensuring they enjoy successful careers is in the best interests of individual businesses. It is also holds the key to the future success of the whole sector, at a time when it faces fresh challenges and increasing change. With this in mind, the International Fertilizer Association (IFA), with the full backing of its member companies, launched the Future Fertilizer Leaders initiative at its annual conference in Istanbul in 2015.

Now renamed the Young Professionals initiative, IFA is holding its next event for up-and-coming professionals at its 2017 annual conference in Marrakech, 22-24 May. As in previous years, IFA is encouraging young people to attend by offering a half-price conference rate to those delegates who are 35 or younger.

Fertilizer International is also pleased to announce that, with IFA's support, it will be backing the initiative by running a series of Young Professional profiles later this year. These profiles will celebrate young talented individuals in the fertilizer industry and showcase the wide-range of career opportunities available in the sector.

Three industry leaders offer their advice

Building on the success of the Istanbul event, IFA arranged for three leading industry executives to talk to an audience of 130 young professionals at its 2016 annual conference in Moscow last May.

Alexa Hergenröther, an executive board member at K+S, Agrium's CEO Chuck Magro and Dmitry Konyaev, the CEO of Uralchem, reflected on their careers and offered first-hand advice to the industry's up-and-coming young professionals. IFA president Dr Abdul Rahman Jawahery and its director general, Charlotte Hebebrand, were also on-hand to lend heavyweight support.

Chuck, Alexa and Dmitry spoke about their top-level leadership experience and the future of the industry with remarkable candour. A summary of the advice offered by these three leading executives is shared on the following pages. In their view, developing a successful career in the fertilizer industry ideally requires dedication to your company, having a mentor and a desire for lifelong learning. The ability to fight for your ideas, a gift for innovation and an aptitude for new thinking are also important leadership qualities.

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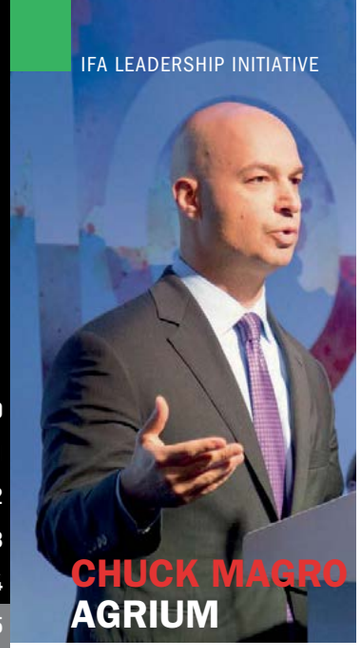

CHUCK MAGRO
AGRIUM

Three key trends

"Welcome everyone, I'm the CEO of Agrium. A little bit about my career. I'm an engineer and I have an MBA and in the last 23 years I've had 14 jobs. I've lived in two countries, five cities, bought and sold nine houses. Every two years, my kids will come and say to me 'when are we moving?' – and I know more about furniture than any man should!

I'm a Canadian. I grew up in a small town in Ontario, one of our provinces. When I was about 14 I went to work on a farm and that was my first exposure to agriculture. So for four years in high school I worked on a dairy farm with about 50 head of cattle.

Back then, farming was very, very simple. The world wasn't connected. When I was on the farm we never talked about nutrients and the environment, never talked about climate change. We never had smartphones and the internet wasn't a commercial piece of equipment like it is now.

But today, you'll understand that we've got a pretty important mission as an industry – which is to feed the world in a responsible manner. That's very important but I also think that this industry in the next 10 years is going to go through some very radical changes. I see three trends that I'd like you to think about which are going to help you map your career.

The first will be consolidation. It's happening at farm-level today. Farms are consolidating very rapidly, and when you have less farms you're going to have less distribution channels and you're going to have less producers. It's normal, it happens at this time in the cycle. It's a very healthy thing that consolidation is coming. If you have any association with crop chemical companies, it's clear that consolidation is underway in that space.

The next trend is really productivity through technology and innovation. Specialty fertilizers, precision agriculture techniques, big data analytics, these are all driving us towards the customisation of individual farms. We have the technology, the science to do that, and agriculture today, fertilizers today, it's a hi-tech business and that's an opportunity, I think, for you.

The third trend is complexity. To deliver our products – in a combination of seeds, chemistry and fertilizer – that's extremely complex. And if you add regulation and what's happening in sustainability today, farming is very complex – which will provide opportunities for you too.

Feeding the world

If you go back to the farm I grew up working on 35 years ago, I learnt from a young age what agriculture was, what fertilizer was and what feeding the world meant. But in North America, and I think this trend is common around the world, 80% of people live in cities today, and many of them haven't seen farms. That's a truth you have to think about.

We are also trying to recruit people in Canada, a massive resource country with opportunities for jobs in the oil & gas sector, metals and coal mining. So how do we compete in the fertilizer and agricultural sector?

One of the areas where we can do a better job is to educate people on our mission to feed the world. It's actually the reason I joined Agrium in 2009. I had worked in the petrochemical industry for about 20 years and I wanted to go back to farming. I was happy to do that as it felt good to do something more than just make money.

Fertilizer and agriculture is a hi-tech business. Yes, we need agronomists and scientists. But we also need data scientists now, people that can understand satellite imagery, complex chemistry people, sophisticated finance people. So the job opportunities, the career opportunities in our industry are almost endless and it's very important that we don't forget that.

I think as an industry we have to give young people more of a chance, we have to take more risks on young people. Sometimes there's a defined career ladder where you have to go up each rung to get to my chair. I think that's obsolete and we need to be thinking more as a meritocracy where the best can get to the top and not necessarily have to go through every rung on the ladder.

Get a mentor

I've learnt a number of things and I'll share three of them. The first piece of advice I'll give you which has helped with my career enormously is this: if you don't have one today, get a mentor. They're going to be your advocates, they're going to tell you what you're good at, what you're going to need to develop and they're going to give you some wonderful advice.

I'm the CEO of Agrium, a $15 billion company, one of the top 30 companies in Canada, and I have a mentor today, he's a retired CEO. Now at this level, the mentorship is very different, we usually have a breakfast every three weeks and we just talk.

If you can't talk to your bosses, you need someone you can have an honest dialogue with about the challenges you've got and how you're feeling. So if you don't have a mentor I would strongly encourage you all to get one.

Never stop learning and blaze a trail

The second area I need you to think about is never stop learning. It sounds very trite and simple but I think it's very important. Things are moving very quickly and this industry is going to change many times over in the next 10 years and it's really important that you stay connected and at the competitive edge.

The last piece of advice I'll give you is a bit unorthodox, but I'll leave it with you to think about: I would not follow in our footsteps. I think this industry is a wonderful industry but too many industries are steeped in tradition and I think you really need to turn this industry upside down.

If you're given the opportunity, don't do it the way we did it, because the pathway to the future is going to be different. I think you need to take a different path, blaze a trail for yourself, bring your own unique identity to it. You have so many more skills sets than we had when we were starting out. The connectivity of the world, how you use technology, I think you need to bring that to this industry. Thank you. ■

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ALEXA HERGENRÖTHER K+S

The challenge for women

"When I look around this room, there are still not too many women. K+S is more a mining company than a fertilizer company and very often I'm the only woman in meetings. At executive level, I'm the only woman. So, for me, it's sometimes a special situation.

In Germany, yes, we are a highly developed country, but in some jobs, especially in leadership positions, you rarely find women. This has always been an additional challenge for me, I have to say. It comes from society, from the culture. [But] throughout my career I have never tried to make something special out of the fact that I'm a woman. This is really important.

Dedication

My grandparents, they had a small farm but I never thought about doing something agricultural for my profession. I studied economics and at first I wanted to go into consulting and auditing. That's where I started but I ended up with K+S [after] a very good offer.

As I mentioned, we are a mining company and what I loved from the first day was the dedication of the people – they really love what they are doing. After a while, I saw not just the production side but also what products are used for and how the people are dedicated to that side of the business too. This was something I really loved a lot.

Willing to go the last mile

I couldn't agree more [with Chuck] about the challenges ahead. The industry is changing dramatically. There is so much innovation out there. After a decade of very good earnings, sometimes companies tend not to go the last mile. This would be my first advice to you. What's ahead of us is really challenging. The industry will change very dramatically in the next decade and we need people who are willing to go the last mile, the extra mile. We need to have innovative people.

Fight for your ideas

We also need open-minded people who are willing to fight for a good idea. Sometimes in companies, if you are young and go to executives and tell them about a very good idea they will say "ah, we thought about that 10 years ago, it will not work". There will always be good arguments about why it's not possible to change what we've been doing for years. For the future, and for the success of companies, it is absolutely necessary that we break free of this and that you as young leaders push hard with executives to listen to your ideas.

