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IFA Annual Conference, Monaco

CBAM – Europe's low-carbon leap

How to revamp a urea plant

European potash innovation

Cover: Illustration of Monaco
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What does CBAM mean for the fertilizer industry?

K+S move into the green fertilizer market

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Guest Editorial

The future of food

Alzbeta Klein, CEO and Director General of the International Fertilizer Association (IFA), sets the scene for IFA's Annual Conference in Monaco, 12-14 May.


PHOTO: IFA

Alzbeta Klein, IFA's CEO and Director General.

As we approach the 2025 IFA Annual Conference, I once again find myself reflecting on the rapidly changing world around us, and the impact of these changes on our industry. The theme we have chosen for this year's Annual Conference, *Investing in the Future of Food*, couldn't be more timely or relevant – as we continue to work together to overcome challenges such as geopolitical realignments, shifting consumer demands, environmental imperatives and technological disruptions. Yet, within these challenges lie immense opportunities for innovation and growth.

IFA 2025 Annual Conference will delve into the heart of these issues.

Securing food for all

We'll explore how *What we eat is about to change*, for example, examining the forces that are reshaping our food systems. From the protein transition to evolving consumer behaviours, we're witnessing a transformation in global agriculture. As an industry, we must not only adapt to this change but demonstrate leadership and innovative thinking.

The conference session on *Farming 4.0* will be particularly important. We'll investigate how digital technologies are revolutionising agriculture, from AI-driven precision farming to blockchain-enabled supply chains. This isn't just about exciting new gadgets; it's about fundamentally reimagining how we produce food and manage precious resources. I am excited to be part of these discussions and proud to convene our industry to resolve some of the most pressing issues of our time.

Food security continues to loom large over our discussions, particularly as the global population is projected to reach nearly 10 billion by 2050. Meeting the growing demand for food will require consideration of the entire agri-food system and value chain. The fertilizer industry is uniquely positioned to play a leading role in this transformation, ensuring that agricultural productivity keeps pace with population growth, while addressing critical issues such as nature protection and water management. To secure food for all, we must rethink how food is grown, transported, processed, and consumed. This requires not only technological innovation but also systemic changes that prioritise resilience.

AI and young leaders – the shape of things to come

As with many of IFA's recent conferences, artificial intelligence will be a major focus of this year's event. We'll examine how AI can optimise production, deliver precise fertilizer recommendations, accelerate R&D and explore the ethical questions it raises.

Building on those discussions, our most exciting Young Leaders Session will turn to the human side of innovation. Because technology alone cannot drive change, we'll explore how to attract, empower and retain the brightest minds whose energy and ideas bring AI's promise to life and keep our sector future-ready.

Whatever next?

As we look to the future, several key themes emerge:

- **Technology** will continue to reshape agriculture. From AI applications to precision farming, we must be at the forefront of these innovations.
- **Consumer demands** are evolving rapidly. Understanding and responding to these changes is crucial for our industry's relevance.
- **Collaboration** is key. The challenges we face are too complex for any one company or sector to solve alone. We must foster partnerships across the agricultural value chain.
- **Talent development** is critical. Attracting and nurturing the next generation of leaders will determine our industry's long-term success.
- **Sustainability** solutions continue to be the cornerstone of our industry's future.

From input providers to partners

We have the knowledge and the resources to back our responsibility to drive meaningful change in global agriculture. We must move from mere input providers to true partners in sustainable food production. We must invest in fresh thinking, innovate to meet sustainability challenges and empower the next generation of leaders to reimagine the future of agriculture and food production. The challenges are significant, but so are the opportunities.

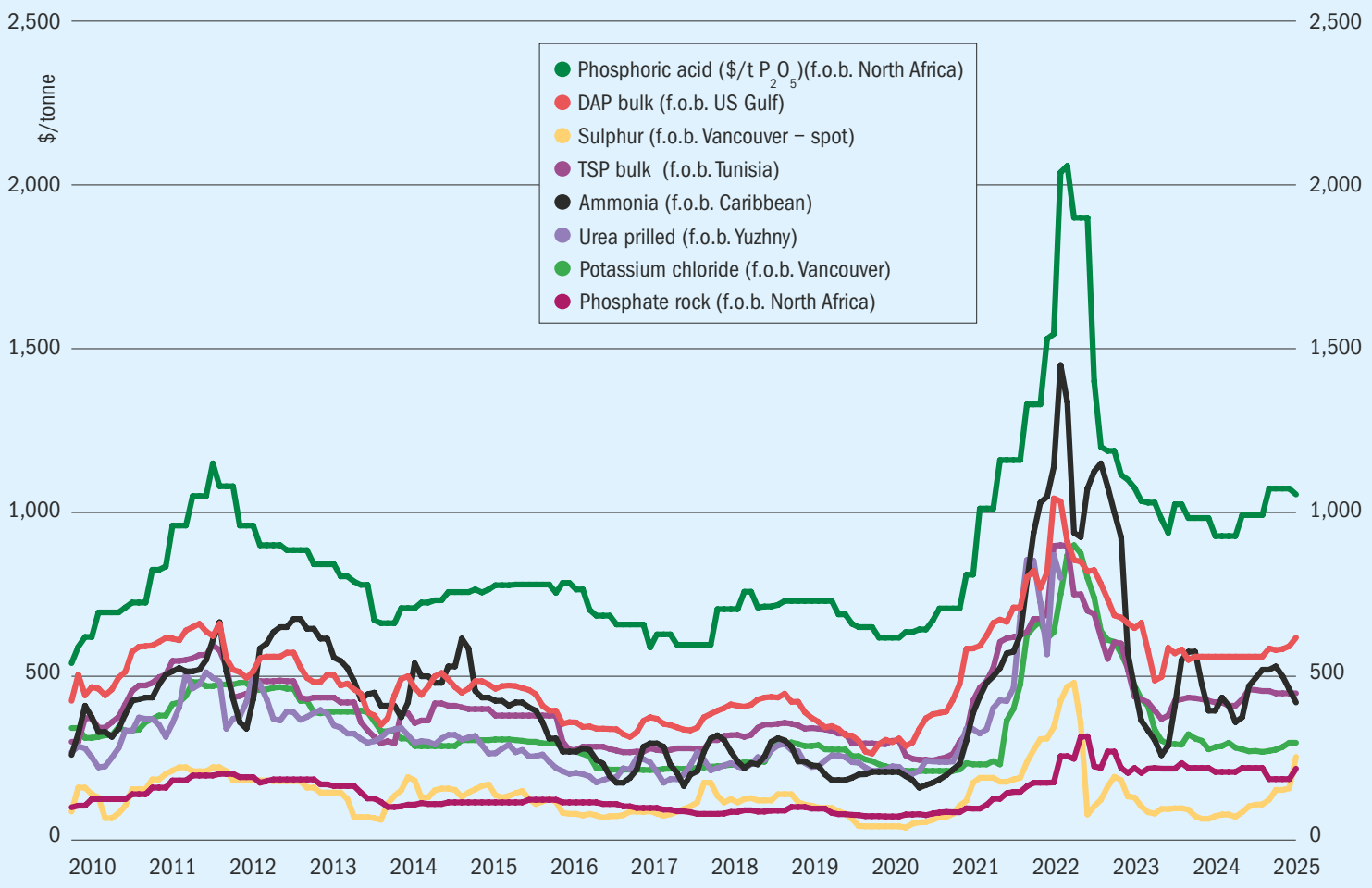
A call to action

As we gather for this year's Annual Conference, I would like to challenge each of you attending the event to think boldly about our industry's future. How can we contribute to a more resilient global food system? How can we leverage our expertise to address the pressing challenges of our time?

The 2025 IFA Annual Conference is a call to action. It's an opportunity to shape the future of agriculture and food production. Let's seize this moment, invest in the future of food, and create an industry that not only adapts to change but drives it. Together, we can nourish the planet and power the future. I look forward to engaging in these critical discussions with you in Monaco. ■

Market Insight

Historical price trends $/tonne



Source: CRU

PRICE TRENDS

Market snapshot, 10th April 2025

Urea takes strength from India. Suppliers were looking to gain ground in mid-April with India in search of urea and spot interest emerging from Australia.

India's IPL closed a tender for 1.5 million tonnes on 8th April – 800,000 tonnes for the west coast and 700,000 tonnes for the east coast – for shipment by mid-June latest. It is not yet clear whether IPL can secure the tonnages required, with just short of 400,000 tonnes accepted to date. The lowest offer was $385/t cfr west coast for 50,000 tonnes and $398/t east coast for 75,000 tonnes.

NOLA prices, unsurprisingly, have been volatile as US tariffs have come and gone, hitting $425/st before slipping below $400/st. There have been some market negatives too. Brazil, for example, saw offers fall to $383/t Paranagua while bids slumped with unconfirmed reports of trades at $370-375/t cfr.

Ammonia bearish amid tariff complexities. Ammonia prices east and west of Suez remain firmly on the downside, with supply still heavily exceeding demand and suppliers scrambling to place excess tonnages. This bearish market sentiment was exemplified by a Trammo sale to OCP at $415/t cfr Morocco, some $20/t below Tampa's $435/t cfr settlement for April and around $44/t down on what OCP last paid for spot tonnes in early February.

Across the Atlantic, exports from the US Gulf are continuing. Price suggestions there are now below $400/t f.o.b. – and possibly as low as $350/t f.o.b. – amid healthy availability from regional suppliers.

Market length in Southeast Asia, and poor demand from adjacent markets, has seen Mitsui resort to shipping a Kaltim cargo from Indonesia to the Americas. Industrial appetite from East Asia remains limited, with contract prices in South Korea, Taiwan and China steadily slipping towards the $300/t cfr mark.

No end in sight for DAP/MAP price rises. Key DAP and MAP benchmarks both east and west of Suez – including prices in India, Brazil and the US – continued to climb in mid-April, amid firm demand and exceptionally tight availability.

The US market received extra support from tariff expectations and uncertainty, with prices for New Orleans DAP and MAP barges rising on concluded trades. The evolving tariff situation in the US may further limit import options and/or drive-up US pricing.

The absence of Chinese DAP/MAP supply is keeping global availability tight and, consequently, news is keenly awaited on when China might return to the export market. The spot price for DAP to India has increased sharply to $668-675/t cfr. Further increases are widely expected over the coming weeks.

Additional demand from EABC's latest tender, closing 23rd April, is another cause of tight DAP availability. EABC, which typically imports more than one million tonnes NPS from Morocco annually, is understood to have secured around 660,000-720,000 tonnes of DAP to date.

Market price summary $/tonne – end March 2025

Nitrogen	Ammonia	Urea	Ammonium Sulphate	Phosphates	DAP	TSP	Phos Acid
f.o.b. Caribbean	395	-	f.o.b. E. Europe 287	f.o.b. US New Orleans*	619	-	-
f.o.b. New Orleans*	-	438	-	-	-	-	-
f.o.b. Yuzhny	Port closed	Port closed	-	f.o.b. N. Africa	635	465	1,053
f.o.b. Middle East	290	391	-	cfr India	649	-	1,153
Potash	KCl Standard	K_2SO_4	**Sulphuric Acid**		**Sulphur**		
f.o.b. Vancouver	307	-	cfr US Gulf	130	f.o.b. Vancouver	268	-
cfr India	284	-	-	-	f.o.b. Arab Gulf	280	-
f.o.b. Western Europe	-	629	-	-	cfr China	268	-
f.o.b. Baltic	270	-	-	-	cfr India	295	-

*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*

Potash bullish yet largely flat. Potash benchmarks outside of Southeast Asia and China are mostly stable. Bullish sentiment is being supported by the continued limited availability of product for prompt shipment.

In Southeast Asia, Pupuk Indonesia's long awaited 170,000 tonne standard MOP import tender is expected to contribute further to the upward price momentum. Initial offers were reported between $360-400/t cfr for shipments from July to September. This pathfinder tender is expected to provide a clearer indication of pricing in the coming months. In the meantime, standard MOP prices held at $320-335/t cfr.

Brazil's MOP import prices held steady at an average of $348/t cfr, with May shipments sold out and limited availability. Offers for June have spiked to $350-370/t cfr, although no sales at the higher end of this range have been confirmed.

The US market has remained quiet this week following the Trump administration's 2nd April announcement confirming potash's exemption from import duties under Annex II. Market uncertainty still persists, however, this being compounded by severe weather and flooding causing operational disruptions and delays along the Mississippi River. The NOLA market experienced a slight decline, with MOP values averaging $316.5/st f.o.b.

Global sulphur prices mostly unchanged. Global sulphur prices were mostly unchanged in mid-April, except for Chinese domestic prices which slid back on weakening demand.

Prices in China have dropped to a delivered price of approximately $272/t cfr. Domestic demand from both the agricultural and industrial sectors has weakened in recent weeks. This has been due to uncertainty over US tariffs and Chinese export restrictions, as well as the imminent closing of the spring application window.

Middle East prices remained flat for the third consecutive week. Monthly contracts from Kuwait Petroleum Corporation, Adnoc and QatarEnergy Marketing ranged $275-280/t f.o.b., while second quarter contracts were settled at $240-250/t f.o.b., an average increase of $90/t.

OUTLOOK

Urea prices bottom out. Urea's downwards trajectory ended with India finally stepping into the market. Prices should now stabilise in the short term, given that India is likely to have to tender again. Not all benchmarks are expected to increase, however, with fading European interest likely to take its toll on Algeria and Egypt. While prices have recovered somewhat, further pressure is expected going forward as European and US demand diminishes. Higher prices could be seen, however, if Chinese exports fall below CRU's forecast of the 2.6 million tonnes for 2025, and if the EU moves to impose tariffs on Russian imports from July.

Ammonia declines to continue. Prices should continue to come under pressure in late April, although it remains to be seen just how much further Asian values can decline before producers begin to shutter output. Conversely, questions remain about how much of an upside impact the 10% US import tariff will have on May's Tampa settlement. In general, ammonia price declines are forecast to continue into the second quarter as healthy supply continues to outweigh global demand. Prices could come under further downward pressure if EuroChem's Port Favor terminal at Ust Luga ramps-up transshipment capacity to one million t/a resulting in an uptick in Baltic Sea exports.

Phosphates firming on tight supply. Phosphates prices have firmed over the past month and are expected to increase further over the coming weeks, as demand picks up while supply remains exceptionally tight. The second quarter outlook is now more bullish due to China's delayed return to export markets. Slight price declines are possible towards the end of the quarter, but the bullish sentiment should prevail at least until then. Prices could, however, remain firmer for longer if China exports return even later than expected and/or in lower volumes than forecast.

Potash prices revised higher. Firm sentiment persists in the MOP market, driven by limited May product availability in most key markets. In Southeast Asia, the settlement of the latest Pupuk Indonesia tender is expected to provide further clarity on price direction in coming weeks. Key MOP contracts are expected to settle in May at prices higher than previously forecast. Potash spot prices outside the US have also been revised slightly higher due to healthy demand, ongoing uncertainty over US tariffs and second quarter mine production cutbacks. US tariffs, by creating uncertainty, could raise the US premium over global prices, while supply issues may worsen if producers scale back their output.

Sulphur at its peak. Sulphur prices are expected to reach their peak in April and then gradually decrease after the Chinese spring application season, with additional volumes entering the market. Prices could decline more sharply than expected if current market conditions in Asia change and demand weakens further. In the short term, global sulphur prices are likely to enter a period of limited movement as demand in China weakens. ■

Fertilizer Industry News

UNITED STATES

US tariff pause brings relief to fertilizer exporters

PHOTO: SIMON INGLETHORPE

Washington paused reciprocal tariffs on 9th April, just one week after their launch on 'liberation day'.

President Donald Trump delayed his 'liberation day" tariffs by three months on 9th April, while simultaneously ramping up levies on China.

In this latest twist to the on-off US tariffs saga, the Trump administration's 90-day pause on additional duties should provide international suppliers to the world's biggest fertilizer market with some respite – for now.

With the exception of China, the US will now cut back its so-called 'reciprocal tariffs' to 10% for the duration of a three-month suspension period. The European Union's tariff is now halved to 10%, for example, with the trade bloc also pausing its trade countermeasures against the US.

At the time of writing in mid-April, fertilizer producers that export urea, UAN, ammonia and DAP/MAP/TSP to the US will generally face a blanket 10% rate.

Under the 90-day pause, tariffs on urea imports from Algeria will fall the most, being cut from 30% to 10%, while Nigeria's urea tariff was cut from 14% to 10%. The rate on Middle Eastern urea producers was unchanged, being at 10% already.

Previous levies on granular phosphate imports from Jordan (20%), Israel (17%) and Tunisia (28%) will also now fall to the more favourable 10% flat rate. Saudi Arabia and Australia were already at this lower rate and therefore unaffected. The additional 10% tariff on phosphate imports from Morocco is expected to be added to the existing US countervailing duties (CVDs) of 16.6%, although this has yet to be confirmed.

Importantly, a number of fertilizer commodities are exempted from any US import tariffs under the Harmonized Tariff Schedule (Annex II). These include potassium chloride, potassium nitrate, potassium sulphate, phosphate rock and NP/NPK fertilizers.

The 10% blanket tariff does not apply to America's northern and southern neighbours, Canada and Mexico, either. Instead, any imports from these two countries that comply with the United States-Mexico-Canada Agreement (USMCA) are exempted from the current 25% tariff imposed by the US.

This USMCA exemption notably covers US sulphur imports. While US sulphur consumption is primarily domestically sourced, imports still account for around 20% of total demand, with Canada being the primary supplier, making up 90% of total non-US purchases.

