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Cover: Casale

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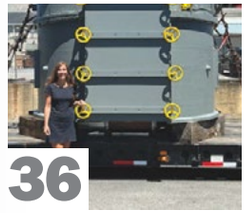
Dr Patricia Imas, 1961-2025



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Lancaster Products and Bradley Pulverizer: better together

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REGULARS

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New potash entrants at the door


Alexander Chreky, Analyst, Potash Market Services.

PHOTO: CRU

CRU's **Alexander Chreky**, Analyst, Potash Market Services, provides a potash market overview ahead of the CRU Phosphates+Potash Expoconference in Paris, 13-15 April.

For the third year in a row, 2026 is forecast to be yet another year of record potash demand. Following 2024 deliveries of 72.5 million tonnes, deliveries last year reached nearly 74 million tonnes, per CRU's latest estimate.

In good news for producers, potash prices in recent times have risen concurrently with ever growing demand – albeit largely on fears of supply shortages that ultimately failed to materialise.

Southeast Asia the standout performer

Globally, as deliveries reached new peaks in 2025, several growth engines stood out.

Brazil, following historical trends, continues to set new potash demand records, most of it imported. This has been driven by the country's agricultural powerhouse status, particularly expansions in the soybean and corn crop areas, both of which are heavy consumers of potash fertilizer.

Yet it was Southeast Asia, primarily Vietnam, Thailand, Indonesia, and Malaysia, which emerged as the standout performer in 2025, with regional potash demand growing by 23% year-on-year on the back of strong affordability supported by high palm oil prices.

Other regions lagged last year: the US saw poor farm economics and policy uncertainty hamper its potash demand; while India's demand remained stagnant amid low subsidy levels; and China's imports remained flat versus 2024, despite production issues in Qinghai affecting domestic supply.

Major exporters increase supply share

As demand has increased, supply has continued to concentrate among the major potash-producing countries: Russia, Belarus, and Canada. In 2022, these three countries accounted for 73% of global exports. This share has since risen to 78%. Yet this still remains below historical norms, with this trio previously having captured 80% of supply in the years prior to 2022.

Their failure to regain this supply share, despite record production from the major producers, underscores increasing supply diversification in recent times. The most notable example of this is the rise of Laos as a major supplier – with the country quadrupling it exports in four years. Additional capacity in Canada and Russia, despite new Chinese investments in places like Thailand and Congo, is likely to reinforce supply concentration over the longer-term.

New capacity looms

New capacity from both incumbent and new producers is set to reshape the market from 2027 onward. BHP, which has spent billions of dollars to establish itself as a potash major, is expected to begin production from its new Jansen mine next year. BHP also has plans to potentially add capacity in roughly four million tonne increments from 2031, pending final investment decisions. It enters the market with high ambitions, but will face stiff competition from Nutrien and Mosaic, as well as K+S's Canadian operations, for a share of an already well-supplied US market.

Internationally, competition could be even more intense. The capacity additions planned by EuroChem and Acron in 2027 and 2028 are comparable to, even in excess of, the volumes expected from BHP's Canadian mega project. If fully utilised, this capacity wave has the potential to push the market into deep oversupply, pressuring prices and the market's marginal producers. This could, in turn, drive consolidation in the potash industry as the landscape adjusts to a prolonged period of lower prices.

2026 – the prelude to increasing competition?

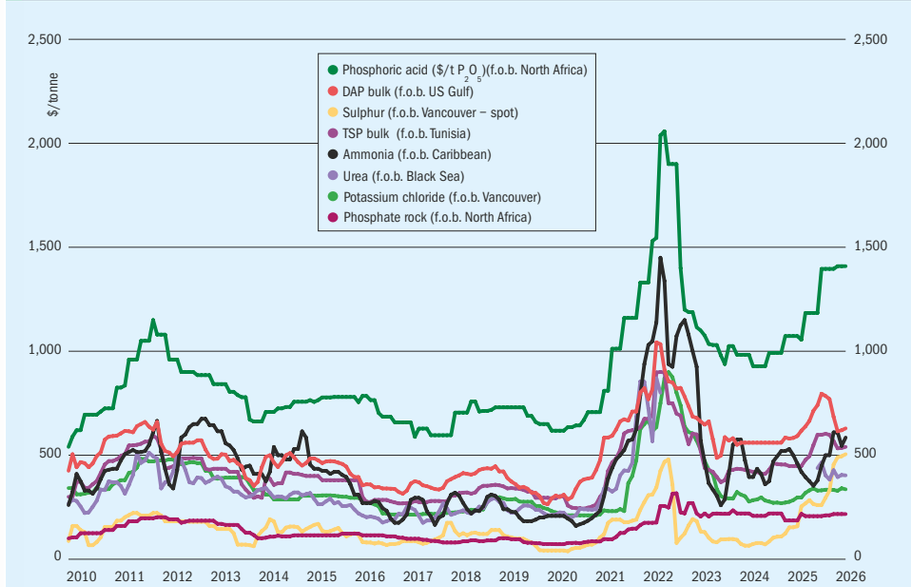
The potash market, having endured intense periods of oversupply previously, continues to be characterised by investment in new capacity that outpaces expected demand growth.

Nonetheless, long-term trends are highly supportive of demand for potassium as a nutrient, particularly relative to nitrogen, which is overapplied in many regions. In the medium-term, however, the potash market remains more than adequately supplied, and new producers may struggle to add supply without impacting prices, even if new demand segments, such as batteries, emerge.

In my view, 2026 may be the best opportunity for potash producers to benefit from higher prices before major new capacity additions come online in 2027 and beyond. BHP's Jansen project in Canada, new Russian capacity from EuroChem and Acron, and various other projects, particularly those linked to Chinese overseas investments, have the potential to tip the market into significant oversupply.

Following a year of record demand, it will be highly instructive to watch the reactions of incumbent potash producers over the coming months – as they position themselves for the arrival of new entrants in 2027. ■

Historical price trends $/tonne



Source: CRU

PRICE TRENDS

Market snapshot, 26th February 2026

India's purchase tender sets urea market tone. The urea market was dominated by the conclusion of Rashtriya Chemicals and Fertilizers Limited's purchase tender on 18th February. RCF secured just over 1.3 million tonnes of urea at the lowest offer prices of $508/t cfr west coast and $512/t cfr east coast.

Middle East urea prices have firmed to $490-495/t f.o.b., aligning with netbacks from the RCF tender, with Fertiglobe set to ship around 180,000 tonnes from the UAE. In Iran, Pardis sold two 50,000 tonne granular cargoes to Turkey at $430/t f.o.b.

In Southeast Asia, Indonesian urea producer Kaltim sold 45,000 tonnes granular to Ameropa in the low-$490s/t f.o.b. for March shipment. In Brunei, BFI is understood to have sold 30,000 tonnes granular to Indagro in the high-$490s/t f.o.b., also for March.

West of Suez, two Egyptian producers sold a combined 30,000 tonne granular shipment to the US at $485/t f.o.b., with Mopco selling a further 10,000 tonnes at $490/t f.o.b. NCIC was said to have awarded its 19th February sales tender at $488/t f.o.b., amid speculation the 20,000 tonnes offered will be directed to India.

Ammonia divided between firmer west and softer east. The global ammonia trade continues to show a clear east-west divide. West of Suez, prices remain underpinned by constrained availability, while the market east of Suez is weighed down by ample availability and weak spot demand.

In the US and Caribbean, new guidance from Nutrien confirmed the removal of 1.6 million tonnes of sales volumes from its portfolio in 2026, on the assumption of no ammonia production from its Point Lisas, Trinidad, and New Madrid, Missouri, production plants. This helps explain the continuing ammonia supply tightness felt west of Suez.

East of Suez, the Middle East price spread for ammonia remains wide. Although supply continues to stay long, buying interest west of Suez has helped support westbound offers. India has reinforced the east of Suez softness, with buyers there increasingly eyeing up Indonesian tonnes, as Southeast Asia values continue to trend lower and availability remains comfortable.

Phosphate prices firm on supply scarcity. Global DAP and MAP prices have continued to increase. Bullish sentiment is being driven by an exceptionally tight supply outlook and high raw materials prices, with these offsetting seasonally slow demand and affordability concerns.

Prices in key MAP import market Brazil moved higher, continuing a trend of ascending prices seen over seven of the last eight weeks. MAP prices were assessed at $730-740/t cfr, their highest level since August 2025 and a rise of 16% ($100/t) over the year to date.

Prices in the key DAP market India were also up at $705-710/t cfr, despite a

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Market price summary $/tonne – end-February 2026

Nitrogen	Ammonia	Urea	Ammonium Sulphate	Phosphates	DAP	TSP	Phos Acid
f.o.b. Caribbean	585	-	f.o.b. E. Europe 312	f.o.b. US New Orleans*	618	-	-
f.o.b. New Orleans*	-	474		f.o.b. North Arica	737	515	1,409
f.o.b. Middle East	470	483	-	cfr India	708	-	1,290
f.o.b. Black Sea	-	458					
Potash	KCl Standard	K_2SO_4	**Sulphuric Acid**		**Sulphur**		
f.o.b. Vancouver	333	-	cfr US Gulf 163		f.o.b. Vancouver	493	
cfr India	349	-			f.o.b. Arab Gulf	503	
fca Western Europe**	-	590			cfr China	518	
f.o.b. Baltic	309	-			cfr India	525	

*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. ** €/t*

dearth of deals, with some sources pegging prices as high as the $720s/t cfr. Latest business to Pakistan, which is typically priced at a $10-15/t premium over India, was concluded in the mid-to-high $720s/t cfr for a Saudi cargo, with producer Maaden achieving even higher netbacks on a DAP cargo to Southeast Asia.

Morocco's OCP, meanwhile, continues to reach higher f.o.b. sales on small-volume shipments to Europe. In the US market, on the other hand, DAP prices at NOLA softened to $615-620/st f.o.b., while MAP prices were steady.

Potash prices stable as seasonal demand builds. Global MOP markets remain firm, with seasonal demand building across key regions and tightening availability shaping sentiment ahead of the second quarter.

In India, the 180-day MOP contract remains unsettled, although market participants expect agreement by the end of March. Suppliers are pushing for an increase from the existing $349/t cfr level, possibly as high as $20/t above this. The outcome of this contract is widely expected to set MOP price direction over the next quarter.

In Brazil, MOP was assessed at $365-380/t cfr. Russian and Belarusian producers are sold out for March and are now taking orders for April, tightening availability.

In Southeast Asia, standard MOP was assessed at $360–390/t cfr and granular at $390-410/t cfr. In China, port wholesale MOP prices were assessed at RMB3,000-3,580/t fca, with modest increases at the upper end of this range due to tight availability. In Europe, meanwhile, MOP prices remain broadly stable, with limited spot deals reported.

Sulphur correction deepens on muted demand. The downward correction in global sulphur prices gathered pace, as hopes for a strong post-holiday rebound in Chinese demand failed to materialise. While one deal was heard at $515/t cfr, interest from Chinese buyers remains sluggish. This has sent a bearish signal through the market, directly impacting prices in Vancouver, which fell to $490-495/t f.o.b. in response.

Price weakness in China, a key destination market, rippled through to other major export hubs. The Middle East f.o.b. assessment fell sharply to $490-515/t. The US Gulf f.o.b. price also softened to $495-500/t, aligning with weaker sentiment in its key export market, Brazil. The CRU European sulphur index, meanwhile, captured this broad-based decline by falling to $498/t.

OUTLOOK

Urea supported in near term. Global demand is expected to support prices in the short term, primarily driven by purchasing from India and Australia. The anticipated return of Chinese exports in the second quarter is then expected to cause a price correction. The upside risk of a bullish natural-gas market on both sides of the Atlantic could, however, see urea costs soar, with the potential for domestic nitrogen production in the US being scaled back in favour of more lucrative LNG exports. Geopolitics could also provide unforeseen price support, particularly with the threat of US military action looming in Iran.

Ammonia on downwards trajectory. The current east-west split looks set to persist into March. Although ammonia prices have been revised higher for February, a general downwards trajectory is forecast through the first half of 2026 as steady supply growth alleviates the prevailing tightness. There is a downside risk that prices could sharply correct lower if Gulf Coast Ammonia and Woodside's Beaumont project bring meaningful volumes to the market earlier than expected.

Phosphates bullish on tight supply outlook. Given severe export restrictions in China, granular phosphates prices are forecast to climb even higher this year than in 2025, with no respite likely for buyers until the third quarter at least. There is a downside risk that prices could move lower if China's NP exports are greater than forecast.

Higher first quarter potash prices expected. MOP prices in most regions are forecast to rise in the coming quarter as potash remains the most affordable nutrient, and suppliers are in bullish mood. There is an upside risk that prices may firm more than expected on the back of supplier confidence and stronger demand in most regions.

Sulphur prices peak in February. Sulphur prices are now forecast to peak in February, later than previously anticipated, as ongoing supply disruptions in the Middle East and Kazakhstan continue to support the market. There is an upside risk that prices may not decline as quickly or as sharply as forecast, if ongoing supply disruptions continue to limit the recovery of global export availability. ■

Note As *Fertilizer International* went to press, the fertilizer market was reacting to news of hostilities between Iran versus the United States and Israel on 28th February. Stay on top of the latest market developments, plus full analysis, via CRU's *Fertilizer Week* service, the industry's most trusted source: crugroup.com/en/solutions/fertilizer-services/fertilizer-week/

UNITED KINGDOM

Mitsubishi invests in Woodsmith polyhalite mine

Mitsubishi Corporation has invested an undisclosed sum in Anglo American's under-construction Woodsmith polyhalite mine in the UK.

The investment agreement was announced by both companies on 20th February.

Although the details are confidential, the agreement includes an initial equity investment by Mitsubishi in Woodsmith. This will support the continued development of the mine, located west of Whitby near England's North Sea coast, until a final investment decision (FID) is made by the Anglo American's board. This is now expected from 2028 onwards.

Anglo American has made its final approval of the Woodsmith mine project subject to three tests:

1. The completion of a feasibility study to demonstrate its "robust economic potential"
2. A clear "pathway to syndication" by securing one or more investment partners
3. "Sufficient deleveraging" of Anglo American's balance sheet, i.e., debt reduction.

Mitsubishi will decide whether to contribute further financing to the project when the FID is made, potentially acquiring an equity stake of 25% at this time. Until then, Anglo American will press on with critical construction activities at Woodsmith, with an annual investment of approximately $300 million.

The company confirmed to *Fertilizer International* that Woodsmith's capex and opex have been updated, with $300 million per annum now committed for both 2026 and 2027. More than 1,000 people are working on the project currently.

Mitsubishi says it will contribute to and help fund the project's feasibility study. The two companies will carry out joint pilot sales to validate the marketability of Woodsmith's POLY4 polyhalite product, for example. Mitsubishi will also explore opportunities to boost demand for POLY4, including options for further agronomic trials.

The feasibility study will "assess development and operational plans, economic viability, and social and environmental impacts of the project", Mitsubishi said.

Anglo American hailed the support from Mitsubishi as a major boost to the development of the Woodsmith mine by a major international investor.

Tom McCulley, CEO of Anglo American's Crop Nutrients, said: "This is fantastic news for the Woodsmith project. We are delighted that Mitsubishi has shown such confidence in the enormous potential of Woodsmith and the global market for our highly effective POLY4 fertiliser product."

Peter Kyle, UK Secretary of State for Business and Trade, also welcomed the news: "This partnership between Anglo American and Mitsubishi is a major milestone for this significant project, building on the almost £2 billion boost to North Yorkshire's economy and over 1,000 jobs created since construction began in 2017. It's a game changing investment that will help the UK to become a major global fertiliser producer, boosting sustainable and secure food production, whilst delivering £1.5 billion per year to the UK economy."

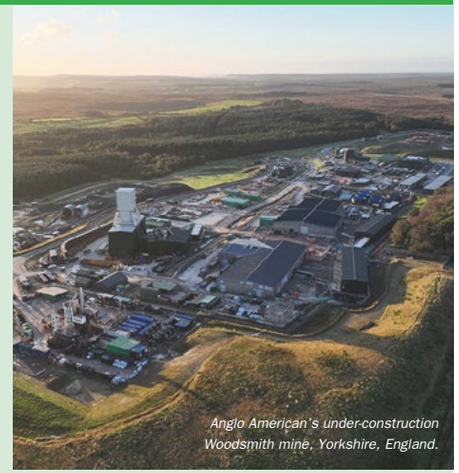

PHOTO: ANGLO AMERICAN.

Anglo American's under-construction Woodsmith mine, Yorkshire, England.

The new agreement builds on a longstanding partnership between Anglo American and Mitsubishi Corporation, most recently at the Quellaveco copper mine in Peru, which is 40% owned by Mitsubishi.

Yuuki Yoshioka, General Manager of the Fertilizer Resources Unit at Mitsubishi Corporation, said: "We are really pleased to build on our existing partnership with Anglo American on such an exciting project. Demand for sustainable fertilizer products is poised to increase as agriculture faces rising expectations to reduce environmental impact and adopt responsible farming practices. We will use our expertise in mine development and Mitsubishi's strengths across business segments—including the food and agriculture related businesses—to generate new value for the project."

New agronomic results

The investment from Mitsubishi follows the recent publication of a comprehensive study of polyhalite's agronomic benefits in *Agronomy Journal*. Based on a decade's worth of global trials, this confirmed that Anglo American's POLY4 product typically improves crop yields by 3-5%, compared to conventional fertilizer practice, across a wide range of crops, soils and growing environments.

"The study… found to the highest possible scientific standard that polyhalite's ability to improve yield across a range of diverse soils, crops and geographies demonstrated its value as an effective and sustainable future farming solution," Anglo American said.

In potentially a major consolidation of the mining industry, Anglo American and Canada's Teck Resources announced a mutually agreed "merger of equals" on 9th September last year. The merger agreement was unanimously back by the boards of both companies. It is expected to complete within 12-18 months, subject to customary regulatory and clearance conditions (*Fertilizer International* 529, p7). ■

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EUROPE

EU suspends fertilizer tariffs to offset CBAM costs

The European Commission says it will temporarily suspend most favoured nation (MFN) duties on EU urea and ammonia imports for one year.

The tariff suspension, announced on 24th February, implements a commitment made at an EU ministerial meeting on 7th January. It will apply to all countries, except Russia and Belarus, and is designed to safeguard the availability and affordability of fertilizers in Europe.

MFN tariff rates are currently 6.5% for urea and 5.5% for ammonia.

The Commission says it is committed to addressing rising costs faced by EU farmers – including the high costs of fertilizers.

"The measure will strengthen the EU's agri-food sector, lowering costs for farmers and the fertilisers industry by saving an estimated €60 million in import duties. It will also facilitate the reduction of the EU's dependency on Russia and Belarus and support diversification of supply, where imports are still needed for the EU agricultural sector and the fertiliser industry," the Commission said in a statement.

The plan to suspend MFN tariffs was first proposed by Maroš Šefcovic, European Commissioner for Trade, at the 7th January ministerial meeting. He noted that fertilizer prices are currently around 60% higher than they were in 2020.

"This is not sustainable. That is why the Commission is putting forward an additional targeted response. We will propose to temporarily suspend the remaining most-favoured nation (MFN) tariffs on urea, ammonia, and, where necessary, other fertilisers," Šefcovic said.

"This measure can enter into force swiftly in 2026 and its impact would broadly offset the costs linked to the carbon border adjustment mechanism (CBAM) which took effect this January," he added.

Šefcovic also confirmed that the Commission will issue guidance on new CBAM measures proposed last December. The measures included a flat 1% markup on fertilizer default values, as an exception to CBAM's standard calculation rules (*Fertilizer International* 530, p8). Fertilizers were the only CBAM-affected commodity to benefit from such an exception.

"We will continue to monitor fertilizer prices closely," Šefcovic said. He also confirmed that an EU fertilizer action plan will be published in the second quarter of 2026. This will "focus on greater market transparency and on scaling up recycled nutrients" and be "supported by regulatory adjustment where needed".

"Let me be absolutely clear, EU agriculture is a global export powerhouse," Šefcovic said. "Farmers concerns are not an afterthought in our trade policy – they are central."

EU agricultural exports hit €235bn in 2024, a 3% year-on-year rise.

UNITED STATES

USDA deputy calls Nutrien and Mosaic a "duopoly"

Stephen Vaden, the US Department of Agriculture (USDA) Deputy Secretary, has called Nutrien and Mosaic a "duopoly", saying they limit "fertilizer supply in this country" and "[drive] up the cost that farmers are paying", according to media reports.

In escalating rhetoric, Vaden made the accusation against North America's two largest fertilizer producers during a 21st January webinar hosted by the National Agricultural Law Center.

"This administration is going to do everything it can to ensure that farmers have the fertilizer [they] need, at a price that they can pay," Vaden reportedly said.

Without specifically naming BHP's Jansen potash mega project, Vaden, a former judge at the US Court of International Trade, mentioned a Canadian fertilizer mine that is on schedule to export to the US market:

"We're not going to allow these two companies to do anything to undermine this or any other new market participant that wants to come in, provide new fertilizer supply and break up the cute little game that Mosaic and Nutrient have been playing for the last several years," Vaden was quoted as saying by *Agri-Pulse*.

The US fertilizer market is coming under increasing scrutiny. In February, two corn grower groups – the Texas Corn Producers Association (TCPA) and the Iowa Corn Growers Association (ICGA) – wrote to US Attorney General Pam Bondi requesting a formal status update on a Justice Department investigation into fertilizer pricing and market concentration.

In December 2025, President Trump also signed an executive order instructing the Attorney General and the Chairman of the Federal Trade Commission to establish a Food Supply Chain Security Task Force. They were instructed to: "Take all necessary and appropriate actions to investigate food-related industries … and determine whether anti-competitive behavior exists in food supply chains in the United States."

The executive order specifically names fertilizers – alongside meat processing, seeds and equipment – as having "vulnerabilities to price fixing and other anti-competitive practices".

The eventual outcome of these federal investigations remains unclear. But, against the backdrop of vocal criticisms from USDA leadership and farmers groups, the market dominance of leading North American fertilizer producers is being questioned.

"While I remain cautious about the likelihood of any near-term structural shift in supply policy, pressure is clearly building from farm groups and grower associations focused on input costs and access to product," commented CRU's Justin Rackleff, Americas Lead, Fertilizer Value Chain, Intelligence & Prices. "And although legislative and trade processes tend to move slowly, the volume and consistency of that pushback is becoming increasingly difficult for producers to ignore," he added.

Recently, Mosaic voluntarily ceded some supply by selling its New Mexico specialty potash (SOPM) business for $30 million to new entrant International Minerals Carlsbad (*Fertilizer International* 530, p8). Nutrien, meanwhile, is carrying out a strategic review of its entire phosphates business, with divestment being one option. A decision on this is due later this year.

Corey Rosenbusch, president and CEO of trade body The Fertilizer Institute (TFI), has argued that the very real pressures faced by US farmer have more to do with global market dynamics, not domestic decisions. He said geopolitics was "taking the headlines" when it came to fertilizer supply and demand.

"It's even harder for the American farmer right now than it was a few years ago when markets exploded. At least, back then, [agricultural] commodity prices were high. Right now, it's a perfect storm. Commodity prices are low, and input costs keep going up and up," Rosenbusch said in November.

"Our message is simple: We need farmers to be successful because if they're not, we don't exist. But the factors driving this market are frankly outside of our control and, honestly, outside of this country's control," he added.

The US government's own policies, such as the on-off import tariff situation since April 2025 and longstanding countervailing duties (CVDs) on Russian and Moroccan phosphate imports, have arguably added to current fertilizer costs and supply issues.

Months of uncertainty ended in November when a presidential executive order finally exempted fertilizers from 'Liberation Day' tariffs (*Fertilizer International* 530, p7). More recently, the legal basis for the use of these tariffs by the US President – under the International Emergency Economic Powers Act (IEEPA) – was itself struck down by the US Supreme Court in a 20th February ruling.

However, the White House immediately moved to counter this judgment by imposing a 15% global import surcharge under Section 122 of the 1974 Trade Act. These tariffs will be time-limited, though, and only apply for up to 150 days. Regardless, the imposition of Section 122 is not expected to have a direct impact on fertilizers anyway, due to their presence on an exemption list.

While fertilizer raw materials – such as ammonia, sulphur and sulphuric acid – do fall under Section 122, shipments from Mexico and Canada should also be protected by the USMCA (United States-Mexico-Canada Agreement).

INDIA

Kakinada green ammonia project inaugurated

Construction has officially begun on India's largest green ammonia project. The foundation stone was laid for the 1.5 million t/a capacity Kakinada project in

The inauguration ceremony for AM Green's Kakinada project was attended by Andhra Pradesh's Chief Minister N Chandrababu Naidu.

PHOTO: AM GREEN

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a groundbreaking ceremony attended by Andhra Pradesh's Chief Minister N Chandrababu Naidu.

Kakinada is located on a 495-acre site in Andhra Pradesh formerly owned by Nagarjuna Fertilizers. It is one of the largest under construction green ammonia projects globally.

"The first production of 0.5 million metric tonnes of green ammonia is expected to be achieved by mid-2027 as part of AM Green's annual production target of 1.5 million metric tonnes," Naidu said. "Today's equipment erection ceremony marks the beginning of a new chapter for Andhra Pradesh as a leader in the clean energy transition."

The $10 billion Kakinada project is being developed by the consortium AM Green Ammonia, a partnership between AM Green, Gentari, GIC and Abu Dhabi Investment Authority (ADIA). The project reached a final investment decision (FID) in 2024 and all the major contracts and key approvals are in place.

The project's technology and engineering partners include CASALE, Air Liquide, Rely (a joint venture between Technip Energies and John Cockerill), Toyo, Gentari and NTPC Renewables.

The integrated project will generate green hydrogen from a 1.95 GW alkaline electrolyser array powered by 7.5 GW of wind and solar electricity capacity. Access to 2 GW of pumped-storage hydropower will also be used to avoid power intermittency and ensure uninterrupted production.

In January, AM Green signed a long-term binding offtake agreement with Uniper for 500,000 tonnes per annum of green ammonia. This will be destined for the European market and be RFNBO (Renewable Fuel of Non-Biological Origin) certified. The first shipment is expected to happen as early as 2028.

"For Uniper, the agreement represents a significant step forward in developing a diversified portfolio of renewable and low-carbon molecules for European customers. As a feedstock and a potential hydrogen carrier, renewable ammonia will help decarbonize industrial sectors such as chemicals, fertilizers, refining, and, over time, shipping," Uniper said in a statement.

Uniper CEO Michael Lewis added: "We are proud to help establish one of the first large-scale supply corridors between India and Europe." While AM Green's founder Anil Kumar Chalamalasetty said: "This partnership is milestone for India's role in the global energy transition."

PHOTO: KOCH

CASALE's new converter for Koch's Beatrice, Nebraska, plant is 30 metres by 4 metres in size and weighs 363 tonnes.

Massive CASALE converter installed at Koch Beatrice

After a 6,000-mile transatlantic and continental journey, Koch Fertilizer finally installed a new CASALE ammonia converter at its Beatrice, Nebraska, fertilizer plant in mid-February.

The massive converter is 98 feet tall by 14 feet wide (30 metres by 4 metres) and weighs 800,000 pounds (363 tonnes).

The new unit replaces two smaller converters and is part of a multimillion-dollar upgrade at the Beatrice plant. It will generate ammonia used in the production of liquid urea ammonium nitrate (UAN) fertilizer.

The converter was built by CASALE in Venice, Italy. Its transport to Nebraska and its installation at the Beatrice site was a complex logistical and engineering task:

- In Italy, the converter was firstly placed on a ship bound for the Port of Houston – a 5,000 nautical mile journey.
- On arrival in Houston, it was offloaded from the ship and loaded onto rail cars for the next stage of its trip – a 1,200-mile northbound train journey from Texas to Nebraska.
- After rolling into Plymouth, Nebraska, the converter was moved from the rail cars onto a crawler for the last leg of its journey – a slow 10-mile drive from Plymouth to Koch's fertilizer plant in Beatrice.

Once at the plant, a 300-foot (91 metres) high VersaCrane TC24000 was used to lift the converter and place it on its foundation. This tall crane was built on site, after being delivered in 50 loads, and took about a month to put together using two smaller cranes.

