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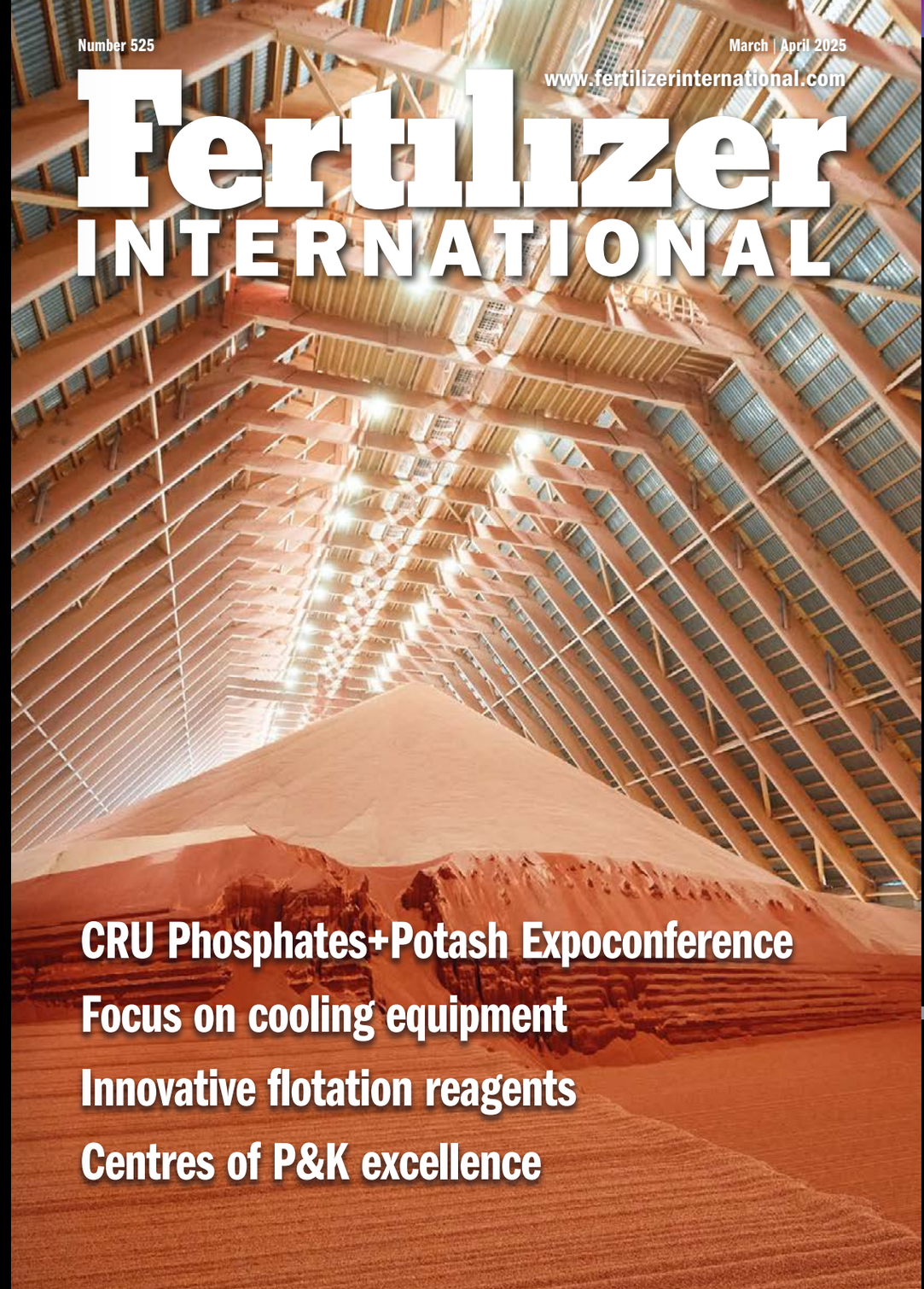

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Cover: Large heap of potassium fertilizers in plant storehouse. PHOTO: NORDRODEN/SHUTTERSTOCK

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The reluctant thought leader

> **The fertilizer industry's main long-term challenge is switching to low-carbon production and getting ourselves on the right agricultural emissions pathway."**

Last December, I was invited by the International Fertiliser Society (IFS) to speak at its annual conference in Cambridge. The theme was the main challenges facing the fertilizer industry – and the innovations needed to overcome these.

I admit I was surprised. Mainly because, as a generalist, there are plenty of people more qualified than me able to answer this question in depth.

Yet, it also became clear that – having covered the whole industry as a journalist for a decade – there was an expectation that I should at least have an opinion.

In the end, I accepted the Society's conference invitation, and chose to highlight just four things in my short speaking slot. Firstly, I started by naming the main challenge I think we're facing as an industry, then followed this up by quickly touching on three innovations that make me hopeful about the future of crop nutrients.

So, to mark 10 years as editor of *Fertilizer International*, I thought I'd share – as a very reluctant thought leader! – my take on both the hurdles facing our industry and how best we can vault these.

Many would agree that the fertilizer industry's main long-term challenge is switching to low-carbon production and getting ourselves on the right agricultural emissions pathway. In my view, the fertilizer challenge is even more complex – effectively a decarbonisation trilemma – as it requires us to solve three problems at the same time:

- Firstly, how do we place agriculture on a sustainable low emissions trajectory.
- While, secondly, continuing to supply farmers at scale with the fertilizers they need to feed an ever-growing population.
- Yet, thirdly, do so profitably without imposing a crippling cost burden on fertilizer producers, farmers, the food industry and ultimately food consumers.

The scale of this challenge is just huge.

For example, cutting direct emissions from global ammonia production, currently totalling 450 million tonnes CO_2 equivalent per annum, by 70-95 percent by 2050 will require a $14-15 billion investment annually. Every single year for 25 years. It will also mean tackling the even bigger 717 million tonnes CO_2 equivalent of agricultural emissions associated with the global use of nitrogen fertilizers each year – so-called Scope 3 emissions.

So, if that's the challenge, what disruptive innovations might be coming down the track to help?

Firstly, there's been the market entry of low-carbon fertilizers over the last 18 months. In Europe, we've seen the commissioning of the first large-scale electrolysis systems for green hydrogen and ammonia production. And, while green fertilizers are a tiny demonstration market currently, production is scaling up. *Financial Times* even reported recently on a 'green fertilizer gold rush' by leading food and drink companies.

Moving on, the second disruptive change I'm seeing is the mainstreaming of biologicals. Biostimulants are now emerging as mainstream products with major fertilizer producers – including Yara, Mosaic, Fertiberia and ICL – launching their own biostimulant lines and expanding production capabilities. It's a $2.6 billion market that's growing at 10 percent per annum currently.

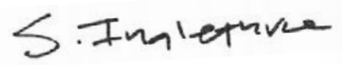
The final innovation I'm observing is the move from volume to value in the market and the steady rise of specialty fertilizers. The increasing use of value-added fertilizers has very clear agronomic and environmental upsides – as they are associated with enhanced efficiency, balanced fertilization, precision technology and effective nutrient delivery systems, such as fertigation and foliar spraying.

Summing up, then, we have three promising innovations.

Firstly, the market entry of green fertilizers is starting to give farmers a low-carbon choice on inputs. Secondly, the mainstreaming of biostimulants is providing crops with an 'insurance policy' by giving added protection against extreme weather conditions such as heat and drought events. Lastly, the rise of value-added fertilizers is allowing less wasteful and more precise and balanced crop nutrient delivery.

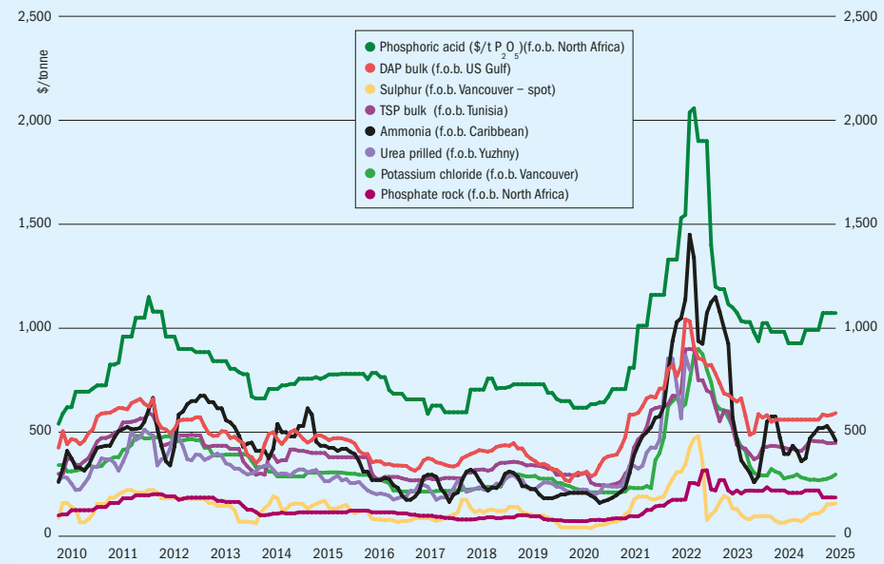
Regrettably, what I've neglected to mention so far is cost – both who pays for decarbonisation and ag emissions reductions and how much. Will it be fertilizer producers, farmers, the food companies, retailers or consumers?

In the end, that's the most fundamental question of all, as shifting to a more sustainable global food and farming system depends on us coming up with answers that are both affordable and equitable. ■



Simon Inglethorpe, Editor

Historical price trends $/tonne



Source: CRU

PRICE TRENDS

Market snapshot, 20th February 2025

Global inactivity sparks urea declines. The urea market has been jittery in response to delays in the India tender announcement. This has been noticeable in the US, where the February price fell to $380/st f.o.b. NOLA. Most attribute the slide to trader nerves in the absence of the India announcement, with sellers quickly agreeing to lower values.

The Brazil benchmark has proved more resilient with a trade at $450/t cfr. Demand is underwhelming, however, and sales are proving the exception rather than the rule.

January urea sales in India, meanwhile, surged by 29% year-on-year, totalling 4,559,000 tonnes compared to 3,543,000 tonnes in January 2024. This has reduced inventory by 1.3 million tonnes to just below 4.5 million tonnes at the start of February.

Ammonia on downwards path. Globally, the price direction for ammonia is still downwards, with healthy supply more than sufficient to cover the limited demand seen across most regions. The exception remains NW Europe, where interest is supporting prices in the face of a generally weak wider market.

News of a $459/t cfr sale into Morocco by Trammo may weigh on prices in coming weeks. A rollover or slight decline on $500/t cfr agreed for February has been mooted for the March Tampa settlement. That could place pressure on US Gulf values, while clarity on the status of 1.3 million t/a capacity Gulf Coast Ammonia (GCA) project is awaited.

East of Suez, continued length in the Middle East has pushed prices towards the $300/t f.o.b. mark, with little support expected heading into March. Ma'aden plans to export 200,000 tonnes in March – up 50,000 tonnes on February. Just over a third of that total is earmarked for India, where FACT issued a fresh purchase tender for up to 15,000 tonnes

Tight availability supports DAP/MAP prices. DAP and MAP prices continue to be supported by exceptionally tight availability, with several benchmarks assessed higher, while others were stable. The latest deal to India was up at $636/t cfr. Spot prices were assessed up at $632-636/t cfr following five weeks at $632-633/t cfr. While Indian importers face steep losses buying at these prices – under the current subsidy regime – exceptionally low DAP stocks in the country are creating pressure to buy.

Unverified reports, meanwhile, suggested the long-discussed India-Morocco phosphate supply deal for DAP and TSP may have been finalised, although this had not been confirmed at the time of writing.

Prices for DAP and MAP barges at New Orleans also continued to increase, while the DAP premium over MAP widened. Prices were also higher for Moroccan MAP exports, Tunisian DAP exports, and DAP imports to Argentina/Uruguay.

Bullish potash outlook bolstered by Uralkali. Potash prices rose in China, Brazil and the US, while other regions saw little change, as Pupuk Indonesia closed two

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Market price summary $/tonne – late February 2025

Nitrogen	Ammonia	Urea	Ammonium Sulphate	Phosphates	DAP	TSP	Phos Acid
f.o.b. Caribbean	420	-	f.o.b. E. Europe 286	f.o.b. US New Orleans*	608	-	-
f.o.b. New Orleans*	-	434	-	-	-	-	-
f.o.b. Yuzhny	Port closed	Port closed	-	f.o.b. N. Africa	622	448	1,073
f.o.b. Middle East	310	405	-	cfr India	634	-	1,055
Potash	KCl Standard	K_2SO_4	**Sulphuric Acid**		**Sulphur**		
f.o.b. Vancouver	297	-	cfr US Gulf 138		f.o.b. Vancouver	180	-
cfr India	284	-	-	-	f.o.b. Arab Gulf	207	-
f.o.b. Western Europe	-	608	-	-	cfr China	223	-
f.o.b. Baltic	255	-	-	-	cfr India	215	-

*Prices are on a bulk, spot basis, unless otherwise stated. Phosphoric acid is in terms of $/t P_2O_5 for merchant-grade (54% P_2O_5) product. Sulphur prices are for dry material. n.a. = not available. *$/short ton*

tenders and Uralkali announced a cut in second quarter production.

The Southeast Asia MOP market took the spotlight this week as Pupuk Indonesia closed two tenders. The importer received five offers from suppliers for their 20,000 tonnes sMOP tender, ranging from $335-360/t cfr for May shipment, while its gMOP tender received six offers, ranging between $335-435/t cfr. Neither tender has been reported as awarded at the time of writing.

In other news, Uralkali plans to cut MOP production by 300,000 tonnes at its Berezniki-2, Berezniki4, and Solikamsk-3 mines for maintenance in the second quarter. CRU does not expect this to support significant price increases.

Sulphur prices increase in China, flat elsewhere. In China, domestic port stock and international offers have risen to above $200/t cfr, despite a lack of fresh import deals. The Indonesia price was assessed flat but sentiment is bullish, with a 150,000 tonne Huayou tender expected to push prices higher. All other benchmarks were assessed flat amid muted market activity.

Since the Lunar New Year celebrations, no fresh import deals for China have been reported. As a result, Indonesia has played a key role in supporting prices by continuing to purchase, mainly from the Middle East. Consequently, other delivered markets have had to adjust their prices to align with f.o.b. prices from the Middle East.

In India, subdued demand has kept prices flat. The market there is expected to remain steady until demand recovers around April in preparation for the Kharif season. Activity in Brazil has also been restricted by weak demand. Consequently, prices from the US Gulf have also remained flat as Brazil is one of its primary delivered markets.

OUTLOOK

Urea prices firming. Urea prices are expected to remain firm and keep climbing in February. India has taken just over half a million tonnes out of the market for February loading. The US has yet to step up but Australia is already paying higher prices and increased demand is anticipated in March. European and Turkish interest is supporting North African prices as Iran remains largely closed. Upside risks also abound. A surge in US interest, a return to the market by India, a move by Australia to secure March tonnes – as well as continued buying in Europe and Turkey – could all see urea prices move higher than forecast.

Softening ammonia market. The price declines that began in January are expected to continue in ammonia markets east and west of Suez, against a backdrop of assured short-term supply and only limited pockets of regional demand. Delays to the commissioning of new capacity in the US Gulf and Black Sea could, however, moderate forecast declines, while potential US tariffs on Canadian ammonia imports could also provide indirect support for future Tampa price settlements. Similarly, a further run-up in natural gas prices in NW Europe could prompt further regional shutdowns and pave the way for an uptick in import demand.

Potential for slight phosphate price declines. Phosphates prices are expected to remain stable in the first quarter, with tight supply offsetting limited demand and overcoming affordability concerns, while slight declines are likely in the second quarter as availability improves. A lack of exports from China is expected to add support to bullish first quarter sentiment in global markets. Supply from China should pick up in the second quarter, however, giving buyers another supply option. OCP has already increased its production and sales significantly. Exports from Morocco may therefore be higher than previously expected, particularly in the early months of 2025.

Potash price forecast revised upwards. Globally, CRU is currently forecasting higher short-term potash prices, particularly in the US, driven by a risk premium. This is centred on the prospects for US tariffs on Canadian potash and lower production from Belarus. Canada currently supplies around 80% of US MOP needs. With a healthy volume of potash already in US warehouses, the price impacts of tariffs – should they materialise – are likely to emerge later rather than sooner. CRU expects the 180-day India potash contract negotiations to begin soon, with a potential settlement of $300/t cfr in June.

Gradual sulphur price decline. In an upwards revision, sulphur prices are now expected to either plateau or increase slightly through February before decreasing into March. While the overall trend remains unchanged, price falls during the first half of 2025 are now expected to be more gradual into June. However, prices may not follow this expected pattern, if global markets behave reactively to US import tariff announcements. ■

Fertilizer Industry News

EUROPE

EU targets Russian fertilizer imports with tariffs

The European Commission is proposing to place tariffs on EU fertilizer imports from Russia and Belarus.

The import tariffs, announced ahead of the third anniversary of the start of the Russia-Ukraine conflict, combine percentage-based *(ad valorem)* and fixed-rate €/t duties. The new tariffs could be imposed on selected fertilizers from the start of July – if backed by a majority of member states in the European Council and MEPs in the European Parliament.

Under the new proposal, adopted by the Commission on 28th January, nitrogen-based fertilizers from both Russia and Belarus would be subject to import tariffs from July onwards. For the initial 12 months these would impose:

- A 6.5% import duty *(ad valorem)* plus a €40/t duty on urea, ammonium nitrate (AN), calcium ammonium nitrate (CAN) and ammonium sulphate (AS) imports.
- A 6.5% import duty *(ad valorem)* plus a €45/t duty on diammonium phosphate (DAP), monoammonium (MAP) and NP/NPKs imports.

The €/t duties would then rise in annual increments – on top of the fixed 6.5% *ad valorem* duty – over the next three years, to ultimately reach €315/t for urea/AN/CAN/AS and €430/t for DAP/MAP/NP/NPKs from 1st July 2028.

The Commission's proposal also includes an accelerator clause. This would automatically raise the €/t duties to their maximum level before the start of July 2028, if total annual EU fertilizer imports from Russia and Belarus exceed the following thresholds:

- 2.7 million tonnes between 1st July 2025 and 30th June 2026
- 1.8 million tonnes between 1st July 2026 and 30th June 2027
- 0.9 million tonnes between 1st July 2027 and 30th June 2028.

Conversely, a brake mechanism also provides the option to loosen import restrictions if European fertilizer costs "substantially exceed" 2024 levels.

Previously, while the EU has moved to reduce its dependency on Russian gas imports since the war in Ukraine began, it has not – until now – taken similar action on fertilizer imports. Russia is the EU's largest non-European NP/NPK supplier. While Russian urea imports into the EU did increase by 11% in 2024 (January-September), they remain below pre-2020 norms, according to an analysis by CRU.

"These tariffs are carefully calibrated to serve multiple goals," said Maros Sefcovic, the EUs' trade commissioner. "We aim to weaken further Russia's war economy, while reducing EU dependencies, supporting our industry, and preserving global food security. We will take every step necessary to protect our fertilizers industry and farmers."

The proposed tariffs will add to long-standing anti-dumping duties already imposed on Russian urea ammonium nitrate (UAN) and AN, the Commission confirmed to CRU.

The EU extended anti-dumping duties of €32.71/t on Russian AN for a further five years in December 2020. Russian AN imports into the EU are also subject to a 6.5% customs duty at present.

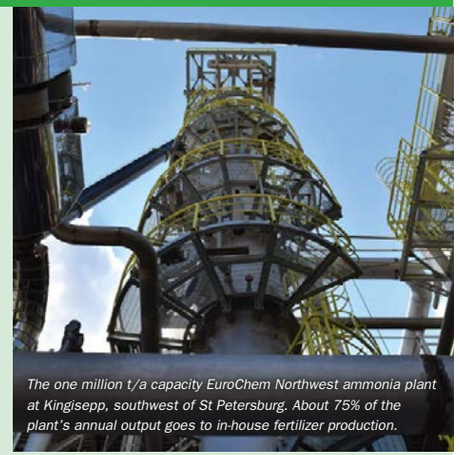

PHOTO: EUROCHEM

The one million t/a capacity EuroChem Northwest ammonia plant at Kingisepp, southwest of St Petersburg. About 75% of the plant's annual output goes to in-house fertilizer production.

The EU has also applied anti-dumping duties on Russian UAN – along with duties on UAN from the US and Trinidad and Tobago – since October 2019. These duties are set at a rate of €42.47/t for all Russian UAN exporters, except for Azot and Nevinnomyssky Azot which face a lower duty of €27.77/t. These rates are due to be reviewed in December this year.

Trade body Fertilizers Europe welcomed the European Commission's tariffs proposal. It said these needed to be introduced quickly and at a level that would effectively stop nitrogen fertilizer imports from Russia and Belarus.

"The European Commission's proposal for tariffs is a clear recognition of the pressing need to level the playing field and ensure that European producers can continue delivering high-quality, sustainable fertilizers for farmers across Europe," said Leo Alders, Fertilizers Europe's president.

"For too long, the European fertilizer industry has been exposed to artificially low-priced imports from Russia and Belarus, seriously distorting the market and undermining fair competition. We recommend that the gradual implementation of import duties occur every six months, rather than annually," Alders added.

Europe's farmers are less happy about the proposed tariffs. EU farming group Copa Cogeca called for "urgent fixes" to mitigate economic harm to farmers.

"The current proposal leaves European farmers and their co-operatives up against a wall without viable or alternative solutions, while no prior impact assessment has been conducted to evaluate its effects on food security and the economy," Copa said.

It wants the Commission to remove import duties on fertilizers from non-EU countries, except for Russia and Belarus, and prioritise manure use by allowing derogations to the nitrates directive.

The group is also calling on the EU to postpone the proposed tariffs on Russian and Belarussian fertilizers by a year – and limit its scope to nitrogen fertilizers only. ■

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GERMANY

Indefinite ammonia plant shutdown

SKW Piesteritz, one of Germany's last remaining fertilizer producers, cut production and closed one of its two ammonia plants indefinitely in mid-January, citing market and political conditions.

PHOTO: AGROFERT

SKW Piesteritz has been producing ammonia in Germany for more than 50 years.

Antje Bittner, the company's chief strategy officer/managing director, said: "For almost three years, we have been warning of massive disruptions in the fertilizer market as a result of the Russian war of aggression. To date, politicians have done absolutely nothing effective to prevent the European market from being flooded with cheap Russian fertilizers. In addition, companies like SKW Piesteritz are being forced out of the market by decisions of the federal government that are increasing our competitive disadvantages."

Previously, SKW Piesteritz said it has been able to maintain fertilizer production during the critical domestic application period for German agriculture. But that this was no longer the case.

"This has been challenging in the past, but we have always taken responsibility for the long-term stable supply of domestic products to agriculture. This is no longer possible for economic reasons," said Bittner.

"Since 2022, federal policy has increasingly placed a burden on our company beyond what is economically viable, despite urgent warnings to the responsible federal ministers. Now we are forced to react. We are being pressured by politicians to massively reduce fertilizer production," she added.

The company called on the German federal government to create viable economic conditions for Germany's domestic fertilizer industry.

Carsten Franzke, SKW Piesteritz's Managing Director, said: "If production in Germany is still desired at all, then the procurement costs for energy and gas must be reduced urgently. In the short term, the gas storage levy must also be abolished without replacement for domestic industry, and not just for foreign consumers as was recently the case."

He added: "The CO_2 certificate system must also be fundamentally revised in the foreseeable future. The ancillary energy costs must be reduced to a level before 2022. All the facts are known."

RUSSIA

Russia mulls potash export quotas

Russia is considering limiting potash exports from the second quarter of 2025, *Bloomberg* reported on the 25th February, citing Russian national daily *Kommersant*.

Russia's agriculture and trade and industry ministries are currently preparing export quota recommendations, at the request of Deputy Prime Minister Dmitry Patrushev, and will also be tasked with overseeing these quotas, *Bloomberg* said. The quotas are designed to secure potash supplies for the domestic market where they are needed to support the production of complex fertilizers.

This development emerged shortly after major Russian potash producer Uralkali announced a temporary shutdown of its Berezniki-2, Berezniki-4, and Solikamsk-3 mines for maintenance in the second and third quarters of 2025, with potash production reduced by at least 300,000 tonnes.

EGYPT

MOPCO invests in carbon capture at Damietta

MOPCO – the Misr Fertilizers Production Company – has selected thyssenkrupp Uhde to supply advanced technology for its Damietta ammonia-urea complex in Egypt.

The aim is to remove up to 145,000 tonnes of CO_2 annually from the flue gas of three existing ammonia production plants, by installing thyssenkrupp Uhde's innovative carbon capture and usage (CCU) technology, and use this for urea production. At the same time, three state-of-the-art uhde® ammonia converter cartridges will be installed to increase ammonia production capacity, while also lowering natural gas consumption in the synthesis loop by around 10%.

To bring down Damietta's CO_2 emissions even further, additional green hydrogen feedstock will be sourced from new water electrolysis units powered by renewable energy. MOPCO plans to produce up to 150,000 tonnes of green ammonia annually.

Ahmed Mahmoud El-Sayed, MOPCO's chair, said: "This collaboration with thyssenkrupp Uhde marks a significant step towards our sustainability strategic goals. Their world-leading technologies will not only increase our production capacity but also deliver proof for our commitment to provide more climate-friendly urea and produce green ammonia, where MOPCO will become one of the leaders to produce such products in MENA."

Nadja Håkansson, thyssenkrupp Uhde's CEO, added: "We are proud to enable our longstanding partner MOPCO to expand their business towards a greener production through our innovative carbon capture and low-emission ammonia solutions."