US tariffs on China, meanwhile, have increased from 104% to 145%.

Russia, in contrast, has emerged as a clear winner amid the policy chopping and changing by the Trump administration. US fertilizers imports from the country are not currently subject to any import tariffs or restrictions. Russia was notably absent from the 'liberation day' country list shown by President Trump to the world on 2nd April. At the time, the US administration said that Russia was not being targeted for 'reciprocal tariffs' because existing sanctions already "preclude any meaningful trade".

While Russian fertilizer suppliers were spared from further tariffs, the country's phosphate producers already face prohibitive countervailing duties (CVDs), as does Morocco's OCP. These have largely killed off phosphate fertilizer shipments from Russia and Morocco to the US since their implementation in 2020.

New US tariff policy may also reroute ammonium sulphate (AS) trade. Europe became the largest supplier of AS into the US market last year, surpassing Canada. With the introduction of 10% duties, the flow of European AS into the US may slow down but is unlikely to cease, given the attractive US market premium and the oversupply of AS elsewhere globally.

Summing up, international fertilizer suppliers to the US, and buyers within it, will have breathed a sigh of relief on the news of a three-month pause in 'reciprocal tariffs'. However, while fertilizer suppliers such as Algeria, Tunisia and Jordan may be able to retain some of their US market share, a newly-built if slightly lower tariff wall remains in place.

Tariffs at their current levels will still raise the cost of fertilizers in the US and, consequently, these are likely to be priced at a premium in coming months compared to other global markets. ■

UNITED STATES

CF Industries announces low-carbon ammonia joint venture

CF Industries is set to construct the world's largest low-carbon ammonia plant in Louisiana as part of a joint venture (JV) with Jera and Mitsui.

Production is scheduled to start in 2029. The project, which is located at CF Industries' Blue Point Complex, expects to qualify for 45Q tax credits for approximately 2.3 million tonnes per year of sequestered CO_2.

The JV will cover the construction, production and offtake of low-carbon ammonia. Its ownership is divided between:

- CF industries (40%)
- JERA, Japan's largest energy company (35%)
- Leading global investment and trading company Mitsui (25%).

Together, the three partners will construct an autothermal reforming (ATR) ammonia production plant at the Blue Point Complex. This will have a nameplate capacity of around 1.4 million t/a, making it the largest ammonia production facility in the world, according to CF. The new ammonia plant will be coupled to an on-site carbon dioxide (CO_2) dehydration and compression unit to prepare the captured CO_2 for onward transportation and sequestration.

Carbon capture, utilisation, and sequestration (CCUS) for the project will be handled by PointFive, a subsidiary of Occidental. This company will transport and then sequester approximately 2.3 million tonnes of CO_2 annually at its Pelican Sequestration Hub in Louisiana.

The project's estimated $4 billion construction cost will be funded by each partner according to their ownership percentage. The respective ownership stakes will also determine the division between the three companies of the ammonia offtake from the plant.

CF Industries will be responsible for the operation and maintenance of the new ammonia production plant. The company will also invest approximately $550 million in supporting infrastructure for the project at its Blue Point site, including product storage and loading facilities.

"CF Industries is proud to partner with global leaders JERA and Mitsui to build the leading low-carbon ammonia production facility in the world," said Tony Will, CF Industries' president and CEO. "Our joint venture represents tangible progress towards building a reliable and affordable low-carbon ammonia value chain to meet what we expect to be robust global demand for low-carbon ammonia for both traditional and new applications."

The JV awarded the engineering, procurement and module fabrication contract for the low-carbon ammonia production plant to Technip Energies. The process license was awarded to Topsoe for its low carbon (blue) SynCOR ATR ammonia plant technology.

CF said pre-construction activities and engineering evaluations at the Blue Point Complex will begin this year, with construction expected to begin in 2026.

JORDAN

Metso awarded beneficiation plant contract

Metso has secured a two-year life-cycle contract with Ideal Development for Manufacturing Industries (IDMI) for a new phosphate beneficiation plant at the Eshidiya phosphate mine in the south of Jordan.

Metso will support the commissioning, ramp up and optimisation of Eshidiya's new beneficiation plant. Its contract with IDMI covers both maintenance and plant operations.

The latest agreement is a follow up to Metso's previous equipment contract with IDMI – its first phosphate contract in the Middle East Region – signed in 2023. Metso previously supplied most of the critical equipment in the beneficiation flowsheet, including grinding, flotation, thickeners, filters and pumps, as well as Metso's energy and water efficient UltraFine Series™ screens. These are the first ultra fine screens to be installed at a phosphate beneficiation plant, according to Metso.

PARAGUAY

ATOME awards Casale $465 million EPC contract

ATOME has signed a definitive engineering, procurement and construction (EPC) contract with Casale for its Villeta project in Paraguay.

The 260,000 t/a capacity project will produce low-carbon calcium ammonium nitrate (CAN) and is the first of its kind in the Mercosur region. It will be powered using 100% renewable baseload hydroelectricity from the adjacent Itaipu dam.

"Once constructed, the Villeta project will service a developed and ready market in the heart of the largest food-producing region in the world, meeting critical demand for low-carbon fertilisers from the agriculture and food sectors," ATOME said in a statement.

The $465 million, fixed-price, lump-sum contract commits Casale to completing the Villeta project and starting production within 38 months of the final investment decision (FID). ATOME is aiming to make the FID for the project in the first half of 2025.

The signing of the contract follows Casale's appointment as EPC Contractor in November last year (*Fertilizer International* 524, p31) and the recent announce-

PHOTO: METSO

Metso signs a two-year beneficiation plant contract with Jordan's IDMI


PHOTO: ATOME

ATOME and Casale at the latter company's HQ, Lugano. Switzerland.

ment of Hy24 as a major equity investor in the project (*Fertilizer International* 525, p10). Advanced engineering work has already started in Paraguay, according to ATOME, this being consistent with the current timeline for project start-up and the first sales of green fertiliser in 2028

Olivier Mussat, ATOME's CEO, said: "ATOME is delighted to announce the signing of our EPC Contract with Casale, on time and on track to our project schedule. This underscores our ability to deliver final agreements and marks another milestone achieved as we advance to reach FID for the Villeta Project towards the end of H1 2025. Casale is a world leader in ammonia and fertiliser engineering, and I have every confidence in the team as the right partners to deliver our flagship project in Paraguay, the first green fertiliser facility of its kind."

Federico Zardi, CEO of Casale, said: "We at Casale are immensely proud to be an integral part of ATOME's world-first green fertiliser Villeta project in Paraguay. For over a decade, Casale has been advancing the development of CO_2 emissions-reduction technologies in fertiliser production. Through these technological advancements, we are delivering an extremely optimized design at Villeta, setting a precedent for sustainable fertiliser production at costs that are competitive with, or even lower than, conventional 'grey' fertilisers, paving the way to a sustainable agricultural future."

He continued: "This partnership reaffirms our role as pioneers in the industry, consistent with our historical trajectory and DNA. It is an honour to work alongside a company that is as committed to innovation and sustainability as we are, and we are confident in ATOME's ability to execute on this project, successfully scaling and leading this first green fertiliser platform."

The EPC contract forms a part of the total estimated cost of $625 million for the Villeta project.

MOROCCO

OCP Nutricrops unveils nine million tonne production boost

OCP Group subsidiary OCP Nutricrops has announced a major investment to expand its phosphate fertilizer production capacity by nine million tonnes by 2028.

The company will achieve this by developing two new mining and industrial hubs in Morocco, at Mzinda in Youssoufia and Meskala in Essaouira, respectively. These will incorporate cutting-edge 'Industry 5.0' technologies, artificial intelligence and automation, according to OCP Nutricrops.

The two new production centres will also run exclusively on renewable energy (solar and wind) and consume non-conventional water sources, such as desalinated water and treated wastewater. The adoption of a modular, scalable design also means their production output – principally triple superphosphate (TSP) – can be adjusted in response to fluctuating market demand and the needs of farmers worldwide.

"These facilities, integrating cutting-edge technology and sustainability principles, will progressively increase fertilizer production capacity by 9 million tons by 2028 (notably TSP and TSP+), with 4.5 million tons expected as early as 2026," OCP Nutricrops said in a statement.

The newly announced investment forms part of OCP's strategic programme for Mzinda-Meskala (SP2M). This is designed to significantly increase OCP Group's production capacity while strengthening its competitiveness and commitment to carbon neutrality by 2040.

To help deliver the expansion programme, OCP Nutricrops is working with key partners, such as Mohammed VI Polytechnic University (UM6P), INNOVX, and JESA, to develop local and international partnerships in green energy, the circular economy and Industry 5.0.

MALAYSIA

Pursell Agri-Tech partners with Wastech on CRF plant

Pursell Agri-Tech is to build and operate a fertilizer coating plant in Malaysia dedicated to the production of advanced controlled-release fertilizers (CRFs)

The leading fertilizer coating technology company, based in Sylacauga, Alabama, in the US, has entered into an agreement to construct the plant for Wastech Group, an integrated agricultural and landscaping solutions provider based in Southeast Asia.

"Partnering with Wastech to build a plant in Malaysia is ideal," said Tim Ferguson, Pursell's CEO. "It's located near key substrate and material suppliers and creates opportunities to address the diverse nutrition needs of customers in the region in a predictable, prescriptive and profitable way."

The new plant is expected to become operational and start producing CRFs in spring 2027 – and will capitalise on Pursell's innovative coating materials and proprietary processing techniques. The company's patented technology will also enable the creation of bespoke CRF formulations incorporating micronutrients and temperature-sensitive additives, such as biologicals, growth enhancers and soil health promoters.

"This partnership with Pursell marks a significant step forward in our commitment to sustainable agriculture in Southeast Asia," said Nicholas Hii, Executive Director of Wastech Group. "We are well-positioned to deliver high-performance, cost-effective, and environmentally responsible fertilizer solutions that meet the needs of our plantation and agricultural customers."

CRFs produced at the plant will target key crops in the region, with a primary focus on oil palm. Trials conducted with major plantation groups have shown that CRFs can reduce fertilizer application frequency by up to 30%, while increasing nutrient uptake efficiency and minimising losses due to leaching, particularly in challenging environments such as peat and sandy soils.

The plant's production capacity will enable Wastech to expand further into high-growth segments including rice fields and fruit orchards, such as those for durian.

The new CRF production plant will serve markets across Southeast Asia, as well as Australia, New Zealand, South Korea, and Japan, where demand for advanced fertilizer technologies is growing due to an increasing focus on sustainability and evolving agricultural practices.

IRELAND

OMEX opens liquid fertilizer hub

OMEX Ireland officially opened the country's first and largest dedicated liquid fertilizer distribution hub at the Port of Cork in March. The hub's opening marks a major milestone for Irish agriculture, according to OMEX, as it ensures farmers across the country will now have reliable access to high-quality liquid fertilizers.

With significant storage capacity at Cork terminal, the hub is strategically positioned to serve all the country's key agricultural regions. The state-of-the-art facility will operate continuously to supply high-performance liquid N+S fertilizers on a 24/7 basis.

The hub was inaugurated on March 5th with key representatives from OMEX attending, including Chairman Max Winkler and Managing Director Sam Bell, together with leading figures from the Irish farming community.

Liquid fertilisers are revolutionising nutrient management for both tillage and grassland farms across Ireland, according to Luke Thornton, Sales Manager for OMEX Ireland.

"Our liquid fertiliser solutions are designed to optimise nutrient uptake, maximise productivity, and support sustainable farming practices," he said. "Irish farmers are facing increasing pressure to enhance yields while managing input costs and reducing environmental impact. OMEX liquid fertilisers offer a precision-based approach, delivering essential nutrients exactly where and when they are needed."

OMEX said the new hub reinforces its long-term commitment to Irish agriculture. By improving nutrient efficiency and minimising waste, liquid fertilizers play a crucial role in reducing the environmental footprint of farming systems across the country, the company added.

The first liquid fertilizer shipment arrived at the hub on 10th March.

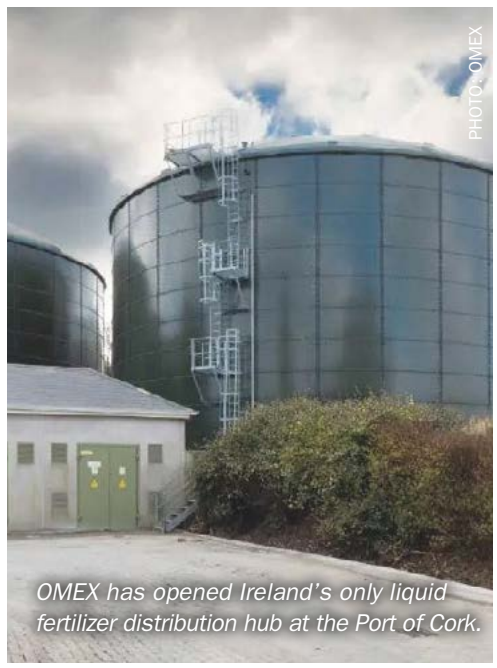


PHOTO: OMEX

OMEX has opened Ireland's only liquid fertilizer distribution hub at the Port of Cork.

People

Dr Andreas Kreimeyer (70) will be stepping down as chair of the supervisory board of K+S Aktiengesellschaft at the end of his current term. His mandate will expire at the company's Annual General Meeting on 14th May.

"Dr Kreimeyer has always been a wise advisor during his many years as Chairman of the Supervisory Board who, in close consultation with the Company's Board of Executive Directors, has accompanied the Company's key strategic decisions. These included in particular the reduction of the Company's debt, the strengthening of its international competitiveness under challenging conditions, the further development of governance structures and processes in a rapidly changing environment," K+S said in a statement.

The supervisory board intends to appoint **Dr Harald Schwager** as its next chairman. Dr Schwager (64) has particular expertise in restructuring and crisis management, strategic leadership and sustainability. As a member of the German Council of Science and Humanities, he also advises the German federal and state governments on science and research issues.

Yara appointed **Magnus Krogh Ankarstrand** as its CFO on 21st March. Ankarstrand has been a member of Yara's Group Executive Board since 2023 in his previous role as EVP Corporate Development. His other roles at Yara have included CEO Yara Clean Ammonia, SVP Yara North America, CFO of the Industrial segment and Director of Strategy & Business Development.

In a coordinated move, Yara also announced that outgoing CFO **Thor Giæver** will be its acting EVP Corporate Strategy & Business Development until August – before becoming SVP Strategic Advisor to the CEO.

"I want to thank Thor Giæver for his strong contribution as CFO for almost four years. With more than 20 years' experience in key roles in Yara, he has deep knowledge of the company which will come to good use in his new role," said Svein Tore Holsether, Yara International's president & CEO.

Other executive board changes announced by Yara on 21st March include the appointment of **Fernanda Lopes Larsen** as EVP Corporate Development and **Hanna Opsahl-Ben Ammar** as EVP People & External Affairs, Chief of staff. **Solveig Hellebust**, EVP & Chief HR Officer, has decided to leave Yara to pursue opportunities outside the company.

"I am pleased to strengthen the Group Executive Board with Opsahl-Ben Ammar and making use of the extensive experience held by Lopes Larsen and Ankarstrand in new roles that are key to strategy execution," said Holsether. ■

2025 Fertilizer Sustainability Symposium

A new event is coming to London this summer that's designed to foster collaboration and inspire actionable insights into sustainability challenges facing the global fertilizer industry.

The 2025 Fertilizer Sustainability Symposium will take place on 28-29 July at Brunel University in London, England. Presented by Solex Thermal Science, the gathering will provide a collaborative platform for industry leaders, innovators and educators to exchange ideas, share experiences and discuss solutions to some of the industry's most complex issues.

"We are looking forward to catalyzing meaningful progress by uniting diverse perspectives that tackle the complexities of fertilizer production now and into the future," said Gerald Marinitsch, Chief Executive Officer of Solex Thermal Science.

"Through open dialogue, innovative ideas and practical solutions, this first-of-its-kind symposium will serve as a platform that empowers the industry to take measurable steps toward a more sustainable future," he added.

The symposium, held in partnership with the 17th International Conference on Sustainable Energy & Environmental Protection (SEEP), will feature in-depth discussions on critical topics such as: carbon emissions and nitrogen's environmental impact; transition to organic and slow-release fertilizers; green ammonia/hydrogen, and; global perception of energy use in the fertilizer industry.

The keynote speaker will be Steve Kenzie, Executive Director of the United Nations Global Compact UK. Additional confirmed speakers include Mark Brouwer of Ureaknowhow.com, Willem Frens of BA2C Europe/Latin America and Hussam Jouhara of Brunel University.

Fertilizer International magazine is pleased to be supporting the symposium as media partner. Registration is now open. Visit www.solexthermal.com/fertilizer-sustainability-symposium. ■

Calendar 2025

APRIL

30 APRIL - 1 MAY

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

MAY

12-14

IFA Annual Conference, MONTE CARLO, Monaco
Contact: IFA Conference Service
Tel: +33 1 53 93 05 00
Email: ifa@fertilizer.org

JUNE

6-7

48th Annual International Phosphate Fertilizer & Sulfuric Acid Technology Conference, ST PETERSBURG BEACH, Florida, USA
Contact: Michelle Navar, convention chair
Email: vicechair@aiche-cf.org

JULY

1-2

IFA Global Markets Conference, LONDON, United Kingdom
Contact: IFA Conference Service
Tel: +33 1 53 93 05 00
Email: ifa@fertilizer.org

13-17

99th Annual Southwestern Fertilizer Conference, NASHVILLE, Tennessee, USA
Contact: Pat Miller
Tel: +1 (512) 259-2118
Email: swfc@swfertilizer.org

28-29

2025 Fertilizer Sustainability Symposium, London, United Kingdom
Contact: Solex Thermal Science
Tel: +1 403 254 3500
Email: info@solexthermal.com

CBAM – Europe's low-carbon leap

Implementation of the European Union's Carbon Border Adjustment Mechanism (CBAM) is scheduled to start in January next year. In this CRU Insight, **Halima Abu Ali** and **Charlie Stephen** look at what forthcoming changes to the EU's carbon taxation and pricing regimes will mean for the fertilizer industry.