"The converter project – from intricate engineering to international logistics – was a monster undertaking by the entire Beatrice team and a broad network of partners," Koch Fertilizers said in a statement. "The successful delivery and installation of this enormous piece of equipment was a daily demonstration of incredible focus, attention to detail and an unwavering commitment to safety, setting the stage for continued success at Koch Fertilizer Beatrice."

The converter project reflects Koch Fertilizer's commitment to long-term growth and partnership with the Beatrice community, added Jason Stowell, Beatrice's plant manager: "It's a huge testament to the investment Koch has in this facility and the support for the employees here as well as the community."

POLAND

Grupa Azoty adds new sulphur fertilizer to its portfolio

Grupa Azoty launched DuoS®, a new nitrogen–sulphur fertilizer, at the end of February. Its formulation is based on ammonium sulphate, ammonium nitrate and anhydrite and includes:

- Two forms of nitrogen – nitrate and ammonium
- Two sulphur sources – ammonium sulphate and anhydrite
- Calcium to support crop resilience and the quality of produce.

The new nitrogen–sulphur fertilizer with added calcium is designed to improve nutrient use efficiency and reduce leaching and other nutrient losses. It is recommended for pre-sowing and top dressing on winter and spring cereals, winter rapeseed, sugar beet, potatoes, legumes, grassland, as well as vegetables and fruit crops.

Grupa Azoty says it is introducing DuoS® in the current season as part of a strategy to develop its fertilizer business and focus on specialty products.

"Developing more advanced fertilizer formulations is part of our focus on our key technological competences. We clearly see a trend towards products that increase nutrient use efficiency and reduce environmental losses. DuoS® responds to these needs by combining proven solutions with a precisely designed nutrient-release profile," said Jacek Zaborowski, director, corporate trading department, AGRO Segment, Grupa Azoty.

The product's different rates of sulphur release should ensure availability during initial crop growth stages as well as later in the growing season. Its nitrogen-to-sulphur ratio, meanwhile, is designed to match crop nutrient uptake, and should therefore reduce the risk of overapplication, particularly in early spring and late autumn.

Grupa Azoty previously launched POLIFOSKA Multi S, a high-sulphur multi-nutrient fertilizer product, in February last year. This contains 7% nitrogen in ammonium form, 10% phosphorus, 20% potassium, 5% calcium, 1% magnesium, and 23% sulphur in sulphate form.

NEW ZEALAND

Kapuni green hydrogen project gets the greenlight

The Kapuni green hydrogen project has reached financial close, co-operative Ballance Agri-Nutrients and its project partners have confirmed.

The decision gives the go-ahead to develop the landmark renewable electricity and green hydrogen venture in South Taranaki, New Zealand.

The Kapuni project is aiming to decarbonise multiple sectors, including transport, energy, industry and agriculture. The green hydrogen generated will be partly used in low-carbon fertilizer production by augmenting natural gas feedstock at Ballance's nearby Kapuni ammonia-urea plant.

The multi-partner consortium behind the project includes Ballance Agri-Nutrients, Hiringa Energy, Todd, Parininihi ki Waitōtara (PKW) and the New Zealand Ministry of Business, Innovation and Employment (MBIE). Contractor Hiringa is due to start project construction in early March 2026, with first production of renewable electricity and green hydrogen expected next year.

The integrated project combines four 6.4 MW wind turbines (25.6 MW total installed capacity) with a 5 MW electrolyser linked to Ballance's Kapuni fertilizer plant. The wind farm, which is expected to generate around 100 GWh per year, will supply electricity to Ballance's site operations, produce hydrogen for transport, and export electricity to the national grid.

"Ballance Agri-Nutrients (Ballance) has supported the Kapuni Project from day one because we know how important reliable, low-emissions energy is for the future of agriculture in New Zealand," said Kelvin Wickham, CEO, Ballance Agri-Nutrients.

"We also know the wider challenges around gas supply aren't going away overnight. This project … opens up new options … and helps us keep working toward nutrient production that's powered by renewable energy and supports agricultural businesses for generations to come. At its heart, this project is about backing farmers and growers with solutions that support productive, profitable and sustainable farming today and into the future," Wickham added.

Ballance Agri-Nutrients is currently consulting on ending sulphuric acid and single superphosphate (SSP) manufacturing at its Mount Maunganui site in New Zealand, while continuing urea production at Kapuni. ■

Note

Additional reporting by Natalie Noor-Drugan.

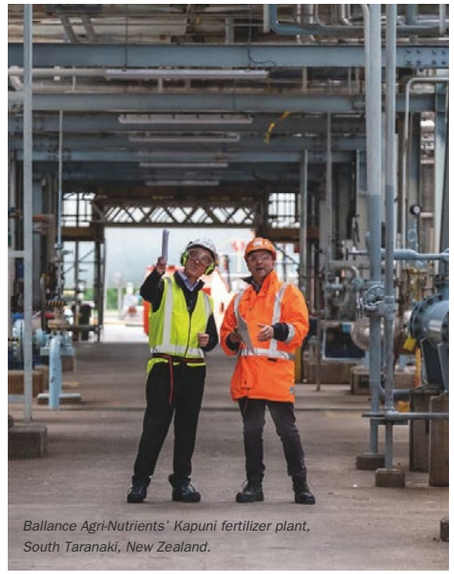

PHOTO: HIRINGA

Ballance Agri-Nutrients' Kapuni fertilizer plant, South Taranaki, New Zealand.

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People

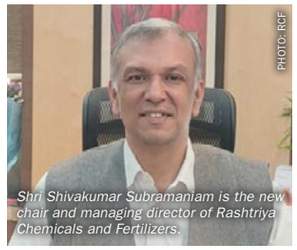
PHOTO: RCF

Shri Shivakumar Subramaniam is the new chair and managing director of Rashtriya Chemicals and Fertilizers.


PHOTO: BASF

Dr Livio Tedeschi, President, BASF Agricultural Solutions, will head a new management board for the business division ahead of its spin-off as a separate company.

Shri Shivakumar Subramaniam became the new chair and managing director of Rashtriya Chemicals and Fertilizers (RCF) Limited on 13th February 2026.

Shri started his career with RCF in 1998 as a senior finance officer and holds a bachelor's degree in commerce and an MBA in finance. During more than 27 years of fertilizer industry experience, he has held positions of responsibility in business areas such as treasury, taxation, corporate accounts, corporate financial strategy, fertilizer policy and subsidies, and ministry co-ordination. He has also been actively associated with project evaluation, project financing and joint venture investments.

Itafos Inc appointed **Joseph McConnell** to its board of directors on 16th January 2026. He is the nominee of the company's principal shareholder, CL Fertilizers Holding LLC (CLF). Mr McConnell is a partner and deputy co-chief investment officer at Castlelake, an affiliate of CLF. He replaces Isaiah Toback.

"We are pleased to announce the appointment of Joe to the Board of Directors. His experience and expertise will strengthen the Board's ability to provide oversight and guidance, bringing valuable skills and new perspectives as the Company advances its business objectives and strategic initiatives," said Anthony Cina, chair of the company's board of directors.

"On behalf of the Board, I would also like to thank Isaiah for his contributions to the Company," Mr Cina added.

BASF has announced a new management board for its Agricultural Solutions division. The move comes ahead of its spin-off as a separate company and its initial public offering (IPO) and listing on the Frankfurt Stock Exchange.

The new management board will be operative from 1st May 2026 and will lead Agricultural Solutions through its transition to an independent, publicly listed company. It will comprise of four members:

- **Sascha Bibert** will join BASF Agricultural Solutions from Vallourec SA and will be in charge of finance.
- **Maximilian Becker**, Senior Vice President Vegetable Seeds, BASF Agricultural Solutions, will be in charge of business.
- **Dr Melanie Bausen-Wiens**, Senior Vice President Regulatory, Stewardship & Public Affairs, BASF Agricultural Solutions, will be in charge of technology.
- **Dr Livio Tedeschi**, President, BASF Agricultural Solutions, will assume overall responsibility as the head of the management board.

Dr Tedeschi will also become member of the board of executive directors of BASF SE with responsibility for the Agricultural Solutions segment. Commenting on these appointments and the company spin-off, he said:

"For over a century, Agricultural Solutions has supported farmers and breeders with innovations that help them grow their crops to their full potential. As we move forward as a fully integrated company with proven strengths in crop protection, seeds and traits, digital farming, and sustainability, we are uniquely positioned to serve evolving customer needs, while continuing to advance agriculture and create sustainable, resilient food systems for generations to come. Together with the new Management Board and our teams worldwide, we will turn our strategy and vision into reality – opening a new chapter for our business to become publicly listed."

BASF says the separation of Agricultural Solutions will "establish the standalone business as an independent, pure-play agricultural company with global reach, robust growth prospects and strong cash flow generation". It will remain the majority shareholder and therefore continue to benefit from the new company's growth and success.

Grupa Azoty has dismissed its CEO **Andrzej Skolmowski**. He had been in the job less than one year, having originally been appointed in June 2025.

Skolmowski was removed from his role as president of the company's management board on 12th February, along with vice presidents Paweł Bielski and Andrzej Dawidowski. Grupa Azoty's vice-chair, **Aleksandra Machowicz-Jaworska**, will now act as temporary president of the management board for up to three months until a replacement CEO is found. ■

Calendar 2026

APRIL

7-9
AFA International Annual Conference & Exhibition, CAIRO, Egypt
Contact: Arab Fertilizer Association
Tel: +202-23054464 – 67
Email: events@arabfertilizer.org

13-15
CRU Phosphates+Potash Expoconference, PARIS, France
Contact: Event Client Services
Tel: +44 (0)20 7903 2444
Email: conferences@crugroup.com

21-23
CRU Nitrogen+Syngas Expoconference
USA, DALLAS, Texas, USA
Contact: Event Client Services
Tel: +44 (0) 20 7903 2444
Email: conferences@crugroup.com

MAY

4-6
IFA Annual Conference 2026,
ABU DHABI, UAE
Contact: IFA Conference Service
Tel: +33 1 53 93 05 00
Email: ifa@fertilizer.org

JUNE

2-4
IFA Cultivating Tomorrow, BUDAPEST, Hungary
Contact: IFA Conference Service
Tel: +33 1 53 93 05 00
Email: ifa@fertilizer.org

SEPTEMBER

28-30
TFI World Conference, DALLAS, Texas, USA
Contact: Valerie Sutton, Director, Member Services and Conferences
Tel: +1 202-515-2709
Email: vsutton@tfi.org

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Fertilizer Latino Americano 2026

More than 900 attendees from 56 different countries gathered at the Trump National Doral Miami, Florida, 26-28 January, for the 2026 Fertilizer Latino Americano (FLA) conference. We present selected highlights from this year's three-day conference.

Sustainability at the heart of doing business

In a highlight of FLA's opening morning, a keynote panel discussed innovations in sustainability and decarbonisation.

"Our commitment to the future is totally linked with sustainability. It is at the heart of how we do business," said **Henrique Mattos**, Legal, Compliance & Corporate Affairs Director, OCP Brazil.

"We [OCP Group] are investing $13 billion from 2023 to 2027 to achieve sustainability goals. These include zero conventional water consumption by 2027, 100% green energy use about 2027, and carbon neutrality by 2040," he said.

"OCP Nutricrops is dedicated to developing soil health and plant nutrition – delivering precision technology and mapping soils. We invest a lot to drive sustainability and innovation with partnerships around the world including Brazil," Mattos added.

"P is not only phosphate for us," said Mattos. "P is also people, plants and planet. We help farmers feed soil and the world through innovative initiatives, innovative products, tailored crop fertilization and responsible farming practises."

For Yara, sustainability was at the heart of the company's strategy.

"It is present in every decision we make," said **Marcelo Altieri**, SVP, Yara Brasil. "Bringing prosperity to farmers is crucial and one of the pillars of our strategy. We work hard with bringing technology, bringing science to the farmers – so they can produce more, produce better and can improve their profitability," he added.

Sustainability generated more value, compared to just increasing production, in his view.

PHOTO: ARGUS

"We are working on the first scaled-up green fertiliser project in Villeta, Paraguay with our partner CASALE. You can read all about it in Fertilizer International!," said Terje Bakken, ATOME's Director for Ammonia and Fertiliser Markets, in his panel discussion.

"Sustainability can open doors, create new revenue streams for farmers. We should all push together with partnerships across society. Industry cannot do this alone," Altieri said. "But always bringing farmers to the centre, because there are no green transitions with red numbers," he concluded.

Eti Maden, meanwhile, were seeing a step change in the agricultural consumption of boron, a key crop micronutrient.

"We are now having extensive demand for boron from agricultural users," said **Haluk Gani**. Eti Maden's CEO. "40-50 years ago nobody had heard of boron in agriculture. Mainly we were selling to industrial customers. The agricultural percentage of our 2.5 million tonne sales was 2%. Now we're looking at 15-20% – so it's significant growth," he added.

Farmers were responsible for this growth, said Gani.

"Farmers, when they use it, they see the results of this micronutrient. When they make the investment, they see the return makes sense. If it's profitable they will go with it," he said.

Spotlight on LatAm green ammonia

Two Latin American green fertilizer projects, ATOME's Villeta project in Paraguay and Atlas Agro's Uberaba project in Brazil, were highlighted in the opening day's other discussion panel on regional clean ammonia developments.

Terje Bakken, ATOME's Director for Ammonia and Fertiliser Markets, brandished a copy of *Fertilizer International* magazine on stage to make his point.

PHOTO: ARGUS

The CRU stand was a busy meeting point for networking throughout the whole of FLA's three days

"We are working on the first scaled up green fertiliser project in Villeta, Paraguay, together with our partner CASALE," Bakken said. "You can read all about it in *Fertilizer International*. It's on the front page!"

Bakken said the Villeta project was close to financial close.

"That's what we're focusing on," he said. "My boss Olivier Mussat [ATOME's CEO] was meant to be here, but he is busy doing the final investment decision," adding: "It takes time to develop projects. It's like running a marathon, but now we're inside the stadium, so it's a number of days until we are crossing the line."

Bakken continued: "In order to cross the line, the stars need to be aligned. The challenges are: it's the demand side, it's the sourcing side, the energy side, it's the cost side – that's the cost of the project not only the cost of production," he said.

Being in Mercosur (Paraguay, Brazil, Argentina), an important region for global agriculture, was also helpful, in Bakken's view.

"We didn't start by asking for big green premiums," he said. "We are a manageable, small-scale operation with a local source of energy. We will be a local producer of nutrients in the middle of a market dependent on imports."

The $1.1 billion Uberaba project in Brazil was a textbook case of power shoring, suggested **Lieven Cooreman**, CEO, Atlas Agro Brasil.

"Why? Because we are bringing a hard-to-abate sector into a country where the renewable grid is 88%," said Cooreman. "Where there is a very low levelised cost of renewable energy and we're also helping a country, Brazil, be strategically less dependent on nutrient imports."

Creativity in sharing the green premium was necessary, Cooreman said:

"I need to offer the Uberaba product at import price parity," he said. "Due to the energy matrix, the capex involved, it's really important to push the green premium down the value chain, so we can monetise it maximally through the companies involved, such as packaged goods companies – the final customer – where the premium on the end product is a minor percentage and much more palatable."

Paolo Bonucci, CASALE's Commercial Division Head, emphasised the company's wide-ranging expertise as a technology provider and its strengths from combining this with EPC (engineering, procurement and construction) capabilities.

"Our technology portfolio ranges from hydrogen to green, blue and grey ammonia, to nitric acid, to all the complex fertilisers like calcium ammonium nitrate," he said. "Basically, the technologies that will be applied at Villetta and hopefully also for Atlas Agro."

He added: "Villetta is an example of a one-stop shop. CASALE can provide the technology going all the way up to the full EPC for the project that's awaiting the final investment decision."

Global trade – navigating new realities

Day two opened with discussion of new global trading realities – specifically tariffs and duties and how to navigate these.

Milton Sato, Fertistream's Head of Global Market Intelligence, saw ammonium sulphate emerging as a cheaper alternative to more volatile urea. This had spurred development of large-scale international trade flows.

"Ammonium sulphate is a by-product of the caprolactam process, so the cost of production is marginal and in China farmers don't use much, so most ammonium sulphate production is for export," he said. "So that's the dynamic – a traditional by-product that's a cheap alternative to expensive urea."

On CBAM (carbon border adjustment mechanism) implementation in the EU, Sato said: "From January this year, CBAM started to roll out. So, what happened was that buyers started to front-load imports from Q1 2026 into December [instead]."

Current policy uncertainty on CBAM was also having an effect, in his view, as importers don't wish to make the wrong decision on cost.

"So, what we see now is that the importer does not have much visibility on the actual CBAM cost because the EU is discussing whether they are eligible or not," Sato said.

He was generally bullish looking ahead at early market prospects in 2027. He linked this to the effects of policy developments in the EU, China and the US on prices.

"In my team, based on the next three months, we see more bullish factors across nitrogen, phosphate and potash," summed up Sato. "These policies tend to push up prices because any barrier to trade increases the cost of access."

Spotlight on Brazil – production and policy update

The day's other panel discussion focused on policy affecting domestic fertilizer production in Brazil.

Jose Carlos Polidoro of Brazil's agriculture and livestock ministry provided an update on Brazil's National Fertilizer Plan. His key takeaways were:

- Firstly, that Brazil has an action plan to be a world leader in the 'new fertilizer industry' by 2030.
- Secondly, with growing demand, Brazil is expected to become the second/third-largest global fertilizer market globally by 2035.

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- Thirdly, the resulting increase in consumption will be largely met by biostimulants, green fertilizers and fertilizers with high agronomic efficiency.

Brazil is preparing for this and taking action as part of the country's National Fertilizer Plan 2025-2029. The objectives are to:

1. Improve the business environment and reduce capex costs for investment in Brazil.
2. Create a 'new fertilizer industry' based on energy efficiency, low carbon technologies, bio-inputs and high-tech materials.
3. Encourage public-private partnerships for fertilizer production, e.g. Petrobras.

The overall objective of the national fertilizer plan is to reduce Brazil's external dependency on fertilizers from 85% to 50% by 2050. On an individual nutrient basis, the ambition by 2050 is to reduce external nitrogen dependency from 93% to 50%, external phosphate dependency from 72% to 34%, and external potash dependency from 98% to 45%.

National fertilizer production was around 7.21 million tonnes in 2024, around 17% of total supply. Brazil plans to increase this to 19.6 million tonnes by 2030, or 35% of supply. This is likely to require $25 billion of extra investment in domestic fertilizer capacity during this decade.

PHOTO: ARGUS

For CRU's analyst team, FLA provides a valuable opportunity to meet LatAm market participants at the start of the year.

Phosphates at a market inflection point?

FLA's final day began with a fireside chat with **Wafaa Settar**, the Chief Strategic Marketing Officer of OCP Nutricrops. "I lead on strategic marketing at OCP Nutricrops where my role is to connect farmer realities with soil science," she said.

Prior to her 15-year career with OCP, Wafaa worked in the washing powder industry for more than a decade. There were surprising similarities.

"Making granular fertilizer is not that different from producing laundry powder. It requires precision formulation, additives, coatings, inhibitors," she said

"So that experience shaped how I feel about fertilizers today – not only as commodities but as engineered solutions. It naturally led me to my current role where my focus is how nutrient formulations translate into tangible value for the farmer and the food system," she added.

Phosphates were at a pivotal moment, in Settar's view.

"The market is at an important inflection point. For a long time, it was viewed through supply and demand cycles, cost, production capacity, the logistic. Those factors still matter, but today they are not enough to explain market dynamics," she said.

"We are seeing growing pressure on soils, on phosphorus use efficiency in cropping systems that are still below 20-30%. At the same time expectations on sustainability are much higher now," Settar added.

"Regulators, retailers and shoppers are asking for better nutrients, better efficiency and a lower environmental footprint. While farmers are increasingly looking for solutions that help stabilise yield, improve crop quality and reduce agronomic and commercial risk, so it's not just the product price per tonne," she said.

Phosphorus is also wrongly classified as a starter nutrient by some.

"It's widely received as a nutrient that's mainly needed for early growth starting at planting stage to secure establishment. That view is incomplete," Settar said.

Phosphorus actually plays a critical role throughout the crop cycle, she suggested.

"It's also involved in nutrient use efficiency and stress resilience. Phosphorus has a key role to play during the reproductive cycle and stages such as flowering and fruit set, where the plants energy demand gets higher," Settar said.

The separation of nutrients and the presence of calcium are both important yet often overlooked factors.

"We are a strong believer in nutrient separation and improving alignments with soil chemistry and crop timings," Settar said. "When you apply the right nutrient at the right time you get the most of each because nutrients may compete with each other when you apply generic fertilizer.

"Good quality phosphorus fertilizers naturally contain calcium whose benefits are rarely discussed. Calcium is really key in cell wall strength, fruit firmness and stress tolerance, particularly during flowering and fruit development," she added.

Summing up, Settar said: "The focus is shifting from how much we produce, to how well we produce and quality across the whole value chain. Yield will always matter, but today's farmers are increasingly rewarded for consistency and marketability, not just volume."

Well-designed fertilizers contributed to this.

"What we need as an industry is a strategic shift that starts to recognise phosphorus not as a starting nutrient, not as a commodity anymore, but at the level of performance. With the presence of calcium, you have a stronger plant structure, improved quality, and tolerance to stress and drought," Settar concluded.

The CRU team look forward to seeing everyone at FLA 2027 in Rio De Janeiro, 17-20 January next year. Save the date!

Shipping state of play

The final panel discussion of FLA 2026 turned the spotlight on shipping fertilizers to Latin America and the current state of play. The rise in ammonium sulphate supply out of China has been notable in 2025.

"I want to focus on Chinese ammonium sulphate a topic everyone has been seeing for the last year. Looking at volumes from China, what we're seeing is affordability and availability increasing a little bit," said **Julia Santos**, Senior Market Data Analyst at Kpler.

"The new trade coming from China is also using bigger vessels. What we're seeing is a decrease in Handysize vessels and an increase in the bigger size Supramax and Panamax classes," Santos added.

The main characteristics of shipping fertilizers from China were long haul distances and higher cargo volumes, said **Viviane da Rocha Goncalves**, Head of Dry Cargo Brazil at D/S Norden.

"Long haul voyages with their higher fees are the perfect business for the ship owners, who bring ships in with fertilizer to Brazil to discharge and send them out to China filled with grain," she said. "But when you consider the lineups, the port congestion [for Panamax ships], they can become more expensive because of it."

Consequently, the shipping of fertilizer to Brazil in larger vessels – Panamax instead of Handysize – is not necessarily cheaper overall, in her view:

"The message I want to bring to the room today is that when we have Panamax ships and cheaper cost of freight, does that mean we have cheaper final costs for your receivers – [when] they are going to face more congestion competing with other commodities. Handysize ships might cost more, but you may be able to discharge them faster [or] change to a different port that has the flexibility to receive them."

China is becoming one of Brazil's biggest fertilizer supplies accounting for 28% of the current shipping line up by origin, reported **Arthur Neto**, Partner at Alphamar.

For fertilizer supply currently [end-January], port congestion is not a problem in Brazil, with the exception of the port of Francisco Do Sul. Neto was not expecting this situation to last, however.

"We have roughly 2.2 million tonnes of cargo expected to arrive in the next 60 days," he said. "So the good times are expected to be over soon, with further congestion in ports in the upcoming months."■

Fertilizer Latino Americano 2027 – save the date!

The 2027 Fertilizer Latino Americano Conference, hosted by CRU in collaboration with Argus, will take place in Rio de Janeiro, Brazil, 17-20 January 2027. Register your interest today at: fertilizerlatinoamericano.events.crugroup.com/register2027

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PHOTO: ICL

Dr Patricia Imas – tribute to a valued contributor

ICL announced the passing of **Dr Patricia Imas**, the company's renowned Chief Agronomist, on 17 December 2025. Dr Imas was well known to our readers as a frequent magazine contributor for more than a decade. In this article, Simon Inglethorpe, editor, *Fertilizer International*, celebrates her life and career by looking back at a selection of her authoritative and insightful articles.

Polysulphate is a natural multi-nutrient fertilizer sourced from the mineral polyhalite. It offers a unique combination of four nutrients – sulphur, magnesium, potassium and calcium.

Introducing a new multi-nutrient fertilizer

When I was appointed editor of *Fertilizer International* in 2015, Dr Patricia Imas was one of the first people to contact me proposing a magazine contribution. The resulting article, published over the summer of that year, introduced our readers to a novel multi-nutrient fertilizer: polyhalite.

ICL was introducing this naturally-occurring crop nutrient product to the market under the trademark Polysulphate. Patricia was very good at demystifying polyhalite – which was then almost unknown – and explaining its range of applications and agronomic benefits.

Here's what she wrote (*Fertilizer International* 468, p36):

"Polysulphate is a natural, multi-nutrient fertilizer sourced from the mineral polyhalite. Its unique combination of four nutrients, sulphur, magnesium, potassium and calcium, makes it a particularly unusual product. Importantly, Polysulphate's solubility means that all these nutrients are readily available for plant uptake.

"The new product is mined by ICL subsidiary, Cleveland Potash, at its North Yorkshire Boulby mine in the UK. Polyhalite formed 260 million years ago and is extracted below the North Sea at a depth of more than 1,000 metres from a layer 150-170 metres beneath the Boulby mine's main potash seam. The first polyhalite samples were brought to the surface by Cleveland Potash in September 2010.

"Polysulphate can be applied to soils as a straight or blended fertilizer, according to customer requirements, and is also suitable for the manufacture of compound fertilizers. The 2-4 mm granular product has excellent spreading characteristics and is an ideal fertilizer for applying alongside straight nitrogen.

"Being a low-chloride fertilizer, Polysulphate can be applied on all crops and is even suitable for the most chloride sensitive varieties. It is produced in its naturally-occurring state, without processing, and is therefore a low environmental impact product with a small carbon footprint. It is also certified for organic use.

"Polysulphate is suitable as a natural source of nutrients for all crops, especially brassicas, cereals, pulses, field vegetables, clover-rich grassland leys and silage crops. It is particularly well-suited to crops, such as tobacco, grapes and other fruit, which prefer low levels of chloride in the soil, and for potatoes where higher dry-matters are desired."

In this, our first ever article on Polysulphate, favourable crop trial results were presented for winter wheat, potatoes, cauliflower, cabbage and mustard seed. Agronomic benefits for cereals, oilseeds, brassica and forage crops were also described.

The article illustrated Patricia's gift for communication by showing what she did best: making scientific information accessible by writing about crops and crop nutrients with lucidity, authority and enthusiasm.

Carbon footprint and nitrogen use efficiency

The value of polyhalite as a crop input was a subject Patricia would return to frequently in a number of articles over the next 10 years. This included an overview called 'The agronomic advantages of Polysulphate' (*Fertilizer International* 503, p53).

This was effectively a mini-monograph – summarising ICL's agronomic evidence base for polyhalite as of 2021 – and brought out some of the product's key characteristics, such as its low carbon footprint, as well as its affect on nitrogen use efficiency:

"Polysulphate has the lowest carbon footprint (0.034 kg CO_2e per kg of product) when compared to common fertilizer alternatives, according to the results of a new study (Figure 1). Its production footprint is less than three percent of that of ammonium nitrate, for example. Its low carbon footprint is making Polysulphate the fertilizer of choice for those farmers wishing to manage their carbon usage and lower greenhouse gas emissions."

Its nitrogen-free composition can also be advantageous:

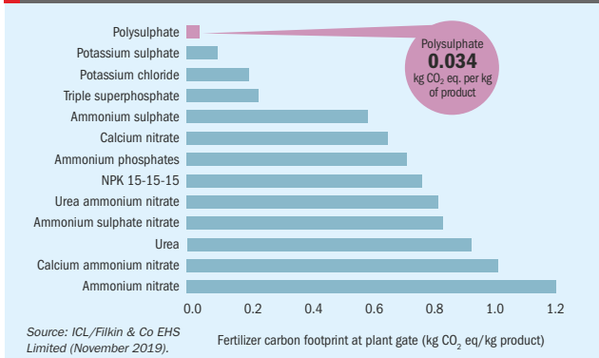
"By allowing farmers to separate S and K application from N application, this provides full flexibility with the choice of nitrogen source and application rate. Polysulphate can be applied before planting, for example, while nitrogen can be applied after germination – at the right time for the crop, in the right form, and in right weather conditions.

"This approach avoids the over-application of nitrogen and/or leaching. Higher nitrogen use efficiency can therefore be achieved without wastage and unnecessary cost to the farmer, or losses to the environment."