Do what's best for the company

This leads on to my second piece of advice. So far in my career, when trying to achieve something, I never keep in mind what this might mean for me personally. [Instead] I always have in mind what is best for the company, and I try to push in that direction. Clearly, there are always some company politics, and you have to watch out for this. But I think it's absolutely necessary that you really try to do the best for the company and not always think about what's best for you.

Attracting young professionals a necessity

Last but not least, we have a lot of challenges ahead and I want to give you a short picture of what we are facing. We are shrinking as a company in Germany so we do not have too much young talent and, overall, the agricultural industry does not have a great reputation.

As an industry, it's absolutely necessary to work on attracting young professional people. We have good arguments on our side. But we are still too shy about using them. That is the most important lesson of all – the real need to attract young professionals to work with us in our industry.

DMITRY KONYAEV URALCHEM

Changing times

"I'm a Muscovite who's lived most of his life in Moscow. I'm part of an interesting Russian business generation because I was born in Soviet times then studied at Moscow State University.

Russian [private sector] business, it's 20-25 years old, maximum – the loss of the Soviet Union in 1991 and then 25 years of normal business development in the country. That period was really a time of opportunities for young people – specifically for my generation now in their 40s and 50s.

Now the situation is extremely different in Russia. In my time, if you spoke a foreign language, if you were an intelligent person, you had all kinds of opportunities. Nowadays, of course, you need an education, you need to be a specialist to develop your future – that is for sure.

A different attitude

In general, we are in quite a conservative industry. We need more innovation and I think that there are really big opportunities right now for young people, specifically in our industry. Young people have a different attitude, different thinking about many things, helping to look at normal things from an absolutely different angle. I have examples in my own company of people getting fast [tracked] through their untraditional outlook – and I think the fertilizer industry will need this.

Reality television lends a hand

I just want to provide one example about attracting young people, not only top management but workers. For us it's a big, big problem attracting young people to work at fertilizer plants because most young people are unfortunately trying to run from industrial cities to Moscow etc. So one of the directors of plant in a city where 110,000 people live, an absolute industrial city, decided to make a reality show [Zavod, The Factory] to attract young people to the plant. The whole winning team got job offers for this plant!

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Panoramic view of the Mosques of Sultan Hassan and Al-Rifai, Cairo.

The AFA welcomes you to Cairo

"Reserve your seat to meet with fertilizer sector decision-makers from the Arab region and the rest of the world."

Mohamed Zain, AFA Secretary General.

The theme of the 23rd Arab Fertilizer Association International Annual Fertilizer Forum & Exhibition is 'Arab Fertilizer Producers Continue to Shine'. This year's Forum will be held at the Semiramis Intercontinental Hotel, Cairo, 31 January to 2 February 2017. AFA Secretary General, **Mohamed Zain**, provides a preview of what is the Arab region's showcase annual fertilizer event.

Above left: Panoramic view of the Mosques of Sultan Hassan and Al-Rifai, Cairo. Above right: Mohamed Zain, AFA Secretary General.

The Arab Fertilizer Association (AFA) is made up of Arab companies and institutions involved in fertilizer production, trade and allied fields. Established in 1975, the AFA's aims include the development of the Arab fertilizer industry – and maximising its contribution to global food security.

Arabic countries are increasingly taking a lead when it comes to the world-wide supply and trade in fertilizers and associated raw materials. Globally, the Arab region possesses one-third of gas reserves and 70% of phosphate rock reserves, for example.

The AFA promotes the sustainable use of fertilizers and believes this involves taking a long-term approach and making balanced judgments based on social, environmental and economic considerations.

A warm and hospitable Egyptian welcome

Mr Mohamed Zain, AFA Secretary General, looks forward to welcoming delegates to Egypt this January and February:

"The Arab Fertilizer Association (AFA) would like to invite you to participate with more than 600 leaders in the 23rd International Annual Fertilizer Forum and Exhibition titled 'Arab Fertilizer Producers Continue to Shine'. It is an opportunity to be seized. Note it down and reserve your seat to meet with fertilizer sector decision-makers from the Arab region and the rest of the world.

"The 2017 Forum will pave the way for networks between clients as well as experts and partners. As usual, the Forum will include high-profile speakers who will deliver remarkable presentations and share experiences with attendees. It also provides an opportunity to meet with old friends, establish new relationships and plan for the coming year."

Conference programme

The 2017 AFA Forum programme include three days of plenary sessions starting on Tuesday 31 January. The overall theme of these sessions will be the rapidity changing fertiliser market, and the exponential growth in the Arab region in particular. Arab producers continue to shine and are achieving a very high performance in terms of production, exports and social responsibility.

Presentations will focus on global fertilizer policies, major challenges facing the international fertilizer industry, the market outlook and strategic developments for both fertilizers and raw materials. The production and consumption of water-soluble fertilizer in the Arab region will also be addressed.

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Table 1: **Arab region fertilizer production and exports** 2014-15, million tonnes

Product	Production 2014	Production 2015	Arab region share of world total (%) 2015	Exports 2014	Exports 2015	Arab region share of world total (%) 2015
Ammonia	16.23	15.45	9	3.83	3.24	19
Urea	18.92	18.56	12	15.54	16.42	34
Ammonium nitrate	1.22	1.17	10	0.08	0.05	<1
Phosphate rock	48.94	48.01	25	18.13	17.73	64
Phosphoric acid	6.84	6.89	16	2.41	2.36	58
TSP	1.82	1.41	29	1.87	1.39	42
DAP/MAP	8.33	6.96	21	6.86	6.21	38
Potash	2.09	2.36	6	2.02	1.97	7
Sulphur	7.27	9.53	16	6.85	9.06	30

Sustainability, innovation and investment, and the role of fertilizers in agricultural productivity and food security, will also be highlighted during the Forum's third day.

Moreover, the exhibition running alongside the conference provides an ideal platform for manufacturers and suppliers to showcase their products and services to a high-level national and international audience of professionals.

In a nutshell, the AFA hopes the Forum's diverse programme in Cairo this year will be fruitful for everyone.

AFA launches new working groups

To enhance the AFA's role in serving member companies, new specialised working groups have been established to develop and pursue the organisation's objectives during the coming years:

- Energy saving working group
- HSE working group
- Operations and maintenance working group
- Communication & public affairs working group
- Training & development working group
- Agricultural working group

The new working groups will allow member companies to exchange information, pool expertise and share experiences, particularly on technical production and process challenges. The groups will issue reports and make recommendations, and take advantage of the collective expertise and common vision of Arab fertilizer companies. A task force of member companies will also follow-up and implement any recommendations made.

Promoting and increasing agricultural production

The AFA secretariat hopes the agricultural working group will strengthen the relationship between fertilizer companies, on one side, and agriculture output and farmers on the other. It will help bridge the communications gap between fertilizer producers and farmers by promoting and expanding the touring 'Agricultural Caravans' initiative successfully adopted by OCP with the AFA's backing.

The AFA has launched an ambitious plan to help member companies benefit and learn from Morocco's 'Agricultural Caravans' and replicate these throughout the Arab region. This will enable fertilizer producers and experts to directly communicate with farmers in agricultural regions, and help identify and overcome obstacles faced by farmers when using fertilizers. This new approach to agricultural extension also allows fertilizer manufacturers to raise awareness about modern fertilizer application methods and water conservation techniques.

Agricultural Caravans

The AFA has a leading role to play in supporting agricultural production and strengthening the community development work of its members. Following the success of OCP's 'Agricultural Caravans', Evergrow launched a similar initiative in Egypt in April 2016 in cooperation with the AFA. Subsequently, SABIC launched another 'Agricultural Caravan' in Riyadh in November 2016. This is supporting date farming in Saudi Arabia and has the backing of both the AFA and the country's environment, water and agriculture ministry. SABIC's caravan hopes to raise farm efficiency by providing advisory services to date palm farmers and offering solutions to the problems they encounter in the field.

All of these caravans hold workshops for farmers to educate them on plant care, land preparation and seeds. Workshops generally cover modern soil analysis, ploughing, seed application and irrigation methods. The caravans are also involved in medical and educational programmes for farming communities. This demonstrates the commitment of the AFA and its member companies to community development and improving the daily lives of farmers.

A growing world market share

The natural abundance of a wide-range of raw materials – including natural gas, phosphate rock and potash – has enabled the Arab region to establish itself as a major international fertilizer industry hub. The latest production and export figures reveal how Arab producers have consolidated their leading role in the global production and trade of urea, phosphate rock, phosphoric acid and phosphate products, while also being key players in fertilizer raw materials such as ammonia and sulphur (Table 1).