PHOTO: EUROPEAN COMMISSION

The European Commission's College of Commissioners.

Overview

The Carbon Border Adjustment Mechanism (CBAM) and a revised Emissions Trading Scheme (ETS) entered into European Union (EU) law on 16 May 2023. This marked the end of a two-year legislative process which first began with the European Commission's launch of its 'Fit for 55 package' in July 2021.

Now, following a transition period, CBAM is due to be implemented from the start of 2026.

The 2023 reforms to the ETS were designed to reduce carbon emissions by raising the carbon price and extending the scheme's coverage. The revisions include:

- More ambitious emission reduction targets
- Extending this 'cap & trade' scheme to cover more sectors
- Reducing the supply of ETS allowances, i.e. lowering the 'cap'
- A gradual phase-out of the free allowances currently offered.

CBAM complements the reformed ETS by comprehensively addressing carbon leakage (see below). The aim is to create a level playing field for domestic and foreign producers by charging a carbon tax on imported goods. CBAM will initially apply to imports of cement, iron and steel, aluminium, fertilisers, electricity and hydrogen – as these commodities, and some of their selected precursors, are deemed to be at most significant risk of carbon leakage.

Between October 2023 and December 2025, CBAM only applies as a reporting obligation. This will be followed by the definitive phase of the mechanism from the beginning of 2026.

From that point onwards, importers of designated products will have to purchase and surrender CBAM certificates to pay for the embedded emissions they bring into the EU. Free ETS allowances for the six above-mentioned sectors will also be gradually withdrawn between 2026 and 2034 – while CBAM is phased-in in parallel.

CBAM EXPLAINER

In a nutshell…

- Europe has implemented an emissions trading scheme (ETS) since 2005 – impacting its global competitiveness
- Europe is levelling the playing field, in terms of carbon taxation, through the Carbon Border Adjustment Mechanism (CBAM)
- CBAM initially covers six sectors (cement, iron and steel, aluminium, fertilizers, electricity, hydrogen) but could expand to encompass more
- CBAM will significantly raise the cost of fertilizers and fertilizer raw materials in Europe – this presents opportunities for both European and international fertilizer players
- Demand and policy uncertainty are, however, holding companies back from investing and capitalising on this opportunity
- Importantly, structurally higher fertilizer feedstock costs in Europe will not be fixed by CBAM

The upshot is that CBAM is poised to financially penalise embedded carbon emissions present in EU imports. The higher the carbon intensity, the greater the cost for the importer. From the start of 2026, a gradual reduction of free allowances under the EU ETS will expose ever larger volumes of emissions to CBAM levies.

For fertilizers, urea will the worst affected by this increased exposure. CBAM should, however, make nitrate fertilizers produced using blue or green ammonia – due to their significantly low emission intensities – an attractive option for importers looking to reduce their costs.

Pre-existing EU policy – the ETS

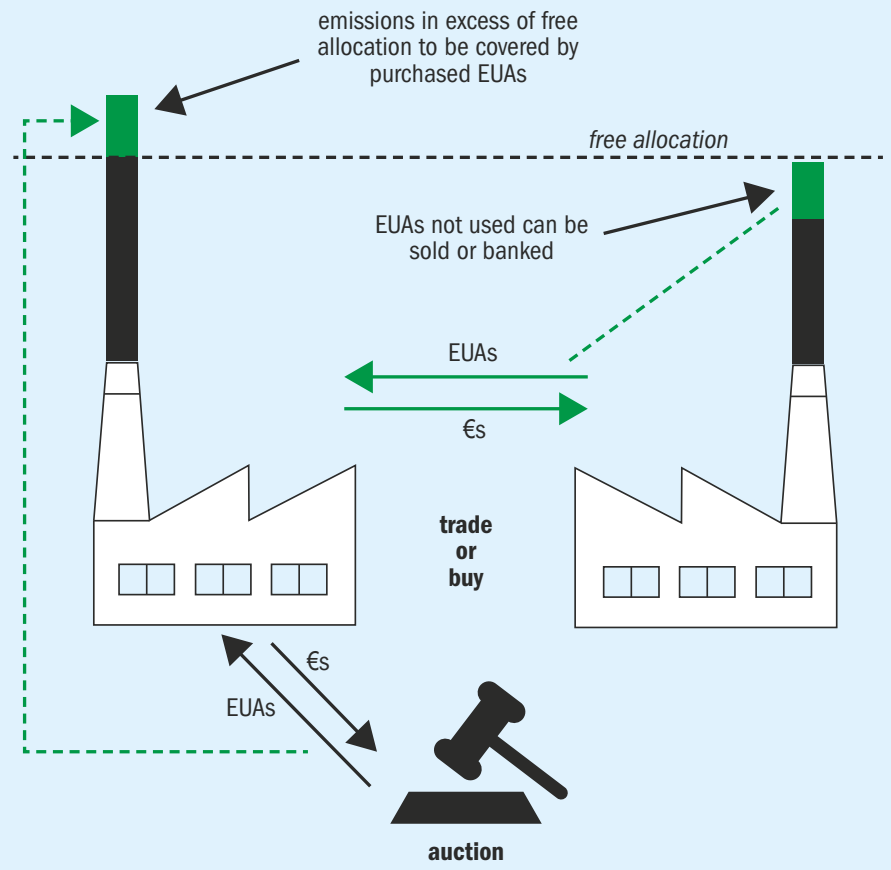
Launched in 2005, the EU operates the world's most advanced emission trading system (ETS). This requires polluters to pay for their greenhouse gas emissions. Under the ETS, polluters must surrender one EU Allowance (EUA) for every tonne of CO_2 they emit.

The ETS incorporates some safeguards against carbon leakage, a potentially significant consequence of the policy. Carbon leakage occurs when companies, faced with stricter environmental regulations and carbon pricing in one region such as the EU, relocate their production to another region with less stringent or no policies to avoid costs. This is undesirable and damaging for EU industry, as it would lead to the loss of production capacity and plant closures within the region, as well as higher global emissions overall.

To help prevent this, free EUAs are allocated to emitters in those sectors at risk of carbon leakage. The level of free allocation is set by product benchmarks – these representing the average emission level of the 10% most efficient installations within each sector. Any emissions above the free allocation level must be covered by purchasing EUAs. These can be bought at auction or from other emitters with excess EUAs.

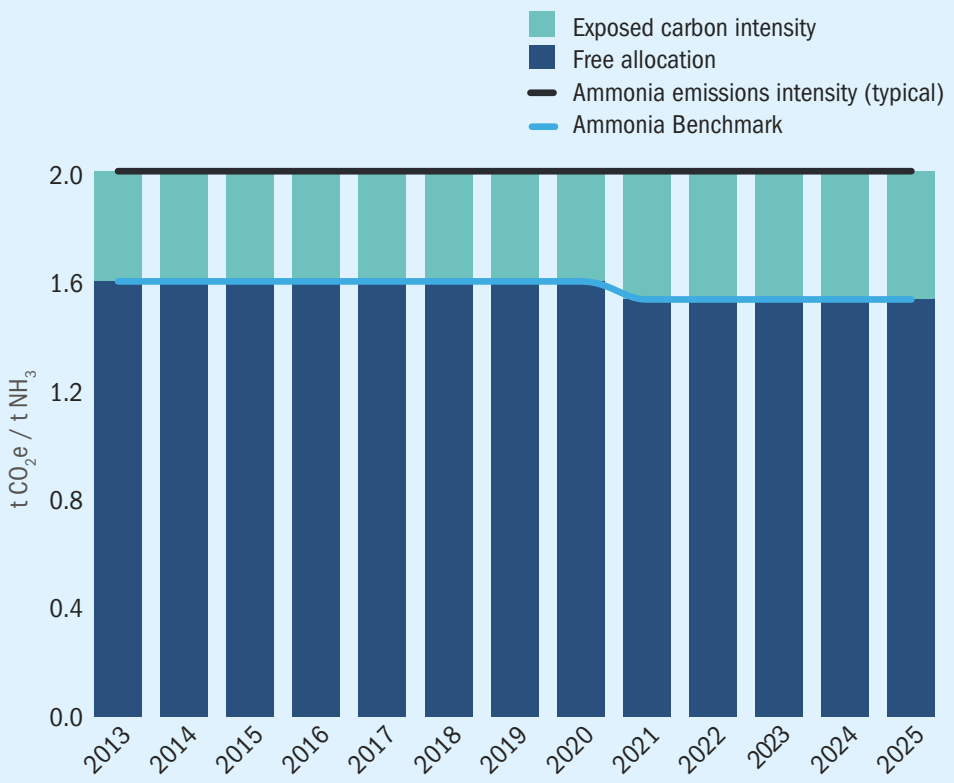
The ETS essentially functions as a 'cap & trade' market (Figure 1) with a limited amount of EUAs available each year. The supply of EUAs also decreases each year – the aim being to drive up their price, incentivise decarbonisation and as a consequence drive down EU emissions.

Fig. 1: **The EU Emissions Trading System (ETS)**



Source: CRU

Fig. 2: **Free allocations vs exposed carbon intensity for ammonia in the EU ETS, t CO_2e / t NH_3**



Source: CRU

To date, the ready availability of free EUA allocations has largely protected the EU fertilizer industry by limiting the exposure of ammonia producers to carbon costs (Figure 2). Nonetheless, the price of EUAs has risen significantly over the last 4-5 years increasing the overall cost burden the ETS places on EU ammonia producers (Figure 3).

CBAM phases in, free allocations phase out

While there is a general acknowledgement that free EUA allowances will eventually need to be removed to drive up decarbonisation, there are justifiable fears that the resulting higher carbon costs within the EU could destroy Europe's industrial competitiveness – without a protective policy in place. This is the purpose of the Carbon Border Adjustment Mechanism (CBAM).

Essentially, CBAM is designed to reduce carbon leakage by levelling the playing field between EU producers and non-EU producers exporting into the EU.

Under CBAM, importers selling into the EU will be required to pay for the carbon emissions embedded in imported products by purchasing CBAM Certificates (1 CBAM certificate = 1 t CO_2). There will be equivalence between the EU ETS and CBAM (Figure 4) in terms of the:

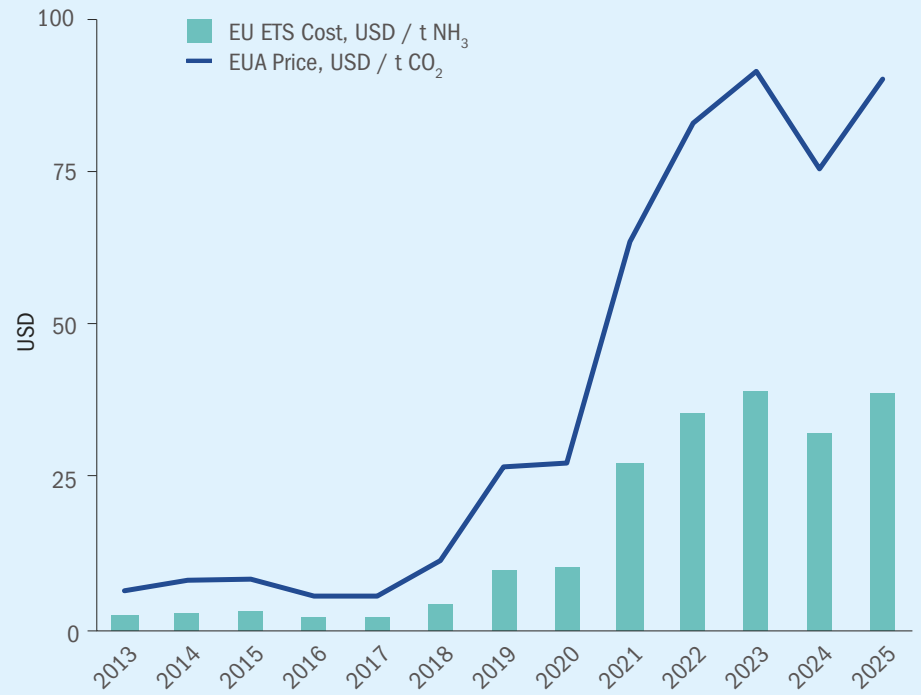
- Level of exposed carbon emissions – as both CBAM and ETS product benchmarks will be equivalent
- Carbon price to be paid – as the price of CBAM certificates is linked to the EUA price.

Under these level playing field arrangements, any carbon cost incurred by the producer in the country of origin is deducted from the CBAM cost. Essentially, this means importers will be exempted from paying CBAM if the country of origin has an equivalent carbon trading scheme.

Importantly, CBAM will be phased-in as free EUA allocations are phased-out (Figure 5). The gradual phase-in of CBAM, by aligning with the phase-out of free allowances under the EU ETS, should result in a smoother regulatory transition.

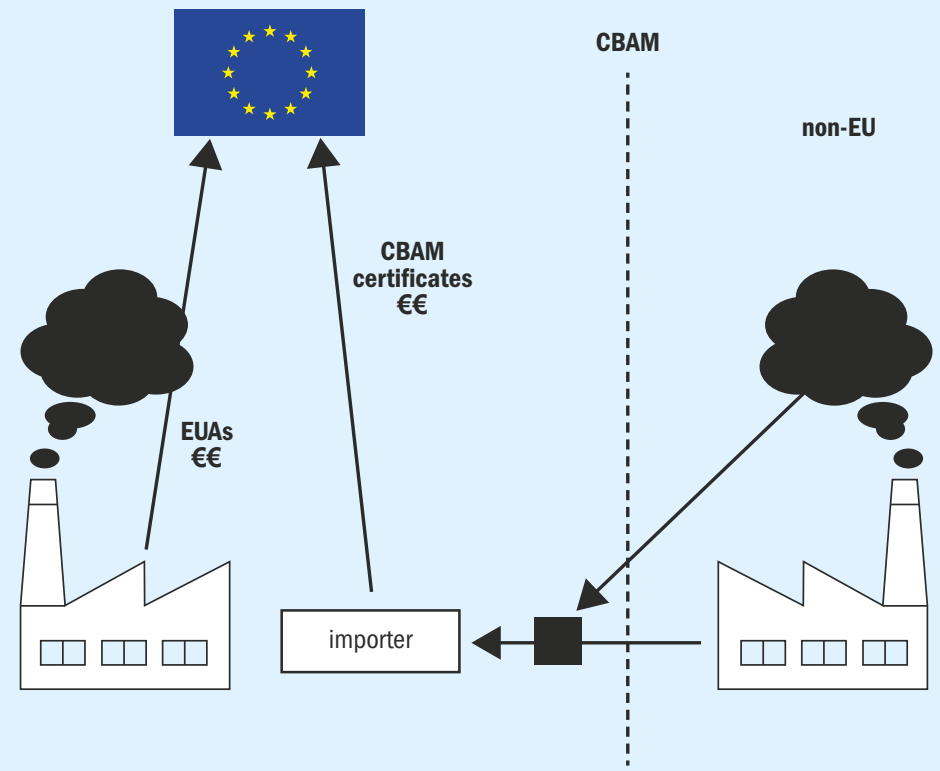
This will be achieved using a CBAM 'phase-in factor'. This factor will concurrently:

Fig. 3: **EU ETS cost ($/t NH_3) and EUA price ($/t CO_2) for a typical European ammonia producer**



Source: CRU

Fig. 4: **To level the playing field, there will be equivalence between the EU ETS and CBAM with a link between the price of CBAM Certificates for importers and the price of EUAs paid by EU producers**



Source: CRU

Table 1: **Reporting requirements for CBAM transitional phase, Oct 2023 – Dec 2025**

	Cement	Fertilisers	Iron & Steel	Aluminium	Hydrogen	Electricity
Reporting metrics	(per) Tonne of good					
Greenhouse gases covered	CO_2	CO_2 + nitrous oxide for certain fertilisers	CO_2	CO_2 + PFCs for certain goods	CO_2	CO_2
Emission coverage	Direct and indirect					Direct
Determination of direct embedded emissions	Based on actual emissions unless they cannot be adequately determined					Default values unless certain conditions met
Determination of indirect embedded emissions	Based on default values unless certain conditions met					-

Source: CRU

- Reduce free allocation of EUAs to EU producers, as set by the EU ETS product benchmarks
- While increasing the obligation of importers to buy CBAM Certificates, as set by the CBAM product benchmarks.

Initially, the ETS/CBAM product benchmarks will only be reduced by 2.5%, shielding the bulk of the carbon intensity of products from the carbon price. Eventually, however, both producers in the EU and importers will be fully exposed to the carbon price – from 2034 onwards.

CBAM – preparing for the definitive phase

Under the current EU timetable, the transitional phase of CBAM which began in October 2023 is due to end on 31st December this year. This two-year transition is intended to allow companies to get up to speed on reporting requirements, as set out in Table 1.