The three ammonia and three urea plants at Damietta were originally built by thyssenkrupp Uhde between 2006 and 2015, each of these having a capacity of approximately 1,200 t/d for ammonia and 2,000 t/d for urea, respectively. The insertion of the three new uhde® ammonia converter cartridges will raise ammonia production capacity at each plant by 150 t/d.

The new cartridges incorporate the latest design principles, such as an axial-radial configuration and removable beds, to boost ammonia production. Additionally, the use of Johnson Matthey's KATALCOTM 74-1 high-performance catalyst will deliver a significant increase in effective catalyst volume. The new cartridges can also be installed in existing pressure shells, enabling the revamp to be carried out with minimal downtime.

thyssenkrupp Uhde says it will provide comprehensive services throughout the project's installation and start-up phases, including the tie-in of the planned green hydrogen supply.

Damietta is Egypt's largest nitrogen fertilizer complex. It was established in 1998 with one ammonia-urea production train. MOPCO later acquired two more ammonia-urea production trains from the Egyptian Nitrogen Products Company (ENPC) in 2011.

Misr Phosphate starts 'low-dust' rock exports

Misr Phosphate has started to export phosphate rock with a low dust content via the port of Damietta on Egypt's Mediterranean coast.

A newly constructed 'de-dusting' unit at the company's Abu Tartour phosphate mine in the New Valley Governate, southwestern Egypt, is currently operating at a capacity of 1,000 t/d. This unit removes around 80% of the fines (less than 80 micrometres in size) from crushed phosphate rock. Beneficially, this de-dusting process also raises phosphate rock grade – by about 1.0-1.5% P_2O_5 – while also reducing heavy metal content, according to the company.

To date, Misr Phosphate has exported 15,000 tonnes of low-dust phosphate rock (27-29% P_2O_5) to southern Europe. The company also loaded a slightly lower grade 7,000 tonne shipment (26-27 P_2O_5) destined for Brazil at the end of February. Future consignments include a planned 15,000 tonne March shipment to Brazil and a 20,000 tonne April shipment to Spain.

Egypt's phosphate rock exports reached 5.2 million tonnes last year, according to EMPHCO, the Egyptian phosphate and fertilizer marketing company, and are expected to rise to six million tonnes in 2025. EMPHCO is currently forecasting 1.2 million tonnes of phosphate rock exports from Egypt in the year's first quarter.

Misr Phosphate produces around five million t/a of phosphate rock from its Abu Tartour mine, located about 50 kilometres west of El Kharga City, the capital of the New Valley Governate. The new fines removal unit at the site is expected to ramp up to 2,000 t/d capacity in the second quarter.

INDIA

Casale to convert Kakinada complex to green ammonia

AM Green has selected Casale as its technology partner for India's largest under-development green ammonia complex in Kakinada, Andhra Pradesh.

Casale will convert two existing 'grey' ammonia plants at the complex to produce 1,500 t/d of carbon-free ammonia instead. The green ammonia project has already reached a final investment decision (FID), placing Kakinada on track to become the largest green ammonia complex in India – and possibly the world – according to Casale.

To deliver the Kakinada project, Casale is combining its extensive experience in delivering revamping projects with its innovative FLEXIGREEN® suite of low-carbon technologies. Its scope of services includes the:

- Green ammonia license
- Basic engineering package
- Review of detail engineering
- Supply of proprietary equipment.

Casale is delivering the project as part of an international consortium alongside Technip Energies and John Cockerill.

Federico Zardi, Casale's CEO, said: "As we embark on this transformative journey with AM Green, we are immensely proud to leverage our expertise in executing revamping projects alongside our cutting-edge FLEXIGREEN® technology. This collaboration not only highlights our strong track record in revamping ammonia

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plants but also underscores our role as a leading partner in green ammonia technology."

Gautam Reddy K, AM Green Ammonia's CEO, said: "We are proud to partner with Casale on this groundbreaking project to transform our a previously fossil feedstock based grey ammonia plant into a renewable energy driven, one million tonnes per annum green ammonia complex in India – one of the largest in the world. This collaboration represents a pivotal moment not only for AM Green but also for India's progress towards reducing energy dependence and creating a decarbonised economy."

PARAGUAY

Hy24 plans $115 million Villeta project investment

ATOME has secured a non-binding agreement from Hy24 to invest $100-115 million in its flagship Villeta green fertiliser project in Paraguay.

The 260,000 t/a capacity Villeta project is the first of its kind in the Mercosur region (*Fertilizer International* 524, p31). The proposed investment would make Hy24 the lead equity partner in the low-carbon calcium ammonium nitrate (CAN) project.

The source of the investment is Hy24's Clean Hydrogen Infrastructure Fund, a world-leading asset manager for green hydrogen projects.

ATOME said the announcement was a "significant milestone towards the financial investment decision (FID)" in the Villeta project, with this decision currently expected during the first half of 2025. The plan is for Hy24 to make an advance equity payment of up to $5 million to ATOME between now and the FID, subject to predefined milestones being reached.

"This would mark Hy24's first direct investment into South America, further complimenting the rest of its portfolio throughout the world," ATOME said in a statement, adding that: "The project benefits from leading industrial partners including engineering contractor Casale and offtake partner Yara International."

Under the current timetable, a definite investment agreement between ATOME and Hy24 is expected during the second quarter of 2025. This is subject to pre-conditions, however, these including satisfactory completion of due diligence and the successful execution of binding offtake, EPC and lending agreements.

PHOTO: ATOME

ATOME's Chair Peter Levine (centre) and Hy24 CEO Pierre-Etienne Franc (right) meet with Paraguay's President Santiago Peña (left).

Olivier Mussat, ATOME's CEO, said: "We welcome Hy24, a worldwide leader in hydrogen private equity finance, as an anchor equity investor and are excited to bring the project to full financial close in the first half of this year. The Hy24 team has demonstrated deep industry expertise that will accelerate our project development."

Pierre-Etienne Franc, Hy24's CEO and co-founder, said: "This marks Hy24's first step toward a potential direct investment in the region through our Clean H2 Infra Fund. ATOME's Villeta project stands as one of South America's most advanced green fertiliser initiatives, driven by Paraguay's exceptional renewable resources, a highly experienced team that has effectively advanced the project's development, and strong offtake potential within the Mercosur region."

ATOME will maintain day-to-day management and operational responsibility for the Villeta project.

POLAND

Grupa Azoty launches new sulphur-enriched fertilizer

Grupa Azoty has started production of POLIFOSKA Multi S, a new sulphur-enriched multi-nutrient fertilizer, at its Police complex in Poland. The new product contains 23% sulphur.

This latest product launch is the latest addition to the company's expanding fertilizer product portfolio, alongside the likes of:

- megAN – a high-granule ammonium nitrate fertilizer
- RSM OPTIMA – a nitrate-urea solution with a distinctive light blue colour for ease of identification
- eNpluS – an ammonium fertilizer enriched with sulphur and calcium.

These four products have all commenced production in recent months.

"Expanding our product range this time with a multi-component fertilizer, we have formulated POLIFOSKA Multi S to be highly efficient. Its balanced nutrient composition not only promotes proper plant growth and development but also enhances crop yield quality—with notable economic benefits," said Hubert Kamola, Grupa Azoty's VP, adding: "I am convinced that we are introducing a fertilizer that will soon become one of the flagship products in Grupa Azoty Police's range,"

POLIFOSKA Multi S is water-soluble and contains the following plant-available nutrients: 7% nitrogen in ammonium form, 10% phosphorus, 20% potassium, 5% calcium, 1% magnesium and 23% sulphur in sulphate form.

The product is also enriched with silicon.

CHINA

Stamicarbon to revamp urea plant

Hulunbeier New Gold Chemical Co has selected Stamicarbon to revamp a urea plant in Hulunbuir, northeastern Inner Mongolia.

Stamicarbon will integrate its proprietary EVOLVE MELT MP Flash design, part of the company's NX STAMI Urea™ portfolio, at the plant as part of its revamp. This upgrade will increase the plant's urea production capacity by about 26% – to 3,600 t/d – while reducing high-pressure steam use by 15%.

BRAZIL

Mosaic sells phosphate mine for $125 million

The Mosaic Company has announced the sale of its Patos de Minas phosphate mine to Fosfatados Centro SPE Ltda.

Fosfatados Centro will pay Mosaic $125 million in cash for the mine over six years. It will assume responsibility for both the Patos de Minas mine and its tailings dams, once the transaction closes.

"This transaction aligns with Mosaic's strategy to scrutinize and monetize non-core assets and redeploy capital to high-returning areas, and we believe the full value of the Patos asset will be realized in the capable hands of Fosfatados Centro," said Karen Swager, Mosaic's EVP, Operations.

The transaction is subject to regulatory approval from the Brazilian Administrative Council for Economic Defense (CADE) and other conditions. ■

People

Sonya Little and **Kathleen Shanahan** joined the board of directors of The Mosaic Company in mid-January.

Ms Little is the former executive vice president (EVP) and chief administrative officer of Strategic Property Partners, the developer of Water Street Tampa, having worked at the company from 2019 until her retirement last year. Previously, she was the chief financial officer (CFO) of the City of Tampa and, prior to that, worked as a financial advisor and investment banker. Sonya is currently a director of Hancock Whitney Bank.

Ms Shanahan is a senior adviser and the former CEO of Turtle & Hughes, an electrical and industrial distribution company. She joined the board of Turtle & Hughes in 2015 and served as the company's CEO from 2020 until her retirement in 2024. Kathleen previously held CEO roles at both URETEK Holdings and WRScompass.

"We are pleased to add Sonya and Kathleen to the Mosaic board of directors," said Gregory Ebel, Mosaic's chairman. "They are both extremely accomplished professionals with broad executive experience and as long time Floridians, they will add great insight into our activities located in Mosaic's headquarters state of Florida."

The two appointments have increased the size of Mosaic's board to 12 directors.

Tom Snipes became Ostara's new CEO on 3rd February. His appointment brings decades of leadership experience and expertise in sustainable crop nutrition, the company said in a statement.

"Tom brings a valuable combination of agricultural experience and business expertise to Ostara. He has a track record of innovation and growth that will enable us to continue expanding our presence and product line," said Monty Bayer, the executive chairman of Ostara's board of directors.

PHOTO: OSTARA

Tom Snipes is Ostara's new CEO.

Most recently, Mr Snipes served as the CEO of Custom Agronomics. Prior to that, he was the CEO of Plant Response, a global biotechnology company specialising in nutrient use efficiency and plant immunity and physiology. Under his leadership, Plant Response grew rapidly, thanks to aggressive commercialisation and strategic acquisitions, successfully raised substantial funding and expanded its portfolio. Plant Response was subsequently acquired by The Mosaic Company in 2022 and is now part of Mosaic Biosciences™.

"The emphasis on sustainability, improving nutrient efficiency, and enhancing both plant and soil health has presented strong market opportunities for Ostara. The company has already built an incredible base of technologies, manufacturing capabilities, and customer relationships complimented by proven agronomic results globally. I'm excited about capitalizing on opportunities to drive the business to the next stage of growth," Tom Snipes said.

Gonzalo Avendano was appointed as a new independent director of Intrepid Potash in mid-January. He brings extensive experience in capital markets and business strategy to the company.

"We are pleased to welcome Gonzalo to our board," said Barth Whitham, the chair of Intrepid Potash. "He is a seasoned business leader with extensive knowledge of global investment markets. His industry experience along with his unique perspective as an investor will make him a valuable addition to our board."

Kevin Crutchfield, the CEO of Intrepid Potash, added: "Gonzalo's insights into evolving market dynamics and his commitment to driving value creation will play a crucial role as we continue to enhance our operations."

In connection with this appointment, Intrepid Potash has entered into a cooperation agreement with Clearway Capital Management.

Gonzalo Avendano, an investment advisor for Clearway, said: "I am pleased to join the Intrepid Board. Clearway owns approximately 9.1% of Intrepid and first purchased shares in Intrepid nearly a decade ago. As one of the company's largest shareholders, Clearway is focused on the long-term value of the company and I look forward to working constructively with my fellow board members and the management team to grow shareholder value."

The new appointment increases the size of the company's board to eight directors, seven of whom are independent, including Mr Avendano. ■

Calendar 2025

MARCH

31 MARCH - 2 APRIL

CRU Phosphates+Potash Expoconference 2025,
ORLANDO, Florida
Contact: Event Client Services
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APRIL

1-3

CRU Nitrogen+Syngas Expoconference
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1-3

IFA Cultivating Tomorrow,
BARCELONA, Spain
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30 APRIL - 1 MAY

New AG International Annual,
BANGKOK, Thailand
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Tel: +44 (0)20 8052 2011
Email: info@newaginternational.com

MAY

12-14

IFA Annual Conference,
MONTE CARLO, Monaco
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Email: ifa@fertilizer.org

JULY

1-2

IFA Global Markets Conference,
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PHOTO: CRU

FLA sunset reception hosted by BHP.

Fertilizer Latino Americano 2025

More than 1,100 attendees from 500 companies and 56 countries gathered at the Windsor Oceanico Hotel, Rio de Janeiro, 26-29 January, for the 2025 Fertilizer Latino Americano (FLA) conference. We present selected highlights from this year's four-day conference.

Record delegate numbers

CRU's Humphrey Knight formally opened the event on Monday morning. Acting as conference chair, he welcomed the 1,100+ registered delegates to Rio and Fertilizer Latino Americano 2025.

He confirmed that delegate numbers had exceeded the previous record set when CRU hosted the event in Rio in 2023.

"FLA is the fertilizer sector's curtain raiser event for the calendar year," Knight said. "On behalf of everyone at CRU, I wish you a truly successful FLA 2025!"

Potash hungry Brazil

The conference opened with a panel discussion on global fertilizer markets between:

- **Talita Arcaro**, Canpotex's Vice President Marketing, Latin America, Europe, and Africa
- **Motti Levin**, Haifa Group's CEO
- **Mario Suffriti**, Commercial Director, Profertil
- **Gustavo Daudt**, Ma'aden's Managing Director, Brazil

"Potash global shipments in 2024 are estimated at 72 million tonnes. And as a result of this increased demand we recorded price increases in the last month," said Talita Arcaro.

"We were able to reach new record [potash shipment] levels last year, with virtually all the important markets returning to help demand reach the levels seen in 2021," Arcaro said. "This was stimulated by product availability and good affordability – as potash today is underrated compared to nitrogen and phosphate."

"We start 2025 with strong demand in practically all regions of the globe," she said. "It also important to note that potash consumption grows the most, among all the nutrients, simply because it has been underapplied and therefore has the greatest potential for growth in the future."

When it comes to potash, Arcaro singled out Brazil for having more balanced fertilization compared to many other countries.

"Brazilian soils are very deficient in potash and application rates are quite high, even compared to our neighbours here in Latin America," she said. "The crops that we plant here, soybean and second crop corn, require a lot of potash."

PHOTO: CRU

CRU's Humphrey Knight, Principal Analyst, Phosphate & Potash, opened the event, acting as FLA conference chair.

Precision agriculture – a model for the future?

Haifa Group together with Netafim virtually created 'fertigation', according to Motti Levin, a method that combines water-efficient drip irrigation with the precise delivery of crop nutrients.

Israeli is a small, water scarce country the size of the US state of New Jersey with 60% of its land classed as desert. Yet its agriculture can act as a pathfinder for other crop-producing countries and help them overcome the challenges they face, suggested Levin.

"More than 90% of Israeli cultivated land is irrigated," he said. "We can become a pilot for much greater nations on how to adapt to precision agriculture and increase yields by minimising resources."

Summing up, Levin said: "The future is sustainable and regenerative farming. And when I'm talking about regenerative, we're talking about soil restoration, the capture of carbon and embedding it in soil, crop diversity, water conservation, and many other actions which can go hand-in-hand with agriculture and fertilizer production."

Boots on the ground in Brazil

In recent years, Ma'aden has invested heavily in production capacity to become the second largest phosphate fertilizer exporter in the world. It's a trend that's set to continue.

"Our current P_2O_5 capacity is around three million tonnes and we are actually on track to increase it by one million tonnes in the next few years," said Gustavo Daudt. "We are also the largest ammonia exporter with a dedicated fleet of eight vessels."

The company is expanding its global presence and ability to distribute fertilizers by establishing offices in India, Africa and now Brazil.

"We are expanding our offices around the globe – most recently our office in Brazil – with what we call, in a gentle way, boots on the ground," said Daudt. "The purpose of our offices is to get more information, to hear more about our customers."

While Brazil's monoammonium phosphate (MAP) imports fell year-on-year in 2024, according to Daudt, the country's total phosphate demand was unchanged.

"Overall, P_2O_5 imports in Brazil were pretty much stable compared to the previous year, even though we had a reshuffle between products," he said. "We had less MAP but more imports of SSP and other products."

The Latin American region remains a key export destination for the giant Saudi phosphate producer.

"Despite the challenges that 2025 brings, Brazil and Latin America are resilient and will keep growing, will keep expanding," summed up Daudt. "Looking back, you see Ma'aden exporting 20% of its production to Brazil during the last years – we've been keeping a constant flow of products to our customers, making ourselves a reliable supplier."

Fertilizers out of sync

In a two-hander, CRU's **Humphrey Knight** and **Charlie Stephen** took a deep dive into phosphate, nitrogen and potash fertilizer price expectations. They provided delegates with four key takeaways:

- Firstly, US tariffs are expected to impact on US fertilizer demand in the second half of the year – although their introduction remains a hypothetical scenario.
- Urea's first quarter price rally, meanwhile, won't last.
- While the current out of sync P & K price disparity will persist.
- Finally, novel energy transition uses – namely the LFP battery market – face early challenges outside of China.

"The more tangible takeaways are that fertilizer affordability is not so favourable at the start of 2025 as it was a year ago, with energy prices also in a similar situation," Knight said. "On the nitrogen side, the urea price rally will not last, particularly towards the end of this year when Chinese exports finally resume, while phosphate and potash prices remain extremely far apart – with only very modest changes to supply outlooks on the horizon."

PHOTO: CRU

The green ammonia discussion panel (left to right): João Braz, Chief Commercial Officer at Porto Do Acu; Mauricio Medici, Stamicarbon's Licensing Manager/Area Sales Manager; Knut Karlsen, Co-Founder and President South America, Atlas Agro; Terje Bakken, Atome Energy's Head of Ammonia and Fertilizers.

Businesses, not charities

The day's second panel discussion covered the outlook for green ammonia projects and new production technologies with:

- **Mauricio Medici**, Stamicarbon's Licensing Manager/Area Sales Manager
- **Terje Bakken**, Atome Energy's Head of Ammonia and Fertilizers
- **João Braz**, Chief Commercial Officer at Porto Do Acu
- **Knut Karlsen**, Co-Founder and President South America, Atlas Agro

Terje and Knut, the two speakers from green ammonia projects, were keen to emphasise that their business models did not depend on subsidies to be competitive.

Knut Karlsen addressed the issue of higher costs and green premia head on:

"There is no doubt that producing green hydrogen and their derivatives, green ammonia and green nitrogen fertilizers, is more expensive. Yes, we know that. So, the question is, how do you then become competitive?

"Well, the way we do it is to position our plants in import markets where there is a high logistical cost for the 'grey' conventional alternative. That's why Uberaba in Brazil was primarily chosen as Atlas Agro's project site, because the cost of importing fertilisers can reach up to almost 50% of the total product cost.

"Yes, we have high costs through green hydrogen electrolysis. But, by being next to farmers, we avoid the logistical costs and, in that way, we can compete directly with a grey product."

The cost increase for food consumers from the switch to green fertilizers – for foods such as processed potatoes and bread – should in any case be limited, suggested Terje Bakken:

"There have been interesting analyses showing that it can be done with a mere 1% additional cost. We are not talking about dramatic changes to make a very concrete impact – so I think, in the end, the retailers, the food majors and the consumers will want to see that change.

"Will there be a higher price for carbon-free foods – yes, there will be. How much of a higher price?

"Well, I think we can do a lot to offset extra costs by focusing on fertilizers with better nutrient use efficiency like calcium ammonium nitrate (CAN). In that way, we'll also make the consumers and the retailers, the packaged goods companies, desperate to make changes – because they need to show that they are part of the future."

Summing up, Knut Karlsen said cost was not really the issue anyway:

"The elephant in the room is not really the cost. It's can you finance it?

"We can be cost competitive, we will be cost competitive. In addition, we'll have green premiums.

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"There is actually a lot of opportunities to get green premiums. We're having very good negotiations with financiers, with packaged goods companies, to pay a green premium, because this is not about planting trees, it's about direct cuts to CO_2 emissions in their value chain.

"But that is not enough. You need to de-risk cashflow in the long term – and the main way of doing that is through green fertilizer off-takes."

Interested in learning more? Atlas Agro, Atome, Casale and Stamicarbon all spoke to *Fertilizer International* magazine about their green ammonia ambitions in our January/ February magazine (*Fertilizer International* 524, p31).

A modern twist on an ancient innovation

Latin America's specialty fertilizer market was the theme of **Vatren Jurin**, DunhamTrimmer's Chief Technology Officer.

DunhamTrimmer class these products as value-added fertilizers (VAFs), with foundational, functional and enhancing components, as he recently explained in a companion article in the conference edition of *Fertilizer International* magazine (*Fertilizer International* 524, p28).

VAFs are nothing new, suggested Jurin. Ancient civilisations used seaweed in their agriculture, for example.

"So, it's a way that you really bridge ancient wisdom with modern science," he said. "The use of biostimulants really honours agricultural heritage – learning how to use waste is nothing new, you know."

VAFs represent a $19.3 billion market globally, according to a new DunhamTrimmer report published this month, a sizeable market that's growing at between 6-7% annually. Regionally, Latin America is the VAF market's jewel in the crown, being valued at $3.2 billion with applications to 130 million hectares of cropland.

"The success of VAFs in Latin America demonstrates that innovation doesn't announce itself with a fanfare," said Jurin.

The value-added fertilizer segment is sizeable too, now representing almost one tenth of the total crop nutrient market, according to DunhamTrimmer.

"It's about 8.5 to 9 percent of the global fertiliser market," summed up Jurin. "Compared to the 200 plus billion dollar fertilizer market, we're under 20 billion, you know, but it's growing and a very interesting and profitable area."

US farmers face inflation risk

Jason Newton, Nutrien's Chief Economist, in his presentation on fertilizer demand drivers, highlighted five themes – with these encompassing geopolitical risks and trade disruptions, the tight global grain supply, Chinese export restrictions, the global potash supply/demand balance, and Brazilian ag trends.

"I had the opportunity to speak at this conference last year. As we start 2025, all of those geopolitical risks that existed in 2024 are still in place – and there's actually some additional risks and uncertainties," Newton said.

He included ongoing global conflicts, namely those between Russia and Ukraine and others within the Middle East, as part of the current mix of trade and armed disputes. "Overall, all trade disputes create uncertainty and the potential for supply disruption and price collapse," Newton said

US protectionism, particularly the prospect of tariffs on US imports, promises to be a source of uncertainty in the coming months and years, suggested Newton.

"That likely leads to inflation for US farmers across their inputs – fertilizer and crop protection will be two that are impacted. At the same time, because of the importance of US agricultural exports, any type of retaliation from other countries is likely to target agriculture – so farms could get impacted on the crop side as well," he said.

Nutrien's estimate for Brazilian fertilizer imports in 2024 is 38 million tonnes, up by two million tonnes on the previous year The country has become an ever bigger player in global fertilizer consumption due to rising demand from domestic soybean and corn farming. Combined, the cultivation of these two crops has been expanding at around 1.5 million hectares annually, rising from 45.9 million hectares in 2013 to 69.6 million hectares in 2024.

"To wrap up, I'd say we've entered 2025 in relatively tight agriculture and fertilizer market conditions and a really positive outlook, as we look towards demand in the first half of this year, with both Brazilian planting and northern hemisphere grain planting. But with potential for volatility driven by supply disruptions and potential geopolitical uncertainties," Newton concluded.

PHOTO: CRU

Alzbeta Klein, CEO, International Fertilizer Association (IFA), praised start-ups as engines of innovation.

Region of pressure, region of promise

Alzbeta Klein, the CEO of the International Fertilizer Association (IFA), focused on AgTech start-ups as engines of industry innovation in her keynote presentation. "There is a need for innovative plant nutrition, a need that's never been more than today," she said.

More efficient fertilizer use is vital, Klein said, given that the fertilizer industry underpins global food security. Yet around half of the nitrogen applied as fertilizer globally is lost to the environment, she noted, including as greenhouse gas emissions.

"Latin America is a region of promise, a region of pressure," Klein said, with just five countries providing 90% of global calories. "In Brazil, we stand in one of those countries," Alzbeta said.

On agricultural technology, Brazil is blazing the trail.

"There are 1,500 AgTech start-ups in Brazil – it's dynamic, it's growing," Klein said. "Start-ups in the region are growing at 15.8% annually."

Latin America has an unparalleled opportunity to lead on sustainable agriculture due to it's thriving start-up ecosystem, in Klein's view.

"How do we realise the potential we're seeing in Latin America? Firstly, public-private partnerships. Secondly, incubation of new technologies. The next one is R&D," summed up Klein.

US tariffs good news for Brazil?

Daejin Lee, Global Head of Research, Fertistream Freight, provided a world freight outlook. Dry bulk shipments grew by 3.9% year-on-year in 2024, according to Fertistream.

Looking ahead at Brazil's fertilizer needs, Lee said: "In 2025, the seasonality of Brazilian bulk fertilizer imports should see freight rates recover after early corrections."

Brazil's grain exports should also be favoured in the second quarter of 2025, if the US acts as promised and introduces tariffs on Chinese goods. "That's good news for Brazilian grain and Brazilian fertilizer [imports]," Lee said.

In general, his view is that: "Whatever you look at [in the shipping market], look at the incentives and motivation." This philosophy applies to market trends as diverse as Red Sea re-routing and use of green ammonia as a shipping fuel.

"The Red Sea route should come back to normal by the end of the year," said Lee, "as the Trump administration has the incentive to bring it back."

