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Number 529

November | December 2025

www.fertilizerinternational.com

# Fertilizer INTERNATIONAL





FERTILIZER INTERNATIONAL

ISSUE 529

NOVEMBER-DECEMBER 2025

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# Demand is everything


The fertilizer industry – as a sector dedicated to the manufacture of crop nutrients – is rightly focused on production and supply.

In this issue, for example, we're lucky enough to feature an excellent update on the production of 'green' ammonia from renewable energy (p14). This reveals that operational renewable ammonia projects have collectively exceeded one gigawatt (GW) of installed electrolyser capacity for the first time. This is quite the landmark.

Production and supply are, however, only one side of the equation. Because green ammonia projects can't be magicked into existence without demand. This key pull factor cannot be neglected – as decarbonising both fertilizer production and the food system, rapidly and at scale, depends on demand creation.

To put it starkly, demand is everything. Because green fertilizer projects will fail to reach final investment decisions (FID) unless investors are confident that a sizeable and growing market exists for these products. Similarly, demand is equally reliant on supply to produce affordable products at scale.

> **"The holy grail here is a virtuous circle in which supply and demand, working in harmony, create an ever-growing market for decarbonised fertilizer products."**

The holy grail, therefore, is to link output and uptake together in a virtuous circle: a self-perpetuating accelerator in which supply and demand, working in harmony, create an ever-growing market for decarbonised fertilizer products.

Thankfully, there are lots of imaginative ways of joining up green fertilizer supply and customer demand, with collaboration across the food value chain being crucial.

Low-carbon fertilizer innovator CCm, for example, has partnerships in place with PepsiCo, Nestle, Cargill, Tesco and others (*Fertilizer International* 528, p47). Low-carbon fertilizer project developer FertigHy, meanwhile, has Heineken as a founding partner and shareholder (*Fertilizer International* 528, p49). Most recently, ATOME secured an offtake agreement with Yara International for all of the green fertilizer output from its under-development Villeta project in Paraguay (see p11).

Major fertilizer producers such as Yara and Fertiberia are themselves working in close partnership with fast-moving consumer goods companies (FMCGs) on creating the necessary market demand for green fertilizers. This includes end-to-end collaborations, for products such as bread and potato chips, that cover the whole of the food value chain from the farm to the supermarket (*Fertilizer International* 522, p27).

But, Europe being Europe, policy levers are also in the spotlight. Deloitte, for example, recently published a report on the demand-side policies needed to shift European heavy industry (steel, chemicals, refining and fertilizers) to low-carbon production[1]. This looked at a specific policy instrument – demand-side mandates – and if and how these could be implemented.

"Heavy industry – including fertilizers – is critical to European prosperity and strategic autonomy. At the same time, they account for a significant share of the EU's greenhouse gas emissions. EU heavy industry is under increasing pressure, especially from high energy and feedstock prices, costs of $CO_2$ emissions, and low-cost imports," says the Deloitte report.

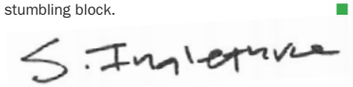
"The transition to sustainable alternatives is not economically viable yet. The cost gap between conventional and sustainable production is substantial and unlikely to close through market forces or technological advances alone," it adds.

This is where demand mandates might help. Essentially, these would aid the transition to more sustainable products, such as green fertilizers, by placing mandatory purchasing requirements on large-scale end users.

The Deloitte report concludes that food retailers and service providers are strong candidates for fertilizer demand mandates – due to their proximity to consumers and their relative market concentration. Dairy producers were identified as another candidate sector, given their significant share of fertilizer use, although they are further removed from the consumer.

The report suggests that EU heavy industry could begin to decarbonise at scale – with the help of demand mandates – without major impacts on affordability. The additional costs to consumers, in terms of higher retail prices, would typically be less than 1%, it says, because materials like steel, plastics and fertilizers represent just a small fraction of the cost of finished products.

Demand mandates would, however, require legal backing, possibly under the EU's proposed Industrial Decarbonisation Accelerator Act. Whether this will happen, of course, remains to be seen, with the extra regulatory burden and costs likely to be a stumbling block. ■



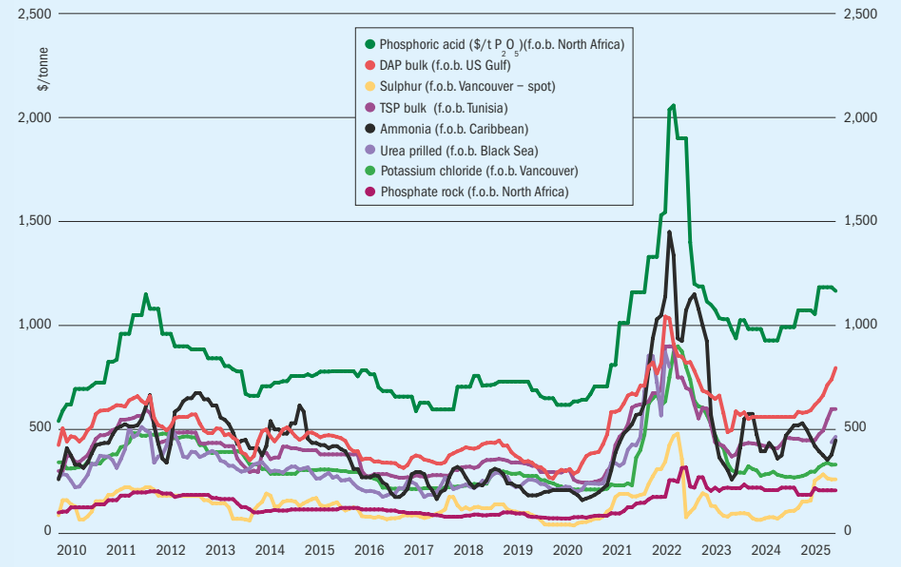
*Simon Inglethorpe, Editor*

1. Helmi, T., et al., 2025. *Mobilizing consumer demand for sustainable investments.* Deloitte, September 2025.





**Historical price trends** $/tonne




*Source: CRU*

## PRICE TRENDS

**Market snapshot, 23rd October 2025**

**Urea market springs to life.** Eyes have been fixed on India and the fulfilment of RCF's two million tonne urea tender issued on 15th October. RCF had issued counter-offers to all participants at $395/t cfr East Cost India (ECI) and $402/t cfr West Coast India (WCI). But it became clear that suppliers west of Suez were unwilling to commit tonnes at these prices.

Early reports suggest RCF is likely to receive offers for only one million tonnes of the requested volume initially. The bulk of acceptances are now expected to emerge out of the Middle East, almost exclusively destined for India's west coast. Clarity is still awaited on the extent of Chinese participation in the tender. Unconfirmed reports suggest up to 200,000 tonnes is ready for shipment, while others have indicated quantities below this level.

In the Middle East, Sabic sold a November cargo at $395/t f.o.b. That was later eclipsed by Oman's SIUCI, which placed a November consignment at $399-400/t f.o.b. In the UAE, meanwhile, Fertiglobe sold 150,000 tonnes at $406.50/t f.o.b. for November shipment to Ethiopia.

In Egypt, a raft of buying activity took place at $425-440/t f.o.b. Along the coast in Algeria, Sorfert sold November material at $435/t f.o.b., with reports of further business concluded by the producer AOA at $440/t f.o.b.

Across the Atlantic in Brazil, bids slipped into the $390s/t cfr this week with offers also falling as low as $405/t cfr in some ports. In Europe, buying activity remains subdued on poor affordability and increasingly weak farmer economics. Looking west, activity at NOLA was similarly muted.

**Ammonia market pushes higher as supply falters.** The ammonia market tightened further, with Nutrien's shutdown in Trinidad being the latest blow to buyers seeking relief from relentless price rises. Ammonia is tight globally, linked to a significant extended outage in Saudi Arabia, and there is increasing talk of demand destruction.

Algeria's export price ($625/t f.o.b.) is now at its highest level since CRU began the assessment in around 60% 57% up from its low of $390/t f.o.b. seen in June. The delivered price in northwest Europe is also its highest in approaching two years.

In the Middle East, Ma'aden's MPC outage continues with speculation that the curtailment may now continue into 2026. The 1.1 million t/a capacity ammonia unit went down unexpectedly at the end August and is likely to be down until the end of the year, with the loss of at least 300,000 tonnes of production. Contract prices in the Far East continue to firm on restricted supply, with those in Taiwan and China up around $70/t in a month. China is emerging as one of the few sources of spot cargoes in the region. Prices in India are also climbing.

**Phosphate prices under pressure while activity limited.** DAP and MAP prices remain under pressure, although overall global spot market activity was limited. Spot prices for MAP sales to Brazil were assessed lower at $650-670/t. While





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**Market price summary** $/tonne – late October 2025

| Nitrogen | Ammonia | Urea | Ammonium Sulphate | Phosphates | DAP | TSP | Phos Acid |
|---|---|---|---|---|---|---|---|
| f.o.b. Caribbean | 550 | - | f.o.b. E. Europe 285 | f.o.b. New Orleans* | 770 | - | - |
| f.o.b. New Orleans* | - | 375 | - | f.o.b. North Africa | 758 | 593 | 1,396 |
| f.o.b. Middle East | 425 | 368 | - | cfr India | 750 | - | 1,290 |
| f.o.b. Black Sea | - | 388 | - | - | - | - | - |
| **Potash** | KCl Standard | $K_2SO_4$ | **Sulphuric Acid** | | **Sulphur** | | |
| f.o.b. Vancouver | 334 | - | cfr US Gulf 128 | - | f.o.b. Vancouver | 330 | - |
| cfr India | 349 | - | - | - | f.o.b. Arab Gulf | 385 | - |
| f.c.a. Western Europe** | - | 605 | - | - | cfr China | 403 | - |
| f.o.b. Baltic | 308 | - | - | - | cfr India | 395 | - |

*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*



DAP markets were quieter, assessments still inched down.

The key India DAP spot benchmark declined further to $747-752/t cfr amid limited market activity. This price assessment, although down from the $810/t cfr level seen two months ago, is still well up on $632-634/t cfr at the end of February and $690-700/t cfr at the start of May.

China's total January-September DAP and MAP exports were around 3.8 million tonnes, leaving limited remaining export quota allocations. Meanwhile, another week passed with a lack of DAP, MAP or TSP barge deals at New Orleans, leaving price assessments unchanged.

**Potash stability prevails with all eyes on China.** Potash prices remained mostly steady, with only slight fluctuations seen in Europe and parts of the US. Market attention continues to centre on the upcoming China contract and how it might influence the market. Despite expectations of potential price declines, if contract negotiations are delayed, formal talks have yet to begin.

In India, focus is now on the Fertiliser Association of India (FAI) Annual Seminar in December, where both producers and importers expect negotiations to take place. For now, the market is adopting a wait-and-see approach ahead of the government's upcoming announcement of nutrient-based subsidy (NBS) rates for the next quarter.

The Southeast Asian MOP market continues to show price stability, serving as a key reference point regionally. In Europe, standard potash prices edged down slightly, with most offers now around €340/t cif. The Brazilian MOP market remained largely unchanged, with limited deals as buyers shift focus to SSP for the upcoming season. New offers at $365/t cfr emerged, but market participants generally viewed these as inflated.

**Sulphur prices rise globally.** Sulphur prices advanced further in the third week of October. The bullish sentiment is present even in markets where activity has been limited.

Transactions into both Indonesia and southern China are understood to have taken place at $400/t cfr, with Indonesian demand expected to continue through November. Offers of Middle East material into both China and Indonesia are understood to now be around the $340/t cfr price. This price level is supported by the latest QatarEnergy tender (35,000 tonnes) which, reportedly, was awarded above $400/t f.o.b. for November shipment.

## OUTLOOK

**Urea prices to find floor in near term before advancing.** While the urea market has bottomed out with India back in the import market, and interest in Brazil and Europe picking up, prices have been revised lower in CRU's latest forecast. Looking ahead, key downside risks include possible demand destruction in Europe in the first quarter of next year, due to a lack of clarity over the carbon border adjustment mechanism (CBAM). Demand in Brazil could also be lower than expected linked to increased ammonium sulphate (AS) consumption. Prices could also come under increased pressure if India stepped back from the market at the end of the year.

**Ammonia buoyed in immediate term following Tampa price hike.** Prices should continue to retain support in the immediate term amid ongoing supply constraints both east and west of Suez, although prices should begin to correct downwards as 2026 nears. The market looks very tight through to the end of the year, although some expect supply to improve in the fourth quarter. The commissioning of new capacity in the US Gulf, Baltic Sea and Middle East is likely to apply significant downward pressure on the market, as and when they emerge.

**Phosphates prices to fall further but remain elevated.** Prices are expected to decline further through the fourth quarter as buyer resistance to high prices grows across the globe. Despite this, prices are still likely to remain historically high, given the limited overall global availability resulting from China exiting the export market until at least the second quarter of 2026.

**Potash prices expected to drift lower as demand softens.** Prices are expected to remain stable to soft in the short term. Market focus will remain on upcoming contract negotiations, particularly in China, due to their influence on future price trends. Larger-than-expected price declines could occur, however, if falling crop prices negatively affect affordability and potash demand.

**Sulphur prices to peak in fourth quarter.** Global sulphur prices were adjusted upwards in CRU's latest forecast, after the market moved to a higher price environment during September. Globally, sulphur price sentiment is likely to remain bullish in the coming weeks. Although sulphur demand in China is likely to decrease, now that the phosphate export window has closed, demand in Indonesia is expected to persist until the end of year. Short-term constraints on FSU-sourced sulphur are also likely to add to market tightness. ■





UNITED KINGDOM

# Anglo American announces merger of equals with Teck

PHOTO: ANGLO AMERICAN

*Anglo American's under-construction Woodsmith polyhalite mine in the UK.*

Anglo American and Teck Resources jointly announced a merger agreement on 9th September.

The agreement – which brings together the two major miners to form Anglo Teck – is a merger of equals that will create a global critical minerals champion, both companies said.

Headquartered in Canada, the merged business would be strongly positioned as a top-five global copper producer. The creation of a premier critical minerals portfolio, including the possession of world-class copper assets, is a key part of the merger's rationale.

Major operational savings (synergies) and a substantial uplift in earnings (EBITDA) are also anticipated.

Unlike BHP's hostile bid for Anglo American last year, the boards of Anglo American and Teck have both given unanimous support to the merger and recommended the transaction. On completion, Anglo American shareholders would own around 62.4% of Anglo Teck plc with Teck shareholders owning the other 37.6% of the new company.

Anglo Tech's combined copper production would be around 1.2 million tonnes per annum (t/a), with this expected to grow by around 10% to 1.35 million t/a in 2027. The merged entity would also be:

- A major producer of premium iron ore (61 million t/a) able to supply cleaner steelmaking from mines in South Africa and Brazil.
- One of the world's largest producers of mined zinc through the world-class Red Dog mine in Alaska, as well as the owner of one of the world's largest integrated zinc and lead smelting and refining facilities at Trail Operations in British Columbia.

The financial benefits accruing from the merger include:

- A special dividend to Anglo American shareholders of $4.5 billion (around $4.19 per share) ahead of completion.
- An estimated $800 million in annual synergies (pre-tax, recurring) realised by the end of the fourth year after completion.
- Additionally, from 2030-2049, an average annual uplift to EBITDA of $1.4 billion is predicted, this being delivered by synergies between the adjacent Collahuasi and Quebrada Blanca mining operations. Potentially, these are expected to raise annual copper production by an additional 175,000 tonnes approximately.
- Finally, a stronger balance sheet underpinned by a larger, more diversified asset and cash flow base, including premium iron ore and zinc.

### Assets include crop nutrients

"Anglo Teck will remain committed to Anglo American's announced portfolio simplification, including ongoing work to separate De Beers for value alongside completion of the steelmaking coal and nickel disposals. Anglo American will continue to advance these efforts prior to completion," the companies said in a statement.

Anglo American's assets also include crop nutrients, namely the under-development Woodsmith polyhalite project in northern England. As part of its current portfolio simplification, the company is cutting capital expenditure on Woodsmith, with this declining to $300 million in 2025 and then to zero in 2026, as Anglo American deleverages its balance sheet and looks for an investor/strategic partner to take an ownership stake (*Fertilizer International* 523, p32).

The decision to simplify Anglo American's portfolio to just copper, iron ore and crop nutrients was triggered by a failed hostile takeover bid by BHP in May last year (*Fertilizer International* 523, p32). At the time, although crop nutrients were retained as one of the three "core pillars" of the business, the Woodsmith project was also described as having "optionality" by CEO Duncan Wanblad.

Project costs for the UK polyhalite mine are estimated to have tripled between 2017 and 2023, from $2.9 billion to around $9 billion (*Fertilizer International* 518, p9) Despite current uncertainties, around 1,100 people were still employed on the Woodsmith project, as of mid-2025, working on shaft sinking activities and carrying our critical studies.

Earlier this year, Anglo American set out three pre-conditions that would allow Woodsmith to proceed to a final investment decision (FID). These were only likely to be met in 2027 at the earliest, according to the company (*Fertilizer International* 528, p10).

Anglo Teck's global headquarters will be located in Vancouver with corporate offices in London and Johannesburg. Named in key leadership roles are: Duncan Wanblad as CEO, Jonathan Price as Deputy CEO, and John Heasley as CFO, with Sheila Murray as Chair.

The merger is expected to complete in 12-18 months, subject to customary regulatory and completion conditions. ■





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## UNITED KINGDOM

### ERM to develop a low-carbon roadmap for potash and phosphate

Sustainability consultancy ERM has been commissioned by the European Bank for Reconstruction and Development (EBRD) and the International Fertilizer Association (IFA) to develop a low-carbon roadmap for the global potash and phosphate fertilizer industry.

The roadmap, which will be developed with support from UK consultancy Systemiq, will set out the industry's path toward net-zero emissions. It will identify policy measures and technology deployments necessary to reduce or mitigate the industry's climate change impacts. The aim is to help the potash and phosphate industry continue to supply fertilizers – which underpin food security for a growing global population – while managing local environmental impacts and global emissions.

ERM will analyse the potash and phosphate fertilizer market, assess the industry's Scopes 1, 2 and 3 emissions, and develop a low-carbon roadmap. It will also seek industry insights and views, through a stakeholder engagement programme, to build a sector-wide consensus and ensure the effective implementation of the roadmap,

Felicity Spors, Director, Sustainable Business & Infrastructure, Climate Strategy & Delivery at the EBRD, said: "This new roadmap builds on our strong partnership with IFA to advance the fertiliser sector's low-carbon transition. Whilst designed with a global perspective, it speaks directly to the priorities of the EBRD's countries of operation – including Morocco, Tunisia, Egypt, and Jordan – where phosphate and potash industries are central to growth and employment."

Volker Andresen, IFA's Sustainability Director, said: "Building on our successful collaboration with the EBRD on ammonia, including the development of local Low Carbon Pathways with ERM in countries such as Egypt, this new initiative expands decarbonization efforts to phosphate and potash. Together with EBRD and ERM, we are equipping the global fertilizer industry with practical tools and guidance to support producers in designing resilient, robust, and science-based decarbonization strategies."

Richard Platt, Partner at ERM, said: "Decarbonization efforts to date have largely focused on nitrogen fertilizers. There is a clear need for a focused, actionable strategy, for potash and phosphate fertilizers. We look forward to working with EBRD and IFA to set out a practical, data-driven pathway to significant emissions reductions."

## IRELAND

### MEPs warn of CBAM price hikes

Irish MEPs have urged the European Commission to rethink its introduction of the carbon border adjustment mechanism (CBAM) due to concerns about fertilizer price rises.

Fianna Fáil MEPs Barry Cowen, Billy Kelleher and Cynthia Ní Mhurchú raised their concerns in a letter to Wopke Hoekstra, European Commissioner for Climate, Net Zero and Clean Growth, the website *Agriland* reported on 23rd October.

The letter said that Ireland's heavy reliance on imported fertilizer, particularly urea, left the country's farmers "more exposed than others to new carbon tariffs". The MEPs warned the Commissioner that CBAM could "hit Irish farmers hard" and have requested an urgent meeting to "explore solutions".

From 1st January 2026, CBAM will require importers to buy certificates based on the EU carbon price. At the current price of €70/t $CO_2$e, this will add €35-80/t to the cost of fertilizers such as urea and calcium ammonium nitrate (CAN), according to calculations by the Irish Co-operative Organisation Society (ICOS).

The extra cost of CBAM on fertilizers could rise to as much as €250/t by 2034, ICOS said. The Society also warned that CBAM could increase overall costs for Irish farmers by €100 million by 2030.

Speaking to *Agriland*, MEP Barry Cowen said: "Ireland's farmers must not become collateral damage of well-intended climate policy. As a country, we import virtually all our fertiliser – about 80% of our urea comes from outside the EU.

"If Brussels imposes a one-size-fits-all carbon tariff on fertilisers without accounting for that reality, it will hit Ireland far harder than other member states. I have grave concerns that our farmers will bear the brunt of a policy that was never tailored to our national circumstances, and that is why I've urgently reached out to Commissioner Hoekstra on this matter."