The ability to supply sulphur – separately from nitrogen – also has quality advantages for wheat used in bakery products:

"At the same time, Polysulphate can benefit wheat cultivation by delivering better grain protein quality and improving baking quality characteristics. In US wheat trials, the application of Polysulphate reduced the N:S ratio in harvested wheat grains. This helps improve baking quality by optimising dough and bread-making properties. Additionally, lowering this ratio avoids the unwanted asparagine and glutamine accumulations that can result from an S deficiency or an N surplus."

Fig. 1: **The carbon footprint of Polysulphate in comparison to other commonly-used fertilizers**



Source: ICL/Filkin & Co EHS Limited (November 2019).

Potatoes and Polysulphate – the perfect match

Another 2021 article from Dr Imas highlighted the characteristics that made Polysulphate especially suitable for potato crops (*Fertilizer International* 505, p45). She wrote:

"In general, the application of Polysulphate to potato crops will result in:

- Higher yields
- Good skin finish
- Improved dry matter
- Increased starch content.

"Polysulphate application rate of 400-700 kg/ha is generally suitable for potato and other vegetable crops. Straight Polysulphate can be incorporated into the seed bed before planting or instead applied as a constituent of a fertilizer blend at planting.

"It provides an adequate and balanced supply of four essential nutrients (S, K, Mg and Ca) in one single application. Polysulphate, when incorporated pre-plant or at planting, delivers a natural and sustained release of all four nutrients which closely corresponds to the demand for these from potato plants."

Polysulphate can also deliver quality as well as yield improvements:

"Quality in potato is more critical than with many other crops, as it holds the key to securing the best economic returns. In particular, an adequate supply of K, S, Mg and Ca is needed to ensure quality

PHOTO: ICL

Demonstration plot for seed potato at the Potato Technology Centre, Shamgarh, Karnal, Haryana, India: plant response to farmer's fertilization practice (left) versus Polysulphate at a dose of 250 kg/ha (right).

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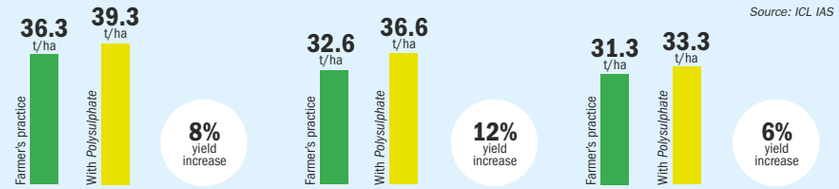
Fig. 2: **Results of demonstration plots in Gujarat, India: Polysulphate delivered yield increases for all three potato varieties at different locations**



Variety:	Lady Rosetta (LR)
Farmer:	Dharmendra Kumar Kalidas Patel
Village:	Navi Shinol
Tehsil:	Dhansura
District:	Aravalli
State:	Gujarat

Variety:	Lady Rosetta (LR)
Farmer:	Dhavlbhai Bhemjibhai Patel
Village:	Poshina
Tehsil:	Idar
District:	Sabrkantha
State:	Gujarat

Variety:	Lokar
Farmer:	Jasbhai Shankarbhai Patel
Village:	Poshina
Tehsil:	Idar
District:	Sabrkantha
State:	Gujarat

is delivered – whether that is the desired size, uniformity, colour or shelf life of potatoes. Calcium is particularly crucial for skin quality. Nutritional disorders such as internal brown spot and hollow heart in potatoes, for example, are all caused by low Ca supply to the tubers.

"This article illustrates how Polysulphate, as a fertilization option, is becoming key to high quality, sustainable potato farming around the world," Patricia concluded. "In general, its application to potato crops will result in higher yields, good skin finish, improved dry matter and increased nitrogen use efficiency."

Indeed, potato trials in Gujarat, India, demonstrated that incorporating polyhalite in fertilization programmes could deliver yield increases of 6-12% versus standard farmer practice (Figure 2).

Nutrient needs of nuts

Tree nuts – which include almonds, walnuts, cashew, pistachio, hazelnuts, pecans, macadamia, pine nuts and Brazil nuts – are an important dietary source of unsaturated fatty acids, vitamins and minerals. Orchards require balanced fertilization to promote healthy root growth, maintain tree vigour, and achieve yield targets in response to growing market demand.

With typical thoroughness, Patricia and ICL agronomist colleagues Cristian Filote and Gali Carmi reviewed the nutrient needs of tree nuts for *Fertilizer International* in a 2023 article (*Fertilizer International* 515, p28). The efficacy of water-soluble fertilizers (WSFs), controlled-release fertilizers (CRFs) and polyhalite were highlighted:

"The perfect fertilization plan is always based on fertigation with water-soluble fertilizers, as this precisely supplies nutrients to nut trees according to both the age of the plantation and the tree's phenological stage.

"ICL's Novacid range is made from highly pure ingredients and all the micronutrients present are chelated. These products are perfect for growers needing to deal with high alkalinity in their irrigation water. Their acidic nature means that all the nutrients dissolve efficiently, even in hard water, and the drip lines are kept free of limescale build-up.

"Previously, research trials have proven the effectiveness of foliar feeding in the fertilization of almonds and other nuts. ICL's innovative foliar technologies, such as Nutrivant and Agroleaf, are particularly well suited to tree nuts."

ICL's CRF portfolio is also suitable for tree nuts:

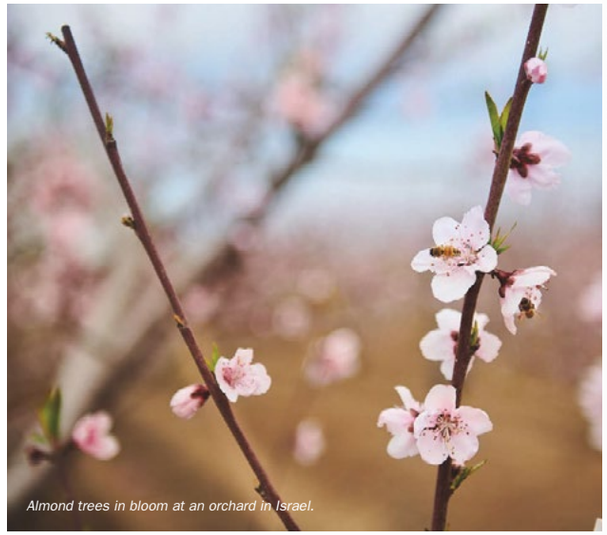


PHOTO: ICL/NATALY COHEN KADOSH

Almond trees in bloom at an orchard in Israel.

PHOTO: ICL

Clementines (variety Nadorcott) ready for harvest, Valencia, Spain.

Fig. 3: **ICL's PuraLoop process**

"The Agroblen CRF range is ideal for establishing nut plantations. These fully coated NPK granules deliver crop nutrients over a period of 8-9 months or 12-14 months, depending on the region where the plantations are being established.

"ICL also offers Agromaster – a CRF product line that combines both coated and uncoated NPKs – for young and fruit-bearing plantations. These powerful fertilizers partly deliver nutrients in an uncoated form for immediate take-up by plants to stimulate intensive growth. At the same time, they also provide NPKs in coated form. This prevents nutrient losses via run-off, leaching from light soils and/or losses under heavy rainfall conditions."

Polysulphate also supplies nutrients in a balanced way that nurtures nut trees and maintains soil fertility:

"Research shows that nutrients (S, K, Mg and Ca) are gradually made available to the crop over time due to Polysulphate's mineral composition. The product's gradual and prolonged nutrient release profile maximises nut yields by promoting healthy tree growth and development.

"Polysulphate also provides a low-chloride source of potassium, as well as being a reliable source of sulphur. Trials conducted on Californian almond trees in the US have demonstrated that applying Polysulphate can deliver a 5-11 percent increase in kernel yield in comparison to growers' standard practice."

High yielding and sustainable citrus production

In another notable agronomic review, Dr Imas and ICL agronomists Fabio Vale and William Wang and Francisco Morell outlined the nutrient requirements of citrus fruit – a regionally important crop in the Americas, Europe and China (*Fertilizer International* 517, p26).

The article explained how a proper fertilization programme is necessary to sustain both citrus productivity and soil fertility over the longer term. For example, in **rainfed systems**:

"Fertilizers are applied to the soil surface with two-thirds applied under the canopy and one-third outside. The total fertilizer supply is usually split between five or six applications across the growing season. The use of controlled-release fertilizers (CRFs), such as ICL's Agromaster product, is advantageous, as this allows the number of applications to be reduced while, by avoiding 'plant hunger', improving yields as well as nutrient use efficiency (NUE) in most cases.

"Citrus fertilization programmes can also include ICL's Polysulphate fertilizer, either applied together in combination with Agromaster or as a separate application. This multi-nutrient (K, Mg, Ca, and S) polyhalite product continues to fertilize citrus plants following rainfall events, as its special solubility pattern prolongs nutrient availability."

While in **irrigated systems**:

"Crop fertilization is performed via fertigation. ICL's Agrolution family of water-soluble fertilizers (WSFs) are ideal for the fertigation of citrus trees. These products, as well as components such as PeKacid, provide a range of formulations with different nutrient balances for each development stage of the crop.

"A fertilization programme that combines fertigation (e.g., Agrolution) with soil application (e.g., Agromaster and Polysulphate) can be suitable for citrus growing in areas with meaningful spring rainfall (>200-300 mm). Fertigation can avoid periods of plant nutrient hunger, while the application of Polysulphate ensures the supply of secondary macronutrients to the crop during wet periods.

"Polyhalite (Polysulphate) has been shown to improve the productivity and nutrients status of citrus trees across trial results from different regions. For example, improvements to the yield of sweet oranges (fruit counts and size) and plant nutrient status were observed in Polysulphate trials in Brazil. Combining the use of Polysulphate, at an application rate of 400 kg/ha, with potassium chloride increased orange yields by 30 percent, versus the control in which potassium chloride was applied alone as the sole potassium source."

These observations are backed by global trial results:

"ICL experiments with Polysulphate in China have also shown increased grapefruit yield and quality. The application of

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PHOTO: ICL

Polysulphate also reduced N, P and K inputs by 44 percent, 38 percent and 17 percent, respectively, versus standard NPK practice. This lowered fertilizer costs by 11 percent while raising the income of growers by seven percent, compared to conventional NPK fertilization.

"Citrus trials with the CRF product Agromaster have also demonstrated proven benefits. When applied in mandarin plantations at a rate of 4 kg/tree, Agromaster (18-10- 18) delivered a yield increase of 23 percent and – by improving fruit size – raised the percentage of commercial fruit, versus growers practice that applied conventional fertilizers at similar rates."

Suitable products are also available for new plantations and foliar feeding:

"When starting a new plantation, the CRF Agroblen can be added to the planting hole (50-100 grams per tree) during transplanting operations – in either rainfed or irrigated production systems. Agroblen, by fulfilling nutrients needs throughout the first year, helps young plants to become well-established, thereby reducing the numbers that will require replanting.

"A full foliar nutrition programme for citrus plantations can be designed using ICL's Agroleaf and Nutrivant product ranges, as these offer a wide range of formulations for each development stage. Agroleaf Power improves the assimilation of nutrients by the plant – thanks to its DPI and M-77 growth enhancer technologies. Nutrivant Booster, meanwhile, comes in macro- and micro-nutrient formulations designed for citrus crops."

PuraLoop – a circular solution that delivers for crops

Last summer, in what – extremely sadly – proved to be her final article for *Fertilizer International*, Dr Imas and colleague Lucas van der Saag introduced PuraLoop – a new phosphate fertilizer from ICL created from recycled phosphorus. This innovative product 'closes the loop' by transforming previously discarded waste into a valuable agricultural resource. The article highlighted its environmental, economic and agronomic benefits (*Fertilizer International* 526, p54):

"Interest in the recovery and reuse of phosphorus – as a more sustainable alternative to primary phosphate rock mining – has grown in recent years, particularly in Europe. This is being driven by several factors:

- Currently, the EU has access to one phosphate resource only – Yara's Siilinjarvi phosphate mine in Finland – and consequently the region is import-reliant for phosphate rock.
- The EU also added phosphorus to its critical minerals list in 2023 to highlight its strategic importance and the need for supply security.
- The gradual introduction of cadmium limits under the EU's Fertilising Products Regulation (FPR), which entered into force in 2022, also excludes phosphate rock imports from certain countries."

In response, ICL has developed an innovative process known as PuraLoop to transform sewage sludge ash (SSA) into an efficient phosphate fertilizer and effective crop nutrient source. By recovering and reusing phosphorus on a commercial scale (Figure 3), ICL's PuraLoop process benefits Europe in several ways, as the authors explained in the article:

"One is that we can turn waste into a product of agronomic and economic value. We can also reduce our dependency for critical raw materials on outside sources and, finally, we can have a leadership role in environmental and technological innovations for food and fertilizer production.

"In the PuraLoop process, SSA is firstly mixed with sulphuric acid or phosphoric acid in an acidulation step. The run-of-pile (ROP) material is then granulated to produce the fertilizer end-product. In 2023, test runs with this SSA-based process met all the necessary EU regulatory requirements to produce single superphosphate (SSP) and triple superphosphate (TSP). This included legal stipulations such as the FPR D1 conformity audit and full REACH registration.

"The advantages of using SSA as a fertilizer production raw material is that it eliminates odour (compared to the processing of phosphate rock) and is essentially cadmium- and fluorine-free. Agronomic trials have also shown very good results."

The article outlined plans for ramping up production and expanding the product range:

"A full-scale industrial PuraLoop installation is now up and running at ICL's Amfert production site at the port of Amsterdam. This is capable of producing two products – the phosphate fertilizer PuraLoop 0-38-0 and NPK fertilizer PuraLoop 5-5-22.

"Around 1,000 tonnes of PuraLoop 0-38-0 – known as PuraLoop 38 – was manufactured during successful production runs at the end of 2023. Production of PuraLoop 38 was 6,000 tonnes in 2024 and is expected to reach 15,000 tonnes in 2025. Looking ahead, ICL is also planning to expand the PuraLoop product range by introducing SSA-based PK products."

A lasting legacy

As these selected excerpts show, Patricia's contribution to agronomy over a lengthy career was wide ranging and deep. It's fitting to end with a few words from someone who knew Dr Imas well – her close colleague of 30 years, Hillel Magen, former VP Agronomy, ICL Fertilizers, and Director, International Potash Institute:

"Patricia had an incredible ability to take science and convert to practical applicable message. Her agronomic recommendations were clear and practical while at the same time were carefully aligned to the scientific principals.

"Her untimely passing leaves us, her many colleagues and friends around the world with deep sorrow and grief.

"Rest in peace dear Patricia. You have contributed to so many people on this earth." ■

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PHOTO: MUSTANG JOE/FLICKR

Foliar fertilizer for better blooms

Colombia is the world's second-largest exporter of cut flowers. Foliar fertilizer applications, rather than soil-applied nutrients, could have significant economic and agronomic benefits for the country's flower producers, reports Levity Crop Science in new trials results.

Chrysanthemums are reported to be Colombia's fourth biggest export earner.

Cut flowers with greater marketable value

The benefits of foliar fertilization have been highlighted by a recent collaboration between Colombian flower farmers and the pioneering British 'smart' fertilizer company Levity Crop Science. Trials on chrysanthemums treated with foliar formulations showed significant improvements across a range of measurements, including stem length, numbers of stems and flowers, and shelf life. These improvements translated into greater marketable value for the produce from treated plants.

"Traditionally, fertilizer has been seen as a soil-applied product," explains Dr David Marks, Levity's founder and managing director. "Plants obtain the nutrients they need via the roots, and indeed that's the route generally taken for most chrysanthemum production.

"Fertilizer is applied to the soil at the same time as the seeds are sown, a practice regarded as the easiest and most cost-effective."

Yet Dr Marks says this may prove a false economy for many growers. Key nutrients such as nitrogen can be lost to the environment before the plant can take it up. Other nutrients, such as calcium, are only mobile in the plant's xylem, which means they bypass areas of the plant that are calcium deficient.

"While a soil-applied fertilizer may display the correct nutrient analysis, it's very difficult to guarantee that those nutrients will be available to the plant as it needs them: the right source, at the right time, in the right place, and in the right amounts," Dr Marks points out.

He says there's a large body of research that shows how soil fertilization can be supplemented, or even replaced, by foliar nutrition. "By choosing timings more carefully – during the growing season, rather than just at the start – and applying the fertilizer in the right place, to the leaf, it's possible to make better use of crop inputs, while increasing yield."

Chrysanthemum trials in Cundinamarca

In the trials, which were carried out at two separate farm sites in Cundinamarca state with varieties including *Deliflor*, *Golden Polaris* and *Pink Atlantis*, chrysanthemums were grown in glasshouses and subjected to foliar experimental treatments involving four liquid fertilizers developed by Levity. Each of the four 'smart' fertilizers contain specific ingredients designed to improve nutrient-use efficiency (NUE).

"Applying nutrient products at higher rates, in order to increase a crop's uptake of a particular nutrient, is neither sustainable nor profitable," says Dr Marks. "Levity's 'smart' approach is to find compounds that either helps the plant make better use of those nutrients, or which stimulate the plant into absorbing greater quantities of them, or both.

"Often this results in an overall decrease in application rates, while seeing an increase in yield or other metrics such as quality, shelf life or number of blooms, and, in the case of fruit, improved firmness, colour and sweetness."

Levity's trials in Colombia – where it has been working with flower growers since 2020 – focused on four of Levity's products. The first, **Lono**, contains nitrogen in the form of stabilised amine nitrogen (SAN) – co-formulated with either potassium (Lono K) or calcium (Lono Plus). As the name suggests, SAN allows nitrogen applications to be made without it being lost to the environment, as happens with nitrates or urea. SAN also encourages the plant to concentrate its resources on strong stem and flower development, rather than vegetative growth.

Another calcium-containing product in the trials was **Albina** formulated with **LoCal**, Levity's specially developed calcium transport stimulant. LoCal encourages the plant to transport calcium to all parts – especially stem, leaf and root tips – rather than being limited to xylem transport. Levity says LoCal makes it easier for flowers and older leaves to absorb calcium.

The fourth product, **Indra**, contains nutrients that promote and enable the plant's antioxidant production, helping to counter the accumulation of reactive oxygen species (ROS) caused by abiotic stresses, such as heat, cold, salinity, drought and high levels of UV light.

Rigorous methodology

Five treatments at different rates were made for each fertilizer, with four replicates. The foliar applications were made in addition to the grower's standard programme using soil-applied, edaphic fertilization (EF).

Results were assessed for various metrics: stem length and diameter for all products, plus vase life and fresh weight (Albina); fresh and dry stem weight (Indra); number of buds and stem fresh weight (Lono K and Lono Plus).

Additionally, for each of the four fertilizer products in the trial, a cost-benefit analysis was conducted to determine which of the application rates, if any, gave the best return on investment. This was assessed by comparing the cost of buying the products against the value of any increase in saleable yield – based on a standard 0.5kg export-type bouquet achieving a Colombian peso sale price of COP8,000 (February 2022 prices, when the trial programme began).

Across the board economic boost

Results showed the four fertilizers each gave significant increases over a standard EF programme, with all metrics demonstrating improvement.

But it's how that improvement translates into benefit for the grower, says Dr Marks, that makes these results significant.

"Our cost-benefit analysis showed that in all cases, apart from the very lowest application rates for Indra and Lono Plus, the grower would see an economic boost from the use of these products," he notes.

"At the other end of the scale, the economic benefit was as much as COP175,000 from an application that costs just COP236 – in other words, a 740-fold return on investment."

By analysing all the cost-benefit ratios, the research team was able to establish the right rate for each fertilizer, based on its economic value to the grower: Albina at 1 l/ha Albina; Indra at 0.75 l/ha; and Lono K and Lono Plus both at 1.5 l/ha.

"This work has reinforced our already extensive research work on the role of SAN in increasing crop yields," says Dr Marks. "The applied nitrogen remains available to the crop rather than being lost to the environment."

Levity chose Colombia for the trials as the world's second-largest exporter of cut flowers – it's the country's fourth most valuable exported product.

"Giving growers the tools to improve their agronomic and economic performance, while also being able to demonstrate more sustainable and more efficient resource-use, should be of further benefit in raising margins and improving the already strong perception of Colombian-grown cut flowers amongst export buyers," concludes Dr Marks. ■

Acknowledgment

Reporting by Adrian Bell of Agromavens.

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Sulphur deficiency drives structural shift to ammonium sulphate

Ammonium sulphate has emerged as one of the fastest-growing segments of the global nitrogen market. Chinese exports reached record highs in 2025, driven by surging demand from Brazil and India. In this CRU Insight, **Arina Syrdybayeva** looks at the dynamics underpinning this high growth market.

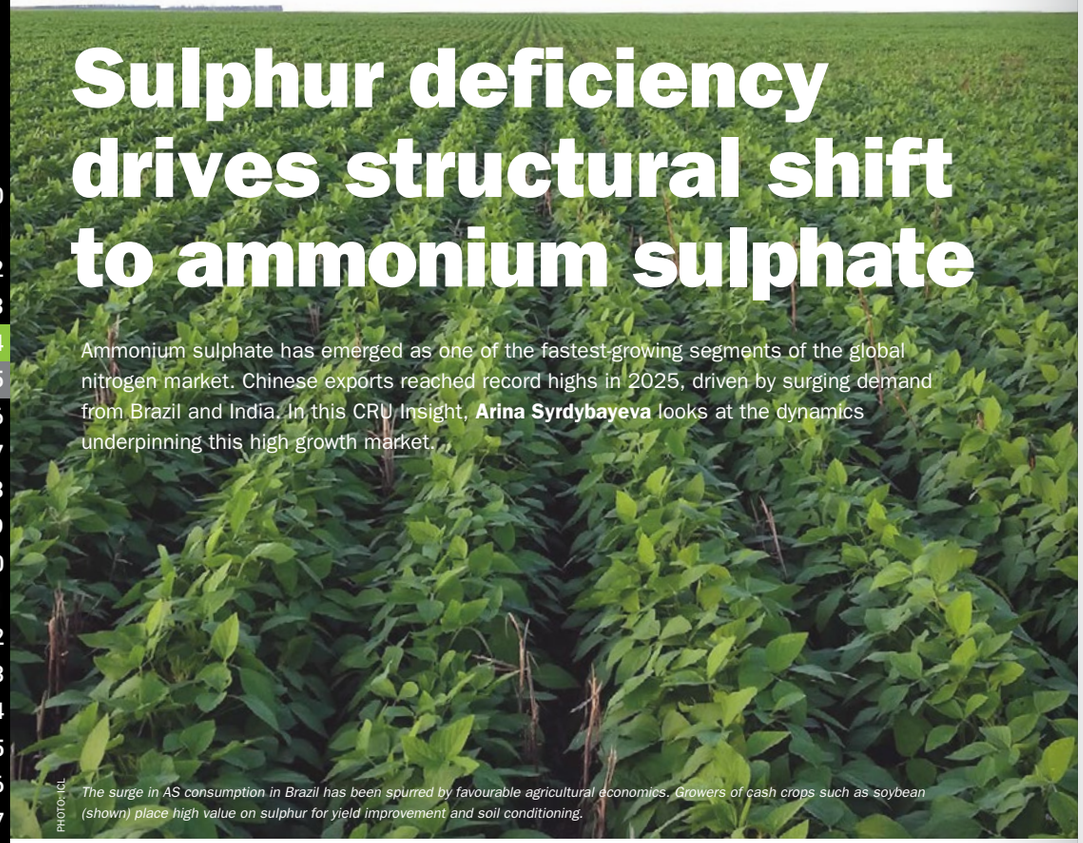


PHOTO: ICL

The surge in AS consumption in Brazil has been spurred by favourable agricultural economics. Growers of cash crops such as soybean (shown) place high value on sulphur for yield improvement and soil conditioning.

Ammonium sulphate (AS) is a fertilizer containing 21% nitrogen (N) and 24% sulphur (S). Global production reached 35.78 million tonnes in 2025, with 36.72 million tonnes forecast for 2026. It remains the second most widely used nitrogen fertilizer globally, after urea, and the largest sulphur fertilizer by volume.

China dominates supply, accounting for 59% of worldwide production. Chinese output is primarily by-product-based, being derived from caprolactam (CPL) manufacturing for nylon fibres, methyl methacrylate (MMA), and methionine production. Lithium iron phosphate (LFP) battery production is also expected to add 2.0 million tonnes of AS capacity by 2029.

This production surge has reshaped global trade. Chinese material is forecast to account for 76% of the globally traded AS market by 2029, up from 70% in 2022, as European production has struggled with closures and weak operating rates, while high costs have made European AS uncompetitive in most markets except the United States.

Despite its origin as a by-product, AS has captured an increasing share of global nitrogen consumption, particularly in the Americas and Southeast Asia, where the crop mix and recognition of sulphur's agronomic value have driven adoption. Brazil exemplifies this trend, with AS demand growing significantly faster than the broader nitrogen market as it substitutes for urea and ammonium nitrate.

This increase in popularity is underpinned by both agronomics and economics. Persistent sulphur deficiency in soils favours AS as a dual-nutrient solution. Its agronomic advantages, lower volatility in hot and wet conditions, longer storage stability, and suitability for sulphur-responsive crops have all supported uptake. While urea prices have remained elevated, AS has also offered a cost-effective alternative, on a per-unit nitrogen basis, despite being logistically less efficient due to its lower nutrient density (21% N for AS versus 46% N for urea). China's exclusion of AS from export policy controls has also accelerated international adoption by allowing unrestricted trade.

Production – China secures market dominance

Global AS capacity growth this year will be driven primarily by by-product routes, with CPL and LFP production accounting for the majority of incremental additions. Approximately 70% of global AS capacity is by-product-based, although this proportion does vary by region: 83% in China, 73% in North America and 90% in Europe.

CPL-based supply is the largest growth engine, contributing approximately half of global capacity expansions. LFP-based capacity, critical to China's electric vehicle battery manufacturing, surged in 2023 and added 0.5 million tonnes of AS capacity in 2025 alone. By 2030, China's total AS capacity is forecast to reach 29 million tonnes, nearly double its 2020 level, with CPL-based capacity contributing 41% and LFP-based production 21%.

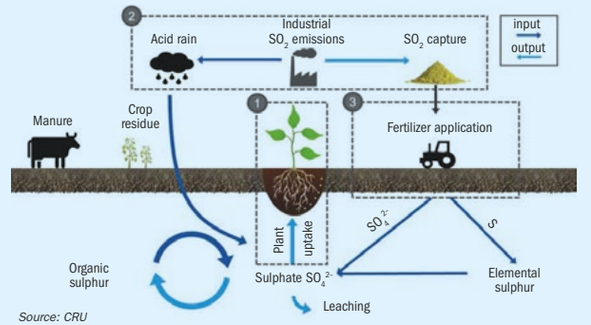
Underpinning both routes, sulphur and sulphuric acid serve as critical raw materials. In CPL manufacturing, approximately one tonne of sulphur produces three tonnes of sulphuric acid, which in turn yields 0.4 tonnes of sulphur content per tonne of caprolactam. Similarly, sulphuric acid serves as a key feedstock in tMAP (technical monoammonium phosphate) production for LFP batteries.

While high sulphuric acid prices indirectly impact AS production economics, the by-product nature of this fertilizer means its supply is driven by output decisions of industries producing something else entirely. Elevated sulphuric acid costs in 2025, driven by tight sulphur supply and strong phosphate fertilizer demand, supported AS floor prices but did not fully offset the sheer volume of AS being produced as a by-product globally.

Coke oven gas-based ammonium sulphate (COG-based AS), meanwhile, faces structural headwinds. Although it accounts for roughly 20% of global production, COG-based AS output – also called steel-grade AS – is forecast to decline as China curbs its coke production to align with steel operating restrictions and environmental regulations. COG-based AS also suffers from impurities and darker colouration, limiting market acceptance. Chinese producers increasingly compact COG-grade and CPL-grade material into granular forms to meet export requirements, particularly for Brazil.

These capacity additions, combined with limited domestic consumption and AS's exclusion from China's restrictive fertilizer export policy, have triggered a sharp rise in traded volumes. China has secured market dominance by tailoring exports to consumer specifications and developing new markets in Africa and Myanmar, positioning itself to control 76% of globally traded AS by 2029.