No CBAM payments are required – just yet. Instead, the emphasis during the transition has been on getting the reporting right. For the fertilizer sector, CBAM covers both direct and indirect emissions (Table 1). The determination of direct embedded emissions is based on actual emissions, unless these cannot be accurately measured. The determination of indirect embedded emissions, meanwhile, are based on default values, unless certain conditions are met.

"The taxation of carbon embedded within imports is on the political agenda in many advanced countries. Businesses would therefore be wise to prepare for other CBAM-like policies that could shape global trade flows in future."

Affected importers will have to start making CBAM payments once the definitive phase begins, although this requirement has been deferred until 2027, based on recent Commission proposals.

Nonetheless, importers covered by CBAM need to do the following to prepare for the definitive phase of CBAM starting on 1 January 2026:

- First, acknowledge that the transitional phase of CBAM marks a step change in the way the EU engages in international trade. The sooner that affected businesses rise to the challenge of reporting embedded emissions along their supply chain (based on the EU methodology) the better prepared they will be for the definitive phase starting in 2026.
- Second, to avoid double taxation, importers should start keeping track of any carbon taxes or carbon prices they might have paid on emissions that took place outside the EU. While a failure to do so would not result in non-compliance with EU regulations, it would place the company and other non-EU businesses in its supply chain at a competitive disadvantage.
- Third, companies should ensure they are in the position to purchase the required CBAM certificates on the central platform and declare and surrender these when required on the CBAM registry, these covering emissions embedded in imports during the previous calendar year. The first time this will be required will be on 31 August 2027 for the 2026 calendar year.
- Last but not least, companies need to keep on top of developments as the required structures and institutions are not in place yet. These will only be developed over the coming years and – based on experience during the transitional phase – are likely to be launched only just in time for the definitive phase. Policies are also likely to change over time as the European Commission gains practical and operational insights.

What does CBAM mean for the fertilizer industry?

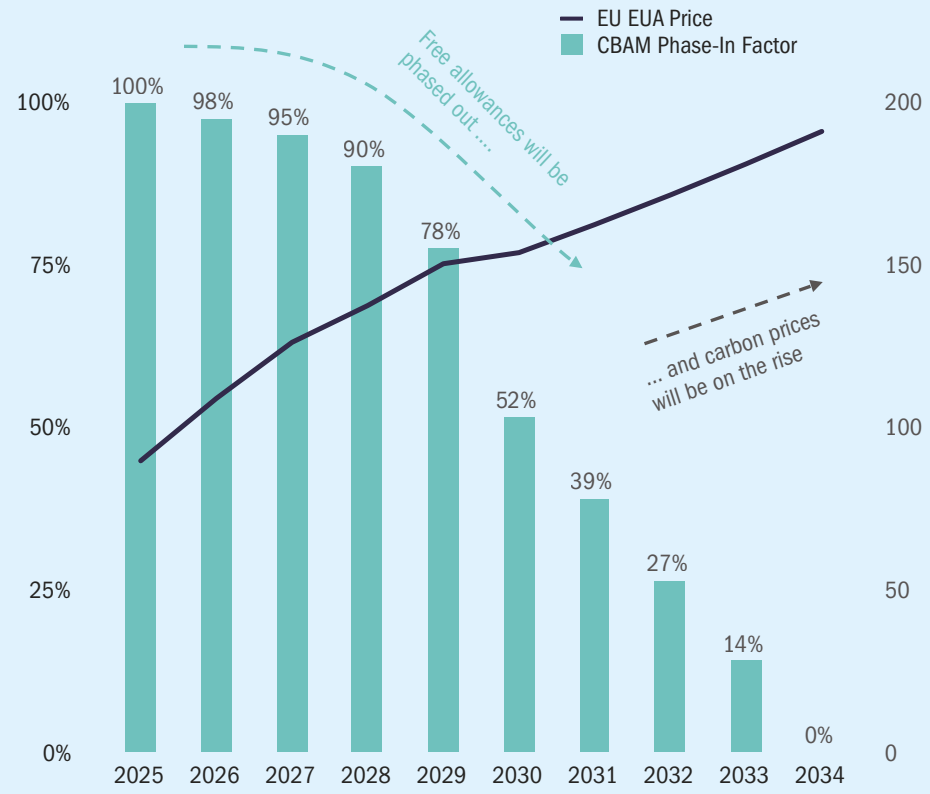
CBAM taxes carbon dioxide (CO_2) and nitrous oxide (N_2O) embedded in:

- Ammonia
- Nitric acid
- Urea, ammonium nitrate (AN) and urea ammonium nitrate (UAN)
- Potassium nitrate
- Diammonium phosphate (DAP), monoammonium phosphate (MAP) and NPKs.

CBAM has been applied to a wider selection of fertilizers then originally anticipated, including phosphate fertilizers and potassium nitrate. Europe is a major importer of both nitrogen and phosphates, mainly from the CIS and North Africa. There is a substantial nitrogen production base in Europe and a much smaller phosphate industry.

The extension of the ETS to cover imports of nitrogen and phosphate fertilizers through CBAM means makers of these products destined for the EU market need to review their emissions profiles. Fertilizer

Fig. 5: **CBAM phase-in factor (%, LHS) and forecast EUA price ($/t CO_2, RHS), 2025-2034**



Source: CRU

exporters/traders targeting the EU will also now need to factor in an additional emissions cost when sourcing products. Producers of fertilizers for the European market will also need to consider this as a factor affecting their competitive position

Impacts – cost and trade flows

Currently, only EU-based emitters face EU emissions costs. This means that, to date, EU prices for imported goods and precursors have not reflected the cost of their embedded emissions. Moreover, so far, manufacturers within the EU have been partially protected from this through the issuance of free allowances.

This will now change. The launch of CBAM, in conjunction with the parallel full withdrawal of free allowances in the EU ETS, will mean that all goods sold in the EU market – regardless of origin – will face EU emissions costs. Over time, the EU market price will begin to internalise this.

CRU expects prices for CBAM goods sold within the EU to increase. This will be a gradual process as the mechanism ramps up over an eight-year period to finally fully apply in 2034.

In terms of trade flows, putting a price on embedded emissions should make higher-emission products imported into the EU less attractive over time. Industries that are currently more dependent on the supply of higher carbon imports will experience a greater shift to trade flows, as CBAM prices gradually kick in over the next eight years.

While European ammonia suppliers gain competitiveness under CBAM, the outlook for regional production remains ominous. Capacity is still likely to close over the coming decade, in CRU's view, due to a mixture of factors, such as already high production costs, ageing infrastructure, and the impacts of other EU 'green' policies (e.g., REDIII). Consequently, European producers looking to maintain downstream fertilizer production within the region are expected to import ammonia from lower cost and less carbon-intensive production centres instead.

Taste of things to come?

It is clear that carbon taxation and the related issue of carbon border adjustments is high on the political agenda in many advanced countries. Businesses would therefore be wise to prepare for other CBAM-like policies that could shape global trade flows in future.

With current climate change mitigation efforts falling short of what is required to achieve the climate ambitions set out in the 2015 Paris Agreement, expect to see more governmental drives to bring down carbon emissions. Carbon pricing and trade policies based on emission intensities will play a crucial role in delivering this.

Businesses in the commodity markets will therefore need to keep on top of these global developments and how they are shaping global trade flows – and should prepare for this as much as they can. Improving emissions measurement across the entire product value chain to meet future stricter emission reporting requirements is one example.

Is CBAM being watered down?

The EU is proposing a one-year delay in the implementation of CBAM, *Reuters* reported on 24 February, citing a leaked European Commission document.

Specifically, the obligation to purchase CBAM certificates is set to be postponed from 2026 until 2027, providing importers with additional time to prepare for the bloc-wide measure. Costs associated with embedded emissions within 2026 imports will still apply – but will be incurred in 2027 instead.

In addition, companies importing less than 50 tonnes of goods or goods containing less than 100 tonnes of embedded carbon dioxide (CO_2) could be exempted from CBAM payments entirely. This new proposal will apparently exempt around 90% of importers from this carbon policy but still cover 99% of emissions. ■

Acknowledgement

Additional reporting by Simon Inglethorpe and Lewis Walters.

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Fertilizer financial scorecard – price falls hit earnings

We compare and contrast the 2024 financial performance of selected major fertilizer producers following the publication of fourth quarter results.

PHOTO: OCI GLOBAL

Netherlands-headquartered OCI Global has teamed up with Chivas Brothers and Simpsons Malt in the UK to create 'greener' whisky using a carbon-saving fertilizer.

Fig. 1: **Market capitalisation snapshots, 2025 vs 2024**

Source: finance.yahoo.com

Nutrien – higher sales volumes, lower earnings

Nutrien is the world's largest crop nutrient company with a market capitalisation of more than $24 billion (Figure 1). The Canadian fertilizer giant combines manufacturing might with retail reach, producing around 25 million tonnes of potash, nitrogen and phosphate products annually from operations and investments in 13 countries, and then distributing these to agricultural, industrial and feed customers across the globe. Its agricultural retail business serves more than 500,000 farmers worldwide through 2,000 plus outlets across the Americas and Australia.

Nutrien's revenues fell back by 11% year-on-year (y-o-y) in 2024 to $26.0 billion (Figure 2). Similarly, annual earnings (adjusted EBITDA) for the year declined by 12% to $5.4 billion (Figure 3). Free cash flow, a measure of profitability, ended 2024 at $1.4 billion (Figure 4), versus $2.4 billion for the preceding year.

While the company's long-term debt remained stable – standing at $8.9 billion at the end 2024 (Figure 5) – net debt relative to earnings increased slightly, with a ratio of 2.2 compared to 1.9 for 2023.

Nutrien linked its 2024 earnings decline to lower realised potash and nitrogen selling prices, although these factors were partially offset by record potash sales volumes and higher earnings from its Nutrien Ag Solutions retail business.

Nutrien is the world's largest potash producer. The company's potash sales from its Canadian mines reached 13.9 million

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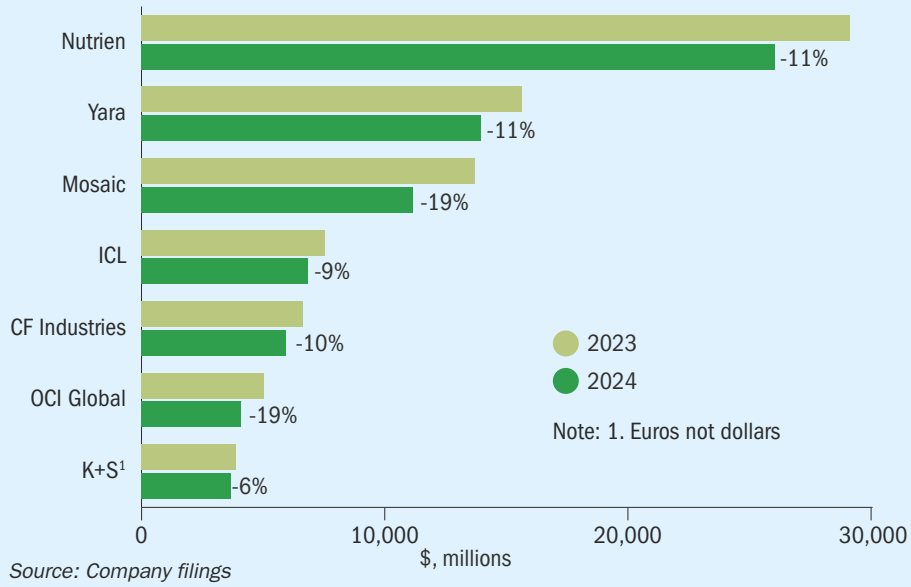
tonnes in 2024, a new annual record helped by low channel inventories and strong potash affordability in North America and other key markets. Of this volume, 9.2 million tonnes were shipped overseas with the remaining 4.7 million tonnes being sold within North America.

Potash accounted for 34% of Nutrien's full-year earnings. The company's potash earnings, at $1.8 billion (adjusted EBITDA) in 2024, were down 20% y-o-y, with lower realised selling prices cancelling out record sales volumes. The costs of goods sold (COGS) for potash fell slightly to $104/t last year, helped by a combination of higher production and greater mine automation.

Nutrien's nitrogen earnings, meanwhile, fell by 2% in 2024 to $1.9 billion. Lower net selling prices offset higher sales volumes – 10.7 million tonnes in 2024 versus 10.4 million tonnes in 2023 – and lower natural gas costs. The average COGS for nitrogen products declined 9% y-o-y to $213/t in 2024, mainly because of cheaper North American natural gas.

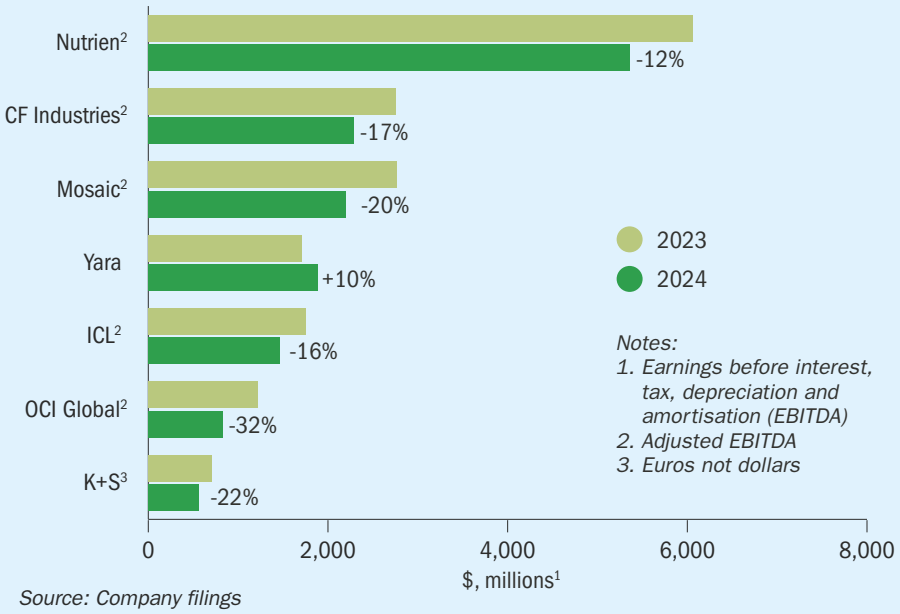
Annual earnings at Nutrien's retail business, Nutrien Ag Solutions, grew by 16% to $1.7 billion in 2024, boosted by higher product margins and lower costs. Crop nutrient product sales, however, were down 14 percent y-o-y at $7.2 billion due to lower selling prices and sales volumes.

Fig. 2: **Revenues, 2024 vs 2023**



Source: Company filings

Fig. 3: **Earnings[1], 2024 versus 2023**



Source: Company filings

Nutrien's phosphate earnings declined by 18% y-o-y to $384 million. Falls in input costs for sulphur and ammonia raw materials failed to counter the hit to earnings from lower production volumes and weaker selling prices for industrial and feed phosphates.

Phosphate sales volumes fell back by 5% to 2.4 million tonnes last year, while the average COGS for phosphate products increased slightly (+3%) to $603/t. This was linked to lower production volumes and higher water treatment costs – a consequence of weather-related events, according to the company.

"Nutrien delivered higher upstream fertilizer sales volumes, accelerated operational efficiency and cost savings initiatives and increased downstream Retail earnings in 2024, demonstrating significant progress towards our 2026 performance targets," said Ken Seitz, Nutrien's president and CEO. "We took a disciplined and intentional approach, optimizing capital expenditures and returning $1.2 billion to shareholders through dividends and share repurchases."

The company expressed confidence about 2025 market prospects.

"The outlook for our business in 2025 is supported by expectations for strong crop input demand and firming potash fundamentals. Nutrien has a world-class asset base, and we remain focused on strategic priorities that strengthen our core business and deliver structural improvements to our earnings and free cash flow," Seitz said.

Yara bucks the trend with earnings growth

Norway's Yara International, with a market capitalisation of $7.8 billion (Figure 1) and 18,000 global employees, is one of world's largest crop nutrient providers, vying internationally with Nutrien for leadership on production and deliveries.

The Oslo-headquartered company produced 19.7 million tonnes of finished fertilizers and 7.2 million tonnes of ammonia from its global assets in 2024, achieving year-on-year growth of 7% and 12%, respectively. Finished fertilizer production included:

- 6.3 million tonnes of compound NPKs
- 5.9 million tonnes of nitrates
- 4.6 million tonnes of urea
- 1.7 million tonnes of calcium nitrate (CN)
- 0.9 million tonnes of urea ammonium nitrate (UAN)
- 0.2 million tonnes of single superphosphate (SSP).

Yara Birkeland is the world's first fully electric and autonomous container vessel.

Yara calculated that premium product sales in 2024 – namely its straight nitrate fertilizers and premium NPK offering – generated $1.4 billion in added-value, compared to the commodity fertilizer alternatives.

Yara's product deliveries rose by 3% percent to 31.2 million tonnes last year. These were divided between:

- 22.9 million tonnes of fertilizers
- 6.5 million tonnes of industrial products
- 1.7 million tonnes of traded ammonia.

Yara's annual revenues fell back by 11% y-o-y to $13.9 billion in 2024 (Figure 2), while earnings (EBITDA) – in contrast – bucked the general trend and grew by 10% to $1.9 billion (Figure 3). The earnings improvement – 20% higher y-o-y excluding special items – mainly reflected higher product deliveries and better margins following inventory write-downs and position losses in 2023.