Cowen said a "cross-border fiasco" in Ireland must also be avoided. "We need the EU and UK in sync on CBAM timing to prevent a loophole that could hurt both our single market and Ireland's agri sector," he said.

The UK will not apply similar charges to CBAM until 2027.

"I'm urging the commission to hit the pause button on CBAM for fertilisers until these issues are resolved," Cowen added. "This is about being smart as well as green – my Fianna Fáil MEP colleagues and I absolutely support climate action, but it has to be done in a fair and workable way."

## UNITED STATES

### CF ships first low-carbon cargo to Europe

CF Industries, the world's largest ammonia producer, has announced the first shipment to Europe of certified low-carbon ammonia from its Donaldsonville, Louisiana, nitrogen production complex in the United States.

Commodity supplier Trafigura loaded the 23,500 tonnes of low-carbon ammonia at Donaldsonville on the 25th September. It is destined for Antwerp, Belgium.

The 'blue' ammonia cargo has been certified as having a significantly lower carbon footprint than conventional 'grey' ammonia production, under The Fertilizer Institute's (TFI's) Verified Ammonia Carbon Intensity (VACI) Programme.


PHOTO: CF INDUSTRIES

*Loading of the first low-carbon shipment for Europe at CF Industries' Donaldsonville*







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Trafigura purchased the low-carbon ammonia on behalf of materials manufacturer Envalior. It intends to use the shipment as a feedstock for low-carbon caprolactam production.

"We are proud to partner with industry leaders Trafigura and Envalior as we work together to develop a low-carbon ammonia supply chain in advance of the implementation of the European Union's carbon border adjustment mechanism," said Bert Frost, EVP, Sales, Market Development And Supply Chain at CF Industries. "We also are pleased to reach an important milestone for CF Industries by delivering our first low-carbon premium offering to Europe."

"At Envalior, sustainability is not just part of our strategy – it's part of who we are. This shipment of low-carbon ammonia marks a significant step in our journey to decarbonize our supply chain and deliver climate-resilient solutions," said Thorsten Bredemann, the company's VP, Global Marketing & Sales Intermediates. "By integrating certified low-carbon feedstocks into our production of caprolactam/ammonium sulphate and downstream into PA6, we are showing our commitment to low-carbon materials and helping our customers meet their environmental goals."

In a landmark moment for CF Industries, the carbon capture and storage project at its Donaldsonville site became operative in July (*Fertilizer International* 528, p9). This has the capacity to sequester up to two million tonnes of $CO_2$ generated by ammonia manufacturing annually – enabling the production of low-carbon ammonia at the site.

Consequently, CF now expects to produce approximately 1.9 million tonnes of VACI-certified low-carbon ammonia per annum at Donaldsonville. This can also be used to manufacture low-carbon fertilizer products.

## MCO-I delivers critical turbomachinery to Beaumont project

Mitsubishi Heavy Industries Compressor International Corporation (MCO-I) has successfully delivered syngas and ammonia refrigeration compressor trains for the Beaumont ammonia project in Texas.

This includes the supply of two API 617 compressors and a double-ended synchronous motor for the syngas train, as well as an API 617 compressor train driven by an API 612 steam turbine for the ammonia refrigeration service. The project was executed by dedicated teams from MCO-I and its parent company Mitsubishi Heavy Industries Compressor Corporation (MCO).

The project, originally developed by OCI Global and now owned by Woodside Energy (*Fertilizer International* 522, p10), will be one of the world's first large-scale 'blue' ammonia plants. Beaumont, which has a capacity of 3,000 tonnes per day, uses carbon capture and sequestration (CCS) technology. It is more than 95% complete (*Fertilizer International* 528, p10).

Michael McCurry, MCO-I, said, "We are proud to have played a key role in supporting the construction of one of the largest clean energy ammonia plants in North America. MCO's strong presence in the ammonia market and best-in-class mechanical drive steam turbines have been key advantages for this project. With a legacy of supplying turbomachinery to over 35 world-scale (2,000+ metric tons) ammonia plants globally, this project underscores our commitment to delivering reliable turbomachinery solutions that support large-scale, clean energy initiatives."

## Nitricity raises $50M to go global


*Nitricity's liquid fertilizer Ash Tea is made using recycled organic almond shells, air, water and renewable power.*

US fertilizer startup Nitricity secured $50 million in Series B funding in September, ahead of the groundbreaking ceremony at its new liquid fertilizer production plant in Delhi, California.

The funding round was co-led by new investor World Fund, Europe's leading climate venture capital firm, and returning investor Khosla Ventures. Chipotle's Cultivate Next venture fund, Change Forces, Susquehanna Sustainable Investments, EIP, and Fine Structure Ventures also took part.

Nitricity manufactures a nitrogen liquid fertilizer – Ash Tea – from recycled organic almond shells, air, water and renewable power. This is being marketed as a low-carbon and organic alternative to traditional nitrogen-based synthetic fertilizers. Crop trials with Ash Tea have shown yield increase of up to 30% and noticeable improvements in early plant growth, the company reports.

Nitricity says Ash Tea is a safer, more effective fertilization option designed to meet the growing demand for sustainable, regenerative practices. The company, founded in 2018 by three Stanford University graduates, has grown to secure over $150 million in its sales pipeline following a period of rapid growth.

Nitricity will use the fresh capital to scale its fertilizer technology across the US and into Europe. Its plans include hiring 10 extra staff, adding to its existing 38-person team, and R&D investments.

The company is currently building production capacity in the western US to serve organic farmers and expand into high-value fruit markets. The new funding will also enable Nitricity to start pilot and field trials across Europe and recruit staff on the continent.

Nitricity plans to use local agricultural waste materials, including wood and waste from olive oil manufacturing, for fertilizer production in Europe. The extra R&D investment will also be used to improve system efficiency and expand into markets such as corn and wheat.

Dr Nicolas Pinkowski, Nitricity's co-founder and CEO, said: "This is an inflection point for Nitricity. We're scaling across the US and we're very excited to expand into Europe in a serious and assertive way. The European market for our organic fertilizer is even larger than in the US, and demand is only growing against a backdrop of European governments looking to boost resilience and create circular agriculture economies. We offer an exceptional organic, circular solution for the market."

World Fund, which invests in climate tech companies with decarbonisation potential, has previously backed successful startups IQM, Space Forge and Planet A Foods. Nitricity is its first US investment.

Dr Nadine Geiser, Principal at World Fund, said: "The Haber-Bosch process typically sees around 60-70% of nitrogen applied to crops get lost. This cannot continue. Our calculations show Nitricity's brilliant, price-competitive sustainable, organic alternative provides an <92% reduction in emissions on average. As the EU looks to meet sustainability and organic requirements, demand for Nitricity's solution is only rising, and we are proud to be supporting Nicolas and the team as they scale into Europe and beyond."

Nitricity's under-construction organic fertilizer plant in Delhi, California, is scheduled to enter production in 2026. With a 100-fold increase on previous capacity, it will produce organic nitrogen fertilizer at commercial-scale. The total output of the plant, which was funded by Elemental Impact and Trellis Climate, is already sold out through to 2028 under binding offtake agreements with local organic growers.





## PARAGUAY

### Yara seals Villeta project offtake agreement

ATOME has signed a definitive offtake agreement with Yara International for its Villeta project in Paraguay.

This commits Yara to purchase the entire 260,000 tonnes per annum of low-carbon fertilizers produced by the renewable-powered project for a minimum of 10 years. These will be sold though Yara's market-leading distribution network in South America.

The Villeta project is designed to produce low-carbon calcium ammonium nitrate (CAN) fertilizer at scale from green ammonia. The project will run on hydropower-sourced renewable electricity and is being financed without subsidies or grants.

Through the offtake agreement, ATOME will benefit from Yara's ability to market and commercialise low-carbon fertilizers. As a first-mover in this market, Yara is selling low-carbon fertilizers directly into the agricultural supply chains of the world's largest food and beverage companies.

ATOME views the definitive offtake agreement as the last commercial milestone before moving to a final investment decision (FID) later this year. The developer is working to secure and finalise the finance for the $630 million Villeta project, with construction expected to start in the fourth quarter of 2025.

Casale signed a $465 million lump-sum engineering, procurement and construction (EPC) contract for the project in April this year (*Fertilizer International* 526, p8). This followed the announcement of Hy24 as the anchor equity investor in February (*Fertilizer International* 525, p10)

Situated at the heart of Mercosur, the world's largest fertilizer import market, Villeta is a first-of-its-kind project in the region with the Argentinian and Brazilian markets on its doorstep.

ATOME hopes the project will 'disrupt' the world's largest food-exporting region and end its heavy reliance on imported fertilizers. As these are mostly produced by carbon-intensive processes in Russia and China, their substitution with Villeta's low-carbon fertilizers should help advance both food security and climate goals regionally, says ATOME.

"ATOME is pleased to sign this definitive and final offtake agreement with Yara, the global leader in crop nutrition. We know that making the switch to low-carbon fertiliser is one of the most effective ways to reduce food production emissions. The agreement with Yara is an important validation of our commercial model, underpinned by the market case for the world's biggest food and beverage producers to urgently address agricultural emissions in their supply chains," said Terje Bakken, ATOME's Director for Ammonia and Fertiliser Markets.

## AUSTRALIA

### Mining licence for Ammaroo phosphate project

Australia's Northern Territory (NT) Government awarded developer Verdant Minerals a mining licence for its Ammaroo phosphate project in October.

The approval follows the granting of two mineral leases in March and allows the project to proceed to the construction and mining phase, subject to a final investment decision (FID).

"Securing the mining licence puts Verdant Minerals' Ammaroo Project firmly on track to reach Final Investment Decision and commence construction as early as mid-2027," the NT Government said in a statement.

Located 200 kilometres south-east of Tennant Creek, the Ammaroo project is expected to create around 400 jobs during construction and 250 long-term operational roles over its 25-plus year mine life. With phosphate ore reserves of more than one billion tonnes, Ammaroo could generate $15 billion in production revenues over this period, Verdant Minerals estimates.

"Mining approval from the NT Government is a major milestone for Ammaroo and clears the way for Verdant Minerals to advance the process of project financing to enable the construction of the first stage of the project, delivering local jobs, contracting opportunities, and long-term economic benefits across the NT," said Chris Tziolis, Managing Director, Verdant Minerals.

"Ammaroo will help strengthen regional phosphate rock supply at a time of global uncertainty. We're ready to move from planning to execution and create a reliable, NT-made phosphate rock product for regional agriculture.

"With this approval secured, we will now move swiftly to finalise project funding with our lenders and partners, paving the way for FID and a targeted construction start in 2027," he added.

Verdant Minerals has so far invested more than $10 million in project engineering, environmental and civil works. ■


*Ammaroo phosphate deposit, Northern Territory, Australia.*





FERTILIZER INTERNATIONAL
ISSUE 529
NOVEMBER-DECEMBER 2025

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# People


PHOTO: CF INDUSTRIES

*Christopher Bohn will become CF Industries' new CEO and president in January*


PHOTO: ROVENSA NEXT

*Victor Sonzogno is the new head of Brazil for Rovensa Next.*

**Anthony Will** has announced he will to retire as president and CEO of CF Industries on 4th January 2026. Current executive vice president and chief operating officer, **Christopher Bohn**, has been elected as his successor.

Mr Will is staying on in an advisory capacity to CF Industries until 15th March next year and will serve out his remaining term on the board of directors.

"I want to thank Tony for his outstanding leadership, his commitment to CF Industries' employees, shareholders and communities, and his tremendous success guiding the Company through a period of evolution and growth. He has been instrumental in shaping the Company's strategic direction and high-performance culture. We are deeply grateful for his many years of contributions and wish him the best in retirement," said Stephen Hagge, chair, board of directors, CF Industries Holdings, Inc.

"We are pleased to have elected Chris as CF Industries' next president and chief executive officer, which is the result of the Board's thorough and disciplined succession process. The Board believes his proven leadership, deep expertise, and strategic vision will serve CF Industries and our shareholders well in the years ahead," added Mr Hagge.

Mr Will joined CF Industries in 2007 and has served as president and CEO since 2014. During his 12-year tenure leading the company, he has delivered world-class safety and operational excellence, disciplined growth, and been committed to rewarding long-term shareholders.

"It has been my honor and privilege to lead this great Company, and I am tremendously proud of what the CF Industries team has accomplished over that time," said Tony Will. "I am excited to see what the Company achieves in the future with Chris as CEO. I have worked side-by-side with him for 16 years, and believe his strong leadership, knowledge of the Company and our industry, and keen strategic vision will lead CF Industries to continued success."

Mr Bohn is a 16-year veteran with CF Industries with responsibility for many of the company's key functions during that time. In recent years, he was instrumental in the formation of the Blue Point joint venture announced in 2025, the acquisition of the Waggaman, Louisiana, ammonia production plant, and CF's strategic focus on low-carbon ammonia.

In February 2024, Mr Bohn was appointed as the company's executive vice president and chief operating officer, with responsibility for global manufacturing, distribution, sales, supply chain, and clean energy solutions. He was simultaneously elected to the board of directors.

"I am honored to succeed Tony as CF Industries' next president and chief executive officer," said Chris Bohn. "I believe the future of CF Industries is bright and look forward to working with our outstanding Board and management team to build on our success, fulfill our mission to provide clean energy to feed and fuel the world sustainably, and continue to create value for long-term shareholders."

Leading biologicals company Rovensa Next has appointed **Victor Sonzogno** as its new head of Brazil. He will report directly to Riccardo Vanelli, the company's chief commercial officer.

"I am incredibly excited to become a part of Rovensa Next and join the talented Brazilian team," said Sonzogno. "Brazil is in a pivotal moment on biosolutions adoption and quality differentiation among suppliers. I am certain Rovensa Next's comprehensive biosolutions portfolio, technology, and enlarged sales and technical teams in Brazil can deliver exceptional value to Brazilian Agriculture, growers and partners, while fostering innovation and accelerating our growth."

"We are thrilled to welcome Victor Sonzogno to Rovensa Next as our new Head of Brazil," said Riccardo Vanelli, chief commercial officer. "His proven track record of leadership, strategic vision, and deep understanding of the agribusiness landscape, especially in biologicals, will be invaluable as we reinforce our market positioning in this growing region and drive our strategic journey forward."

Prior to joining Rovensa Next, Sonzogno was the head of Syngenta Biologicals in Brazil and LatAm, and was Valagro's Brazil country manager before that. ■

## Calendar 2025/2026

**DECEMBER**

10-12
FAI Annual Seminar 2025, NEW DELHI, India
Contact: Secretary, The Fertiliser Association of India
Tel: +91 (11) 46005204
Email: secy@faidelhi.org

**JANUARY 2025**

26-28
Fertilizer Latino Americano 2026, MIAMI, USA
Contact: Argus Media
Tel: +55 (11) 45603597
Email: conferencesupport@argusmedia.com

**FEBRUARY**

10-12
CRU Nitrogen+Syngas Expoconference 2026, BARCELONA, Spain
Contact: Event Client Services
Tel: +44 (0) 20 7903 2444
Email: conferences@crugroup.com

**APRIL**

7-9 April
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
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ISSUE 529
NOVEMBER-DECEMBER 2025

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# Status of renewable ammonia projects and technology licensors

Globally, operational renewable ammonia projects have exceeded one gigawatt (GW) of installed electrolyser capacity for the first time. **Kevin Rouwenhorst** of the Ammonia Energy Association (AEA) provides an overview of well-advanced projects and the associated technology options for ammonia synthesis.

While a large number of renewable ammonia projects have been announced, one of the concrete steps toward their realisation is the selection of the ammonia technology provider. In this article, we highlight how project momentum is building globally, as shown by the increase in licensor selection for renewable ammonia synthesis.


*Envision green ammonia production plant, Chifeng City, Mongolia. This wind-powered plant has been operating since 2024.*

PHOTO: MARUBENI

## Status of renewable ammonia production

The Ammonia Energy Association (AEA) tracks progress on ammonia decarbonisation globally via its Low-Emission Ammonia Data (LEAD). The database is updated quarterly and includes information about ammonia plants, ammonia-fuelled maritime vessels, and ammonia infrastructure. The underlying source data for LEAD are available to the AEA's membership.

LEAD shows a large number of announced renewable ammonia plants, mainly powered by solar and wind generated electricity. In the third quarter of this year, operational renewable ammonia projects collectively exceeded one gigawatt (GW) of installed electrolyser capacity for the first time – in excess of 85% of this capacity being based on alkaline electrolysis, with the remainder representing proton exchange membrane (PEM) electrolysis.

Combined, these operational plants are capable of producing around 625,000 tonnes per annum (t/a) of renewable ammonia. Newbuild projects in Northern China, like Envision's Chifeng project and SPIC's Da'an project, collectively represent 500,000 t/a of this production capacity. Smaller 5-25 megawatt (MW) capacity revamps at existing gas-based ammonia plants represent 95,000 t/a of this production total.

Projected capacity for low-emission and transitional ammonia plants by project type (newbuild and revamp) and by technology pathway (gas reforming, water electrolysis, other) are shown in Figure 1. This includes completed and well-advanced projects that are either:

- **Operational** – already in production
- '**Firm**' – having reached financial investment decision (FID)
- '**Mature**' – at the front-end engineering design (FEED) stage.

It is expected that individual ammonia plants with electrolyser capacities in the gigawatt range will come online in 2026 and 2027. These notably include the 2.2 GW capacity NEOM project in Saudi Arabia which will have the capability to produce 1.2 million t/a of renewable ammonia.

## Renewable ammonia licensors

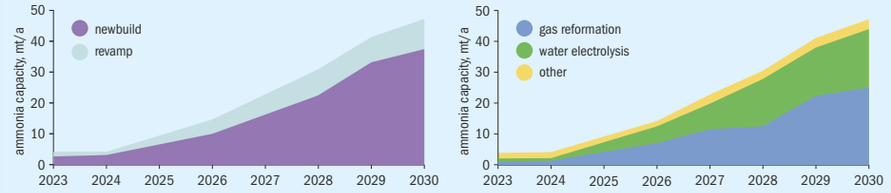
The selection of the licensor is a critical milestone in the development of renewable ammonia projects.

A key requirement for these projects is the flexibility of the ammonia synthesis loop. In particular, the ability of this loop to operate at low loads is desirable, in response to variable solar and wind electricity supply, as well as being necessary to avoid excessive hydrogen storage requirements.

Most licensors for renewable ammonia projects claim the ability to operate at 10% minimum load, although maintaining a minimum load of 20% is generally preferable to minimise both metallurgical fatigue and the power consumption of the ammonia synthesis loop.



Fig. 1: **Low-emission and transitional ammonia plants*: by project type (newbuild and revamp) and by technology pathway (gas reforming, water electrolysis, other)**




*Source: Ammonia Energy Association*

**Data represent projects that are either operational, 'firm' (reached financial investment decision) or 'mature' (at the front-end engineering design stage).*

*JGC's Green Ammonia Plant in Japan use KBR technology.*

PHOTO: KBR

## KBR: licenses for 14 K-GreeN® plants

Science, technology and engineering giant KBR is a major ammonia licensor. Around 50% of global ammonia production capacity, excluding China, uses a KBR license, according to the company.

KBR's K-GreeN® technology offers a fully integrated process for:

- The electrolysis of water to produce hydrogen
- The separation of air to produce nitrogen
- Haber-Bosch synthesis of renewable ammonia
- Plus battery and hydrogen storage capacities.

KBR's ammonia synthesis section can use a vertical or horizontal ammonia converter, depending on project requirements, as KBR has designed both types of converter for many plants currently in operation. The other distinctive feature of KBR's renewable ammonia technology is the unitised chiller. This significantly reduces the equipment count, and therefore capex, as well as providing ease of operation.

K-GreeN can run in a dynamic mode, with the ability to turn down to 10% of nominal capacity, and ramp up and down from 100% of capacity within an hour. K-GreeN includes an Advance Process Control to manage dynamic operation. This overarching proprietary control system looks after the whole plant – including the electrolysers, the air separation unit and hydrogen storage – to maximise and optimise ammonia production, factoring in weather forecasts and grid electricity prices, for example, if applicable.

KBR's licensed technology package includes associated performance guarantees alongside the delivery of proprietary equipment such as the ammonia converter and unitised chiller. In developing its K-GreeN concept, KBR has leveraged its 75-plus years of experience in designing ammonia plants, with these ranging from very small capacity (four tonnes per day (t/d) of ammonia) to the largest single-train capacity (6,000 t/d of ammonia).

K-GreeN can be fully modularised to meet the required capacity by following an engineering, procurement and fabrication (EPF) strategy. Alternatively, KBR can use its engineering services to offer an integrated stick-build construction strategy covering the entirety of a project, from its first stages to engineering, procurement and construction management (EPCm) services.