Gulf of Aden shipments were down 74% in December 2024 versus December 2023, although transits are now likely to recover, given the Gaza ceasefire, Lee suggested.

Nutrient nightmares

Long time FLA speaker, **Dr Luis Prochnow**, Director General of the NPCT, gave a typically forthright and insightful presentation on FLA's last morning:

"It's a little bit of a polemic. After 50 years in the industry, I will tell you what keeps me awake about crop nutrition."

Dr Prochnow is being denied sleep by a combination of misleading information, pseudoscience, a lack of vision, questionable product options, and inefficient soil and fertilizer management.

"Misleading information – I'm very worried by this. We have lots of information in our environment. But the truth is not easy to find," he said.

Pseudoscience was particularly problematic, according to Dr Prochnow, because it cherry picks. "Science considers all information, pseudoscience selectively presents information," he said.

More visionary ag industry leadership was also necessary, Dr Prochnow suggested.

"Certain countries do not understand that their capability and vocation is for efficient agriculture. This includes the transformation of agricultural products," he said.

Dr Prochnow called for more respect for the evidence too.

"No matter what, plants should have the final say. Environmental and economic evidence holds the key," he said.

Summing up, Dr Prochnow said: "[In future], we will need evidence-based agriculture and knowledgeable and well-informed professionals. We will need robust evidence that comes from sound science."

That was his personal prescription for a much better night's sleep! ■

PHOTO: CRU

Dr Luis Prochnow, Director General, NPCT, explains what keeps him awake at night.

RIO CONFERENCE DIARY

PHOTO: CRU

The CRU Communities FLA conference team delivering another successful event.

Simon Inglethorpe, editor of *Fertilizer International*, gives his personal impressions of this year's Fertilizer Latino Americano conference.

Most successful year ever

Firstly, 2025 has demonstrated to me that FLA is not just front running, it is *the* crop nutrient event for the Latin American region. The surge in delegate numbers we've seen this year show that – and have cemented FLA's status as a must-attend conference.

Bellwether region that sets the tone

Secondly, as we heard from **Jason Newton**, Nutrien's chief economist, Brazil is becoming ever more important as a fertilizer demand market, due to the seemingly inexorable annual rise in soybean and corn cultivation.

This means, now more than ever, that the country and region act as a bellwether for the wider health of the global fertilizer market. Consequently, FLA is uniquely positioned and timed to offer up key insights and intelligence on this pathfinder demand centre.

Essentially, the conference acts as an insightful scene-setter at the very start of the year. Its popularity reflects that in my view.

Leadership on ag innovation

Thirdly, the region is now taking on a leadership role when it comes to both innovation and sustainability. **Alzbeta Klein**, IFA's CEO, praised Brazil for its remarkable cluster of 1,500 AgTech start-ups for example. While **Vatren Jurin**, partner at DunhamTrimmer, highlighted Latin America's quiet revolution in value-added fertilizers and its role as a biostimulants trailblazer.

Overall, if you want to understand how the fertilizer industry will adapt to the challenges it faces – on ag productivity, extreme weather, decarbonisation – then Latin America is a very good place to start.

On behalf of my hardworking CRU colleagues, I would like to thank all our delegates, exhibitors and sponsors for contributing to the success of this year's conference. ■

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PHOTO: ICL

Brazil survey signals market optimism

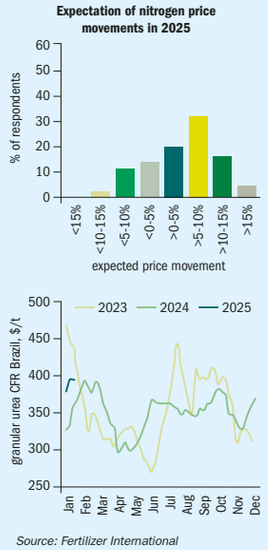
Brazil is the world largest soybean producer. The country is a fertilizer market bellwether, importing and consuming huge volumes of crop nutrients to support its status as an agricultural powerhouse.

Fertilizer International conducted its inaugural Brazil Fertilizer Market Sentiment Survey at the recent Fertilizer Latino American (FLA) conference in Rio de Janeiro. The results, says **Chris Lawson**, CRU's Head of Fertilizers, point towards an optimistic outlook for 2025 markets in Brazil and beyond.

Price rises expected to continue

The survey began with questions on expectations for price movements in 2025. Nitrogen, phosphate and potash markets have started the year with upwards momentum, and this was reflected in the results.

Fig. 1: **Nitrogen prices expected to increase**



Source: Fertilizer International

Urea prices have surged so far in 2025 (Figure 1, bottom), on the back of supply shortfalls in Iran and strong demand, with key importer India tendering. More than half of survey respondents expected price rises of more than 5% for the year. Opinion was weighted to the mid-range, with price increases of 5-10% attracting 32% of votes (Figure 1, top).

Phosphate price movements have been spectacularly unspectacular since mid-2024 (Figure 2, right). Price volatility has been non-existent, despite demand concerns given the relatively high valuation of phosphate compared to nitrogen and potash. With a lack of supply relief in the pipeline, prices are expected to remain firm in 2025, and this sentiment was echoed in the survey results, with 36% of respondents expecting price rises of 0-5% for the year (Figure 2, left).

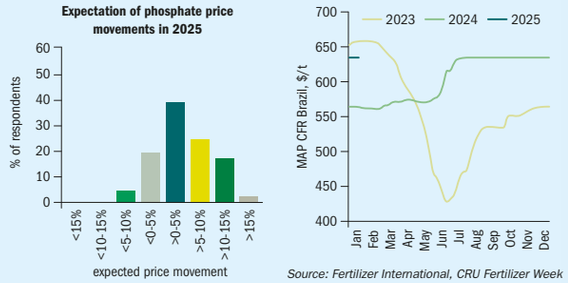
Potash prices plummeted through 2023, following the highs of 2022, and remained low in 2024. Still, markets have picked up some recent momentum, increasing more than $20/t since mid-December last year (Figure 3, bottom). The consensus view is that potash prices have found a floor, and this was reflected in the survey, with 77% of respondents predicting price rises this year, with the majority pegging gains at 0-5% (Figure 3, top).

Demand supported by robust agricultural growth

Latin America continues to be the most reliable source of demand growth for the fertilizer industry. With Trump 2.0 and tit-for-tat trade wars on the horizon, Brazil stands to benefit and become an even more important agricultural commodity exporter. While the macro factors are positive for fertilizer demand, survey respondents struck a more cautious tone, with 70% expecting steady demand in 2025. And 27% said they expect strong demand, leaving just 3% expecting weak demand (Figure 4, top). CRU forecasts nitrogen and potash demand growth of 3% year-on-year in 2025, with phosphate growth at 1% year-on-year (Figure 4, bottom).

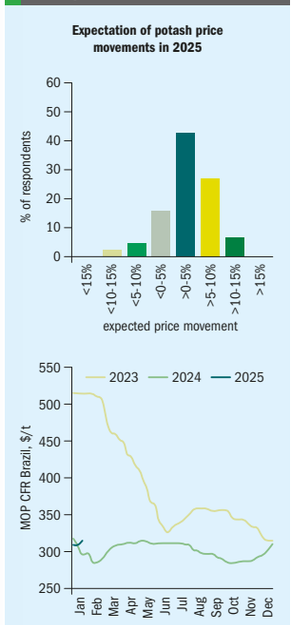
While demand is expected to increase, no major shift in inventories is expected, reflecting confidence in the market being adequately supplied (Figure 5).

Fig. 2: **Phosphate prices will remain high after flatlining for six months**



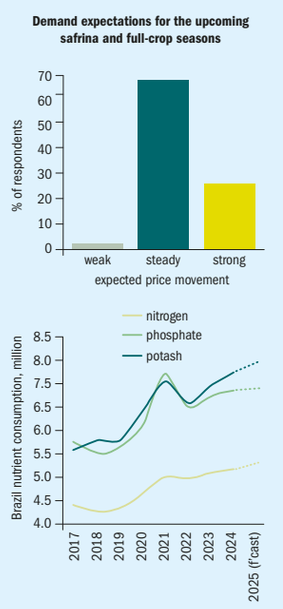
Source: Fertilizer International, CRU Fertilizer Week

Fig. 3: **Modest gains for potash prices**



Source: Fertilizer International

Fig. 4: **Survey respondents more cautious on 2025 demand growth prospects**



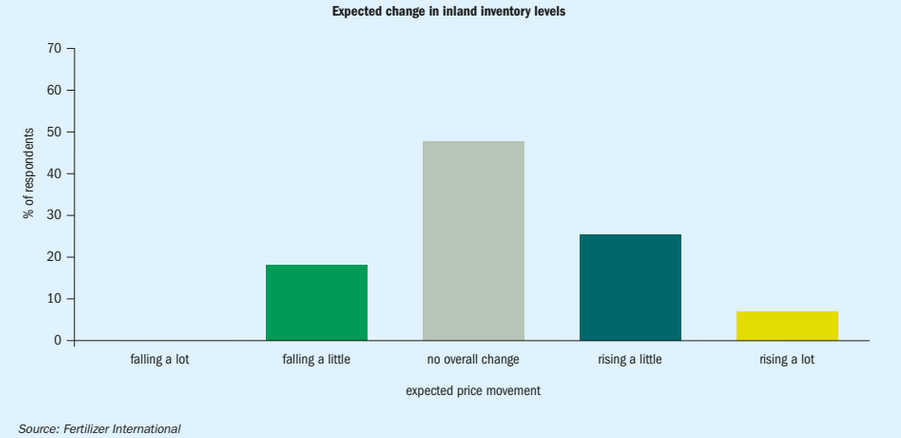
Source: Fertilizer International

Biological and value-added fertilizers are on the up

Latin America is famed for its agricultural innovation. This is evident in the growth of specialty, biological and value-added fertilizer products across the region, particularly Brazil. While 66% of respondents expected more biological products over the long term, 56% said they expected little change in 2025 (Figure 6).

Similar results were observed for specialty/value-added fertilizer products. Some 66% of respondents expected a positive shift over the long term, with 53% also suggesting higher applications in 2025 (Figure 7).

Fig. 5: **No major drawdowns in inventories anticipated**



Source: Fertilizer International

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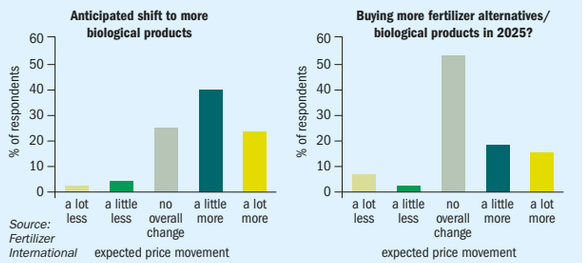
Fig. 6: **A shift to biological products over the short and long term**



Source: Fertilizer International

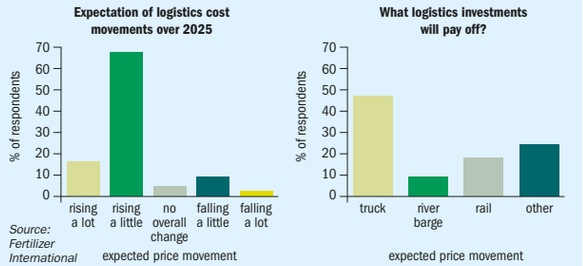
Logistics and investments surprisingly resilient

High inland logistics costs have long plagued the efficiency of the Latin American – and more specifically the Brazilian – fertilizer market. In our inaugural survey, 68% of respondents expect logistics costs to rise modestly in 2025 (Figure 8, left), while 48% believe the investments in trucks, rather than barges or rail, will provide the best returns (Figure 8, right).

The price shocks of 2022 triggered reactionary measures from governments across the globe to invest in fertilizer supply. This was particularly the case across Latin America, with urea facilities and projects dusted off thanks to government support. 42% of respondents were neutral on the success of these investments (Figure 9, left). We had anticipated more pessimism, given the long history of failed government-backed projects.

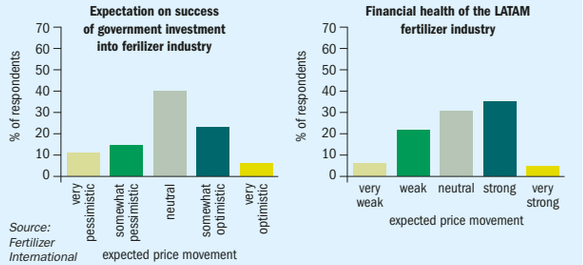
When surveyed on the financial health of the Latin American fertilizer industry, there was no dominant response. Given the financial hardships experienced across the agricultural input industry over recent years, we had anticipated more responses at the weaker end of the scale. However, 36% of respondents considered the industry to be in good financial health (Figure 9, right).

Fig. 8: **Logistics costs expected to rise, trucks provide the best value investment**



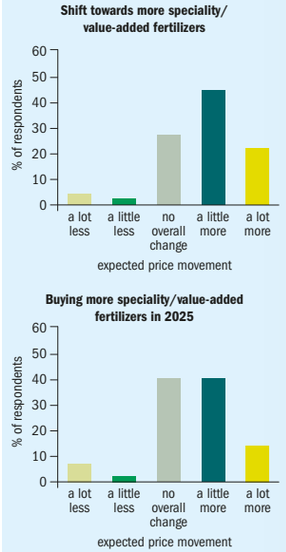
Source: Fertilizer International

Fig. 9: **A neutral outlook for government investments and surprisingly strong financial health**



Source: Fertilizer International

Fig. 7: **Positive demand outlook for specialty and value-added products**



Source: Fertilizer International

Unique insights from a unique partnership

Fertilizer International – a magazine with a 55-year heritage – is now part of the CRU family. Combining complete coverage of the global fertilizer industry, from factory to farm gate, with in-depth technical expertise and market insights, our new website provides great value to a growing online community.

To become a subscriber or sign up for a free trial, please visit www.bcinsight.crugroup.com/subscribe/

Note: CRU surveyed 51 FLA delegates.

Begg Cousland – more than 70 years in the making

In this exclusive interview, *Fertilizer International* sat down with **Graeme Cousland**, Managing Director, and **Martyn Dean**, Sales Director, Begg Cousland Envirotec Limited, ahead of the CRU Phosphates+Potash Expoconference in Orlando at the end of March.

Introduction

Begg Cousland Envirotec Limited has long-standing experience in the manufacture of both:

- Knitted wire, mesh pad type demisters
- Fibre bed type candle filters.

The company combines this with in-depth expertise in solving wet gas cleaning problems across a variety of industrial applications. In many cases, this includes designing and supplying complete filtration systems as a turnkey package, as well as tailoring mist eliminators to address particular customer problems.

Quality has always been of paramount importance to Begg Cousland. Its products are manufactured under direct control according to strict quality procedures. Key market applications include, but are not limited to:

- Chemicals production, e.g. fertilizers, process chemicals and petrochemicals
- Non-ferrous metals smelting off-gas treatment
- Pharmaceuticals production
- Electronics industry
- Oil & gas production
- Pulp & paper industry.

Fertilizer International sat down with the company's leadership team, Graeme Cousland (GC) and Martyn Dean (MD) in February for an in-depth discussion about dust and emissions control and scrubbing technology.

PHOTO BEGG COUSLAND

Martyn Dean, Sales Director (left) and Graeme Cousland, Managing Director (right), Begg Cousland Envirotec Limited.

Proudly Scottish, internationally focused

Graeme and Martyn, it's a privilege to have the opportunity to speak to you both today. **Begg Cousland has been in business for many decades, can you provide our readers and CRU conference delegates with a brief overview of this proudly Scottish but internationally focused manufacturing and export business, its origins and its involvement in the fertilizer industry?**

GC: Begg Cousland has a history going back 170 years. It was in the 1950s when we changed, from only being wire weaver, to making a variety of wire products and started knitting wire to make demisters.

"So that was the point at which we got into mist elimination and then in the 1960s we added the fibre bed technology, so we were able to catch smaller mist and not just droplets, and from the 1970s onwards those products became the main turnover, main income for the company.

"In the 1980s, we started adding gas scrubbing, gas cleaning technology, so we could sell these package systems to the fertilizer industry, other industries as well. After 2012, the company became Begg Cousland Envirotec which has now been running for 12-13 years.

"In the introduction you very correctly

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PHOTO: BEGG COUSLAND

Begg Cousland Envirotec staff outside the company's Glasgow office and HQ.

mentioned quality – that's always of paramount importance – but I would also add process knowledge too. What has also been of paramount importance, since the 1960s, is that we didn't just make or copy something, we actually built the process knowledge which is still here today – and it's understanding processes that allows us to solve customer problems better."

> **"We have a unique rotary brush scrubber called the Becoflex. It's a modified ventilator with a brush that can do mass transfer and de-dusting in one step – and it can be used with dryers, pre-dryers, conveyors and at the back end of granulators."**

MD: "We're not just a products company, you know. Yes, many of our competitors do just sell product. But we sell product and service and knowledge – and that comes as a package.

"Begg Cousland now exists as Begg Cousland Envirotec, the sales, marketing and engineering arm in the UK, and we have a daughter company Begg Cousland SRL that does all the manufacturing in Italy nearer to market demand – which is in Europe and globally.

"We've still got highly experienced process engineers within our UK sales and marketing team, and we've actually improved the manufacturing quality by moving to Italy in 2015. Our new large factory there is in a very good stainless-steel fabrication and machine building area."

MD: "Because of Brexit, Simon, more by accident than design, we had the two companies and very quickly pivoted manufacturing and started taking orders directly into Italy. Having the two companies, one foot outside of Europe and one foot inside Europe, has been highly beneficial for the business."

GC: "We've also had a licensee in China for more than 24 years – a strong relationship which has been our foundation in that country. They manufacture for the Chinese market and for products included in EPC supplies by Chinese contractors outside of China. And for the last 10 years there's also been a production facility in India for their domestic market as well."

Unique product offering

Begg Cousland is well known throughout the industry as a manufacturer of high-quality demisters and candle filters. **What's so special about the company's two product ranges and what do they offer the nitrogen and phosphates industries and sulphuric acid producers?**

MD: "In mist elimination, it's actually more than two product ranges – we have demisters, coalescers, candle filters etc. When you move into nitrogen fertilisers, yes, you can incorporate these mist elimination products – it could be ammonium nitrate filters, for example, going back to the early days of Hydro Supra (Yara) – but the focus is more likely to be on gas and dust scrubbing.

"We have bespoke engineered processes for prilling towers, a unique rotary brush scrubber called the Becoflex. It's a modified ventilator with a brush that can do mass transfer and de-dusting in one step – and it can be used with dryers, pre-dryers, conveyors and at the back end of granulators."

"This rotary brush scrubber is unique to the marketplace. It's very flexible, self-cleaning, less prone to fouling and it lends itself to the phosphate industry as well, where there's a lot of sticky components.

"The Becoflex is niche but liked by a lot of EPC contractors and end-users and also has nitrogen fertilizer applications as well. I mean, there's 12 of these units in and around the dryers and pre dryers at a big explosives-grade ammonium nitrate complex in Australia, for example.

"Then, in a partnership with a Belgian company, we do crossflow scrubbers with structured mesh packings. These do the de-dusting first and then do mass transfer, by optimising performance with different mesh apertures."

GC: "You would also use a crossflow scrubber for phosphoric reactor fumes, for example."

MD: "Actually, we can offer rotary brush scrubbers, venturi scrubbers or crossflow scrubbers – or a combination of all the above.

"Then you have crossflow scrubbers for FSA – the big markets for that are Morocco and Saudi Arabia. Any kind of phosphate rock you attack you're going to produce fluorine. Silicon tetrafluoride will break down to HF and you produce fluorosilicic acid (FSA) as a result.

"Depending on what process is used, we can also remove HF or ammonia with conventional packed bed scrubbers. Each Customer is different, each application is different."

> **"We draw on all of our experience and like to see ourselves as service providers, rather than as an equipment supplier – you get that service along with the equipment."**

GC: "We've just got a new order for internals for a cross-flow scrubber in India. For us, everything's customised. Yes, we have our 'most common' products, but we don't have a standard product."

Well positioned for the future?

What changes are Begg Cousland observing in the fertilizer industry – particularly in terms technological innovation and advances?

GC: "We want to put the Becoflex brush scrubber that Martyn talked about in combination with a crossflow scrubber Because it would be able to remove more dust more efficiently and with less liquid – rather than simply belting it with showers of water at the inlet to the cross-flow scrubber – so it would have energy savings and effluent savings."

MD: "A lot of the cross-flow scrubbers, Simon, have a venturi that uses maybe 5-6 times the amount of liquid as a spray at pressures of 3.5-4.5 bar. Whereas our Becoflex uses 15-20% of the liquid at 0.5 bar – so you've got the energy saving straight away with less liquid and lower motive pressure.

"The Becoflex moves the air as well – because you always need a fan. It's not as efficient as a standard ventilator, but it's 65-70 percent efficient. So, you you've got all these benefits and the opex is less."

GC: "For sulphuric acid plants, we developed two innovations in conjunction with Outotec, now Metso. The first was a wetting system for candle filters developed for two different reasons.

"Firstly, to be able to absorb sulphur trioxide during plant start-up to abate start-up fumes – which could last for eight hours or more. Secondly, to deal with NOx problems, by helping solubilise crystals which, if they form, reduce the capacity of the plant and use more energy. So, this was a double-edged problem-solving solution."

MD: "We've done candle wetting systems for a long time, but this one was a bit more unique. Instead of having a spray nozzle, at the top or the bottom, it's like an annular ring where you introduce the liquid directly into the fibre bed – which also has benefits.

"We've actually reversed engineered this into a lot of systems which were using spray nozzles. Because introducing uniform liquid into the fibre bed is a far more efficient way to wet the filter."

GC: "The second thing we developed with Metso Outotec was a vertical demister system. This meant you could install and remove the demister panels through the roof of the tower – so nobody needed to go inside the tower.

"So, this was a safer design without loss of performance that also saved time – to be able to change the demister in hours rather than days. Quick is also important to a customer in Southern Africa with one of these systems, because of the dirty environment, the demister blocks within about six months. They can now change this demister quickly without having to have a big shutdown or restricting their production for long periods."

MD: "We've evolved over the years so if environmental regulations change, we change the approach."

CRU Phosphates+Potash Expoconference

Based on attendee feedback, last year's CRU Phosphates event in Warsaw was one of the most popular and successful in the conference's history. **What is Begg Cousland hoping to achieve when the phosphate and potash industries convene again in Orlando near the Lakeland phosphate district at the end of March?**

GC: "It's a perfect place to keep building our relationship with the major players who are in the Lakeland area and will anyway be at the conference. We would like to push some of our equipment and technologies more into the North American market."

MD: "Geographically, it's quite fortuitous as it's near Lakeland. There are ongoing projects and people we met in Warsaw last year – so it's natural for Begg Cousland to stay onboard and go to Lakeland.

"A lot of the main players will be there. The whole Lakeland area is a hotbed of people that are in the phosphate industry.

"It's about catching up. There'll be people there we don't know, or a new project we don't know about – we attend for the market intel as well."

A leadership double act

Graeme and Martyn, I've known you both since joining the industry in 2015. **I think people are interested in your successful long-term business partnership – and why that works so well to the benefit of the company.**

MD: "We've consciously changed the company dynamic so that the majority of our process engineers are focused on customer support. We draw on all of our experience and like to see ourselves as service providers, rather than as an equipment supplier – you get that service along with the equipment.

"We're also smaller, more dedicated, not part of a multinational that just pushes product, product, product. That has its benefits since we can react a lot quicker – you don't have to go through layers of bureaucracy."

GC: "With our 70 years of mist elimination, we have customers today who have been customers over the 70 years. It's repeat customers coming back – which is a reflection of the company's reputation, customer support and quality. That remains at the core of what we do, as is the fact that, with Martyn and I together, it's a small team making quick decisions." ■

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Casale – leading the green fertilizer revolution

Casale's technologies, by transforming hydropower into green fertilizers, are helping ATOME's Villeta project revolutionise the future of agriculture in Paraguay. This Latin American venture combines innovation with solid engineering and the very highest standards in project execution, as **Francesco Baratto**, the Head of Casale's Syngas Department, explains.

Introduction

As the world irreversibly pivots towards low-carbon energy and industrial sustainability, the need for 'green' solutions in food and farming have also become a priority. Conventionally, fertilizers – while essential for boosting agricultural productivity – have been produced using energy-intensive methods that rely on fossil fuels and generate greenhouse gas (GHG) emissions.

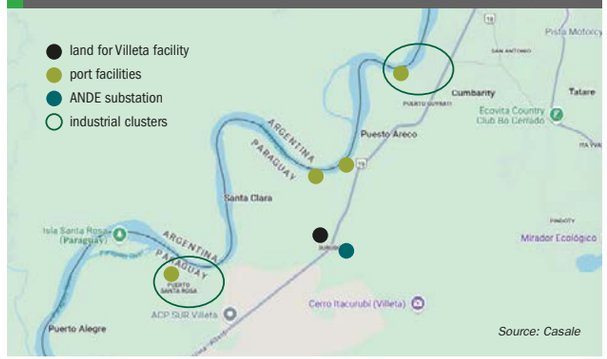
Against this backdrop, the Villeta Green Fertilizer Project (GFP) in Paraguay represents a step change in fertilizer industry sustainability – capturing renewable energy and transforming this into zero-carbon fertilizers using innovative technologies.

The Villeta project, located 35 kilometres from Asunción along the Paraguay River, will establish a world-scale green fertilizer production plant using Paraguay's abundant hydropower. The project is designed to meet both domestic and international fertilizer demand while significantly reducing GHG emissions, offering an exemplary model for sustainable industrial development.

IMAGE: CASALE

The ATOME/Casale project team at the Villeta Green Fertilizer (GFP) project site in Paraguay.