Fig. 1: **The sulphur cycle**



Source: CRU

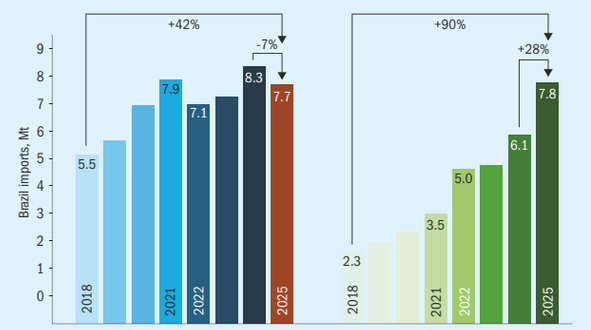
Sulphur deficiency helps drive demand

AS consumption is virtually all fertilizer-based (95%), with its sulphur content becoming increasingly relevant as soil deficiencies intensify. Demand is more widely distributed than production, with the strongest markets in Asia, excluding China, and Latin America, particularly Brazil. AS accounts for approximately 50% of sulphur-containing fertilizer demand.

Persistent sulphur deficiency in soils remains a structural demand driver for AS, positioning it as a dual-nutrient solution addressing both nitrogen and sulphur requirements. Areas with pronounced sulphur deficits, South Asia and East Asia, represent long-term addressable markets, particularly as atmospheric sulphur deposition (Figure 1) continues to decline following stricter emissions controls on industrial processes and fuel sulphur content (*Fertilizer International* 520, p20).

The global sulphur deficit, estimated to exceed 12 million tonnes annually as crop demand outpaces fertilizer application, remains elevated, supporting incremental AS uptake where agronomic and price conditions allow. The shift towards high-analysis fertilizers such as urea,

Fig. 2: **Brazil import trends for urea (left) and ammonium sulphate (right)**



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DAP (diammonium phosphate) and MOP (muriate of potash) over the past three decades has also exacerbated soil sulphur depletion, as these products contain little to no sulphur compared with traditional alternatives (*Fertilizer International* 520, p20).

Modern agricultural practices, including intensive cropping systems, higher-yielding varieties, and expansion onto marginal land, have further intensified sulphur removal rates. Certain crops such as soybeans require 50-60 kg S/ha compared with 5-10 kg S/ha for low-intensity grazing. In regions where sulphur deficiency has become acute, AS offers an economically viable and agronomically effective solution.

Brazil's 2025 demand surge

Brazil reinforced its position as the world's largest AS importer in 2025, accounting for over one-third of global imports. Shipments surged to 7.8 million tones through 2025, driven by robust substitution of urea and ammonium nitrate, expansion of farmed areas, and an AS discount to urea that accelerates substitution. Brazilian AS consumption rose from 1.9 million tonnes in 2017 to 6.0 million tonnes in 2024 (Figure 2), with forecasts pointing towards 9.7 million tonnes by 2029.

Brazil's preference for granular AS has reshaped Chinese export capacity. Brazilian imports are split 15:85 between standard and granular product, with Chinese compacted granules accounting for the vast majority. China has responded to this preference with a surge in compaction capacity, accounting for more than 99% of Brazil's total AS imports in 2025, pushing European and US exports to seek alternative destinations.

The surge has been underpinned by favourable agricultural economics. Corn, cotton, soybean, and pasture rotations place high value on sulphur for yield improvement and soil conditioning. In the second and third quarters of 2025, AS also traded at a discount to urea for the first time on record, catalysing substitution. While urea imports declined 15% year-on-year in the first half of 2025, AS volumes grew, reconfiguring Brazil's nitrogen import basket. So far this decade, ammonium sulphate's share of its nitrogen demand has doubled, rising from 14% in 2020 to 28% in 2025.

Other markets

Southeast Asia's AS imports reached 5.14 million tonnes in 2025, although year-on-year growth decelerated sharply to just 0.1%, down from 15.8% in 2024. This slowdown reflects affordability pressures. High AS prices due to freight costs, combined with declining rice prices in Thailand and Vietnam, undermined affordability and slowed buying activity. Demand in Indonesia and Malaysia, in contrast, has shown greater resilience supported by favourable palm oil economics. Combined, Myanmar, Indonesia, and Vietnam accounted for over 60% of regional imports in 2025.

Outside Brazil and Southeast Asia, global demand growth in 2025 was concentrated in India, Turkey, and Egypt, driven by policy changes and favourable pricing.

India's imports rose from 140,000 tonnes in 2020 to 600,000 tonnes in 2025, with China accounting for 96% of supply. The updated Nutrient-Based Subsidy (NBS) policy for 2025-26 incorporated domestic and imported AS, signalling long-term governmental support. Yet the market remains at an early stage with strong growth potential as AS represents just 1.4% of India's total nitrogen demand in 2025.

Turkey's imports, meanwhile, rose 102% year-on-year in 2025, supported by low pricing and higher acceptance of AS for NPK production. Egypt also switched from a net AS exporter to a net importer last year as its domestic production faced gas supply disruptions.

> **"Ammonium sulphate has captured an increasing share of global nitrogen consumption, particularly in the Americas and Southeast Asia, where the crop mix and recognition of sulphur's agronomic value have driven adoption."**

Current market situation

The global AS market in 2025 has been defined by three forces:

- Surging Chinese exports
- Structural demand shifts in Brazil and India
- A narrowing premium with urea that is reshaping farmer economics.

China's exports reached 21.4 million tonnes in 2025 dominated by Fujian and Hubei regions. The exemption of AS from fertilizer export inspections, due to its origins as a by-product and a domestic preference for industrial uses, has allowed volumes to move abroad freely. Chinese AS consumption has also weakened as urea has become more affordable, trading at a discount to AS on a per-unit nitrogen basis for the first time in months.

Brazil's dynamics shifted decisively in late 2025. AS demand weakened considerably as the urea premium over AS compressed, making urea more attractive on a per-unit nitrogen basis. High trucking rates, with transported volumes for AS being double those of urea due to its lower nutrient density, have seen activity in 2026 increasingly concentrated in southern Brazil closer to ports.

Production curtailments in the last quarter of 2025 and into 2026 have also shifted market dynamics. A progressive reduction in operating rates by Chinese CPL producers, from 80% in November to 70% by the end of 2025, has counteracted structural oversupply and prevented a slump in CPL-grade prices. This supply discipline has instead kept AS values elevated, even with slower demand from Brazil.

European AS demand is forecast to jump to 2.7 million tonnes in 2026 as domestic supply remains stagnant and import requirements rise. Southeast Asia imports are likely to decline slightly, as buying activity from major consumers remained subdued in 2025.

The key question for AS in 2026 is whether a host of factors – new urea capacity, China's export quotas, AS production controls and CBAM in Europe – will undermine its affordability, a key advantage, and the rationale for substitution that has reshaped global nitrogen trade. ■

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Fertipaq – 2026 is the year of microgranular sulphur

Fertilizer International recently spoke to **Elise van der Linde**, Fertipaq's manager, as the company prepared to launch a new, highly-concentrated microgranular product on the market. This innovative and easy-to-disperse fertilizer contains 80% bio-sulphur.

Introduction

Netherlands-based start-up Fertipaq recovers sulphur from wastewater and biogas streams for use in fertilizer manufacture. The company was created in 2013 by Leo Habets, the winner of an in-house innovation competition at wastewater treatment company Paques.

Fertipaq recovers, stabilises and reuses the organic sulphur generated by THIOPAQ® biogas desulphurisation units. THIOPAQ® technology was developed by Paques – Fertipaq's parent company – in collaboration with universities, research institutes and industry customers. The units remove hydrogen sulphide gas (H_2S) from a wide range of biogas streams (generated at anaerobic digestion plants, wastewater treatment plants and landfill sites etc.) because of equipment corrosion and health, safety and environmental reasons (*Fertilizer International* 520, p24).

Fertipaq manufactures and markets the liquid suspension fertilizer S-600. This highly concentrated source of sulphur (600 grams per litre) is spray-applied to crops 4-5 times each season (3 litres per hectare concentration). It is ideal for crops with a high sulphur requirement and is suitable for organic farming (*Fertilizer International* 520, p24).

S-600 has a small particle size (5-20 microns), is naturally hydrophilic and easy to disperse. There is also evidence that it boosts nitrogen availability. The company is also placing a new higher concentration microgranular sulphur fertilizer (80% S content) on the market in 2026.

PHOTO: FERTIPAQ

Elise van der Linde is the manager of innovative sulphur fertilizer company Fertipaq.

The use of recovered sulphur in fertilizer applications is likely to increase in future. The International Fertilizer Association (IFA) recently commented that:

"Hidden hunger is back. This time, it's sulphur. Across the world's major cropping systems, a constraint is tightening: widespread sulphur deficiency."

The Association, which has launched a project to map this deficiency globally, specifically mentions alternative sulphur sources – such as sulphur recovered from waste streams – as a potential supply solution, especially as we decarbonise the world economy.

Fertilizer International spoke to Elise van der Linde, Fertipaq's manager, in February about the company's origins, its circular business model, new product launch and how recovered bio-sulphur can help address growing demand for 'the fourth crop nutrient'.

From a winning idea to a commercial business

Fertipaq is a truly 'circular' business that emerged from the wastewater treatment industry and, for the fertilizer sector, has a very unusual and inspiring origin story. How did the company come into being?

"You've summarised it quite well in the introduction. An innovation competition within Paques provided employees with an opportunity to accelerate their knowledge and business opportunities. Leo Habets, the competition winner who started Fertipaq, was a THIOPAQ® specialist who knew all about desulphurisation, especially for the pulp and paper industry. Leo thought, okay, let's do something with the recovered sulphur because it's a valuable raw material that can be easily reused for fertilizer purposes.

"About 12 years ago, Leo started with the idea of reusing this valuable waste. The next milestone was learning how to re-suspend the sulphur and formulate it into a stable, high quality suspension. The density is quite high and, in general, suspensions always like to settle – and that's no different with bio-sulphur.

"Finding the right additives to stabilise this product was a big step and took a few years of research. Different universities within the Netherlands, like Wageningen and Van Hall Larenstein, together helped formulate the product we have today.

"We're now working with a lab researcher who's a full-time employee and the third member of our team. She's focusing on lab research and product development, as well as on crop trials with the University of Wageningen.

"This year, we're actually starting to launch pilot production at one of our THIOPAQ® sources. So, instead of transporting this product to an off-site manufacturer, we're now going to manufacture the finished product at source, where it's recovered. This will save on transportation costs and lower the carbon footprint.

"Right now, we source our sulphur raw materials from different places in Europe, manufacture the product here and then transport it globally. But there are THIOPAQ® installations all over the world which can recover sulphur and our ideal would be to sell it where we recover it – in India, for example.

"In terms of sales, we have a sulphur cake product, we have the liquid suspension fertilizer S-600, and we're also working on a new microgranular product. In the past, sales of the cake and the suspension were 50:50 by volume. But our sales are now mainly the finished liquid suspension product. This goes to distributors, because we sell business to business, and also to the end-user which is the farmer.

"Most of the product goes to western Europe, the Netherlands, Germany, Belgium etc, but we are expanding and now sell some suspension in Italy. The cake we mainly sell to Spain, for example, and the UK. We're also focusing on Canada with the new microgranular product.

"The microgranular product [which contains 80% bio-sulphur] is mainly for export. It's a great product for transport, right, as you're transporting less water – which contributes to the carbon footprint – and more product. That's much more efficient and cost effective compared to a suspension containing 50% water. You get a much higher nutrient density and are supplying a more concentrated amount of nutrients per kilo of product."

Solving a problem, creating value

How does Fertipaq create organic sulphur fertilizer from wastewater – solving an equipment corrosion and health, safety and environmental problem and generating a commercial valuable product instead?

"THIOPAQ® is a desulphurisation unit. Biogas goes in and after washing clean biogas free of H_2S comes out to generate renewable energy. The H_2S is oxidised to sulphate during washing and eventually converted to elemental sulphur in a reactor with the help of bacteria.

PHOTO: FERTIPAQ

One 10 litre container of S-600 liquid fertilizer contains six kilograms of finely dispersed elemental sulphur particles (5-20 microns).

"Wastewaters from all kinds of different industries need to be treated such as landfill, also the pulp and paper industry, plus food and beverage companies, as a brewery will generate wastewater. Even in oil and gas refineries, you have sour gas that needs to be treated. While you can do that with the help of the Claus process, nowadays, more refineries are changing to biological fibre installations instead."

Bio-sulphur beings benefits

Does Fertipaq's S-600 fertilizer, being biologically-recovered rather than chemically-derived, have advantageous properties?

"Yes, indeed bio-sulphur in S-600 does have some benefits over chemical sulphur due to its properties. The product is easy to disperse in water as it's hydrophilic – we say it is rain-fast – and it oxidises quickly in the soil because of its small particle size.

"With the oxidation rate, you will see faster results and will need less product to get the same results. Those are definitely big benefits – and we do have crop studies that show differences between applying chemical sulphur and bio-sulphur sources."

Launching microgranular sulphur on the market

Fertipaq has been developing a new easy-to-disperse microgranular fertilizer containing 80% bio-sulphur. Is there a clear need and a gap in the market for this product and when will it be launched?

"It's been in the pipeline one and a half years now. We did the research, got some great results in the third quarter of 2025, have now received the first big batch of four tonnes, and are working on the organic certification for this microgranular fertilizer product as we speak.

"It works in the same way as the suspension except that it's dispersed in the mixing tank. It disperses very, very easily because it's hydrophilic and the particle size is very small, manufactured to beneath 10 microns, as we use wet milling and fluid bed technology.

"For us, 2026 is going to be the year of microgranular sulphur. We're now working on launching the product in the first quarter. The first batch has arrived and we're shipping off to customers in mid-February.

"It's a great example of how we've been working to develop different kind of products with all this beautiful sulphur. This product, particularly, will be great for export as now, instead of transporting water with 45% sulphur, we can also ship 80% sulphur and fill the same container with more products. The shelf life is also two years."

A solution to global sulphur deficiency?

Is the recovery of biological sulphur part of the supply solution needed to address widespread sulphur deficiency in the world's major cropping systems?

"Yes, with bio-sulphur we can at least partly solve sulphur deficiency, although not everything at this point, to be honest. If you look at the scale of sulphur production from oil and gas refineries it's huge, definitely a commodity, and we're still on the niche side of the market.

"Paques is looking at solutions for melting bio-sulphur. This is not as easy as it is for chemical sulphur. But, if we can find the right answer, melting will allow bio-sulphur to be used and applied in different ways and demand will grow.

"For us, it's great if the paper or food and beverage industries can recover sulphur from biogas. But for them, selling sulphur to us will be of no importance as long as the value of sulphur is low – or if legislation allows them to dispose of it in water systems.

"If the market need for sulphur becomes high enough for legislation to change, then the value of sulphur will grow, and companies will have the incentive to invest in dewatering. That would automatically mean more bio-sulphur – which now simply goes to waste – will become available.

"So, yes, bio-sulphur can at least partly solve soil sulphur deficiency. Although we are still niche, both demand and availability will grow in future." ■

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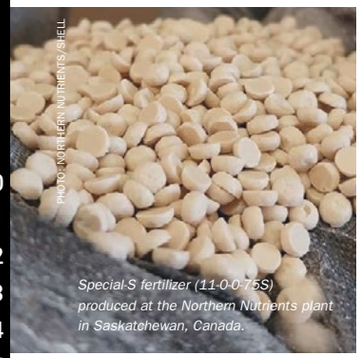


Special-S fertilizer (11-0-0-7.5S) produced at the Northern Nutrients plant in Saskatchewan, Canada.

Industry trends in sulphur-enhanced fertilizers

The increasing prevalence of sulphur-deficient soils, combined with pressure to improve nutrient efficiency, is driving interest in sulphur-enhanced fertilizers. The integration of elemental sulphur directly into urea offers a practical pathway to addressing these challenges at scale. **Kent Martin** and **Rafael Garcia-Martinez** outline how elemental sulphur is being used within the fertilizer industry to improve both agronomic performance and logistical efficiency.

Sustainable intensification driving market change

The fertilizer industry is undergoing significant transformation as agriculture intensifies its focus on sustainability and resource efficiency. Increasing adoption of nutrient stewardship principles and precision agriculture is reshaping fertilizer selection and management across global farming systems.

At the same time, a more competitive and increasingly consolidated market is pushing leading producers to diversify. A broad product portfolio, once a strategic advantage, has now become a fundamental requirement for long term relevance.

Sulphur has experienced drastic changes in recent years – a consequence of its continued recognition as the 'fourth major crop nutrient'. In the US Midwest, for example, a rapid increase in sulphur fertilizer application, compared to nitrogen, phosphorus and potassium, has been observed[1].

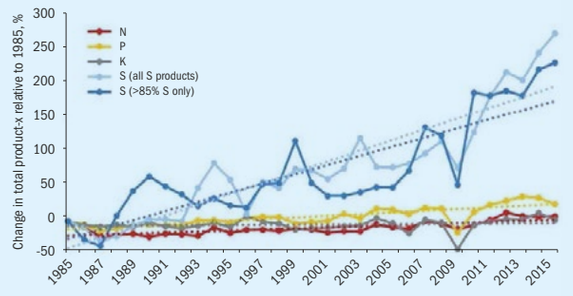
Most recently, sulphur demand has also increased for use in industrial processes to produce batteries and other high value products. This has placed additional pressure on sulphur producers to increase the efficiency of fertilizer products to maximise the value and agronomic benefits of applied sulphur.

Reduced atmospheric deposition driving widespread deficiency

Strict fuel desulphurisation regulations have successfully reduced industrial sulphur emissions and improved air quality. These successful environmental policies have, however, also significantly lowered sulphur deposition onto agricultural soils. As a result, many cropping systems that historically relied on atmospheric inputs must now receive sulphur directly through fertilizers.

Despite the introduction of numerous sulphur-containing fertilizer products, a global imbalance remains. In 2015, The Sulphur Institute (TSI) estimated that approximately 10 million tonnes more sulphur was removed from soils annually than was replenished. To reassess the current situation, the International Fertilizer Association (IFA) together with TSI and a selected group of academic and industrial partners are conducting an updated global assessment of the crop sulphur balance. This is compiling data across major crop systems worldwide – information that will be key to farmers, industry, investors and the public in general.

Fig. 1: **Percentage change in the agricultural application of N, P, K, and S products in the Midwestern US, 1985-2015**



Source: Hinckley & Driscoll (2022)

Sulphur as a critical plant macronutrient

Sulphur plays a vital role in crop development. It is an essential macronutrient required for protein synthesis, enzyme activation, and chlorophyll formation. It heavily impacts crop yield and quality parameters like sugar content and oil percentage. Its role in supporting nitrogen use efficiency has also become increasingly important, as crop yields rise and nutrient management practices become more precise.

In recent decades, sulphur deficiencies have emerged across many agricultural regions due to clean air standards. This has made supplemental sulphur applications a critical component of balanced fertilization programmes. Farmers have historically been able to increase nitrogen fertilization rates alone and achieve maximum yields. But, with increasing sulphur deficiency, reaching yield potential requires sulphur fertilizer application alongside nitrogen. Indeed, the valuable synergies between nitrogen and sulphur as crop nutrients are becoming more apparent as soil sulphur deficiency increases.

Urea as a platform for sulphur-enhanced fertilizers

Urea is the most widely used nitrogen fertilizer globally, both on a volume basis and geographically, making it a logical carrier for sulphur delivery at scale. Integrating sulphur into urea allows producers to address nutrient deficiencies without altering established fertilizer-handling and application infrastructure.

Combining nitrogen and elemental sulphur within a single granule supports balanced nutrient delivery and enables growers to apply sulphur at appropriate rates and timings. This integrated approach can improve nutrient efficiency across a wide range of soils, climates, and cropping systems.

Urea-ES® and Special-S: sulphur-enhanced urea technologies

To combine sulphur and nitrogen delivery to crops, Shell has developed a second generation of sulphur-enhanced fertilizers – Urea-ES® and Special-S – under the Shell Thiogro platform. These incorporate elemental sulphur into nitrogen fertilizers in a form designed to improve agronomic performance and logistical efficiency.

Urea-ES® and Special-S fertilizers are both manufactured using a patented process that emulsifies micron-sized particles of elemental sulphur within molten urea to generate a homogeneous granule. This approach differs from conventional sulphur-coated urea products, in which sulphur is applied as an external layer. In Urea-ES® products, elemental sulphur particles with diameters typically

SULPHUR FERTILIZER OPTIONS

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Table 1: **Representative product specifications for Urea-ES® (40-0-0-13S) and Special-S (11-0-0-75S)**

Urea-ES® (40-0-0-13S)		**Special-S (11-0-0-75S)**	
Nitrogen:	40.0 wt% (minimum)	Nitrogen:	11.0 wt% ±0.5
Sulphur:	13.0 wt% ±1.0	Sulphur:	74.0 wt% ±1.0
Typical granule size:	2–4 mm	Typical granule size:	2–4 mm
E-Sulphur particle size:	5–20 µm	E-Sulphur particle size:	20–80 µm

Source: Shell

below 40 micrometres are uniformly dispersed throughout the urea matrix, promoting rapid biological oxidation following soil application.

The high nutrient concentration of elemental sulphur (>99% S) enables the production of fertilizers with nutrient-dense formulations. For example, while standard urea contains 46% nutrient, Urea-ES® formulations such as 40-0-0-13S and 35-0-0-24S deliver total nutrient contents of approximately 53% and 59%, respectively. Higher nutrient density is a valuable characteristic due to the potential to reduce transportation, storage, and handling costs across the fertilizer supply chain.

Agronomically, urea – by providing a soluble matrix – substantially reduces the delay in sulphur release from the fertilizer product to the soil system. This earlier release to soil, in turn, allows for faster conversion of the elemental sulphur to sulphate for plant uptake.

Development with a focus on performance

Traditionally, two main sulphur fertilizer types were available, both with their own drawbacks: the sulphate fertilizer and elemental sulphur fertilizer families. These have always been placed on opposite ends of the spectrum in terms of sulphur availability.

While sulphate fertilizers were immediately available, there was also a substantial leaching loss potential from the moment of solubilisation in the soil. Sulphur bentonite, in contrast, the traditional elemental sulphur fertilizer, underwent a lengthy oxidation process to sulphate and therefore was less vulnerable to leaching loss.

There are two primary reasons for oxidation delays in traditional sulphur bentonite:

1. The time taken for sulphur particle release. This is regulated by the gradual expansion and disintegration of the bentonite clay matrix in contact with moisture. (In Urea-ES® and Special-S, in contrast, the solubility of the urea matrix maximises the speed of sulphur particle release.)
2. The time taken for the elemental sulphur to oxidise to sulphate once it is released. This oxidation process is highly size dependent. While differing for each product, the average elemental sulphur particle in sulphur bentonite is relatively large, being generally greater than 150 micrometres.

For elemental sulphur, the interaction of particle size and microbial activity holds the key to sulphur oxidation and availability – with a large particle size limiting surface area and therefore microbial access. Understanding this dynamic allowed Shell Thiogro Technology to focus on the control of elemental sulphur particle size and tailor this to enhance early season availability.

Although smaller particles can achieve faster oxidation, a particle size of 30-40 micrometres was carefully selected to properly balance nutrient use efficiency with sulphate availability. This optimal size range provides a sulphur oxidation 'sweet spot' – being not too fast and not too slow – as it provides sufficient available sulphur for plant uptake while protecting against sulphate leaching loss.

Production technology and emulsion stability

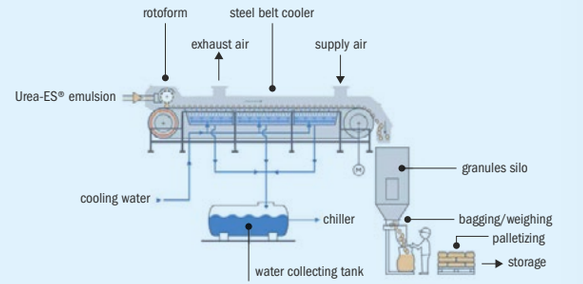
A key technical challenge in sulphur-enhanced urea production is the immiscibility of molten urea and molten sulphur, this arising from differences in their density and surface tension. Shell Thiogro technology addresses this through the formation of a stable urea–sulphur emulsion.

In this process, molten urea and molten sulphur are dispersed using a high-shear mixer, the Shell ThioMill, in the presence of a proprietary additive system (Shell ThioAdd). The result is a stable emulsion consisting of finely dispersed sulphur droplets within a continuous urea phase. This emulsion can be processed using conventional urea solidification technologies, including drum and fluid bed granulation and pastillation.

Pastillation using IPCO Rotoform technology

Shell Thiogro has partnered with IPCO to deploy Urea-ES® and Special-S production on Rotoform pastillation systems. IPCO Rotoform units have been widely used since the late 1970s for solidifying a broad range of chemical products and are characterised by their operational simplicity and product uniformity.

Fig. 2: **IPCO Rotoform pastilliation process for Urea-ES®**



Source: IPCO/Shell

The key benefits of IPCO's Rotoform pastillation systems are:

- **Dry process** – there is no cross contamination between the product and cooling medium
- **Pastilles solidified directly from the melt** – eliminating the energy and equipment costs associated with subsequent crushing, breaking or grinding processes.
- **Virtually dust-free production** – pastilles are of a highly uniform shape and stability
- **Pastilles are free flowing** – ideal for handling, blending, storage and further processing.
- **Higher bulk density** – with better packing properties than bulky flakes

In the Rotoform process, the urea-sulphur emulsion is deposited as uniform droplets across the full width of a moving steel belt, where it is cooled and solidified into dust-free pastilles with diameters of between 2-4 mm (Figure 2).

The pastilles are free flowing, mechanically stable, and well suited for storage, blending, and downstream handling.

The production of Shell Thiogro Urea-ES® via the IPCO Rotoform system is modular in nature with production capacity directly related to the number of Rotoform units in operation. This flexibility allows producers to scale capacity incrementally in response to market demand.

Integration into fluidised-bed granulation plants

Shell has also collaborated with thyssenkrupp Uhde to integrate sulphur-enhanced urea production into fluidised-bed granulation plants. In this configuration, the urea-sulphur emulsion is introduced into the granulator, where it is converted into Urea-ES® granules.

Producing sulphur-enhanced urea in fluidised-bed systems requires a modified recycle and evaporation process to prevent sulphur-containing dust from entering the high-pressure urea synthesis loop. Dedicated evaporation units process recycle streams from the granulation plant, ensuring system integrity while maintaining overall steam efficiency.

The incorporation of elemental sulphur reduces the heat input required during granulation due to sulphur's lower heat of crystallisation compared with urea. By reducing cooling air requirements, this can also reduce equipment size and capital investment in new plants. In retrofit applications, the reduced load on existing evaporation systems can help deliver higher plant throughput.

Fluidised-bed granulated Urea-ES® fertilizer (43-0-0-7S), Leuna, Germany.

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Commercial production

The first commercial Special-S facility was commissioned in South Korea in 2019. Since then, additional Urea-ES® and Special-S plants have been licensed in the Middle East and North America, including facilities in the United Arab Emirates and Canada.

Recent capacity expansions reflect growing interest in sulphur-enhanced urea products. In 2025, Shell Trading Canada partnered with Northern Nutrients Ltd in a joint venture to triple the capacity of its Saskatchewan fertilizer plant. This investment is designed to boost local fertilizer production, increase supply security in North America, improve farming efficiency, and advance sulphur utilisation.

Value propositions

Shell Thiogro Technology delivers a range of unique value propositions. While the ability to provide **available sulphur nutrition** to crops (as previously described) remains the cornerstone, other valuable characteristics also deliver substantial value.

The value of **high nutrient density** is clear to both the fertilizer producer and the farmer – as it means less transportation, storage space and logistical cost. Special-S (11-0-0-75S), for example has an 86% nutrient content, compared to the 45% nutrient content of ammonium sulphate (21-0-0-24S).

Traditionally, ammonium sulphate contained too much salt at planting, while the oxidation of sulphur bentonite was too slow to provide agronomic benefit. In contrast, farmers can apply Special-S (11-0-0-75S) with crop seeds at the required application rates **without the risk of salt injury**.

Saline and sodic soil reclamation projects, meanwhile, have found that Special-S functions as **an effective in-season amendment** that avoids the sudden 'shock' of chemical reactions associated with sulphates.

Shell Thiogro Technology has been designed to perform well in both **fertilizer blending and field application**. Urea-ES® and Special-S provide uniform blends and spread well with traditional nitrogen, phosphorus and potassium fertilizers due to their density, size, and high performance.