Arab fertilizer production is particularly export-oriented and in 2015 the region's exports accounted for around:

- 64% of world phosphate rock trade
- 58% of world phosphoric acid trade
- 42% of world TSP trade
- 38% of world DAP/MAP trade
- 34% of the world urea trade
- 30% of world sulphur trade

Arab countries currently have a 9% share of total world **ammonia** production and a 19% share of world ammonia trade. Saudi Arabia is the leading Arab ammonia producer accounting for 26% of regional production, followed by Qatar (24%), Egypt (14%) and Oman (8%). Arab producers exported 3.2 million tonnes of ammonia in 2015. The main ammonia exporter is Algeria with a 37% share of regional exports, followed by Saudi Arabia (30%), Qatar (18%), Egypt (5%) and Oman (4%).

Arab countries have a 12% share of total world **urea** production and a 34% share of world trade. Production is concentrated in Qatar with a 31% share of regional production followed by Saudi Arabia (22%), Egypt (13%), UAE (10%) and Oman (8%). Urea production is highly export-oriented. Qatar, notably QAFCO, is the leading regional urea exporter. Its urea exports of 5.3 million tonnes in 2015, out of a production total of 5.7 million tonnes, accounted for 33% of total Arab region urea exports.

Arab **phosphate rock** producers have a 25% share of world production and a 64% share of world trade. OCP, Morocco, is the regional leader with a 55% slice of total Arab region production. Jordan (17%), Saudi Arabia (10%), Egypt (8%) and Tunisia (7%) and are also major regional producers. OCP, the world's largest exporter of phosphate rock, has a 48% share of the region's exports. Jordan, Egypt and Algeria also contribute significantly to phosphate rock exports in the region.

Arab **phosphoric acid** producers have a 16% share of world production and a 58% share of world trade. Morocco again predominates in this sector, with a 66% share of regional production. The other main regional producers are Saudi Arabia (19%), reflecting the increasing contribution of Ma'aden, as well as Tunisia (8%) and Jordan (6%).

Arab countries also have a sizeable slice of the **TSP** market, amounting to 29% of world production and 42% of world trade. OCP is again the market leader, supplying 58% of regional TSP output, together with Tunisia (20%) and Lebanon (18%).

In the **DAP/MAP** market, Arab countries contribute 21% of world production and 38% of world trade. Morocco's OCP is once again the leading regional producer (46%) followed closely by Saudi Arabia (41%) and supplemented by production from Jordan (7%) and Tunisia (5%). Saudi Arabia is emerging as a major player in the world DAP/MAP market.

Jordan's APC is the sole **potash** producer in the Arab region, its output accounting for 6-7% of world production and trade.

Arab countries, especially those in the Gulf, enjoy a high profile in the **sulphur** sector globally, contributing 16% to world production and 30% to world trade. The UAE leads the way with a 46% share of regional sulphur production, supplemented by sizable output from Saudi Arabia (34%), Kuwait (9%) and Qatar (9%). Much of the region's sulphur output is exported.

Investments in new capacity

New capacity continues to be developed throughout the Arab region, enhancing the contribution Arab countries make to global fertilizer supply and world trade. Looking to the future, by 2020, additional production capacity in Arab countries will undoubtedly raise the region's contribution to world fertilizer production and trade even further.

AFA FORUM PREVIEW

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Cutting conveyor maintenance costs

Hostile operating environments can severely corrode the metal rollers used in conveyor systems in fertilizer plants. Switching to polymer rollers instead extends the life of costly conveyor belts, as **Prasad Dhond** of Global Conveyor Systems explains.

The conveyor belt is one of the most expensive parts of the conveyor systems used in fertilizer plants. The rollers (idlers) on which the belt travels affect maintenance and wear and therefore play a particularly critical role in ensuring long belt life.

Fertilizer production exposes belt conveyors to heavy corrosion, chemicals and a wide range of temperatures. The resulting corrosion causes metal rollers to fail prematurely. This is costly as it results in plant downtime and the purchase and installation of replacement rollers. The hardening of material on roller surfaces can also make belts travel off-centre. Fortunately, a new class of rollers can effectively address such challenges by incorporating a high performance polyethylene (HPPE) shell.

The *HPPE Polymer Roller*, a patent-pending product developed by Global Conveyor Systems, combines an outer shell made from HPPE with a composite non-metal shaft (Figure 1). This roller overcomes several drawbacks commonly encountered when using other metal, HDPE and PVC rollers currently on the market.

Belt conveyors in fertilizer plants are typically used to handle raw materials such as phosphate rock, potash, gypsum and sulphur, as well as intermediate and finished products including NPK, MAP, DAP and urea. Materials transported by belt conveyors can spill onto the rollers causing two major problems:

- **Corrosion:** Belt conveyor rollers in fertilizer plants are prone to severe corrosion (Figure 2) causing premature damage to the roller shell. Traditional solutions for preventing corrosion, including rubber-lined metal rollers, HDPE or PVC rollers, have several drawbacks such as higher-cost, shorter-life, heavier-weight and metal shafts (Table 1). HPPE polymer rollers, in contrast, effectively eliminate any chance of corrosion by combining an HPPE shell with a non-metal shaft.
- **Material build-up:** Fines present in transported materials stick to rollers and then harden to form an uneven surface (Figure 3). The build-up of an uneven surface on rollers is particularly undesirable as it causes the belt to travel off-centre, ultimately leading to product spillage and damage to the belt. The HPPE rollers manufactured by Global Conveyor Systems are extremely smooth with a surface roughness of just 0.00022 µRa. This helps them resist any material build-up and so prevents belts from wandering.

Fig 1: **Polymer roller with an HPPE shell and composite shaft**

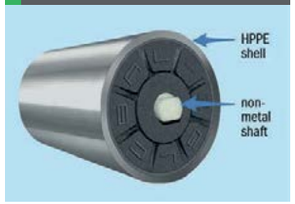

Fig 2: **A corroded metal roller**

Table 1: **Comparison of HPPE polymer rollers with other available roller types**

	HPPE polymer rollers	Metal stainless steel rollers	Metal carbon steel rollers	Other polymer rollers
Shell material	HPPE	Stainless steel	Carbon steel	HDPE or PVC
Shaft material	Composite (non-metal)	Metal	Metal	Metal
Typical weight (CEMA C return roller)	14 lbs	40 lbs	40.5 lbs	24 lbs
Resistance to corrosion	Excellent	Good	Poor	Good
Resistance to material build-up	Excellent	Good	Poor	Good
Life of roller	Very long	Long	Moderate	Moderate
Load bearing capability	Moderate (CEMA C, D)	High	High	Moderate

Other Advantages

Conventional metal rollers, when seized or frozen, develop a sharp knife edge that can easily damage the top and bottom cover of the entire belt (Figure 4), leading to costly downtime while the belt is repaired or replaced. Rollers with an HPPE shell, on the other hand, do not generally cause any damage to the belt during a seizure as they only develop rounded edges. HPPE rollers are also fitted with moulded ABS housings instead of the conventional steel end caps that can damage the belt when rollers seize.

HPPE polymer rollers generate 60% less noise than traditional metal rollers. This makes them ideal for noise-sensitive conveyor installations near populated areas. The significantly lower weight of HPPE polymer rollers also makes them easier to handle and reduces the chances of worker injury during the installation of new or replacement rollers. Their lower weight also minimises power requirements of the conveyor system. Other polymer rollers on the market use HDPE shells which can wear easily, or PVC shells that are prone to cracking. Rollers with HPPE shells, by striking a balance between the properties of HDPE and PVC, offer a long life and a load capacity comparable to that of steel rollers.

Fig 3: **A return metal roller with material build-up**

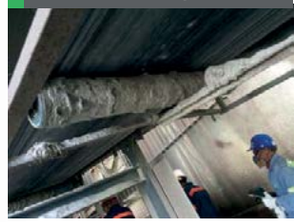

Fig 4: **Seized metal rollers with sharp knife edges**

HPPE polymer rollers manufactured by Global Conveyor Systems are successfully running in several fertilizer plants in India and North America. Plant managers have welcomed their benefits, especially the reduction in downtime and maintenance costs for their belt conveyors.

"Global's *HPPE Polymer Rollers* have helped us resolve a major corrosion issue and enhanced belt life by material not sticking to the rollers. Considering the good performance of these rollers, we are planning to procure HPPE rollers for all our conveyors," said Mr U.N. Mishra, associate vice president of engineering at Deepak Fertilizers and Petrochemicals Corp Limited in India.