Fig. 1: **The Villeta Green Fertilizer Project (GFP) is located in Paraguay, 35 kilometres from the capital city of Asuncion on the River Paraguay**



Source: Casale

Paraguay – a land of opportunities

Paraguay is uniquely positioned to lead the green energy revolution. With nearly 99% of its electricity derived from renewable sources, primarily from the Itaipu Dam, Paraguay boasts one of the world's greenest energy profiles. The country uses only 30% of its 50% share of Itaipu's electricity,

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leaving a significant surplus available for industrial development.

Agriculture is the backbone of Paraguay's economy, employing approximately 20% of its workforce. The nation is a leading sugar, stevia, and soybean exporter with its thriving agricultural sector driving substantial domestic fertilizer demand. Ag commodities, as well as supplying the domestic market, are vital for international trade, particularly with neighbouring Brazil and Argentina.

The demand for fertilizers in Paraguay is driven by the need to maintain and increase agricultural productivity. Ultimately, agricultural sector growth is also determined by fertilizer availability, given the strong linkage between fertilizer use and crop yields.

Fertilizers are essential for replenishing soil nutrients and supporting the cultivation of crops with high nutrient demand like soybeans and stevia. The Villeta Project, due to Paraguay's strategic location, is well-positioned to serve both domestic fertilizer needs and the larger South American market – helping to guarantee regional food security by reducing dependency on imported fertilizers.

Villeta Green Fertilizer Project – the fundamentals

Spanning a 75-acre site in a designated free-trade zone, the Villeta project will produce green fertilizers using 100% renewable baseload electricity. Its location is ideal logistically, offering proximity to the river and the capital city with easy access to import and export routes. These excellent logistics – by enabling the efficient transportation of raw materials and finished products – are a major contributor to the project's economic viability.

The Villeta Green Fertilizer Project is notable for the following key features:

- A 145MW power purchase agreement (PPA) with ANDE
- Advanced and efficient production technology capable of producing more than 250,000 tonnes per year of calcium ammonium nitrate (CAN)
- Zero-carbon production processes powered entirely by hydropower.

This world-scale green fertilizer plant aligns with global efforts to decarbonise agriculture while also contributing to economic growth in Paraguay. The project, by capturing and monetising Paraguay's surplus hydropower, addresses the environmental impacts associated with traditional fertilizer production, making it a model for sustainable industrial development.

Key project partnerships

The Villeta project brings together a consortium of top level international and domestic partners:

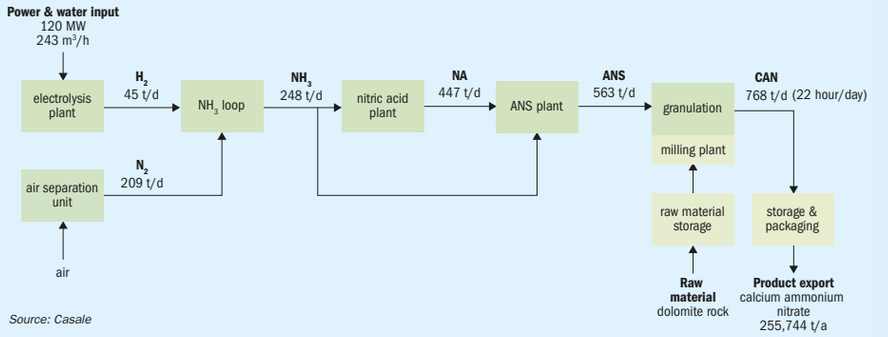
- **ATOME** is a leading UK-based green fertilizer project developer listed on the London Stock Exchange. It is spearheading the project alongside a global pipeline of other green energy ventures with a total capacity of more than 600MW.
- **Casale** is implementing the project's cutting-edge green fertilizer production solutions. The century-old engineering firm is renowned for its expertise in ammonia and fertilizer production technologies. The collaboration between Casale and ATOME began in 2022 with the award of the basic engineering design contract for the Villeta project's green ammonia synthesis loop. Subsequently, the scope of Casale's project work has expanded beyond engineering design to encompass the licensing of all core technologies — for ammonia synthesis, nitric acid, ammonium nitrate solution (ANS), nitrate granulation — and, most recently, providing all the necessary engineering, procurement and construction (EPC) services required to bring the entire project to completion
- Paraguay's national electricity authority **ANDE**, as renewable energy provider, is the project's backbone.
- **Inter-American Development Bank (IDB)** acts as the project's international financial advisor, providing financial stability and credibility while ensuring project objectives align with sustainable development goals.

Collectively, these partner companies, by bringing a wealth of expertise and innovation to the project, should ensure its success and sustainability.

Technology and processes

The Villeta project stands out for incorporating advanced technologies designed to ensure high efficiency, sustainability and scalability (Figure 2). The project's main technological pillars are outlined below.

Fig. 2: **Block flow diagram for the Villeta Green Fertilizer Project**



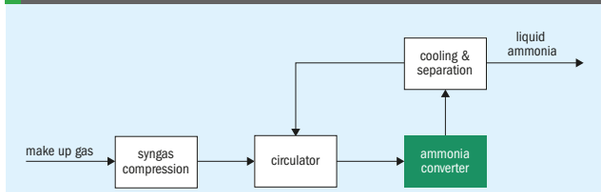
Source: Casale

Hydrogen production

Hydrogen, a cornerstone of green ammonia production, will be generated using alkaline electrolysis (AEL) technology with the following key benefits:

- **Proven track record**: Alkaline electrolysis is a mature and reliable technology with over 100 years of industrial application.
- **Efficiency challenges and mitigation**: While AEL has a relatively low efficiency (approximately 5 kWh/Nm³ of H_2), its robustness and cost-effectiveness ($700–1000 per kW) make it suitable for large-scale applications.
- **Scalability**: Modular designs enable rapid scaling to meet the project's substantial hydrogen requirements (1,876 kg/h production rate).

Fig. 3: **At the core of the Smart-N ammonia synthesis scheme is a converter which incorporates Casale Axial-Radial® technology**



Source: Casale

Nitrogen production and ammonia synthesis

Nitrogen, another critical input for ammonia synthesis, will be supplied by a cryogenic air separation unit (ASU) with the capacity to produce 8,712 kg/h of nitrogen. The ASU provides a steady and high-purity nitrogen supply for continuous plant operations.

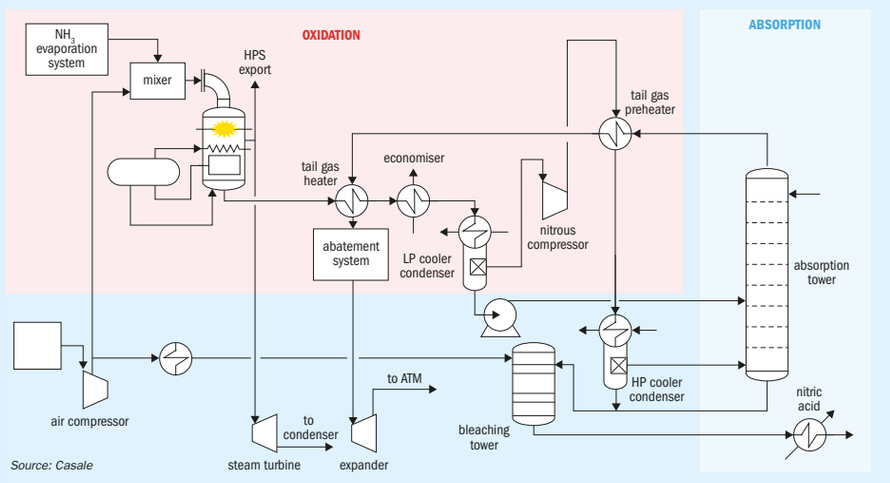
At the heart of the Villeta project is Casale's SMART-N sustainable solution for small-scale green ammonia synthesis plants (Figure 3). SMART-N has the following unique advantages:

- **Compact and modular design**: Reduces the physical footprint and construction costs while enhancing operational simplicity.
- **High conversion efficiency**: The technology, by achieving an impressive ammonia-to-hydrogen conversion ratio of 5.64 kg NH_3/kg H_2, optimises resource utilisation.
- **Proven track record**: Casale has successfully installed over 100 ammonia synthesis loops globally, underscoring its reputation for reliability and effective delivery.

A distinctive feature of Casale's Smart-N ammonia synthesis process is its ability to cope with a wide capacity range. If required, it can reliably operate with an erratic renewable power supply, yet still avoid or minimise the negative effects of cyclical operation and fatigue. Another key feature of the Smart-N synthesis loop is the lower number of equipment items required for green ammonia production – with a minimal configuration of just five items required. This reduces both capex and the project's geographical plot size.

This process scheme is also extremely flexible – being able to produce either pressurised or atmospheric (cold) ammonia as an output.

Fig. 4: **Schematic diagram of Casale's DualPURE nitric acid process**



Source: Casale

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Nitric acid production

The Villeta project will employ Casale's dual-pressure DualPURE process for nitric acid production (Figure 4). DualPURE combines decades of experience with state-of-the-art technology and a proven. cost-effective design. Nitric acid plants based on this process offer reliability, high-energy efficiency and easy maintenance. They can also be customised to suit client requirements – for the fertilizer and explosives industries or other chemical applications – operating at up to azeotropic concentration.

The DualPURE process is distinguished by:

- **Lower ammonia consumption** per tonne of nitric acid produced, through efficient mixing and the even gauze distribution provided by the design of the waste heat boiler (WHB) dome.
- **Reduced platinum-rhodium catalyst losses**, minimising operational costs and increasing the operational campaign length (up to 12 months).
- **Low emissions** via an extended absorption column design that operates at high-pressure to deliver superior NOx recovery while minimising selective catalytic reduction (SCR).

As its name suggests, DualPURE technology maximises overall plant efficiency by operating at two pressure levels (Figure 4) – this providing optimised conditions for ammonia oxidation and then nitrous oxide absorption:

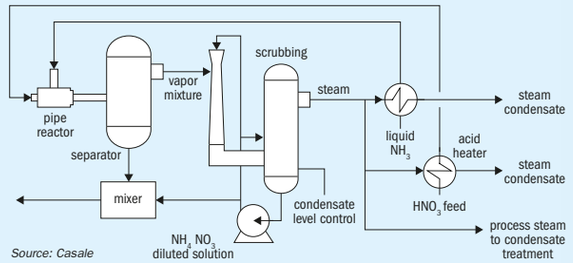
- Ammonia oxidation occurs at 4-5 bar, maximising ammonia conversion and reducing the precious metal losses of the gauzes.
- Nitrous oxides are absorbed at 11-13 bar, enabling high NOx recovery and increasing the conversion of NOx to nitric acid.

Granulation and fertilizer production

The final step of the green fertilizer production process requires the conversion of ammonia nitrate solution into granular fertilizers. This is achieved using two advanced Casale process technologies: NitroPIPE and NitroCULTIVA.

NitroPIPE is Casale's technology for ammonium nitrate solution (ANS) production (Figure 5). This state-of-the-art process is intrinsically safe, reliable, highly efficient and easy to maintain, due to its cost-effective design backed by decades of experience. NitroPipe can also be customised to suit either fertilizer or explosives industry applications.

Fig. 5: **Schematic diagram of Casale's NitroPIPE ammonium nitrate solution (ANS) process**



Source: Casale

Central to the process is the specially designed, tubular Casale Pipe Reactor.

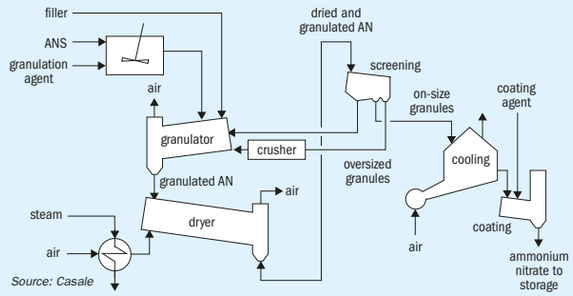
This is used to mix preheated ammonia and nitric acid feeds at a pressure of 6-8 bar. Ammonium nitrate forms almost instantly in the Pipe Reactor releasing a significant amount of heat. On exiting the Pipe Reactor, hot ANS enters a separator at close to atmospheric pressure. The liquid ANS product collects at the bottom of the separator and is then sent to storage.

The NitroPIPE process offers simplicity and reliability due to its small reactor volume and minimal equipment requirements.

Casale's **NitroCULTIVA** drum granulation technology generates high-quality granules with uniform size and durability, these being well-suited to the wide diameter field spreading techniques used in modern agriculture. This highly versatile technology has been successfully installed in more than 50 plants worldwide and can produce both ammonium nitrate (AN) and calcium ammonium nitrate (CAN) in the same unit. The drum granulation plant (Figure 6) consists of the following major items:

- **A rotary drum granulator**: This sprays ANS over a moving bed of recycled particles. These consist of fines, dust, coarse ground particle, recycled final products, filler (e.g. limestone or dolomite), as well as solid raw materials, if required (e.g. ammonium sulphate or calcium sulphate).
- **A rotary dryer**: This uses hot air to dry the final product to 0.2% residual moisture content.
- **A screen**: This separates the on-size products from below-size and oversize materials.
- **A dedusting and scrubbing system**: This prevents pollution and minimises process losses by recovering ammonia and dust from all the gaseous effluents.

Fig. 6: **Schematic diagram of Casale's NitroCULTIVA granulation process**



Source: Casale

Combined, these Casale process technologies meet the Villeta project's ambitious output targets by collectively enabling the production of 768 tonnes per day of calcium ammonium nitrate (CAN).

Environmental and economic benefits

The transition to green fertilizers is part of global efforts to combat climate change and reduce reliance on fossil fuels. By harnessing renewable hydropower, the Villeta project significantly reduces carbon emissions, effectively displacing up to 500,000 tonnes per annum of CO_2 that would be generated by conventional nitrogen fertilizer production at the equivalent scale. The project's environmental benefits extend beyond carbon reduction, by also promoting the efficient use of natural resources and supporting sustainable agriculture.

Additionally, the project enhances Paraguay's trade balance and contributes to economic stability by:

- Creating construction, operational and associated supply chains jobs
- Attracting inward investment
- Widening the country's export capabilities to include green fertilizers
- Supporting domestic agriculture, a sector that provide employment and is a major source of income for many Paraguayans.

Project status

As of the end of 2024, the Villeta project has achieved the following milestones:

- Securing a Power Purchase Agreement (PPA) with ANDE
- Obtaining environmental licenses and free-trade zone status
- Completion of the front-end engineering design (FEED) phase
- The signing of a Heads of Terms with Yara International for the long-term offtake of all of the project's green fertilizer output
- The appointment of Casale as engineering, procurement and construction (EPC) contractor.

ATOME is close to making a final investment decision (FID) for the Villeta project with production currently scheduled to start in 2027.

Conclusions

The Villeta Green Fertilizer Project, by capturing Paraguay's abundant hydropower and implementing cutting-edge technologies, provides a model for green industrialisation. Indeed, it sets a benchmark for the future of fertilizer production by aligning the twin goals of economic growth and ecological responsibility.

The project also exemplifies how renewable energy and industrial innovation can come together to address the dual challenges of environmental sustainability and agricultural productivity. This landmark venture notably combines innovation, entrepreneurialism and leadership with solid engineering and the very highest standards in project execution.

As this project illustrates, Casale remains firmly engaged in promoting sustainable development throughout the global chemical industry and is committed to transforming the production of essential chemicals. ■

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Why the right cooling option matters

For fertilizer producers, there is no one-size-fits-all solution when it comes to selecting the best cooling technology to handle their process needs. Each technology offers distinct advantages, whether it is minimising emissions, ensuring product quality, or helping to meet decarbonisation goals. Selecting the right technology is therefore crucial for today's fertilizer operators. **Igor Makarenko** of Solex Thermal Science reviews the main cooling equipment options and their relative merits.

Introduction

This article examines three commonly used fertilizer cooling technologies – rotary drums, fluid beds and moving bed heat exchangers. The heat transfer, energy consumption and maintenance demands of each type are assessed. Their ability to support sustainability and decarbonisation efforts is also examined.

It is important to note that there is no one-size-fits-all solution for fertilizer cooling. Instead, each method offers distinct advantages and challenges. During equipment selection, it is therefore essential for operators to understand how the relative merits of different types of cooling equipment – each of which have contrasting strength and weaknesses – match up against their specific cooling requirements.

PHOTO: SOLEX

Plate-based vertical heat exchanger cooling installation at a fertilizer plant.

Rotary drum technology

Rotary drums are a popular and flexible method for drying and cooling fertilizers, given their large-scale and proven ability to process different product grades and cope with variable feed conditions. In a typical indirect rotary cooler, material introduced at one end is repeatedly raised and dropped using lifters as the material moves through the drum.

Process considerations with a rotary drum include:

- Minimising fine particle losses: Fine particles can be carried away with the warm exhaust air leading to product losses. Adjusting air velocity and using cyclones, bag filters and scrubbers does, however, help minimise potential environmental emissions.
- Coping with sticky materials: Some fertilizers are more hygroscopic than others. These may become sticky during the cooling process, causing agglomeration and affecting flowability. Regular cleaning of equipment internals is usually necessary to avoid buildup, as this adds extra weight to the drum and places unnecessary stress on components.
- Avoiding non-uniform cooling: Inconsistent air flow or temperature distribution can result in uneven cooling. This can affect product quality – for example, by transferring hot material to storage. Regular maintenance of the air distribution system and careful monitoring of operational parameters, such as the correct bed depth, are therefore essential prevent this.
- Energy consumption: Keeping a large size drum continually in motion requires a significant amount of energy. A typical rotary drum can consume more than 600kW of energy to achieve a 25°C temperature change at 100 t/h throughout.

Process considerations with a fluid bed include:

- Maintaining fluidisation: Materials may not fluidise properly due to factors such as non-uniform particle size (including dust) and moisture content, leading to clumping or channeling across the moving bed. This issue can be avoided by ensuring uniform material characteristics, proper design of the distributor plate, and careful operating practices to ensure the correct bed depth is maintained
- Energy consumption: A fluid bed requires either a dedicated air treatment system, or access to a common treatment system, to comply with emission regulations. This requires a substantial energy input.
- Minimising fine particle losses: Fine particles can be carried away with the warm exhaust air leading to product losses. Similar to rotary coolers, adjusting air velocity and using cyclones, bag filters and scrubbers helps minimise potential environmental emissions.
- Coping with sticky materials: Some fertilizers are more hygroscopic than others. As with rotary coolers, materials can become sticky during the cooling process, causing agglomeration and affecting flowability. Regular cleaning/maintenance of the fluid bed's perforated plate is therefore necessary to ensure consistent operation.
- Ensuring uniform cooling: Fluid beds should offer even cooling as long as they provide a consistent airflow and temperature distribution. Regular maintenance of the air distribution system and careful monitoring of operational parameters – such as correct bed depth – are essential, however.

> **"The use of plate-based moving bed heat exchangers (MBHEs) at the cooling stage offers operators the opportunity to improve the energy efficiency of their process."**

Moving bed heat exchangers

The use of plate-based moving bed heat exchangers (MBHEs) at the cooling stage offers operators the opportunity to improve the energy efficiency of their process. They also offer the added benefits of less air consumption and fewer opex penalties.

First, a bucket elevator brings the fertilizer from the dryer, granulator or prilling tower into the heat exchanger's inlet hopper – typically constructed with stainless steel 304L, 316L or 254 SMO. The product then flows at between 1-200 t/h at a controlled speed – usually 0.3 metres per minute – through the MBHE while cooling water flows counter-

Fluid bed technology

Fluidised beds, including vibrating types, are also commonly used to dry and cool fertilizers. Large volumes of ambient air are used to directly fluidise materials, so they flow from one end of the bed to the other, with drying and then cooling occurring as this happens. Fluidised beds can also be used for standalone cooling.

Air has two functions in fluid bed technology. First, it creates the fluidised state enabling the product to flow. Second, it either heats or dries the material through direct contact. Fertilizer producers commonly use a combined fluid bed system, with the first unit operating as a dryer and the second unit as a cooler.

Alternatively, producers can combine a rotary drum dryer with a fluid bed cooler. In this arrangement, exhaust air from the fluid bed cooler can be used in the rotary drum dryer. This reduces the volume of ambient air required and, being pre-heated, also delivers an energy saving.

PHOTO: SOLEX

Fluid bed cooler.

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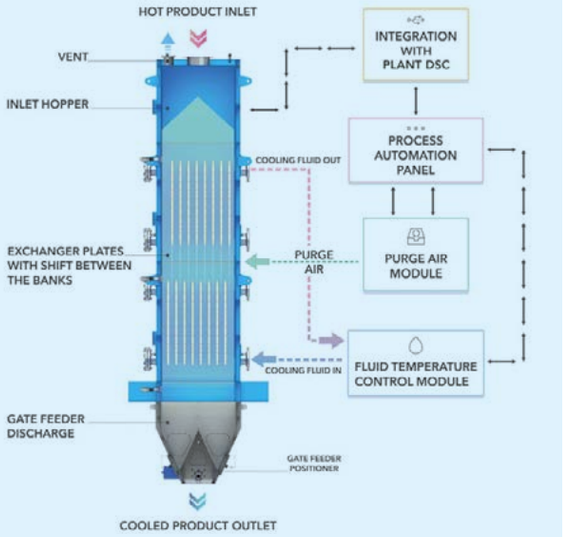
Fig. 1: **Schematic of a Solex plate-based moving bed vertical heat exchanger**



Source: Solex

currently through internal channels within the plates (Figure 1).

The product's low downward velocity between the plates of the MBHE helps prevent the creation of fines/dust. Even in a worst-case scenario, producers can expect the amount of dust generated to be equal to that created at the feed point. Also, product contamination and degradation are largely avoided because of the slow and controlled movement of granules/prills and the lack of contact with air or water.

Chilled water for MBHEs is usually supplied by an existing chilled water circuit, plant cooling tower water or chilled ammonia. In some cases, natural water sources can be used by incorporating a closed-loop fluid temperature control circuit.

A complete standalone chilled water system can also be installed. By using a dedicated closed-loop circuit with a dedicated electric chiller and free-cooling non-evaporative towers, this ensures that no water intake from the operator is required.

If the MBHE is installed in a hot, humid location, a small amount of dehumidified purge air (1,000-2,500 Nm^3/h) may need to be injected between the heat exchanger banks to prevent condensation and caking from occurring.

Process considerations with a plate-based heat exchanger include:

- Need to avoid caking: Caking can occur during the cooling process when the critical relative humidity temperature and dewpoint temperature of the air in the void space between the product particles becomes higher than the temperature of the plates. This is remedied by correctly calculating the amount of purge air and properly adjusting the cooling water regime (flow rate and temperature).
- Prevention of physical plugging: Products containing different size particles can block the space between the plates. Placing a product cleaning system upstream of the MBHE, and correctly calculating the plate spacing for each fertilizer, can successfully preventing plugging.
- Installation: Plate-based MBHEs can usually be retrofitted easily at existing production plants due to their small installation footprint (less than two metres by two metres). MBHEs can also be used in conjunction with existing equipment. For example, they can be installed as a secondary cooler, placed after an existing fluid bed or drum cooler, to provide additional cooling capacity. This type of revamp can improve production capacity and finished product quality.
- Energy consumption: Average energy consumption of MBHEs is just 0.4 kWh/tonne of fertilizer – versus 4-5 kWh/tonne for rotary drums and fluid beds. This data is based on a system cooling 65-100 t/h of fertilizer granules/prills.
- Emissions: Solex estimates that plate-based MBHEs generate just 0.42 kilograms of CO_2 emissions per 1 kWh, some eight times less than comparable cooling technologies.

ADDITIONAL COOLING CONSIDERATIONS

Fertilizer type

Individual fertilizers have different cooling needs. Hygroscopic fertilizers, such as potash and phosphate types, for example, are more prone to caking – and therefore require purge air with a lower dew point to prevent clumping. Effective cooling of ammonium nitrate-based fertilizers, meanwhile, requires a greater heat flow area.

Product integrity

Preserving fertilizer integrity during the cooling process is crucial for maintaining product size, quality and longevity, as well as preventing issues such as caking and product losses. The surfaces of coated fertilizers also need to be preserved. Cooling methods that involve fluidisation or tumbling of materials are more prone to creating dust, due to the mechanical nature of the heat transfer process, and therefore can negatively affect product integrity. This is less true of plate-based MBHEs due to the indirect nature of their heat transfer.

Throughput requirements

Previously, rotating equipment was often preferred by fertilizer producers as its higher throughput was more compatible with large-scale operations. However, the robustness of all three major cooling technologies has improved in recent years with examples of installations at high throughput operations.

Capex/opex

Each technology comes with different associated costs. These include:

- Equipment investment cost – for equipment assets and implementation/installation etc.
- Operating costs – such as energy input requirements, maintenance costs and required scheduled downtime.
- Costs of post-processing – such as air abatement and water cooling.

Maintenance and reliability

Lastly, the following factors need to be considered when evaluating the maintenance requirements and reliability of cooling equipment:

- Maintenance needs: Rotating equipment such as drum coolers generally requires more frequent maintenance due to their moving parts. This includes regular lubrication, alignment checks and wear-and-tear inspections. In contrast, static equipment with fewer moving parts, such as fluid bed coolers, typically require less frequent maintenance. Similarly, plate-based MBHEs requires minimal maintenance, being gravity fed with product discharge controlled by a low-speed oscillating pneumatic device.
- Failures: Common cooling equipment failures include bearing failures, seal leaks and mechanical wear. Frequent monitoring and preventive maintenance are necessary to avoid these.
- Stability: Being more stable and less prone to mechanical failure, static equipment can offer greater reliability and more consistent operations.
- Cost and availability: Operators must factor in the cost of the equipment and its availability. During retrofits, assessing how easy it is to integrate cooling equipment within the available space, plus the required downtime, are also cost considerations.