While Yara's global deliveries increased by 3% overall in 2024, the regional picture was mixed:

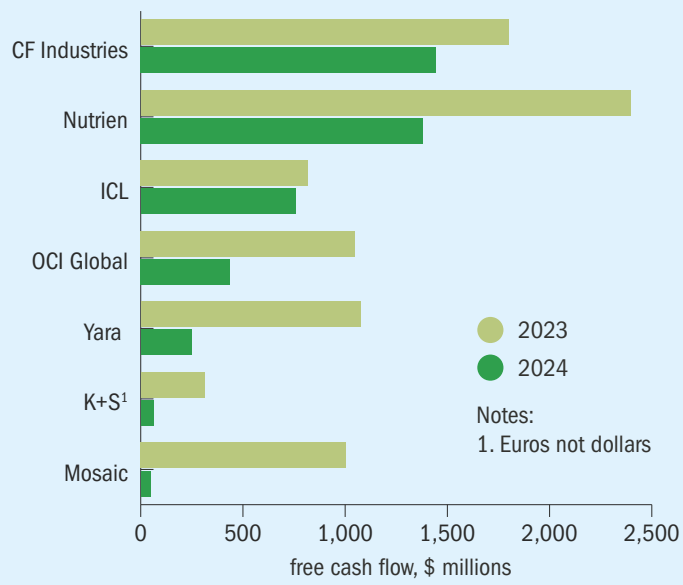
- European deliveries were 14% higher compared with 2023, a year when the region was hit by both slow demand and production curtailments.
- In the Americas, 2023 deliveries fell by 4% compared with 2023, mainly due to less favourable farmer economics and disruptive flooding in Brazil, with these factors more than offsetting higher demand elsewhere in Latin and North America.
- Deliveries to Africa and Asia, meanwhile, were 2% higher in 2024, reflecting less production downtime from maintenance and outages.

Yara's reported a y-o-y decline in full operating cash flow of $1.0 billion, primarily due to a larger release of operating capital in 2023 versus 2024. Free cash flow stood at $248 million at the year's end (Figure 4). The company also saw its net debt position increase by $126 million to $3.7 billion in 2024 (Figure 5).

Announcing its full year results in February, Yara described 2024 as record year in production – and targeted higher free cash flow and better shareholder returns as its top priorities. The company's total recordable injuries (TRI) notably fell to 0.9 per one million working hours at the end of 2024 – an all-time low.

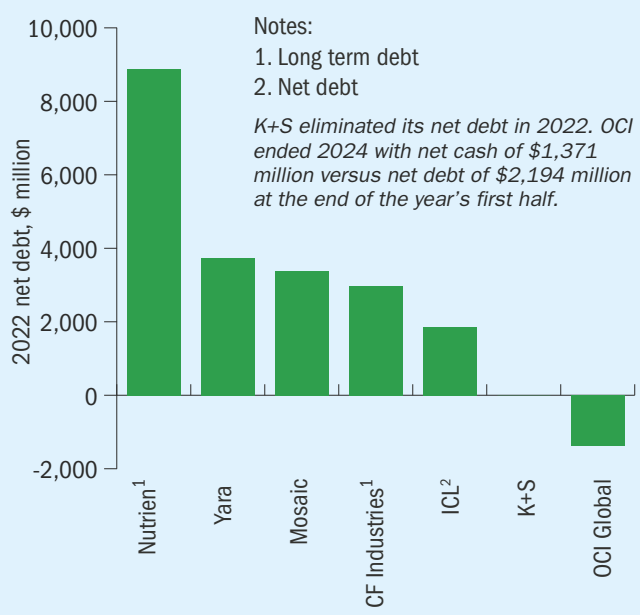
Commenting on the company's fourth quarter 2024 results, Svein Tore Holsether, Yara's president and CEO, said: "Operational performance this quarter is strong, with record-high production and safety performance. This marks a significant milestone in our continuous work to improve safety and resilience in Yara. We're also progressing well on our cost and capex reduction program, with a USD 90 million reduction achieved in 2024."

Fig. 4: **Free cash flow, end 2024 vs end 2023**



Source: Company filings/finance.yahoo.com

Fig. 5: **Net or long term debt, end 2024**



Source: Company filings

Mosaic – signs of P&K volume recovery

Florida-headquartered The Mosaic Company is the world's leading combined phosphate and potash producer with a market capitalisation of $7.9 billion (Figure 1). The company sold around 24.1 million tonnes of products in 2024 – down from 25.6 million tonnes in 2023 – with sales volumes split between three business segments:

- Potash segment: 8.7 million tonnes
- Phosphates segment: 6.4 million tonnes
- Mosaic Fertilizantes: 9.0 million tonnes.

Mosaic's earnings fell back by 20% y-o-y to $2.2 billion (adjusted EBITDA) in 2024 (Figure 3). These results were achieved from full year revenues of $11.1 billion (Figure 2).

"We delivered our highest quarterly EBITDA of the year with great prospects for all three segments for 2025," said Bruce Bodine, Mosaic's president and CEO, commenting on the company's fourth quarter and overall 2024 results. "Despite a series of operational and weather-related issues, which reduced our phosphate production by over 700,000 tonnes and potash production by about 250,000 tonnes in 2024, we see encouraging signs that we will deliver significant volume recovery in phosphates and potash in 2025 as we progress on projects to restore reliability."

Phosphate earnings (adjusted EBITDA) were stable y-o-y at $1.2 billion in 2024, with higher selling prices and elevated stripping margins offsetting lower sales and production volumes. Mosaic's phosphate sales volumes declined from 7.0 million tonnes in 2023 to 6.4 million tonnes in 2024, while the average diammonium phosphate (DAP) selling price rose by around $12/t to $585/t. Mosaic lost around 700,000 tonnes of phosphate production last year because of hurricanes and "other unusual events", the company said.

The company's potash earnings (adjusted EBITDA) totalled $0.9 billion in 2024, down from $1.5 billion in 2023, with this significant fall largely reflecting lower prices. In fact, versus 2023, Mosaic's average MOP (muriate of potash) selling price fell by $86/t to $222/t in 2024, while its average gross potash margin for the year declined to $74/t, versus the more lucrative 2023 average of $137/t.

Mosaic's potash sales volumes also decreased from 8.9 million tonnes in 2023 to 8.7 million tonnes in 2024, with the company citing third quarter "production challenges" at its Esterhazy and Colonsay mines as the cause of a 250,000 tonne production loss.

Full year earnings (adjusted EBITDA) at Mosaic's Brazilian subsidiary Mosaic Fertilizantes, meanwhile, grew by 5% to $344 million in 2024. This earnings improvement reflected strong underlying operating and cost performance, the company said. Mosaic Fertilizantes stopped importing phosphate rock in early 2024, for example, by shifting to domestic rock production instead. This change should deliver a $35-40 million annual production cost saving with $15 million of this already being realised in 2024.

Mosaic should be well positioned to benefit from improving market conditions in 2025, in Bruce Bodine's view.

"We also made significant progress on our cost performance in the Mosaic Fertilizantes business, leading to the prospect of increased margins in 2025. With the conclusion of the Ma'aden deal and the signing of the Patos de Minas sale, we continue to execute our strategy to redeploy capital from non-core assets to our highest returning areas," he said.

CF Industries highlights decarbonisation progress

Leading North American and UK nitrogen producer CF industries reported a modest decline in revenues and earnings in 2024. Full-year revenues ($5.9 billion) and earnings ($2.3 billion adjusted EBITDA) fell by 10% and 17% y-o-y, respectively (Figures 2 and 3). Despite these falls, CF's 2024 earnings – like many of the major listed fertilizer producers featured in this article – still exceed pre-pandemic levels. Full year net cash from operating activities ($2.3 billion) and free cash flow ($1.4 billion, Figure 4) for 2024 also remain healthy.

CF highlighted the following company initiatives in its 2024 results:

- The completion of the front-end engineering and design (FEED) study on for the autothermal reforming (ATR) ammonia project with carbon capture and sequestration (CCS) at CF's Blue Point Complex in Louisiana. The company expects to make a final project investment decision for the $4.0 billion project in the first quarter of 2025.
- The CCS project at CF's Donaldsonville, Louisiana, complex is being commissioned and remains on track to start up this year. Completion of the project's dehydration and compression unit will enable up to two million t/a of captured process carbon dioxide to be transported and permanently stored by ExxonMobil.
- The commissioning of the 20-megawatt alkaline water electrolysis plant at the Donaldsonville nitrogen complex, meanwhile, was paused in the fourth quarter of 2024 "due to an issue".
- The signing of commercial agreement in July 2024 with ExxonMobil for the transport and permanent geological storage of up to 500,000 t/a of carbon dioxide as part of a CCS project at CF's Yazoo City, Mississippi, production complex.

"CF Industries' 2024 results reflect strong execution by our team against the backdrop of constructive global nitrogen industry dynamics," said Tony Will, the company's president and CEO. "We believe our cost-advantaged North American-based production network, operational capabilities and disciplined strategic initiatives position CF Industries well to continue to create substantial value for long-term shareholders."

The Illinois-headquartered company has a market capitalisation of $13.0 billion (Figure 1). It attributed the 2024 decline in earnings to lower average selling prices, commenting that "lower global energy costs reduced the global market clearing price required to meet global demand".

Average selling prices, representing all of CF's nitrogen product segments, fell by 10% y-o-y to $425/t in 2024. This price level compares to average selling prices for the company of $473/t in 2023, $936/t in 2022, $498/t in 2021 and $271/t in 2020.

The company did, however, benefit from lower cost of sales in 2024, with this being linked to much lower natural gas costs. Its average natural gas cost last year was $2.40/MMBtu, versus annual averages of $3.67/MMBtu in 2023 and $7.18/MMBtu in 2022.

CF's production volumes last year were relatively stable at 22.4 million tonnes, and included:

- 9.8 million tonnes of ammonia
- 4.4 million tonnes of granular urea
- 6.7 million tonnes of UAN (32%)
- 1.4 million tonnes of AN.

Total product sales volumes in 2024 were down slightly at 18.9 million tonnes versus 19.1 million tonnes for 2023.

ICL – focus on specialties and cash generation

Israel's ICL Group is a leading producer of potash, phosphates and specialty fertilizers with a market capitalisation of around $7.9 billion (Figure 1). The company delivered annual sales of $6.8 billion, earnings (adjusted EBITDA) of $1.5 billion and free cash flow of $758 million in 2024 (Figures 2, 3 and 4).

While ICL's earnings fell back by 16% last year, they remain elevated compared to the company's pre-pandemic performance. ICL also highlighted the significant value delivered to shareholders in 2024, via more than $240 million in dividend payments, and the company's strong cash flow generation.

"ICL delivered 2024 adjusted EBITDA of $1,469 million, with our specialties-driven businesses contributing 70% of that amount, as we continued to focus on cash generation while increasing market share across Industrial Products, Phosphate Solutions and Growing Solutions. We remain committed to growing our leadership position for these three businesses," said Raviv Zoller, ICL's outgoing president and CEO.

ICL's Phosphate Solutions business ($549 million) and Potash ($492 million) business segments contributed 36% and 32%, respectively, to overall company earnings (EBITDA) in 2024. The Industrial Products segment ($281 million) also generated a 18% share of earnings, while ICL's specialty fertilizer business, Growing Solutions, delivered the final 13% of earnings ($202 million).

ICL operates potash production assets in Israel (Dead Sea works) and Spain (Cabanasses mine). Total potash output in 2024 (4.5 million tonnes) was up by 82,000 tonnes y-o-y, mainly due to higher production in Spain. Potash sales (4.5 million tonnes) were 127,000 tonnes lower y-o-y, linked to a fall in sales to China and Brazil. ICL has, however, signed new contracts to supply its Chinese customers with 2.5 million t/a of potash between 2025-2027, with the option to supply an additional 960,000 tonnes during the three-year agreement.

Overall, ICL's Potash business unit generated revenues of $1.7 billion in 2024, versus $2.2 billion in 2023. Revenues were affected by a fall in the average realised potash price (CIF) to $299/t last year, versus averages of $393/t in 2023 and $682/t in 2022.

Total revenues accrued by ICL's Growing Solutions segment were $2.0 billion in 2024. This segment markets and sells the company's controlled-release fertilizers (CRF), water-soluble fertilizers (WSF), liquid fertilizers and straights (MKP/MAP/PeKacid), polyhalite products (FertilizerpluS), soil and foliar micronutrients, secondary nutrients, biostimulants, soil conditioners, seed treatment products and adjuvants.

ICL uses phosphate rock and fertilizer-grade phosphoric acid to produce phosphate-based fertilizers and value-added specialty products. The company's Phosphate Solutions business generated revenues of $2.2 billion in 2024.

"During 2024, amidst persistent potash price declines and geopolitical challenges, we achieved strong profitability and cashflow, introduced dozens of innovative specialties products, developed new global partnerships, set production


PHOTO: K+S

As well as mining potash, K+S is a major salt producer.

records at multiple sites, completed complementary bolt-on acquisitions, and continued to be vigilant in the execution of cost savings and efficiency efforts, while continuing to drive significant value to our shareholders," said Raviv Zoller. "As a result, we are entering 2025 in a solid position and looking forward to improving market conditions in key end-markets."

Looking ahead, ICL expects its specialty business segments (Industrial Products, Phosphate Solutions and Growing Solutions) to deliver earnings (adjusted EBITDA) of around $0.95-1.15 billion in 2025. Total potash sales of 4.5-4.7 million tonnes are also forecast for this year.

K+S targets sustainable transformation

Revenues at K+S Aktiengesellschaft declined by 6% y-o-y to €3.7 billion (Figure 2), while earnings (EBITDA) for the year fell by 22% percent to €558 million (Figure 3). The company generated free cash flow of €62 million in 2024 (Figure 4) and, unusually for the sector, has been without net debt since the end of 2022 (Figure 5).

With a market capitalisation of $2.6 billion (Figure 1), K+S is western Europe's largest potash producer, having a global market share of around nine percent. It also has a production presence in Canada, owning and operating the Bethune potash mine in Saskatchewan. The company is also growing its portfolio of specialty fertilizers. These products are chloride-free and/or supplement potassium with other elements such as magnesium, sulphur, sodium and micronutrients.

"We are on track and performed well despite low potash prices in 2024," said Dr Burkhard Lohr, the chair of K+S. "Our strength are our integrated potash plants on both sides of the Atlantic as well as in our European salt business.

"With our global positioning and our specialties, we have demonstrated that we can implement our sustainable transformation under challenging conditions with our own resources. The Werra 2060 project and the ramp-up of our Bethune plant in Canada are fully on track," Dr Lohr added.

The Werra 2060 project is designed to make Germany's domestic potash production more sustainable and competitive by taking major steps towards production decarbonisation. The project will also extend the lifetime of the integrated Werra potash production plant. K+S recently launched a range of low-carbon potash and magnesium fertilizers as part of this decarbonisation shift (see page 48).

In Canada, meanwhile, K+S plans to expand the production capacity of its Bethune potash plant – through secondary mining – to four million tonnes per annum. "This will gradually and significantly improve our cost position," commented Dr Lohr.

Lower realised prices for potassium chloride (averaging €282/t in 2024 vs €360/t in 2023) and fertilizer specialities (averaging €362/t in 2024 vs €394/t in 2023) were a feature of 2024 market conditions. The company's agricultural segment did, however, sell 7.9 million tonnes of fertilizer products in 2024, up significantly on the 7.3 million tonnes sold in 2023. This sales volume was divided between 4.35 million tonnes of potash and 3.55 million tonnes of specialty fertilizers.

K+S fertilizer products sold at an average price of €323/t in 2024 versus averages of €372/t in 2023, €628/t in 2022 and €298/t in 2021.

K+S is currently forecasting earnings (EBITDA) of €500-620 million for 2025. Reaching the upper end of this estimate assumes that Brazil's potassium chloride price will recover during the spring season, compared to the mid-February 2025 price, with this price level then spilling over into other markets during the second half of the year; it also assumes agriculture segment product sales of 7.7 million tonnes.

OCI Global – leaner and agile with $11.6bn in proceeds

Netherlands-headquartered OCI Global drastically restructured in the second half of last year via a series of strategic divestments. These included the sale of:

- OCI Methanol to Methanex (announced but not completed)
- OCI's entire Fertiglobe equity stake to ADNOC
- Iowa Fertilizer Company (IFCo) to Koch Industries
- OCI Clean Ammonia to Woodside Energy.

"These transactions will collectively amount to over $11.6 billion in gross proceeds, which has allowed us to repay

approximately $1.8 billion in debt and return $3.3 billion in cash distributions to shareholders," said Hassan Badrawi, OCI Global's CEO. "An additional cash distribution of up to $1 billion is further planned for Q2 2025, subject to the necessary approvals."

The company reported revenues of $4.1 billion and earnings (adjusted EBITDA) of $826 million in 2024, compared to totals of $5.1 billion and $1.2 billion, respectively, in 2023 (Figures 2 and 3). These financial results do, however, include substantial revenues and earnings from operations which will be discontinued in future as a consequence of the above divestments.

Financial results for continuing operations are more relevant to OCI's new streamlined company structure. Earnings (adjusted EBITDA) for OCI's European nitrogen business – its sole remaining operating segment – were $55 million in 2024, for example, compared to an earnings loss of $51 million in 2023. Earnings recovered last year due to higher sales volumes and lower average natural gas prices, according to OCI.

OCI's total fertilizer sales in 2024 were down 13% y-o-y at 7.4 million tonnes, with this total divided between:

- 1.8 million tonnes of ammonia
- 3.3 million tonnes of urea
- 1.0 million tonnes of calcium ammonium nitrate (CAN)
- 1.2 million tonnes of urea ammonium nitrate (UAN).