In summary, rollers are a critical but often overlooked component of a belt conveyor system. HPPE polymer rollers allow fertilizer plant managers and maintenance engineers to run their conveyor systems at full capacity, yet keep the total cost of ownership to a minimum by lowering maintenance requirements and extending belt life. It is therefore true to say that using HPPE rollers can offer all the advantages of metal rollers without any of their usual drawbacks. ■

EQUIPMENT & TECHNOLOGY

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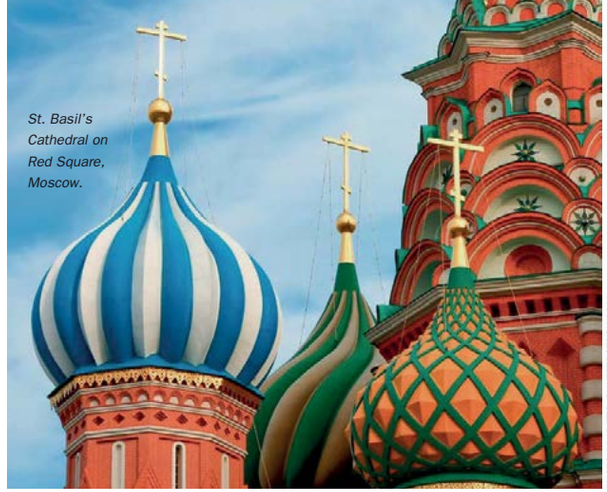

St. Basil's Cathedral on Red Square, Moscow.

PHOTO: VLADITTO/SHUTTERSTOCK.COM

The Russian fertilizer market was buoyant in 2016, thanks to the continuing recovery of the national economy and growth in domestic agriculture. Our St Petersburg-based correspondent **Eugene Gerden** reports on the current health of the Russian fertilizer industry.

Russian producers gear up for growth

Russia's huge endowment in natural resources allows it to produce the whole range of N, P and K mineral fertilizers. The country's fertilizer production should total 21 million tonnes in 2016, according to Russian ministry of agriculture statistics. The Russian fertilizer industry also continues to be highly export-oriented, with about 75% of 2016 production output being sold internationally.

Russian fertilizer producers have also become increasingly competitive in the global marketplace following the rouble's devaluation and oil price falls. The purchasing of gas on the spot market instead of through long-term contracts has also helped cut company input costs.

For Russian producers, the rouble's decline has more than offset falls in fertilizer prices during 2016. International sales were also buoyed by increased seasonal demand in Latin America and India during the second half of the year.

Although fertilizer output has been largely targeted at international customers in the past, domestic consumption rose last year and the home market is becoming increasing important for Russian fertilizer producers because of the growth opportunities it offers.

Domestic consumption

Official statistics show that only 2.6 million tonnes of the 20 million tonnes of fertilizers produced annually in Russia end up supplying the domestic market. Alexander Tkachev, Russia's agriculture minister, has spoken out about the low levels of fertilizer use domestically, particularly the large gap between current consumption levels and the annual fertilizer needs of Russian agriculture, estimated at some 10 million tonnes. Fertilizer application rates in Russia are around 40 kg/ha on arable land, well below lower the 130-140 kg/ha applied in the US and EU and the 90 kg/ha Latin American rate.

Ammonium nitrate (AN) remains Russian agriculture's fertilizer of choice. Fertilizer demand and buying is, however, influenced by the types of crop grown, soil characteristics, geography and climate. This means that requirements for individual nutrients vary greatly across Russia. Minister Tkachev has drawn attention to the phosphate deficit in Russia's fertile 'Central Black Earth' area, for example, whereas many soils in the north of Russia have nitrogen deficits.

Low domestic consumption has been a major and long-standing feature of the Russian fertilizer market. Many Russian farmers place fertilizer buying behind the purchase of fuel, agricultural machinery and other inputs and consumables. The absence of finance, particularly the lack of access to long-term low-cost loans, is also a major issue. State subsidies for fertilizer purchases in Russia were also abolished following new obligations introduced on joining the WTO.

More encouragingly, domestic fertilizer demand will be boosted in future if leading agricultural producers implement a plan to increase overall Russian grain production to 110-115 million tonnes. This should provide a welcome stimulus to Russian fertilizer production and consumption, according to analysts at the Russian Association of Fertilizer Producers (RAFP).

In addition to the expansion in grain production, projected increases in sugar beet, flax, oilseeds and vegetable growing should also spur growth in domestic fertilizer demand. The Russian government is planning to raise the domestic output of these crop to counteract an embargo on Western food and agricultural imports approved by president Putin. Overall, government policy measures should boost domestic fertilizer production by 2-2.5% during 2016, predicts the Russian agricultural ministry, and increase domestic fertilizer consumption by 10-12% compared to 2015.

The current market situation will remain favourable for Russian fertilizer producers until at least the end of 2017, says Daria Snitko, deputy head of economic forecasting at Gazprombank and one of Russia's leading fertilizer analysts:

"This year [2016], the demand for fertilizers in Russia has significantly increased,

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mainly due to continuing export growth and the recovery of the domestic agricultural industry from Western sanctions and the financial crisis. Russian agriculture reported record profits in 2015 and 2016. For local fertilizer producers, favourable market conditions have allowed them to invest – mostly self-financed – in company development and introduce new technologies in their production processes. The latter, especially, has contributed to the overall growth of fertilizer production in Russia."

Transport costs and monopoly concerns

High transportation costs, meanwhile, remain a perennial problem for the Russian fertilizer industry. Because of this, the RAFP has called on the national government to cap rises in fertilizer rail transport tariffs for 2017-2019. The association has sent an official petition to Russia's prime minister, Dmitry Medvedev, requesting that tariff increases are limited to 4.5% in 2017. Dmitry Mazepin, the chairman of Uralchem and a major shareholder in Uralkali, has backed this petition. In his view, the combination of ever-growing transport costs and the decline of global fertilizer prices in 2016 could potentially burden Russian producers with large losses.

At the same, the Russian government, from its side, intends to tighten regulation of the country's leading fertilizer producers and their activities. Stricter measures on the pricing policy of producers are planned by the Russian Federal Anti-Monopoly Service (FAS).

In recent statements, the FAS has concluded that uncontrolled growth of fertilizer prices in Russia in recent years could be the result of a cartel formed by some domestic companies. As a consequence, Andrei Tsyganov, deputy head of the FAS, has said the agency plans to introduce stricter pricing controls on Russia's largest fertilizer producers.

The FAS became involved after Russian farmers made numerous complaints about fertilizer price increases ahead of last year's spring and autumn sowing seasons. Fertilizer prices in Russia have increased by 22-37% since the beginning of 2016, according to the FAS, although the devaluation of the rouble is partly to blame. Many farmers also face an additional surcharge of 20-50% on prices due to fertilizer transportation costs and payments to intermediaries in the supply chain.

Exports

Russia will keep its status as one of the world's largest fertilizer exporters in 2016, in the view of Igor Shamatrin, the deputy head of the department for regulation of foreign trade at Russia's industry and trade ministry. Russia has a 13.5% share of the global fertilizer export market by value and a share of about 15% in volume terms, according to government estimates. Major sale markets for Russian fertilizer exporters include Brazil (19.3%), China (12.3%), the US (10.5%) and India (3.3%). The country's fertilizer exports are broadly divided between phosphates and compound products (40%), nitrogen products (40%) and potash (20%).

The Russian fertilizer industry continued to be mainly export-oriented in 2016, confirmed Igor Kalugsky, executive director of the RAFP, the country's fertilizer trade association, supplying more than 90 countries globally, particularly those in Asia. Russian producers, are also increasing their market presence in Europe and North America.

In a major development, the US government terminated its long-standing 65% anti-dumping duty on urea imports from Russia at the end of last year. The move followed an earlier US decision, taken last August, to end the 254% anti-dumping on Russian-produced ammonium nitrate imports. The RAFP will now lobby the EU to completely lift its duties on Russian fertilizer imports, says Andrey Guriev, RAFP's president and the CEO of PhosAgro:

"We believe that the existing anti-dumping duties on the imports of mineral fertilizers to the EU discriminates against local farmers and limits opportunities for Russian producers in this competitive market. The European market is a priority market for Russian fertilizer producers, where they have good prospects for further development.

"The duties were, in fact, introduced to support local [EU] producers of phosphate and nitrogen fertilizers. However, the number of local producers has significantly decreased in recent years. So there is no need to provide the same support... as in the past.

"The existing duties force the EU farmers to pay more. A few years ago the duty was reduced from 6.5% to 3% as a result of negotiations between Russia and the EU. However, it was restored to the previous level in 2014. This time RAFP plans to lobby not only for the reduction of the duty, but its complete lifting."

Major investment projects

Russia's improving economic situation, in the meantime, and growing domestic demand is creating good investment conditions for the country's major fertilizer producers.

PhosAgro, for example, is investing 43-45 billion roubles ($800 million) in its business in 2016. Although CEO Andrey Guriev has confirmed that investment levels will be 30% lower in 2017, existing investment projects will not be affected. PhosAgro is currently completing the construction of a new 760,000 t/a ammonia plant and a 500,000 t/a urea plant at its Cherepovets subsidiary in the Vologda region. Both plants are due to be commissioned later this year.