Conclusions

Cooling represents an important stage in the fertilizer production process – being necessary for the delivery of high-quality finished products, while at the same time supporting operational efficiency. Yet, as the fertilizer industry advances, the focus is shifting beyond production performance alone to also examine how cooling technologies can contribute to broader sustainability goals.

This is already happening. Being relied upon for decades as the cornerstones of fertilizer production, cooling technologies are now helping to decarbonise operations as well.

Selecting the right cooling technology requires a careful evaluation of many factors – from process requirements to energy efficiency.

As such, each operator must weigh up the pros and cons to find the best fit for their production process. In doing so, they have an opportunity to meet their operational and decarbonisation goals while still feeding the world.

FOCUS ON COOLING EQUIPMENT

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Rotary coolers: the key to superior fertilizer cooling

Effective cooling is a vital step in fertilizer production as it directly impacts product quality, operational safety, and process efficiency. Rotary coolers combine durability and flexibility with the delivery of uniform results. They remain a popular choice with fertilizer producers, explains **Shane Le Capitaine** of FEECO International, thanks to their ability to meet the industry's rigorous demands.

Flights in a rotary cooler.

PHOTO: FEECO

Introduction

From preventing caking to safeguarding downstream equipment, proper cooling is essential for producing a resilient, high-performance fertilizer product. Among the available cooling technologies, rotary coolers continue to dominate, offering robust performance, design flexibility, and consistent results. This article explores the importance of cooling in fertilizer production, the advantages of rotary coolers, and key considerations for optimising the cooling process.

Why cooling is necessary

Whether producing diammonium phosphate (DAP), ammonium sulphate, potash, NPK, or something in between, cooling is a vital finishing step in the fertilizer production process, achieving several objectives that allow fertilizer producers to bring a quality product to market. By cooling product exiting the dryer, fertilizer producers can:

Prevent caking. As any fertilizer producer can confirm, the presence of caking is highly problematic, resulting in lost product, process upsets in downstream equipment, and dangerous storage conditions.

Caking occurs when crystal bridges begin to form between particles. While additional measures to combat caking may be necessary, depending on the type of fertilizer and its hygroscopicity, cooling helps to maintain product integrity and reduce the potential for caking.

When warm granules are not properly and uniformly cooled, moisture can migrate within the product or between particles, allowing crystal bridges to form. These interparticle bridges are the foundation of product caking.

PHOTO: FEECO

FEECO Rotary Cooler.

Valuably, cooling the product exiting the dryer, by stabilising the moisture content, prevents caking and promoting a more flowable product.

Reduce potential for bacterial growth. In addition to preventing the formation of crystal bridges, reducing the material's temperature also helps to guard against bacterial or mould growth during storage.

Protect downstream equipment. Fertilizer typically exits the dryer at around 90°C (200°F), a temperature that could easily damage handling and bagging equipment. Cooling the product down to less than 50°C (120°F) is therefore an effective measure for protecting downstream equipment from potential heat damage.

Create a more resilient product. Cooling is the final step needed for producing a finished, resilient, and flowable fertilizer product that is less prone to attrition and dust generation. Importantly, by stopping the drying process, it prevents over drying and potential product degradation from any residual heat.

Why rotary cooling?

Although alternative technologies exist, rotary coolers remain a preferred technology among fertilizer producers for a number of reasons:

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Heavy-duty build. Constructed from heavy-duty materials and equipped with robust drive assemblies, rotary coolers are incredibly durable. When properly maintained, rotary coolers can provide decades of unwavering service, despite the harsh demands of continuous fertilizer production.

Flexible design. Rotary coolers offer a high potential for customisation, particularly when it comes to maximising heat transfer efficiency. Flights – material lifters affixed to the cooler shell interior – pick up material and allow it to cascade through the chilled air stream in the drum's cross section. Both flight geometry and pattern can be customised to work best with the material being handled. Taking account of the angle of repose, crush strength, and other properties helps achieve the most efficient results possible.

Capacity. Fertilizer producers also continue to use rotary coolers for their high throughput. This is unsurprising given that the large tonnages typical of the industry. For example, a rotary cooler with a 10-foot diameter and 40-foot length can easily handle up to 200 t/h of granulated fertilizer, depending on the material's bulk density and cooling requirements.

Uniform results. The fertilizer market has become increasingly discerning thanks to advances in technology. Consequently, product quality issues such as dust and caking are simply no longer acceptable.

Cooling equipment must be able to consistently deliver uniform results, as any variation could result in lower product quality. And where uniformity is concerned, rotary coolers offer the most effective solution for many producers. That is because the heat transfer efficiency created from the flights, paired with the tumbling action of the drum, ensures all solids are uniformly exposed to the cooling medium.

PHOTO: FEECO

Finished monoammonium phosphate (MAP) fertilizer.

Factors to consider in fertilizer cooling

Several factors must be considered in the design and operation of a rotary cooler for fertilizer:

Material compatibility. Fertilizer products are frequently corrosive, abrasive, or both. This requires careful selection of construction materials to ensure material compatibility, particularly at the cooler inlet, where the higher temperature of the incoming material may exacerbate wear.

Poorly chosen construction materials for components in contact with the fertilizer product – such as the cooler shell and flights – will result in rapid degradation of exposed parts.

Retention time. Also referred to as residence time, this is the amount of time required to reach the desired product outlet temperature under the process conditions. In cooler design, retention time is calculated from a combination of factors including feed rate, drum speed, drum slope, air flow velocity, and drum size (length and diameter).

If the cooler is engineered based on representative product data, retention time is unlikely to need adjustment. However, to optimise cooling conditions, it may be necessary to increase retention time, especially if process conditions change, or operators struggle to achieve efficiency.

In existing systems, retention time can be increased using one of two main approaches: either by installing a dam or by slowing the drum's rotational speed. Both options have potential process implications and therefore should be carried out with the help of an expert.

Entrainment. This occurs when particles become suspended in the air flow and are carried out through the exhaust gas system. This is problematic for a number of reasons.

While a dust collection system is already required, excessive fines in the off gases will either need to be reintegrated into the system, used elsewhere, or taken as a loss.

Care, therefore, must be taken during the initial design stages to reduce the potential for entrainment. Minimising entrainment relies on finding the right balance between drum size, air flow velocity, particle size distribution, and bulk density.

Efficiency. The high rates of production associated with fertilizer plants make optimising for efficiency particularly important, as even small inefficiencies can quickly turn into major losses.

Cooling efficiency can generally be measured by comparing the temperature of the inlet material with the outlet gas temperature – with the difference between the two being a good indicator of efficiency. A small temperature difference is desirable as it indicates that the air flow has extracted as much heat as possible from the material.

A well-optimised rotary cooler achieves an outlet gas temperature within 10°C (15°F) of the inlet material temperature, indicating maximum heat absorption by the cooling medium. A large temperature difference, in contrast, indicates unused cooling potential and consequently wasted energy.

While the original design of the cooler is a major factor in the unit's operating efficiency, further efficiencies can be gained by recycling air to reduce mechanical cooling or air treatment requirements on the front end of the system.

Optimising efficiency also reduces the load and strain on auxiliary systems such as fans, motors, and dust collection systems, contributing not only to lower energy costs but also to a longer service life and lower maintenance costs.

Conclusions

Effective cooling is indispensable in fertilizer production, serving as a vital step that directly impacts product quality, operational safety, and process efficiency. Rotary coolers, with their durability, flexibility, and ability to deliver uniform results, remain a preferred choice for handling the rigorous demands of this industry.

By considering factors such as material compatibility, retention time, and entrainment during system design and operation, fertilizer producers can achieve an efficient, reliable cooling process that delivers a high-quality product ready for market. In future, innovative cooling solutions will play a key role in helping the fertilizer industry meet increasing quality standards and production demands. ■

March-April 2025

phosphates & potash INSIGHT

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PHOTO: HYATT

CRU Phosphates+Potash welcomes you to Orlando!

CRU will convene the 2025 Phosphates+Potash Expoconference in Orlando, Florida, at the Hyatt Regency Grand Cypress Resort, 31 March – 2 April.

This year's conference venue is Orlando's Hyatt Regency Grand Cypress Resort.

CRU's 2025 Phosphates Conference – now in its 17th year – is returning to Orlando, Florida, this year. The 2024 event in Warsaw was one of the most successful to date – attracting more than 370 delegates from over 150 companies and 40 countries (*Fertilizer International* 519, p4).

Building on that success, this year's event has even more to offer. That's because it will also champion the potash industry – as its new name CRU Phosphates+Potash Expoconference makes clear. Leading international producers, traders and engineering, technology and equipment providers are all expected to attend.

Bringing together two sister segments

So, why potash? Unbelievably, for a sector that produces close to 70 million tonnes of potassium chloride annually, there's never actually been a regular yearly event for the global potash industry.

Potash and phosphate are both mined commodities with common extractive and process technologies. Crushing, grinding, screening, pumping, froth flotation, liquid-solid separation, dewatering, drying, evaporation and crystallisation are common to both industries.

Because of that, phosphates people are, more often than not, also potash people. That applies to engineering companies, equipment manufacturers, reagent suppliers, technology providers and crop nutrient producers.

That's why it makes perfect sense to bring these two sister industries together in a single event. The massive investments currently underway in highly efficient potash mining and processing technology – and the pursuit of electrification, automation and digitalisation – also need highlighting. In short, the potash industry deserves an annual gathering where it can network, hear the latest market intelligence and share new knowledge.

Consequently, starting in Orlando this year, CRU is building a new global community that jointly celebrates the phosphate and potash industries. We invite you to join us there – as well as spread the word that potash has a new home.

A return to Florida

Orlando's North American location makes it an ideal place for the global phosphates and potash industries to meet up, network and access crucial market intelligence and technical updates. Especially as the region is home to Florida and Saskatchewan – two global centres of phosphates and potash excellence (see page 48).

This timely spring conference will inform and spur discussions on key issues such as sustainability, trade, supply chain challenges and technical advances – all of which are occurring against a tumultuous market backdrop of geopolitical upheaval, volatile fertilizer prices and supply constraints.

What to expect – the 2025 agenda

Uniquely, CRU Phosphates+Potash combines a commercial agenda with a technical agenda in one single event. This enables the conference to cover the entire value chain of the phosphate and potash industries from both an operational and market perspective.

This year's conference features a typically strong commercial programme. This will offer up key insights and in-depth market information on the supply, demand and pricing of P&K raw materials and finished products. Programme highlights include:

- A global perspective on potash and phosphate
- Phosphate and potash prices, demand and supply outlooks
- Outlook for the North American phosphate market
- Applying phosphate when grower profitability is challenged
- The future of potash in a changing world
- Fifty years of phosphorus research at IFDC
- The Indian fertilizer market
- Phosphate project prospects
- The yellow phosphorus market
- Collaborative innovation
- LFP batteries
- Feed phosphates update
- Phosphate rock supply.

The event also offers a separate but equally strong technical programme (see selected abstracts p39). This is designed to cater to the needs of production personnel throughout the phosphate and potash value chains. Indeed, the 2025 conference is set to break records with an impressive lineup of more than 30 technical innovation presentations and six dynamic technical showcases.

These will offer a deep dive into the intricacies of new technology, groundbreaking processes, novel materials and state-of-the-art equipment. Delegates will discover how these innovations can elevate production efficiency, ensure environmental compliance, and increase operating capacities and plant output.

Register today for your place at CRU Phosphates+Potash 2025 in Orlando. For more information visit: events.crugroup.com/phosphates/home ■

Technical programme highlights

A selection of Phosphates+Potash 2025 abstracts from the conference's technical programme.

Improving 4-Rotor continuous mining performance

The Mosaic Company

A fleet of 4-Rotor continuous boring machines are used for underground mining at Mosaic's Esterhazy K3 Potash mine. Rooms of 6,000 feet in length are cut in three passes, with the first pass being the most challenging. Mosaic uses a patented Automated Hardware Installer (AHI) for its entire mining fleet at Esterhazy K3. This follows behind the mining machine, automatically drilling post holes and installing hardware posts and idlers. Two key programmes have now been implemented at K3 to improve first pass cutting performance and AHI uptime: Routine Equipment Care (REC) of the first pass mining process; and Reliability Centered Maintenance 2 (RCM2) analysis of the AHI. This presentation provides an overview of the implementation of REC and RCM2, summarises the results and outlines the lessons learned.

Sustainable bio-based coatings

ArrMaz-Arkema

This presentation evaluates the performance of an alternative, bio-based dust control and anti-caking coating for potash and monoammonium phosphate (MAP). Both these fertilizers are prone to dust generation and caking during storage and transport. Results show that the bio-based coating delivered equal or superior dust control and anti-caking performance compared to conventional oil-based coatings, with significant environmental advantages. Other studies have revealed that fertilizers coated with this bio-based material also offer agronomic benefits by improving crop growth.

Coarse phosphate flotation at the Elandsfontein mine

Eriez

HydroFloat® Coarse Particle Flotation (CPF) has been implemented at Kropz's Elandsfontein phosphate mine since its recommissioning in December 2021. CPF reduces turbulence and particle detachment by combining a fluidised bed with the absence of a froth zone. It also increases the flotation rate of both coarse and partially liberated particles, compared to conventional flotation. The redesigned Crago flotation circuit at Elandsfontein now consists of fine (+25-212 micron) and coarse (+212-425 micron) flotation circuits using Eriez CavTube® column flotation and HydroFloat® CPF technologies, respectively, together with a conventional reverse coarse flotation circuit cleaning stage. The adoption of a split-feed flotation circuit has enabled the recovery of coarsely liberated apatite particles while reducing grinding requirements.

Fine screening in potash

Derrick Corporation

The use of closed-circuit screening systems in potash processing enhances product recovery and purity. Benefits include improved product quality, reduced operational costs and increased throughput. This presentation explores how potash particles can be efficiently separated, based purely on size, by integrating vibrating screens within closed circuits. Screening systems maximize the recovery of valuable minerals – while minimising waste and ultrafine generation – by recycling oversized material back into the crushing or grinding process. The effectiveness of screening is influenced by operational parameters such as screen mesh size, feed rate and percent solids.

Reducing fines in potash processing

Hatch

Minimising fines generation in potash operations is critical for improving recovery and overall economic viability. Fines account for a significant portion of product losses and can consume additional flotation reagents. They also adversely impact flotation performance and require more energy for dewatering and drying. The fines produced during comminution, attrition scrubbing and handling (-10 µm particles) are of particular concern – as these are below the minimum size that can be recovered economically.

Innovative leaching technologies

Prayon Technologies

Phosphoric acid producers are currently facing two significant challenges. First, the rising cost of high-grade phosphate rock is putting increasing financial pressure on the industry. Second, regulatory requirements for lower cadmium, arsenic and other contaminants are also becoming stricter. Last year, Prayon Technologies introduced a targeted leaching process for removing magnesium from phosphate rock. Building on that success, Prayon has since broadened its leaching capabilities – and now offers additional solutions for removing total organic carbon (TOC), cadmium and other impurities. The ability to provide phosphoric acid producers with a custom-made leaching process is economically beneficial, as it avoids the need to switch from lower-quality phosphate rock to more expensive high-grade sources.

Adapting JPMC's phosphoric acid plant to low-grade rock

Prayon Technologies, De Smet Agro

The performance of the Jordan Phosphate Mines Company (JPMC) phosphoric acid plant in Aqaba has been declining due to the decreasing quality and increasing moisture content of the phosphate ore. These factors, by reducing plant capacity and filtration performance, have made achieving target merchant-grade acid (MGA) concentration increasingly difficult. To address these challenges, Prayon Technologies and De Smet Agro jointly conducted a comprehensive revamping study aimed at restoring the plant's operational performance to its historical peak in the mid-1990s, a time when phosphate rock quality was higher. Several modifications were proposed that – while preserving the plant's current attack-digestion section – are capable of delivering the necessary process improvements.

Halite removal from potash using X-ray-transmission sorting

TOMRA Sorting

TOMRA Sorting and K+S have jointly developed a sensor for the separation of halite (NaCl) from sylvinite (KCl) in potash ore mining. This resulted in the design, construction and commissioning of a pilot X-ray-transmission (XRT) sorting plant in the Zielitz underground potash mine in Germany in 2022. This plant enables more than half of the mined material to be sorted in situ and remain underground, instead of being hoisted to the surface and then deposited on top of already huge waste stockpiles. Further investigations are currently underway at the mine to optimise separation performance, increase throughput and implement XRT technology at full scale.

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Conference agenda

(Correct at time of going to press)

DAY 1: Monday, 31 March

12:30 REGISTRATION OPENS

13:30 EXHIBITION OPENS

TECHNICAL SHOWCASES

15:15–15:30 **Why graphite is a preferred material of construction in manufacturing of green and white phosphoric acid**
Adam McGaughey, *Apex Engineered Products*
presenting for *Strategic Partner Graphite India Limited*

15:30–15:45 **Expertise on phosphate ore beneficiation and fertilizer coating additives**
Eric Barrientos, *Kao Chemicals*

15:45–16:00 **New catalyst for acid making: platinum promoted honeycomb ceramics on way to OPEX and CAPEX reduction**
Johannes Hofer, *P&P Industries AG*

16:00–16:15 **Leveraging the power of advanced filter aids for enhanced water and phosphate recovery**
Rajesh Raitani, *Nalco Water, An Ecolab Company*

16:15–16:30 **Scale Inhibition in Phosphoric Acid Process Elements - PHOSFLOW® applications**
John Carr, *Syensqo*

16:30–16:45 **Optimising longevity of slurry pumps and processing equipment in highly corrosive and abrasive services**
Josh Vines, *Duechting Pumps North America, LP*

17:00 WELCOME RECEPTION

18:30 END OF DAY 1

DAY 2: Tuesday, 1 April

08:00 REGISTRATION & EXHIBITION OPEN

PLENARY SESSION

09:00–09:15 **Opening Keynote: A Global Perspective on Potash and Phosphate**
Kelly Strong, *Phosphates North America, Mosaic*

09:15–09:45 **Global phosphate and potash prices dovetail amid opposite supply outlooks**
Humphrey Knight, *CRU Group*

09:45–10:45 **Industry Keynotes: A spotlight on the Supply Demand Dynamics and Emerging Market Opportunities for the North American Phosphate Industry**
Jason Newton, *Nutrien;* Daniel Gleeson, *Fertoz Ltd;* Andy Jung, *Mosaic:* Justin Rackleff, *CRU*

10:45 NETWORKING COFFEE BREAK

DAY 2: Tuesday, 1 April

PHOSPHATES COMMERCIAL

11:15–11:45 **Keynote: Optimizing phosphate fertilizer applications when grower profitability is challenged**
Karl Wyant, *Nutrien*

11:45–12:15 **The rationale for and financing of new upstream phosphate Assets**
Joe Garofoli, *Roc Global*

12:15–12:45 **Fifty years of phosphorus research at IFDC**
Upendra Singh, *IFDC*

12:45 NETWORKING LUNCH

14:00–14:30 **Regional Focus: Asia an overview of the indian fertilizer market: Key challenges & opportunities**
Harshdeep Singh, *PPL - Paradeep Phosphates Limited*

14:30–15:00 **The yellow phosphorus export market and Kazakhstan's unique position**
Konstantin Pisarchuk, *NovoDzambul Phosphorus Plant*

15:00 NETWORKING COFFEE BREAK

15:30–16:30 **Latest updates from selected phosphate mining developments and discussion of the key challenges and opportunities faced by project developers**
Chris Tziolis, *Verdant Minerals Ltd*
Jørgen Stenvold, *Norge Mineraler*
David Högnelid, *LKAB*

16:30–17:00 **Innovation through collaboration – an essential part of next generation technological breakthroughs**
Hannes Storch, *Outotec GmbH & Co. KG*

PHOSPHATES TECHNICAL

PHOSPHATE ROCK: MINING, GRINDING AND PROJECTS MANAGEMENT

11:15–11:45 **Developing a phosphate rock production project in Bayovar, Peru**
Marco Carrasco, *Fosfatos Del Pacifico*

11:45–12:15 **JPMC PAP adaptation to low-grade rock**
Sébastien Havelange, *Prayon Technologies*
Jan Tytgat, *De Smet Agro*

12:15–12:45 **Reducing wear during size reduction of phosphate**
Ian Keith Hancock, *Bradley Pulverizer*

PHOSPHATE FLOTATION AND BENEFICIATION

14:00–14:30 **The impact of HydroFloat® coarse particle flotation technology at Kropz Elandsfontein phosphate mine**
Morake Hlahane, *Eriez*

14:30–15:00 **Coarse and fine phosphate flotation**
André Braga, *BASF*

15:30–16:30 **Novel surfactants and their application as collector additives to enhance the direct flotation of apatite**
Lucas Moore, *Colonial Chemical, Inc.*

16:00–16:30 **Management of wet phosphate treatment sludge - Optimisation of the flocculation operation during the centrifugation of phosphate treatment sludge**
JESA, *TBC*

16:30–17:00 **Test method development for the identification of scale inhibitors for tailings slurries**
Fauzia Mujid, *Ecolab*

17:00–17:30 **Flotation of apatite beneficiation tailings – Advances that enhance mine sustainability**
André Braga, *BASF*

POTASH COMMERCIAL

11:15–11:40 **Focus on potash: prices, markets, supply and demand trajectories, projections near, mid and long term**
Justin Rackleff, *CRU*

11:40–12:20 **The future of potash in a changing world – Comprehensive look at the evolving potash industry economics, exploring current trends and future directions**
Kirk Brecht, *Saskatchewan Ministry of Energy and Resources*
Lawrence Berthelet, *The Mosaic Company*
Chris Reynolds, *Nutrien*

12:20–12:45 **Potash and SOP**
Humphrey Knight, *CRU*

14:00–14:30 **Industry Keynote Address**
Talita Arcaro, *Canpotex*

14:30–15:00 **Focus on regional markets: Dynamics of growing potash demand from India**
Dinesh Pratap Singh, *Deepak Fertilisers and Petrochemicals Corporation Ltd*

OPERATIONAL EXCELLENCE AND SUSTAINABILITY

15:30–16:00 **Development and implementation of reliability-based programs to improve 4-rotor continuous mining and automated hardware installer (AHI) performance in first pass**
Jason Kinoshita, *The Mosaic Company*
Stephen Warwaruk, *The Mosaic Company*

16:00–16:30 **How to determine the best mining method? Recent case studies from potash engineering**
Thomas Kießling, *ERCOSPLAN Ingenieurgesellschaft Geotechnik und Bergbau mbH*

16:30–17:00 **Removal of sodium salt from potassium salt using TOMRA X-Ray -Transmission sorting. Experiences from a K+S underground pilot plant**
Jens-Michael Bergmann, *TOMRA Sorting GmbH*

17:00–17:30 **Digitalising potash quality for improved process control using PGNAA**
Ryan Khoo, *Scantech International Pty Ltd*

17:30 NETWORKING DRINKS RECEPTION

18:30 END OF DAY 2

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DAY 3: Wednesday, 2 April

08:00 REGISTRATION & EXHIBITION OPEN

PHOSPHATES COMMERCIAL

09:00–09:30 Agricultural Outlook: Bumper crops and weaker demand pressure crop prices, will fertilizer demand
Anthony Rizzo, *CRU*

09:30–10:00 Feed Phosphate Market Update
Alan Lec'hvien, *Phosphea*

10:00–10:30 The strategic importance of inorganic feed phosphates (IFP) in sustainable global food security
Abdelati Tantaoui, *OCP*

PHOSPHATES TECHNICAL

PHOSPHORIC ACID: PRODUCTION, OPERATIONS AND PROCESSES

09:00–09:30 Addressing key challenges in phosphoric acid production through innovative leaching technologies
Kevin De Bois, *Prayon Technologies*

09:30–10:00 Optimisation of phosphoric acid production with various sources of phosphate rock
Liliek Hermianto Purbawinasta, *PT Petrokimia Gressik*

10:00–10:30 Use of impervite advanced graphite tubing in phosphoric acid evaporator service (IFP) in sustainable Global Food Security
Joan Bova, *CG Thermal*

POTASH COMMERCIAL

OPERATIONAL EXCELLENCE AND SUSTAINABILITY

09:00–09:30 Reduction of fines generation in potash processing
Jon Goodwin, *HATCH*
Jørgen Stenvold, *Norge Mineraler*

09:30–10:00 Fine screening in potash
Danny Luu, *Derrick Corporation*

10:00–10:30 Potash processing: alternatives to flotation?
Eike Kaps, *ERCOSPLAN Ingenieurbüro Anlagentechnik GmbH*

10:30 NETWORKING COFFEE BREAK

11:00–11:30 Asian LFP producers go overseas: the emergence of a local supply chain
Frank Nikolic, *CRU*

11:30–13:00 LFP batteries: Innovation and uptake
Brian Ostroff, *Arianne Phosphate*
Ernesto Lima, *Bifox LLC*
Max Kushner-Lenhoff, *Mitra Chem*
Jacob Jin, *Austin Elements Inc*

11:00–11:30 Case studies of steam optimisation using modern tools in phosphate facilities
Ryan Johnston, *The Mosaic Company*

11:30–12:00 Forecasting the energy demand of phosphate industry using an artificial neural network to quantify the impact of energy management system "ISO 50001" on energy efficiency, Morocco
Alaoui Sosse Jihad, *JESA*
Adnane Mahmoud, *JESA*

12:00–12:30 Integrated surface protection and maintenance solutions for the phosphate and potash industries
Michael Labbe, *REMA TIP TOP*

PHOSPHATES AND POTASH: SOIL NUTRIENTS AND FERTILIZERS

11:00–11:30 Enhancing granulation efficiency in phosphatic and NPK compound fertilizers
Avdhesh Mathur, *NAQ Global Companies*

11:30–12:00 Sustainable bio-based coatings: improving dust control, anti-caking, and agronomic performance of fertilizers
Anand Sundararaman, *Arrmaz-Arkema*