Stripping out divestments from this total, continuing operations accounted for a sales volume of 1.8 million tonnes in 2024, divided between CAN (58%), ammonia (24%) and UAN (18%).

Looking ahead to 2025, Hassan Badrawi said OCI's priority would be to capitalise on the "operational excellence and strategic value" of its European nitrogen assets. The company believes these are competitively positioned due to an in-house natural gas efficiency of 32 MMBtu per tonne of ammonia versus an EU average of 37 MMBtu per tonne. Additionally, OCI's Rotterdam terminal also provides the company with the flexibility to import ammonia during periods of elevated natural gas pricing.

In future, OCI expects its European operations to benefit from:

- Rising near term demand for ammonia and the curtailment of European capacity.
- The EU's introduction of the carbon border adjustment mechanism (CBAM) from January 2026 – as this will impose carbon costs on importers while bolstering European ammonia and fertilizer prices.
- Increasing demand for low-carbon ammonia over the longer term for use in power generation and as a maritime fuel and hydrogen carrier.

"Latterly, our nitrogen production facility in Geleen, independent ammonia import terminal in Rotterdam and leading pan-European distribution platform are positioned favorably with respect to recent rationalization in the industry and increasing ammonia throughput into Europe. OCI is set to benefit further in the medium- to longer-term based on growing regulatory support and our expectation of normalized gas pricing.

"Beyond this, with a leaner, more agile and streamlined organization, OCI Global is well placed to navigate its future," Badrawi said. ■

Sulphur fertilizers – the processes, the products

While sulphur is regarded by many as the fourth crop nutrient, soils globally are becoming increasingly sulphur deficient. Fortunately, there are proven and successful process technologies available for incorporating sulphur – in elemental or sulphate form – into urea, the world's most widely applied commodity fertilizer. **Mark Brouwer** of UreaKnowHow.com reviews the main production options and highlights key reference installations.

Sulphur is present in all crops and plays an important metabolic role. It is essential for the formation of proteins, amino acids, vitamins and enzymes, being vital for photosynthesis, energy metabolism and carbohydrate production. Sulphur also contributes to the flavour and aroma of crops such as onions and can therefore influence the quality of farm produce (*Fertilizer International* 497, p24).

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

- Light and sandy soils with low organic matter
- Sulphur leaching during high winter rainfall
- Low sulphate mobility during dry spring conditions
- Slower mineralisation at low temperatures
- Low input of organic matter and mineral sulphur
- Low atmospheric deposition of sulphur to soils.

PHOTO: NORTHERN NUTRIENTS

Canada's Northern Nutrients produces Artic-S, a urea product that incorporates micronised elemental sulphur, using Shell Thiogro technology.

Crops can typically remove between 15 to 30 kilograms of sulphur per hectare from soil. Root vegetables, onions and brassica, especially oilseed rape (canola), have a particularly high demand for sulphur. Pasture and other widely grown crops such as coffee, corn, cotton, rice, soybean, sugarcane and wheat also require moderately high sulphur applications. For these crop types, sulphur requirements can match or even exceed demand for phosphorus (*Fertilizer International* 497, p24).

Increasingly widespread sulphur deficiency is having an impact on crop yields and quality in many regions. The reasons behind growing global soil deficiency include:

- Declining industrial and vehicle SO_2 emissions and, consequently, less deposition of atmospheric sulphur to soil
- Greater sulphur removal due to expansions in the land area devoted to crops and higher crop yields
- The increasing prevalence of high-analysis fertilizers with little or no sulphur content.

Sulphur demand

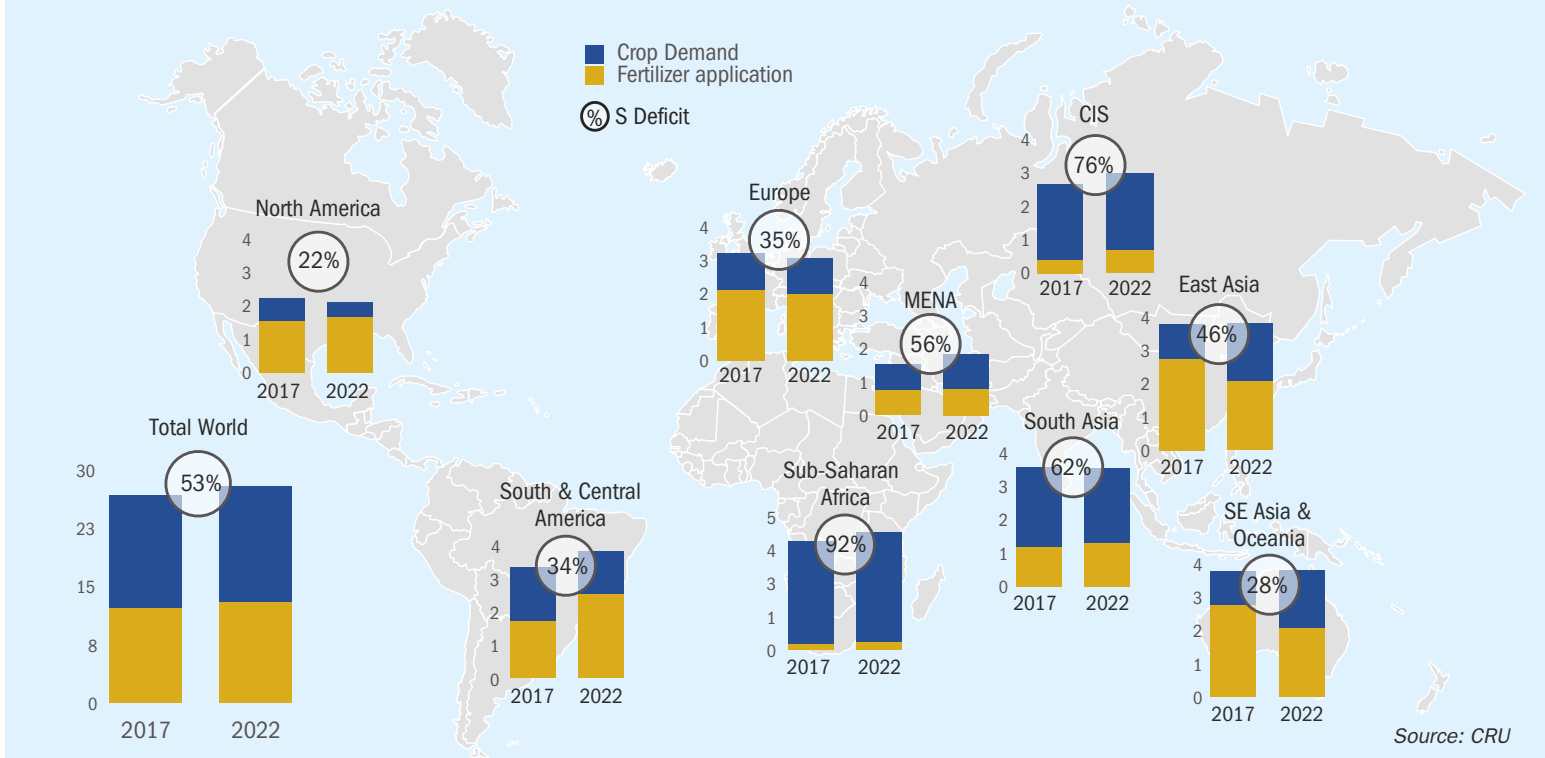
Globally, it is possible to estimate crop nutrient demand for sulphur by multiplying different crop growing areas by their specific sulphur requirements. Regional sulphur deficits can then be calculated by comparing this demand with actual sulphur fertilizer applications.

Only around half of the global sulphur requirement from crops is being met by fertilizer applications currently, based on CRU estimates. (*Fertilizer International* 520, p20). All global regions are calculated to be operating with a sulphur nutrient deficit, this being most pronounced in India, Africa and the CIS region. Despite high levels of sulphur nutrient application in East Asia and South Asia, sulphur nutrient deficits in these two regions are calculated at 46 percent and 62 percent, respectively (Figure 1).

Sulphur and nitrogen – inseparable nutrients

Importantly, sulphur does not act alone as a plant nutrient, as it works in tandem with nitrogen to enable the formation of amino acids during protein synthesis. Sulphur

Fig. 1: **Global sulphur nutrient crop demand and deficit, by region, 2017 versus 2022**



is also part of the plant enzyme required for nitrogen uptake. Sulphur and nitrogen are inseparable nutrients because of this, according to major fertilizer producer Yara International:

"Many agronomists now consider sulphur to be the second most important nutrient after nitrogen. Certainly, sulphur is an essential nutrient, closely linked with nitrogen in biological processes with both elements forming an inseparable team.

"Previously, crop requirements were generally met from atmospheric deposition, so sulphur was confined to a secondary role. However, today it is back in its rightful place as an essential component of optimum nitrogen management."

The link between nitrogen and sulphur metabolism in plants has been known for many years. As a general rule, every kilogram of S enables 5-10 kilograms of N to be used fully in crop growth and ultimately maximise crop yields.

As the world's most popular commodity fertilizer, enriching urea (U) with sulphur, by adding elemental sulphur (ES) or ammonium sulphate (AS) – to create U+ES and UAS products, respectively – can be an effective approach that addresses both soil sulphur deficiencies and improves nitrogen use efficiency (NUE)

Sulphate is readily available for uptake by plants but can be prone to leaching, especially under high rainfall conditions. While elemental sulphur remains in soils longer than sulphate, its plant availability depends upon its oxidation to sulphate – with this being controlled by soil conditions and other factors. Generally, elemental sulphur particles below 20 microns in size are better dispersed in soils and more prone to microbial oxidation.

SOURCE: KREBER

Prilling tower.

Enriching urea with sulphur or sulphate

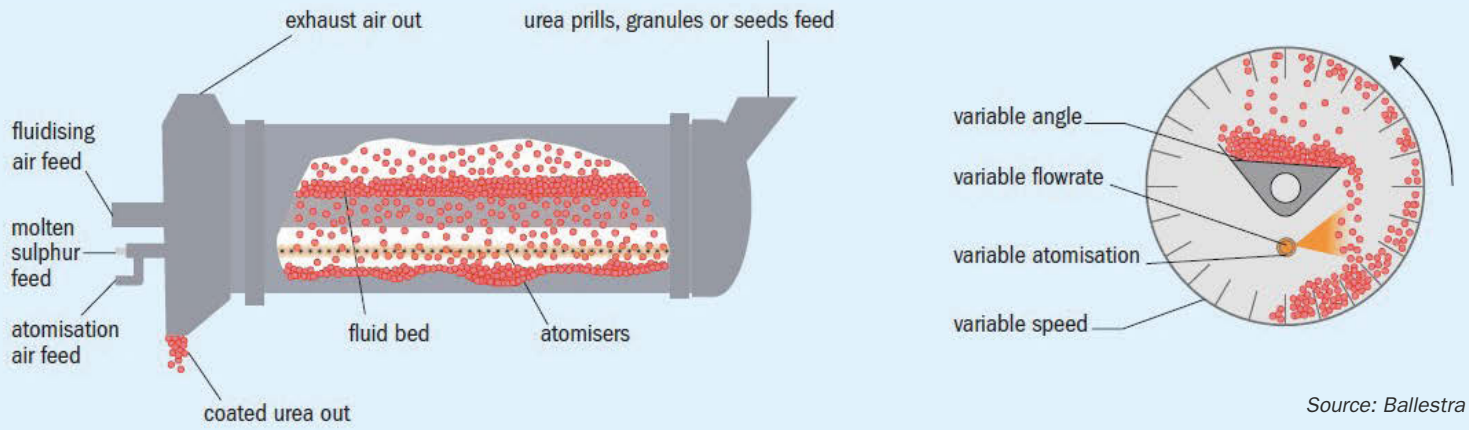
This article reviews and summarises the different commercial finishing technologies used to create U+ES and UAS fertilizers. Recent industrial references are also included as examples.

In practice, there are four main finishing options:

- Prilling
- Fluid bed granulation
- Drum granulation
- IPCO Rotoform pastillation.

Each of these finishing technologies, while having their own distinct pros and cons, have been successfully used by fertilizer producers to manufacture urea products enriched with sulphur in elemental or sulphate form.

Fig. 2: **The innovative bi fluid drum granulation (BFDG) process developed by Italy's Ballestra is suitable for sulphur-coated urea production**



Source: Ballestra

Prilling

Around 75% of urea plants globally use prilling as their finishing technology. Urea melt (99.6 wt%) is fed to a rotating prilling bucket (or shower heads with numerous small holes) located at the top of a prilling tower (see photo). This creates droplets of urea melt that solidify as they fall from the top of the tower – essentially an empty vertical cylinder of great height – and are cooled by a large volume of air flowing upwards in counter current.

Prilling tower capacities can range between 100 t/d and 4,000 t/d. The urea prills obtained typically have a diameter of 1.7-2.1 mm with a crushing strength of around 1 kg/cm^2. These prills, due to their relatively low strength, are generally not suitable for bulk blending processes or long-distance transport – and are usually bagged for local consumption instead.

The main advantages of the prilling process are its simplicity and its flexibility when it comes to incorporating additional crop nutrients. Kreber, for example, offers prilling tower technology for both U+ES and UAS. Valuably, adding ES or AS to prills improves handling properties by increasing crushing strength and their diameter.

Fluid bed granulation

Most of remaining 25% of urea plants operate a fluid bed granulation unit for fertilizer finishing. Capacities range from 500 t/d to 4,000 t/d. The concentration of urea melt varies between 96-98.5 wt% depending on the fluid bed granulation technology (Uhde, Stamicarbon, Toyo, Casale etc.). Fluid bed granulation is generally a more complicated process than prilling and, consequently, sprayer design and spraying conditions can have a real influence on overall urea plant performance.

Similar to prilling, large air flows are used to remove heat during solidification. Urea granules (average size typically 3 mm) are larger than prills and have a higher crushing strength (3 kg/cm^2). Fluid bed granulation is typically used in export-oriented urea plants as the robust granules obtained are suitable for both bulk transport and bulk blending.

Drum granulation

Globally, some ten urea plants currently use drum granulators in their finishing sections. Capacities vary between 100-500 t/d, although Ballestra's new bi-fluid drum granulator (BFDG) – see Figure 2 – can handle higher capacities due to its superior cooling performance (*Fertilizer International* 513, p33). Typically, 96 wt% urea melt is used as feed and, again, large air flows are required during solidification to remove heat.

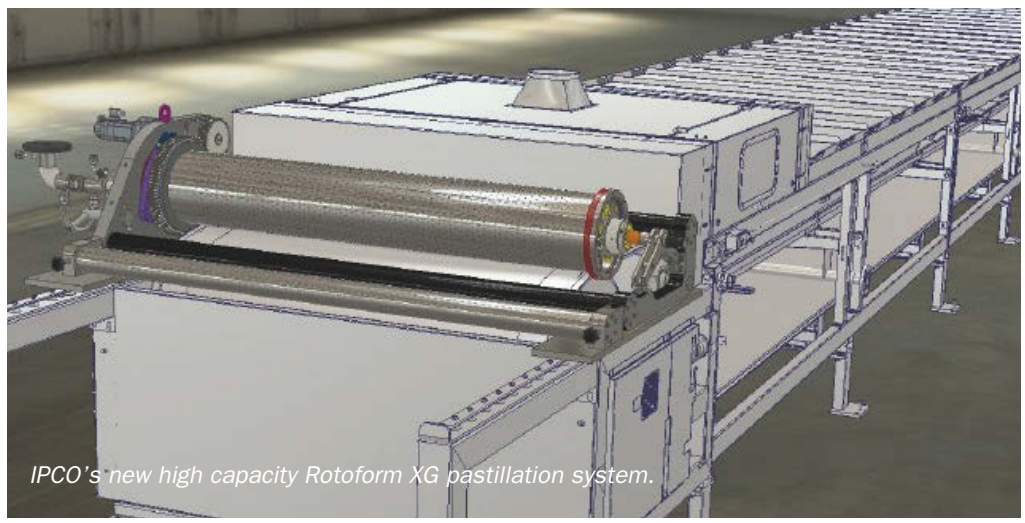
Drum granulation is a more flexible process, compared to fluid bed granulation, and thanks to a simpler sprayer design can be used to create multi-nutrient fertilizers as well as applying a coating. The granules obtained have similar properties to those from fluid bed granulation. Additionally, drum granulation can also be used to 'fatten' prills and convert these into granules, although the resulting crushing strength is lower than that of conventional granules.

IPCO Rotoform pastillation

Ten or more IPCO Rotoform urea finishing units are operating currently, with many more units installed for sulphur pastillation. Each line has a 125 t/d capacity and uses a 99.6 wt% urea melt. Heat is removed during solidification by cooling water. The process helps to avoid atmospheric emissions as hardly any air flow is required.

Rotoform equipment generates very uniform pastilles and allows the size of these to be varied from 1-5 mm. The crushing strength of pastilles is intermediate between that of prills and granules. IPCO recently introduced the Rotoform XG high capacity pastillation system for fertilizer finishing (see photo).

IPCO can also supply upstream solutions including blending and grinding units (Figure 3) that, by combining liquid and



IPCO's new high capacity Rotoform XG pastillation system.