EuroChem, another of Russia's major fertilizer producers, is investing up to 20 billion roubles ($300 million) in a project to modernise its Belorechensk complex in the Krasnodar region and expand fertilizer production capacity at the site from 600,000 t/a to 1.6 million t/a. The project involves the refurbishment of a sulphuric acid plant and the construction of a new production plants for phosphoric acid, nitrogen-phosphorus fertilizers and water-soluble fertilizers.

EuroChem's total capital expenditure for 2017 is likely to reach around $1 billion. The firm is proceeding with a further three major projects – including the construction of two major greenfield potash mines – as part of its large-scale investment programme:

- EuroChem's is planning to invest $1.5 billion between now and 2023 in the VolgaKaliy potash project in the Volgograd region
- Its sister Usolskiy potash project in the Verkhnekamskoye field will require an investment of $1.6 billion for the period 2016-2026
- EuroChem has also launched a $679 million project to build an ammonia plant in the St Petersburg region for completion in 2020

Uralkali, for its part, is continuing to invest up to $315 million in the construction of its new Solikamsk-2 potash mine. The company has, however, been hit by falls in potash prices during 2016. Uralkali's pre-tax profits could fall to $1.35-$1.4 billion in 2016, down from $1.9 billion in 2015, according to recent company statements.

Additional reporting by Simon Inglethorpe.

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Demand returns to the potash market

PHOTO: POTASHCORP

Potash storage at Rocanville, Saskatchewan.

World potash output is expected to rebound during 2017 and grow for the first time in three years. Potash market recovery is being driven by rising demand in six major consuming countries in Asia and the Americas. The lowest potash prices in nearly a decade, together with the need to replenish low stocks, are also helping push-up global potash deliveries.

Demand for potash in North America, Brazil China, India, Indonesia and Malaysia is set to rise in 2017. The Mosaic Company and analysts CRU are forecasting a 2.5 million tonne (4%) rise in global potash shipments to 61-63 million tonnes in 2017.

Speaking recently, Jochen Tilk, PotashCorp's president and CEO, was cautiously optimistic about the outlook for the current year: "We see that certainly after a difficult year in 2016, there are clearly signs across the globe that things are picking up. Our [potash demand] projection for 2017 is 61-64 million tonnes."

Adjusting to price collapse

Such predictions will be welcomed by the major potash producers, given recent price falls and anaemic demand, the two defining market characteristics of the last two years. A collapse in potash prices began in the latter part of 2014 and continued until mid-2016.

"The New Orleans (NOLA) barge price plunged 54% from a peak of $413/t in September 2014 to $190/t per tonne in July 2016," observed Mosaic[1]. "The Brazil vessel price also dropped 43% from a high-water mark of $382/t per tonne in November 2014 to a low of $218/t per tonne in June 2016."

Table 1: **Global potash production closures and curtailments, 2014-2018**

Company	Plant	Capacity reduced/closed ('000 tonnes)	Comment
Mosaic	Carlsbad	500	Closed at the end of 2014
	Colonsay re-scale	800	-
	Hersey	100	Ended operations and sold as a salt-only plant in 2014
PotashCorp	Penobsquis	800	Closed in November 2015
	Picadilly	2,000	Suspended development and start-up
Intrepid Potash	Carlsbad East & West	700	Carlsbad East Idled in July 2016. Carlsbad West converted production to Trio, a speciality K+Mg+S fertilizer
Uralkali	Solikamsk 2	50% of 2,400	-
ICL	Boulby	900	Production switch from MOP to polyhalite

Source: Mosaic

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Prices did rally, however, as 2016 drew to a close. The NOLA price was around $232/t at the end of October, for example, up by a fifth from its mid-year low but still more than two-fifths below the 2014 peak. Brazil prices have also begun to rebound and were at the $235/t per tonne level at the end of October, although this, again, is around two-fifths less than the peak of 2014.

In their post-mortem on the price collapse, analysts at Mosaic concluded that a combination of three factors proved "lethal to potash prices" over the last two years[1]:

- The "extraordinarily large" build-up of channel inventories in 2014 and subsequent declines in global deliveries in 2015 and 2016
- New brownfield capacity commissioned between 2013 and 2015
- Lower potash industry costs due in large part to currency depreciation in key producing countries

In particular, the huge build-up of channel inventories in 2014 (see box) has cast a long shadow over the market and helped trigger the subsequent two-year decline in global shipments in 2015 and 2016.

Thankfully, the potash market has reacted relatively nimbly to sustained low prices, as demonstrated by a number of rapid and significant adjustments[1]. For example, five major producers have permanently closed high-cost operations and shifted production to low-cost plants, helping to maintain margins and scale-back supply. Plant closures and curtailments globally have taken around six million tonnes of capacity out of production (Table 1). Distributors have also been continuing to destock high channel inventories. Lower prices are also stimulating demand, an illustration of the adage that "the cure for low prices is low prices".

Prices and demand to rebound?

As a consequence, the global potash market began to come back into balance during the second half of last year, as shown by the rebound in spot prices in the Americas and higher Southeast Asian tender prices, for example. The large draw-down in North American producer stocks during the second half of 2016 was another sign of market readjustment[1].

Mosaic is currently predicting a "constructive" outlook for 2017 built on "solid on-farm demand worldwide, a rebound in global shipments, and restructured operations by several leading producers".

"Beyond next year, we see no chronic supply/demand imbalance," comments Dr Michael Rahm, Mosaic's vice president for market and strategic analysis. "In fact, we project that the global operating rate will remain stable during the next five years as a result of steady demand growth, restructured operations, and likely delays and slower ramp-ups of the much anticipated greenfield projects in Canada and Russia." This view, says Rahm, is also in line with the latest CRU forecasts.

Falling inventories and closures

Inventories, whether producer-held stocks or those kept at ports or by distributors, did fall in 2016, as Jochen Tilk makes clear[3]: "We see that both the producer inventory and the distributor inventory has gone down. The reason for that is, quite frankly, that PotashCorp very carefully managed our inventory. Others have done the same."

The long shadow of 2014

Events of three to four years ago are still playing out in the potash market. The massive build-up of potash inventories that followed a record buying spree in 2014 holds the key to understanding many recent market developments. The surge in potash supply in 2014 was itself triggered by Uralkali's 2013 withdrawal from the Belarusian Potash Company (BPC), its joint export venture with Belaruskali.

Record deliveries

Global potash deliveries increased by 7.5 million tonnes net between 2010 and 2015, an average of 2.6% per annum. In reality, supply growth over this period was concentrated in 2014, as deliveries were flat between 2010 and 2013 and fell back in 2015. Indeed, 2014 global deliveries surged by 9.2 million tonnes (17%) to a record 63.1 million tonne level (Figure 1). Even more significantly, at least one-half of that increase, some 4.6 million tonnes, is thought to have gone into building channel inventories rather than being applied to land[1].

Destocking

Destocking from this 2014 highpoint depressed new potash purchases over the next two years, as distributors met agricultural demand by running down their elevated stock levels. Consequently, global potash deliveries fell 1.8 million tonnes (2.8%) in 2015 and are projected to fall by another 1.8 million in 2016.

A buying frenzy

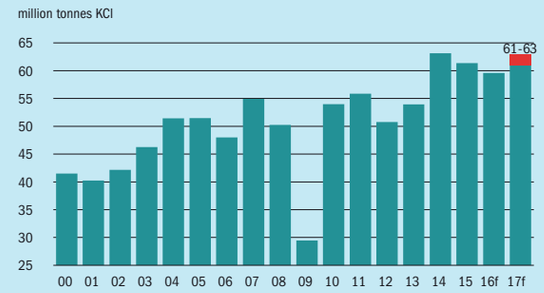
It was Uralkali that set off the sequence of events that ended with potash deliveries rocketing in 2014. In mid-2013, the company commented that its withdrawal from the BPC could cause potash prices to fall by around $100 to $300/t. Uralkali also said it would be raising production by 2.5 million tonnes to 13 million tonnes in 2014 in a bid to expand its market share in China, India and Brazil.

As a consequence, buying interest dried-up in the second half of 2013 as distributors reacted to these announcements by selling potash from inventory while they waited for prices to hit the $300/t mark. Strong potash demand unleashed by high agricultural commodity prices at the start of 2014 was another contributory factor to what followed.

The upshot of all this, according to Mosaic, was that: "Potash prices began to increase in January 2014 and the buying frenzy began."

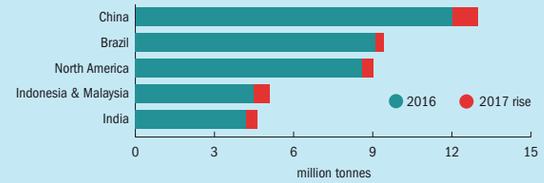
NOLA barge prices rose from $340/t in January to $413/t by September 2014, for example. Similarly, the Brazil vessel price started 2014 at around $320/t only to finally peak at $382/t towards the year's end. By the time the 2014 tumult came to an end, deliveries had jumped by a staggering 9.2 million tonnes. ■

Fig 1: **Global potash deliveries**



Source: CRU/Mosaic *f: forecast*

Fig 2: **Rise in 2017 deliveries for the 'Big Six' global potash consumers**



Source: Mosaic

PotashCorp's closure of New Brunswick and its investment in Rocanville is a good illustration of how producers are rationalising and optimising their operations.