KBR sold its 14th license for a renewable ammonia synthesis loop to Celsia in Colombia. The list of known KBR licenses includes:

- ACME's Green Hydrogen and Chemicals SPC project, Oman, 300 t/d capacity
- JGC's Green Ammonia Plant, Japan, 4 t/d capacity pilot project
- Enaex's HyEx project, Chile, 57 t/d capacity pilot project (full-scale plant later)
- Atlas Agro's Pacific Green Fertilizer Plant, United States
- The MadoquaPower2X project of Madoqua Ventures, Power2X, and CIP, Portugal, 1,200 t/d capacity
- Avina Clean Hydrogen's Nueces Clean Ammonia project, United States, 2,200 t/d capacity hybrid plant
- The H2biscus project of Lotte Chemical, Samsung Engineering and POSCO, Malaysia, 2,286 t/d capacity





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PHOTO: TOPSOE

*Topsoe is the technology provider to the green ammonia demonstration plant, Ramme, Denmark.*

- Fortescue's Holmaneset project, Norway, 675 t/d capacity
- OCIOR's project in Gopalpur, India, 600 t/d capacity
- Project Celsia, Colombia, 84 t/d capacity.

## Topsoe: licensing DynAMMO™ to NEOM

Topsoe licenses its DynAMMO™ ammonia loop for renewable ammonia production. The company claims a load flexibility of between 10-100% with full ramp up within minutes, as well as fast restarts after stand-by mode or total shutdown. The technology is demonstrated at the 24 t/d capacity REDDAP ammonia demonstration plant in Lemvig, Denmark. Small ammonia plants of up to 600 t/d capacity, known as Topsoe ModuLite Green Ammonia, can be prefabricated rather than stick built on-site.

Topsoe has licensed the world's largest renewable ammonia synthesis loop so far – the 3,500 t/d capacity unit for NEOM's solar and wind project in Saudi Arabia. Other examples of synthesis loops licensed by Topsoe for renewable ammonia projects include the:

- 1,650 t/d capacity unit for Project Nujio'Qonik in Newfoundland, Canada
- 1,800 t/d capacity unit for Mintal Hydrogen Energy Technology in Baotou, China
- 2,500 t/d capacity unit for Allied Green Ammonia in Gove, Northern Territory, Australia
- 750 t/d capacity unit for Hygenco in Gopalpur, Odisha, India.

Additional to its leading capabilities as a catalyst provider and ammonia licensor, Topsoe has also constructed a factory for manufacturing solid oxide electrolysers in Denmark, with 5 GW of capacity already secured by project developer First Ammonia.

## thyssenkrupp Uhde: dynamic Uhde® ammonia synthesis technology

thyssenkrupp Uhde is an ammonia licensor and a full engineering, procurement and construction (EPC) provider to the chemical industry. It licenses its flexible ammonia synthesis loop, dynamic Uhde® ammonia synthesis technology, with capacities available from 50 t/d up to 6,000 t/d.

thyssenkrupp Uhde's RHAMFS® methodology also offers full concept process optimisation, from the renewables stage up to ammonia production. With the company's proprietary Master Controller, it is possible to ramp the ammonia plant up and down between 10-100% load in response to fluctuating renewable energy availability. Overall, thyssenkrupp Uhde's design offers a combination of operational flexibility and energy efficiency.

The world's oldest operational electrolysis-based ammonia plant, the 50 t/d capacity in Cuzco plant operated by Enaex in Peru, is based on thyssenkrupp Uhde technology.

As well as providing licenses, thyssenkrupp Uhde has built four operational electrolysis-based ammonia plants – including KIMA's 400 t/d capacity ammonia plant in Egypt.

As an experienced chemical engineering and EPC provider, thyssenkrupp Uhde has the capability to deliver fully integrated and modularised ammonia plants This combination of technology and deployment expertise allows thyssenkrupp Uhde to significantly de-risk the overall project – via schedule and cost assurances and performance guarantees.

As of 2024, thyssenkrupp Uhde has conducted numerous techno-economic,

IMAGE: THYSSENKRUPP

*Graphic visualisation of a Thyssenkrupp Uhde renewable ammonia plant.*







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pre-FEED and FEED studies for renewable ammonia projects globally, with a production capacity equivalent to 30 million t/d. Examples include studies in Australia, Pakistan, Spain, the United Arab Emirates, and Vietnam. Notable pre-FEED and FEED studies have been performed in:

- Australia for Fortescue, CQH2 and CIP
- Spain for Hive Energy
- South Africa for Prieska Power.

Floating ammonia production concepts have also been developed by Uhde for SwitchH2 and BWO.

Spin off company thyssenkrupp nucera, meanwhile, is a leading OEM for alkaline electrolysers. It will supply the more than 2 GW of electrolyser capacity needed for the NEOM project in Saudi Arabia.

## Casale: Flexigreen® Design for Green Ammonia Plants

Licensor Casale is well known for its proprietary axial-radial vertical converter which lowers the pressure drop and improves the performance of the ammonia synthesis loop. Casale has installed these converters in over 250 plants globally, most recently using the AmoMax®-Casale catalyst jointly developed with Clariant. Casale also provides revamping solutions for horizontal ammonia converters.

Casale's experience with electrolysis technology goes back to the origins of the ammonia industry. More than a dozen of the first grassroot ammonia plants licensed by Casale in the 1920s were based on hydrogen generated by electrolysers.

Casale licenses the Flexigreen® Green Ammonia designs for renewable ammonia plants (*Fertilizer International* 525, p22). To ensure optimal performance, small-scale plants utilise the company's SMART-N synthesis loop, with minimal equipment items and relatively higher pressures, while large-scale plants utilise its FlexAMMONIA synthesis loop.

Casale offers operational flexibility down to 10% of nominal load. This has been industrially tested in a world-scale ammonia plant with 1,500 t/d capacity. Fast load changes in ammonia synthesis capacity – of 3% per minute – are also claimed.

Casale offers an advanced process controller to optimise plant operations under varying power supply conditions. The operation and design of the ammonia synthesis loop avoid fatigue issues for various components by taking account of potential load cycling. Additionally, optimisation tools and dynamic analysis are available to minimise ammonia production costs.


IMAGE: ATOME/CASALE

*ATOME's Villeta project in Paraguay will incorporate Casale's Flexigreen® technology.*

Casale has licensed 12 renewable ammonia plants, as of 2024. Examples of renewable ammonia synthesis loops licensed by Casale include:

- SkiGA's Skipavika project, Norway, 300 t/d capacity, modularised design
- ATOME's Villeta project, Paraguay, 240 t/d capacity
- Incitec Pivot's (now defunct) Gibson Island revamp project Australia, 1,100 t/d capacity
- AM Green's revamp project in Kakinada, India, two plants with a capacity of 1,500 t/d each
- Avaada's project in Gopalpur, Odisha, India, 1,500 t/d capacity
- EverWind Fuels' Point Tupper project in Nova Scotia, Canada, 750 t/d capacity
- ACME's Gopalpur project in Odisha, India, 1,200 t/d capacity
- RTI International and the University of Minnesota's pilot project in Morris, Minnesota, 1 t/d capacity.

Casale has also developed hybridisation projects with MIX-N technology, such as Fertiglobe's 1,350 t/d capacity EFC 2 plant revamp in Egypt. This is partially converting the existing plant to renewable ammonia as part of the Egypt Green project.


IMAGE: STAMICARBON

*Computer generated 3D model of a Stamicarbon Green Ammonia plant.*





## Stamicarbon (NEXTCHEM): NX Stami Ammonia™ for various scales of ammonia production

Stamicarbon, the nitrogen technology licensor of NEXTCHEM, offers two distinct ammonia technologies as part of its NX STAMI™ Ammonia portfolio (*Fertilizer International* 528, p52). The medium-pressure design is available for large-scale plants of up to 3,500 t/d capacity. The alternative high-pressure design is suited to medium-scale renewable ammonia production (50-500 t/d) and is flexible and responsive – being able to operate down to 10% of nominal load and quickly ramp up and down. The relatively high pressure of the ammonia synthesis loop enables capex savings by reducing the number of equipment items. This also means the plant has a relatively small footprint (e.g., 50 x 50 metres for a 500 t/d capacity unit).

Notably, Stamicarbon has secured the technology license for JWC Gburg's wind-powered 450 t/d capacity Meadowlark green ammonia project in Nebraska in the United States. Stamicarbon is also the ammonia technology licensor for FertigHy's low-carbon fertilizer project in Northern France (*Fertilizer International* 528, p49).

The company is also involved in renewable ammonia projects in Angola, Indonesia, Kenya, Qatar and the United States.

## GoodChina: ammonia converters for renewable ammonia production

Nanjing GoodChina Chemical Technologies (GoodChina) is a Chinese ammonia converter manufacturer. While, historically, the company has mainly delivered ammonia and methanol synthesis converters for coal-based processes, it has also successfully delivered equipment for renewable ammonia projects in recent years.

In fact, GoodChina delivered the ammonia converter for ACME's renewable ammonia pilot in India back in 2021, a 5 t/d capacity plant constructed by KAPSOM. It also supplied the reactor for Envision's 20,000 t/a demonstrator in Chifeng, Inner Mongolia, which began operating in March 2024.

Various GoodChina ammonia converters have been ordered for commercial-scale renewable ammonia plants, including:

- Two ammonia converters, each producing 150,000 t/a of ammonia, for Phase 1 of Envision's Chifeng project which began operating in July
- The ammonia converter for SPIC's 180,000 t/a capacity Da'an project in Jilin province which also entered production in July
- The ammonia converter for Phase 1 of China Energy Engineering Group's Green Hydrogen-Ammonia-Methanol Integration Project at Songyuan Hydrogen Energy Industrial Park, which is scheduled to start producing 200,000 t/a of ammonia from late 2025 onwards
- The ammonia converter for Shenzhen Energy's 150,000 t/a capacity project in Otog Banner, Inner Mongolia
- The ammonia converter for Ningxia Baofeng Energy's 80,000 t/a capacity project in Ningdong, Ningxia. ■







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# Smarter fertilizer handling

Fertilizers are tough on equipment – dusty, corrosive, and hard to manage. Siwertell's enclosed systems handle them cleanly and efficiently, with minimal waste or emissions. From ship to storage, the company aims to ensure safe, reliable, high-capacity dry bulk transfers.


PHOTO: BRUKS SIWERTELL

*Siwertell ship unloader, Paradeep, India.*

## A large volume global market

The bulk fertilizer market is largely driven by population growth, with demand strongly tied to the adjacent grain, food and farming sectors. The same is true for fertilizer raw materials, which are subject to the same market forces as the finished product.

Siwertell – which first introduced its screw-type unloaders to the dry bulk handling market more than 40 years ago – is ready to meet this growth with safe, sustainable, high-volume fertilizer handling systems.

The most common dry bulk fertilizers traded and shipped globally include urea, monoammonium and diammonium phosphate (MAP/DAP), muriate of potash (MOP) and NPKs.

These finished fertilizers, together with fertilizer raw materials such as sulphur and phosphate rock, are generally dusty to handle. Many are also hydroscopic with this leading to clumping and crusting in the hold during shipping, if exposed to moisture.

This affects their free-flowing characteristics and, consequently, port fertilizer handling systems need to be able to cope with compaction when discharging bulk fertilizers from the hold, as well as the harsh properties of the various fertilizer product types. Bruks Siwertell screw-type ship unloaders are robust and designed to meet these needs – enabling them to efficiently discharge even the most heavily compacted and corrosive cargoes.

It's a difficut balancing act, as Bertil Andersson, Bruks Siwertell's sales manager, has explained previously (*Fertilizer International* 475, p44):

"Handling dry fertilizers and fertilizer raw materials in bulk poses some challenges. The three key aspects to handling fertilizers successfully are minimising cargo degradation, limiting environmental impacts and maintaining high safety standards.

"However, to provide the greatest commercial benefits, fertilizer handling technology also needs to provide the high capacity and efficient through-ship performance that operators expect. Totally enclosed systems with high performance screw-type unloaders are leading the way, as they have the advantage of being able to satisfy all these demands.

"Many operators and sectors have adopted and embraced this new technology!"

## Sustainable handling in changing times

Strict environmental regulations governing bulk fertilizers are generally in force at ports and terminals.

In response to these requirements, Siwertell's fertilizer handling systems offer totally enclosed conveying lines from the ship to the shore – ensuring that material spills are eliminated and dust creation and emissions are kept to an absolute minimum.

The company's range of ship unloaders, loaders, conveyors, and storage and reclaiming systems are making significant inroads into the worldwide trade in bulk fertilizers, an industry that has traditionally relied on grab cranes and bucket systems at its discharge ports.

Behind the switch by industry operators is the desire for increased efficiency, improved safety standards and a much cleaner operating environment. Indeed, the adoption of Siwertell equipment is often driven by increasingly stringent environmental protection regulations and the corresponding need to ensure sustainable fertilizer handling.

## A vital bulk commodity with handling issues

Agriculture relies on bulk fertilizers, which are primarily made from nitrogen, phosphorus and potassium compounds along with sulphur. Dry bulk fertilizer handling systems need to have wide-ranging capabilities as they:

- Must minimise cargo degradation and environmental impacts
- Yet keep the risk of fire and explosion as low as possible
- While dealing with these hazards in a way that presents no risk to personnel, ships and terminal infrastructure.

The dusty nature of bulk fertilizers and fertilizer raw materials can create serious localised environmental problems when discharged using grab cranes or bucket systems. Siwertell, in contrast, offers extremely clean bulk fertilizer ship unloading, loading and conveying systems designed to eliminate spillage and keep dust emissions to an absolute minimum.

## Helping india expand fertilizer raw material imports

PHOTO: BRUKS SIWERTELL

*Rail-mounted Siwertell ship unloader, Paradeep, India.*

### Doubling capacity for Paradeep Phosphates Limited

PPL's new rail-mounted ST 640-D unit installed in 2021 has the capacity to discharge sulphur from vessels of up to 60,000 dwt in size at a rated capacity of 1,500 t/h. Alternately, it handles sulphur and phosphate rock cargoes at a rate of 1,200 t/h and muriate of potash (MOP) at 1,050 t/h. It has a similar set up as the existing unit, but also features updated, modern components and Industrial Internet of Things (IIoT) capabilities.

Both units, like all Siwertell ship unloaders that handle sulphur, are fitted with the Siwertell Sulphur Safety System (4S), which was first developed more than 30 years ago to minimise the risk of explosions when handling this extremely volatile and corrosive dry bulk material in a contained environment. Siwertell technology is the only ship unloading system able to offer safe and totally enclosed sulphur handling.

PPL's new unloader works on the same jetty as Siwertell's previous delivery and doubles its material handling capacity, delivering a very efficient terminal with outstanding environmental credentials. The high efficiency of both Siwertell machines means that vessel unloading times are kept to an absolute minimum, reducing demurrage while maximising the utilisation rate of the jetty.

### Long-serving machines for IFFCO

Since 2011, Paradeep Port has also been served by a high-capacity, rail-mounted Siwertell ST 790-D unloader delivered to the Indian Farmers Fertiliser Cooperative Limited (IFFCO). IFFCO is another leading player in India's fertilizer industry and runs one of the world's largest DAP plants with a production capacity of around two million tonnes annually.

The plant needs raw materials, particularly phosphate rock and sulphur. This is where the Siwertell ship unloader delivers. This unit can unload sulphur from vessels up to 75,000 dwt at 1,800 t/h. Dust emissions have been prevented by replacing the previous grab crane a fully enclosed conveying system, further improving the environmental conditions at the port. ■

The company, thanks to its long track record and knowledge of bulk handling, combined with some unique capabilities, has become a leading global supplier of safe, totally enclosed unloading systems for fertilizers and associated raw materials.

In sulphur unloading and transfers, for example, the proprietary Siwertell Sulphur Safety System (4S) detects and extinguishes fires early – safely containing them by shutting down the system to stop their spread. Fire detectors are installed along the length of the conveying line. These automatically trigger the fire-extinguishing system and stop the conveyors to prevent any fire from spreading to

PHOTO: BRUKS SIWERTELL

*Sulphur unloading.*



FERTILIZER INTERNATIONAL
ISSUE 529
NOVEMBER-DECEMBER 2025

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storage areas. Furthermore, the system's extra-thick steel casings can withstand an explosion, while venting valves relieve the resulting pressure. The incorporation of robust stainless-steel components also minimises corrosion.

## Serving India's fast-growing dry bulk markets

In many countries, the environmental performance of Bruks Siwertell's systems has delivered its industry customers an operational lifeline when handling bulk fertilizers. The company is involved in almost all of India's dry bulk markets, for example, with particular prominence in the bulk fertilizer industry (*Fertilizer International* 475, p44).

Major equipment deliveries to the fertilizer sector include four Siwertell ship unloaders for handling phosphate rock and sulphur imports, important ingredients in domestic fertilizer manufacture.

Working hard to secure these imports, for example, is Paradeep Phosphates Limited (PPL), a leading fertilizer industry company operating in the state of Odisha, India. Bhubaneswar-headquartered PPL is a major phosphate fertilizer manufacturer, being one of Asia's largest producers of diammonium phosphate (DAP).

Since 2006, a rail-mounted Siwertell 640 D-type ship unloader has been serving the company. This machine has been a critical part of the port's environmental transformation, supporting a switch from open-air handling of sulphur with a bucket-type unloader to safe, fully enclosed, dust-free operations.

The installation has now been in operation for more than 15 years and has been successful at speeding up vessel turnarounds for PPL, and thereby reducing freight costs and demurrage, achieving a return on investment in a short space of time.

Building on this success, in 2021, Bruks Siwertell won a contract to deliver a second Siwertell 640 D-type ship unloader to PPL, enabling the company to keep pace with its expansion plans and increased volume demand (see box).

## Efficient, safe unloading in the Arctic Circle

For more than 30 years, Yara's Glomfjord fertilizer plant within the Arctic Circle has employed a well-maintained, high-performance Siwertell ship unloader. When greater capacity was required in 2018, the company looked to Bruks Siwertell to meet its needs (*Fertilizer International* 504, p38).

### The challenge

Glomfjord is the world's most northerly fertilizer plant. Served by its own harbour, operator Yara needed to increase capacity and was looking to retire its long-serving Siwertell unit, delivered in the early 1980s.

The new unloader had to be able to handle demanding dry bulk materials such as phosphate rock and potash. It also needed to meet strict environmental criteria, manage high prevailing winds and operate successfully in the extremely low temperatures of the Arctic Circle.

Compounding the challenge was limited jetty space. Any new machine would have to fit into the existing footprint of the older model, while providing higher capacity. It would also have to be lifted into place using a heavy-lift vessel.

### The solution

To ensure that any new unloader would fit the site and meet the installation requirements over the whole travelling length, Bruks Siwertell conducted a 3D scan of the Glomfjord jetty. After confirming that it would be suitable, Yara ordered a rail-mounted Siwertell ST 490-M ship unloader.

To ensure that Yara's production schedules were not interrupted, the unloader needed to be installed, tested, commissioned and fully operational within a pre-planned maintenance stop of just one week.

Able to serve vessels of up to 20,000 dwt, the new unloader is equipped with a dust-suppression system and an advanced electrical control unit, including the Siwertell monitoring system, known as SiMon. With a PC-based interface, this offers quick troubleshooting, easy unloader start-up, an analysis tool for problem-solving, a preventive maintenance guide and remote access by Siwertell engineers.


PHOTO: BRUKS SIWERTELL

*Ship unloader at Yara's Glomfjord jetty, Norway.*

### The results

Just 18 months from the order being placed, Yara was very satisfied to have the new machine up and running and meeting the required stringent environmental standards – all without a single day of delay.

The new unloader maintains a continuous rated discharge of 600t/h, with a peak capacity of 700t/h, depending on the material being handled. Yara plans to upgrade its belt conveyor system to match the capabilities of its new unloader.

The delivery continues a long-standing partnership with the company and includes follow-up service visits and a comprehensive set of spare parts. With capacity to spare, Yara expects to get another three decades of service from its new Siwertell system. ■

## Long term partnership with Yara

Norway's leading mineral fertilizer producer, Yara International, operates the Glomfjord fertilizer plant within the Arctic Circle. When greater capacity was required, the company ordered a new replacement ship unloader from Bruks Siwertell, its original supplier. The new machine needed to handle demanding fertilizer raw materials, meet strict environmental criteria, manage high prevailing winds, and operate successfully at extremely low temperatures.

Yara now operates a rail-mounted Siwertell ST 490-M ship unloader at Glomfjord. The unloader is equipped with a dust-suppression system and an advanced electrical control unit, including Siwertell's SiMon monitoring system (see box on previous page).

## Efficiency and reliability for all fertilizer applications

Bruks Siwertell's tailor-made ship unloaders, ship loaders and conveying systems provide the perfect bulk handling arrangements for all sizes of fertilizer operations. Reliability, efficiency and excellent through-ship performance deliver significant commercial benefits.

The company's machines offer an integrated, uncompromising and economic option for fertilizer handling, according to sales director and industry veteran Bertil Andersson (*Fertilizer International* 475, p44):

"With the exception of the standardised conveyor system, Siwertell unloaders are typically tailor-made to suit the individual requirements of operators. Our unloaders have a small physical footprint and are lightweight when considered alongside other technologies with comparable through-ship rates.