PHOTO: IPCO

solid raw materials, enable the production of specialty urea products (*Fertilizer International* 497, p24) such as:

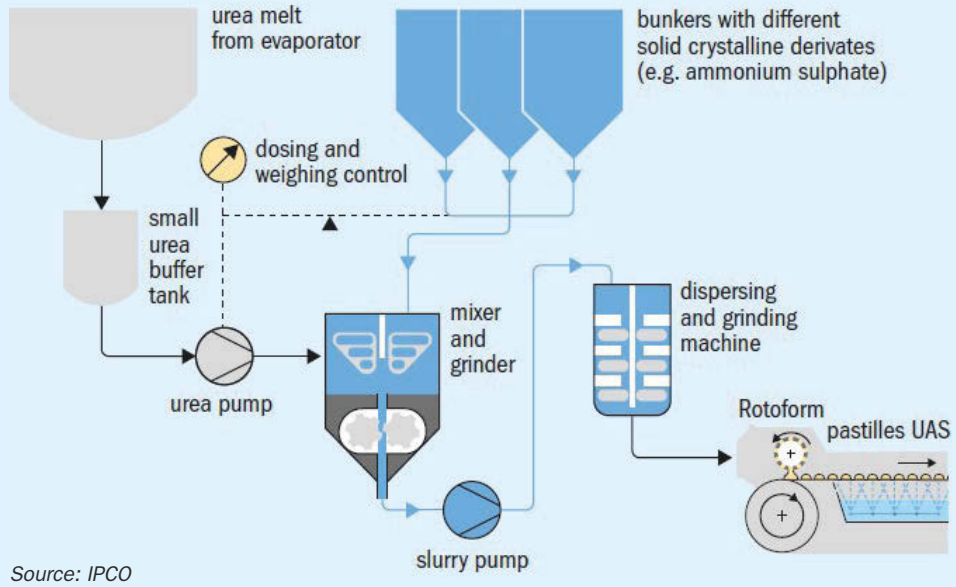
- Urea + elemental sulphur
- Urea + ammonium sulphate
- Urea + potassium
- Urea blended with micronutrients.

Urea plus elemental sulphur (U+ES) production

Successful production of U+ES has a number of requirements:

- The ability to cope with the different melting melt points of urea (133°C) and elemental sulphur (115°C)
- Then properly mix the urea melt and sulphur melt using an emulsifier. This is necessary as they are immiscible, like oil and water.
- Finally, the elemental sulphur needs to be finely dispersed and incorporated within prills, granules and pastilles as micron-size particles. This is necessary to provide a large available surface area that will subsequently allow soil bacteria to quickly convert elemental sulphur into plant-available sulphate.

Fig. 3: **IPCO mixing and blending plant – for efficient dosing, weighing, mixing and grinding with accurate control and easy maintenance**



Source: IPCO

Three companies, Yara International, Shell Sulphur Solutions and Sulvaris, have developed technologies that combine elemental sulphur with urea (including a patented emulsifier) and – except for Yara – license these to third-party fertilizer producers.

Shell Sulphur Solutions successfully commercialised its patented Thiogro technology in the early 2000s. This was initially developed for dispersing sulphur within granulated ammonium phosphates. Sulphur-enhanced phosphate lines have

subsequently been licensed and installed at phosphate fertilizer plants in Asia, North America and Australia. This includes a major collaboration with SinoChem in China (*Sulphur* 381, p24). Shell also landed a major licensing deal with OCP Group in 2016. This allows the Moroccan phosphate giant to produce its own range of highly concentrated sulphur-enhanced fertilizers using Thiogro technology at its Jorf Lasfar site.

Shell subsequently introduced Urea-ES – a product with a nitrogen content of 37-43% and containing a 7-20% dispersion of micronised sulphur in a urea matrix – to the market in 2015. This was followed in 2017 by the introduction of high sulphur urea product Special-S (11-0-0-75ES).

Shell has successfully collaborated with both thyssenkrupp (Uhde Fertilizer Technologies) and IPCO, leading providers of fluid bed granulation and Rotoform pastillation, respectively. These partnerships mean Urea-ES and Special-S technologies are now widely available to producers wishing to expand their portfolios to include sulphur-enhanced fertilizers (*Fertilizer International* 492, p44).

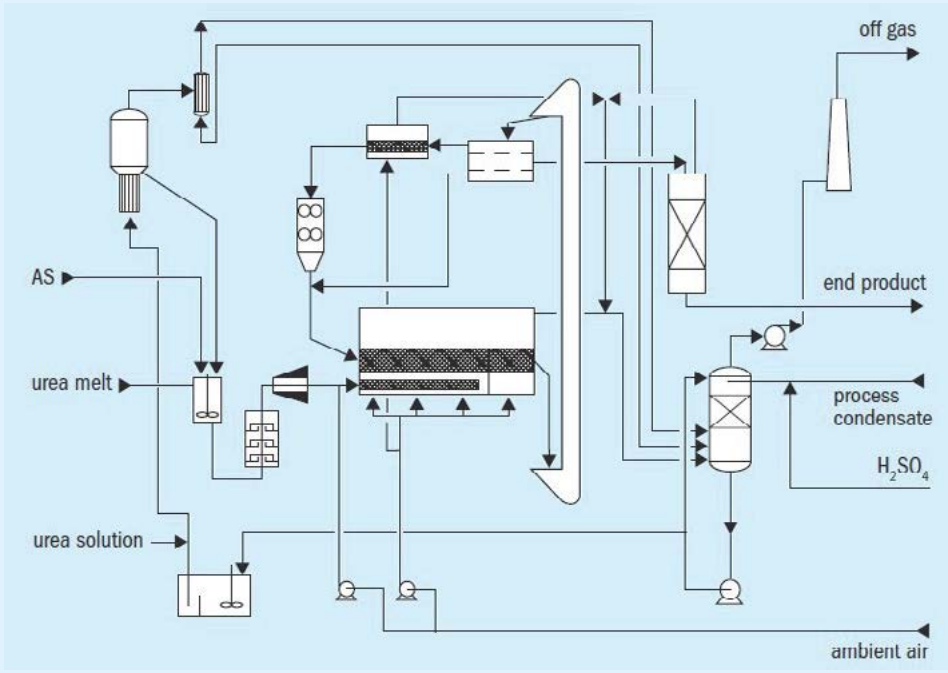
In the US, Thiogro technology was installed at Two Rivers Terminal's production site in Moses Lake, Washington state, in 2018. The company produces highly concentrated Special-S pastilles (11-0-0-75ES) for the Pacific Northwest and California markets using IPCO Rotoform equipment.

H Sulphur Corp, one of Asia's leading sulphur suppliers and sulphur-bentonite producers, commissioned the first ever Special-S production plant in South Korea in 2019 using Thiogro technology under license from Shell. The company has successfully sold and shipped Special-S to customers in Canada, Australia and Brazil under its own Super S brand name (*Fertilizer International* 492, p44).

Canada's Northern Nutrients has been producing Special-S (10-0-0-75, Artic-S) and Urea-ES (38-0-0-18+stabiliser) products under license from Shell using two IPCO Rotoform units since 2022 (see main photo). In comparison to AS, the highly concentrated Special-S formula delivers transportation, storage and application cost savings by efficiently moving almost double the per tonne nutrient content through the supply chain.

In the Middle East, RNZ International has been producing the sulphur-enhanced Purti NS Plus fertilizer (10-0-0+75S) at its Kizad production plant in Abu Dhabi since 2022 using Thiogro technology under license (*Fertilizer International* 520, p26).

Fig. 4: **Stamicarbon's UAS granulation process**



Source: Stamicarbon

Calgary-headquartered Sulvaris has commercialised a proprietary micronised sulphur technology (MST®) that reduces elemental sulphur to an average size of less than 10 microns. MST® has successfully been incorporated into a range of fertilizers, including AS, monoammonium phosphate (MAP), potash, triple superphosphate (TSP) and urea ammonium nitrate (UAN).

In collaboration with Nutrien, the world's largest fertilizer producer and retailer, Sulvaris has developed a product that combines with MST® with MAP. This is marketed by Nutrien under the brand name Smart Nutrition™ MAP+MST® (*Fertilizer International* 513, p33).

Sulvaris has also created a patented urea + MST® product. This is manufactured by incorporating micronised elemental sulphur directly into the urea melt during granulation. The resulting Urea + MST® granules have a 5-12 percent elemental sulphur content. The Canadian company is also collaborating with Netherlands-based prilling experts Kreber on incorporating MST® into urea prills.

Urea ammonium sulphate (UAS) production

Successful UAS production is a particular challenge because the two components have a eutectic point at around 9-12% AS, depending on the water content. Increasing AS content beyond this significantly increase the melting point and therefore creates a suspension at higher AS levels.

Despite this potential drawback, Casale, IPCO, Stamicarbon, Toyo/Agrofert and Yara International have all successfully developed production processes for UAS. Again, all these companies – except for Yara – license their UAS technologies to third-party fertilizer producers.

In Germany, Toyo and Agrofert (formerly SKW) have jointly developed a UAS production route using Toyo's 'spouted bed' fluid bed granulator. The process uses a solid AS feedstock prepared with a mixer-grinder. The 500 t/d unit has been in operation since 1998 and produces a 33-0-0-12 fertilizer, corresponding to around 50% AS by weight.

Yara has been producing UAS at its Sluiskil plant in the Netherland since 1998. The company added another 2,000 t/d capacity UAS fluid bed granulation line at the site in 2020.

Sluiskil operates as an integrated urea/UAS unit that generates AS within the urea melt plant. Sulphuric acid is added to the urea solution downstream of the high-pressure CO_2 stripper using a pipe reactor. The heat of reaction between ammonia and sulphuric acid reduces energy consumption by helping to evaporate water. Sluiskil produces a 40-0-0-5.6 UAS product, this corresponding to an AS content of around 23%.

In Poland, Grupa Azoty Pulawy has been producing UAS from two IPCO Rotoform pastillation units (125 t/d capacity each)

since 2013. These consume a solid AS feedstock prepared with a mixer-grinder which also features a slurry pump. The site produces a 36-0-0-8 fertilizer with 35% AS content.

Stamicarbon designed its first commercial UAS plant for EuroChem's Novomoskovk Azot production site. This was formally opened in December 2018 as Russia's first urea-UAS plant with a capacity of 400 t/d for urea and 600 t/d for UAS (*Fertilizer International* 490, p31). Stamicarbon's UAS process is designed for 0-50% AS content, with up to 32% being realised. This process (Figure 4) also uses a solid AS feedstock prepared with a mixer-grinder.

Most recently, China's Xinjiang Xinji Energy Recycling was expected to start up a 1,900 t/d capacity Casale UAS fluid bed granulation unit in December 2024. The plant, which consumes a solid AS feedstock, is fully flexible with the ability to produce either standard urea or UAS with an AS content of up to 25%.

Casale uses a 'double granulator' design to avoid reaching the eutectic point in UAS production. This enables the continuous production of UAS at any composition between 0-25% AS under optimum granulation conditions, by allowing melts of different compositions to be fed to separate sections of the granulator. This flexibility also provides the plant operator with the ability to continue production even if the supply of AS becomes unavailable or is reduced.

Conclusions

- While sulphur is regarded by many as the fourth crop nutrient, soils globally are becoming increasingly sulphur deficient.
- Fortunately, there are several proven and successful process technologies available for incorporating sulphur – in elemental or sulphate form – into urea, the world's most widely applied commodity fertilizer.
- Beneficially, the addition of sulphur also increases the nitrogen use efficiency (NUE) of urea.
- The production of urea plus elemental sulphur (U+ES) fertilizers requires an emulsifier to properly disperse sulphur particles within granules, prills and pastilles.
- The elemental sulphur is also micronised so it can be quickly converted into plant-available sulphate by soil bacteria.
- Successful urea ammonium sulphate (UAS) production is a particular challenge because the two components – urea and ammonium sulphate (AS) – have a eutectic point at around 9-12% AS.
- Despite this potential drawback, the nitrogen industry's main technology licensors and leading fertilizer producer Yara International have all successfully developed production processes for UAS. ■

Author's note

This article is based on the paper presented at the International Fertiliser Society (IFS) Conference, Cambridge, UK, 12th December 2024, and subsequently published by the Society. Additional reporting by Simon Inglethorpe.

Reference

Brouwer, M., 2024. Proven process technologies for urea fertilisers enriched with elemental sulphur or ammonium sulphate. *International Fertiliser Society Proceedings*, 890. ISBN 978-0-85310-527-5.

How to revamp a urea plant

Revamps are performed to deliver production improvements at existing urea plants. While increasing capacity is the most typical objective, revamps can also cut operating costs, increase plant availability and reduce environmental impacts. In this article, **Marc Wieschalla** of thyssenkrupp Uhde provides an overview of some of the main revamp options – from an engineering, procurement and construction (EPC) perspective.

Introduction

Plant revamps deliver improvements by changing, designing or making something differently. Applied to urea plants, revamps can have very different objectives with the range of improvements including:

- **Increasing production capacity**
- **Utilising CO_2 sources or surplus ammonia**
- **Cutting operating costs**, e.g., by reducing energy consumption
- **Reducing environmental impacts**, e.g., by cutting emissions
- **Increasing plant availability and reliability**, e.g., through the use of improved construction materials or state-of-the-art technologies
- **Production of additional urea products** – such as AdBlue® or melamine
- **Improving operability**, e.g., by modernising the control system.

Raising production capacity is the most common urea plant revamp goal, simply because the additional output delivers a rapid payback on investment. There are three main revamping options for increasing capacity:

- Melt plant revamp
- Granulation plant revamp
- Providing additional CO_2 to the synthesis process (see box).

thyssenkrupp Uhde GmbH (Uhde) has more than 65 years of experience in the engineering, supply of equipment and commissioning of urea plants with more than 120 plants built worldwide. Uhde works with Stamicarbon, the world's leading licensor for urea synthesis, this making an ideal combination with thyssenkrupp Uhde Fertilizer Technology (tk UFT), the preferred licensor for urea granulation. This enables Uhde to offers revamps for both urea synthesis and granulation units, based on Stamicarbon and tk UFT process design packages, even when their original technologies are different.


PHOTO: THYSSENKRUPP

Yara urea plant

How to approach a revamp

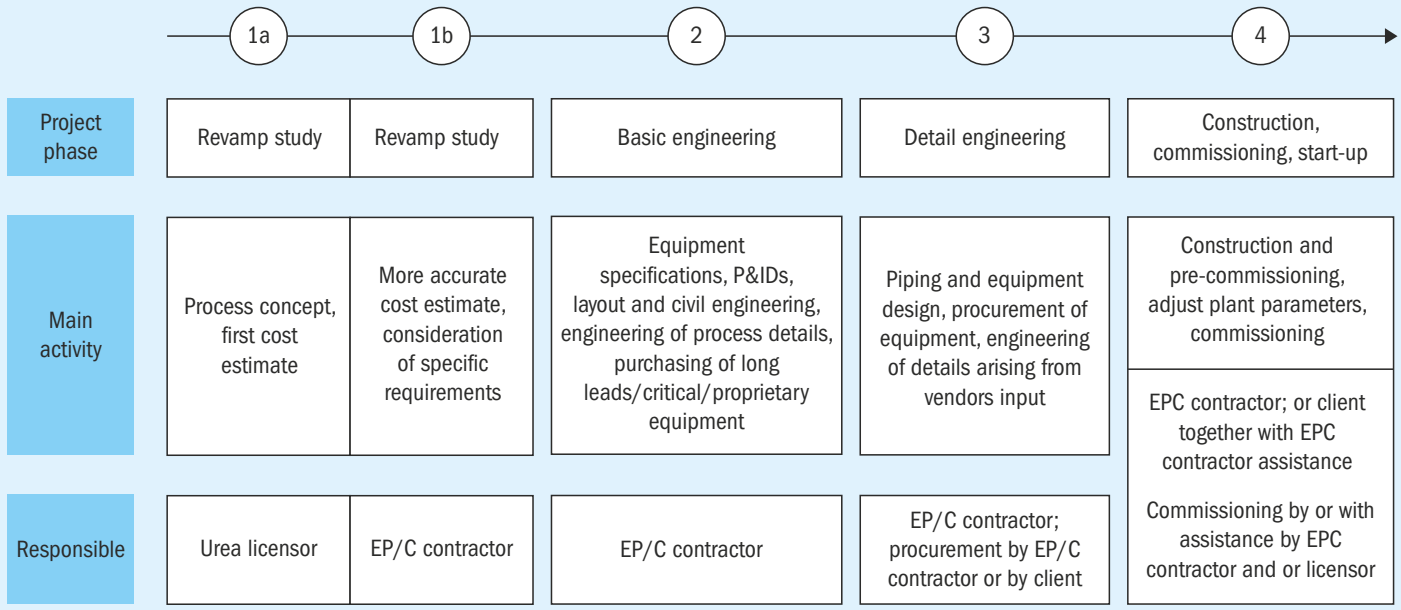
There are basically four steps in approaching a urea plant revamp (Figure 1).

Revamp study (Steps 1a and 1b). The initial phase of the revamp starts with a study to determine the process concept and provide an initial cost estimate (1a). The EPC contractor must be involved at this phase – if a more precise cost estimate is required (1b). Detailed concepts can then be considered. These need to answer several questions, such as:

- Where do the required utilities come from – and how can the higher quantities of raw materials required be made available at source?
- Is there enough space available to place new structures?
- How can the revamp be carried out to minimise downtime?