Carbon footprint reduction

Reducing greenhouse gas emissions (GHGs) and the carbon footprint of fertilizers are environmental priorities in agriculture. Shell Thiogro Technology can reduce the climate impacts of fertilizer production and use in two ways:

1. Greater nutrient efficiency and availability help to deliver more productive crop output per unit of fertilizer input.
2. The potential for reducing nitrogen losses from ammonia volatilisation and N_2O emissions is another more direct benefit.

In a recent study, Urea-ES® and Special-S, when combined with a urease inhibitor, demonstrated a significant reduction in ammonia volatilisation, relative to standard urea treated with a urease inhibitor. Additionally, Shell Thiogro Technology has been shown to reduce N_2O emissions with, and independent of, nitrification and urease inhibitors[2].

Conclusions

The increasing prevalence of sulphur-deficient soils, combined with pressure to improve nutrient efficiency, is driving interest in sulphur-enhanced nitrogen fertilizers. Technologies that integrate elemental sulphur directly into urea offer a practical pathway to addressing these challenges at scale. As fertilizer producers seek to diversify portfolios and enhance product performance, sulphur-enhanced urea formulations are also likely to play an increasingly important role in global nutrient management strategies. ■

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About the authors

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Fig. 3: **Summary of the value propositions for Shell Thiogro Technology**

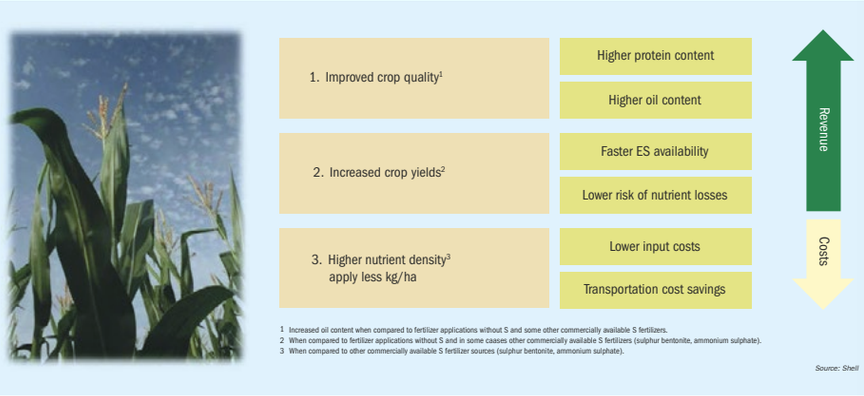

PHOTO: NORDRODEN/SHUTTERSTOCK

Potash storage.

Fertilizer INTERNATIONAL index 2025

A complete listing of all articles and news items that appeared in *Fertilizer International* during 2025.

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A classic US red barn on the Midwest plains.

PHOTO: IMAGINEGOLF/ISTOCKPHOTO.COM

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phosphates & potash INSIGHT

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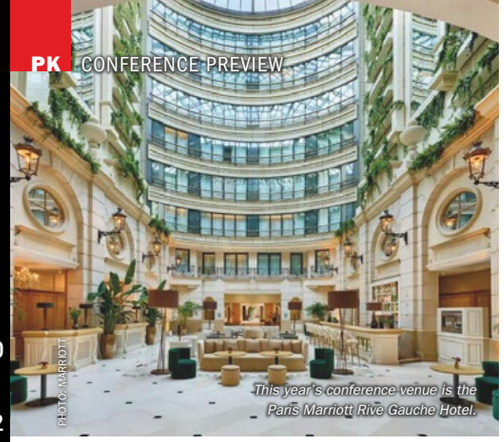
PHOTO: MARRIOTT

This year's conference venue is the Paris Marriott Rive Gauche Hotel.

CRU Phosphates +Potash welcomes you to Paris!

CRU will convene the 2026 Phosphates+Potash Expoconference in Paris, France, at the Paris Marriott Rive Gauche Hotel, 13 – 15 April.

CRU's 2026 Phosphates+Potash Conference – now in its 18th year – is returning to Paris this year. The 2025 event in Orlando was one of the most successful to date – attracting more than 400 delegates from over 150 companies and 30 countries.

It was all change in Orlando last year with the event championing the potash industry – alongside the phosphates sector – for the very first time. Paris will build on that success with a P&K themed event that lives up to its Phosphates+Potash name. Leading international producers, traders and engineering, technology and equipment providers are all expected to attend.

Bringing together two sister segments

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 CRU is building a new global community that jointly celebrates the phosphate and potash industries. We invite you to join us in Paris – as well as spread the word that potash and phosphates have a new joint home.

Paris in the spring

Paris is on the world's great capital cities and at its best in the springtime. The event's convenient and accessible western European location also makes it an ideal place for the global phosphates and potash industries to meet up, network and access crucial market intelligence and technical updates. Europe is a large demand centre for phosphate and is the original home of the potash industry. Germany and Spain remain large-scale potash producers.

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 2026 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. Commercial programme highlights include:

- Phosphates and potash markets in transition
- The LFP-driven specialty phosphates boom
- Phosphate rock market dynamics and LatAm production
- Investment outlook and financing trends for phosphate & potash assets
- Recent phosphate industry dynamics and factors to watch in 2026
- Phosphate and potash industry decarbonisation
- Cost pressures – sulphur price effects on phosphate production
- Benefits to producers from better phosphate use efficiency (PUE)
- Elemental phosphorus markets
- Unconventional phosphate production
- Other phosphates uses – electrification.

See our full conference guide on page 42.

The event also offers a separate but equally strong technical programme (see selected abstracts on page 41). This is designed to cater to the needs of production personnel throughout the phosphate and potash value chains. To kick things off, the 2026 conference offers an impressive lineup of 14 technical showcase presentations on the opening afternoon. These punchy 15-minute pitches are a great primer and an 'industry 101' on all things technical.

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

Register today for your place at CRU Phosphates+Potash 2026 in Paris. For more information visit: events.crugroup.com/phosphates/home ■

Technical programme highlights

A selection of CRU Phosphates+Potash 2026 abstracts from the conference's technical programme. Conference presentations are also covered in the six articles on pages 48-69.

RevoCaP: enabling Europe's phosphorus independence

EasyMining

EasyMining's patented Ash2Phos technology provides a proven, scalable process for recovering phosphorus from sewage sludge ash (SSA) to produce the fertilizer product RevoCaP. EasyMining is bringing this innovation to market through two pioneering plants.

RevoCaP fully complies with EU fertilizer regulations and supports the European Green Deal's objectives of circularity, resource efficiency, and reduced dependency on critical raw materials. With the first Ash2Phos plant soon to enter operation, RevoCaP will be available at industrial scale for the European market. It has also gained full approval for use in organic farming under Regulation (EU) 2018/848.

A cost-effective approach to SOP production

Ballestra

Potassium sulphate (SOP) is a premium fertilizer that provides essential potassium and sulphur and is ideal for chloride-sensitive crops. Ballestra S.p.A. has developed a novel wet-route process for SOP, as a more sustainable alternative to the Mannheim production. This innovative production method is based on a water-based reaction between potassium chloride (KCl) and ammonium sulphate ($(NH_4)_2SO_4$). It operates at room temperature, eliminates emissions, avoids HCl formation, and generates a secondary liquid fertilizer (N+K+S) alongside high-purity crystalline SOP. This state-of-the-art technology offers significant energy savings, improved operational safety and environmental benefits, while delivering pure SOP that meets market standards.

Pushing the boundaries of innovation in phosphate production

Technophos

Phosphates are essential to modern life. Yet, this finite, non-renewable resource faces critical challenges. With only one third global phosphate resources economically viable under conventional methods, innovation is no longer optional – it is an imperative. Technophos, an R&D and innovation centre offering advanced alternative processes, aims to transform low-grade ores and industrial waste into high-value products such as feed-grade dicalcium phosphate (DCP) and high-purity phosphoric acid. These technologies tolerate impurities, allow the valorisation of by-products, and achieve excellent recovery rates, proving that sustainability and profitability can coexist. Our capabilities span laboratory feasibility, pilot validation, and semi-industrial demonstration, ensuring reliable scale-up for complex projects.

Food- and electronic-grade phosphoric acid made easy

Sulzer

This presentation focuses on Sulzer's advanced technologies – OptimEXT™ liquid-liquid extraction and fractional melt crystallisation – and their role in producing food-grade and electronics-grade phosphoric acid, efficiently and economically. Approximately 90% of phosphoric acid is used in fertilizer production in 'crude' merchant-grade form. Yet, its transformation into high-purity grades is essential for industries such as food and semiconductors. The wet process route, while dominant globally, faces significant purification challenges. We will show how Sulzer's OptimEXT™ technology, utilizing Kühni™ agitated columns, achieves superior separation efficiency for food-grade phosphoric acid. In addition, a multi-stage melt crystallisation process for ultra-high purity electronic-grade acid will also be described.

Vertical roller mills (VRM) for high efficiency phosphate rock grinding

Loesche

Vertical roller mills (VRMs) are an ideal solution for grinding phosphate rock, reducing operating costs, improving flexibility, and delivering high and stable product quality. In this case study, two former petcoke VRMs were reconditioned for phosphate rock grinding. After a deep process analysis and mechanical and electrical auditing, both mills were reconditioned and relocated for use in grinding phosphate rock at different industrial fertilizer plants. Since their commissioning, both installations have operated successfully, in terms of output and product quality, at optimised energy consumption.

Advanced process solutions for potash and phosphate production

Haver & Boecker Niagara

Haver & Boecker Niagara provides fully integrated process solutions for phosphate and potash that are proven in large-scale reference projects worldwide. In phosphate crushing and screening, we have delivered more than 86 Niagara vibrating screens, each of these having a capacity of 150 tonnes per hour (t/h). Successful installations include the basic engineering for a phosphate ore crushing and screening plant with a capacity of 5,500 t/h, and the design of a potash crushing and screening plant with three lines offering a capacity of 800 t/h each. Haver & Boecker Niagara have also supplied a complete loading terminal for potash that satisfies the customer's 480 t/h production requirements.

How to increase potash production and yield

Derrick Corporation

The use of Huck Bolted screens in potash processing often results in high circulating loads, excessive overgrinding, and reduced recovery rates. This paper highlights the transformative role of high-frequency multi-deck vibrating screens, like Derrick's SuperStack®, in overcoming these limitations. Drawing on case studies from potash plants in Saskatchewan, results show significant improvements in classification efficiency (up to >95%), reduced power consumption, lower reagent usage, extended equipment lifespan, and enhanced mineral recovery. Fine screening not only optimises flowsheets and reduces operational costs but also contributes to sustainability by minimising energy use and plant footprint.

SSP plant upgrades to meet emissions targets and eliminate effluent

Armatec

Ferchem Fertilizers and Chemicals Co, one of the largest producers of single superphosphate (SSP) fertilizer in Egypt and the Middle East, have installed three new gas scrubbing systems designed by Armatec Environmental Ltd. These SSP plants now have stack emissions that comply with local and international environmental standards. The systems are designed to cope with the inevitable silica deposits that result from SSP gas scrubbing. To comply with tighter Egyptian government regulations on fluoride emissions (<5 mgF/Nm³), they were designed with a removal efficiency greater than 99.99%. The systems also reduce or eliminate liquid effluent and recycle up to 100% of fluorosilicic acid (FSA) back to the process.

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Conference agenda

(Correct at time of going to press)

DAY 1: Monday, 13 April

13:00 REGISTRATION & EXHIBITION OPEN

TECHNICAL SHOWCASES

13:30–13:45 **Thickener Drive – Case Study of Revamping Old Reducer in the Phosphate Industry**
Vincent Nocton, *CMD Gears*

13:45–14:00 **Expertise on Phosphate Ore Beneficiation and Fertilizer Coating Additives**
Miquel Serra, *KAO*

14:00–14:15 **ANDRITZ and Technip Energies (T.EN) Introduce the New Generation UCEGO® Table Filter with Model UCEGO® 12 Installed on T.EN's High Recovery Dihydrate Process at Eti Bakir, Samsun, Turkey**
Fabian Germain Bodinaud, *Andritz Environment & Energy*

14:15–14:30 **High Purity Potash and Phosphate Crystal Process**
Cansu Uygur, *Asos Process Engineering*

14:30–14:45 **Technological Solution for Designing Customised Products from Liquid and Powered Raw Materials**
Johannes Buchheim, *Glatt Ingenieurtechnik GmbH*

14:45–15:00 **Guidelines for Performance, Safety and Operational Risk Management of Shell & Tube Phosphoric Acid Evaporators**
Yogesh Gujarathi, *Graphite India Limited*

15:00–15:15 **Industrial Pilot Plant for Feed and Food Phosphates**
Juan Hailer, Ingetecsa

1515–15:30 **Latest Development on Phosphate Based Cathodes (LFP, LMFP) and Sustainable Iron Phosphate Precursors**
Behnam Hormozi, Integrals Power Limited

15:30 NETWORKING COFFEE BREAK

TECHNICAL SHOWCASES

16:00–16:15 **Roller Screening Performance for Phosphate Fertilizer Granules: A step beyond vibrating screens**
Alexandre Gonçalves Andrade, *Metal7 Inc.*

16:15–16:30 **Use of Nalco Mining Optimiser and Reverse Osmosis Optimizer to Select Antiscalants and Antiscalant Dose for Mining Applications**
Ronald Davis, *Nalco Water, an Ecolab Company*

16:30–16:45 **Converting Industrial Waste into Agricultural Input: "Phosgreen"Fertilizer from Gypsum and Phosphoric Acid Sludge**
Kevin Esmunaldo, *PT Petrokimia Gresik*

16:45–17:00 **On the Way to Zero-Waste? UM6P and TOMRA Sorting GmbH Started a Pilot Plant to Treat Phosphate Mine Waste Rock in Morocco**
Jens-Michael Bergmann, *TOMRA Sorting GmbH*

17:00–17:15 **Process Solutions for Stripping of Purified Phosphoric Acid**
Christian Woltz, *SGL Carbon GmbH*

17:15–17:30 **MAGUIN – The 182-Year-old World Leader of your Production Key Equipment**
Mathieu Bailly, MAGUIN

17:30 WELCOME RECEPTION

19:00 END OF DAY 1

DAY 2: Tuesday, 14 April

07:30 REGISTRATION & EXHIBITION OPEN

COMMERCIAL AND MARKETS

08:30–08:35 **Welcome Address**
Simon Inglethorpe, CRU

08:35–08:55 **Keynote: Phosphate & Potash Market Dynamics – Structural Supply Shifts and Divergent Price Paths**
Humphrey Knight, *CRU*

08:55–09:40 **Phosphates and Potash in Transition: Navigating Supply Shocks, Trade Fragmentation, and the New Geopolitical Realignment**
Ilya Motorygin, *GG Trading DMCC*
Monika Tothova, *Food and Agriculture Organization of the United Nations*
David Sacht, Oryx Global Partners
Jani Kiuru, Finnish Minerals Group

09:40–10:00 **IN FOCUS: LFP Demand is Booming, and with it, the Demand for Specialty Phosphates**
Sam Adham, *CRU*

10:00 NETWORKING COFFEE BREAK

PHOTO: CRU

The event is a once-a-year opportunity to network with industry peers

(Correct at time of going to press)

DAY 2: Tuesday, 14 April

COMMERCIAL AND MARKETS

10:30–11:00 **Phosphate Rock – Market Dynamics**
Maria Gamboa, *CRU*

11:00–11:30 **Investment Outlook and Financing Trends: The Rationale for and Financing of New Upstream Phosphate & Potash Assets**
Joe Garofoli, *Roc Global*

11:30–12:00 **Recent Phosphate Industry Dynamics and Factors to Watch in 2026**
Andy Jung, *The Mosaic Company*

PHOSPHATE ROCK

10:30–11:00 **Pushing the Boundaries of Phosphates**
Anna Dikova, *Technophos*
Axel Yakub, *Technophos*

11:00–11:30 **Reassessment and Installation of Petcoke Vertical Roller Mills (VRM) for Phosphate Rock High Efficiency Grinding**
Alfonso Fernández, *Loesche*

11:30–12:00 **Management of Wet Phosphate Treatment Sludge: Optimisation of the Flocculation Operation during the Centrifugation of Phosphate Treatment Sludge**
Zinab Largate, *JESA*

POTASH PRODUCTION

10:30–11:00 **Potash Fertiliser Production – Meeting Growing Global Demand**
Dr Vadim Greshnov, *ERCOSPLAN Ingenieurgesellschaft Geotechnik und Bergbau mbH*

11:00–11:30 **How to Increase Potash Production and Yield with Derrick Screens**
Danny Luu, *Derrick Corporation*

11:30–12:00 **Reducing the Environmental Impact in Phosphate and Potash Applications through sustainable Materials and Products Choices**
Dr. Carsten Düchting, *Düchting Pumpen Maschinenfabrik GmbH & Co. KG*

12:00 NETWORKING LUNCH

COMMERCIAL AND MARKETS

13:30–14:00 **Phosphate and Potash Industry Decarbonisation**
tbc

14:00–14:30 **Phosphate Cost Pressures: Sulphur Price Effects on Phosphate Production**
Viviana Alvarado, *CRU*

14:30–15:00 **Benefits to Producers for Improving Phosphate Use Efficiency (PUE)**
Hunter Swisher, *Phospholutions, Inc.*

PHOSPHORIC ACID: PRODUCTION, OPERATIONS AND PROCESSES

13:30–14:00 **Optimisation of Phosphoric Acid Production with Various Sources of Phosphate Rock**
Liliek Harmianto Purbawinasta, *PT Petrokimia Gresik*

14:00–14:30 **Time-Resolved CFD Simulation for the Characterisation and Optimisation of Phosphoric Acid Reactor Trains**
Ben Boyer, *SPX Flow – Mixing Solutions*

14:30–15:00 **Improved Technology for Arsenic Impurity Removal in Phosphoric Acid**
John Carr, *Syensqo*

POTASH PRODUCTION

13:30–14:00 **Sustainable Slimes Beneficiation in Phosphate and Potash Operations Using CavTube™ Column Technology**
Michele Tuchscherer, *Eriez*

14:00–14:30 **Engineering Sustainable Growth – Advanced Process Solutions for Potash and Phosphate Fertilizer Production**
Francisco Dos Reis, *Haver & Boecker Niagara*

14:30–15:00 **Potassium Sulphate: Ballestra's Recent Developments on a Cost-effective Approach to SOP production**
Stefano Vignando, *Ballestra S.p.A.*

15:00 NETWORKING COFFEE BREAK

COMMERCIAL AND MARKETS

15:30–16:00 **Elemental Phosphorus (P4) Markets: End-Uses, Supply Bottlenecks, and European Project Pathways**
Willem Schipper, *Willem Schipper Consulting*

16:00–16:30 **Phosphate Rock Production in Latin America**
Ernesto Lima, *Bifox LLC*

16:30–17:00 **Unconventional Phosphate Production**
Timothy Cotton, *Novaphos*

17:00–17:30 **Phosphates Other Use: Electrification**
Brian Ostroff, *Arianne Phosphate*

PHOSPHORIC ACID: PRODUCTION, OPERATIONS AND PROCESSES

15:30–16:00 **ATMOS: A new Energy and Environment Saving in Phosphoric Acid Concentration Process**
Aziz Chbeir, *Yara*
Azza Kioua, *GEA Process Engineering*

16:00–16:30 **Merchant Grade Acid Preparation and Logistics**
Jan Tytgat, *De Smet Agro*

16:30–17:00 **Improved Process for Arsenic Removal from Phosphoric Acid**
Einat Shooster, *Tenova Advanced Technologies*
Roy Movsowitz, *Tenova Advanced Technologies*

17:00–17:30 **From Raw to Refined: Food and E-grade Phosphoric Acid Made Easy**
Emanuele Dal Pos, *Sulzer Chemtech Ltd*
Ronan Goude, *Sulzer Chemtech Ltd*

POTASH+PHOSPHATES TECHNOLOGIES AND INNOVATION

15:30–16:00 **Processing of Solid or Liquid Potassium Chloride Raw Materials**
Dr. Eike Kaps, *ERCOSPLAN Ingenieurbüro Anlagentechnik GmbH*

16:00–16:30 **Sustainable Growth in Fertilizer Demand. Casale's Recent Acquisitions and Relevant Technological Solutions**
Filippo Davolio, *CASALE SA*

16:30–17:00 **Transforming Waste to Value: Sulphate of Potash (SOP) Production from Secondary Resources**
Markus Pfander, *K-UTEC AG Salt Technologies*

17:30 DRINKS RECEPTION

18:30 END OF DAY 2

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DAY 3: Wednesday, 15 April

08:00 REGISTRATION & EXHIBITION OPEN

COMMERCIAL AND MARKETS

09:00–09:30 Specialty Phosphate Market Overview
Mariana Fortuna, *CRU*

09:30–10:00 Understanding and Managing Phosphorus Resources for Long-Term Security
Abdallah El Houari, *Global Phosphorus Institute – GPI*

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

PHOSPHATE BENEFICIATION

09:00–09:30 Innovative Flotation Reagents for Processing Phosphate Ores Worldwide
Guoxin Wang, *Arkema*
Benoit Grymonprez, *Arkema*

09:30–10:00 Performance Study of a Novel Modified Alkylpolyglucoside Towards the Enhancement of Apatite Beneficiation
Lucas Moore, *Colonial Chemical, Inc.*

10:00–10:30 Unlocking the Potential of Phosphate Beneficiation at Nutrien Aurora: A Mine to Mill Transformation
Keenan Collins, *Hatch Ltd*
Edward DeRose, *Hatch Ltd*

PHOSPHATE+POTASH TECHNOLOGIES AND INNOVATION

09:00–09:30 From Reliability to Digitalization: Integrated Maintenance Strategies for Safer, Smarter Phosphate Operations
Patrick Pfeil, *REMA TIP TOP*

09:30–10:00 Innovating an Alternative to Commodity Phosphate Fertilizer: Impact on Manufacturing, Agronomy, and the Environment
Dr. Kyle Isaacson, *Phospholutions, Inc.*

10:00–10:30 RevoCaP: Enabling Europe's Phosphorus Independence with a Legally Approved, Sustainable Phosphate for Traditional and Organic Farming
Philipp Theuring, *Easymining Germany GmbH*
Dr. Yariv Cohen, *EasyMining*

10:30 NETWORKING COFFEE BREAK

COMMERCIAL AND MARKETS

11:00–11:30 Emerging Trends in Promoting Increased Potash Use Efficiency in Crops (KUE)
Karl Wyant, *Nutrien*

11:30–12:00 Potassium Chloride: Market Overview & Outlook
Alexander Chreky, *CRU*

12:00–12:30 Spotlight on a Potash Project: Timelines, Volumes, and Market Impact
Juan von Gernet, *ICL*

PHOSPHOGYPSUM

11:00–11:30 CrystalCleaner Technology for High Purity Phosphogypsum
Jan van Esch, *GEA NIRO PT B.V.*

11:30–12:00 Transforming Phosphogypsum into a Valuable Resource for the Construction Industry
Tibaut Theys, *Prayon Technologies, a division of Prayon SA*

12:00–12:30 Carbon-Free Metallothermic Valorisation of Phosphogypsum as a Pozzolanic SCM
Mohamed Kamar, *Arab Fertilizer Association*

GRANULATION TECHNOLOGY UPDATE

11:00–11:30 Granulation Reactor Modernization for Enhanced Safety and Reliability
Theo Warner, *J.R. Simplot Company*

11:30–12:00 Breakthrough in Constituent-based Ammonium Phosphate Granulation Simulation Modeling
Robert Tinsley, *Hatch Ltd*

12:00–12:30 The Next Generation of JT Granulation Plants (NGGP)
Chris Dennis, *JESA Technologies*

12:30 NETWORKING LUNCH

COMMERCIAL AND MARKETS

14:00–14:30 Phosphoric Acid and Rare Earths Concentrate as a by-product from Iron Ore – a Strategic European Circular Approach
David Hognelid, LKAB

14:30–15:00 Co-recovery of Rare Earths: Extraction from Phosphate Ore
Willis Thomas, *CRU*

15:00–15:30 Unlocking Critical Mineral Potential: Integrating Rare Earth Element Recovery into Phosphate Processing
Lyndsay Tran, *Hatch Ltd*

INDUSTRY #4: DIGITALISATION, AUTOMATION AND AI

14:00–14:30 Environmental Impact Assessment Driven by Artificial Intelligence: A Case Study from the Moroccan Phosphate Industry
Adnane Mahmoud, *JESA*
Jihad Alaoui Sosse, *JESA*

14:30–15:00 Optimisation of Phosphoric Acid Production with Model Predictive Control and Digital Twin Technology
Ali Kheradmand, *ANDRITZ*

15:00–15:30 Enhancing Scrubber Efficiency Through Machine Learning and Virtual Overlap Analysis (VOA) Tool
Roger Makhoul, *Spraying Systems Europe BV*

PLANT OPERATIONS AND EQUIPMENT

14:00–14:30 Gas Scrubber Upgrade Meets Emissions Targets and Eliminates Liquid Effluent
Shane Pope, *Armatec Environmental Ltd*

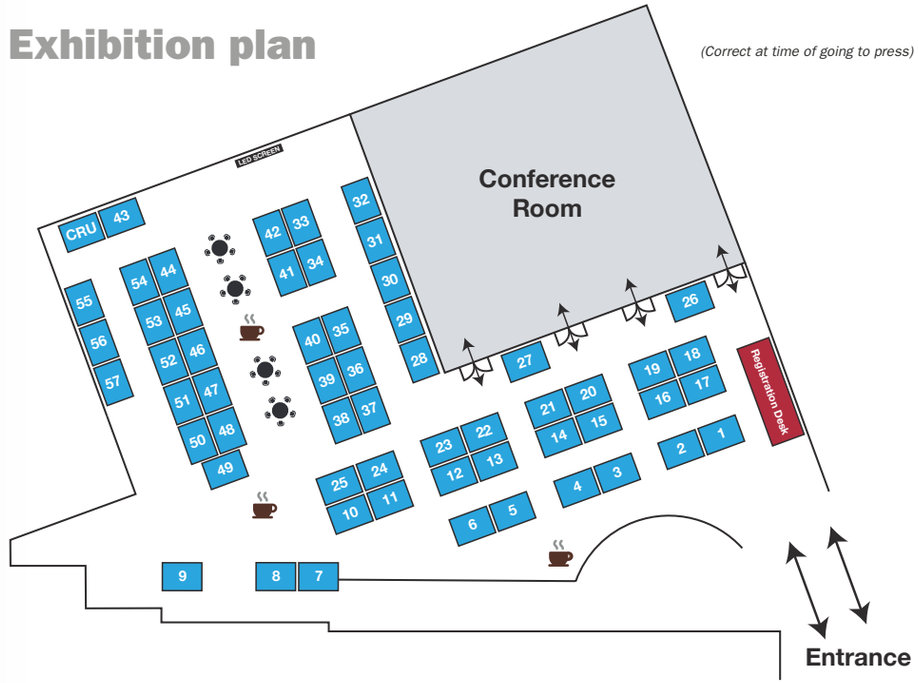
14:30–15:00 Harness the Energy Potential of your Sulphuric Acid Plant
Jesse Huebsch, *Chemetics Inc.*

15:00–15:30 Debottlenecking of Sulphuric Acid Production for Improved Fertilizer Manufacturing Applying Platinum Promoted Honeycomb Ceramic Catalysts
Johannes Hofer, *P&P Industries AG*

15:30 END OF CONFERENCE

Exhibition plan

(Correct at time of going to press)



Exhibitor list

1	OCP Rock Solutions	17	WEIR	32	FERRY CAPITAIN & CMD Gears (GROUPE CIF)	45	Mafoder Foundry
2	TOMRA	18	JESA	33	AKW Equipment + Process Design	46	Gambarotta Gschwendt Srl
3	KAO	19	ANDRITZ	34	Derrick Corporation	47	Graphite India
4	ASOS	20	GEA	35	ERIEZ	48	SAACKE
5	Blair Rubber Company	21	CG Thermal	36	Neelam Aqua & Speciality Chem (P) Ltd	49	DÜCHTING PUMPEN
6	Bradley Pulverizer	22	Kimre/Socrematic	37	Prayon	50	MERSEN
7	BSK Global	23	Syensqo	38	ARKEMA	51	METAL7 Inc.
8	Comessa	24	Nalco Water I An Ecolab Company	39	Glatt Ingenieurtechnik GmbH	52	A.W.S. CORPORATION
9	Munsch Chemie-Pumpen GmbH	25	SULZER	40	PegasusTSI Inc	53	Maguin
10	STEULER-KCH GmbH.	26	HATCH	41	P & P Industries AG	54	EMIRERRI STEEL MANUFACTURER PVT LTD
11	HAVER & BOECKER NIAGARA	27	Rema Tip Top	42	INGETECSA	55	SNF
12	FEECO International, Inc	28	De Smet Agro	43	SGL Carbon GmbH	56	SPX Flow
13	Worley Chemetics	29	Telus Applications For Industry	44	Loesche Latinoamericana	57	ROTEX GROUP
14	JAS Global Industries	30	Keyon Process				
15	OCP	31	Spraying Systems Europe				
16	Begg Cousland Envirotec						

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Exhibitor profiles

The vibrant presentation programme

PHOTO: CRU

Arkema — Stand 38

ARKEMA

ArrMaz Products Inc., the US affiliate of Arkema's Specialty Surfactants business, provides specialty additives and process solutions for the crop nutrition and mining industries. Our crop nutrition technologies enhance fertilizer manufacturing, handling, and product quality by improving granulation efficiency and reducing dust and caking. Our mining flotation collectors, frothers, and specialty reagents enhance mineral recovery, grade, and plant efficiency across phosphate, lithium, and industrial minerals. We partner with customers worldwide to optimize performance and improve operational results.