"This lowers the investment needed in jetty construction, adding to their overall competitiveness. With effective maintenance, timely replacement of worn parts and periodic upgrades, our systems can be expected to give excellent performance over many decades.

"In addition to delivering stand-alone systems, Bruks Siwertell can provide fully-compatible downstream and upstream conveying solutions, ideally matched to the unloader or loader.

"We also offer design, construction and installation services. This is valuable for customers planning complex import/export terminals with high capacity loaders, unloaders, conveying systems and flexible storage arrangements.

"Our market-leading totally enclosed unloading and conveying systems minimise dust emissions and eliminate spillage. This means there is no wastage and the operator receives all of the shipped cargo.

"Finally, clean-up costs are also minimal or non-existent as the ship, terminal and surrounding areas remain unpolluted. The working conditions for crew and port personnel are greatly improved too." ■





Fertilizer International 529 | November-December 2025 www.fertilizerinternational.com



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# Ukraine's fertilizer market abides

Having endured more than 40 months of conflict and crisis, Ukraine's resilient fertilizer market has undergone an import-led revival following a calamitous collapse in consumption in 2022.

*Wheat field, Ukraine. The country was the world's fifth largest wheat producer prior to 2022.*

PHOTO: OLEKSANDR K/FLICKR

With the conflict with Russia now well into its fourth year, Ukraine's fertilizer market is still beset with war-related disruptions. Imports into the country have surged, as domestic production capacity, constrained by power outages and war damage, has been unable to match rising demand.

Nonetheless, given the daunting daily challenges faced by Ukrainians and the war footing of its economy, it is the resilience of Ukrainian agriculture – and its persistence and ingenuity in successfully securing fertilizer supplies – that is perhaps most surprising. Ukraine's fertilizer market continues to recover, showing resilience and adaptability under the most difficult conditions.

At the start of the conflict in 2022, fertilizer consumption in Ukraine fell dramatically. While some farmers had access to stocks accumulated during previous years, others were forced to stop using fertilizers completely for logistical and/or cost reasons. Since then, Ukrainian fertilizer supply has been radically reconfigured, as market participants have found new and creative ways of satisfying domestic fertilizer demand.

## A vast and fertile steppe

Agriculture is a key pillar of Ukraine's economy, being the third largest sector after services and industry. Prior to 2022, the sector generated more than 10 percent of GDP and employed 2.5 million people, some 14% of the country's workforce.

Ukraine is the second-largest country in Europe after Russia. Before the current conflict, 41 million hectares (Mha) of land were devoted to agriculture, almost 70% of the country's total area, with arable land contributing 33 million Mha to this total.

The country has long been called the breadbasket of Europe, thanks to its famously fertile black soil (chernozem) and vast tracts of arable land. Three export oriented crops – wheat, maize and sunflower – dominate the country's agricultural output. Collectively, agricultural goods accounted for more than 40 percent of Ukrainian exports in 2021 with these generating $27 billion in foreign revenues.

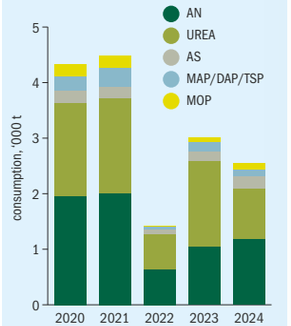
Ukrainian control of arable land slipped to an estimated 27 Mha in 2024, down from 33 Mha previously, as a direct result of Russian incursions to the east. The country's agricultural system also sustained $80 billion in war damages and losses, as of December 2023, according to a Kyiv School of Economics review. This total splits into revenue and asset losses of $70 billion and $10 billion, respectively.

The shock to agriculture and the economic hit to farmers from the first year of fighting was dramatic. This period saw a 30% contraction in Ukrainian grain and oilseed production, together with a dramatic 45% fall in farm gate prices for maize and wheat.

## Import-led demand recovery

Having endured 10 months of conflict and crisis, Ukraine's apparent fertilizer consumption plummeted by close to 70% year-on-year (y-o-y) in 2022 – down from 4.58 million tonnes in 2021 to 1.45 million tonnes – before partly recovering to 3.08 million tonnes in 2023 and then slipping back to 2.58 million tonnes last year. These figures are estimates, however, and may not represent the full picture, being based on a basket of seven products (Figure 1).

Fig. 1: **Ukraine's apparent fertilizer consumption*, 2020-2024**




*Source: IFA*

**Estimate based on a basket on seven products*





Ukraine's fertilizer supply is heavily import dependent, with urea, ammonium nitrate (AN) and NP/NPKs among the main product preferences. Conflict-related disruption to domestic production plants has deepened import reliance, especially from suppliers in Lithuania, Turkey and Poland.

Since 2021, new but higher cost land routes have partly replaced shipping for import supply, as Oliver Watkins of Waypoint Commodities has noted:

"The ongoing conflict has severely impacted Ukraine's logistics network, which is essential for both importing fertilisers and distributing them domestically. Major shipping routes through the Black Sea have been disrupted, making it difficult for Ukraine to access global markets and receive fertiliser supplies efficiently. Railway infrastructure, which has historically been a vital means of transporting agricultural inputs like fertilisers, has too faced intermittent blockages, further complicating the distribution network.

"Despite these issues, [Ukraine] … has made considerable efforts to adapt. Alternative routes via land through Poland and other neighbouring countries are being utilised, though at a higher cost."

Ukrainian fertilizer importer GOL highlighted the following 2024 fertilizer imports trends in an end-of-year review:

- Imports last year rose by 14.5% y-o-y with notable increases for both nitrogen fertilizers (to 1,256,700 tonnes) and NPKs.
- Ammonium sulphate (AS) imports also reached a record 435,500 tonnes in 2024, with 182,600 tonnes arriving in the last two months of the year. More than 302,000 tonnes were imported from China, supplemented by European supply from Poland, Latvia, Belgium and Serbia. Domestic AS production, meanwhile, totalled 90,000 tonnes.

This import-led recovery in fertilizer use is set to continue in 2025. In September, agri-food data company Tridge reported that Ukrainian farmers increased their fertilizer consumption by more than 20% in the year-to date – with this figure reflecting a surge in imports.

The country consumed 3.42 million tonnes of fertilizer in total during the first eight months of 2025, it said, quoting figures sourced from Infoindustry, the Ukrainian information agency.

Table 1: **Ukrainian January-August fertilizer imports, 2025 vs 2024**

| Product | 2025 ('000 t) | 2024 ('000 t) | Change (%) |
|---|---|---|---|
| **N** | 1,149 | 865 | 32.8 |
| **NPK** | 529 | 468 | 13.2 |
| **NP** | 346 | 318 | 8.9 |
| **K** | 132 | 109 | 20.7 |
| **P** | 63 | 54 | 15.7 |
| **S** | 31 | 34 | - 8.6 |
| **PK** | 22 | 16.6 | 32.4 |
| **Total** | 1,971 | 1,596 | 23.5 |

*Source: Infoindustry*

Ukraine's fertilizer imports reportedly reached almost two million tonnes during January-August 2025 (1,971,000 tonnes) – an increase of around 24% y-o-y – with nitrogen fertilizers predominating and accounting for 1.149 million tonnes (58%) of total imports over this period (Table 1).

Domestic fertilizer production in Ukraine, meanwhile, was 1.450 million tonnes in the first eight months of 2025, according to Infoindustry data.

## Domestic production decline

Although Ukraine operates significant nitrogen fertilizer production capacity, domestic output fell last year.

Major Ukrainian producer OSTCHEM, part of Group DF, produced 1.8 million tonnes of fertilizers from its two operative sites in 2024 – a 13% fall on the 2.1 million tonnes produced in 2023. Its Cherkasy Azot complex maintained its production level at 1.4 million tonnes, while the Rivneazot site saw its output volume decline by 22% y-o-y to 407,000 tonnes, versus the 528,000 tonnes produced the previous year.

On a product basis, OSTCHEM manufactured the following in 2024:

- Ammonium nitrate (AN) – 760,200 tonnes
- Urea ammonium nitrate (UAN) – 506,700 tonnes
- Urea – 401,900 tonnes
- Ammonia – 75,000 tonnes.

The company attributed last year's production decline to low grain prices on global markets, power outages, the ongoing war, and the import of cheap, low-quality fertilizers.

Ukrainian farmers are going through difficult times due to falling profitability, said Sergiy Pavlyuchuk, OSTCHEM's nitrogen production director, at the start of this year, "This is reflected in domestic demand for mineral fertilizers – sometimes priority was given to cheaper, low-quality fertilizers imported in large quantities in 2024," Pavlyuchuk said. "We take a long-term approach, and even in hard times, we have ensured the high international quality of our products and 100% fulfilment of obligations. Even during periods of forced shutdowns at Rivneazot due to power outages, these business values remained unchanged."

OSTCHEM's average capacity utilisation rate remained below 70% last year, with the company again citing the market entry of "uncontrolled imports" as being to blame.

More positively, the company launched a new UAN production line at Rivneazot in 2024. An investment project for the launch of urea production in 2025-2026 is also planned, Pavlyuchuk added.

"The key task for the year ahead [2025] is to ensure sustainable production despite unstable energy supply, reduce production risks, and displace imports through better quality," Pavlyuchuk said in January, adding: "Our long-term strategic priority remains unchanged: import substitution and increasing market share. We will continue to invest in the production of the most in-demand fertilizers and expand our product line."

In March, Ukraine's cabinet approved the sale of the government's stake (>99%) in the NP/NPK producer PJSC Sumykhimprom. The plan is to auction this stake at a starting price of UAH 1.158 billion ($27.4 million).

Sumykhimprom, which is located in the war-torn Sumy region of north eastern Ukraine, has previously manufactured ammonium sulphate, ammoniated superphosphate, Superagro NP (10:40/12:24) and a wide range of Superagro NPK formulations.

The company announced the resumption of fertilizer production in April of last year. Although the latest output figures and the plant's current status are unavailable, Sumykhimprom is reported to have manufactured around 120,000 tonnes of fertilizers annually prior to 2022.

## Logistical rerouting

The EU, together with Ukraine and Moldova launched the EU-Ukraine Solidarity Lanes in May 2022, establishing new transport routes to keep Ukraine's imports and





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ISSUE 529
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PHOTO: OSTCHEM

*Major Ukrainian producer OSTCHEM produced 1.8 million tonnes of nitrogen fertilizers from its two domestic production sites in 2024.*

exports flowing via rail, road and inland waterways. These have acted as a lifeline to the country's economy and in January this year transported:

- Around 80% of Ukrainian imports (in comparison to around 20% through the Black Sea)
- Around 40% of Ukrainian exports of non-agricultural products (in comparison to around 60% through the Black Sea)
- Around 40% of Ukrainian exports of grain, oilseeds and related products (in comparison to around 60% through the Black Sea).

In total, around 180 million tonnes of Ukrainian grain, oilseeds and related products have been exported through the Solidarity Lanes (50%) and Black Sea ports (50%) during the period May 2022 to January 2025.

The new trading corridors have also played a crucial role in Ukrainian import supply. Over the same period, they have supplied around 70 million tonnes of goods, including fertilizers, as well as military and humanitarian assistance.

During the early stages of the conflict, with Black Sea ports blockaded, the Solidarity Lanes were Ukraine's only export option for its agricultural produce. Grain shipments from Ukraine's Black Sea ports did, however, restart in August 2022 under the UN-brokered Black Sea Grain Initiative (BSGI). This allowed the export of nearly 33 million tonnes of grains during its year-long existence.

Subsequently, following Russia's ending of its participation in the BSGI in July 2023, Ukraine launched a new Black Sea corridor for trade vessels heading to and from Ukrainian ports. The role of this 'Ukrainian corridor' has increased over time – helped by new insurance schemes for shipping – with monthly grain and oilseed exports of around three million tonnes in January 2025, for example.

## Naval ban on ammonium nitrate

Ukraine did, however, face a fresh fertilizer supply headache in July, after the country's navy imposed a ban on the import of ammonium nitrate via seaports due to safety fears. The resulting supply chain disruption could add 20% to fertilizer prices, according to Volodymyr Huz, commercial director of Ukrainian logistics company GOL.

"Now, when preparations for nitrate shipments should be underway ahead of the autumn season, alternative routes must be explored – including the Romanian ports of Galati and Braila. From there, cargoes can be transshipped and transported to Ukraine via broad-gauge wagons.

"However, this is an expensive option for Ukrainian importers, since nitrate is a basic fertilizer with minimal margins. As a result, any additional logistics cost significantly affects demand – this will lead to higher prices for all fertilizers, as nitrate is a fundamental component in their production," Huz said in July.

In August, Ukraine's biggest farming union UAC called on the government to lift the new maritime import ban, warning that grains crop yields could suffer due to supply shortages.

"The key factor here is the ban on imports into Ukraine via seaports not only of grade A ammonium nitrate, which is indeed an explosive substance, but also of other nitrogen fertilisers that are completely non-explosive," the UAC said in a statement.

The farming union said that Ukraine was potentially facing a 30% reduction in the yield of key crops unless the problem was urgently resolved.

Similarly, the Association of International Freight Forwarders of Ukraine (AIFFU) has also called on the government and military to either lift or amend the import ban. It suggested using terminals at Reni, a port on the Danube, for "ammonia-based fertilizer" imports – with safety stipulations such as daytime unloading, direct transshipment without storage, and prompt vessel departure.

## Sufficient fertilizers for 2025 planting?

Ukraine's total agricultural crop area will exceed 23 million hectares (Mha) in 2025, according to the start-of-year forecast by the country's Agrarian Policy and Food Ministry. Ukraine also had sufficient fertilizers and fuel for the 2025 sowing campaign, the ministry said in January.

According to data released by the Ministry of Economy in late October, 31.5 million tonnes of grains have been harvested by Ukraine this year from 7.2 Mha, around 65% of the growing area sown with these crops. The wheat, barley, peas, and rapeseed harvests have all been completed.

The breakdown is as follows:

- Wheat – 22.5 million tonnes harvested from an area of 5.0 Mha hectares
- Barley – 5.3 million tonnes harvested from an area of 1.3 Mha
- Corn – 2.1 million tonnes harvested from an area of 0.4 Mha
- Peas – 0.6 million tonnes harvested from an area of 0.3 Mha
- Other grains and legumes – 0.9 million tonnes harvested from an area of 0.3 Mha.

Reports suggest that weather has caused more damage to Ukraine's harvest this year than the war, especially in the south-east of the country. ■







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# Artificial intelligence – the new normal?

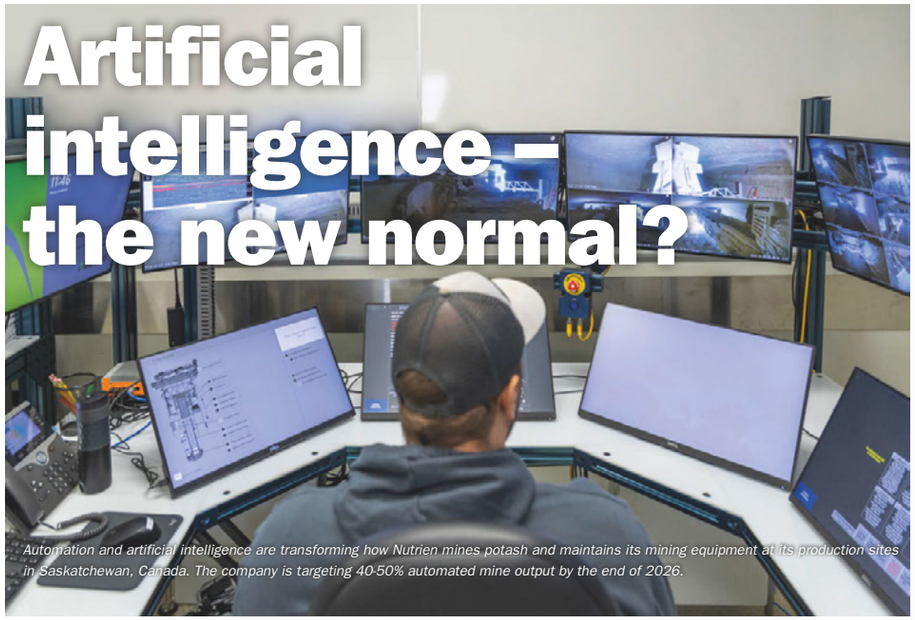

PHOTO: NUTRIEN

*Automation and artificial intelligence are transforming how Nutrien mines potash and maintains its mining equipment at its production sites in Saskatchewan, Canada. The company is targeting 40-50% automated mine output by the end of 2026.*

Businesses are capturing the transformative potential of artificial intelligence (AI) to deliver a step change in productivity. But does AI really herald a revolution in fertilizer production and, if so, what are the practical examples of this?

## Protecting food security and the environment

Artificial intelligence (AI) has come a long way in a short time since the launch of ChatGPT in 2022. The AI chatbot is now firmly fixed in the public consciousness, with over 700 million active weekly users currently.

In terms of industry awareness, AI was placed front and centre at the International Fertilizer Association's 2024 Annual Conference in Singapore (*Fertilizer International* 521, p34). In the event's opening keynote, Caroline Yap, Google's former global managing director for its AI business, explored the technology's potential to transform the fertilizer business – and help agricultural input providers with their key priorities such as protecting food security and the environment.

"AI is the new normal," Yap said, adding: "Imagine farmers using this technology to look at and identify what is wrong with their crops and their soils."

In her view, AI can provide the insights into crop health, crop productivity and water consumption needed as the world shifts to a higher yielding and lower impact food system: a system that is currently under strain due to climate change.

Yap illustrated the benefits of AI via several case studies. These included its use in identifying climate resistant varieties of rice and an AI app used by village farmers in Kenya to diagnose diseases in cassava, maize, potato and wheat.

Overall, AI can maximise the use of geospatial data and combine this with cloud services and data science to deploy agricultural solutions at scale, Yapp concluded.

## Impending production revolution?

The presentations programme at IFA's 2024 conference closed as it began, by returning to the theme of artificial intelligence.

"We're all at the forefront of a global revolution," ICL's head of artificial intelligence **Lior Frimet** said. "AI is everywhere. It's also becoming a key function in ICL and our industry. We use AI to extract real value in our businesses. It increases product production efficiency and yield and reduces our inputs," he said.

"We now have AI models autonomously operating in some areas of our production plants. This is the first big step in this revolution," Frimet added.

AI is now being used to make real time decisions at ICL's production plants, with humans transitioning to supervisory roles.





PHOTO: IFA

*Caroline Yap, Google's former global managing director for its AI business (centre), placed artificial intelligence centre stage during a discussion with fertilizer industry CEOs at IFA's Annual Conference in Singapore last year. She described AI as the "new normal".*

**Majda Moumni**, the director general of OCP Solutions, stressed that AI is just the latest tool for continual improvement – part of the global digital transformation that manufacturing companies have been undergoing for the last 20 years.

"We need to see it as something that will boost the tools and data that are already available. It will also help build more integrated value chains and enhance mining and industry 5.0 initiatives," she said.

In mining and production, OCP is using AI for blasting optimisation, energy efficiency, operational performance, predictive maintenance and safety improvements. For small holder farmers, AI can also democratise access to and the use of data.

In Morocco, for example, OCP has developed a generative AI app that can provide local farmers with access to information in their native language and dialect.

IFA is clearly taking the artificial intelligence revolution seriously, making it a key theme of both its 2024 and 2025 annual conferences. The Association also launched an AI working group last year with the participation of 30 member companies initially.

Several case studies are provided below as an illustration of how the fertilizer industry is incorporating AI into its production processes.

## Transforming predictive maintenance

AI is revolutionising predictive maintenance, according to OCP Maintenance Solutions, by using advanced data analytics and machine learning algorithms to foresee equipment malfunctions before they occur. AI systems can:

- Identify impending failures through real-time data acquisition and sophisticated analysis
- Reduce unexpected downtime and extend machine lifespan by continuously monitoring equipment performance
- Optimise operational schedules and reduce maintenance costs
- Allow for the timely scheduling of repairs and parts replacement.

The company has developed I-Predict®, an advanced AI model for predictive maintenance of critical equipment items. The model can foresee potential failures to ensure uninterrupted industrial operations. Its capabilities include:

- **Detecting anomalies** in vibration, temperature and oil data
- **Anticipating equipment failures** using advanced time to failure (TTF) models
- **Optimising maintenance schedules** through a machine health index (MHI)
- **Automating fault classification** for bearings, cavitation, misalignment, etc
- **Identifying early warning signals** to reduce downtime and cut maintenance costs
- **Transforming raw sensor data** into actionable recommendations with AI decision support.

By detecting anomalies, identifying sensor defects and filtering out bad data, I-Predict® is able to guarantee high quality data for predictive maintenance and accurate diagnostics.

"Our AI doesn't just monitor. It detects [equipment] faults like bearing wear, misalignment, cavitation, oil turbulence, and electrical issues before they escalate," says OCP Maintenance Solutions. "By identifying these problems early, I-Predict® helps prevent costly downtime, optimises maintenance, and keeps operations running at peak performance."