"With Rocanville, we have built the world's largest potash mine, and now it is ramping up to a capacity of six million tonnes," comments Tilk. "That mine is about three average potash mines combined. It's got a tremendous cost benefit. We have very carefully, but I think very smartly, shifted our production toward Rocanville."

Demand returns to the market

The short-term potash market outlook looks increasingly positive thanks to solid global demand underpinned by the lowest prices in nearly 10 years and falling inventories. Signs of a market pick-up first began to emerge in the second half of 2016. Significant pent-up demand was "let loose" by the settlement of annual Chinese and Indian contracts mid-year, combined with strong, North American autumn requirements[1].

PotashCorp also pinpoints last year's contract settlements as a market turning point[2]:

"The recent strength in potash has been fuelled by the emergence of strong demand following the conclusion of this year's Chinese contracts. We expect this strength will continue into 2017, in line with historical trends.

"In 2017, we expect [China and India] to be more engaged, as they have drawn down inventories and, in certain cases, have contracts in place that will remain active into 2017. Historically, a late contract settlement in China has also set the stage for increased demand in the following year."

Canpotex, North America's potash exporting consortium, now expects shipments for final six months of 2016 to set a new record, even though its year-on-year exports are likely to be down on 2015. It reinforced this view by announcing in October that it was sold out for the rest of the year. Mosaic is also projecting second-half North American shipments in 2016 to be the second highest of the last five years.

'Big Six' drive the market

The current market upswing is expected to continue throughout 2017. Potash demand in the 'Big Six' consuming countries and regions – North America, Brazil, China, India, Indonesia and Malaysia – is set to rise this year. As a consequence, Mosaic and CRU are forecasting a 2.5 million tonne (4%) increase in global MOP deliveries to 61-63 million tonnes in 2017 (Figure 1).

PotashCorp thinks the market recovery in the latter part of 2016 could set the stage for potentially record levels of demand this year[2]:

"After a relatively slow start to the year, which saw many buyers draw down inventories… strength in the second half is expected to raise full-year global shipments to 58-61 million tonnes [in 2016]. Importantly, we see the potential for record demand in 2017 with annual shipments in the range of 61-64 million tonnes."

Forecast increases in deliveries for the 'Big Six' potash consumers this year are shown in Figure 2.

Replenishing soil potassium

North American deliveries are forecast to rise 0.4 million tonnes to 9.0 million tonnes in 2016/17 (fertilizer year to the end of June), reversing the year-on-year declines since 2014[1].

While potash deliveries dropped by 8% to 8.6 million tonnes in 2015/16, North American farm purchases are thought to have increased more than 4% that year, so clearing-out channel inventories. This means that the region's potash deliveries are likely to reflect actual farm use more closely this year. Although North American application rates are expected to decline slightly for wheat, they should remain steady for corn and soybeans due to large nutrient withdrawals last year, and the scope for replacing or building soil potassium at a low cost. PotashCorp suggests that replenishment of soil potassium will emerge as a key North American market driver:

"A high percentage of soils continue to test below the critical level for potassium [and], without potash application, these soils have a higher probability of yield loss. We believe this application deficit [in the US Southeast, the Northern Cornbelt and Eastern Canada] is not sustainable and if not addressed could jeopardize the soil's long-term productivity."

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Brazil stays above trend

Brazil's potash deliveries are projected to grow to 9.1 million tonnes in 2016 and reach a record 9.4 million this year[1]. This positive outlook is supported by the record or near-record level prices for the country's leading crops. Access to farm credit also appears to be less of an issue than it once was, and potash stock levels have fallen year-on-year by 200,000 tonnes, according to recent ANDA statistics.

PotashCorp highlights an expansion in growing area, strong farm returns and the replenishment of low inventories in its outlook: "Brazil's potash consumption has grown at a very robust pace, driven by expanding crop acreage and increases to application rates. We anticipate that Brazil will continue to increase its potash usage at rates above the global average."

Demand overrides policy change

Chinese deliveries are set to increase from just over 13 million tonnes in 2016 to 14 million tonnes this year. Agricultural demand is expected to be increasingly met from new deliveries rather than existing stocks, as distributors run down the massive inventory build-up dating from 2015.

Although recent changes in government price support has created uncertainty for corn producers, analysts at Mosaic think this will not greatly affect potash application rates[1]. PotashCorp has a similar view about the consequences of Chinese corn policy changes[2]:

"Corn acreage could be reduced by about 8.2 million acres (or ~9%) by 2020. We believe the impact on potash would be less [than for nitrogen fertilizers], given current low potash application rates on poor quality corn land and a more neutral application rate trade-off between corn and substitute crops."

Bulk blending for NPK fertilizers is a growth market in China, and continues to provide good opportunities for the major potash exporters[2]. "Demand for granular potash, which is mostly used in bulk blending fertilizers, is increasing and is expected to see major long-term growth," comments PotashCorp. "Canpotex has signed a number of agreements with some of the largest fertilizer distributors and NPK producers in China for the supply of granular-grade potash for use in bulk blending."

Greater affordability

Indian potash deliveries are projected to increase from 4.2 million tonnes in 2016 to 4.6 million this year[1], the main drivers of demand being:

- Average or above average monsoon rains in key agricultural states
- Lower international potash prices
- A 'workable' fertilizer subsidy
- A relatively stable rupee
- Lower retail prices
- A strong Rabi season
- Profitable farm economics
- A 50% fall in inventories

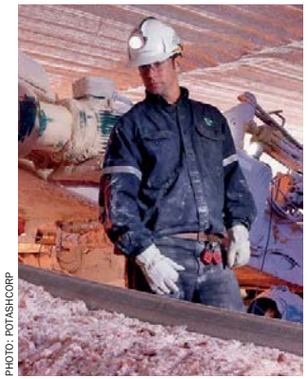

PHOTO: POTASHCORP

Potash on a conveyor at PotashCorp's Rocanville mine, Saskatchewan.

PotashCorp is optimistic about prospects for India in 2017[2]: "We believe greater fertilizer affordability for importers and farmers will increase potash demand in India. Not only have fertilizer prices come down considerably over the past year, the Indian government lowered the Maximum Retail Price (MRP) that farmers pay for potash and DAP, making both more affordable to farmers.

"We expect that recent improvements in affordability will be a catalyst for near-term improvements in application rates and overall potash demand."

Potash deliveries to Indonesia and Malaysia, although still affected by the 2015/16 El Niño event (*Fertilizer International* 475, p36), are set to reach 4.5 million tonnes in 2016. A strong recovery in potash consumption is forecast this year as palm oil production rebounds and monsoon conditions return to normal.

"USDA is projecting a recovery in palm oil output during 2016/17 as the impact of El Niño dryness wanes," comments PotashCorp[2]. "Healthy palm oil prices and the potential for improved weather conditions are expected to support regional fertilizer demand during the second half of 2016 and in the coming year."

Swing high or low?

The solid global outlook for 2017 is underpinned by a positive set of demand drivers and moderate potash prices. Nevertheless, Mosaic cautions that "prices could swing high or low depending on a few factors"[1]. These include:

- **Crop prices:** a bumper harvest and attendant crop price falls could worsen farm economics and put a brake on demand
- **Russian and Belarusian exchange rates:** the currencies of both countries tend to track the value of oil, and an oil price hike could therefore raise the dollar cost of production of both these major potash exporters
- **Volumes from new mines:** the commissioning date and ramp-up of greenfield projects, such as EuroChem's VolgaKaliy and Usolskiy mines in Russia and the K+S Legacy mine in Saskatchewan, will also influence the market, this year and next

Oil sector developments and potash supply growth could therefore have as much influence on the potash market in 2017 as agricultural commodity price changes.

However, by "lowering our costs in difficult times", PotashCorp's CEO Jochen Tilk believes that tough but necessary decisions taken by producers in 2016 should lead to brighter prospects this year.

Speaking last November[3], Tilk said: "We have gone through a number of mine closures… and inventory adjustments. That's our approach to the market, and we see potash prices improving. Today, they're approximately $250/t, [whereas] just six months ago, they were around $200/t. That's an increase of 25%, and we think that step was absolutely fundamental to how we see next year [2017] shaping up." ■

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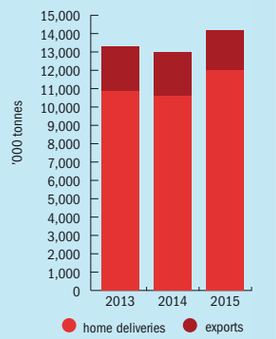
Premium products from quality rock

Buoyant Russian production has helped underpin global growth in phosphate rock supply, and countered production shortfalls in other countries. Russia's phosphate fertilizer producers are fortunate to benefit from low operating costs and access to high-quality phosphate rock. The EU, Latin America and India all offer major markets for the country's competitive and highly export-oriented phosphate fertilizer sector. We profile the phosphate industry in Russia and neighbouring countries and examine its influence on world supply and trade.