12:00–12:30 Creation of SP-26 as ecogreen phosphate based fertilizer product innovation
Kevin Esmunaldo, *PT Petrokimia Gressik*

12:30–13:00 Microbial phosphate solubilisation: a potential strategy for increasing soil phosphorus availability
Wissal El Haissoufi, *Mohammed VI Polytechnic University*

13:00 NETWORKING LUNCH

14:00–14:30 Phosphate Rock Outlook
Maria Gamboa, *CRU*

14:30–15:00 Challenges for on-shoring the phosphate supply chain
Timothy Cotton, *Novaphos*

14:00–14:30 Optimising phosphoric acid concentration through Nalco Water's SCALE-GUARD™ scale inhibition program
Ronald Davis, *Nalco Water, an Ecolab Company*

14:30–15:00 Unlocking phosphogypsum valorization – The risk of inaction
Julien Rey, *Orano Mining*

15:00–15:30 Phosphogypsum valorization – The risk of inaction
Ben Lucas, *Rapid Building Systems*

14:00–14:30 LIBS – Radiation-free technique for online fertilizer analysis
Mindaugas Dailide, *Lyncis*
Alexander Baryshnikov, *Lyncis*

14:30–15:00 Introduction of Rhizosorb – The next generation of phosphate fertilizer
Dr. Kyle Isaacson, *Phospholutions, Inc.*

15:00–15:30 From shaking to rolling – Transforming phosphate-based fertilizer screening techniques
Alexandre Gonzalves Andrade, *Metal7 Inc*

15:30 END OF CONFERENCE

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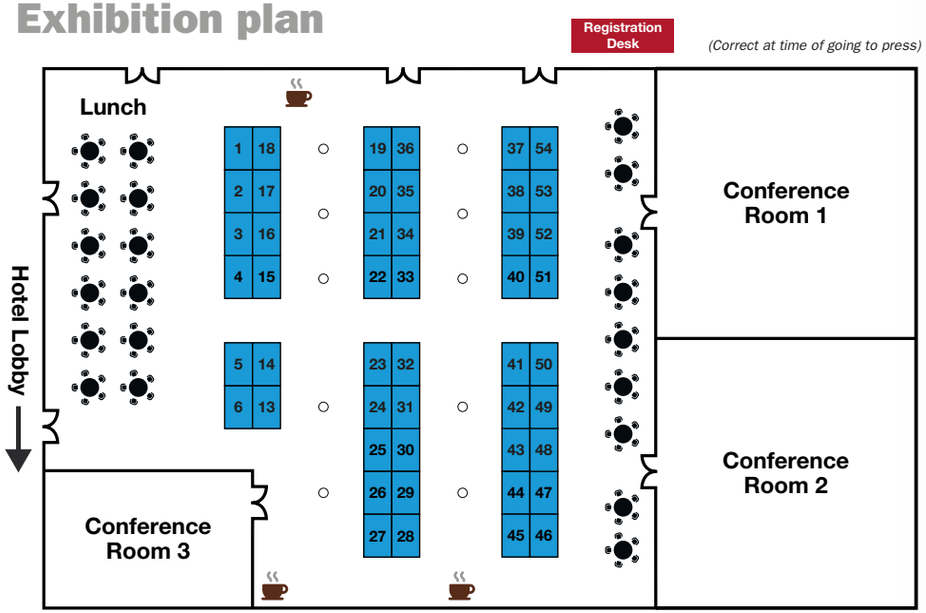
Exhibition plan



Exhibitor list

1 Scantech International Pty Ltd
2 JAS Global Industries
3 Apex Engineered Products
4 Arkema
5 P & P industries
6 BSK Global
13 Eriez
14 De Smet Agro
15 DUECHTING PUMPS
16 Rema Tip Top
17 Mersen
18 GEA
19 Glatt Ingenieurtechnik GmbH
20 Teknokon Makina
21 Kimre/Socrematic
22 ANDRITZ
23 Prayon
24 Keyon Process
25 KAO
26 CiDRA Minerals Processing Inc.
27 HAVER NIAGARA GmbH
28 TOMRA Sorting GmbH
29 OCP
30 Steuler-KCH
31 OBI Linings
32 PegasusTSI Inc
33 SULZER
34 Blair Rubber Company
35 FEECO International, Inc
36 Gambarotta Gschwendt Srl
37 Nalco Water | An Ecolab Company
38 CG Thermal
39 NAQ Global
40 Begg Cousland Envirotec
41 Syensqo
42 Endura Paint
43 Forbon Technology
44 Schurco Slurry
45 NEELAM AQUA & SPECIALITY CHEM
46 GKD-USA Inc.
47 Bradley Pulverizer
48 Polycorp
49 Derrick Corporation
50 Hatch
51 Weir
52 Lyncis
53 JESA
54 Worley Chemetics

Exhibitor profiles

ANDRITZ Separation — Stand 22

ANDRITZ Separation provides mechanical and thermal solid/liquid separation technologies, together with comprehensive services and solutions for automation and digitalization. The company's customised, innovative solutions ensure optimal performance and efficiency. The well-proven ANDRITZ Tilting Pan Filters, combined with UCEGO® vacuum table filter technology, are perfect for phosphoric acid filtration. These filters deliver unsurpassed performance when complemented by ANDRITZ's Metris addIQ ACE technology.

Contact: Kristina Wertenbruch
separation@andritz.com
www.andritz.com/separation

Haver & Boecker Niagara — Stand 27

Haver & Boecker Niagara offers sustainable and efficient equipment and solutions for the processing, handling, packing and storage of organic, mineral and chemical fertilizers. Its signature screening and pelletizing technologies are complemented by a complete portfolio of products and services for the fertilizer industry, from the extraction and processing of raw minerals through to packaging and loading for delivery at facilities worldwide.

Contact: Julie Andras
j.andras@haverniagara.ca
www.haverniagara.com

De Smet AGRO — Stand 14

De Smet AGRO, a subsidiary of De Smet Engineers & Contractors, located on the outskirts of Brussels, provides engineering and project management services to the fertilizer industry. Our focus is on technologies for phosphoric acid, MCP-DCP, ammonium nitrate and granulation. We support clients worldwide – from technical audits through to full EPCM implementation.

Contact: Jan Tytgat
agro@dsengineers.com
www.dsengineers.com/en

JAS Global Industries — Stand 2

JAS Global Industries is a leading global manufacturer and partner to the fertilizer industry. Our innovative, sustainable and cost-effective chemical additives include anti-caking, dust control and colouring agents for all types of granular fertilizers. In addition, JAS Global Industries offers an extensive portfolio of innovative process solutions for the complete value chain – from ore processing to coated fertilizer.

Contact: Khaled Matalka
kmatalka@jasind.com
www.jasind.com

GEA — Stand 18

GEA is one of the world's largest suppliers of process technology and components for sophisticated production processes. We offer a wide range of plant technologies, including evaporators, crystallizers, centrifugal separators, spray dryers and fluid beds for agglomeration/granulation. These are tailored to fit the requirements of fertilizer and phosphates applications.

Contact: Chris Walton
Chris.walton@gea.com
www.gea.com/en

KAO Chemicals — Stand 25

KAO Chemicals has supplied the fertilizer industry for more than 45 years with anti-caking and dust control agents for MAP, DAP, TSP, NPK blends, AN, CAN, urea, AS, etc. The company also supplies agents for LDAN (external and internal), corrosion inhibitors for liquid fertilizers and flotation collectors. Its well-known brand names include SK FERT®, URESOFT®, DANOX® FL and COLMIN®.

Contact: Eric Barrientos
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ww.kaochemicals-eu.com

PHOTO: CRU

The exhibition is where delegates gather to network, meet with exhibitors and take refreshments.

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NAQ Global — Stand 39

Driven by innovative green technology, NAQ GLOBAL is a world-leader in environmentally sustainable and cost-effective products for mining, fertilizer processes and fertilizer quality improvement. Our product lines include: froth flotation agents, flocculants, surfactants, defoamers, descalants & anti-scalants, granulation additives, anti-caking coating agents, dust control coating agents, organic coating agents, micronutrient binders, colouring agents and nitrogen stabilisers. NAQ GLOBAL supplies these specialised products to over 200 fertilizer production and blending units worldwide.

Contact: Fernanda Dias
operations@naqglobalcorp.com
www.naqglobal.com

Prayon Technologies — Stand 23

Headquartered in Belgium, the Prayon Group is a worldwide leader in phosphate chemistry and, with more than 130 years experience, offers the best solutions for phosphate production. The Group specialises in phosphate chemicals and operates production sites in Belgium, France, Switzerland and the United States. Prayon manufactures and distributes a wide range of purified phosphoric acids, phosphate salts and fluorine products geared towards the food and fertilizer sectors, as well as for many different industrial applications. Prayon Technologies (PRT) sells the know-how and techniques developed by our Group, and also supplies consultancy and support services. Profile develops and sells equipment solutions (filtration, mixing, and product recovery) that enable processes to function at optimum efficiency.

Contact: Corine Petry
cpetry@prayon.com
www.prayon.com

Sulzer — Stand 33

With 190 years of experience, Sulzer offers its customers best-in-class products and services in pumping, agitation and mixing solutions. These add value, especially to processes involving corrosive and abrasive media. Sulzer offers a complete range of process and slurry pumps, axial flow pumps, heavy-duty agitators and liquid ring vacuum pumps tailor-made for the phosphates and potash industries. These cover applications ranging from mineral beneficiation of phosphate and potash ores to the manufacture of fertilizers. Our advanced design and materials, plus a wide range of shaft seals and sealing systems, ensure a reliable process and maintenance-free operation. Our Sense wireless condition monitoring solution, meanwhile, supports our commitment to digitalization.

Contact: Christian Guillaume
christian.guillaume@sulzer.com
www.sulzer.com

TOMRA Sorting GmbH — Stand 28

TOMRA Sorting supplies sensor-based ore-sorting technology for the mineral processing industry. The company's technology offers effective material separation in various mineral and ore applications, such as in the processing of gold, diamonds, gemstones, industrial minerals and metal recovery from slag. World-wide, numerous TOMRA Sorting systems are already contributing to more energy-efficient and cost-effective pre-concentration, as well as material recovery. These solutions help to extend the life of mining operations and increase the value of ore deposits.

Contact: Oxana Penning
oxana.penning@tomra.com
www.tomra.com/mining

Worley Chemetics — Stand 54

Worley Chemetics is a leading provider of technology, solutions and equipment fabrication for sulphuric acid, chlorine chemicals and other specialty chemical facilities. Since 1964, we have been servicing worldwide customers in the chemical, oil & gas, fertilizer, pulp and paper industries. Chemetics technology helps customers to achieve higher capacities and reliability, lower their operating costs, substantially decrease emissions, improve safety and maximize long-term profits. Our CORE-SO2™ Sulphuric Acid Plant technology unlocks green fertilizer and sustainability goals. It decreases environmental footprint and greenhouse gas emissions, recovers CO_2-free electrical power and enhances profitability. The small physical size of CORE-SO2™ confers significant construction advantages, while low internal gas flows and fewer pieces of equipment enable modularisation.

Contact: Mike Fenton
michael.fenton1@worley.com
www.worley.com/chemetics

Last year's presentation programme proved highly popular with some sessions standing room only.

PHOTO: CRU

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North America's potash and phosphate industries

With CRU's Phosphates+Potash Expoconference returning to North America in 2025, we profile the region's phosphate and potash industries – focusing in on Florida and Saskatchewan, those two centres of P&K excellence.

US industry overview

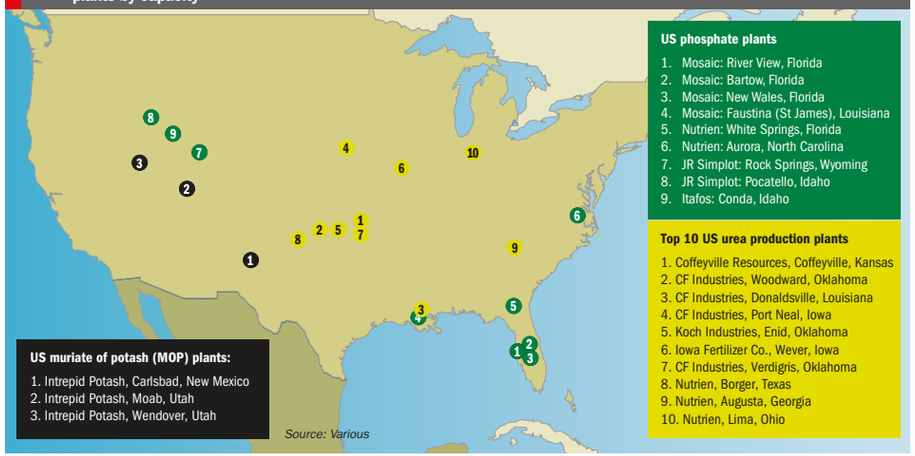
The United States is the world's fourth largest fertilizer consuming region, being responsible for around 9% of global consumption and ranked behind only China, India and Brazil globally. On an individual nutrient basis, the country is also the world's third largest nitrogen and potash consumer and fourth largest consumer of phosphates (*Fertilizer International* 522, p14)

The United States has developed a large-scale and responsive domestic fertilizer industry to satisfy the high demand

PHOTO: MOSAIC

State-of-the-art remote operations station at Mosaic's Integrated Operations Center, Lithia, Florida.

Fig. 1: **US fertilizer production: Location of main phosphate and potash production plants together with top 10 urea production plants by capacity**



FLORIDA – WHERE IT ALL STARTED

PHOTO: NUTRIEN

Wetlands restoration at Nutrien's White Springs production site in Florida.

Florida's pre-eminence as a phosphate-producing region dates back to the industry's earliest days. Phosphate rock deposits near Hawthorne in Alachua County were the first to be mined in 1883.

The discovery of exceptionally large phosphate reserves in Florida during the late 19th century came at a time when agriculture was also of increasing importance to the state's burgeoning economy. Although phosphate mining was a primitive affair in those pioneering times, early Florida settlers were quick to recognise the agronomic benefits of phosphate, which were readily apparent when applied to the citrus trees they were planting in ever larger numbers.

Florida leads, others follow

Indeed, the presence of abundant citrus groves on its doorstep provided Florida's nascent phosphate industry with a ready-made market. It was this near-perfect match of supply and demand in Florida that created ideal conditions for a number of crucial and landmark mining and production innovations. In the 1920s and 1930s, a growing market, and the drive for greater efficiency and lower costs, provided all the incentives necessary for the introduction of draglines and the development of flotation and other beneficiation technologies.

As process engineering improved, and agricultural knowledge also grew, Florida's phosphate producers introduced new downstream processes, pioneered by the Tennessee Valley Authority (TVA) in the 1960s, to manufacture more concentrated phosphate fertilizers. The new high-analysis products –monoammonium phosphate (MAP) and diammonium phosphate (DAP) – were able to deliver more phosphate to farmers at a lower cost. As a consequence, ammoniated phosphates ended up displacing superphosphate as Florida's primary fertilizer commodity. This development ultimately transformed what had been largely a mining industry in Florida into a chemicals business.

As the 20th Century progressed, Florida's state of the art phosphate production processes offered a mining and manufacturing template which others could learn from and follow. The landmark developments pioneered in the state became standard phosphate industry practice, setting an operational benchmark for the other phosphate-producing countries which have emerged around the world subsequently.

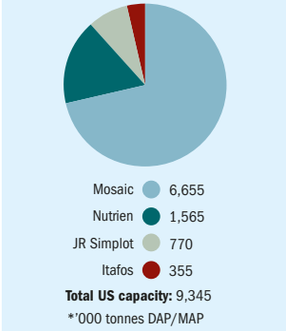
Eventually eclipsed

For decades during the post-war period, Florida enjoyed a commanding position globally as a supplier of phosphate rock and finished phosphate products. But since the 1990s the state's global hegemony has been increasingly challenged by the rise of other centres of phosphate production – in China, Morocco, India, Saudi Arabia, Russia, Brazil and elsewhere. Having once been a major phosphate import market, China, in particular, has transformed itself through a crash programme of industrialisation into the world's largest producer of finished phosphates and a net exporter.

Seamless reinvention

To its credit, North America's phosphate industry has neither stood still or been left behind. Instead, it has parlayed its world-class expertise to become the purveyor of process engineering, technology, products and services to the global phosphate industry (*Fertilizer International* 489, p31). North American phosphate producers such as The Mosaic Company, with acumen and foresight, have secured their competitive position and continued market access – via a programme of global acquisitions and investments, and by forging strategic partnerships internationally. ■

Fig. 2: **US phosphate producers, by capacity*, 2022**



Source: Nutrien (2024)

generated by its sizeable and sophisticated farming sector. By capacity, the country is the world's third and fourth largest phosphate and nitrogen fertilizer producer, respectively, as well as being the ninth largest potash producing nation globally.

Overall, the US fertilizer industry, is ranked fourth in the world, in terms of total production capacity (22.7 million nutrient tonnes), exceeded by China (81.0 million nutrient tonnes), Russia (31.5 million nutrient tonnes) and its northern neighbour Canada (27.1million nutrient tonnes)[1].

US fertilizer production is stable but in relative decline – with the country's capacity for phosphate and nitrogen fertilizers being overtaken by Morocco and India, respectively, in recent years.

US phosphate and potash industries

The US can draw on 9.3 million tonnes of domestic production capacity for diammonium phosphate and monoammonium phosphate (DAP and MAP). Following several decades of consolidation, phosphate industry ownership is highly concentrated (*Fertilizer International* 496, p40) with just four companies – Mosaic, Nutrien, JR Simplot and Itafos – operating nine DAP/MAP production sites across Florida, Idaho, Louisiana, North Carolina and Wyoming (Figure 1).

Florida-headquartered Mosaic is the

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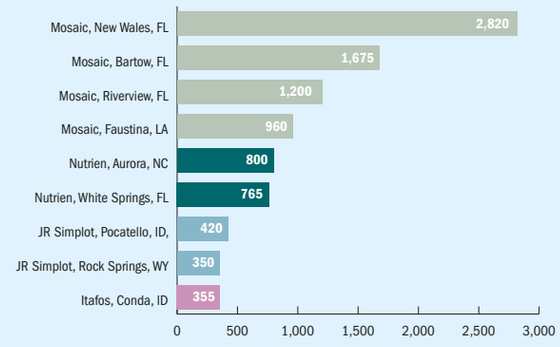
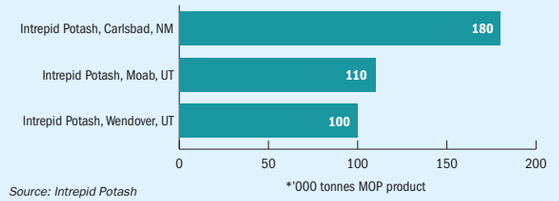
Fig. 3: **US phosphate production plants, by company, location and capacity*, 2022**



Source: Nutrien (2024)

Fig. 4: **US muriate of potash (MOP) production plants, by company, location and capacity*, 2023**



Source: Intrepid Potash

dominant US phosphates market player (Figure 2). It operates around 6.6 million tonnes of DAP/MAP capacity from four sites in Florida and Louisiana. This includes New Wales, the country's largest phosphates production complex (Figure 3).

Intrepid Potash is the sole US source of muriate of potash (MOP, KCl). The company has the capacity to produce around 365,00 tonnes of potash annually via solar evaporation from three mining sites (Figures 1 and 4).

Canada – preeminent in potash

Canada is the world's third largest producer of primary (NPK) plant nutrients, a position achieved thanks to the unequalled might of its potash industry and strengths in nitrogen manufacturing (*Fertilizer International* 490, p18). The country's fertilizer industry, while highly export oriented, also serves a large domestic agricultural market.

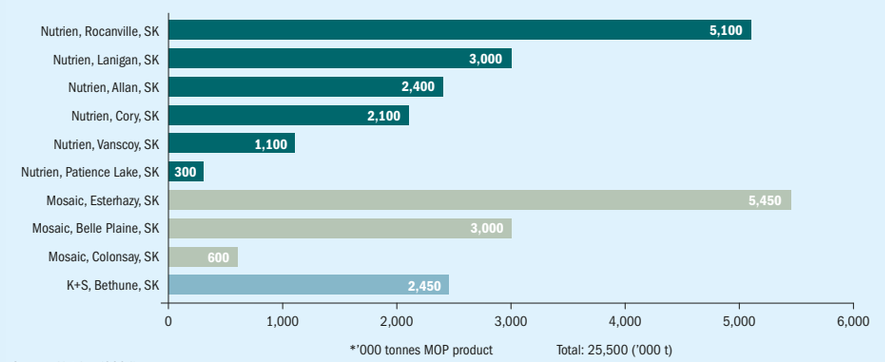
Some 95 percent of potash and 40 percent of nitrogen products are exported. In fact, Canadian fertilizers are traded with over 75 countries and represent some two percent of the nation's total exports. Importantly, Canada is ranked as the number potash producer globally, with 10 major operations in Saskatchewan providing production capacity in excess of 25 million tonnes (Figure 5).

Canada exported more than 22.4 million tonnes of potash in 2023, making it by far the world's largest exporter, the US, Brazil and China being the main export destinations. Consequently, potash exports are a major revenue earner for the country.

PHOTO: BHP

The 4.35 million t/a capacity Jansen S1 project is expected to produce its first potash ore towards the end of 2026, following a six-year construction phase. The project is located 140 kilometres east of Saskatoon, Saskatchewan.

Fig. 5: **Canadian muriate of potash (MOP) production plants, by company, location and capacity*, 2022**



Source: Nutrien (2024)

Fertilizer production (mining, processing and manufacture) in Canada is on the rise and generates $23.5 billion in economic activity and $12.7 billion in GDP. The industry supports over 76,000 jobs, directly and indirectly, throughout the supply chain and contributes over $5 billion in wages annually. ■

References

1. Nutrien, 2024. *2024 Fact Book*. Nutrien, Saskatoon.

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Dead Sea Works – delivering a profitable and sustainable potash future

The Dead Sea is a unique resource rich in dissolved minerals.

PHOTO: SHUTTERSTOCK/ICL

Potash is an essential and prized commodity that will always be in demand. ICL Group is investing in production from its unique potash assets to help secure global food security and contribute to a more sustainable world. The company uses a natural solar evaporation process at its Dead Sea Works plant to produce high-quality potash products, as **Dr Patricia Imas** ICL's Agronomy Content Manager & Commodities Specialist, explains.

Introduction

Potash may be under the radar for many people outside the agricultural sector and minerals industries. Yet, its role in crop production is indispensable. This makes potash fertilizers the world's most highly-valued and widely-used source of potassium – a key nutrient that is vital for healthy plant growth.

Indeed, with the world's population surpassing eight billion and projected to reach 10.4 billion by the end of this century, the demand for potash has never been more crucial. It's not merely a commodity either: the global production of potash is absolutely fundamental to global food security.

Potash has been an important commodity for centuries, being used in various industrial processes, including glass, ceramic, textile, and soap manufacture. While there are still important niche industrial applications for potash, the agricultural sector accounts for around 95% of potash demand. Along with nitrogen and phosphorus, potassium is a pillar of efficient, sustainable, and high yielding modern agriculture, as one of the three most essential crop nutrients.

This article explores the pivotal role that potash plays in industry and agriculture, and how this seemingly ordinary mineral helps to fuel our farms and feed the world. It also highlights the quality of potash products generated by ICL at its Dead Sea Works production site.

More than a world-class producer

ICL Group is one of the world's leading potash producers and manufacturer of potash-based fertilizers. The company, originally formed a century ago to explore and develop mineral reserves in Israel's Negev Desert, has unrivalled experience in managing potash mines and fertilizer production plants.

Israel is the world's 6th largest producer of potash and ICL has access to the country's vast Dead Sea reserves. It also mines potash in Spain through its ICL Iberia subsidiary. In total, the company currently extracts over 4.6 million tonnes of potash every year.

ICL has a strong presence in some of the largest global markets for potash and its fertilizer derivatives. These include China, Brazil, the EU, India, and South East Asia. The demand for potash is set to grow in many of these markets.

ICL potash operations in Israel and Spain have particularly reliable infrastructures and are located close to international cargo ports. The company – as well as being a major potash producer – is also a fertilizer industry leader when it comes to the integration of smart technologies, sustainable practices, and making progress towards net zero.

Agricultural importance

With the United Nations predicting global population to peak at 10.4 billion later this century, feeding every human on the planet will continue to be a major challenge. That's especially true as we face issues like global warming, extreme weather events, soil erosion, and geopolitical instability.

An adequate supply of affordable and environmentally safe fertilizers is therefore crucial. Any increase in potash prices, for example, can result in rapid rises in the price of food staples and natural fabrics like cotton.

PHOTO: SHUTTERSTOCK/ICL

Valuable minerals and elements are harvested from the Dead Sea, one of the world's most abundant, enduring, and cost-efficient sources of potash and bromine.

Potassium plays an important role both in plant and in soil health. Some of the major benefits of this macro nutrient include:

- Higher crop yields
- Increased nutritional density and value
- Better crop quality – with improvements in the taste, colour, and texture of fruits and vegetables
- Stronger, more robust plants with greater stress tolerance
- Improved plant resistance to disease
- Helping plants properly regulate their water use.

A distinctly different potash process

In contrast to conventional potash ore mining and processing, ICL uses a natural solar evaporation process at its Dead Sea Works site to produce exceptionally pure potash products. These are recognised worldwide for their premium quality, organic certification and significantly lower carbon footprint, versus the potash produced by other standard methods.

Potash production at Dead Sea Works involves extraction and precipitation of carnallite, a compound comprising potassium chloride (KCl) and magnesium chloride mixed with sodium chloride (NaCl), in some of the largest solar evaporation ponds in the world. Subsequently, the carnallite is transferred to production plants, where chemical and physical processing breaks down the carnallite crystals into potash, using cold crystallisation and hot leach technologies.