FERTILIZER INTERNATIONAL

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By incorporating AI, the technology offers the following specific benefits, in comparison to standard approaches to equipment maintenance:

**Automated fault detection**. With advanced algorithms and AI models, I-Predict® automatically identifies and diagnoses errors without the need for manual intervention. To hunt the root cause, data gathered from global vibrator monitoring is used to diagnose and measure the severity of underlying critical issues – such as misalignment, bearing wear and gear defects.

**Early fault detection (EFD)**. This enables the identification of probable equipment failures through the analysis of the main warning signals – such as unusual vibration, out of the ordinary temperatures and wear patterns – for quick maintenance and rapid intervention to reduce the risk of costly downtime.

**Machine health index (MHI)**. The MHI takes complex data from sensors and turns it into a simple, intuitive score ranging from 0-100, making it easy to track the condition of equipment at a glance. Powered by AI, it constantly monitors vibration patterns and key performance indicators, helping to catch early signs of wear and mechanical stress. MHI captures both real-time monitoring and historical data trends to provide a reliable assessment of an asset's condition.

**Time to failure (TTF)**. Knowing when a component is likely to fail is just as important as knowing its current condition. TTF uses AI to predict the time of the next potential failure under real operating conditions, an insight that allows operators to plan ahead with accuracy. Instead of scrambling to deal with unexpected breakdowns, operators can proactively schedule maintenance at a suitable time.

**Action advisor**. This 'smart' tool offers real-time recommendations on maintenance tasks. Based on predictive analytics, it provides straightforward advice on when to replace components or make operational tweaks.

Deploying AI in predictive maintenance does, however, requires a clear strategy, says OCP Maintenance Solutions:

"Companies need to integrate predictive models with their computerised maintenance management system (CMMS), ensure high-quality sensor data, and train maintenance teams to adopt new workflows. By combining condition-based maintenance with our advanced AI model, organisations can align operations, improve reliability, and maximise return on investment," it advises.


*American energy technology giant Baker Hughes is using AI to help producers unlock plant performance, improve energy efficiency and boost margins.*

PHOTO: BAKER HUGHES

## New era for fertilizer production?

**Baker Hughes** is using AI and machine learning (ML) to help producers unlock plant performance, improve energy efficiency, and boost margins. The company's AI solution – Cordant™ Process Optimization – is aiming to allow energy and chemical producers to thrive in a tightening market.

As the fertilizer industry embraces digital technologies, AI-driven real-time optimisation (RTO) is emerging as a key approach to generating the best value from existing assets, suggests Baker Hughes[1].

Digital adaptation has been underway for decades with tools such as advanced process control (APC), and model predictive control (MPC) now widely used. Yet, says Baker Hughes, these often fall short when it comes to delivering plant-wide optimisation.

This is where AI-driven optimisation could change the game, in its view. Ammonia plants, for example, can close the gap between current performance and true potential by continuously analysing live data and adjusting key process levers – such as reformer outlet temperature, steam-to-carbon ratio and compressor suction pressure. The end result is increased throughput, reduced energy consumption, and improved operating margins.

In a recent case study, AI-powered Cordant™ Process Optimization was implemented by a major ammonia producer in the Middle East to address production losses caused by dynamic operating conditions. The outcome was a 1.2–1.8% increase in daily production – this being achieved over and above what APC systems had already delivered.

These kinds of improvement translate into significant value, says Baker Hughes, especially in high-cost or resource-intensive operating environments.

"Calling it a new era for fertilizer production might be a stretch, but the challenges facing the fertilizer industry aren't going away. But with the right tools, producers can turn complexity into opportunity. By embracing AI-powered process optimization, they can unlock hidden value in their existing assets – without the need for costly upgrades or overhauls. This isn't just about automation. It's about building a smarter, more resilient, and more sustainable future for fertilizer production," says Jesper Poulsen, Senior Sales Manager, Cordant Solutions – Process Optimization.

AI-powered process modelling is fundamental to how Cordant™ Process Optimization works.

Unlike traditional models, which often oversimplify complex plant behaviour, this system uses customised non-linear models based on pre-designed templates tailored for industrial processes. This means they can capture the true dynamics of a plant – in terms of how variables interact, how conditions shift, and how performance changes over time.






PHOTO: NUTRIEN

*"[The AI app] BeltVision is working and worth it", says Dylan Stewart, a reliability specialist at Nutrien's Rocanville potash mine, Saskatchewan, Canada.*

Development, training and deployment is remarkably fast too. While traditional model implementation can take a year or more, Baker Hughes' AI enabled Cordant™ system can be up and running in just 3–4 months.

Working independently of the existing APC system, AI can also unlock additional efficiency gains without disrupting current operations. This was the case for the Middle Eastern ammonia producer mentioned above, who achieved results above and beyond what APC alone could offer.

So, what does AI mean for plant operators?

"It means they're no longer just reacting to or chasing setpoints. They're making informed decisions, guided by predictive insights and real-time simulations. They can run 'what-if' scenarios, visualize performance gaps, and steer the plant toward optimal conditions – all through an intuitive interface designed for real-world use," concludes Baker Hughes.

"In short, AI-driven real-time optimization doesn't just improve numbers – it elevates the role of the operator, turning them into strategic decision-makers at the heart of a smarter, more resilient plant," the company adds.

## Deploying AI at potash mines

**Nutrien** is putting AI into practice at its potash mining operations in Saskatchewan, Canada, deploying the technology for the predictive maintenance of ore handling equipment such as conveyors[2].

BeltVision was first introduced at Nutrien's Rocanville site in 2020, after the company identified the mainline conveyor belts as a significant bottleneck and source of downtime. These belts, which stretch over many kilometres, transport the ore from boring machines to the hoists that bring it to the surface – essentially operating as the mine's arteries.

Splice failures, however, are a major recurring maintenance issue with these belts. Mechanical splices, a series of zipper-like clips, are used connect two pieces of belt together – and, unfortunately, sometimes they fail.

BeltVision uses AI to recognise and analyse belt splices and damage.

"We can see detailed images of splice clips while the belt conveys ore. We also have employees doing a physical visual inspection of the belt and documenting how many damaged splices they observed. We use BeltVision to help determine when we should schedule a repair," says Dylan Stewart, a reliability specialist at Rocanville, speaking last year.

"The cameras operate in hot, dusty environments. They see a lot of vibration. We must stay on top of keeping the camera lens' clean, and ensuring the proper hardware is installed to keep the camera protected," Stewart added.

Prior to BeltVision being installed, production at Rocanville was regularly halted due to scheduled shutdowns. Expensive manual splice inspections needed to be carried out, resulting in downtime.

In an early shift in May last year, Stewart experienced firsthand why BeltVision is being talked of as a game changer for the mining industry. While using the AI app that morning, he noticed that a conveyor belt splice had incurred significant damage.

"Under normal conditions, if a splice was noticed in the middle of the night, a decision would be made on whether it is going to last until the belt crew arrives. A reliability team member happened to be viewing the active belts that the miners were dumping ore onto that night and, as this was happening, the damaged splice was noticed.

"The damage was significant enough that operations had to be notified immediately to avoid a failure. The crew captain made the decision to stop the belt and allow our employees to make the repair," he explained.

That single incident improved awareness of BeltVision's predictive maintenance abilities.

"This opened a lot of positive conversations around proactive maintenance, BeltVision technology, and using operations to repair belts. There were some production employees who were unaware of our ability to monitor splice conditions. Without having the ability to view the splices in detail, we stood a greater chance of having a failure on a splice," Stewart concluded. ■

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FERTILIZER INTERNATIONAL
ISSUE 529
NOVEMBER-DECEMBER 2025

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# Flexible fertilizer pastillation

PHOTO: IPCO

With more than 2,500 systems installed globally, IPCO's Rotoform technology has become the default solidification solution for a wide range of chemical products – delivering efficiency, quality, and sustainability benefits.

*IPCO's latest Rotoform XG high-capacity pastillation system for fertilizer finishing.*

With the world's population projected to reach around 9.7 billion by 2050, the pressure on agricultural systems to deliver higher yields – despite increasingly degraded soil conditions and finite nutrient resources – continues to mount.

For fertilizer producers, the challenge is twofold: they need to develop multi-nutrient fertilizers that respond to varying soil deficiencies, while doing so within a framework of reduced emissions, improved safety, and enhanced process efficiency. For many, IPCO's Rotoform granulation system has proved to be the ideal solution.

Originally developed for solidifying the sulphur extracted from oil and gas, Rotoform has gone on to become the default solidification solution for a wide range of chemical products, with more than 2,500 systems installed since its introduction in the early 1980s.

Designed to convert chemical melts into uniform, free-flowing pastilles in a single step, Rotoform combines speed, simplicity, and high product quality with low energy consumption and minimal environmental impact. For the fertilizer industry, it has enabled manufacturers to enhance product quality, reduce emissions, and explore new markets with multi-nutrient and specialty fertilizers.

## Controlled, consistent pastillation

The system is based on a simple yet highly controlled process. A liquid fertilizer melt is deposited onto a continuously running stainless steel belt in the form of uniformly sized droplets. As these droplets travel down the belt, cooling water sprayed onto the underside extracts heat, converting them into solid pastilles with high mechanical strength and consistent shape.

One of the key environmental advantages of this process is the separation between cooling water and product: there's no direct contact, eliminating the risk of cross-contamination and minimising water usage. In addition, the Rotoform system generates virtually no dust or off-gassing, ensuring a safe, clean working environment with very low emissions.

Rotoform technology offers significant advantages over traditional prilling or granulation methods:

- **Consistent particle size**: Adjustable between 1–5 mm
- **High crushing strength**: Suitable for both agricultural and technical-grade products
- **Low emissions**: Negligible dust and vapour generation
- **Low power consumption**: Efficient use of energy and cooling water
- **Minimal waste**: No need for crushing, screening, or recycling

These benefits make Rotoform an ideal solution for new installations, plant revamps, or de-bottlenecking projects. With its compact footprint and modular scalability, the system can be integrated alongside existing facilities with minimal disruption.

## High-capacity pastillation with Rotoform XG

The Rotoform principle has undergone constant evolution since it was first launched, with the development of a whole range of models designed for specific applications. IPCO recently introduced the Rotoform XG, a high-capacity pastillation system for fertilizer finishing, offering superior handling of low viscosity melts containing solid particles. This new model is an ideal granulation solution for urea products and other suspensions.

The enhancements incorporated into this latest addition to the company's Rotoform range include significantly easier cleaning and maintenance.

This new Rotoform model – designed for applications such as sulphur-bentonite and urea mixes as well as NPK and other fertilizers – can convert melts containing solid particles into consistent, high quality pastilles from 2-4 mm diameter. The XG is able to process products containing solid additives or contaminant particles up to 200 µm in size. Offering twice the throughput rates of the base Rotoform 4G model, the XG can also process slurries with melt viscosities up to 100 mPas.





PHOTO: IPCO

*Highly uniform urea pastilles.*

Like all Rotoform models, liquid product is delivered to a stator then deposited in drop form, via a rotating perforated outer shell, onto a continuously running steel cooling belt. However, the XG incorporates several innovations including a sliding base frame that allows the Rotoform to be pulled out for easy access, and a floating stator that makes cleaning and maintenance much easier. A bearing system with fewer parts and increased wear resistance further reduces maintenance requirements.

## Specialty urea products

IPCO can also supply upstream blending and grinding units for use with Rotoform models. By combining liquid and solid products as suspensions, these enable the production of specialty urea products such as:

- Urea + sulphur
- Urea ammonium sulphate (UAS)
- Urea + potassium
- Urea blended with micronutrients

These integrated systems can also produce other special fertilizers, including ammonium nitrate, calcium nitrate, magnesium nitrate, and sulphur-bentonite. Precise dosing and mixing capabilities mean that producers can tailor nutrient ratios to specific crop needs or soil deficiencies.

The Rotoform system has additional benefits including quick change overs with minimal downtime, enabling an agile production response to changing market demands. This opens the door to value-added products that can command premium pricing in competitive agricultural markets.

IPCO's engineering teams can deliver full end-to-end solutions, from upstream mixing and dosing systems to downstream handling, storage, and bagging.

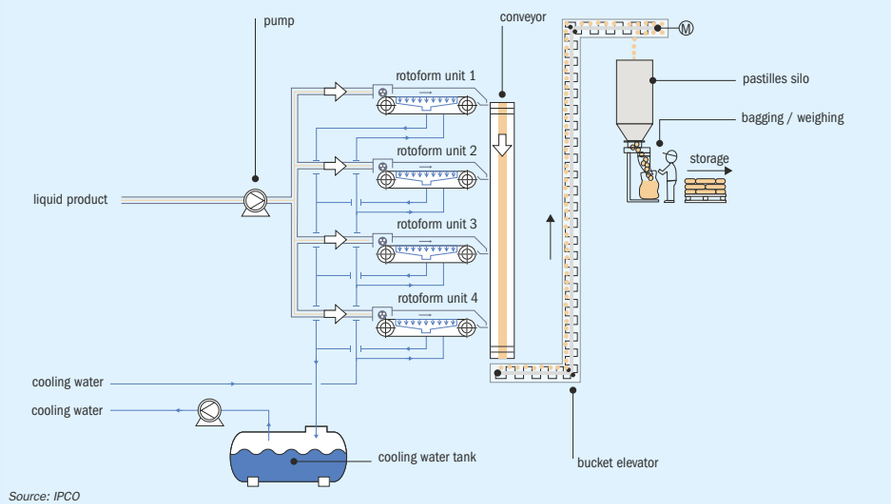
## Scalable, modular design for every plant size

Each Rotoform unit offers a throughput capacity of up to 10 tonnes per hour, depending on the product. For larger operations, multiple Rotoform lines can be run in parallel (Figure 1) to deliver capacities exceeding 2,500 tonnes per day. The modular nature of the system means that lines can be activated or shut down based on demand, improving operational efficiency and reducing overheads during low-production cycles.

For companies looking to test new formulations or evaluate the system's performance under real-world conditions, a complete Rotoform-based production line is available for customer trials at the company's Productivity Center close to Stuttgart, Germany. Here, customers can run pilot batches using their own materials, validating performance, evaluating emissions, and optimising product quality before scaling to full production.

Being the culmination of more than 90 years' experience in chemical industry solidification, IPCO's Rotoform pastillation system provides an efficient, clean, and flexible platform for producing high-quality fertilizers, safely, reliably, and cost-effectively.

Fig. 1: **Parallel arrangement of IPCO Rotoform machines for urea pastillation**




*Source: IPCO*





FERTILIZER INTERNATIONAL
ISSUE 529
NOVEMBER-DECEMBER 2025

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# 37th AFA International Technical Conference & Exhibition

Delegates gathered at the University Mohammed VI Polytechnic (UM6P) in Benguerir City, Morocco, 16-18 September 2025, for the 37th Arab Fertilizer Association (AFA) International Technical Conference & Exhibition. We present selected highlights from this year's three-day event.

PHOTO: SIMON INGLETHORPE/CRU

*The event's gala dinner celebrated AFA's 50th anniversary.*

## Shaping the future

The theme of this year's event was 'Driving Innovation, Sustainability, and Collaboration in the Global Fertilizer Industry'.

The conference opened with an expert panel discussion on the fertiliser strategies that are needed as the industry shifts to production decarbonisation and moves towards sustainable growth. With this in mind, host **Mike Nash**, Senior Editor, Fertilizer, Argus Media, asked what strategies will most influence and shape the fertiliser industry in the coming years?

"I think it all starts from our ambitions to reach net zero and us driving a very conscious sustainability agenda, in terms of regulations, technological developments, innovation and practical implementation," said **Yassir Ghiyate**, Managing Director, Topsoe, EMEA region. "I think the strategies that producers implement will be rooted in these aspects."

"I would say that one strategy that will take a larger focus in the future is actually trying to navigate the political landscape," said **Frederick Kessler**, Head of Ammonia & Urea Revamps, thyssenkrupp. "It's getting more complicated with protectionist policies, in addition to the $CO_2$ taxes that will probably increase. So that's one strategy – just to simply understand how this will all play out in the future."

"Something we're already seeing now is simply plant efficiency, right?," Kessler added. "Just having production plants run in a more efficient way will automatically translate into reduced carbon dioxide emissions; and this is helpful for the $CO_2$ taxes which will ultimately be put onto the end product."

"The first one [strategy] seems a bit obvious – like Frederick said – it's about the decarbonisation of existing and future plants," said **Ermanno Filippi**, Chief Technology Officer, Casale. "And, in a way, we see this starting to take place with a lot of projects lately."

"A second trend that is just starting – and, I think, will shape the industry in the future – is the fact that renewables are available almost everywhere," Filippi added. "So, this opens the possibility of producing fertilizer where there are no plants today; one example is the plant that will be built [by ATOME and Casale] in Paraguay."

"At OCP, it is much more than upgrading our systems. It's about a new world in mining, shifting to very efficient practises and procedures, remote technology and integrated remote operation centres," said **Noureddine Ajim**, Vice President, Head of Exploratory Mines, OCP. "[But] it is not only about machines; it's also about people sustainability and allowing teams to work smarter and safer to allow us to reduce our footprints."





## Smart solutions, AI and data-driven tech

In this technical session, **Jesper Poulsen**, Senior Sales Manager, Baker Hughes highlighted the benefits of Cordant™ Asset Performance Management (APM).

"With the current Cordant™ APM 3.0 version, we want to bring one integrated solution that can really quantify the risk and cost opportunities to your current assets. This can be deployed from end-to-end to improve overall performance and balance risk versus cost. The three main pillars are: asset health management, asset strategy management, and asset de-fragmentation."

Cordant™ is already generating results. Jesper gave an example for an oil & gas industry customer who'd achieved a 37% cut in production losses over 10 years:

"How do we reap the benefits from it [Cordant™]?," asked Poulsen. "So, one of the largest petrochemical companies in America is already saving more than $15 million per year from increased plant reliability, availability, reduced maintenance costs – I'll let you do your own calculations."

Importantly, Cordant™ incorporates AI-based process optimisation. Poulsen explained how AI was enabling producers to be more predictive in their maintenance schedule, avoid unplanned shutdowns and maximise the efficiency of their operations.

The technology is particularly useful at analysing the dynamic conditions (feed gas compositions; ambient conditions; equipment performance; feed and demand constraints; feed, energy and product prices) that can negatively affect production – in terms of reduced margins, less throughput and lower energy efficiency.

"AI allows you to digest and understand big data that might otherwise be hard to quantify. The metaphor I give is that it's like finding a needle in a haystack: you have a large swathe of data; how do you dig out that right number, the number that can improve your efficiency?," Poulsen asked.

"Well, feed gas efficiency is changing, ambient conditions and your equipment performance are changing, even the demand constraints are changing. All these reduce your margins, they reduce your throughput, they reduce your efficiency. That's the benefits of the [AI-based] solution," he said.

Typical customer benefits of the AI-enabled Cordant™ system include a 1-2% production increase and a 5-10% reduction in specific energy use. Poulsen used the results of a case study for a Middle East ammonia plant to highlight what can be achieved.

"I'm quite proud of this. The major outcome so far has been that we boosted ammonia production by 50 tonnes per day. We ranked critical assets and reduced or avoided more than 50 hours of downtime [over a three month period]," he said.

**Dr Sascha Wenzel**, Head of Asset Management and Digital Products, thyssenkrupp Uhde, outlined how plant performance can be optimised by combining process know-how with digitalisation. His presentation took a deep dive into remote performance monitoring (RPM), operator training simulators, and both 'white-box' and 'black-box' digital twins.

These digital products have a positive impact on ammonia and urea plant profitability. Typical improvements/benefits include:

- Plant availability: +1-3%
- Production: +1-3%
- Efficiency: +3-5%
- Quality: +0.5-3%
- Maintenance costs: -1-3%.

White-box type digital twins are based on a very detailed process simulation and are applicable to ammonia plants, for example.

"The advantage is that users can understand the relationship between input and output parameters. The disadvantage is that you need a very deep knowledge about process steps within the plant, which is not always a given," said Dr Wenzel.

Black-box type models, in contrast, are based on AI or, more specifically, machine learning.

"[The black-box digital twin] is based on AI and statistics; typically, we apply a neural network for this kind of system. The advantage is that it is suitable for very complex or poorly understood systems. The disadvantage is the interpretation of results is not that obvious in some cases," he said.

thyssenkrupp Uhde have applied an AI-based black-box digital twin at a granulation plant for a customer in the Middle East – where it's proving to be helpful predictive tool.

"Our customer can now predict the product quality for this plant and know whether this is being met," Dr Wenzel said. "Even if plant parameters need adjusting before the next lab measurement, operators will still know in which region product quality will land."

A low-carbon ammonia success story for Fertiglobe was presented by **Sheikha Alshamsi** and **Hend Almahri**, both Chemical Engineers at Fertil.