PHOTO: PHOSAGRO

PhosAgro's Cherepovets phosphate fertilizer plant.

Fig 1: **FSU phosphate rock home deliveries and exports,** 2013-2015



Source: IFA

Russia and the neighbouring countries of the Former Soviet Union (FSU) form one the world's key producing regions for phosphate rock and finished phosphate fertilizers. The region's increasingly sophisticated phosphate industry is dominated by three key players: PhosAgro, EuroChem and Acron.

PhosAgro is Europe's largest phosphate producer and possesses an overall fertilizer production capacity in excess of seven million tonnes. The company is also the world's number one producer of high-grade phosphate rock (>35.7% P_2O_5) and ranked third globally as a DAP/MAP producer.

Swiss-headquartered EuroChem Group is a Russian- and European-based fertilizer producer. Its 14 million tonne production capability is divided between 8.9 million tonnes of nitrogen fertilizer capacity and 5.1 million tonnes of phosphate capacity.

Russia's Acron Group manufactures and markets NPK fertilizers, ammonium nitrate and urea ammonium nitrate on a large-scale. The group operates a phosphate mine and owns two NPK fertilizer plants in Russia.

Although markedly different in terms of their resource base, product portfolios and target markets, PhosAgro, EuroChem and Acron do share common strategic goals. Integrated, low-cost production and self-sufficiency in key feedstocks, such as phosphate rock, potash, ammonia and natural gas, are overriding priorities for all three companies, for example. Product diversification, especially increasing the range of premium and speciality fertilizers on offer, is another shared strategic objective.

Growth trajectory for phosphate rock

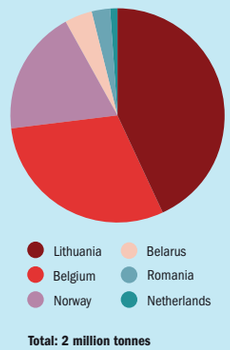
Three FSU countries collectively produced 14.3 million tonnes of phosphate rock in 2015, with 11.5 million tonnes of this originating in Russia, 1.8 million tonnes in Kazakhstan and 0.9 million tonnes in Uzbekistan. Home deliveries in the FSU totalled 12.0 million tonnes in 2015. A further 2.1 million tonnes of phosphate rock was exported (Figure 1), equivalent to around 7% of world trade (29.5 million tonnes).

Three EU countries, Lithuania, Belgium and Norway collectively accounted for over 90% of Russian phosphate rock exports in 2015 (Figure 2), reflecting cross-border shipments to EuroChem's Lifosa and Antwerp production plants as well as Yara's Norwegian fertilizer manufacturing operations. The EU imported around 2.4 million tonnes of phosphate rock in 2015 and remains heavily reliant on Russian, Moroccan, Algerian and Egyptian imports.

In recent times, buoyant FSU production has underpinned global growth in phosphate rock supply and countered production shortfalls in other major-producing countries. For example, a year-on-year increase in FSU phosphate rock output of 1.4 million tonnes in 2015 – as well as production increases in Israel, Jordan, Senegal, and Saudi Arabia – helped boost global phosphate rock production by 2% to 200.7 million tonnes. These rises helped offset falls in phosphate rock output elsewhere, particularly in Egypt, Morocco, Tunisia and Brazil.

The FSU is one of three regions where the International Fertilizer Association (IFA) expects phosphate rock supply to grow most sharply over the medium-term[1]. It forecasts an increase in global supply of more than a tenth to 250 million tonnes by 2020. Incumbent producers will deliver most of this new capacity through a combination of expansions and new mine projects.

Fig 2: **Russian phosphate rock export destinations,** 2015



Total: 2 million tonnes

Source: IFA

Extra phosphate rock supply

Capacity developments in Russia and Kazakhstan are likely to contribute **an extra 2.8 million tonnes** to the 25 million tonnes of new supply expected in the period up to 2020. IFA is currently forecasting the following FSU capacity additions:

- Acron's Oleniy Ruchey mine (North-Western Phosphorus Company) in Russia's Murmansk region to add **one million tonnes** of extra capacity ramping up between 2017 and 2022
- PhosAgro to add **0.5 million tonnes** at its Russian Kola Peninsula operations
- EuroChem to add close to **one million tonnes** of capacity between 2016 and 2020 by expanding its Kovdor operations on the Kola Peninsula
- EuroChem is also expected to complete a capacity expansion of **0.8 million tonnes** at its 0.7 million t/a Zhanatas mining and processing complex in Kazakhstan in late 2020

Acron Group's Oleniy Ruchey phosphate mine in Russia's Murmansk region was commissioned at the end of 2012. The open-pit mine and processing plant, operated by its North-Western Phosphorus Company (NWPC) subsidiary, has the capacity to produce 1.1 million t/a of high-quality phosphate rock concentrate (apatite, 39% P_2O_5 grade). It is estimated to have 261 million tonnes (42.7 million tonnes P_2O_5) of ore reserves.

Acron is investing $1.1 billion in the Oleniy Ruchey mine, 80% of which has already been committed. Mine output will begin a gradual ramp-up to 2.0 million t/a later this year when the project's second stage is commissioned. This involves the construction of an underground mine and an expansion of the site's processing plant. The project should deliver good investment returns for Acron, having required capital expenditure of $500 per tonne of capacity, around half the world average for a phosphate mine, according to the company's calculations.

PhosAgro is 100% self-sufficient in phosphate rock and possesses 2.05 billion tonnes of ore reserves, sufficient for more than 75 years of production. The company's Apatit subsidiary produced 7.9 million tonnes of phosphate rock in 2015, at a standard grade of 39% P_2O_5, a level of output that only Vale, Mosaic and OCP managed to exceed.

A rising proportion of PhosAgro's phosphate rock output is used for integrated production. Some 5.9 million tonnes of this was consumed internally in 2015, compared to 4.6 million tonnes in 2011, leaving 2.0 million tonnes available for sales to third-parties. The company is planning to further expand phosphate rock production to 8.3 million t/a after 2017.

EuroChem produces 2.5 million t/a of high-grade phosphate rock concentrate (apatite, 37-38% P_2O_5) from its Kovdorskiy GOK mining operation south of Murmansk in Russia. This covers around 75% of the production needs at EuroChem's three phosphate plants and its Antwerp operation.

EuroChem is in the process of expanding its phosphate rock supply. The group hopes to increase Kovdorskiy's phosphate rock production capacity by 948,000 t/a by extending limits of the current open-pit mine and bringing several new areas into production.

Additional volumes are also expected from a large-scale project in Kazakhstan. EuroChem has been developing a phosphate rock mining and fertilizer production project in the country's Jambyl region since 2013, and has also invested $18 million in the socio-economic development of this part of Kazakhstan. The company's Kazakh mining operation made its first deliveries to Belorechensk on the Black Sea in autumn 2015 and has a production target of more than 250,000 tonnes for 2016.

EuroChem told *Fertilizer International* that its Kazakh mine is now operating at full 640,000 t/a capacity, having successfully completed the first stage of the project in 2016. The company has plans to raise phosphate rock production to 1.5 million t/a as part of the project's second stage, although a formal timetable for this has yet to be set.

EuroChem owns licenses to develop three sections of the Kok-Djon phosphate deposit in Kazakhstan, as well as an option to acquire licences for the Geres deposit, another of the country's phosphate resources. Its current Kazakh reserves are estimated at 515 million tonnes (P_2O_5).

EU, Indian and Latin American exports

Although six FSU countries manufacture finished phosphate products, two countries, Russia and Lithuania, are the

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region's main producers and exporters. FSU production is heavily export-oriented with over three quarters of 2015 deliveries (2.4 million tonnes P_2O_5) shipped internationally (Figure 3).

Phosphate fertilizer production in the FSU is overwhelming oriented towards monoammonium phosphate (MAP) and diammonium phosphate (DAP) manufacture. MAP and DAP made up 60% and 35% of FSU phosphate deliveries in 2015 (2.4 million tonnes P_2O_5), supplemented by minor deliveries of Belarusian triple superphosphate (TSP).

MAP is produced by five countries in the region, whereas only Russia and Lithuania possess DAP production capabilities. Lithuanian and Russian DAP exports are targeted at the EU, particularly the French, German, Irish, Spanish and UK markets. India is also a major export destination for Russian-produced DAP (Figure 4). Latin America, in contrast, is by far the most important international market for Russian MAP, accounting for 45% of exports.