The resulting potash end-products are among the most highly concentrated available on the market, in comparison to those offered by other producers, with a grade of around 62% K_2O. The company also uses its potash as an in-house starting material for fertilizer production, including for granular NPK and water-soluble NPK fertilizers.

As well as having a focus on quality, ICL is equally committed to implementing sustainable practices in potash mining and fertilizer production. This includes transforming production plants to run on clean energy and developing profitable 'circular' business practices across its worldwide mineral extraction and production operations. This innovative approach to potash production helps to minimise environmental impacts and sets a high benchmark in sustainable fertilizer manufacturing.

> **"ICL uses a natural solar evaporation process at its Dead Sea Works site to produce exceptionally pure potash products. These are recognised worldwide for their premium quality and significantly lower carbon footprint."**

A massive market

The global potash market is hugely valuable – being measured in billions of dollars – due to its vital role as a crop nutrient and the scale of demand internationally. Niche industrial requirements aside, sufficient potash supplies are essential to meet the extra requirements of an agricultural sector that is ever expanding – in response to the increased demand for crops grown for human consumption, animal feed, and clothing like cotton.

ICL's Dead Sea Works production complex in Sodom, Israel.

PHOTO: SHUTTERSTOCK/ICL

The reason potassium is such an essential plant nutrient – vital for plant health, growth, and resilience – is because it participates in unique metabolic functions with no known substitutes. This irreplaceability underscores an urgent message: sustainable supplies of potash are necessary to guarantee global food security. Given its unparalleled value, ICL believes that the quest for sustainable potash extraction methods, in tandem with efficient agricultural usage, is becoming ever more crucial.

While its price per tonne will fluctuate like any other commodity, potash is an essential and prized asset that will always be in demand. Market forecasters all envisage long-term growth for potash from all segments of the supply chain – from extraction to manufacturing and retail sales.

Indeed, the global potash market is already experiencing significant growth. The market size was estimated at around $60 billion in 2023 and is projected to grow at a compound annual growth rate (CAGR) of 4.5% between 2024 and 2032. This growth is driven by a rising global population and the corresponding demand for food and agricultural products.

ICL's extraction and processing operations

Potassium, in its various forms, makes up 2.6% of the earth's crust. There are major potash basins, viable economic deposits and potash mines scattered across the world, while potential reserves below the

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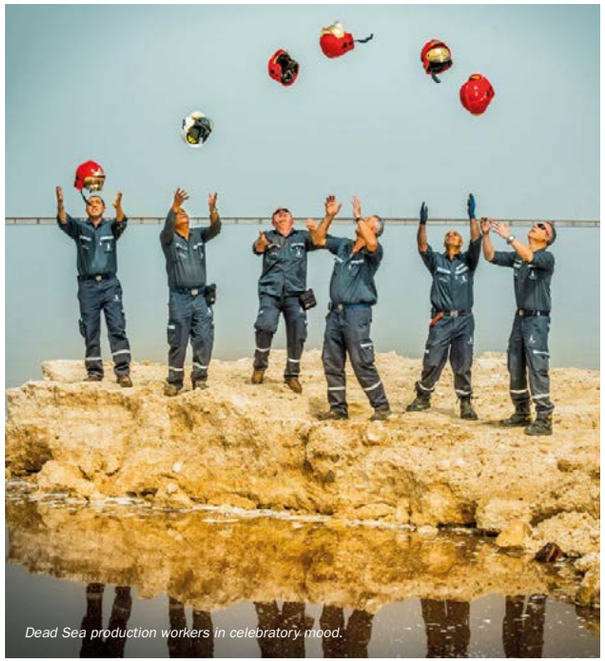
PHOTO: ICL



Dead Sea production workers in celebratory mood.

seabed have barely begun to be explored.

ICL extracts potash at its Dead Sea Works production site in Israel. This employs over 1,500 full-time staff with annual potash extraction alone exceeding four million tonnes. Bromine, sodium chloride, and other minerals extracted from the Dead Sea are also processed for international shipping.

The company's Dead Sea operations are becoming increasingly energy- and water-efficient thanks to a continuous focus on sustainability. Five dedicated sustainability teams are tasked with improving and innovating in the following areas:

- The circular economy
- Greenhouse gas (GHG) emissions reduction and energy efficiency
- Waste reduction and green procurement
- Biodiversity
- Human resources.

ICL Iberia, meanwhile, extracts sylvinite ore from 900 metres below the ground at its Catalonian potash mine in Suria near Barcelona. This is processed into potash and salt at nearby production plants and then shipped to international markets via a dedicated state-of-the-art potash terminal at the Port of Barcelona.

The new terminal, inaugurated in 2020, is partly powered by rooftop solar panels, and offers an annual ship loading capacity of four million tonnes. Long-term agreements with the Catalan Railway Authority are cutting carbon by shifting potash and salt transportation between Suria and the terminal away from trucks and onto rail.

An investment opportunity

Agriculture is arguably the single most important sector of the global economy. After all, without a functioning agricultural system there is nothing. Potash is an integral component of global agriculture, being vital for growing abundant and nutritious staple crops, both as food for humans and feed for animals. Demand for food products is expected to rise – accompanied by potash market growth – as the human population expands and standards of living rise.

As already stated, the potash market has a projected compound annual growth rate (CAGR) of 4.5% and is expected to exceed $90 billion in value by 2032. This places companies such as ICL, that can optimise potash extraction and production by adopting 'smart' technologies and also benefit from access to superior logistics, at a significant advantage.

Ready for potash market growth

As already suggested, potash market predictions are largely positive and companies that can extract or process potash efficiently therefore have plenty of lucrative markets to target.

ICL is not dependent on one single source of raw materials. Neither is it dependent on any single market for its sales of potash fertilizers and other niche potash products. The company also aims to drive down its potash production costs through the use of smart operations, the implementation of circular economy practices, and capturing economies of scale.

As part of ICL's commitment to achieving global food security (in line with the United Nations' Second Sustainable Development Goal of Zero Hunger), the company is investing heavily in agricultural technology and developing effective crop nutrient and agronomic solutions for marginal land. ICL has abundant reserves of potash and intends to use this basic natural resource to benefit humanity as a whole. Its unique portfolio of precision potash-based fertilizers is one example of how technology and innovation are already helping to feed the world.

> **"Potash is an essential and prized asset that will always be in demand. Market forecasters all envisage long-term growth for potash from all segments of the supply chain - from extraction to manufacturing through to retail sales."**

Ready to invest in a future where profitability meets sustainability? Then please contact ICL to learn more about investment opportunities that support potash growth, help secure global food security, and contribute to a more sustainable world. ■

Optimising phosphoric acid supply chains

The dicalcium phosphate (DCP) generated by chemical beneficiation offers distinct advantages as a phosphoric acid feedstock. Prayon's **Marc Sonveaux** outlines how chemical beneficiation can transform current industry supply chains – and provide phosphate producers with an opportunity to reduce waste generation and improve phosphoric acid purity, while maintaining global competitiveness.

Phosphoric acid production – a global perspective

Phosphoric acid is a vital industrial chemical. Its production from naturally-occurring phosphate rock – mined in various regions across the globe – typically follows one of two pathways:

- **Integrated production:** the phosphate rock is processed into phosphoric acid in a production complex located near the mining site.
- **Non-integrated production:** phosphate rock is sold on the merchant market and delivered to a different location or country where its conversion to phosphoric acid then occurs.

Prayon's well-known non-integrated phosphate complex at Engis in Belgium (see photo) is a good example of this supply chain model. It consumes phosphate rock feedstock imported from different locations and then converts this into phosphoric acid. Specific to this plant – thanks to Prayon's CPP phosphoric acid process – is the generation of a high-quality gypsum co-product usable in plaster production. Crucially, achieving this virtuous combination (a sophisticated, efficient process that provides a clean, marketable co-product) relies on the quality of the phosphate rock feedstock.

Let's examine another emerging case of non-integrated production – this time from the United States. Historically, Florida has been a major producer of high-grade phosphate rock. However, as the quality of US domestic reserves has gradually declined, the state's producers have increasingly looked for alternative rock sources as part of their buying strategy. This has resulted in increasing phosphate rock imports from South America where vast deposits exist, in Peru or Brazil, for example.

These non-domestic phosphate feedstocks are usually beneficiated close to the mine and are then transported to the US as rock concentrates. These typically have a 30-32% P_2O_5 content.

Imported rock – processing challenges

As a natural resource, phosphate rock inevitably contains various unwanted 'gangue' elements as well the desired and economically valuable P_2O_5 content. These impurities introduce the following

PHOTO: PRAYON

Prayon's phosphate production complex at Engis in Belgium.

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complications and drawbacks during phosphoric acid production:

- **Calcium (Ca):** High calcium content leads to the generation of more phosphogypsum, a by-product that poses significant disposal challenges.
- **Silicates (SiO_2):** These dilute P_2O_5 concentration, increasing per tonne P_2O_5 transportation costs and potentially affecting process efficiency.
- **Heavy metals (Cd, Pb, As, etc.):** These are elements of concern, due to their environmental and human risks, and partition/accumulate in either the phosphogypsum by-product or the main phosphoric acid product.
- **Magnesium (Mg), aluminium (Al), and iron (Fe):** These so-called minor elements are deleterious to phosphoric acid production and operational efficiency due to their negative effects on viscosity (Mg), yield (Fe) and potentially crystallisation, filtration and acid concentration.
- **Organic matter:** Its presence causes foaming issues and affects the purity of phosphoric acid and gypsum.
- **Radionuclides (U, Th, etc.):** The presence of radionuclides can limit the potential applications of phosphogypsum by making it unsuitable for use in the construction industry.

Phosphate rock handling and transport logistics are other factors that can be problematic for the supply chain. Imported phosphate rock typically requires beneficiation to generate a phosphate rock concentrate that meets the necessary quality standards for phosphoric acid production (P_2O_5 content of around 30%). This beneficiation process requires substantial investment in utilities while the use of chemical reagents add to costs.

Dreaming of the ideal phosphate source

For a phosphoric acid plant to operate sustainably at its maximum efficiency, what would the ideal phosphate rock feedstock look like? Here are some suggestions:

- **Highest possible P_2O_5 content:** Consumption of better quality rock – with a higher P_2O_5 concentration – will lower transportation costs and increase production efficiency, while reducing phosphate rock consumption and the usage of utilities.
- **Low Ca/P ratio:** Minimising calcium content, relative to P_2O_5, helps reduce both sulphuric acid consumption and gypsum generation.
- **Low impurities/less gangue:** Lower levels of unwanted elements improves both process efficiency and phosphogypsum quality, while reducing waste generation and process reagent/chemicals consumptions.
- **Low radioactive content:** Using a rock feedstock as free as possible from radionuclides allows the safe and versatile use of the phosphogypsum by-product in a variety of different end-uses.
- **Optimal particle size:** The phosphate rock concentrate should be fine enough for rapid and effective sulphuric acid digestion while avoiding excessive dust content.
- **Cost-effective production:** The phosphoric acid process step should limit or reduce overall phosphate fertilizer production costs.

Thankfully, finding such a perfect phosphate feedstock is neither a dream or a matter of luck – it is available now thanks to innovative chemical beneficiation technologies. These represent a major scientific advance in the beneficiation process.

Shift to global DCP-based supply chains?

Chemical beneficiation is one highly promising solution for overcoming the challenges of phosphate rock impurities – specifically when this produces a dicalcium phosphate (DCP) feedstock for the phosphoric acid process. Valuably, the chemical synthesis of DCP from lower-grade phosphate rock effectively removes most impurities, generating DCP as a superior alternative feedstock for phosphoric acid plants.

Prayon has developed two proprietary technologies for DCP synthesis:

- **The GetMoreP process** – based on sulphuric acid digestion of phosphate rock
- **The Ecophos process** – based on hydrochloric acid digestion (with the option to recycle HCl).

Prayon has developed both these technical solutions to maximise the benefits of using DCP as a phosphoric acid plant feedstock. This now makes it possible to implement efficient and cost-effective global supply chains based on DCP – via the following steps:

Firstly, at the phosphate rock mining site prior to transport to phosphoric acid plants:

- **Extraction, crushing and grinding:** Mined phosphate rock is reduced to between 0.5-1 mm in size.
- **Acid dissolution:** Ground phosphate rock is dissolved in either dilute sulphuric acid (GetMoreP process) or hydrochloric acid (Ecophos process). The P_2O_5 enters solution while insoluble impurities are separated out.
- **DCP precipitation:** Calcium carbonate or lime is added to precipitate P_2O_5 as purified DCP.

Then, on arrival at the phosphoric acid plant:

- **Feedstock substitution:** Conventional phosphate rock feedstock is replaced with DCP to improve overall process efficiency.

Table 1 compares typical phosphate rock quality with that of a DCP feedstock generated by chemical beneficiation.

Table 1: **Quality of typical low-grade rock versus that of an alternative dicalcium phosphate (DCP) feedstock generated by chemical beneficiation**

	Low-grade phosphate rock	DCP feedstock
P_2O_5 (%)	24	39-41
CaO (%)	45	28-33
F (%)	2.90	0.1-1.5
Al_2O_3 (%)	0.40	0.01
Fe_2O_3 (%)	0.20	0.1
MgO (%)	3.20	0.05 (minimum)
SiO_2 (%)	7.30	0.06

Source: Prayon

DCP feedstocks – advantages and challenges

While the use of DCP feedstock offers significant advantages, a number of challenges should also be addressed to maximise the profitability of this chemical beneficiation approach.

In terms of DCP's advantages – versus low-grade phosphate rock – at the mine and during transportation:

- It reduces or eliminates the need for traditional beneficiation.
- Removes most impurities at the mining stage, reducing contamination risks in subsequent production stages.
- The lower grinding requirement saves on energy costs.
- Waste acid sources can be used in its production.
- Lower levels of impurities and higher DCP grade (38–45% P_2O_5) reduce transports costs per tonne of P_2O_5.

DCP also offers additional advantages at the phosphoric acid plant:

- **Lower calcium-to-phosphate ratio:** Reduces gypsum generation.
- **Cleaner process:** Produces purer phosphoric acid and cleaner gypsum.
- **No more impure phosphogypsum:** Generates clean gypsum instead.
- **Non-radioactive gypsum by-product:** Suitable for use in cement, plaster and plasterboard industries.
- **Increases plant operating capacity:** Lower sulphuric acid consumption and 50% less gypsum generation, combined with a higher phosphoric acid concentration, all result in higher plant capacity.

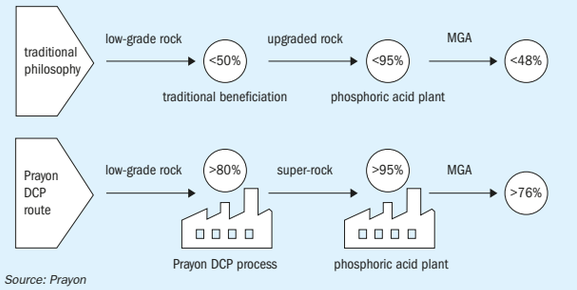
The DCP route also improves the overall global P_2O_5 yield of the process – from mining all the way through to phosphoric acid production (Figure 1).

The main challenges of substituting DCP for low-grade phosphate rock are:

- It requires capital investment in chemical beneficiation plant.
- It involves additional utilities usage and chemicals consumption at the mining site.
- Impurities removed by chemical beneficiation require proper handling and disposal or options for re-use.

These points need to be clearly addressed during the plant feasibility phase.

Fig. 1: **Adopting a dicalcium phosphate (DCP) route for phosphoric acid production can improve global P_2O_5 yield from less than 48% to more than 76%**



Source: Prayon

Case-by-case considerations

Each individual phosphate chemical beneficiation project needs to be carefully investigated by assessing the following variables:

- Raw material costs.
- Project-specific phosphate rock characteristics (types and levels of impurities, reactivity, etc.).
- Sourcing and availability of the acid required for chemical beneficiation.
- Access to water, electricity, chemical reagents and other utilities.
- Options for storing or commercialising by-products.
- Geographic location and space constraints for setting up beneficiation plants.

> **"Chemical beneficiation provides phosphate producers with an opportunity to enhance sustainability, reduce waste generation, and improve phosphoric acid purity, while maintaining global competitiveness."**

Prayon, through its in-house expert team and partnerships with leading engineering contractors, can design, validate and implement tailormade project solutions. The company's project services cover laboratory-scale validation, pilot and semi-industrial testing, economic feasibility studies, full-scale plant design, start-up support, and performance guarantees.

Conclusions

To secure the future of phosphoric acid production, the phosphate industry needs to address and overcome mounting challenges – including declining phosphate ore quality, rising beneficiation costs, and the need to improve its environmental footprint.

Additionally, import dependency for phosphate rock feedstocks is on the rise, both globally and more specifically in the US. Also, at a time when phosphate rock quality is in decline while fertilizer demand is growing, the cost and sustainability of traditional beneficiation methods are becoming less viable, in Prayon's view.

The DCP-based chemical beneficiation approach presented in this article offers a forward-thinking alternative, offering both environmental and economic advantages, although admittedly requiring upfront investment. This innovative method provides phosphate producers with an opportunity to enhance their long-term sustainability, reduce waste generation, and improve phosphoric acid purity, while maintaining global competitiveness.

In Prayon's view, embracing innovation by adopting new processing techniques – in response to regulatory pressures and rising global phosphate demand – will be crucial for the future resilience of the phosphate industry. ■

CRU Phosphates+Potash Expoconference 2025

Kevin De Bois of Prayon Technologies will be speaking on the use of innovative leaching technologies to address key phosphoric acid production challenges at the conference in Orlando on Wednesday 2 April at 09:00-09:30.

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Proven reagent innovations for phosphate flotation

In comparison to the conventional 'Crago' froth flotation process for phosphate ore beneficiation, the new reagent schemes introduced in this article achieve superior rougher flotation performance without requiring pH control during conditioning. As Arkema's **Guoxin Wang** and **Zhengxing Gu** explain, this approach eliminates the need for diesel or fuel oil, simplifies the flotation process, and utilises more sustainable reagents.

Introduction

Phosphate ore mining and beneficiation involves multiple stages including: matrix mining, slurry transportation, washing, sizing, froth flotation, product handling, waste disposal, and water management.

The froth flotation of sedimentary phosphate ore practiced in Florida is typically divided into two circuits based on feed particle size. The coarse flotation circuit handles the -14+35-mesh fraction, while the fine flotation circuit processes the -35+150-mesh fraction.

The flotation circuit, an integral part of phosphate beneficiation, primarily uses the 'Crago' process developed in the 1940s. In this process, the phosphate feed is conditioned with a fatty acid collector and fuel oil or diesel as a secondary collector at a pH range of 9.0 to 9.3, with pH controlled using soda ash or ammonia. The rougher concentrate – consisting of phosphate and some fine quartz particles – is firstly scrubbed with sulphuric acid to remove fatty acids from phosphate particle surfaces and then undergoes a further flotation stage with an amine collector to obtain the final phosphate concentrate.

However, the use of fuel oil or diesel in the Crago process raises significant environmental concerns, due to their slow biodegradation compared to other reagents like fatty acids. Additionally, they may contain hazardous substances such as benzene, toluene, ethylbenzene, and xylene. The process also requires pH control, which complicates beneficiation and poses handling issues, particularly when hazardous pH modifiers like caustic soda and ammonia are used.

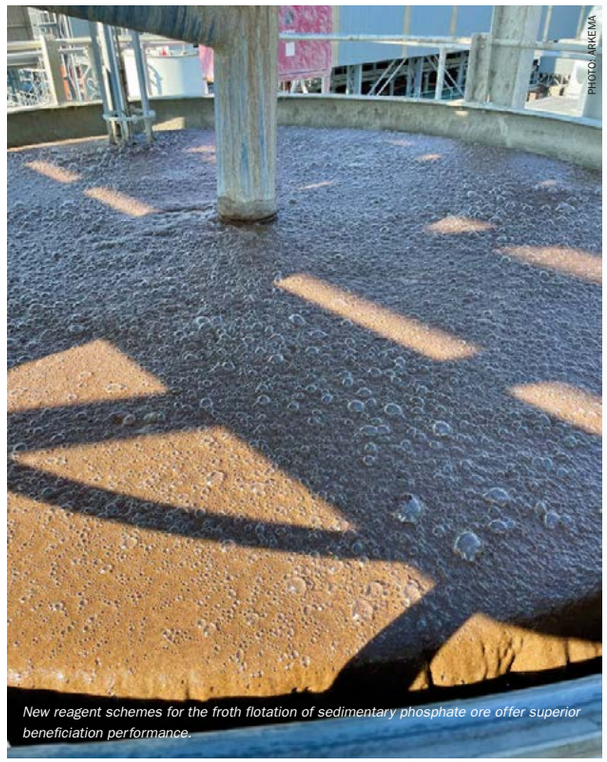


PHOTO: ARKEMA

New reagent schemes for the froth flotation of sedimentary phosphate ore offer superior beneficiation performance.

In recent years, Arkema has focused on developing new reagents for rougher flotation circuits that eliminate the need for pH modifiers and diesel (or fuel oil). These new reagent schemes simplify the flotation process, utilise more sustainable reagents, and enhance environmental stewardship.

In this article, phosphate feed samples from various mines were beneficiated using the rougher flotation circuit of the Crago process. We discuss the results of laboratory studies and plant trials and highlight the positive outcomes obtained for the new reagent schemes in three case studies.

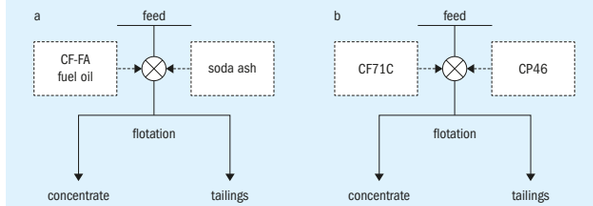
Case study 1: Mine A – without pH modifier and fuel oil (patent granted)

In Mine A, the feed for the traditional rougher flotation process was conditioned with CustoFloat® FA (CF-FA) as the primary collector and fuel oil (FO) as the secondary collector in a 70:30 ratio, at a pH of 9.3, adjusted with soda ash (SA) as a pH modifier. After rougher flotation, the concentrate underwent acid scrubbing and amine flotation to produce the final concentrate.

Arkema developed a new collector, CustoFloat® 71C (CF71C), to streamline the process and eliminate the need for fuel oil. In this patent-granted reagent scheme, the feed was conditioned with the new CustoFloat® 71C collector and the promoter CustoPrep® 46 (CP46) without using fuel oil or a pH modifier.

Figure 1 illustrates the simplified flotation flowsheets of both the traditional and the new reagent schemes. During the tests, the dosage of CustoPrep® 46 was varied at a fixed level of CustoFloat® 71C, and vice versa. Tables 1a and 1b summarise the lab and plant flotation results. The results show that the new reagent scheme achieved higher P_2O_5 recovery while eliminating the need for fuel oil and pH modifiers.

Fig. 1: **Simplified rougher flotation flowsheet for Mine A: a, traditional reagent scheme with fuel oil and soda ash; b, new reagent scheme without fuel oil and soda ash**



Source: Arkema

Table 1b: **Plant Trials at Mine A - Eliminating pH Control and Fuel Oil**

	Test reagents		Existing reagents			
Variable	average	STDEV	average	STDEV	difference	% confident
Feed P_2O_5	3.2	1.6	4.0	5.7	-0.8	89.8
Concentrate P_2O_5	17.2	8.8	15.2	7.7	2.1	96.7
Recovery, %	87.5	15.8	86.1	18.6	1.4	89.0

Source: Arkema

Table 1a: **Flotation results with traditional and new reagent schemes for Mine A feed**

Collector	FA g/t	FO g/t	SA g/t	CP46 g/t	pH	feed	concentrate		tailings		recovery
						P_2O_5%	P_2O_5%	Wt.%	P_2O_5%	Wt.%	
CF-FA/FO 70/30	132	59	168		9.3	4.60	28.09	14.60	0.59	85.40	89.13
	177	77	182		9.3	4.68	27.45	16.18	0.29	83.82	94.86
	222	95	195		9.3	4.56	25.76	17.10	0.19	82.90	96.56
	263	114	209		9.3	4.70	24.45	18.79	0.13	81.21	97.72
CF71C	254			132		4.67	26.78	16.70	0.23	83.30	95.84
	254			259		4.68	25.69	17.68	0.16	82.32	97.10
	254			390		4.64	24.10	18.72	0.16	81.28	97.26
	254			518		4.44	22.41	19.45	0.10	80.55	98.20
CF71C	191			259		4.55	25.13	17.60	0.16	82.40	97.18
	254			259		4.68	25.69	17.68	0.16	82.32	97.10
	318			259		4.56	24.93	17.79	0.15	82.21	97.25
	381			259		4.53	24.87	17.76	0.13	82.24	97.59

Source: Arkema

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Summary of Mine A results:

- A month-long trial was conducted yielding positive results even with a lower feed grade
- The new reagent system resulted in higher rougher concentrate grade, leading to approximately 15% less CustAmine® consumption for silica flotation and an approximate 4% increase in overall recovery
- No soda ash needed for pH control
- Lower collector usage.

Case study 2: Mine B – without saponification and diesel (patent pending)

In Mine B, the fatty acid (FA) type collector is traditionally pre-saponified with soda ash, preparing it as a 5% soap dispersion, and the feed is conditioned prior to phosphate flotation with a soap collector and diesel at about 70% solids. Arkema formulated a new fatty acid type collector, CustoFloat® 390 (CF390), for Mine B. This new collector eliminates the need for pre-saponification and diesel, simplifying the process and potentially enhancing results.

Figure 2 shows the simplified flotation flowsheets for both the traditional and new reagent schemes. The flotation results for Mine B's feed are summarised in Table 2. Notably, the new reagent scheme achieves better P_2O_5 recovery compared to the traditional regent scheme.