Fertiglobe achieved a major milestone when it shipped the world's first certified low-carbon ammonia consignment (2,250 tonnes) to Japan's Mitsui & Co in April 2024. This was followed by the shipment of a second certified consignment (6,459 tonnes) in November 2024, demonstrating Fertiglobe's emerging leadership in low-carbon ammonia.

As Sheikha and Hend explained, the $CO_2$ captured from a carbon dioxide removal (CDR) unit at Fertil's ammonia plant in the UAE was firstly condensed and then transported for injection into an underground reservoir (depth of 2,750 ft) at ADNOC's onshore Al-Falaha Site. Certification body TÜV SÜD evaluated this carbon capture and storage (CCS) process and, in a landmark moment, issued Fertil with its first certificate for low-carbon ammonia production in May last year.

## Innovative process technologies

This information-packed session included presentations from:

- **Abdenour Jbili**, CEO, OCP Maintenance Solutions, on the use of AI-powered predictive analytics – and how these are redefining both industrial reliability and maintenance.
- **Svenja Blechmann**, Department Manager, Steinmüller Engineering, on waste heat boiler optimisation at fertilizer plants.
- Casale's Ammonia Technology Leader, **Davide Carrara**, on technologies for decarbonising fertilizer production, while his colleague **Paolo Bertini**, its Head of Urea, outlined options for carbon mitigation during urea plant revamps (see *Fertilizer International* 528, p20)
- Topsoe's Account Manager, **Casper Frandsen**, on how high-activity, potassium-promoted $V_2O_5$ catalysts can maximise sulphuric acid production and sustainability.

AI-driven predictive maintenance is not a future dream, it's already here, according to **Abdenour Jbili**. He explained how two digital tools from OCP Maintenance Solutions (I-Sense® and I-Predict®) are unlocking the full potential of AI for 'machine health'.





FERTILIZER INTERNATIONAL
ISSUE 529
NOVEMBER-DECEMBER 2025

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He described I-Predict® as "the next evolution in predictive maintenance" as it:

- Learns autonomously from incoming data
- Does not require manual intervention for tuning or validation
- Detects faults dynamically, adjusting to new patterns.

The model continuously improves itself based on real-time operational data. The system is also designed to function independently from human oversight and works from day one, without the need for historical data.

Jbili also stressed the value of using AI in combination with expert human intelligence.

"With AI, you are not only talking about the intelligence you have in the software, but the intelligence we also have in our experts," he said.

Decarbonisation of the fertilizer industry is no longer optional – it's essential for a sustainable future, according to Casale's **Davide Carrara**. He highlighted the importance for Casale of both:

- **Cost-effectiveness**: identifying the most efficient, cost-effective solutions to reduce environmental impact.
- **Flexibility**: different project scenarios demand technical solutions tailored to each business case.

Casale's Flexigreen® green ammonia technology offers this flexibility, being suitable for: new plants, hybridisation revamps (which partly convert grey plants to green ammonia), and full grey-to-green plant conversion.

Casale is the technology licensor and engineering, procurement and construction (EPC) partner for ATOME's Villeta project in Paraguay (*Fertilizer International* 525, p22). Described as the world's first green fertilizer complex, the project will have the capacity to produce 768 t/d of calcium ammonium nitrate (CAN) and incorporates Casale's Smart-N, DualPURE, NitroPIPE and NitroCULTIVA processes.

"The Villeta project is very important to us because the accompanying offtake agreement [with Yara] is signed and ATOME is working fast towards the FID [final investment decision]," Carrara said.

Casale is also participating in a grey-to-green conversion project at the dual-train, 3,000 t/d capacity ammonia plant at Coromandel's Kakinada complex in Andhra Pradesh, India.


PHOTO: WILLIS THOMAS/CRU

*CRU attended, exhibited and presented at the event under a new media partnership with the AFA.*

## Green innovation and process optimisation

Presenting during this session were:

- **Rabie Labiad**, OCP Group's Chief Programme Officer, on the company's demetallization initiative.
- Stamicarbon's Senior Process Engineer, **Paz Munoz**, on how its proprietary technology is revolutionising nitric acid production and making the industry greener.
- **Alireza Moghaddam**, Navigance's Sales Account Manager, on how real-time monitoring and machine learning with CLARITY™ Prime is helping drive ammonia production efficiency and sustainability.
- Ballestra's Sales & Proposals Manager, **Stefano Vignando**, on a new cost-effective potassium sulphate (SOP) production method.

OCP Group's strategic objectives for 2027-2030 include the demetallization of fertilizers, explained **Rabie Labiad**. This includes a target to reduce the cadmium content of all its phosphoric acid and fertilizer output to below 20 mg Cd/kg $P_2O_5$ by the end of 2025, given "the urgency and ease of deployment of the decadmiation technologies".

This target will be achieved by treating phosphoric acid in three ways using:

- Using **co-crystallisation** to remove cadmium from two million tonnes of fertilizer production capacity by the first quarter of 2025.
- Ramping up fertilizer decadmiation based on **additive injection** (by the second quarter of 2025).
- Then deploying JESA technology based on **precipitation** by the first quarter of 2026.

OCP is also planning to use ion-exchange resins to capture cadmium and other metals (As, Cr, Cu, Ni) with a pilot plant planned for the third quarter of next year.

A patented wet-process route for potassium sulphate (SOP) production, recently developed by Ballestra, was introduced by **Stefano Vignando**.

While the established Mannheim process is a technically-proven and widely-used method for commercial SOP production, it does have limitations such as:

- **High energy consumption**. The process requires continuous heating at high temperatures (~600–700°C).
- **Corrosion**. The reaction produces highly corrosive hydrogen chloride (HCl).
- **Emissions**. HCl emissions require treatment to meet environmental regulations.
- **By-product handling**. The HCl by-product needs to be captured (as a 30-35% solution) and used in other processes or sold.

"The Mannheim process, available from Ballestra, is very proven, widely used with a few limitations – [such as] harsh conditions, HCl formation, emissions, gas consumption," said Vignando. "We [therefore] tried to develop an alternative that works in mild conditions, room temperature, with no gas consumption, lower electricity consumption and a product that is compliant with market standards, and has another advantage – a second fertilizer product."

The new wet-route provides a more sustainable and cost-effective method of producing fertilizer-grade SOP, in Ballestra's view. It reacts together ammonium sulphate and potassium chloride to generate a 'mother liquor' alongside SOP. This co-product, a solution of nitrogen, sulphur and potassium, makes a suitable liquid fertilizer, suggests Ballestra, or could be blended with other fertilizers.

## Decarbonisation and resource valorisation

Presenting during this session were:

- Prayon PROFILE's Business Development Manager, **Pierre Henri Thiefaine**, on meeting high industry expectations during liquid-solid separation at phosphoric acid plants
- **Marc Sonveaux**, Head of Industrialization at Prayon Technologies, on using the valorisation of fluorosilicic acid to improve phosphoric acid plant efficiency and sustainability.
- **Hicham Laayouni**, OCP's Head of Sustainability, on the company's decarbonisation initiative.

**Pierre Henri Thiefaine** highlighted the overall strength of Prayon Group and the synergies between its individual companies.

"Prayon PROFILE is the manufacturer of critical equipment positioned at the heart of phosphoric acid plants. It's good to have a machine, for sure, but PROFILE is nothing without the expertise of Prayon Technologies – we don't forget that!," he said.

Thiefaine presented four phosphoric acid plant (PAP) case studies with contrasting demands, solutions and project outcomes:

- Improved liquid-solid separation at a PAP delivered a volume increase of 25-27% $P_2O_5$ through a Prayon PROFILE filter. This involved load cell optimisation and adjustments to the wash supply and rotation speed of the primary filter.
- Supply of 4 attack agitators, 3 digestion agitators and a gas scrubber at a PAP. This provided an additional 450 t/d $P_2O_5$ output for limited capex versus a new line.
- A Prayon PROFILE filter (design capacity 400-1,100 t/d $P_2O_5$) supplied to a new high-end PAP as a package with other equipment items offered the following guarantees: filter (0.2% soluble $P_2O_5$ in gypsum), agitator (1% insoluble $P_2O_5$ in gypsum), Praysep (99.8% $P_2O_5$ yield) and a gas scrubber (5 mg/Nm³ F limit).
- Finally, the operator of a new PAP decided to purchase Prayon PROFILE equipment due to several factors: its reputation as a renowned OEM, the availability of spares and the provision of maintenance services within Morocco.

**Marc Sonveaux** opened his presentation by explaining why problem-solving and sustainability are both important to Prayon Technologies.

"Firstly, sustainability is very important to us as the basis for a brighter future. Secondly, we believe at Prayon Technologies that there are no problems. [Instead,] the problems that we might encounter are actually a source of inspiration – and that's a mindset, I believe, we should all keep in mind," he said

As an example of this approach, Sonveaux suggested that the fluorosilicic acid (FSA) generated at phosphoric acid plants has value and therefore should be recovered not released. Fluorine removal processes widely used currently, which typically neutralise FSA, destroy its value, he said.

Prayon is instead proposing a novel production route for dicalcium phosphate (DCP) – see *Fertilizer International* 528, p16 – as a sustainable method for valorising the acidity of FSA. As well as providing effective fluorine management at phosphoric plants, it also generates high quality, saleable DCP and gypsum products.

Pilot tests suggest that integrating a DCP unit within an existing phosphoric acid plant would typically deliver:

- 28,000 t/a $P_2O_5$
- 70,000 t/a DCP
- 110,000 t/a gypsum.

To implement this DCP route, and ensure it is a viable option for individual phosphate producers, Sonveaux emphasised the importance of laboratory- and pilot-scale testing at facilities such as Technophos. "Every phosphate rock is different and should be fully validated to give its best," he said

The world is entering a critical phase of climate disruption, with increasingly visible consequences, said **Hicham Laayouni**. The socio-economic impacts include some staggering headline figures:

- Number of people exposed to extreme heat waves globally in June 2024: 4.97 billion
- Hours of labour lost due to heat exposure globally in 2023: 512 billion
- Global cost of climate related disasters in 2024: $417 billion
- Cost of natural disasters to the US economy in 2024: $218 billion.

"It's a global change that concern all of us. OCP, as a large-scale manufacturing company, recognises its impact and its contribution to climate change," Laayouni said.

He went on to explain how OCP, as a global leader in agriculture and mining, has launched a structured and ambitious roadmap to decarbonise both its operations and value chain. This includes targets to become operationally carbon neutral (Scope 1 & 2 emissions) by 2030 and then move to complete carbon neutrality (including Scope 3 emissions) by 2040.

OCP's 2024 footprint of 20.37 million tonnes carbon dioxide equivalent ($CO_2e$) includes 16.25 million tonnes of Scope 3 emissions. Its operational emissions (3.35 $CO_2e$ Scope 1 and 0.767 $CO_2e$ Scope 2) split as follows:

- Process (release of $CO_2$ sequestered in the rock): 55%
- Combustion (drying, calcination, own transportation): 26%
- Electricity (Scope 2): 19%.

"We have established a comprehensive and actionable roadmap which has allowed us to decrease our impact," Laayouni said.

The company is acting quickly to reduce its carbon intensity at scale with major wins already achieved (wind power, energy co-generation, slurry pipeline, mine reclamation). Other wide-ranging and large-scale measures, meanwhile, are ongoing and/or well-advanced (e.g., CCS/CCU, green drying, heat recovery, energy efficiency, green ammonia, renewable energy, carbon farming etc).



CONFERENCE REPORT



FERTILIZER INTERNATIONAL
ISSUE 529
NOVEMBER-DECEMBER 2025

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*The presentation from Anna Dikova of Technophos (right, with colleagues) was one of many conference highlights.*

## Next-gen fertilizer solutions

This session included presentations from:

- GEA's Business Unit Head, **Laurent Palierne**, on the company's process engineering activities in fertilizers.
- **Mohamed Baqili**, Process & Product Development Manager, and **Tarik Bou Ighiden**, Strategic Planning Project Manager, OCP Group, on fertilizer customisation to boost agricultural efficiency.
- **Anna Dikova**, R&D Manager, Technophos, on 'pushing the boundaries of phosphates'.
- Saipem's Urea Technology Specialist, **Francesco Viola**, on Snamprogetti Super Cups for enhancing the efficiency of urea synthesis.

GEA's expertise in the design, engineering and supply of production units for tMAP (technical monoammonium phosphate) was highlighted **by Laurent Palierne**. The company's proven track-record for this leading water-soluble fertilizer (WSF) includes a dozen references for production plants, basic engineering, and laboratory- and pilot-scale studies.

GEA's offers two processes for tMAP production from purified phosphoric acid (PPA) and merchant-grade acid (MGA), respectively. Both these routes generate high quality tMAP with up to 0.01% impurities and 0.01 % insolubles. It's also possible to produce other WSFs (DAP 21-53-0 or MKP from PPA) from the same units, subject to lab testing and validation.

The MGA route, which requires two crystallisation stages, delivers tMAP with a purity equivalent to that produced from more expensive PPA, while offering a faster return of investment, Palierne said. The process is also flexible, as the pre-treatment required can be customised according to the origin of the MGA and the target market.

"We have technologies to produce technical MAP from PPA or MGA and can tailor the process, based on requirements," Palierne summed up. "We have a robust and reliable solution to offer the market, and we can make larger units [than 200,000 t/a] if needed."

Phosphates are wonderful resources that have their challenges, said **Anna Dikova**. In fact, Technophos, a research centre located in Devnya, Bulgaria, actively seeks out and embraces such challenges.

"In Technophos, we believe there are no difficult materials – if you choose the right technologies, the right set up to test the process and then optimise," Dikova said. "We love the challenges from raw materials because they give us the opportunity for innovation."

Technophos is owned equally by Prayon Group and Morocco's University Mohammed VI Polytechnic (UM6P). Created in June 2013, this fully equipped R&D and innovation centre, run by a team of 37 skilled and experienced professionals, offers to develop and validate new phosphate industry technologies through:

- A semi-industrial testing and demonstration platform
- The design and production of prototypes and tailor-made equipment
- Training for operators and engineers.

The company's technology portfolio notably includes the HCl-based Ecophos process, the $H_2SO_4$-based GMP process, the Puma purification process, the PELP process and Prayon's FSA process. These are all designed to create value from low-grade phosphate ores.

Dikova encouraged the industry to collaborate on achieving its sustainability goals.

"I urge you, let's explore the limits of phosphate together and work towards a more sustainable industry. Because the boundaries we push today will define the sustainability of tomorrow," she concluded.

## Carbon capture, green additives & global outlook

This final conference session included presentations from:

- NAQ Global's VP Operations, **Fernanda Dias**, on enhancing phosphate efficiency with green additives.
- **Kent Martin**, Agronomic Consultant, Shell Sulphur Solutions, on how Thiogro technology for sulphur-enhanced urea can improve crop uptake and reduce emissions.
- CRU's Principal Consultant, **Willis Thomas**, on fertilizer market supply and demand trends.

**Willis Thomas**, in a thorough and insightful fertilizer market briefing, highlighted both the rise and fragmentation of prices being seen under current supply-controlled conditions. His key takeaways were:

- **Fertilizer affordability is deteriorating in 2025**. Crop prices are in decline and fertilizer prices rising, albeit at vastly different levels.
- **Nitrogen prices are showing continued volatility**. Trade frictions are seeing prices move higher, despite reasonable supply.
- **Phosphate & potash prices continue to diverge**. Polar opposite supply outlooks dovetail previously closely coupled prices.

Looking further out to 2029, Thomas expected fertilizer prices to generally fall, while current price disparities should largely persist, in his view. ■

## 2026 Arab Fertilizer Association Annual Conference

*The 32nd AFA International Annual Conference & Exhibition will be held in Cairo, Egypt, 7–9 April 2026, with the theme 'Sustainable Environment and Safe Food'. The call for papers has been announced: arabfertilizer.org/blog/newss/call-for-papers-announcement/*



November-December 2025

# phosphates & potash INSIGHT





FERTILIZER INTERNATIONAL
ISSUE 529
NOVEMBER-DECEMBER 2025

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# China looks beyond its potash heartland to secure supply

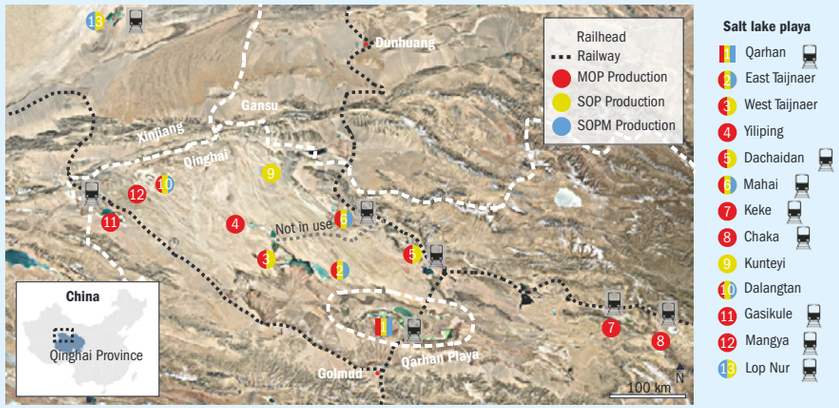
China's potash hub in western Qinghai and eastern Xinjiang is on the wane. Potassium chloride (MOP) output from these regions fell to an 11-year low in 2024. With permanent plant closures and resource depletion pressuring supply, China's reliance on imported MOP and exposure to global pricing is set to rise. In this CRU Insight, **Alexander Chreky** reports on China's potash industry in person – and reveals how the country's investment in potash capacity internationally is also accelerating.

## Introduction

In July 2025, I had an extraordinary opportunity to represent CRU and visit China's impressive yet remote and inaccessible potash brine operations in western Qinghai province. The journey there was tortuous and lengthy, starting with plane and rail travel and culminating with endless hours driving across the dusty Qaidam basin.

However, the end destination was well worth it, as I was able to visit many of the region's potash producers scattered across this basin, both large and small (Figure 1). Lots of these potash brine operations are facing gradual resource depletion and eventual exhaustion over the next two decades – with this raising questions about the future of the Chinese potash industry, and consequently how the country will ensure its fertilizer and food security for future generations.

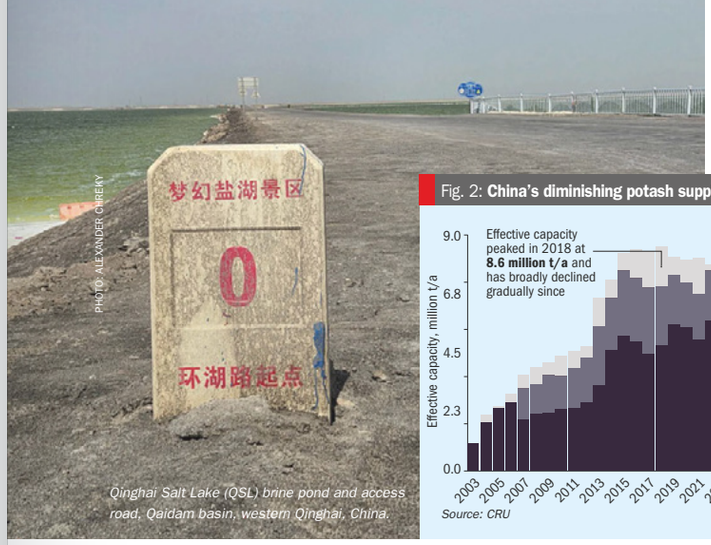
Fig. 1: **Potash producers, Qaidam basin, western Qinghai province, China**




*Source: CRU Map image: © Microsoft Corporation*

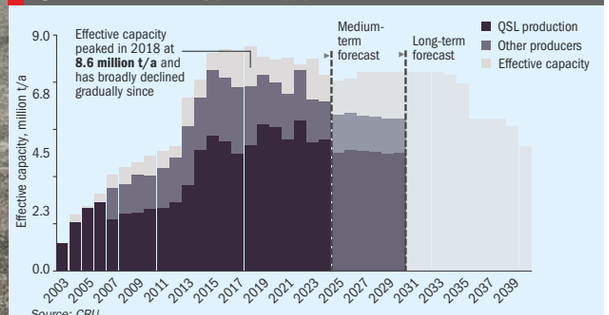







*Qinghai Salt Lake (QSL) brine pond and access road, Qaidam basin, western Qinghai, China.*

Fig. 2: **China's diminishing potash supply**




*Source: CRU*

## Chinese potash production – largely fragmented

The Qaidam basin in China's western Qinghai province is home to almost the entirety of the country's potassium chloride (MOP) capacity and a substantial portion of its primary potassium sulphate (SOP) and potassium magnesium sulphate (SOPM) output (Figure 2). Additionally, the eastern edge of the adjacent Tarim basin in neighbouring Xinjiang province also houses SDIC Luobupo's 1.8 million tonnes per annum (t/a) SOP plant – the largest of its kind in the world.

Although only two companies account for the majority of the region's MOP and primary SOP production – Qinghai Salt Lake (QSL) and SDIC Luobupo, respectively – myriad operators have proliferated across this salt lake playa. Consequently, capacity in Qinghai is the most fragmented of any major potash production centre globally.