Contact:
mining.surfactants@arkema.com
https://specialtysurfactants.arkema.com

Bradley Pulverizer — Stand 6

Bradley PULVERIZER

For over 140 years, Bradley Pulverizer has supplied air classification and pulverizing solutions for mineral processing applications, including Bradley pendulum roller mills for the grinding of limestone and phosphate rock. Bradley Broadfield Dens are the industry standard for the manufacture of SSP and other acidic salts. Bradley Pulverizer offers single source supply for milling and acidulation processing worldwide.

Contact:
info@bradleypulverizer.com
www.bradleypulverizer.com

Comessa — Stand 8

comessa we dry harder

Since the 1950s, COMESSA specialises in the design, manufacturing, erection, and commissioning of equipment for use in the fertilizer industry, with over 300 references worldwide. In partnership with major engineering contractors and process licensors, COMESSA supplies granulation equipment for all types of fertilizers – including rotary granulators, rotary dryers, rotary coolers, rotary coaters, fluid bed coolers and paddle granulators. COMESSA also specialises in the drying and cooling of all types of soluble fertilizers.

Contact: Christophe Chiron
+33 3 88 79 41 41
cchiron@comessa.fr
www.comessa.com

Contact: Fabienne Lang
flang@comessa.fr

De Smet AGRO — Stand 28

DE SMET AGRO

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
jan.tytgat@dsengineers.com
www.dsengineers.com

GEA PROCESS ENGINEERING — Stand 20

GEA

GEA is one of the world's largest suppliers of equipment and services to the chemical and fertilizer industries. GEA offers a wide range of industrial technologies for evaporation, crystallisation, centrifugal separation, and fluid bed drying. These processes are tailored to fit the highest requirements of phosphate producers. We specialise in the concentration and purification of phosphoric acid, the production of water-soluble fertilizers (tMAP, tDAP, MKP) and the valorisation of co-products.

Contact: Aniss Zenati
+33 6 16 24 18 23
aniss.zenati@gea.com
www.gea.com/en

Contact: Laurent Palierne
laurent.palierne@gea.com

Hatch — Stand 26

HATCH

Hatch's global network of 10,000 professionals work on the world's toughest challenges, with experience spanning over 150 countries worldwide in the metals, energy, and infrastructure sectors. Employee-owned and independent – free to bring our best thinking to your business. Our exceptional, diverse teams combine vast engineering and business knowledge, working in partnership with our clients to develop new game-changing technologies, and design and deliver complex capital projects.

Contact: Joanna Blachut
joanna.blachut@hatch.com
www.hatch.com

Contact: Edward DeRose
edward.derose@hatch.com

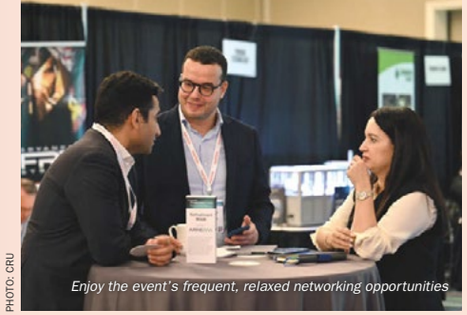
Enjoy the event's frequent, relaxed networking opportunities

PHOTO: CRU

JAS Global Industries — Stand 14

JAS Global Industries

JAS Global Industries is a leading global manufacturer of specialty chemical additives for the fertilizer and mining industries. Our innovative, sustainable and cost-effective chemical additives include anti-caking, dust control and colouring agents for all types of granular fertilizers. These products are backed by five manufacturing facilities, two research and innovation centres, and a global network of sales and technical experts. With more than 30 years of experience and a culture defined by innovation, JAS is more than a supplier—we are a strategic partner.

Contact: Ahmad Kahla
akahla@jasind.com
www.jasind.com

KAO — Stand 3

KAO Kirei-Making Life Beautiful

KAO Chemicals has supplied the fertilizer and mineral flotation industries 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: Alejandro Puerto
marketing@kao.es
www.kaochemicals-eu.com

Prayon SA — Stand 37

PRAYON Enriching daily life through phosphorus chemistry

Headquartered in Belgium, 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 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:
profile@prayon.com / prt@prayon.com
www.prayon.com

SNF — Stand 55

SNF

SNF is a global leader in water-soluble polymers, supporting essential processes in water treatment, preservation and recycling for over one billion people and hundreds of thousands of industrial sites worldwide. We help our customers save energy, reduce carbon emissions, and promote sustainable practices. In mining, SNF plays a key role in the responsible extraction of vital mineral resources. Our commitment is to deliver innovative, tailored, and environmentally conscious solutions that meet the evolving needs of the mining and fertilizer industry.

Contact:
mining@snf.com
www.snf.com

Worley Chemetics — Stand 13

worley chemetics

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Meeting sustainable growth in fertilizer demand with CASALE technology

CASALE offers a wide spectrum of granulation technologies for various NPK/NP/PK/P fertilizer types. **Gabriele Marcon** outlines how an integrated approach to fertilizer production can support global food security – through sustainable, efficient and flexible fertilizer manufacturing.

Introduction

Global demand for fertilizers is expected to steadily increase in future to meet the food needs of the world's population, which is projected to grow to ten billion by 2050.

Ensuring that fertilizers are affordable and available, while meeting ever higher sustainability requirements, will be essential if agricultural productivity is to continue to improve.

While ammonia and urea will remain key nitrogen sources in agriculture, fertilizer producers are diversifying their product ranges, with a particular focus on the sustainability and environmental impact of crop nutrient products.

CASALE – thanks to its deep ammonia and urea production expertise and its broad portfolio of advanced process technologies – is well positioned to help fertilizer producers improve their competitiveness. The company offers a wide range of production options for various fertilizer types, including:

- Ammonium nitrate-based fertilizers
- Complex fertilizers
- Phosphate fertilizers.

PHOTO: CASALE

Granulation plants that use CASALE's dual pipe reactor technology can produce a range of NPK/NP/PK/P fertilizers flexibly in response to market demand and available raw materials.

Dual pipe reactor technology

CASALE offers dual pipe reactor technology as a chemical granulation process for NPK production (Figure 1). The dual pipe reactor has distinct advantages over other types of chemical granulation by providing two separate locations for reactions between sulphuric acid/phosphoric acid (H_2SO_4/H_3PO_4) and ammonia (NH_3) to take place:

- The granulator pipe reactor (GPR)
- The dryer pipe reactor (DPR).

The GPR is located inside the granulator drum. This is supplied with a feed of H_3PO_4 and/or H_2SO_4 together with NH_3 and recycled scrubbing liquor. The DPR is located inside the dryer drum and is supplied with an H_3PO_4 and NH_3 feed. Acid(s) can also be supplied to the scrubbing system to properly control atmospheric NH_3 emissions.

This design configuration makes it possible to widen the range of raw material choices and, consequently, increase the number of NPK grades that can be

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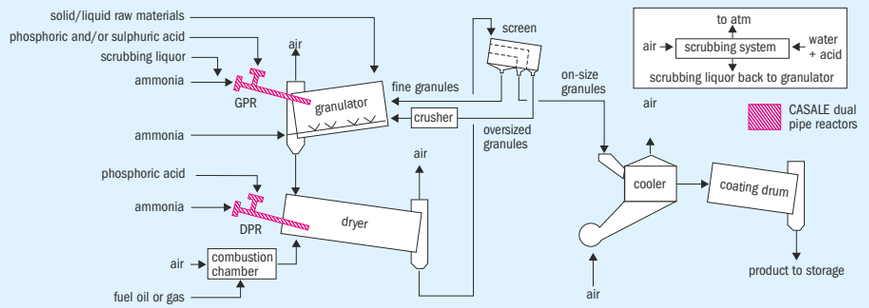
Fig. 1: **CASALE's dual pipe reactor NPK process***



** This process incorporates an additional dryer pipe reactor (DPR) in the dryer in addition to the granulator pipe reactor (GPR).*

Source: CASALE

produced. It also guarantees the lowest possible production cost by adjusting the solid-liquid ratio to lower the recycle rate.

The production of any NPK grade can be targeted by selecting different raw materials such as:

- Solid and liquid ammonium nitrate (AN) and urea
- Liquid (phosphoric acid) or solid (MAP, DAP, SSP, TSP, etc.) phosphorus sources
- Liquid or gaseous ammonia
- Sulphuric acid
- Nitric acid
- Solid ammonium sulphate (AS)
- Elemental sulphur
- Micronutrients.

NPK or NP grades can be produced by either selecting or omitting a potassium source (KCl or K_2SO_4), respectively. NP and NPK grades using different nitrogen sources, such as ammonium nitrate, urea or ammonium sulphate, can also be manufactured.

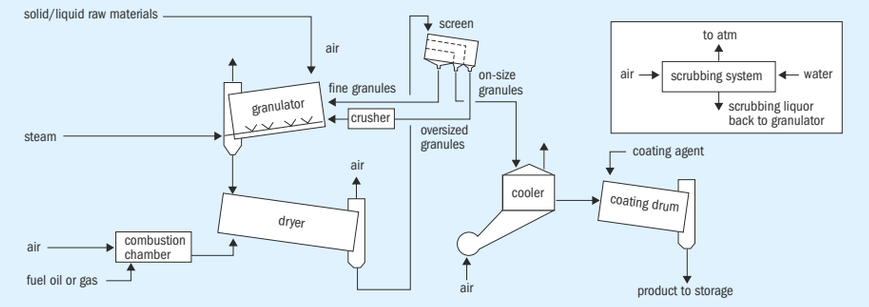
For each NPK grade, raw materials are generally selected according to market availability and cost. Operating costs (particularly recycle rate) also have an impact on raw material selection. Plant flexibility, in terms of raw materials, is therefore a key factor when it comes to the competitive production of NPK grades in response to changing market conditions.

Advantages of chemical granulation

Chemical granulation, because it offers numerous options for selecting different raw materials, can produce a very wide range of different NPK grades. Experience has shown that more than 200 NPK grades can be manufactured at a single plant using different liquid and solid raw materials. This is a priceless advantage as it allows NPK plant operators to respond to market demands, such as the availability of raw materials and customer requests for specific NPK grades.

The NPK granules generated also have the best possible chemical and mechanical characteristics. The level of aggregation inside each granule, for example, is excellent due to the strong links between individual components. At the same time, the granules produced have a uniform chemical composition, good roundness and high crushing strength. These characteristics are ideal as they ensure the field spreading of NPK fertilizers delivers the desired mix of nutrients to the soil in a homogeneous and controlled manner.

Fig. 2: **CASALE's steam granulation process**



Source: CASALE

Steam granulation – suitable for superphosphates

This NPK production method (Figure 2) achieves a specific NPK grade by granulating a ground mixture of solid raw materials in the presence of steam. The addition of steam is used as a 'glue' to stick together the different raw material particles. Raw materials need to be pre-ground prior to steam granulation to achieve effective mixing and agglomeration.

The steam production method, to enable granules to form via agglomeration, must include a full granulation loop (granulator, dryer, screen, crusher, etc). The product granules obtained, although homogeneous in composition, have poor mechanical properties (crushing strength and roundness) because their different components are only held together weakly.

Not all fertilizer raw materials can be mixed and granulated using steam. This limits the flexibility of steam granulation by restricting both the range of acceptable raw materials and the method's ability to produce different NPK grades.

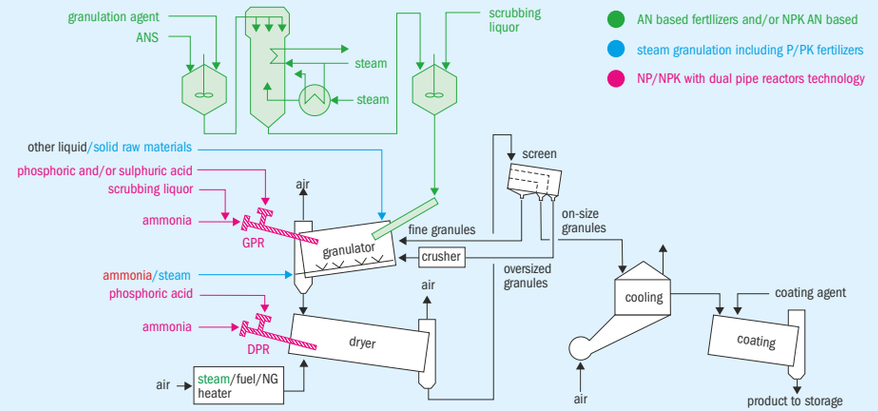
Despite this, steam granulation still has a deserved place in CASALE's technology portfolio because of its ability to produce valuable fertilizers, particularly granular phosphates or PK grades, using only solid raw materials. Notable examples include the steam granulation of single superphosphate (SSP) and triple superphosphate (TSP).

In these fertilizer types, the only nutrients present are phosphorus or phosphorus plus potassium, while nitrogen (in the form of ammonia, for example) is specifically avoided. This means that phosphoric acid or sulphuric acid cannot be used as the ammonia necessary for their neutralisation is absent.

CASALE therefore offers steam granulation as a process step in SSP/TSP production as follows:

- In the first step, SSP/TSP powder is initially produced in a CASALE run-of-pile SSP/TSP plant by acidulating rock phosphate with sulphuric or phosphoric acid.
- In the second step, the SSP/TSP powder, with or without addition of a solid K source such as potassium chloride, is granulated in a steam granulation plant.

Fig. 3: **An integrated granulation plant incorporating three different CASALE processes, including dual pipe reactor technology**



Source: CASALE

The integrated granulation plant

CASALE is a comprehensive licensor of production technologies with wide-ranging expertise and long-standing experience in fertilizer plant design, start-up and operations. By integrating CASALE process technologies (Figure 3), it is possible to design a new granulation plant, or revamp an existing plant, to produce the following fertilizers:

- AN-based fertilizers via chemical granulation
- NP/NPKs via chemical granulation with dual pipe reactor technology
- P/PK fertilizers via steam granulation.

In summary, CASALE can design an efficient, flexible granulation plant able to produce a comprehensive range of NPK/NP/PK/P fertilizers, according to the raw materials available and in response to market demand. ■

About the author

Gabriele Marcon is Solid Fertilizers Technology Manager at CASALE.

CRU Phosphates+Potash Exposconference 2026

Filippo Davolio, Senior Process Engineer, CASALE, will be presenting on 'Sustainable Growth in Fertilizer Demand. CASALE's Recent Acquisitions and Relevant Technological Solutions' at the conference in Paris on Tuesday 14 April at 16:00–16:30. Register now at: events.crugroup.com/phosphates/register

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The strategic transformation of phosphogypsum from a waste to a resource

In a strategic shift for the fertilizer industry, phosphogypsum is being transformed from a waste burden into a valuable construction grade-material. **Tibaut Theys** explains how Prayon Technologies is developing safe, high-value and circular solutions that are allowing increasingly widespread reuse of this voluminous byproduct.

IMAGE: PRAYON

Phosphogypsum is finding increasing use in agricultural, construction, chemical and medical applications.

Background

Phosphogypsum (PG) is one of the fertilizer industry's main byproducts. It is generated during phosphoric acid production by the wet process route at a rate of more than four tonnes for every tonne of P_2O_5 manufactured.

For decades, phosphogypsum was seen mainly as a waste burden and generally stored in large stacks – due to concerns over its environmental impact, natural radioactivity, and the lack of clear regulatory frameworks for reuse.

Today, this perception is changing rapidly (*Fertilizer International* 527, p4). Advances in process technology, combined with higher sustainability expectations and new circular business models, are creating new opportunities for the safe and valuable reuse of phosphogypsum.

Prayon is also playing its role by helping to transform PG into a high-quality material fit for construction applications. This is achieved by controlling the main impurities that limit its use: radioactivity, heavy metals, residual phosphorus, and fluorine.

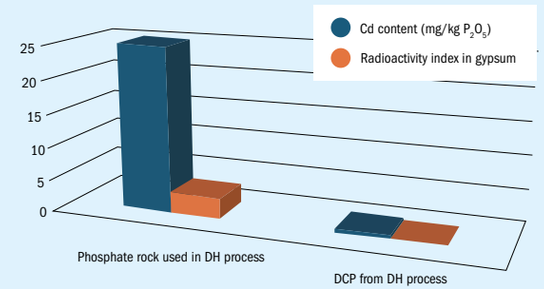
A new perspective: from waste to circular resource

The quality of phosphogypsum is the key determinant of its potential for industrial reuse. Although PG is essentially gypsum, its composition varies depending on the original phosphate ore used and the configuration of the production process. When it comes to reuse, residual P_2O_5, soluble fluorine, heavy metals, organic compounds, and moisture content all influence performance and compliance. The presence of natural radionuclides (mainly radium-226) is also critical, as their levels will dictate regulatory acceptance.

Yet, if generated at high purity, phosphogypsum can be suitable for demanding and high specification construction applications. Gypsum used in plasterboards, plasters, and alpha-hemihydrate products requires low levels of phosphorus, fluorine, and heavy metals. Its radioactivity levels must also comply with European frameworks for Naturally Occurring Radioactive Material (NORM), Basic Safety Standards (BSS) and international guidelines.

Fortunately, with proper process design, phosphogypsum can match or surpass the performance of natural gypsum in construction uses, enabling the production of building materials with a lower carbon footprint.

Fig. 1: **The reduction of cadmium (Cd) and radioactivity levels in phosphogypsum using Ecophos technology**



Source: Prayon

Prayon's technologies are designed to produce cleaner gypsum that meets strict industrial and legislative requirements. They notably include:

- Advanced double-crystallisation routes – the Central Prayon Process (CPP) or the DA-HF process
- Hemihydrate (HH) processes
- Ecophos technology (Figure 1) for rocks with higher natural radioactivity.

This suite of technologies – by significantly reducing impurities, stabilising materials and providing consistent quality levels – offers a broad pathway to the valorisation of phosphogypsum. The highly pure PG obtained becomes suitable for high specification construction end-uses such as stucco plaster, gypsum board and raw material for clinker production.

Construction usage

Valuably, the use of phosphogypsum in plaster block can contribute to energy savings and cut CO_2 emissions, due to the lower energy demand of gypsum block versus cement block production. Looking beyond conventional gypsum plasters and boards, high-purity PG also supports the development of prefabricated construction components and lightweight building systems, end-uses that combine structural efficiency with environmental benefits.

Phosphogypsum also plays a well-established role in cement manufacturing, where it is used as a setting retarder that controls clinker hydration. Gypsum is typically added as a component to cement (3-5% proportion) to prevent flash setting and improves workability by regulating reactions involving tricalcium aluminate. Cleaner PG enhances the stability and predictability of this process.

Additionally, new co-processing routes now allow gypsum to simultaneously serve as both a calcium source for clinker production and as a sulphur source for sulphuric acid manufacturing. This integrated approach has dual benefits as it:

- Reduces CO_2 emissions by avoiding the decomposition of carbonate rocks
- Extends sulphur supply options in a world where fossil fuel derived sulphur sources are declining.

Road base construction

Roadway construction represents another promising valorisation pathway. Phosphogypsum can be stabilised with cement or lime and used to create road base layers. Stabilised PG offers strong mechanical performance, good water resistance, and efficiently immobilises any residual fluorine and phosphorus.

Pilot projects carried out in countries such as Morocco, China, India, USA and Russia show that PG-stabilised road bases can match or improve on the performance of traditional materials, when produced under proper engineering conditions. Road construction is potentially a large-scale application for PG where significant volumes of materials are available and regulatory acceptance is achievable under controlled conditions.

Changing regulations

The potential for reusing high-quality phosphogypsum has closely followed the changing regulatory environment. While some jurisdictions have historically imposed strict restrictions on PG use because of its natural radioactivity, new guidance from bodies such as the International Atomic Energy Association (IAEA) has promoted a more nuanced, risk-based approach.

In *Safety Reports Series No 78*, for example, the IAEA now recommends the controlled use of phosphogypsum in construction, roads, and agricultural applications. Similarly, the European Basic Safety Standards (BSS), following the same logic, promotes proportionality and traceability in PG use rather than blanket bans. Consequently, countries such as Brazil, China, India, and European Union member states have already implemented frameworks that allow phosphogypsum to be classified as a secondary raw material or co-product, when quality criteria are met.

Circularity – from waste to resource

The circular economy dimension of phosphogypsum reuse goes beyond construction to encompass a broad range of end-use applications.

Cleaner PG supports agricultural improvements, for example, by enhancing soil structure, correcting soil acidity at depth, and improving crop root development, especially in tropical or saline soils. It can also be used as an effective mine backfilling material due to its ability to form stable, low-permeability matrices that immobilise contaminants.

Additional opportunities for phosphogypsum include use as a mineral filler (in polymers and technical materials) and rare earth element (REE) recovery. REEs can concentrate in PG, with a significant proportion of the original content of the phosphate rock ending up in the gypsum fraction during processing.

Collectively, all these valorisation pathways underline the versatility of phosphogypsum when its quality is properly controlled.

The Prayon approach

Prayon is supporting phosphogypsum valorisation in a number of ways. It is helping phosphate producers by conducting detailed characterisation studies, for

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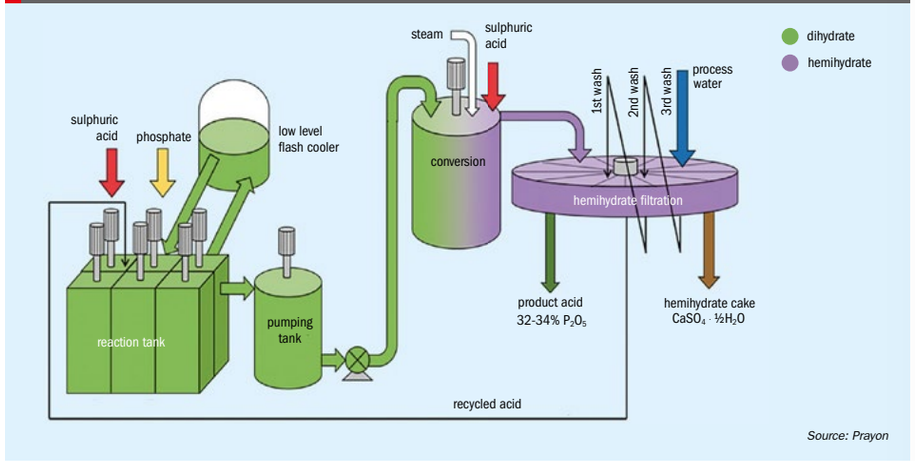
Fig. 2: **Prayon's DA-HF process: this solution can provide a dry, low-P_2O_5 gypsum product from most phosphate rock types on the market**



Source: Prayon

example, as well as supporting the industry's dialogue with regulators, and organising technical visits to industrial plants where PG valorisation is already being implemented at scale.

Prayon offers different ways to improve phosphogypsum quality. In practice, the company applies a targeted and flexible strategy that selects the most suitable technology according to the end-use and final quality required by the customer.

When the objective is to use PG exclusively as a set retarder in the cement industry, we recommend double-crystallization processes such as the Prayon Central Prayon Process (CPP) or the DA-HF process (Figure 2). These technologies offer two major advantages:

- First, they produce a self-drying gypsum product that reduces or eliminates the need for energy intensive drying operations.
- Second, they can operate efficiently on a wide variety of phosphate rocks – including lower grade and more economical raw materials – thereby providing both technical robustness and cost competitiveness.

Prayon recommends the deployment of a dedicated cadmium reduction technology – applied directly during rock beneficiation – in cases where heavy metals such as cadmium are a concern. Using a specific leaching step conducted under controlled conditions, we can consistently reduce cadmium content below the commonly required limit of 20 mg per kg of P_2O_5, allowing producers to meet both regulatory limits and commercial expectations.

Two approaches are available when radioactivity becomes the limiting factor in PG use:

- Either specific radioactivity reduction treatments are applied directly to the phosphogypsum, technologies that are currently being strengthened and industrialised.
- Or we recommend switching to one of our low-grade rock beneficiation technologies, such as the GetMoreP or Ecophos processes.

Both routes generate a phosphogypsum coproduct with very low cadmium levels but, more importantly, with a level of natural radioactivity significantly below industrial thresholds. This enables the direct use of PG in applications such as clinker production or plasters, without requiring additional treatment steps.

By offering all these different valorisation pathways, Prayon ensures that each customer can produce gypsum to a quality fully aligned with its market expectations, the regulatory environment, and raw material constraints.

Conclusion

The transformation of phosphogypsum from a waste to a resource represents not just a technical achievement but also a strategic shift for the fertilizer industry. By combining advanced process technologies, regulatory alignment, and industrial collaboration, Prayon helps turn PG from an environmental liability into a material that supports sustainable construction, efficient resource use, and circular value creation.

This strategic shift enhances the long-term viability of fertilizer production, improves ESG (environmental, social, and governance) performance, and opens new economic opportunities for producers. With the right technological solutions and regulatory frameworks, phosphogypsum becomes not a problem to manage but a resource to develop, one that contributes to safer, more sustainable, and more competitive industrial systems. ■

About the author

Tibaut Theys is General manager of Prayon Technologies.

CRU Phosphates+Potash Expoconference 2026

Tibaut Theys will be presenting on 'Transforming Phosphogypsum into a Valuable Resource for the Construction Industry' at the conference in Paris on Wednesday 15 April at 11:30–12:00. Register now at: events.crugroup.com/phosphates/register

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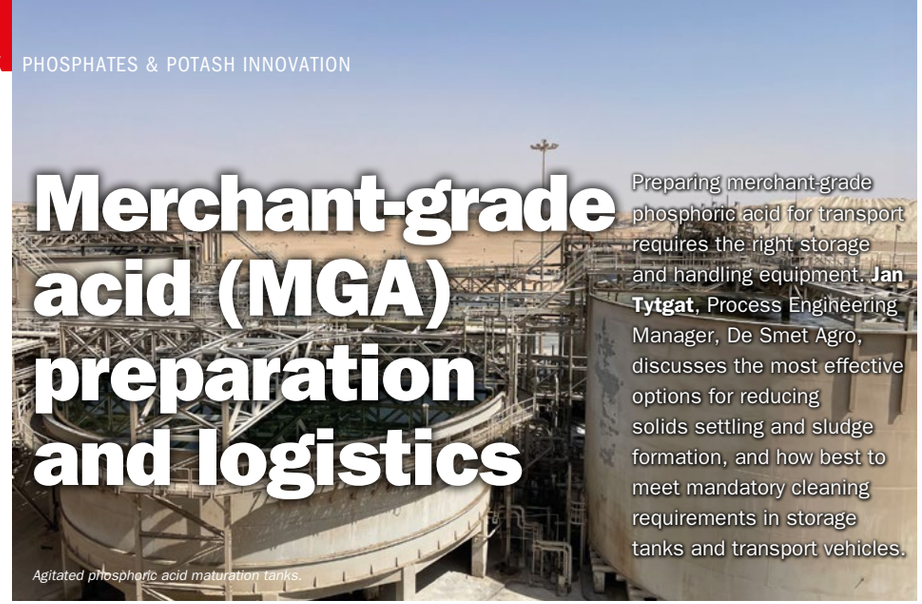
Merchant-grade acid (MGA) preparation and logistics



Agitated phosphoric acid maturation tanks.