Operational flexibility and adding value

The phosphates sector is currently going through a major period of expansion globally, with two companies in particular, Ma'aden in Saudi Arabia and Morocco's OCP Group, investing massively in phosphate fertilizer capacity. Overall, IFA is forecasting that ten countries will commission 20 new finished phosphate plants between 2015 and 2020. Geographically, China and Morocco will spearhead the industry's expansion, each bringing seven new units into production over this five year period.

As a result of these investments, global processed phosphate capacity is predicted to grow by 7.3 million tonnes over the next five years on a P_2O_5 basis, reaching 52 million tonnes P_2O_5 by 2020. Growth for the three main product types is likely to be as follows:

- **Diammonium phosphate (DAP) capacity** will increase by 6.3 million tonnes to reach 34.8 million tonnes P_2O_5, accounting for 90% of the overall rise in phosphates capacity
- **Monoammonium phosphate (MAP)** capacity will increase by 0.5 million tonnes to 12.9 million tonnes P_2O_5
- **Triple superphosphate (TSP)** capacity will increase by 0.4 million tonnes to 4.3 million tonnes P_2O_5

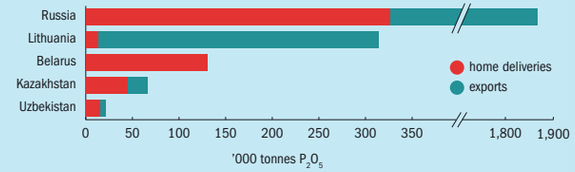
On a product tonnage basis, phosphates capacity is expected to expand by almost one-fifth globally over the medium-term, reaching 110 million tonnes in 2020, up from 94 million tonnes in 2015.

In contrast to the major expansions anticipated elsewhere, IFA is forecasting 3.7 million tonnes (P_2O_5) of Russian phosphate fertilizer capacity in 2020 and is not expecting any major change in MAP/DAP capacity in the short-term. Instead, the country's phosphate producers appear to be mainly focussed on:

- Investing to improve operational performance
- Vertical integration with self-sufficiency in key feedstocks
- Increasing their production flexibility to enable output to be more closely tailored to product demand
- Producing higher volumes of value-added and premium fertilizers as part their product mix

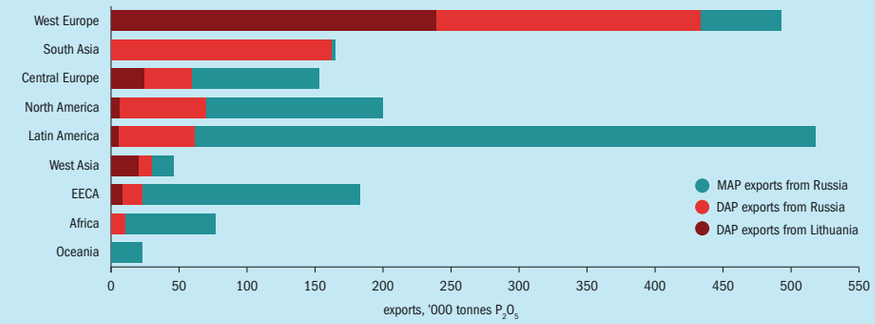
PhosAgro, for example, increased the proportion of NPS fertilizers it produces from 5% of its product mix at the start of 2015 to more than 10% by the start of 2016. Overall, while not ignoring the importance of production growth, Russian phosphate producers appear to be taking advantage of their low operating costs and access to high-quality phosphate rock by choosing to invest in modern and increasingly sophisticated fertilizer manufacturing.

Fig 3: **FSU countries: 2015 processed phosphate home deliveries and exports**



Source: IFA

Fig 4: **FSU processed phosphates (DAP and MAP) export destinations**



Source: IFA

PhosAgro confirms 2020 strategy

PhosAgro produces finished phosphates at two main sites in Russia. Its PhosAgro-Cherepovets site is Europe's largest standalone phosphate fertilizer producer with 3.5 million t/a of MAP/DAP/NPK/NPS capacity. The Balakovo branch of Apatit also has the capacity to produce 1.4 million t/a of MAP/DAP/NPS fertilizers and 270,000 t/a of feed phosphate (MCP).

PhosAgro produced 5.3 million tonnes of phosphate-based fertilizers in 2015, including 2.2 million tonnes of NPK/NPS fertilizers, 1.6 million tonnes of MAP and 1.1 million tonnes of DAP. Production of phosphate-based fertilizers is up 23% (one million tonnes) since 2012 thanks to $70 million of investment in plant modernisation and debottlenecking.

Phosphate fertilizer production capacity looks set to expand from 5.6 million tonnes currently to 6.0 million tonnes after 2017 under plans to raise premium NPK product output. More than two million tonnes of the company's current phosphate production capacity is fully flexible and can be put into NPK production.

PhosAgro's directors recently approved the company's strategy for the period up to 2020. The firm is prioritising production growth and increased sales in target markets such as Russia, Europe and Latin America.

"PhosAgro's plans through to 2020 focus on developing the group's mineral base and expansion of beneficiation capacities at Apatit, modernising sulphuric and wet-process phosphoric acid production facilities and building an ammonia pipeline at Balakovo," commented Andrey Guryev, PhosAgro's CEO.

PHOTO: PHOSAGRO

PhosAgro-Cherepovets site is Europe's largest standalone phosphate fertilizer producer.

EuroChem's Kazakh ambitions

EuroChem invested $764 million in its phosphates business between 2013 and 2015, out of a total capital expenditure of nearly $3.1 billion over this three year period. Ownership of three plants, two in Russia and the Lifosa plant in Lithuania, provides EuroChem with 2.5 million t/a of MAP/DAP capacity, and 5.1 million t/a of phosphate fertilizer and feed phosphate capacity overall.

The group manufactures phosphate and compound fertilizers through its EuroChem-Belorechenskie Minudobrenia (EuroChem-BMU) production subsidiary based in Krasnodar Krai in the south of Russia. Although further capacity expansions are a possibility at EuroChem-BMU, the company told *Fertilizer International* that it was too early to discuss any major new investment projects at this stage.

EuroChem is, however, pushing ahead with a project to construct an integrated phosphates and speciality fertilizer complex in Zhanatas, Kazakhstan, and firmed up these plans by signing a memorandum of understanding with the Kazakh authorities at the end of last year (*Fertilizer International* 475, p13). Once built, the complex will have more than one million t/a of sulphate of potash (SOP) and dicalcium phosphate (DCP) production capacity, and will also produce one million tonnes of by-products annually.

EuroChem told *Fertilizer International* that it has yet to set an overall completion date for its Kazakh production project but would do so in due course. IFA previously reported that the complex will include units for NPK fertilizers (330,000 t/a), DCP (660,000 t/a) and SOP (630,000 t/a) with completion expected in 2019.

Acron boosts NPK production

Acron uses output from its Oleniy Ruchev mine to manufacture compound fertilizers on a large scale. Acron's 1.8 million t/a of NPK production, split between the company's Veliky Novgorod (1.2 million t/a capacity) and Dorogobuzh (0.6 million t/a capacity) sites, consumes around 750,000 t/a of phosphate rock concentrate. Acron sells any excess output from the mine externally.

Last November, Acron announced that successful upgrades of two NPK units at Veliky Novgorod had increased the plant's overall output by over 60,000 t/a. The capacity of each unit was increased from 1,840 t/d to 2,000 t/d capacity as part of the upgrade. The group installed an additional decomposition reactor, crystalliser and rotary duplex filter at each unit, and improved the performance of conveyor drives used in the plant's continuous product handling system.

Acron generated nearly half of its revenue (48%) from NPKs and bulk blends in 2015. These sell at an average premium of almost a fifth (17%), relative to urea, DAP and potash. China and Brazil are large NPK markets for Acron, accounting for 23% and 11%, respectively, of the group's sales volumes in 2015. The firm was the number two NPK supplier to China in 2015, with a 27% share of NPK imports. The sale of its 50.5% stake in Shandong-based producer Hongri Acron last August will, however, curtail Acron's ability to supply NPKs to the Chinese market by about half a million tonnes.

Acron exports fertilizers to 60 countries worldwide and occupies leading sales positions in Russia, China, Brazil the US and Thailand, its key markets. The firm also operates distribution networks in Russia and China and trading companies in both Europe and the US.

Sales volumes are mainly targeted at Asia (33%), Latin America (16%), Europe (11%) and North America (11%). The Russian home market is strategically important for Acron, particularly for AN, NPK and industrial products, although domestic sales volumes remain relatively modest (11%). The 200 kilometre distance between the Veliky Novgorod plant and the Baltic ports provides Acron with logistic advantages over some of its competitors. ■

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