This area of western Qinghai and eastern Xinjiang encompasses nearly all of China's domestic potash resources. The rapid development of the region's potash extractive industry during the late 2000s and early 2010s – which resulted in total potash capacity peaking in 2018 – is, however, now leading to significant resource depletion.

The upshot has been that MOP capacity and production has declined throughout the 2020s, albeit slowly and inconsistently. Symbolically, output in 2024 – a fraction above 6.5 million tonnes – was the lowest recorded in eleven years.

On CRU's prior visit to Qinghai seven years ago [*check*], a number of smaller operations had ceased MOP production in favour of SOP, while some had temporarily idled production in the preceding 2-3 years. Yet very few had actually closed for good.

That is now changing with permanent closures becoming more common in the 2020s. China's nameplate MOP capacity has fallen by 0.8 million t/a since 2018, CRU estimates, equivalent to a 0.9 million t/a fall in effective capacity. Production unit closures at Zangge Potash, Qinghai's second largest MOP supplier, have been the most significant, with worsening resource constraints seeing the company's effective capacity drop from 1.9 million t/a in 2018 to just 1.1 million t/a this year.

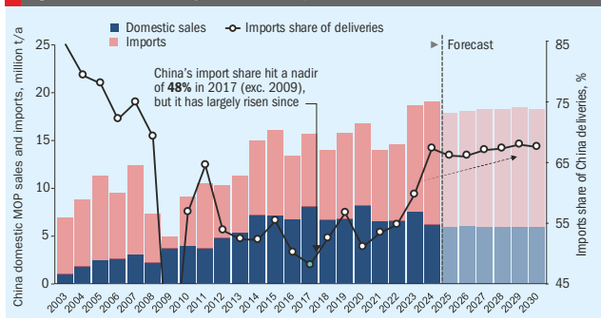
Zangge operates a cluster of smaller refineries on the southeastern periphery of the large Qarhan playa. On this year's visit to Qinghai, it was clear that the company had permanently shuttered six of its smaller units, leaving just its largest two potash production units in service.

Additionally, it was apparent that a further 50,000-60,000 t/a of MOP refinery capacity, from the smaller operators outside the Qarhan playa, has permanently closed since CRU's previous visit, generally due to resource depletion.

## Resource depletion to cause further output falls

While potash production in Qinghai and Xinjiang provinces has varied since capacity peaked in the late 2010s, its future trajectory, in CRU's view, is reasonably clear: downwards. Resource depletion is already beginning to hit Chinese MOP output – and the same will eventually occur with primary SOP too.

Fig. 3: **China's increasing reliance on imports**




*Source: CRU*





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Consequently, China is becoming increasingly reliant on imported MOP to fulfil its domestic potash requirements, both directly and indirectly via the consumption of MOP in secondary SOP production (Figure 3). At their peak in the late 2010s, operations in Qinghai supplied just over half of China's annual MOP demand. But with reliance on imports only going to rise further, as resources in Qinghai and Xinjiang continue to dwindle, China will become increasingly exposed to international pricing, over which it has limited influence. This is fuelling renewed Chinese business interest in developing international potash projects in countries far beyond the country's own borders.

## Chinese firms look abroad to secure supply

In the late 2000s and early 2010s, Chinese companies – ranging from large state-owned enterprises to smaller private entities – began to develop or participate in a number of international potash projects. China's interest in these followed the surge in global MOP prices seen in 2007/08, with both neighbouring Laos and Saskatchewan, Canada, being being key centres of interest. Chinese enterprises also pursued projects in Thailand, Eritrea and the Republic of Congo. Additionally, The Development Bank of China helped finance Slavkali's Lyuban project in Belarus. Separately, there was also some interest in extracting the potash associated with lithium projects in South America.

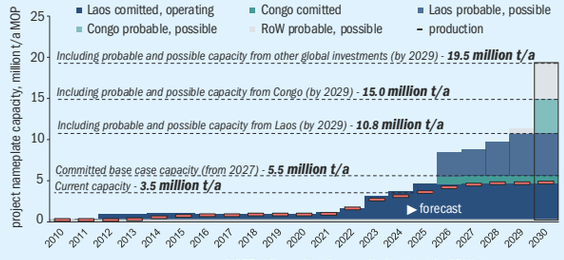
Ultimately, however, the only Chinese-backed potash projects successfully completed during the 2010s – initially at modest scale – were those in Laos, with Lao-Kaiyuan and Sino-Agri Potash Co adding 0.6 million t/a of combined capacity by 2015. Although three other Laos potash projects (two backed by Chinese investors) entered test production in 2011/12, all of these had ceased output by 2016.

Elsewhere, the development of other Chinese-backed projects generally slowed or stopped during the mid-2010s, with none of these reaching fruition outside Laos. The Development Bank of China also stopped financing the Slavkali project in 2021, after western sanctions on Belarus resulted in construction halting.

PHOTO: ALEXANDER CHREKY

*Brine channel, Zangge Potash*

Fig. 4: **Chinese investments and interest in international potash projects**




*Source: CRU, Company reporting*

*NOTE: "Committed" capacity included in CRU's base case, "probable" and "possible" projects excluded from base case*

## International investments now delivering supply

Yet, after a false start, China has regrouped this decade and begun investing and participating in international potash projects in earnest (Figure 4). The rapid expansion of Laotian potash projects has exemplified this, with nameplate capacity jumping from a combined 0.75 million t/a in 2020 to 3.0 million t/a in 2024.

With a further 1.0 million t/a of capacity at Asia Potash and 0.5 million t/a from YTH coming online in 2025, Laos' countrywide capacity is expected to reach 4.5 million t/a this year – making Laos the fifth largest MOP supplier globally, ahead of Israel in nameplate capacity.

Laos is not the only place where Chinese companies are moving forward to develop potash projects. Africa has emerged as a particular construction and investment focus.

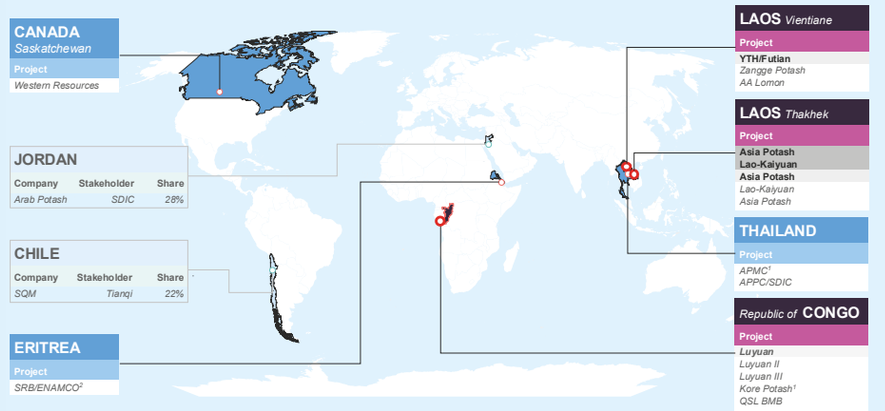
In October 2023, Luyuan Mining – a company which has held potash interests in the Republic of Congo for more than a decade – reportedly began construction of a 2.0 million t/a capacity conventional underground mine at Mboukoumassi, near the Atlantic port of Pointe-Noire.

Luyuan, which was previously backed by China's CITIC, is wholly owned by Shenzhen





Fig. 5: **Map of Chinese overseas projects**




*Source: CRU*

*NOTE: (1) APMC and Kore Potash's Kola projects signed EPC contracts with PowerChina but are not directly financed by Chinese companies; (2) Eritrean Sichuan Bridge & Road (SRB) / ENAMCO project primarily intends to produce SOP, but retains an option to make MOP*

CATIC Resources, itself a subsidiary of Ganfeng Lithium, China's largest lithium producer. Shenzhen initially provided Luyuan with RMB350 million (c.$50 million) of debt finance, representing around 10% of the project's total development capital. While CRU currently classes the overall project as 'probable', pending further information about its funding status, we rate the completion of first one million t/a of capacity at Mboukoumassi as 'firm'.

Also in the Republic of Congo, London-listed Kore Potash signed an engineering, procurement and construction (EPC) contract with PowerChina in November 2024 for its flagship 2.2 million t/a capacity Kola project. This move could potentially lead to direct Chinese investment in the project.

Furthermore, Qinghai Salt Lake, China's biggest domestic MOP producer, has also been evaluating potential MOP projects in the country, according to recent reports.

For many years, the Sintoukola potash basin has been the focus of MOP project development within the Republic of Congo. Indeed, historically, some of these projects have reached relatively advanced stages. But the combination of the basin's mainly carnallite ore geology, plus the country's high-risk investment environment, has ultimately meant no potash capacity has been successfully installed in the country since the 1970s.

> **"China has regrouped this decade and begun investing and participating in international potash projects in earnest. The rapid expansion of projects in Laos has exemplified this."**

Canadian developer MagMinerals, for example, enlisted the services of various Chinese enterprises during the development of its 1.2 million t/a capacity Mengo MOP project in the basin. Disappointingly, having initiated construction in 2013, the venture eventually fell apart little more than a year later.

Whether the two latest attempts to start MOP production in the Republic of Congo will succeed remains uncertain. Nonetheless, recent project moves, such as Luyuan entering construction and PowerChina agreeing an EPC contract with Kore Potash, do clearly signal a resurgence in Chinese project participation and investment. Generally, the renewed focus on the Republic of Congo also highlights the higher risk appetite of Chinese companies, especially when coupled with the freedom to exert more influence and control over potash projects in the country than is possible elsewhere.

## Conclusions

After a period of capacity building and growth in output, followed by production stability, China's potash industry is now entering a final phase of managed decline. China's reliance on imports and exposure to global prices will therefore rise, as the depletion of resources in Qaidam and eastern Xinjiang causes MOP output to fall. As outlined in this article, it is this prospect of domestic decline that is pushing Chinese firms to secure potash supply through accelerated overseas projects in Laos, the Republic of Congo and further afield (Figure 5). ■

## About the author

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FERTILIZER INTERNATIONAL
ISSUE 529
NOVEMBER-DECEMBER 2025

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# Potash project listing 2025

*Fertilizer International* presents a global round-up of current potash projects.

| Plant/ project | Type | Company | EPC/EPCM contractor(s) | Equipment/technology | Location | Product | Capacity '000 t | Status | Start-up date |
|---|---|---|---|---|---|---|---|---|---|
| **AUSTRALIA** | | | | | | | | | |
| Lake Way | G, LBE | Sev.en Global Investments | | | Western Australia | SOP | 200 | C | 2025 |
| Mardie | G, SE | BCI Minerals | | | Western Australia | SOP | 140 | UC* | 2026 |
| Belarus | | | | | | | | | |
| Nedra Nezhin Company | G, CM | Nedra Nezhin (former Slavkaliy) | China State Engineering Corp/ Deilmann-Haniel | Herrenknecht Shaft Boring Roadheader (SBR) system | Lyuban | MOP | 2,000 | UC | 2026- |
| **BRAZIL** | | | | | | | | | |
| Autazes | G, CM | Brazil Potash | CITIC Construction | | | MOP | 2,400 | FS | N/A |
| **CANADA** | | | | | | | | | |
| Bethune | B, SM | K+S Canada | | | Saskatchewan | MOP | 2,000 | UC | 2025- |
| Jansen | G, CM | BHP | DMC Mining | Herrenknecht Shaft Boring Roadheader (SBR) system | Saskatchewan | MOP | 4,400 | UC | 2027 |
| Milestone | G, SM | Western Potash | Artisan Consulting/AKITA Drilling | | Saskatchewan | MOP | 2,800 | UC | 2028 |
| Russel McAuley | G, SM | PADCOM | | Beechy Potash Products Corp (BPPC) | Manitoba | MOP | 40 | UC | 2025 |
| Tugaske | G, SM | Gensource/Helm | | | Saskatchewan | MOP | 250 | FS, P | N/A |
| Wynyard | G, SM | Karnalyte Resources/GSFC | Amec FW (Wood) | | Saskatchewan | MOP | 625 | FS, P | N/A |
| **ERITREA** | | | | | | | | | |
| Colluli | G, CM | Sichuan Road & Bridge/ENAMCO | DRA Global | | Danakil Depression | SOP | 472 | FS, P | N/A |
| **ETHIOPIA** | | | | | | | | | |
| Dallol | G, SM | Thriveni | SNC-Lavalin | | Afar | SOP | 600 | FS, P | N/A |
| Danakil Potash | G, SM | Circum Minerals | | | Danakil | MOP/ SOP | 2,000/750 | FS, P | On hold |
| **JORDAN** | | | | | | | | | |
| Safi | B, LBE | Arab Potash Co | | | Dead Sea | MOP | 300 | UC | 2025-2027 |
| **LAOS** | | | | | | | | | |
| Ganmeng | G, CM | Lao Kaiyaun | | | Ganmeng | MOP | 1,000 | UC | 2024-28 |
| Wangxiang Ganmeng | G, CM | Sino-Agri Mineral (Asia Potash) | | | Ganmeng | MOP | 1,000 | UC | 2025 |
| **MOROCCO** | | | | | | | | | |
| Khemisset | G, CM | Emmerson | | | Khemisset | MOP | 810 | FS | On hold** |
| **PERU** | | | | | | | | | |
| SalSud | G, LBE | Salmuras Sudamericanas | | | Sechura desert | SOP | 100 | P | On hold |
| **REP CONGO** | | | | | | | | | |
| Kola | G, CM | Kore Potash | PowerChina | | Kouilou | MOP | 2,200 | FS, P | N/A |
| Mboukoumassi | G, CM | Luyuan Mining | | | Pointe Noire | MOP | 2,000 | ?UC | N/A |
| **RUSSIA** | | | | | | | | | |
| Solikamsk II | B, CM | Uralkali | | | Perm | MOP | 800 | UC | 2025 |
| Solikamsk III | B, CM | Uralkali | | | Perm | MOP | 500 | UC | 2024-2025 |
| Talitsky | G, CM | Acron (Verkhnekamsk Potash Company) | | | Perm | MOP | 2,000 | UC | 2028 |
| Usolskiy II | G*, CM | Eurochem | | | Perm | MOP | 1,800 | UC | 2027 |
| Berezniniki III | B, CM | Uralkali | | | Perm | MOP | 600 | UC | 2026 |
| **SPAIN** | | | | | | | | | |
| Muga | G, CM | Highfield Resources | | | Navarra & Aragón | MOP | 500 | FS, P | N/A |
| Phoenix | B, CM | ICL Iberia | | | Suria | MOP | 300 | UC | 2024-2027 |
| **UK** | | | | | | | | | |
| Woodmsith Mine | G, CM | Anglo American | DMC Mining/STRABAG AG/ Jacobs | Herrenknecht Shaft Boring Roadheader (SBR) system | North Yorkshire | Polyhalite | 13,000 | UC*** | N/A |
| **USA** | | | | | | | | | |
| Sevier Playa | G, LBE | Peak Minerals (EMR Capital) | | | Utah | SOP | 215 | FS, P | 2028 |

**NOTES:**
Greenfield projects (G): generally, these must have reached the detailed/bankable feasibility study (FS) stage for inclusion.

Brownfield expansions (B): capacity indicates incremental additions, not total capacity.

* Pilot plant only. Awaiting FID end 2026
** Halted due to legal dispute.
*** Project effectively mothballed for now. Anglo American investment will decrease to $200 million this next year and zero in 2026.

**PROJECT TYPE:**
B Brownfield expansion
G Greenfield
CM Conventional mine
LBE Lake brine extraction
SE Seawater extraction
SM Solution mine

**START-UP DATE:**
N/A Not available or provided

**PRODUCT:**
MOP Muriate of potash, KCl
SOP Sulphate of potash, $K_2SO_4$

**PROJECT STAGE:**
FS Feasibility study
P Permitted
UC Under construction
C Completed/commissioned







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EBNER

# Fully-automated mobile evaporation & crystallization test plant

Germany's Ebner GmbH & Co KG is a family-owned specialist designer and manufacturer of evaporation and crystallisation plants. The company develops tailor-made plants completely in-house, from the customer's first enquiry to final delivery, having expertise that encompasses plant design, fabrication, erection, and start-up.


PHOTO: EBNER

*Ebner's new award-winning mobile evaporation and crystallisation unit is unique.*

Ebner is an established global player. To date, the company has successfully constructed 600 new evaporation and crystallisation plants and optimised more than 200 other plants worldwide.

The company has extensive experience in the design and manufacture of evaporators and crystallisers for the potash industry. These are suitable for a range of potash salts, including potassium chloride (KCl) and potassium sulphate ($K_2SO_4$), widely known within the industry as MOP (muriate of potash) and SOP (sulphate of potash), respectively. The production plant capacities for these types of potash can vary from a few kg/h to more than 200,000 kg/h.

Ebner recently developed a mobile test plant that combines evaporation, cooling and crystallisation technologies in one compact unit. The plant, which has won an innovation award, is designed to cover all conventional evaporation and crystallisation processes.

## Unique mobile test plant

The unit's unique design and flexibility offers industrial users an opportunity to explore different process routes in a practical and cost-effective way. Being built into a steel frame, it can be transported easily on either a low-bed trailer or in an open-top container. Managing director, Stefan Ebner, explains the benefits:

"With this plant we provide something that does not exist anywhere else in the world. It is unique in its ability to cover a wide range of evaporation and crystallisation processes in one compact, mobile unit. For our customers, the benefit lies in the fact that the plant can be brought quickly to their site, enabling trials under real process conditions. Instead of investing in their own pilot system, they can rent this plant at low cost and test new process routes efficiently and safely. This approach allows them to save both time and money while accelerating the development of innovative technologies."

## Applications

The test plant can be operated in different modes depending on process requirements:

- Evaporation with/without crystallisation: up to 600 kg/h of water can be evaporated.
- Vacuum cooling with/without crystallisation: cooling capacities up to 200 kW are achievable.
- Direct cooling with/without crystallisation: also up to 200 kW, under vacuum or atmospheric conditions.

## Advantages for potash producers

Potash producers will be among the main beneficiaries of this innovative mobile test plant. Granular potash production involves multiple crystallisation and concentration steps. New process concepts, therefore, often need to be verified before large-scale implementation. Traditionally, such trials are carried out in stationary pilot plants at remote locations. This requires transportation of feed samples and often leads to differences between laboratory conditions and real industrial environments.

*Ebner's mobile evaporation and crystallisation test plant can be transported on either a low-bed trailer (shown) or in an open-top container.*

PHOTO: EBNER





PHOTO: EBNER

*The sophisticated internals of Ebner's mobile evaporation and crystallisation test plant.*

The mobile concept developed by Ebner eliminates these drawbacks. By bringing the test plant directly to a production site, trials can be carried out with the actual raw materials used in day-to-day operations. This ensures more reliable results and minimises the risk of scale-up problems. Furthermore, customers can test variations in feed quality, process temperature, or cooling regimes without interrupting their own production.

The option to rent the plant is a key economic advantage. For companies evaluating new process routes, building and operating their own pilot unit often represents a major financial burden. In contrast, the Ebner test plant can be deployed at relatively short notice and at significantly lower cost. This reduces investment risk and allows companies to pursue innovative ideas that might otherwise remain untested.

## Additional application areas

Although designed with the needs of the potash industry in mind, the test plant is equally well suited to other evaporation and crystallization tasks. Typical applications include:

- The concentration of process wastewater
- Recovery of salts from by-products
- Testing of new crystallisation strategies for specialty chemicals.

In each case, the modular and flexible design of the plant allows process engineers to adapt the operating mode to their specific requirements.

## Practical aspects and transportability

The practical transport and handling of the unit is another advantage. Its compact footprint and transport dimensions enable relocation without significant logistical effort. Once on-site, the plant is quick to start up and easily connected to utilities. Its mobility also makes the plant suitable for multi-site operations, allowing any company to use it at a series of different production plants.

## Conclusions

Ebner's mobile test plant provides the industry with a novel tool for evaporation and crystallisation process development. Its compact design, flexibility and mobility, combined with the option of low-cost rental, make it a unique solution for potash producers and other industries seeking to explore new process technologies.

By enabling real-world trials under practical conditions, the plant helps customers reduce costs, shorten development times and minimise risks. In doing so, it sets a new benchmark for innovation in process engineering. ■

KÖPPERN

# Successful potash sector sales in 2025

Köppern, a family-run business founded in Hattingen, Germany, has been manufacturing briquetting, compaction and comminution machinery since 1898. The company has been supplying compaction and granulation equipment and plants to the fertilizer industry for more than 70 years. Its sales include several hundred roller presses in over 60 countries.

Granular potash is produced almost exclusively by a compaction-granulation process. Fine-grained potash feed is generally compacted on roller presses to produce flakes with a density close to that (>95%) of natural potash. These flakes are then crushed and screened to produce a closely-sized (often 2-4 mm) granular product.