PHOTO: DE SMET AGRO

Preparing merchant-grade phosphoric acid for transport requires the right storage and handling equipment. **Jan Tytgat**, Process Engineering Manager, De Smet Agro, discusses the most effective options for reducing solids settling and sludge formation, and how best to meet mandatory cleaning requirements in storage tanks and transport vehicles.

Introduction

Phosphoric acid leaving the filtration section of wet-process production plants is typically generated at 26-28% P_2O_5 (di-hydrate process) or at 40-42% P_2O_5 (hemi-hydrate process). This acid is further adjusted in a concentration loop to the required fertilizer-grade or merchant-grade acid (MGA), usually up to 52-54% P_2O_5.

Concentrated phosphoric acid (CPA) typically leaves the concentration loop at around 85°C and contains 2-4 % solids. If this CPA is used to produce granulated fertilizers such as MAP, DAP, NPK, on-site or near the phosphoric acid plant, then no further treatment is required. Generally, an agitated storage tank that keeps the solids suspended within a homogenous solution will suffice as buffer storage.

Effective storage and handling for transport

However, there are other situations where CPA needs to be transported over long distances, for example, to another fertilizer production plant – or when it is sold as MGA to a third party. In these circumstances, several precautions need to be considered before MGA can be transported by road and rail tankers or loaded onto shipping vessels.

Because vehicles, rail cars and ships are not equipped with agitators, the solids content of the CPA must be reduced to the lowest possible value to avoid settling and sludges forming at the bottom of transportation containers. While regular cleaning will always be required, cleaning efforts can be reduced by taking the following precautions.

In storage tanks, CPA cools down naturally and more solids are formed as post-precipitation occurs. These need to be removed before loading. The post-treatment of CPA and handling of MGA usually includes the following equipment:

- One or more **agitated maturation tanks** which receive the CPA from various concentration lines in the plant and prepare a homogenous solution.
- **Water-cooled heat exchangers**, fitted in a loop at the maturation tanks, which cool down the CPA to about 45°C.
- One or more **clarifiers** which receive the cooled down CPA by gravity from the maturation tanks. A well-tested flocculant is often added at this stage to enhance the precipitation of the solids, while a rake is installed to collect the sludges at the bottom of the clarifier. The clarifier's base can have a horizontal or a conical geometry.
- A reliable **sludge evacuation system**, preferably located at the centre of the clarifier. This usually sends the sludges back to the weak acid clarifier, where they join with the weak acid sludges and are returned to the reaction tank. Alternatively, sludges can be treated by a centrifuge or a press filter to separate the solids from the MGA.
- **Flat-bottomed MGA storage tanks** – designed to receive the MGA with 0.5-1% solids maximum – equipped with agitators or rakes and export pumps.

The size of the MGA storage tanks and export pumping facilities needs to be able to cope with the volumes of MGA being loaded. For example, the port loading of a 20,000-tonne P_2O_5 shipping vessel in 48 hours will require much larger MGA storage tanks and export pumps compared to those facilities filling a 20-tonne P_2O_5 road tanker.

The loading of rail wagons, meanwhile, requires a set of multiple loading arms to allow the filling of many wagons simultaneously. The required MGA storage capacity will also be determined by factors such as the number of on-site movements of road tankers per day, or the number of rail wagons and their frequency of loading per week or month.

After loading has ended, the export pipelines and load arms need to be flushed, emptied and inspected ready for the next loading operation. Road tanker or rail wagon cleaning facilities must therefore be provided for regular flushing and cleaning purposes. ■

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PHOTO: ARKEMA

Innovative reagents for processing phosphate ores worldwide

Reagent formulations used in the flotation of phosphate ore must be carefully engineered to deliver the required beneficiation performance and compatibility with plant operations. **Benoit Grymonprez** and **Guoxin Wang** present a case study to illustrate how Arkema is developing long-lasting solutions to the new challenges faced by phosphate mining and processing operations globally.

Flotation of phosphate ore in a mechanical cell.

Forward-looking with a 50-year legacy

Do you know that the roots of Arkema's mining solutions date back more than 50 years? Although the company itself did not yet exist, its origins go back to the expansion of the chemical product range developed by the French company CECA S.A. in the 1970s, along with the founding of ArrMaz in 1976 in the heart of central Florida's phosphate mining district. These two historic developments formed the foundation of Arkema's current Specialty Surfactants business dedicated to rock treatment and ore beneficiation.

Froth flotation was discovered in Australia in the early 20th century, with the first industrial flotation operations beginning in the 1920s. While oils (coal tar derivatives, crude petroleum and pine oils) were used as early flotation reagents, the quest for suitable mining chemicals, especially the need for agents to enhance or inhibit mineral floatability, has driven the development of new collectors.

Metallic ores, mainly copper, were the first deposits processed by froth flotation. Major advances in flotation reagents – such as alkyl sulphates and amines in the mid-1930s – subsequently opened the door to the processing of non-metallic ores.

As flotation technology expanded, reagent consumption increased significantly as the amounts of ore processed grew. In the United States, for example, the tonnage of phosphate ore treated by flotation increased from 19 million tonnes to nearly 110 million tonnes between 1960 and 1980, while total floated ore (all minerals) increased from 180 million to 400 million tonnes during this period. It is therefore not surprising that ArrMaz emerged to serve the market during this era of rapid growth.

Today's phosphate flotation challenges

The decades that followed saw the accumulation a growing number of process challenges that remain valid today. In the phosphate industry, flotation and associated reagents are constantly evolving. Consequently, innovation has always been essential and a key driver of Arkema's R&D efforts over the last 50 years. For phosphate flotation, our aim is to find solutions for a demanding process constrained by:

- A drop in rock feed grades and increasingly complex ore mineralogy (carbonates, silicates, aluminium-silicates, iron minerals, clays, salts), following the depletion of higher-quality ores.
- The global pressure to optimise resources, amid increasing depletion, with a trend towards treating slimes (finer particle sizes) that were historically rejected as waste. The evolution of flotation technologies (pneumatic cells, such as columns) has created new opportunities to process finer particle sizes.
- The endless evolution of regulations on the use of environmentally-friendly chemicals, from a toxicity and biodegradation perspective, as well as more stringent limits on fertilizer quality (lower heavy metals content, such as Cd and As).
- The need for better water management practices – as many deposits are in semi-arid or desert regions living under high water stress.
- The decarbonisation of beneficiation processes and the reduction of the carbon footprint of locally-sourced chemicals.
- Access to the raw materials used to manufacture the flotation agents. Geo-political tensions, marked by unstable tax regimes and unpredictable blockages of global shipping routes, can require the search for (and change to) alternative reagents.

We have already shared this familiar – but nonetheless true – cliché:

There is no universal collector, nor universal flotation scheme for phosphate deposits beneficiation.

Instead, the chemical suite developed for phosphate rock flotation and the process design implemented are the result of both **intrinsic** (ore-related) and **extrinsic** factors (see Table 1).

Neither is it a static picture. Constant research is required in response to ore variability and/or operational modifications throughout the life of a phosphate mine – this being necessary to adapt flotation product characteristics to maintain or even improve flotation performance.

For years, Arkema has collaborated on phosphate projects worldwide (Figure 1). Today, the company is still deeply involved with the development of new mines and working to implement long-lasting solutions to the new challenges some operating mines are facing.

Innovation is a central driver of Arkema's approach to reagent and process development. In addition to selecting suitable active substances, formulations must be carefully engineered with complementary components to ensure that the final product delivers the required performance and compatibility with plant operations.

These requirements include:

- Stability and activity over time without adverse reactions or phase separation
- Controlled froth characteristics
- Safe handling
- Viscosity suitable for pumping
- Good dispersion or solubility
- Resistance to changing storage conditions
- Robustness in the face of ore variability or fluctuations in process water quality.

Environmental considerations, reliable access to raw materials, and the economic sustainability of mining operations must also be taken into account.

Balancing these varying parameters is complex, as small changes in formulation can significantly affect performance. The following reagent development case study illustrates the complexity and various sensitivities involved.

Table 1: **List of intrinsic (left) and extrinsic (right) factors driving the development of customised flotation agents for phosphate rock processing**

Intrinsic factors	Extrinsic factors
Gangue minerals suite	Water quality and availability
Phosphate bearing minerals (apatite, francolite, collophane, dahllite)	Local regulations (environment, fertilizer quality)
Phosphate composition and crystal lattice substitution (Ca^{2+}, Mg^{2+}, CO_3^{-2}, F^-)	Plant design and processing steps
Liberation mesh size	Flotation technology
Rock hardness and weathering	Climatic conditions (temperature)
Feed grade	Concentrate requirements for downstream processing

Source: Arkema

Fig. 1: **Global distribution of phosphate projects supported by Arkema, as shown in dark green**

Source: Arkema

Phosphate flotation case study

Arkema supported a major phosphate operation that was experiencing declining ore grades, as higher-quality reserves became depleted, leading to increased operating costs. The question was: how to reduce the content of harmful impurities (such as MgO) and improve the phosphorus recovery rate on a long-term basis, both economically and effectively?

The operation processed mined ore with a feed grade of approximately 12-13% P_2O_5. This contained high silica as the main gangue mineral, along with carbonates (dolomite and calcite), aluminium, and iron. The beneficiation targets for the site's direct flotation circuit were to achieve a concentrate grade above 28% P_2O_5 at a phosphate recovery greater than 65%, while maintaining reagent consumption at a sustainable level.

Initial laboratory testing with our experimental collector (CustoFloat® O) were encouraging, with results demonstrating strong flotation performance under controlled conditions. However, the subsequent plant trial failed unexpectedly. In particular, difficulties in stabilising the froth and lower recoveries resulted in a higher reagent consumption rate.

The discrepancy between the laboratory results and the plant trial performance prompted a detailed investigation to identify the underlying causes, with this extending beyond ore characteristics and operating conditions. Following a comprehensive review, it was determined that an esterification reaction was occurring within the collector over time (Figure 2). In commercial operations, several months may elapse between the manufacture of the reagent and its actual use, allowing the esterification reaction to progress and alter the reagent's performance.

The esterification reaction resulted in reduced fatty acid effectiveness and the formation of by-products that contributed

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to froth instability. However, further reagent development led to a new version of the product with improved long-term stability (CustoFloat® M – see Figure 3).

Successful evaluation of CustoFloat® M using a locked-cycle flotation test (five cycles) resulted in a higher concentrate grade, versus the incumbent reagent, with a significant improvement in phosphate recovery of between 2.4-4.0% (Figure 4 & Table 2).

Conclusion

For more than half a century, Arkema has provided mining solutions for ore beneficiation, with a primary focus on industrial minerals and oxides. Among the wide range of minerals supported by our portfolio, phosphate processing remains a flagship application.

Phosphate beneficiation is particularly complex, as each deposit, every beneficiation plant, and operating environment presents unique challenges that require tailor-made solutions.

The challenges outlined in this article illustrate the evolving demands faced by the industry. Arkema's decades of experience, combined with deep expertise in chemical systems and process optimisation, enable us to address these challenges effectively, with a focus on improving operational sustainability and maximising resource efficiency.

Looking ahead, phosphorus will remain essential not only for fertilizers but also for emerging technologies, such as lithium iron phosphate (LFP) batteries, playing an increasingly important role in the energy transition. Arkema aims to continue contributing to these developments by providing innovative and sustainable solutions for the mining and fertilizer industries. ■

About the authors

Benoit Grymonprez is Technical Sales and R&D Manager Mining EMEA, Arkema, and Guoxin Wang is Global Technical Director, ArrMaz Products Inc, Arkema.

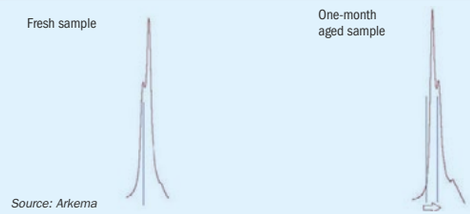
CRU Phosphates+Potash Expoconference 2026

Guoxin Wang and Benoit Grymonprez will be presenting on 'Innovative Flotation Reagents for Processing Phosphate Ores Worldwide' at the conference in Paris on Wednesday 15 April at 09:00-09:30. Register now at: events.crugroup.com/phosphates/register

Note

CustoFloat is a registered trademark of the Arkema Group of Companies.

Fig. 2: **CustoFloat O (experimental version): analysis spectra showing esterification after one month**

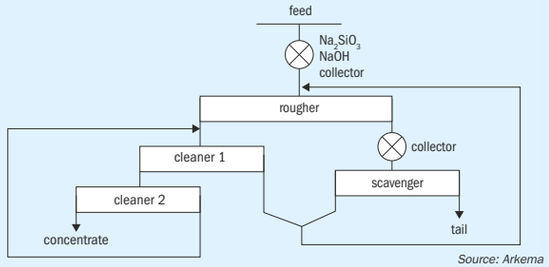


Source: Arkema

Fig. 3: **CustoFloat M (experimental version): analysis spectra showing more stability after one month**

Source: Arkema

Fig. 4: **Process schematic for a locked-cycle flotation test (five cycles) with 400 g/t of CustoFloat® M collector**



Source: Arkema

Table 2: **Flotation results for a locked-cycle test (five cycles) with 400 g/t of CustoFloat® M (CF-M) versus a standard collector**

		Concentrate		Tailings		Recovery
		P_2O_5 %	Wt. %	P_2O_5 %	Wt. %	%
Standard collector	Ore 1	28.46	31.8	4.90	68.2	73.2
	Ore 2	27.48	28.5	4.82	71.5	69.4
CF-M	Ore 1	29.56	32.5	4.60	67.5	75.6
	Ore 2	28.06	29.8	4.32	70.2	73.4

Source: Arkema

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Unlocking phosphate beneficiation potential: a ‘Mine-to-Mill’ transformation

PHOTO: NUTRIEN

Reclaiming material from a stockpile at a fertilizer plant.

By fully unlocking beneficiation potential, a ‘Mine-to-Mill’ transformation project at a North American phosphate complex increased concentrate production by 21%. **Keenan Collins**, **Jayden Ladebruk** and **Edward DeRose** of Hatch show how this was delivered through a combination of mine, mill, and asset maintenance management (AMM) initiatives.

Overview

A phosphate rock beneficiation plant in North America experienced a major setback in 2022. A structural failure and associated repairs disrupted its ability to meet historic concentrate production targets, leaving ongoing challenges in throughput, equipment reliability, and inventory balance.

To restore performance, the client partnered with Hatch to identify value-creating opportunities across the mine, mill, and maintenance workstreams. Key actions focused on:

- Optimising mobile equipment use and feed consistency
- Strengthening preventative maintenance execution
- Improving mill performance through cyclone and flotation optimisation
- Collectively delivering a concentrate production increase of roughly 21% and moving the site significantly closer to its annual target.

A ‘Mine-to-Mill’ transformation project

The focus of this article is a ‘Mine-to-Mill’ transformation project at an integrated North American phosphate production complex that has been in operation for nearly 60 years. Phosphate ore extracted at this facility is processed into phosphoric acid and fertilizer products.

Phosphate ore is mined at the site using draglines, stockpiled and then turned into a slurry before being pumped to the beneficiation plant. At the beneficiation plant, this slurry is sized and impurities are removed to generate a concentrate with an adequate P_2O_5 content for the downstream processing plant. The concentrate obtained is dewatered, stockpiled and later reclaimed for further processing to produce the final phos acid and fertilizer products.

In 2022, a significant mill stoppage occurred when a storage bin failure reduced the stockpile of concentrate. Subsequently, production at the site did not fully recover from this stoppage and its output remained below previous historic levels.

Hatch was engaged by the site owner to identify initiatives that would create value and improve revenues by increasing concentrate production and improving inventory balances. The primary focus of these initiatives was front-end operations at the site, i.e., processes at the phosphate mine and the wet mill.

Challenges and bottlenecks identified

Plant operations were observed during a scoping and diagnostic phase. Useful discussions with experienced site personnel also highlighted day-to-day issues for further review. From this initial work, the following key operational challenges and bottlenecks were identified:

- Water availability and quality
- Fluctuations in mill feed density
- Mill recovery – particularly improvements in clay removal and flotation
- Operator practices
- Equipment maintenance.

These production challenges and bottlenecks are described in more detail below. Following on from this, high priority and longer-term initiatives designed to address these challenges and improve overall production are also highlighted.

Water availability and quality

The production site experienced frequent issues with water availability and quality. The lack of water availability, by affecting the ability to control process water additions, prevented effective density regulation in critical processing areas at the mill. As a result, production was often curtailed as parallel circuits needed to be partly shutdown to decrease water demand and maintain pressure in the operating circuits.

Water quality issues at the mill also created additional complications. During normal operation, the mill would recover clarified water from the mill pond after the settling out the clays. However, insufficient thickening capacity and process upsets often meant the clay content of the water was above target levels. As a result, flotation performance would decrease due to high suspended solids in the plant water. Low-pressure lines also needed to be to shutdown for cleaning because of the build up of solids.

Mill feed density fluctuations

Large fluctuations in mill feed density, resulting from the mining process, caused instability in process operations downstream at the mill. Low clay separation efficiency and phosphate losses in the clay removal circuit were particular problems. Consequently, the front-end processes at the mine required frequent operator intervention, with control systems bypassed, to avoid or minimise complications to the downstream mill equipment.

Mill recovery

A sampling campaign was carried out at the mill by the Hatch team to assess overall recovery and the metallurgical balance. This identified potential for significant improvements in clay removal and froth flotation performance.

Samples from the clay removal and dewatering cyclone, for example, indicated substantial P_2O_5 losses to the clay tailings. Operator inspections confirmed roping in the cyclones and visually noticeable reporting of phosphate to the overflow.

Flotation sampling and test results also confirmed the concerns of site operators that a significant portion of phosphate was being lost in the coarse size fraction. Although a dedicated coarse recovery circuit existed to capture this material, persistent operational challenges at the mill, particularly density variability, prevented the stable operation of this circuit.

While flotation recovery was often on target, the flotation circuit frequently struggled to achieve the required concentrate grade. Observations confirmed that flotation circuits were operating sub-optimally. Several flotation banks showed inconsistent performance, including significant bubble breakage, incorrect colour gradients, excessive reagent addition, and multiple maintenance-related issues.

Operator practices and equipment maintenance

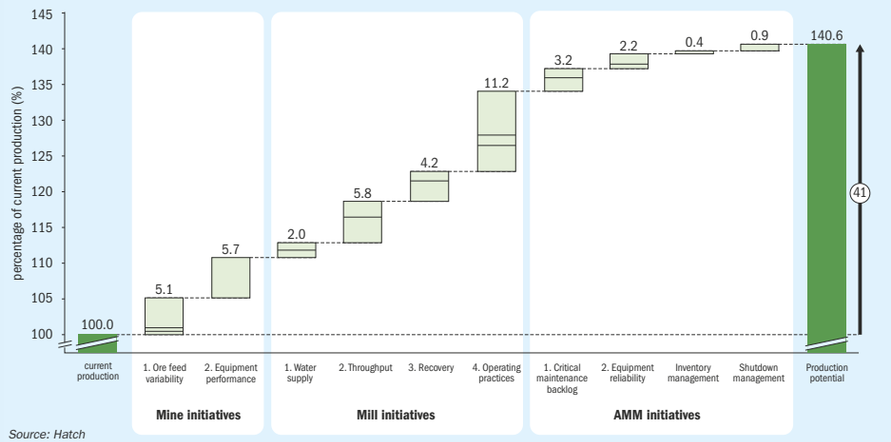
Key operators, including those in the main and flotation control rooms, were frequently required to leave their stations for tasks and inspections in other areas of the plant. This left less experienced operators covering critical roles, reducing the operational team’s ability to respond to upsets. The need to work across multiple areas also created long walking times and lowered the overall efficiency of site workers.

The general approach to maintenance at the site – best summed up as a ‘run-to-failure’ mentality – also created a significant obstacle to meeting long-term and sustainable production targets. Instead, this maintenance philosophy led to frequent production turndowns or process bypass scenarios when major equipment failed.

Development of site improvement initiatives

Improvement initiatives were developed in collaboration with site personnel – a process that involved the discussion of historical observations, analysis of historical data and performing on-site trials. It also relied on Hatch’s internal expertise and past experiences.

Fig. 1: **Potential improvement in production: the individual ‘value’ and combined impact of all the initiatives developed during the diagnostic phase**



Source: Hatch

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For each initiative, the potential improvement in plant performance – their 'value' – was quantified in terms of the increase in concentrate production (tons per day). For most initiatives, the value added was determined from historical data for:

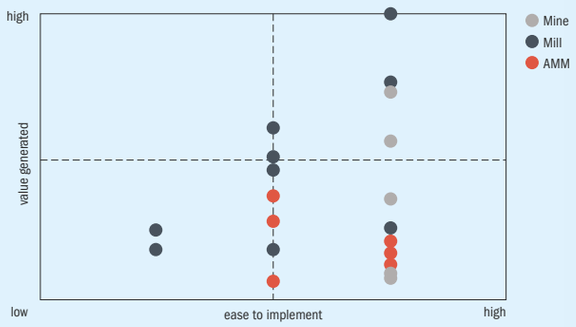
- The frequency and duration of shutdown activities linked to a specific cause
- How equipment operation impacted production
- Turn around time for fleet equipment at the mine, etc.

The value of other initiatives was evaluated using sample data to quantify their impact on phosphate recovery. Combined, it was calculated that all the proposed initiatives could deliver a 41% increase in daily throughput (as summarised in Figure 1).

Each initiative was also evaluated for ease of implementation. Initiatives requiring minimal changes and short implementation timelines, for example, were rated as 'high-ease', while those involving equipment replacement or additional engineering were rated as 'low-ease'.

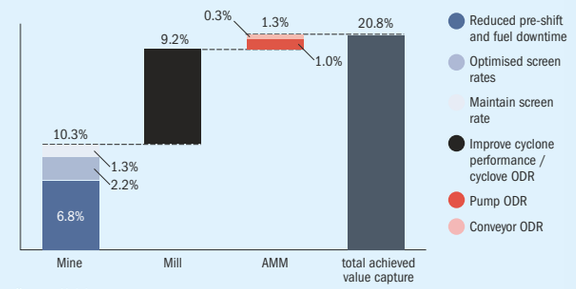
Assessing both their value and ease-of-implementation allowed individual initiatives to be compared using a prioritisation matrix, as shown in Figure 2. Initiatives positioned in the upper-right quadrant (high-value, high-ease) were identified as key actions for execution. Additional initiatives, such as improving water supply, were also recognised as key enablers required to unlock value from other initiatives.

Fig. 2: **Initiative prioritisation matrix**



Source: Hatch

Fig. 3: **Phosphate concentrate production increase at the site, as of 30 September 2025**



Source: Hatch

High priority and longer-term initiatives

High priority initiatives were identified at the mine, mill and for asset maintenance management (AMM).

Mine:

- Reduce pre-shift and refueling downtime by reviewing and updating standard operating procedures (SOPs)
- Install a magnetic system on stackers to remove tramp metal and reduce downtime
- Improve heavy mobile equipment efficiency to optimise screen rate
- Maintain screen rate by updating SOPs to effectively use a spare screen during routine replacements.

Mill:

- Improve cyclone performance through additional maintenance and enhanced operating procedures
- Reorganise operator duties to increase efficiency
- Improve flotation optimisation procedures.

Asset maintenance management (AMM):

- Improve preventative maintenance procedures for conveyors, pumps, and cyclones by introducing operator driven reliability (ODR) programmes that increase operator accountability for monitoring equipment conditions and reporting maintenance concerns
- Prioritise preventative maintenance (PM) backlog of critical maintenance items.

Several longer-term initiatives, listed below, were also selected for eventual implementation, although these have yet to be completed due to budget constraints, procurement timelines, or pending engineering.

Mill:

- Replacement of heavily corroded flotation cells
- Implementation of a flotation feed density control system
- Improved process water availability through replacement of water distribution lines and strengthened preventative maintenance
- Improve mill feed storage system utilisation to further reduce density variability
- Restart and stabilise coarse flotation circuit.

AMM:

- Implement long term asset care programme and maintenance schedules for critical maintenance items.

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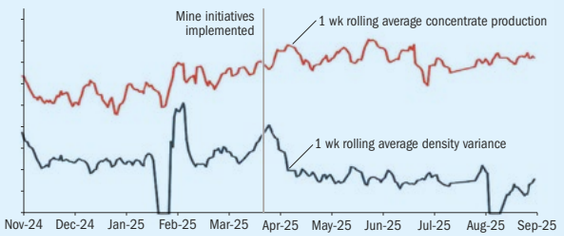
Overall plant improvement and metallurgical performance

The implementation of high priority initiatives at the mine increased concentrate production at the site by approximately 10%, as of September 2025, around seven months after their execution (Figure 3, left column). The higher production was primarily delivered by reducing downtime by approximately 0.8 hours per shift, with this being linked to efficiency improvements in pre-shift and fuelling efforts. The initiative to maintain screen rates, while only improving production by 1%, did significantly improve cyclone performance in the mill washer circuit, as shown by the decrease in mill feed density variability (Figure 4).

High priority initiatives at the mill, primarily directed at improving cyclone performance, increased mill concentrate production by 9% (Figure 3, second column from left). This was delivered by a combination of several initiatives:

- Mine efficiency improvements, by lowering density variations, reduced major cyclone roping (recovery loss in cyclones) and clay rejection (recovery loss in flotation) scenarios.
- Implementation of cyclone flow control, by equalising feed pressure across a cyclone circuit, reduced localised roping. During the testing of one of the four parallel circuits, this approach was shown to improve phosphate recovery of that circuit by 3%.
- Replacement of cyclone apexes, as many of these were either excessively worn or had the wrong size (too small) incorrectly installed.
- Replacement of severely damaged cyclones.

Fig. 4: **Decrease in mine density variance and increase in concentrate production at the site after the implementation of the improvement initiatives**



Source: Hatch

The decrease in mine density variance and the corresponding increase in concentrate production at the site after the implementation of the high priority initiatives are shown in Figure 4.

Additionally, the implementation of AMM initiatives increased overall concentrate production by 1.3% due to reduced downtime (Figure 3, third column from left). The positive production impacts of operator driven reliability (ODR) programmes for conveyors and pumps are shown in Figure 5.

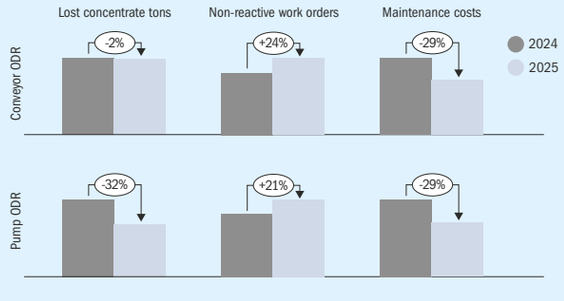
Conclusions

A 'Mine-to-Mill Transformation' project at a North American phosphate complex increased mill concentrate production by 21%. This was achieved through implementation of a number of high priority initiatives across the mine, mill, and asset maintenance management (AMM):

- Initiatives at the mine increased throughput by approximately 10%. This was achieved by decreasing the variability of feed density to the mill by making pre-shift efficiency and fueling downtime improvements and stabilising screen rates.
- Mill initiatives contributed an additional 9% increase in concentrate production. This was delivered by improving cyclone performance using measures such as improved flow control, replacement of worn or undersized apexes, replacement of critically damaged cyclones, and improvements to operator inspection practices.
- Finally, AMM initiatives, by reducing pump and conveyor downtime, increased concentrate production by an additional 1.3%.

Collectively, these project actions produced a substantial and sustained improvement in overall concentrate production within seven months of their implementation at this North American site. ■

Fig. 5: **Conveyor and pump operator driven reliability impacts**



Source: Hatch

About the authors

Keenan Collins is Senior Process Engineer, Hatch, Saskatoon, Canada, Jayden Ladebruk is Process Engineer-In-Training, Hatch, Saskatoon, Canada, and Edward DeRose is Global Commodity Director – Phosphates, Hatch, Tampa, USA.

CRU Phosphates+Potash Expoconference 2026

Keenan Collins and Edward DeRose of Hatch will be presenting on 'Unlocking the Potential of Phosphate Beneficiation at Nutrien Aurora: A Mine to Mill Transformation' at the conference in Paris on Wednesday 15 April at 10:00–10:30.