Summary of Mine B results:

- No diesel was consumed during the trial
- No soda ash was consumed (i.e., no saponification), simplifying the process
- Reduced sulphuric acid consumption for de-oiling
- Collector consumption was reduced
- Improved recovery.

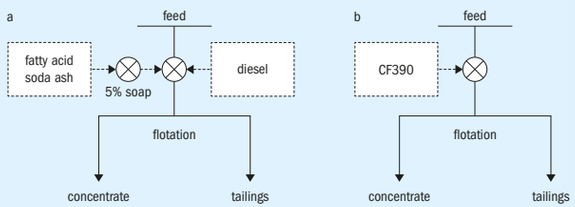
Case study 3: Mine C – without saponification and diesel

In Mine C, the ore is mined and initially sized at 35 mesh (0.425 mm) to reject low P_2O_5 oversize waste, and then further sized at 65 mesh (0.212 mm) to obtain the -35+65 mesh (-0.425+0.212 mm) coarse feed. The minus 65 mesh fraction is deslimed at 400 mesh (0.038 mm) to remove fines, resulting in a -65+400 mesh (-0.212+0.038 mm) fine feed.

Traditionally, the beneficiation plant used a fatty acid soap collector and diesel for both the coarse and fine feeds in the flotation process. The rougher concentrate is then acid scrubbed, rinsed and amine flotation is then carried out to produce the final concentrate. Recently, a new reagent scheme was recommended for the rougher floatation circuit. This introduced CustoFloat® 391, a fatty acid collector, to replace the combination of soap and diesel used in the original flowsheet.

The lab flotation results for both coarse and fine feeds, using the traditional and new reagent schemes, are summarised in Table 3. Results confirm that the new reagent scheme achieves similar or better flotation performance, with significantly lower reagent consumption, while also eliminating the use of diesel. This new scheme has been in commercial use since 2022.

Fig. 2: **Simplified rougher flotation flowsheet for Mine B: a, traditional reagent scheme with saponification and diesel; b, new reagent scheme without saponification and diesel**



Source: Arkema

Table 2a: **Flotation results with traditional and new reagent schemes for Mine B**

Reagent	FA g/t	FO g/t	feed	concentrate		tailings		recovery
			P_2O_5%	P_2O_5%	Wt.%	P_2O_5%	Wt.%	%
Conventional collector	372	150	15.68	28.58	51.13	2.17	48.87	93.24
	558	222	15.62	28.57	51.70	1.75	48.30	94.59
	740	295	15.65	28.31	52.78	1.49	47.22	95.50
CustoFloat® 390	372		15.42	27.37	54.64	1.28	45.79	96.20
	558		15.73	28.14	54.21	0.77	45.36	97.78
	740		15.61	27.48	56.19	0.38	43.81	98.93

Source: Arkema

Table 2b: **A Month-long Plant Trial at Mine B**

	Feed P_2O_5	recovery	conc. P_2O_5	insol.	difference
KPI	15%+	88%+	26-27%	12-13%	
CF390	13.30%	91.20%	26.50%	13.40%	-16%

Source: Arkema

Table 3: **Flotation results with traditional and new reagent scheme for Mine C**

Reagent	soap g/t	DO g/t	total g/t	feed	concentrate		tailings		recovery
				P_2O_5%	P_2O_5%	Wt.%	P_2O_5%	Wt.%	%
Soap and diesel	800	357	1157	10.21	31.656	178.90	2.90	525.30	78.79
	1000	393	1393	10.15	30.687	210.70	1.47	498.70	89.79
	1200	429	1629	10.14	30.495	218.90	0.75	474.30	94.97
	1500	393	1893	10.29	28.181	252.50	0.29	451.90	98.21
CustoFloat® 391	240		240	10.36	32.729	215.30	0.67	497.00	95.46
	360		360	10.61	29.674	251.80	0.07	454.90	99.61
	480		480	9.93	28.58	247.50	0.03	466.30	99.81

Source: Arkema

Conclusions

The conventional 'Crago' flotation process for the beneficiation of sedimentary phosphate ore typically involves conditioning the phosphate feed with a mixture of a fatty acid type collectors and fuel oil (or diesel) at alkaline pH, with solids exceeding 70% for rougher flotation. In contrast, the new reagent schemes described in this article achieve superior rougher flotation performance without requiring pH control during conditioning.

This approach eliminates the need for diesel or fuel oil, simplifies the flotation process, and utilises more sustainable reagents, contributing to enhanced environmental stewardship. Subsequently, these new reagent schemes have been successfully commercialised, offering more efficient alternatives to traditional flotation methods.

It is important to note that, in general, there is no 'universal' reagent or reagent scheme for phosphate ore processing. Instead, reagents need to be developed according to the specific characteristics of each phosphate ore.

As shown in this article, Arkema's new reagent schemes, designed for various phosphate ores from different phosphate mines, have demonstrated satisfactory separation performance without the need for fuel oil, diesel, or pH modifiers required in conventional phosphate processing flowsheets. The success of these new schemes has been proven through beneficiation plant trials and subsequent commercial operations. ■

> **"Arkema's new reagent schemes, designed for various phosphate ores from different phosphate mines, have demonstrated superior separation performance without the need for the fuel oil, diesel, or pH modifiers required in conventional phosphate processing flowsheets."**

CRU Phosphates+Potash Expoconference 2025

Guoxin Wang of Arkema will be available to discuss flotation technology at the conference in Orlando.

Note: CustAmine, CustoFloat and CustoPrep are registered trademarks of the Arkema Group of Companies.

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PHOTO: MISR PHOSPHATE

Phosphates project listing 2025

Conveying crushed phosphate rock.

Fertilizer International presents a global round-up of phosphate rock, phosphoric acid and finished phosphates projects.

Phosphate rock*

Plant/project	Company	Location	capacity ('000 t)	Status	Start-up date
ANGOLA					
Cabinda project	Minbos Resources	Cacata	187	UC	2025
AUSTRALIA					
Paradise South	North West Phosphate	Mount Isa, Queensland	1,000	UC	n.a.
BRAZIL					
Irece expansion	Galvani	Bahia	350	UC	2025
Tres Estradas	Aguia Resources	Rio Grande do Sul	300	n.a.	2025
CANADA					
Lac-a-Paul	Arianne Phosphate	Quebec	3,000	FS	n.a.
REPUBLIC OF CONGO					
Hinda	Kropz	Hinda	1,000	FS	n.a.
GUINEA-BISSAU					
Farim	Itafos	Guinea-Bissau	1,350	FS	n.a.

Excluding China. Standalone, non-integrated projects only. Generally only includes projects with a published feasibility study (FS).

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Phosphate fertilizer, phosphoric acid and integrated phosphate rock projects**

Plant/project	Company	Location	Product	capacity ('000 t)	Status	Start-up date
AUSTRALIA						
Ammaroo	Verdant Minerals	Northern Territory	Phosphoric acid (P_2O_5)	200	PL	2026
Ammaroo	Verdant Minerals	Northern Territory	DAP/MAP	410	PL	2026
BRAZIL						
Ouvidor	CMOC	Goias	TSP	76	C	2024
Serra do Salitre	EuroChem	Patrocinio, Minas Gerais	Phosphoric acid (P_2O_5)	200	C	2024
Serra do Salitre	EuroChem	Patrocinio, Minas Gerais	MAP	479	C	2024
Serra do Salitre	EuroChem	Patrocinio, Minas Gerais	MAP	192	UC	2026
EGYPT						
El Wadi	WAPHCO	Abu Tartur	Phosphoric acid (P_2O_5)	500	UC	2026
INDIA						
Tuticorin expansion	Greenstar Fertilizer	Tuticorin	Phosphoric acid (P_2O_5)	320	C	2024
Tuticorin expansion	Greenstar Fertilizer	Tuticorin	DAP	683	C	2024
IRAQ						
Khour Al-Zubair	AAA Holdings	Basra	DAP	500	C	2024
MOROCCO						
CP2M	OCP	Mzinda	Phosphoric acid (P_2O_5)	2,000	UC	2026-2028
CP2M	OCP	Safi	TSP	5,600	UC	2026-2028
Hub 1&2	OCP	Jorf Lasfar	TSP	1,000	UC	2025
OFAS	OCP/Fertinagro	Jorf Lasfar	TSP	500	C	2024
Phosphore 3&4	OCP	Jorf Lasfar	Phosphoric acid (P_2O_5)	520	C	2024
Phosphore 3&4	OCP	Jorf Lasfar	TSP	2,283	UC	2024-2025
Phosboucraa	OCP	Boucraa	Phosphoric acid (P_2O_5)	473	UC	2026-2027
Phosboucraa	OCP	Boucraa	TSP	946	UC	2026-2027
NIGERIA						
Lekki	OCP/NSIA	Lagos	DAP	250	n.a.	2027
RUSSIA						
Krasnodar	EuroChem	Byelorechensk	Phosphoric acid (P_2O_5)	137	UC	2027
Krasnodar	EuroChem	Byelorechensk	MAP	133	UC	2027
SAUDI ARABIA						
Third mega project	Ma'aden	Ras al Khair	Phosphoric acid (P_2O_5)	1,500	UC	2027
Third mega project	Ma'aden	Ras al Khair	DAP	3,260	UC	2027
SERBIA						
Prahovo	Elixir	Prahovo	MAP	52	UC	2026
TUNISIA						
M'dhilla II	GCT	M'dilla	Phosphoric acid (P_2O_5)	180	n.a.	2027
M'dhilla II	GCT	M'dilla	TSP	587	n.a.	2027

***Excluding China.*

KEY FOR BOTH TABLES

FS Feasibility study complete
PL Planned
UC Under construction
C Project completed
n.a. Not available
DAP Diammonium phosphate
MAP Monoammonium phosphate
TSP Triple superphosphate

PHOSPHATE TECHNOLOGY AND ENGINEERING PROFILES

Profile's model 30-220 tilting pan filter with a total surface area of 220 m². Installed at OCP's Jorf Lasfar phosphates production complex in Morocco.

Good years in perspective

Paul-Henri Legros, general manager, Profile, a division of Prayon s.a. provides a personal update on recent phosphate industry developments:

"Phosphoric acid production in 2024 faced significant obstacles yet achieved notable developments. Globally, the phosphoric acid market continues to grow, despite technological, environmental and regional challenges. This growth is driven primarily by the increased agricultural demand for fertilizers – in response to a rising global population and the need for more and better-quality food as well-being and livelihoods improve.

"Besides agriculture, more and more technical applications are also being developed which require phosphoric acid. Most major phosphate industry players, for example, are anticipating exponential growth in purified phosphoric acid (PPA) capacity in upcoming years for use in LFP car batteries.

"Our company, with its process division Prayon Technologies and equipment division Profile, is uniquely positioned. We not only serve phosphoric acid and phosphate fertilizer producers but also manufacture specialty phosphates ourselves. This makes us optimistic about the future of our business in the short- and mid-term.

"This optimism is reflected in CRU's own data. These forecast the addition of an extra 2.8 million tonnes (P_2O_5) of extra wet phosphoric acid (WPA) capacity between 2023 and 2028.

"Using our Prayon tilting pan filter, Profile is very proud to be helping deliver new production capacities for future years, across almost all producing countries. Impressively, between 2024 to 2027, we have already supplied and commissioned (or are contracted to do so) the following equipment items:

- Two x 260m² size filters to Saudi Arabia
- Six x 220m² size filters to Morocco
- Two x 260m² size filters to Egypt
- One x 220m² size filter to Jordan.

"For us, this is a very exciting industrial challenge – but it's also really motivating to be a game changer in the world of phosphoric acid production.

"Prayon is also very keen to play a major role in reducing the environmental impacts of phosphoric acid production. This is really where Prayon Technologies can make a difference through several innovations, new equipment and practices.

"By offering cutting-edge developments – such as methods for gypsum valorisation and the double filtration, DA-HF or the Ecophos phosphoric acid processes – we are making a real difference. These are providing the market with practical options to valorise low-grade phosphate rocks and increase their production output while improving energy efficiency and water management.

"Our customised and long-lasting production equipment is another strength and a real contribution to the world of tomorrow – as is equipment designed to manage and clean effluents. Prayon's droplet separators and gas scrubbing towers, for example, are very effective at recovering phosphoric acid and fluorosilicic acid, as well as removing cadmium or fluorine.

"At Profile, we are proud to see that our gas scrubbing towers have now moved outside the phosphate industry. In 2025, in collaboration with Prayon Technologies, we are helping an Australian rare earth producer to clean its effluent – an exciting development, for sure.

"Despite challenges, the outlook for phosphoric acid production remains positive, supported by technological innovation and sustainable practices. While it's taken several years post-Covid for the phosphoric acid market to blossom again, the future does now look very promising, both for equipment providers such as Profile and for our industry overall." ■

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Prayon Technologies (PRT)

Prayon Technologies (PRT), the licensing division of Prayon, is internationally renowned for its phosphate production technologies. Currently, plants fitted with Prayon technology are responsible for one third of worldwide phosphoric acid production. Prayon's notable achievements include more than:

- 130 references in over 30 countries
- 120 production processes
- 65 validated phosphate rock types.

Experts at PRT dedicate themselves to designing easily operable and highly reliable phosphoric acid plants. This expertise comes from the company's know-how and its track record with production plants gained during more than 70 years of experience. Prayon incorporates the very latest process developments into its plant designs to benefit all of the phosphoric acid producers the company works with.

PRT offers the widest range of technologies for phosphoric acid production. Each of the company's five processes has its own characteristics. This allows Prayon to offer its partners successful tailor-made production options. The ability to deliver operationally successful phosphoric acid plants is reinforced by incorporating premium-quality equipment specifically designed by Profile, the process filtration and liquid equipment division of Prayon.

Alongside the traditional route for producing feed phosphates from high-grade phosphoric acid, Prayon now offers two cutting-edge technologies that can use low-grade phosphate rock as a starting material. These innovative processes can significantly reduce production costs while generating feed phosphates of the same grade.

Prayon is aware that technological innovation will be vital for improving production processes to meet the needs of future generations. This includes developing technologies that are able to capture and use recycled raw materials. These will allow the phosphate industry to convert waste into valuable products while at the same time increasing the size of available phosphate resources.

PRT works closely with phosphoric acid producers to ensure they meet local environmental regulations. Reliable Profile-designed equipment, such as gas scrubbers and towers, enable businesses to reach high performance levels with close to zero emissions. The liquid bleed from these systems is either cleverly recycled into the process or concentrated to generate valuable co-products. Technologies are available to selectively remove deleterious and unwanted impurities (As, Cd, F, SO4, Mg. etc.).

Prayon has also developed leaching technologies – chemical beneficiation processes – for magnesium (Mg), cadmium (Cd) and total organic carbon (TOC). These can be added as stages between the existing mechanical beneficiation and the phosphoric acid plant. These beneficiation innovations will enable phosphate rocks with high Mg, Cd and TOC contents to be used in the production of high-grade fertilizers such as DAP, while meeting environmental standards and optimising production efficiency.

Our in-depth process knowledge and understanding is the key to getting the best from a phosphoric acid plant. Prayon, through its wide range of services, always accompanies the owner at each and every stage of their project – starting by providing a tailor-made plant design all the way through to offering consultancy services during plant operations.

The company's expertise encompasses:

- Lab to semi-industrial scale testing and validation
- Plant simulation training
- Technical surveys
- Operational excellence through data management and plant optimisation. ■

GEA Group

GEA is emerging as a leading technology and equipment provider to the phosphates industry. The Dusseldorf-headquartered group is one of the world's largest production technology and equipment suppliers and employs about 18,500 people across the globe. GEA generates around 70 percent of its revenues from the food and beverages sector – and is the technology leader in this market.

With more than 100 years of experience in crystallisation alone, the company offers a range of production plant technologies able to meet the diverse requirements of the phosphate and fertilizer industries. They include:

- Evaporators
- Crystallisers
- Membrane filtration units
- Centrifugal decanter and separators
- Spray and fluid bed dryers for drying crystals or granulation.

GEA specialises in the production of water-soluble monoammonium phosphate (MAP) from phosphoric acid. The innovative production technology offered by the company is capable of manufacturing high-quality water-soluble MAP from lower quality merchant grade acid (MGA). This ground-breaking process reduces opex and/or capex costs as it avoids the need to purchase more expensive purified phosphoric acid (PPA) or integrate a purification line within the fertilizer production plant.

GEA's manufacturing process can typically deliver a yield (i.e. the amount P_2O_5 recovered to the crystalline end-product vs the P_2O_5 contained in the feed acid) of between 50-70 percent. The exact yield depends on the impurity levels in the MGA and the purity/quality requirements (non-soluble content) of the final MAP product.

GEA's technology for water-soluble MAP production has already been successfully implemented by an Eastern European customer. The new plant avoided considerable capital and operational expenditure by allowing non-purified MGA to be used as the phosphoric acid feed, while still delivering a pure MAP fertilizer with a high market value as the end-product. As a fertilizer, the crystalline end-product offers the following key benefits:

- Avoids clogging problems on spray systems and pumps
- Suitable for fertigation, foliar applications and fertilizer blends
- Low turbidity after dissolution in water
- High-throughput processing
- Free of chlorine, sodium and other deleterious elements
- Moderate solution pH – safer and less corrosive
- Laboratory back-up, support and expertise. ■

De Smet Agro

De Smet Agro (DSAG) has been providing project management, engineering, procurement and construction management services to the fertilizer industry for more than 65 years. The company, a division of De Smet Engineers & Contractors, is based near Brussels, Belgium, with satellite offices in France, Morocco, and India.

DSAG has strong and globally recognised expertise in the engineering and construction of fertilizer complexes, working in collaboration with multiple partners and different technology licensors. This has enabled the company to deliver more than 250 industrial plants in 35 countries since 1957 – including numerous sulphuric, phosphoric acid and fertilizer granulation plants.

The multi-disciplinary team at DSAG offers engineering services for new 'greenfield' plants. The company also offers revamping and capacity improvement projects at existing production sites.

DSAG is recognised worldwide as the most experienced and wide-ranging licensee for Prayon Technologies (PRT), offering all of the company's industry-leading phosphoric acid production routes, and its processes for phosphoric acid derivatives and by-products. This longstanding cooperation with PRT, which dates from 1960, has delivered many notable project achievements globally.

DSAG has full in-house expertise for all the engineering, procurement and construction supervision steps needed to deliver phosphoric acid projects. (Prayon's process design package being the starting point for these activities.) The company's project capabilities cover the complete production process, from raw materials to the handling and storage of the final product. DSAG possesses in-depth expertise for:

- Single and double crystallisation phosphoric acid processes
- Phosphoric acid purification technologies
- Phosphate salt technologies, including those for animal feed and food phosphates, and new processes such as those for soluble fertilizers
- Dicalcium phosphate (DCP) processes (HCl- or H_2SO_4-based) including a phosphoric acid production process based on DCP
- Fluorine gas scrubbing
- Phosphoric acid concentration and fluosilicic acid recovery
- Phosphate rock solids or slurry handling and storage
- Acidic cooling tower design
- Gypsum transfer as solids or slurry, storage and valorisation.

Additionally, DSAG offers fully proven in-house technologies for nitrogen fertilizer production. The company's nitrogen process design expertise covers synthesis, evaporation, crystallisation, prilling and granulation units for clients all over the world. Specific areas of expertise include:

- In-house fluidised drum granulation technology for ammonium nitrate products (AN/CAN/ASN) and calcium nitrate (CN)
- Prilling of low-density ammonium nitrate (LDAN).
- Ammonium Sulphate (AS)

DSAG also offers a comprehensive range of construction services for fertilizer granulation. These services cover the construction of granulation units for:

- Monoammonium phosphate (MAP)
- Diammonium phosphate (DAP
- NPKs more generally.

The company's granulation expertise also includes the design of gaseous effluent cleaning systems.

To meet client or project needs, DSAG has the capability to team up with other recognised fertilizer technology providers/contractors, thanks to strong relationships built over decades. This provides industry customers with a single point of contact with complete responsibility for the delivery of their fertilizer projects.

DSAG provides a complete range of services to the fertilizer industry all around the world. These range from technical audits to the full delivery of EP and EPCM contracts and typically include:

- Technical audits
- Prefeasibility, feasibility studies, capex and opex estimates, including all on-site and off-site facilities
- Financial studies
- Overall project management
- Front-end engineering design (FEED)
- Basic and detailed engineering design
- Procurement
- Construction management and site supervision
- Training of client personnel
- Pre-commissioning and commissioning services
- Start-up assistance and performance guarantee tests. ■

Client: JPMC
Location: Aqaba, Jordan
Project: Revamping an existing phosphoric acid plant

Due to decreased phosphate rock quality, the phosphoric acid plant requires extra facilities such as a rock dryer, a tilting pan filter, a concentration line and an acidic cooling tower to maintain the original capacity and the required merchant grade acid (MGA) quality.

Image of the phosphoric acid plant modifications for JPMC at Aqaba.

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Reducing wear during size reduction

Factors such as hardness, abrasiveness, brittleness, moisture content, and friability determine the extent of wear on phosphate milling equipment. **Ian Hancock**, Vice President Sales and Operations, Bradley Pulverizer Company, offers expert advice on how to reduce wear during phosphate size reduction. This is becoming a critical issue as the industry moves toward processing lower-grade, high-silica phosphate rock.

Introduction

PHOTO: BRADLEY PULVERISER

Air-swept mill system.

Phosphate processing is a critical component of global fertilizer production, requiring efficient size reduction techniques to ensure optimal particle size and product quality. However, wear during milling operations remains a significant challenge, particularly when processing low-grade phosphate rock with high silica content. This article explores key considerations for reducing wear during phosphate size reduction. Advances in wear-resistant materials and mill design are also highlighted – together with operational strategies that improve equipment longevity and efficiency.

Milling technologies and wear considerations

The physical properties of phosphate rock are known to influence milling efficiency. Factors such as hardness, abrasiveness, brittleness, moisture content, and friability determine both the energy required for size reduction and the extent of wear on milling equipment.

Different milling technologies are employed in phosphate processing, each with varying wear characteristics. Commonly used mills include:

- **Vertical roller mills & pendulum mills:** Ideal for medium-hard phosphates with limited levels of impurities. These mills provide efficient grinding but are susceptible to wear from abrasive materials – although this can be mitigated for with the correct approach.
- **Impact mills (hammer, pin, chain mills):** While highly effective for particle size reduction of brittle materials, impact mills can suffer from rapid wear due to high-speed particle collisions.
- **Ball & rod mills:** Effective for finer grinding but require high containment due to dust generation.

Common wear issues

Wear is particularly prevalent in cyclones, ducts and grinding rolls. In phosphate milling, low-grade rock with high silica content accelerates this wear, especially because of the fine grind that is required for low-reactivity materials.

Common wear mechanisms include:

- **Impact wear:** Caused by particle collisions with mill surfaces, this requires softer wear materials like polyurethane or butyl rubber.
- **Attrition & shear wear:** In this type of grinding, surfaces require harder materials such as Hardox or chrome carbide.
- **Compression wear:** Increased surface degradation during high-pressure crushing necessitates advanced roll designs.

Advances in wear reduction – lining materials & component design

To mitigate wear resulting from impact, attrition and compression forces, the industry has adopted several innovative high-performance wear linings and coatings. Matching wear-resistant materials to specific wear causes can help reduce frequency of maintenance, mill downtime, operational costs and extend equipment life. General recommendations are as follows:

- Rubber (or soft) linings, including butyl and polyurethane (see photo), have proven effective in protecting mill bodies, grinding rolls, and support parts. These materials reduce abrasion in direct impact areas while maintaining process efficiency.
- Hardox or chrome carbide linings, in contrast, are better suited for low-angle impact zones. These hard linings can be used in cyclones, ducts, and classifier components for long-term abrasion resistance.
- Ceramic coatings, meanwhile, offer superior hardness and extended wear resistance when applied in high-stress areas.

To increase the useful life of wear parts, several improvements have been incorporated into the design and composition of common mill components. Adopting advanced geometry in roll designs & grinding media, for example, reduces material slippage and improves grinding pressure distribution. The use of new alloy compositions, by extending roll life, also reduces replacement frequency and maintenance costs.

Operational adjustments for lower wear

A proper assessment of operational parameters helps reduce wear in phosphate milling. Operators, by fine tuning independent parameters such as mill speed, feed material flow, and other process variables, can maximise production while minimising excessive wear and extending equipment service life. The following adjustments are generally advised:

- Optimising air velocity within the system is essential as it has a direct effect on wear.
- Pre-crushing phosphate rock before milling optimises the feed size to reduce stress on primary grinding units. Smaller particles generate less wear because they have lower kinetic energy and lower transport velocity.
- Adjusting moisture content will minimise clogging and cohesion-related wear.

Other successful operational strategies for wear reduction include predictive maintenance and real-time monitoring:

- IoT-enabled sensors, for example, track wear patterns and can help predict failures before they occur.
- Additionally, data-driven maintenance schedules can help ensure components are replaced before performance declines, so reducing unexpected downtime.

Conclusions

Reducing wear during phosphate size reduction is essential for maintaining processing efficiency, lowering maintenance costs, and enhancing equipment longevity. Phosphate producers can significantly enhance operational efficiency by adopting advanced wear-resistant materials, improved roll designs, and strategic milling practices. Innovations in milling technology and wear protection will play an increasingly critical role in sustaining productivity and cost-effectiveness as the industry moves toward processing lower-grade, high-silica phosphate rock. ■

CRU Phosphates+Potash Expoconference 2025

Ian Hancock of Bradley Pulveriser will be presenting on this topic at the conference in Orlando on Tuesday 1 April at 12:15-12:45.

PHOTO: BRADLEY PULVERIZER

Reinforced classifier with wear protected VBC rotor (main photo, left). The use of ALOX tiles and polyurethane coatings (close up, right) prevents abrasion in direct impact areas.

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