## Three key components

A typical compaction-granulation plant for MOP (muriate of potash) consists of three key components – roller presses (compactors), crushers and screens – configured in closed-circuit. The feed is firstly compacted at an elevated temperature. Köppern typically installs compactors with a 1,150 mm diameter and 1,000 mm working width. Multiple compactors are often installed within one potash plant. These presses have a maximum flake throughput of approximately 140 t/h and a gross granular potash capacity of 40-50 t/h. After compaction, impact and roller mills, working in a closed-loop cycle with multi-deck screens, crush the flakes into granulate with an approximate density of 1.9-1.95 g/cm$^3$.





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Since the 1990s, the preferred flake capacity of potash compactors has increased to 110-130 t/h. The majority of new compactor investments made by potash producers in recent years have been in designs of at least 100 t/h flake.

## Design innovation

Köppern has introduced a number of innovations and design changes to ensure compactors of this size are safe, reliable to operate and deliver excellent flake quality. This has involved the modification of various subassemblies, including the frame, feeder, roll design, roll drive and the hydraulic systems.

Vibrations are a particular operational problem when de-aerating and compacting potash – as they can result in severe juddering that damages equipment. The risk of this can be reduced by lowering roll speed and/or feed rate. However, changing the compactor drive design to increase mechanical stiffness is a preferable way of solving this problem at source. This approach also maintains throughput, and is therefore less of a compromise for customers.

For many years, Köppern has stiffened the drive train of large roller presses by manufacturing these with planetary gear reducers mounted directly onto the roll shafts. The company delivered its first large potash compactor (130 t/h) with this drive technology to Germany in 1998. Since then, compactors with this drive design have been widely-adopted worldwide. For example, Köppern's fertilizer compaction customers in Brazil, Canada, China, Croatia. Hungary, Jordan, Italy, Russia, Serbia and Spain have either modified or ordered new roller presses fitted with this type of main drive.

All large potash compactors supplied by Köppern since the early 1990s have also been supplied with a hinged frame. This allows quick access to rollers for assembly or maintenance. Rollers can be picked up easily without dismantling any part of the frame or feeder.

The feeder is an important component of the compactor. It needs to transport large volumes of material, de-aerate this effectively and distribute it evenly over the entire working width of the roller. The ability to independently adjust screw speeds also prevents misalignment by controlling the gap between rollers. Meeting these requirements prompted Köppern to develop a special double-screw feeder design. This design was first introduced into the potash industry in the mid-1990s in roller press upgrades in Germany and Belarus. The newly developed double-screw feeder was subsequently supplied to K+S in Germany and further clients around the world. In 2025, Köppern sold ten potash compactors: two to Canada, six to Congo and another two to a Central Asian state customer.


PHOTO: KÖPPERN

*Köppern builds potash roller press compactors at its state-of-the-art manufacturing and design centre in Germany.*

It is also economically advantageous to provide the roller body with exchangeable tyres, as this allows refurbishment of the tyre profile after wear.

Most of the above improvements and new design features, developed by Köppern over the years, can be found in many compactors used today by the global potash industry. ■





# Innovative cadmium and arsenic removal from phosphoric acid

In this article, **John Carr**, **Lei Zhang** and **Yu Zheng** of Syensqo review the various decadmiation techniques currently available. They introduce Syensqo's ACCO-PHOS® reagent range – and present recent improvements to this technology that increase removal efficiency for heavy metals such as cadmium and arsenic from phosphoric acid.

*Rapeseed (Brassica napus) field, Germany. In the EU, fertilizers applied to fields like this must contain less than 60 mg/kg $P_2O_5$.*

## Introduction

The demand for phosphate fertilizers and feed phosphates is on the rise, due to a growing global population and higher per capita calorific intake. The phosphate rock used in the manufacture of these products can contain cadmium and other heavy metals, often at concentrations that are potentially toxic and mutagenic to humans. Consequently, the introduction of regulatory limits on the heavy metal content of finished fertilizers and feed phosphates – both existing and pending – will increasingly necessitate their removal.

While the toxicity threshold of heavy metals is still the subject of much debate, the EU is currently working towards a phased reduction in permissible cadmium levels in fertilizer products. The 2019 Fertilising Products Regulation (FPR) limits the cadmium content of any fertilizer products placed on the EU market to less than 60 mg/kg $P_2O_5$ – a requirement that entered into force on 16 July 2022. Alongside the FPR, fertilizer producers are allowed to declare their products as low cadmium in the EU, if levels are below 20 mg/kg $P_2O_5$, under a so-called 'green label' scheme introduced in 2021.

Over time, to comply with the FPR and labelling scheme, demand for commercially viable solutions capable of removing cadmium from phosphoric acid and phosphate fertilizers is expected to increase. Similarly, tighter heavy metal regulations for feed and food phosphates should drive market adoption of technologies for cadmium and arsenic removal from phosphoric acid.

Currently, although the permissible levels of heavy metals in fertilizers are generally higher in other regions versus EU regulations, some campaigners and environmental groups are pushing for tougher legal limits. Therefore, fertilizer and feed phosphate producers in other parts of the world, by investigating heavy metal removal now, can ensure they understand and scope their options if tighter regulation of heavy metal content is introduced in the foreseeable future.

> **Cadmium removal from phosphoric acid and phosphate fertilizers is expected to increase.**

Heavy metal removal technologies also offer other benefits. For example, they can provide producers with additional disposal options by lowering the heavy metal content of waste streams. Lastly, producers can potentially gain a competitive advantage by offering low (or no) heavy metal fertilizer and feed products to high value end markets and customers – in response to rising market demand for more 'natural' and 'healthier' food options.

## Need for heavy metals removal

The heavy metal content of phosphate fertilizers products is dependent on several factors. Their original concentration in phosphate rock, the overall type of production process, and individual processing treatments all have an influence.

Heavy metals are partly removed in waste streams such as phosphogypsum and process water. Yet a significant portion still remains in both the phosphoric acid intermediate and finished fertilizer products. In some North African operations, for example, only 10% of cadmium present in the original phosphate rock is recovered with gypsum waste, leaving the remainder in phosphoric acid[1].

Heavy metals like cadmium are toxic to the human body and tend to accumulate in vital organs – where they remain with a very long half-life. Studies suggest that men on average will accumulate 30 mg of cadmium in their bodies by the age of 50[2]. While the exact thresholds (ppm level) which cause harm are still contested, arsenic, lead and cadmium are known to affect human cardiovascular, neurological, renal, respiratory, gastrointestinal and reproductive functions[3]. Consequently, some regions are acting to





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lower cadmium limits in fertilizer and feed products due to these deleterious effects and the associated risks to human health.

## Key technologies for metals removal

Researchers have developed several heavy metal removal technologies for the phosphates industry, with a particular focus on cadmium removal. Cadmium can also be dealt with at the mining and exploration stage.

Cadmium-rich phosphate resources can be specifically excluded from overall reserves estimates at the exploration stage, for example, or reported separately as high cadmium/heavy metal content reserves. Selective mining of phosphate rock from multiple zones can then help avoid ore extraction from high cadmium parts of the deposit.

Cadmium can also be removed via thermal and chemical treatment of various products within the phosphate value chain. A large number of cadmium removal methods are described in the scientific literature. However, only a handful of these – calcination, co-crystallisation, ion exchange, precipitation and solvent extraction – are known to have been applied commercially at industrial-scale to date.

Key reasons behind the slow adoption of decadmiation techniques include:

- Lack of regulatory pressure
- Production of large hazardous waste streams requiring significant capital investments for additional treatment units
- Process flow sheet reconfiguration
- Waste management programmes with little or no economic benefit.

High-temperature **calcination** of phosphate rock (850-1150°C) can be used to volatilise elemental cadmium[4]. Cadmium removals in the range of 75-100 percent have been reported using this approach[5]. Calcination can be achieved at temperatures as low as 700°C in the presence of chloride salts, but may cause excessive corrosion of plant equipment[6].

The only full-scale calcination plant for cadmium removal to date, at Nauru Phosphate Corporation[7], was decommissioned in the late 1990s. The energy intensity of this process may partly explain its lack of adoption to date. Calcination can also require expensive exhaust scrubbing to prevent the atmospheric release of undesirable chemicals, particulates and radionuclides liberated by the process.

Impurities present as ions in phosphoric acid solution are easily amenable to elimination at high removal rates and efficiencies. This is therefore the basis of a large number of technology options for heavy metal removal from phosphate products.

In the mid-1990s, for example, Morocco's phosphates research centre CERPHOS developed a **co-crystallisation** technique for removing heavy metals from phosphoric acid. This exploited the very high affinity of cadmium for anhydrite. The cadmium present in phosphoric acid will readily replace calcium in anhydrite crystals by isomorphic substitution due to their similar ionic radii[8]. The resulting cadmium-loaded anhydrite is then separated by filtration and discarded, similar to phosphogypsum.

> **Researchers have developed several heavy metal removal technologies for the phosphates industry, with a particular focus on cadmium removal.**

Co-crystallisation can achieve cadmium removal in excess of 85% from feed levels of 170 mg Cd per kilo of phosphorus[9]. The technique does, however, have drawbacks. Sub-optimal process conditions can inhibit crystal growth, for example, and result in poor acid recovery. The contaminated gypsum generated by the process is also unmarketable.

Cadmium and other metals can also be removed from phosphoric acid by **precipitation** as insoluble sulphides or metal-ligand complexes. These can then be filtered-out to obtain a cleaner phosphoric acid. Sodium, hydrogen or organic sulphides all make suitable anion sources ($S^{2-}$). These are injected into or pumped through the acid solution – in the form of organothiophosphates – to initiate precipitation.

Elements such as copper, zinc, and iron are also precipitated. This makes the process less selective for cadmium and generates large volumes of toxic sludge. The precipitation process may also release highly toxic hydrogen sulphide gas, depending on the reagent used. This increases overall treatment costs and risks exposure to hazardous chemicals.

**Adsorption** – the capture of metal ions using adsorbents – is another technology for removing cadmium from solutions of phosphoric acid. Suitable adsorbents include synthetic materials, naturally occurring substances, mining overburden, and materials based on micro-organisms, as well as agricultural and agro-industrial wastes[10]. The successful removal of heavy metals from acid mine waters are reported by numerous adsorption research studies, suggesting that adsorbents could be successfully applied as a process solution for phosphoric acid.

**Cementation** offers a similar approach. In this process, metal ions are precipitated at the solid interface of a sacrificial metal, sometimes in conjunction with an organic reagent. While cadmium removal rates from wastewater of up to 95% have been successfully reported by researchers[11], scientific studies for phosphoric acid are more limited. Pilot-scale and plant-scale cementation testing, however, has yielded phosphoric acid containing less than 1 ppm and 8 ppm cadmium, respectively[12].

In **solvent extraction**, selective mass transfer of cadmium and other metals takes place from aqueous phosphoric acid to an organic solvent. The metal loaded organic solvent is then separated and regenerated for re-use after being stripped of cadmium. Solvent extraction is currently a prevalent technology for extracting copper, nickel, uranium and cobalt from sulphuric acid leach solutions.

**Membrane extraction** is a similar technology. In this high selectivity technique, mass transfer from the source phase to the receiver phase takes place across supported liquid or solid film membranes – the key drivers being electrochemical potential, pH, hydrostatic pressure or concentration gradient across the two phases.

Information on the large scale viability of these extraction methods is limited, as most of the research work has been carried out at lab scale. Nonetheless, solvent extraction has been demonstrated at industrial scale (30,000 t/a capacity) at a US phosphoric acid purification plant. The licensor, KEMWorks, reported a successful reduction in cadmium from 125 mg/L to less than 5 mg/L, with low capital and operating costs[13].

In general, solvent extraction processes require pre- and post-treatment of phosphoric acid for effective separation and to remove residual solvents, especially when producing food-grade phosphoric acid or phosphates. The large volumes of solvent needed also add to process costs[4] and are another potential drawback.





The efficacy of **ion exchange** for heavy metals removal, using both anion and cation exchange resins, has been investigated. Research has, however, mostly focused on water and wastewater treatment, with only limited studies of phosphoric acid applications.

Anion exchange resins show a greater selectivity for cadmium, versus cation exchange resins, and are therefore the preferred media for removal from phosphoric acid. The cadmium ions present need to be converted into anionic complexes as a pre-treatment step (generally with halides in a reducing environment) before being selectively removed by the anionic exchange media.

In the mid 1990s, anion exchange was successfully tested at pilot-scale for cadmium removal from phosphoric acid in combination with the hemihydrate-dihydrate (HDH) process – with some researchers even recommending this as a Best Available Technology (BAT)[14]. Cadmium was reduced to less than 2 mg of Cd per kg of $P_2O_5$ with treatment costs as low as $15-25 /t $P_2O_5$[15].

Nonetheless, ion exchange technology has significant drawbacks. These include poor selectivity (especially against divalent ions), the need to pre-treat the phosphoric acid (clarification to prevent media bed clogging), equipment corrosion (from chloride ions) and the careful handling and disposal of the resin regeneration solutions.

### ACCO-PHOS® TECHNOLOGY: MAIN FEATURES AND BENEFITS

**Bolt-on technology**

- No need for heavy capital expense
- Additional unit operations/processes unnecessary
- Add it neat to the acid at the recommended point
- Dosage directly proportional to the concentration of metal impurities

**High heavy metal removal efficiency**

- One reagent product is suitable for multiple metals (Cd, As, Cu, Pb, Hg) depending on the concentration of competing ions
- Complementary solution available in higher dosage situations because of competing metal ion concentrations

**Customised to process conditions**

- Can work at different residence times – from a few seconds to several hours
- Can work at range of temperatures – from room temperature to 80°C
- Stable heavy metal-ACCO-PHOS® complex formed

**Application flexibility**

- Weak acid slurry (reactor slurry to filters)
- Strong acid (merchant grade)
- Super phosphoric acid

**Proven technology**

- Highly efficient and consistent performance in numerous lab tests and plant trials
- Robust to diverse ore and plant conditions
- Supported by Syensqo's strong R&I capabilities and deep application expertise in servicing global mining industries for over a century

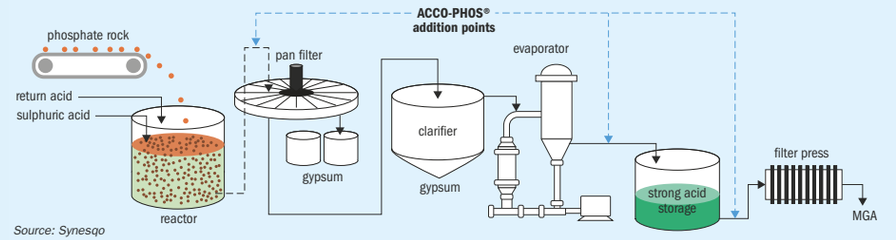
## ACCO-PHOS®: Syensqo's heavy metal removal solution

From the above literature review, it is clear that several technological options for effective heavy metals removal from phosphate rock or phosphoric acid – especially for cadmium – are currently available to producers. However, these options all suffer from various downsides, including high 'in-use' reagent costs or high capital intensity.

Syensqo has developed ACCO-PHOS® technology to specifically address the increased demand for heavy metal removal within the phosphate industry. This family of reagents avoids many of the usual pitfalls and downsides – thereby offering a more attractive and effective commercial option for the removal of heavy metals from weak and strong phosphoric acid. Critically, ACCO-PHOS® reagents are particularly selective for cadmium and arsenic.

Using proprietary chemistry, ACCO-PHOS® forms an insoluble complex with heavy metals in the acidic solution. Advantageously, the reagents can be applied at multiple points of the phosphoric acid production and purification process, as shown in Figure 1.

Fig. 1: **Application of ACCO-PHOS® series reagents**




*Source: Synesqo*





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Table 1: **Cadmium removal results for five plants that have previously or are currently using ACCO-PHOS® at pilot- or industrial-scale**

| | application point | ACCO-PHOS® dose kg/t $P_2O_5$ | temp., °C | contact time | heavy metal removed |
|---|---|---|---|---|---|
| **Plant A** | weak acid filter feed slurry | 5-6 | 72 | 10 seconds | 73% reduction in cadmium |
| **Plant B** | strong acid | 2 | 60 | 20 minutes | 91% reduction in cadmium |
| **Plant C** | strong acid | 3 | 50 | 2 minutes | 90% reduction in cadmium |
| **Plant D** | pilot unit, strong acid | 2.5 | 70 | 5 minutes | 97% reduction in arsenic |
| **Plant E** | pilot unit, strong acid | 5 | 60 | 10 minutes | 83% reduction in cadmium |

*Source: Synesqo*

ACCO-PHOS® is a 'bolt-on' technology that requires only minimal capital investment for most applications. The need to separate the precipitated heavy metal solids formed from phosphoric acid streams is generally the only additional process requirement. These precipitates adsorb onto the surface of solids within the system, such as phosphogypsum, and can therefore be filtered out. The ACCO-PHOS®-heavy metal complex that forms is also less dense than concentrated acid, allowing for removal via gravity separation or centrifugation.

ACCO-PHOS® technology has been proven at an industrial scale, with multiple plants consistently purchasing commercial quantities to purify phosphoric acid. Table 1 provides a list of plants that have used, or are currently using, ACCO-PHOS® at pilot- or industrial-scale, together with pertinent application details and performance results for cadmium removal.

Two charts are included to illustrate the efficacy of ACCO-PHOS® technology for the commercial removal of heavy metals at phosphoric acid plants. Figure 2 shows the percentage heavy metal (Cd, As) removal by ACCO-PHOS® from phosphoric acid (50% $P_2O_5$) for three phosphoric acid plants, (A, B & C). Figure 3, meanwhile, shows the percentage cadmium removal from phosphoric acid (52% $P_2O_5$) using five different ACCO-PHOS® formulations. This illustrates how fine tuning ACCO-PHOS® technology can speed up cadmium removal by altering reaction kinetics and/or dispersion.

ACCO-PHOS® is a robust 'bolt-on' technology that requires minimal capital outlay. The reagent can be applied to reduce the cadmium and arsenic content of the treated acid to the desired level in one of two ways (Figure 1):

- As a single-stage addition to concentrated acid
- By multi-stage additions to weak or concentrated acid.

The extent of heavy metal removal and dosing requirements – being influenced by the concentration of other competing ions such as zinc, copper and mercury – will vary according to the chemical characteristics of the phosphoric acid.

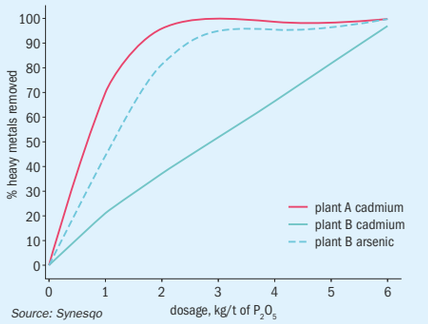
## Summary

As discussed in this article, while a number of decadmiation technologies have been demonstrated at the laboratory- or pilot-scale, only a select few have gone on to be implemented at industrial-scale. The addition of process chemicals required by many of these technologies can be deleterious, having a negative impact on product quality or process efficiency. Examples include the formation of large volumes of toxic sludge, spent adsorbent or solvent, all requiring costly disposal and careful waste management planning. These drawbacks have generally discouraged fertilizer producers from adopting these technologies at industrial-scale.

In contrast, Syensqo's ACCO-PHOS® reagents provide a simple, effective and economical method of reducing cadmium and arsenic levels in phosphoric acid. Importantly, it is a 'future proof' technology that can meet both current and potential future regulatory requirements. Beneficially, these reagents can also provide phosphate producers with the flexibility to develop and produce new low heavy metal content fertilizers, feed phosphates and purified phosphoric acid.

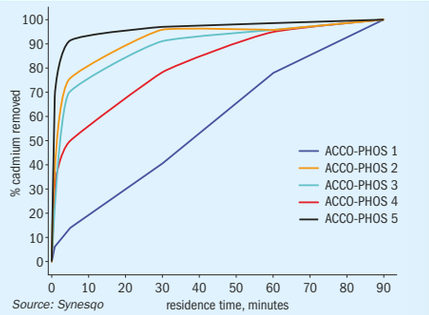
ACCO-PHOS® reagents are already being actively adopted by fertilizer producers at industrial scale. And this is just the start. Looking ahead, Syensqo is committed to investing in the development of more selective, efficient and sustainable technologies to remove other heavy metals of concern. ■

Fig. 2: **Percentage heavy metal (Cd, As) removal by ACCO-PHOS® from phosphoric acid (50% $P_2O_5$) for three phosphoric acid plants, (A, B & C)**




*Source: Synesqo*

Fig. 3: **Cadmium removal from phosphoric acid (52% $P_2O_5$) using five different ACCO-PHOS® formulations. This show how fine tuning ACCO-PHOS® technology can speed up cadmium removal.**




*Source: Synesqo*

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**ISSN:** 0015-0304

**Design and production:**
TIM STEPHENS, CRAIG PORTER

Mixed Sources
FSC

**Printed in England by:**
Buxton Press Ltd
Palace Road, Buxton, Derbyshire, SK17 6AE



**Published by: CRU Publishing Ltd**
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