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Next-generation evaporation units in phosphoric acid plants

The ATMOS process at pilot scale.

Co-developed and patented by GEA and Yara International, the ATMOS process is an advanced heat integration technology for concentrating wet-process phosphoric acid. It combines double effect evaporation with high efficiency fluorine scrubbing to deliver significant improvements in energy performance and environmental control. In this article, **Aziz Chbeir** and **Azza Kioua** present findings from the validation of ATMOS at industrial and pilot scales. These show a 40% reduction in specific steam demand during phosphoric acid concentration, along with a similar reduction in cooling water consumption, and the ability to recover fluorine as fluorosilicic acid.

Background and Objectives

Fertilizer-grade phosphoric acid is typically produced via the dihydrate (DH) route. In this process, the weak acid (26-32% P_2O_5) obtained from the reaction-filtration step is concentrated to 49-54% P_2O_5 through steam driven evaporation. Conventional single effect units require about two tonnes of steam and six tonnes of cooling water per tonne of P_2O_5. This high thermal load conflicts with decarbonisation goals, increases fuel costs, and makes it harder to comply with stricter fluoride emission limits.

In traditional evaporators, fluorine and silica rich vapours are also condensed without heat recovery. This leads to low energy efficiency, scaling risks, high cooling requirements, and costly condensate treatment. ATMOS transforms this step into an energy integrated, low emission operation that can be retrofitted to existing plants.

Process concept and thermal integration

The ATMOS process applies double effect evaporation. It does this by reusing the existing evaporator as the second effect and adding an upstream atmospheric evaporator with an integrated washing column.

In the first effect, green or partially clarified acid is concentrated to 35-40% P_2O_5 at about 110-120 °C and atmospheric pressure. The resulting vapours, which contain high levels of HF and SiF_4, pass through a two stage scrubbing system:

1. **A primary absorber** using diluted H_2SiF_6 to capture most of the HF and SiF_4.
2. **An alkaline polishing stage** to capture remaining HF and SiF_4.

The purified vapours obtained then provide the heating medium for the second effect evaporator. This operates under vacuum (around 0.1 bar) and at 80–90 °C to produce 49–54% P_2O_5 acid. Valuably, replacing live steam with recycled vapours in this second effect cuts fresh steam demand by 40–46%, depending on rock quality and the level of site integration.

Pilot and semi industrial validation

Two evaporators in series were successfully demonstrated at Yara's Siilinjärvi phosphoric acid plant in Finland. The system showed stable hydraulics, level control, and temperature profiles under realistic variations in feed composition and throughput.

A semi industrial ATMOS pilot was also operated at the GEA Test Center. This ran continuously for three days using water scrubbing followed by an optimised alkaline polishing stage to maximize SiF_4 and HF capture and prevent SiO_2 formation.

The stability of heat transfer coefficients in the acid heat exchanger and in the condenser throughout the trial indicated effective scaling control. Condensate analyses confirmed that dissolved silicon stayed well below amorphous SiO_2 solubility limits. This demonstrated the low fouling risk from the process – and proved that fluorine rich vapours can be reused as a clean thermal medium when gas-liquid contact and pH are properly controlled.

Performance gains and environmental impact

ATMOS reduces specific steam consumption in the dihydrate concentration step from about 2.0 to 1.2 tonnes of steam per tonne of P_2O_5, representing a 40% cut in thermal energy demand. The same proportional decrease in cooling water use enables capacity debottlenecking by easing the load on cooling systems.

The multi-stage scrubbing system used in the ATMOS process improves fluorosilicic acid recovery by up to 20% compared to a single stage water scrubbing. This reduces gaseous fluorine emissions and limits the need for neutralising dilute condensates. Lower off-gas fluorine levels and higher conversion to liquid products support compliance with stricter stack and water discharge limits.

Improved energy efficiency, meanwhile, reduces indirect CO_2 emissions from steam generation, supporting climate reduction targets. Overall, the combined steam savings, lower cooling duty, and recovery of fluorosilicic acid reduce operating costs and improve the life cycle footprint of phosphate fertilizers.

Retrofit strategy and implementation

ATMOS is designed for retrofits. The existing evaporator becomes the second effect, while a new atmospheric evaporator and washing columns are added upstream. Column configuration is adapted to site emission limits and targeted fluorosilicic acid recovery, balancing investment with environmental performance.

Mechanical complexity remains moderate thanks to operation of the new equipment at atmospheric pressure. This supports compact layouts and manageable capex for brownfield projects.

The main implementation requirement is a planned shutdown to reroute vapour and condensate lines and connect the existing evaporator as the second effect. This needs to be aligned with plant turnaround scheduling.

Material selection for the first effect evaporator and washing system is critical due to its high operating temperature, fluorine content, and acidity. Elsewhere, alkaline consumption in the polishing scrubber, which depends on primary absorber performance and targeted residual fluorine levels, can be minimised through proper process control.

Conclusions

Overall, the ATMOS process developed by GEA and Yara International offers a mature and economically attractive solution for modernising phosphoric acid concentration, delivering substantial reductions in steam use, cooling demand, and fluorine emissions. ■

CRU Phosphates+Potash Expoconference 2026

Aziz Chbeir of Yara International and Azza Kioua of GEA Process Engineering will be presenting on 'ATMOS: A new Energy and Environment Saving in Phosphoric Acid Concentration Process' at the conference in Paris on Tuesday 14 April at 15:30–16:00. Register now at: events.crugroup.com/phosphates/register

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Lancaster Products and Bradley Pulverizer – a perfect US-UK partnership

In this exclusive interview, *Fertilizer International* sat down with **Curt Snyder**, CEO, Lancaster Products, and **Ian Hancock**, Vice President, Sales and Operations, Bradley Pulverizer, ahead of the CRU Phosphates+Potash Expoconference in Paris in April.

Introduction

Lancaster Products and its sister company Bradley Pulverizer are highly regarded and well known businesses within the fertilizer industry and allied sectors. In terms of complementary expertise and equipment capabilities, it's an almost perfect partnership.

Lancaster Products, with the Lancaster Mixer, is a market leader in one-step mix-granulation – a process that precisely mixes and granulates materials within a single machine (*Fertilizer International* 508, p34).

Its sister company, Bradley Pulverizer, is equally well known for the Bradley Broadfield Den. This phosphate fertilizer manufacturing process dates from the 1930s, yet still has great relevance for single superphosphate (SSP) and triple superphosphate (TSP) manufacturing (*Fertilizer International* 517, p53).

Air-swept mill systems for the phosphate industry are another notable Bradley Pulverizer equipment offering (*Fertilizer International* 525, p68).

PHOTO: LANCASTER/BRADLEY

Bradley Pulverizer's new Sittingbourne facility at night.

Better together

Curt and Ian, it's a privilege to have the opportunity to speak to you both while Curt is visiting the UK. **Could you provide our readers with the lowdown on the acquisition of Bradley Pulverizer in 2020 and how that complements ownership of Lancaster Products?**

CS: "It's Bradley Pulverizer's 140th anniversary this year. From their beginnings in Boston in 1886, the company has endured nearly a century and a half – a testament to Bradley's people and products.

"Bringing together the two businesses made sense. In April, it will be 10 years since I acquired Lancaster. I've been busy building out from the day I bought what was a low-growth, family-owned company, turning the business around and creating a thriving industrial mixer manufacturer.

"Through a common customer, and working together with Bradley Pulverizer in the US, I realised there were a lot of synergies between the two companies – both of us having our equipment in the same process lines, having a manufacturing footprint, and a similar identity and philosophy.

"I also knew Bradley had a UK office. I thought that would help Lancaster do more international sales and establish itself In the UK and Europe.

"It became a good idea to acquire Bradley because there were so many advantages to owning both companies. So fast forward and the acquisition deal that was supposed to close in 2019 got slightly delayed and we ended up buying Bradley in January 2020 – right before Covid hit! Guiding a newly acquired business through a global pandemic was certainly a difficult ordeal.

PHOTO: BRADLEY/LANCASTER

Curt Snyder, CEO, Lancaster Products (right), and Ian Hancock, Vice President, Sales and Operations, Bradley Pulverizer (second from left), alongide Bradley employees Darren Sweeting, Operations Manager, (third from left) and Jamie Paul, Engineering Sales and Support (left).

"It was the right decision, as we're thriving now. There's so many opportunities for both businesses – currently we're working together on another joint project in North America. There's a lot of benefits from having both product lines in lockstep and now, with the licensing agreement, it's not just common ownership either – it's having the ability to manufacture, sell, fulfil warranty obligations and do marketing through the UK."

IH: "I think the combination of the two companies has been great for Bradley. We're not the company we were six years ago when Curt bought us, that's for sure. We've seen wonderful growth through the acquisition and the combination of the two businesses."

Best-in-class mix-granulation

What operational and product quality advantages does one-step mix-granulation offer fertilizer manufacturers?

CS: "The Lancaster Mixer starts with simply being an excellent mixer. It's a high shear, counter current, vertical shaft mixer that we make in a variety of sizes, from lab size all the way up to large production scale, to serve a variety of industries – everything from glass, ceramics to fertilizers, of course.

"It's a really good at homogenising mixes very quickly. It's a best-in-class technology that excels at mixing and distributing uniformly ingredients of different densities, shapes and sizes. That's number one if you're going for a very rapid high-quality mix – because in some industries it's absolutely essential to get that correct at the start.

"Then, as an additional bonus, the Lancaster Mixer can also granulate. We're able to granulate with less liquid and binder than other equipment and be very precise on size. We can also alter the size range from batch to batch.

"We achieve very high granulation yield at what most consider 'difficult' size ranges – so less waste versus conventional granulation. We're typically getting greater than 85% on-size for 2-4 mm granules.

"We can also shift the granulation size: if you're making different products you can go from 1-2 mm in one batch and then go to 2-4 mm. So, essentially, it's got that flexibility in terms of granule size from batch-to-batch.

"We have a high level of confidence in our ability to make really top-notch product in the mixer. An additional point I'd make to your readers is that we're using a lot less binder and liquid. When producing green pellets, that means a lot less drying and therefore less energy use.

"Your inputs are generally less because our mixer is a lot more efficient. You're able to distribute the binder or liquid much more efficiently than you would with other mixing or granulation technologies and [therefore] use less of these expensive added ingredients.

"There's also less cost because there's less to dry. We might be wetting the material to say 15% – and then dry it to 2% or less – whereas conventional mixing granulation, competing technologies, would need to go to possibly 25-30%. So, what you can save on [drying] energy, just by using less water and binder, is a tremendous opportunity.

"The Lancaster Mixer is especially good with thick, viscous, difficult-to-mix materials as well. It's a perfectly versatile machine. With some materials we can start with a very wet mix and can granulate right from that point to create a green pellet – we don't need to pre-dry to a lower moisture level and then add water back in."

The gold standard in acidulation

The Bradley Broadfield Den has a long and proud history. Why does it continue to be relevant and adaptable to modern circumstances – such as minimising heavy metal content, for example?

IH: "Part of the reason the Broadfield Den, particularly the mixer, has stayed

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relevant is its flexibility. It can handle such a wide range of rocks, especially low grade rocks, and we're also finding new markets for it outside of the fertilizer industry.

"So, it's the flexibility, its ability to reinvent itself, to make other products, that's what's kept it alive. It's very well known for SSP. But if you've got a powder and an acid, if you want to mix them, you can do it in the Broadfield.

"It's really good for blending because you've got the flexibility of the paddle mixer. With vertical pot mixers, you haven't got enough residence time. So, if you're using low-grade rocks or you're blending rocks, you don't get a good acidulation, you don't get good coating of the particles.

"Whereas with the Broadfield, with its long length and its ability to change speed, you can customise it to do what you want. For example, in blending to reduce heavy metals, we're doing work where we're successfully adding phosphoric acid to a low-grade rock to bring it back up to a full SSP spec."

Equipment wear – a critical issue

Bradley Pulverizer notably offers robust air-swept mill systems. **Wear during size reduction is becoming a critical issue for the phosphate industry as it shifts towards lower-grade, high-silica phosphate rock – how is the company meeting this challenge with advances in lining materials and component design?**

IH: "We're doing a lot to eliminate wear and, as you rightly say, silica is the biggest issue. Certainly, in the phosphate industries, silica at the moment is a big problem. There's lots of things that can be done and it's going to become more and more important as rock quality declines.

"As we move into a world where many developing countries are pursuing local fertilizer manufacturing, we know without a doubt that rock quality is dropping. For example, we're doing some jobs in Egypt now where we're lining with chrome carbide – in the mill, the cyclone and the ducts – where we've rubber lined before.

"There's a massive focus on buying equipment these days on the capex cost, not on its opex. There's got to be a shift to look at the overall cost of life and, at the moment, that is proving to be a difficult message. Yes, you can buy [a lower capex mill] but the trade off is more than likely you'll be replacing it in five years. We've got mills that have been running for 70-80 years!"

New expanded UK base brings extra capabilities

Bradley Pulverizer recently moved to a new 18,500-square-foot facility in Sittingbourne, Kent. The site is significantly larger and better equipped than the company's previous UK location, providing scope for larger-scale manufacturing, rebuilds and overhauls, supported by overhead cranes.

Tell us more about the Sittingbourne site and what its enhanced manufacturing capabilities will mean for the company.

CS: "This facility has been in planning for around two and a half years. We realised pretty early on in my ownership that Bradley's Dartford site was not sufficient in size to be able to expand, or have the capability in terms of what my aspirations for this business were.

"We then found Sittingbourne, kept on coming back to this facility, and thought it was perfect. It took a while to modernise and update the building, as it needed to be totally retrofitted for our needs. But we started slowly moving in and were able to take over the shopfloor mid-summer 2025.

"The majority of our employees transferred here from a couple of different UK office locations in November. Then I came to the UK from the US in December to officially dedicate the building.

"I knew from the get-go this facility could handle our expansion. It's also located in a less crowded part of the UK with a really strong industrial base, which is good for workforce hiring and partnering with other manufacturers. So, there's a lot of synergies just from being located here.

"We have tests facilities for both Bradley and Lancaster equipment. We have a Lancaster mixer here, we have a lab-size classifier, and we have an acidulation testing capability here as well."

IH: "Sittingbourne has given us the capability to do more and expand what we're doing. It's giving us the ability to do our own fabrication and machining all under the one roof, as well as the assembly. We've also got an absolutely stunning lab facility building here, which has allowed us to do a lot of prototype testing. We've also got larger offices and taken more people on. If you go back five years, there was nine of us in the UK, now there's 21."

Deeper collaboration and a more integrated business

I understand that a new licensing agreement is now in place between Bradley and Lancaster Products.

CS: "Yes, we'd been dabbling in cross-selling Lancaster equipment through Bradley UK and testing the markets it works in – Europe, the Middle East and North Africa – and we discovered there was a good appetite for the things that Lancaster sold. Especially if we were able to cross market in one overall system, combining a mill and a classifier from Bradley Pulverizer and a mixer from Lancaster Products all in one process line. We found there is a market and an appetite for these [combined systems], and also for standalone Lancaster mixers, in the global markets that Ian typically sells in.

"So, we decided to formalise the arrangement and have an official partnership, not just common ownership, with a lot more collaboration and operational level coordination. The licensing agreement allows us to do that. Bradley can now manufacture and repair products and parts on behalf of Lancaster and engage in marketing and sales too.

"Now we have the Sittingbourne site we're able to do a lot more Lancaster repair work here in the UK, as well as mixer final assembly and testing. These extra capabilities in Sittingbourne are putting us closer to our non-US customers. It gives them confidence that they can send a mixer to the UK for service, or we can have somebody come out and fix their issues in the field, if necessary.

"Sam Eastgate, a UK-based Bradley employee, will be embedded in a full-time sales role for Lancaster. There's a lot of opportunities now that Sittingbourne is fully operational. It expands Bradley's capability and capacity to do more work and bring in different types of work to the UK, including for Lancaster Products."

Meeting customers, old and new, and looking to close deals

What are the company's objective for the CRU Phosphates+Potash Expoconference in Paris in April?

CS: "Phosphates, as you know, is a very important market for us. We're doing the majority of our non-US global work with phosphate customers. So, there's a lot of opportunity.

"For the conference, we're hoping to meet with existing customers, potentially close some deals, promote our technology and our capabilities, and meet potential new customers we can work with. It's going to be an excellent event all around and, in phosphate, squares exactly with one of our main focus industries."

IH: "The target, for me personally, is to find out what the new innovations and the new markets are. TSP is making a comeback, while DAP seem to be getting less popular, and, of course, SSP has always been a mainstay: it's the only phosphate fertilizer you don't need phosphoric acid for.

"With phosphoric acid demand for LFP batteries, SSP is looking attractive to a lot of producers again. It still gives them a way of making a fairly low-cost fertilizer. So, I'd be interested in talking to people to see if the trend is still moving that way."

Tara Snyder, Marketing Manager at Lancaster Products and Bradley Pulverizer has the last word: "Let me just add that the minerals industry, and phosphates in particular, is part of the backbone of our long-storied history. We have more than 100 years of acidulation processing experience and our Broadfield Den is the gold standard in that area. So, it's part of our heritage and we're happy to be there in Paris!" ■

PHOTO: LANCASTER/BRADLEY

Tara Snyder, Marketing Manager, Lancaster Products and Bradley Pulverizer, alongside a ready-to-ship mill.

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Phosphates project listing 2026

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	400	UC	2026
AUSTRALIA					
Ammaroo	Verdant Minerals	Northern Territory	1,200	PL	n.a.
Paradise South	North West Phosphate	Mount Isa, Queensland	1,000	UC	2027
BRAZIL					
Irece expansion	Galvani	Bahia	350	UC	2026
Tres Estradas	Aguia Resources	Rio Grande do Sul	100-150	UC	2026
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 projects with a published feasibility study (FS) are listed.*

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

Plant/project	Company	Location	Product	capacity ('000 t)	Status	Start-up date
BRAZIL						
Serra do Salitre	EuroChem	Patrocinio, Minas Gerais	SSP/MAP	1,000	C	2025
CANADA						
Lac-a-Paul	Arianne Phosphate	Quebec	PPA	150	PL	n.a.
EGYPT						
El Wadi	WAPHCO	Abu Tartur	Phosphoric acid (P_2O_5)	250	PL	2028
KAZAKHSTAN						
Karatau	EuroChem	Zhambyl	DCP	200	UC	2027
MOROCCO						
Mzinda Phosphate Hub	OCP	Mzinda	TSP/Phosphoric acid	4,200	UC	2028
Jorf TSP Hub	OCP	Jorf Lasfar	TSP	1,000	C	2025
Jorf TSP Hub	OCP	Jorf Lasfar	TSP	2,000	UC	2026-2027
NIGERIA						
Ikot Abasi	OCP/NSIA	Akwa Ibom	DAP	250	PL	n.a.
SAUDI ARABIA						
Third mega project	Ma'aden	Ras al Khair	Phosphoric acid (P_2O_5)	1,500	UC	2028
Third mega project	Ma'aden	Ras al Khair	DAP/MAP	3,000	UC	2028
SERBIA						
Prahovo	Elixir/K+S	Prahovo	MAP	50	C	2025
TUNISIA						
Samsun	Eti Bakir	Samsun	DAP	450	C	2025

KEY FOR BOTH TABLES

FS Feasibility study complete
PL Planned
UC Under construction
C Project completed
n.a. Not available
DAP Diammonium phosphate
DCP Dicalcium phosphate
MAP Monoammonium phosphate
PPA Purified phosphoric acid
SSP Single superphosphate
TSP Triple superphosphate

***Excluding China.*

PHOSPHATE TECHNOLOGY AND ENGINEERING PROFILES

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.


PHOTO: PRAYON

Prayon's state-of-the-art Engis phosphate production complex in Belgium.

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, SO_4, 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. ■

Profile

Expert guidance

In the demanding world of phosphoric acid production, equipment knowledge is vital, but it is the understanding of the entire process that truly makes a difference. That's where Profile, a division of Prayon, excels, thanks to its ability to work hand-in hand with Prayon Technologies, the process experts.

Delivery, support & maintenance

Profile ensures that state-of-the-art practices are implemented by integrating our experts into your phosphoric acid plant project – from its inception to the end of the production cycle. This approach leverages the best industrial machinery available, as well as optimising Key Performance Indicators.

Our range of services include mounting supervision, site commissioning, and start-up assistance. Contracts are


PHOTO: PROFILE

Profile recently welcomed two new colleagues to the team: Jean-Luc Vangramberen, Operations Manager (left) and Giuseppe Giambarresi, Engineering Manager (right).

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honoured, and quality products are guaranteed, thanks to the expertise of Profile's field engineers.

Delivering the right service at the right time is also crucial. Our team's rapid reaction in troubleshooting situations aims to save precious production time. We are dedicated to addressing any challenge swiftly – ensuring minimal disruption to your operations.

Annual audits are the cornerstone of proactive maintenance. Rather than waiting for issues to arise, our predictive maintenance approach anticipates maintenance needs, significantly reducing the need for reactive and remedial action. Through these audits, we share best practices, train production and maintenance teams, and optimise current equipment with the latest product developments.

Our Service, your benefits

Profile has a focus on enhancing operational performance with a commitment to:

- Increase production: Optimise processes and machinery for higher output.
- Product improvement: Utilise the latest advances to improve product quality.
- Cost reduction on total cost of ownership: Implement efficient practices to reduce overall costs.
- Avoid production stops: Proactive maintenance and rapid troubleshooting to prevent costly downtimes.
- Expert coverage: Benefit from the combined expertise of Profile and Prayon Technologies.
- Original quality spare parts: Ensure reliability and performance with our supply of original, high-quality spare parts.

Building partnerships

Profile believes in the power of partnership, as our success is built on trust and collaboration. We deliver not only equipment and services but also satisfaction and peace of mind.

Our unparalleled mechanical expertise is also supported by Prayon Technologies, who bring a comprehensive understanding of phosphoric acid production routes. This synergy ensures that Profile's clients benefit from a holistic approach to process optimisation

Two new faces join the Profile team!

Profile recently welcomed two new colleagues to the team: Jean-Luc Vangramberen, Operations Manager and Giuseppe Giambarresi, Engineering Manager (see photo). Both bring complementary expertise that will further strengthen Profile's development and structure, supporting its ambition to deliver premium-quality equipment to the phosphate industry worldwide.

Giuseppe Giambarresi, Engineering Manager, joined Profile in June 2025 to oversee the design excellence in Profile equipment. Supported by a team of specialised industrial designers, he develops new projects and customises our product portfolio – including Prayon filters, process agitators, gas scrubbers and Praysep™ droplet separators.

With a strong background in industrial design and mechanical engineering, Giuseppe is passionate about modernising the way Profile approaches equipment development. "My mission is to standardise in a rigorous way how our equipment is engineered, closely collaborate with the rest of Prayon's team, keeping us as a premium-quality, innovative company and partner," he explains.

Jean-Luc Vangramberen, Operations Manager, was recent integrated into the Profile team, and quickly embraced the division's many ongoing projects. As Operations Manager, he now supervises field engineers and coordinates project implementation on site, ensuring Profile's reputation for reliability and responsiveness continues to grow.

With more than 27 years of experience in metal manufacturing – particularly in stainless steel and special alloys – Jean-Luc brings a deep understanding of complex assemblies and operational excellence. "I've always been driven by customer satisfaction," he comments. "Delivering high-quality equipment and ensuring smooth project execution is what motivates me every day." ■

De Smet Agro

Industry engineers for 65+ years

De Smet Agro (DSAG) has been a trusted partner to the global fertilizer industry for more than six decades – delivering smart engineering, project management, procurement, and construction management services. Based near Brussels, with offices in France and India, the company combines a global reach with the agility of a specialised expert team.

With over 250 industrial plants delivered in 35 countries, DSAG has built a worldwide reputation for designing and delivering complex fertilizer facilities. Our strength lies in our ability to work seamlessly with top technology licensors and industry partners, bringing the right expertise to every project. We support clients on both new (greenfield) installations and on revamping projects aimed at boosting capacity, efficiency, and sustainability.

Long-term partner of Prayon

DSAG is a world-recognised licensee of Prayon Technologies (PRT) – a partnership dating back to 1960. This collaboration gives our clients access to PRT's full portfolio of phosphoric acid routes and downstream technologies, backed by DSAG's complete in house EPCM capabilities. We cover every step needed to deliver a high-performing phosphoric acid plant – from the process design package to start-up and performance tests

Full value chain expertise

We bring deep technical know-how across all key phosphoric acid and phosphate processes, including:

- Single and double crystallisation phosphoric acid processes
- Phosphoric acid purification technologies
- Phosphate salt technologies, including those for animal feed, food phosphates and water-soluble fertilizers
- Dicalcium phosphate (DCP) processes (HCl or H_2SO_4 based), including phosphoric acid production from DCP
- Fluorine gas scrubbing
- Phosphoric acid concentration and fluorosilicic acid (FSA) recovery
- Rock grinding, slurry/solids handling and storage
- Acidic cooling tower design
- Gypsum handling (solids/slurry), storage and valorisation.

Proven nitrogen technologies

DSAG also offers in-house technologies for nitrogen fertilizer production. We assist clients worldwide with complete process design for synthesis, evaporation, crystallisation, prilling, and granulation units. Specific areas of expertise include:

PHOTO: PRAYON

Prayon's new SHMP plant, Engis, Belgium.

Client: Prayon
Location: Engis, Belgium
Project: Revamping an existing phosphoric acid plant

De Smet Agro provided the basic engineering (BE) with AACE Class 2 capex estimate followed by a complete engineering, procurement and construction management (EPCM) mandate. The plant was commissioned end-2025.

- Fluidised drum granulation for ammonium nitrate products (AN/CAN/ASN) and calcium nitrate (CN)
- Prilling of low-density ammonium nitrate (LDAN)
- Ammonium sulphate (AS).
- Expertise in fertilizer granulation plants.

We design and support the construction of granulation units for:

- Monoammonium phosphate (MAP)
- Diammonium phosphate (DAP)
- NPK fertilizers.

The company's expertise also includes the design of gaseous effluent cleaning systems to ensure environmental compliance and operational performance.

A single point of contact

Thanks to strong, long-term partnerships with leading technology providers and contractors, DSAG can tailor each project to client needs – while keeping a single responsible partner at the helm. This ensures project execution is smoother, faster, and more reliable.

Our services – from idea to operation

DSAG delivers a full spectrum of services for fertilizer projects worldwide:

- Technical audits
- Prefeasibility and feasibility studies
- Capex and opex evaluation
- Financial studies
- Project management
- Front-end engineering design (FEED)
- Basic and detailed engineering design
- Procurement
- Construction management and site supervision
- Operator training
- Pre-commissioning and commissioning services
- Start-up assistance and performance guarantee tests. ■

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.

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:

- Evaporation
- Solution and melt crystallisation
- Stripping
- Membrane filtration
- Wash columns
- Centrifugal decantation and separation
- Spray and fluid bed drying.

These technologies allow GEA's clients to produce:

- The highest-quality water-soluble fertilizers (technical MAP, DAP, MKP)
- Merchant-grade phosphoric acid (MGA) by concentration from weak acid with reduced energy consumption
- Purified phosphoric acid (PPA) by concentration and stripping
- Ultra-pure phosphoric acid (electronic-grade)
- Purified phosphogypsum.

Water-soluble fertilizers (WSFs)

By making continuous improvements through lab and pilot testing, GEA has developed processes able to produce the purest technical monoammonium phosphate (tMAP, impurities <0.1%, insolubles <0.01%) from different grades of phosphoric acid (PPA and MGA).

GEA's technology for water-soluble MAP production has been successfully implemented worldwide. The ability to deliver a pure MAP end-product with a high market value and an ultra-low concentration of impurities (ppm level) is a key advantage for clients, as this is a necessary requirement for WSFs used in irrigation systems to avoid clogging problems.

The tMAP produced by GEA's processes offers additional benefits:

- Suitable for fertigation, foliar applications and fertilizer blends
- Low turbidity after dissolution in water
- Free of chlorine, sodium and other deleterious elements
- Moderate solution pH – safer and less corrosive
- Suitable for use in the manufacture of lithium iron phosphate (LFP) batteries.

GEA offers an innovative yet proven technology capable of producing tMAP directly 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. ■

PHOTO: GEA

Operational GEA crystalliser at a fertilizer production plant.

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