Basic engineering (Step 2). In the second phase, the basic engineering (BE) is carried out according to the licensor's process design package (PDP) and concepts provided by the EPC contractor. Initial equipment – proprietary equipment, critical equipment and equipment with long lead

Fig. 1: **Revamp execution schedule**



Source: thyssenkrupp Uhde

times – is also purchased during this phase. **Detail engineering (Step 3)**. This third phase is usually performed by the EPC contractor with all the remaining equipment purchased. The client can also carry out agreed parts of the purchasing in this phase.

Construction, commissioning and start up (Step 4). The revamp ends with the construction and commissioning of the new parts of the plant. While the contractor usually carries out construction, there are more options for commissioning. The customer may only need advisory services, for example, if very experienced. For less experienced customers, Uhde also offers complete commissioning services, provided with support from the licensor.

Revamping the melt plant

There are five basic concepts/activities for revamping the melt plant to increase capacity – as set out in Table 1:

- Debottlenecking
- More in, more out
- New/double stripper
- Medium pressure (MP) add on
- Pool condenser.

Debottlenecking can increase capacity by up to 10%. As a general rule, major equipment remains largely untouched with only the control valves, pipes and pump impellers changed or replaced. Bottlenecks can usually be identified during a plant visit – by inspecting data from the distributed control system (DCS), checking equipment datasheets and interviewing operators.

The other four melt plant revamp options shown in Table 1 can increase the original capacity by up to 100%. For these options, the involvement of the licensor is a must. The replacement or modification of static equipment is also required.

Table 1: **Revamp activities in the melt plant for capacity increase**

Method name	Detailed activities	Achievable capacity increase
Debottlenecking	• Add CO_2 sources • Replacement of valves or their internals • Conditioning of CO_2 within CO_2 compression unit • Replacement of pumps or their impellers	up to 10%
More in more out	• Installation of efficient reactor trays • Maximum utilisation of existing design margins • Adding heating and condensation capacity in the low-pressure recirculation unit and the evaporation unit • Install adiabatic flash	10 to 30%
New/double stripper	• Parallel stripper / new bigger stripper • Installation of efficient reactor trays • Installation of parallel LP recirculation and/or evaporation unit • Improvements in desorption unit	30 to 40%
MP add-on	• Installation of efficient reactor trays • Installation of a parallel MP carbamate recirculation unit • Installation of MP CO_2 compressor or modifications at CO_2 compressor unit • Improvements in waste water treatment	30 to 50%
Pool condenser	• Replacing HPCC by Pool condenser • New or additional CO_2 compressor • Installation of a parallel HP stripper • Installation of a parallel LP recirculation unit • Installation of a parallel evaporation unit • Modifications in desorption	50 to 100%

Source: thyssenkrupp Uhde

Revamping the urea granulation plant

Granulation plant revamps can be divided into two types:

- **Smaller revamps** can increase original capacity by up to 15%
- While **larger revamps** are required for higher capacity increases of up to 45% of the original capacity.

Smaller revamps avoid extensive modifications involving structural work and welding. The granulator casing, fluid bed coolers and the material handling circuit are all left untouched. Instead, the granulator can be fitted with new nozzles to deliver more urea melt feed. More cooling capacity is usually required – if no spare cooling capacity is available – to cope with extra crystallisation heat released from the melt feed. This can be achieved by adding additional coolers (e.g., a bulk flow cooler) or by chilling the water circuit of the bulk flow cooler or by adding chillers to the fluid bed air supply.

Larger revamps do require modification of the granulator. For existing zones, for example, capacity can be increased by adding extra spay nozzles and more melt headers. New zones can also be created by extending the granulator. Alternatively, a second granulator can be installed.

Cooling capabilities must also be improved during larger revamps by extending the fluid bed coolers or installing a new bulk flow cooler. New atomisation and fluidisation air fans also generally need to be installed to convey more air and provide sufficient cooling.

The installation of new fans can be avoided, however, if the capacity increase is on the lower side and can be achieved by changing the impellers and installing new pads with a very low pressure drop inside the scrubbers.

ADDITIONAL CO_2 TO INCREASE CAPACITY

There are several ways to generate the additional CO_2 needed to increase urea production capacity. One option is to increase the output of the ammonia plant's CO_2 removal unit. Alternatively, a separate removal unit can be used to collect CO_2 from CO_2-containing streams such as flue gases. The third option is to import CO_2 from external sources, such as a nearby power plant or cement factory.

Ammonia plant CO_2 removal unit

The CO_2 removal unit provides a source of CO_2 at all ammonia-urea plant complexes. The CO_2 required for urea production is normally separated in the CO_2 removal unit from synthesis gas. CO_2 generation can be increased by passing more synthesis gas through this unit.

Excess synthesis gas not needed for ammonia production is fed to the reformer to be used as fuel gas. The extra fuel gas results in a higher synthesis gas throughput and consequently higher outputs in the CO_2 removal unit and other front-end units (desulphurisation, reforming, waste heat recovery and CO shift).

While recycling part of the synthesis gas to the reformer lowers the volume of natural gas used as fuel, this approach does increase natural gas consumption overall. However, the energy generated by this additional natural gas is not lost. Instead, the higher throughput of the synthesis gas generation units increases steam production. This has benefits if the extra steam can be utilised – in surrounding plants, for example.

The required revamp modifications and costs are minor, if the additional amount of CO_2 required is small and the design margin in the front-end units can handle this. However, if higher CO_2 quantities are required, then either CO_2 removal from flue gas or direct CO_2 capture from air is required.

CO_2 removal from flue gas

The high amounts of CO_2 in flue gases from the reformer and the package boiler provide potential sources for urea production. Several technologies to capture and recover CO_2 from these flue gas streams are available. These are based on the same absorption/desorption principle as the ammonia plant's CO_2 removal unit, and use amines as solvents to recover good quality CO_2. The same processes are also used in carbon capture and sequestration (CCS) to separate CO_2 at power stations and blue ammonia plants.

Uhde has developed a proprietary flue gas CO_2 removal process for use in urea plants (Figure 2). Advantageously, the process avoids the need for additional scrubbing agents by using ammonia – which is freely available at the complex – as a solvent instead. Changes to the CO_2 compressor are also unnecessary, as the high-pressure CO_2 generated (approx. 150 bar) is perfect for CO_2 injection at urea plants.

Flue gas CO_2 removal can also be scaled up, if ammonia plant capacity is also increased – so avoiding the need to replace or change the ammonia plant's CO_2 removal unit. Overall, Uhde's flue gas CO_2 removal unit can help achieve significant increases in urea plant capacity while at the same time improving energy efficiency. Critical equipment items such as the CO_2 compressor, meanwhile, can remain untouched.

CO_2 removal units are relatively easy to install as part of a urea plant revamp They are separate, standalone add-ons that are connected to the flue gas outlet of the reformer or the boiler but are generally isolated from the rest of the plant.

Their investment and opex costs (for solvent regeneration and the steam and electricity requirements of pumps and flue gas fans) are, however, relatively high. Solvent losses associated with the process also require constant replenishment with fresh chemicals.

CO_2 from direct air capture

Another emerging CO_2 supply option is direct air capture (Figure 3). In this process, CO_2 is removed from air and added to the urea plant's CO_2 supply – on the suction side of the CO_2 compressor, for example. Because the technology is still being scaled up currently, available systems only offer small production increases of around 1% at a high investment cost.

In the longer term, direct air capture will make the production of green urea from green ammonia possible. Green urea dissociates when applied to soil but only releases the amount of CO_2 previously captured from the air. ■

Nonetheless, new fans are still typically necessary. This is because emissions usually need to be reduced during a revamp and the additional ammonia abatement increases the pressure drop. Despite this, booster fans can be installed to reduce the investment cost. This allows the existing fan to be operated at a flow below its design capacity, with the booster fan making up any shortfall.

In larger revamps, material handling equipment must also be adapted to deal with the higher throughput of granules, although spare capacity can be used to keep investment costs low.

Environmental improvements – emission reduction

In recent decades, managing ammonia and dust emissions at urea plants has become a challenge. While reducing emissions from normal continuous operations remains a priority, focus has also shifted onto accidental emissions and emissions generated during plant upsets.

Customer requirements, international standards and local regulations (Table 2) have also become more stringent over time. As a result, older plants often do not comply with current legal requirements.

There are usually three emission points in a urea granulation plant:

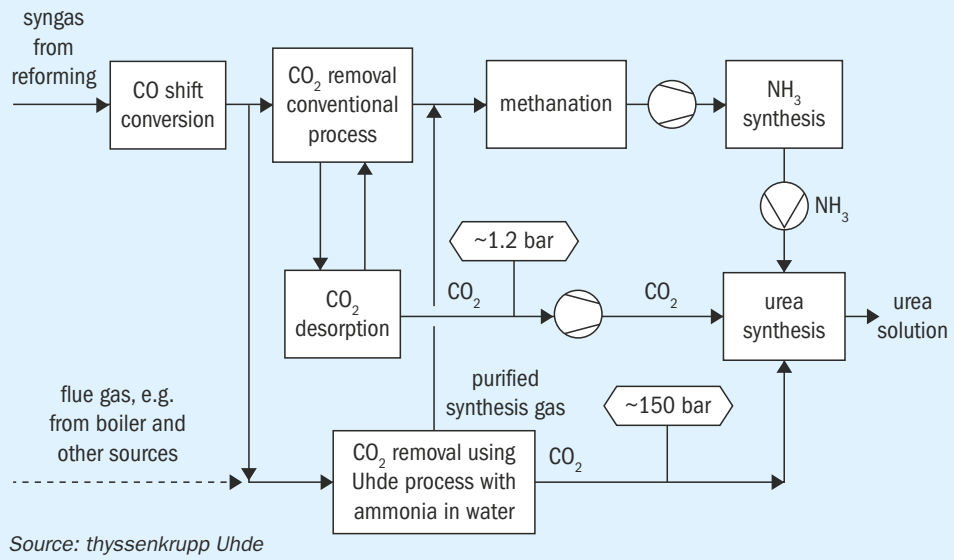
- The low pressure (LP) absorber
- The atmospheric absorber
- The granulation stack.

Although the ammonia emission rate from the two absorbers in the urea melt plant (Figure 4) are low (approx. 4-6 kg/h), ammonia concentration limits can still be exceeded due to the very low total volume throughput. Ammonia emissions from the granulation stack (Figure 5), meanwhile, are an order of magnitude higher (approx. 80 to 90 kg/h), but the large volume of air dilutes ammonia concentration to around 100 mg/Nm³.

State-of-the-art scrubbers for ammonia and dust reduction (Figures 4 and 5) can now meet even the strictest emissions regulations. In operational plants, revamping for emissions reduction can be achieved by:

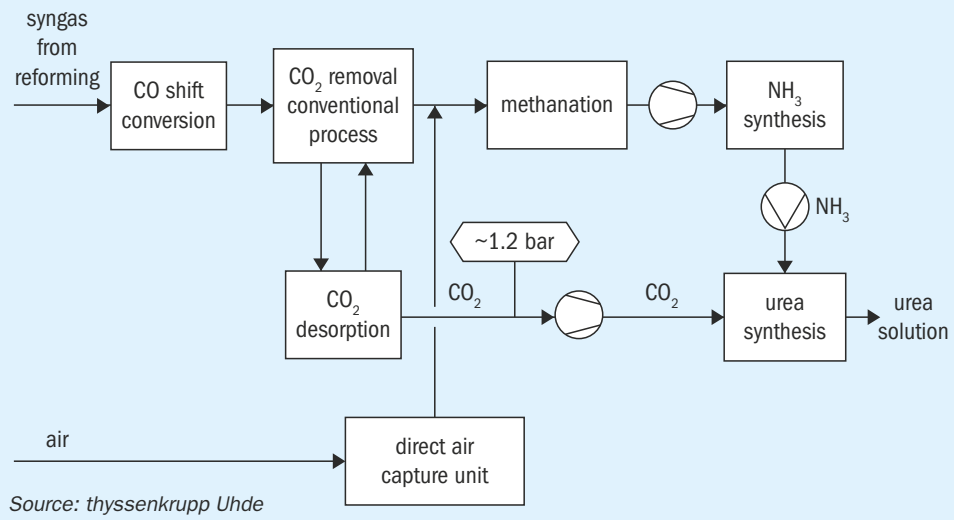
- Replacing the inner pads or trays of the existing scrubber
- Installing a dedicated acidic scrubber
- Replacing the existing scrubber with a new combined dust and ammonia scrubber.

Fig. 2: **Adding a CO_2 removal unit using Uhde's proprietary ammonia scrubbing**



Source: thyssenkrupp Uhde

Fig. 3: **Adding CO_2 which is removed from air by means of a direct air capture process**



Source: thyssenkrupp Uhde

Table 2: **Overview of international and local emission standards for urea granulation plants**

Standard	Ammonia	Dust
IFC (World Bank, 2007)[1)]	< 50 mg/Nm³	< 50 mg/Nm³
EFMA BAT Booklet (2001)[2)]	< 50 mg/Nm³ < 50 mg/Nm³	< 0.25 kg/t < 0.25 kg/t
EU BREF LVIC (2007)[3)]	< 3 - 35 mg/Nm³	< 15 - 55 mg/Nm³
Louisiana (2012)	< 30 mg/Nm³	PM10 / PM2.5 < 8.3 mg/Nm³ < 20 % opacity
Iowa (2012)	BACT[4)]	PM2.5 < 20.96 mg/Nm³ No visible emissions

[1)] IFC: International Finance Corporation (World Bank Group)

[2)] EFMA: European Fertilizer Manufactures Association (today: FE: Fertilizers Europe)

[3)] EU BREF LVIC: European Commission, Integrated Pollution Prevention and Control, Reference Document on Best Available Techniques for the Manufacture of Large Volume Inorganic Chemicals, August 2007

[4)] Best available control technology

Source: thyssenkrupp Uhde

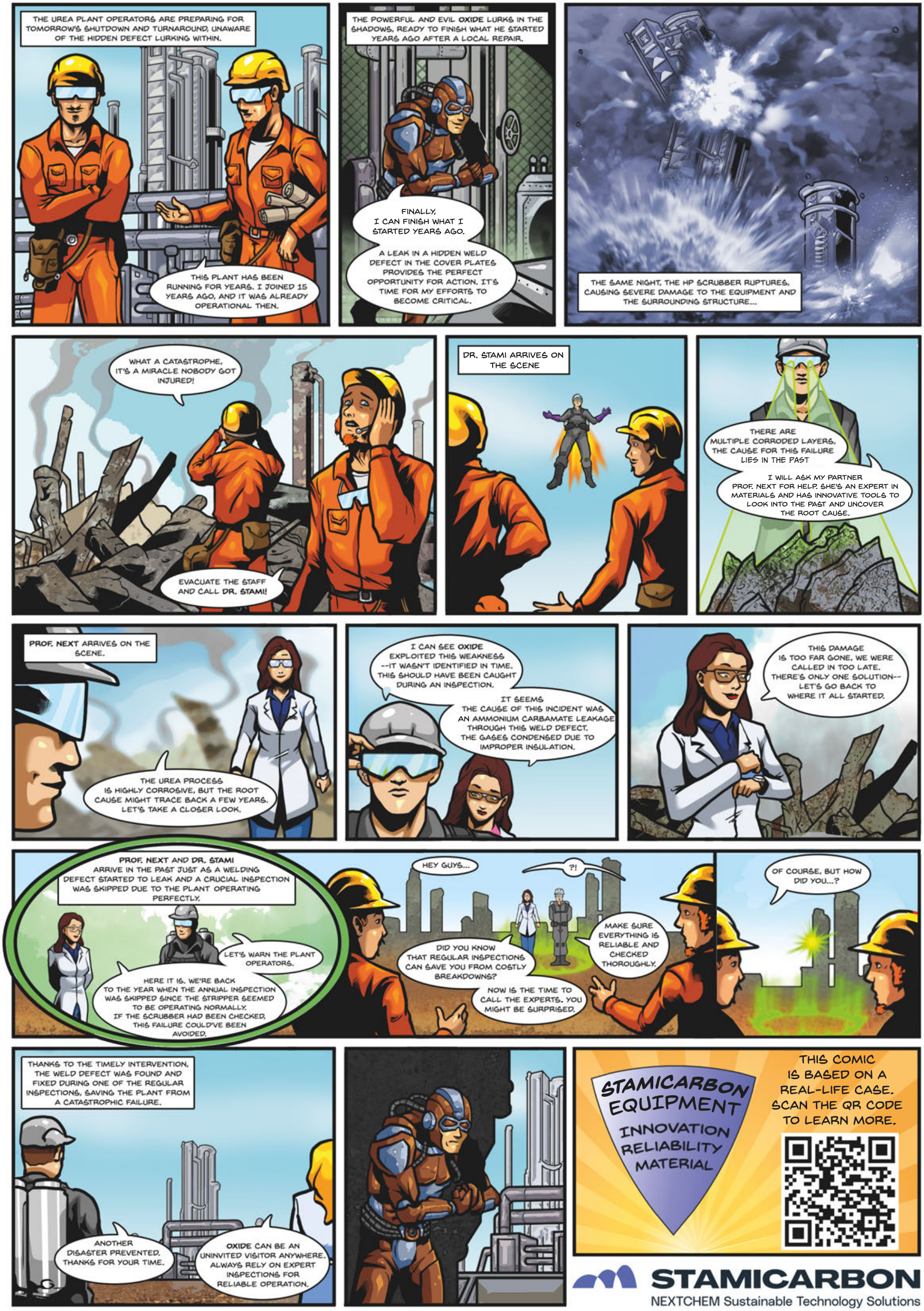
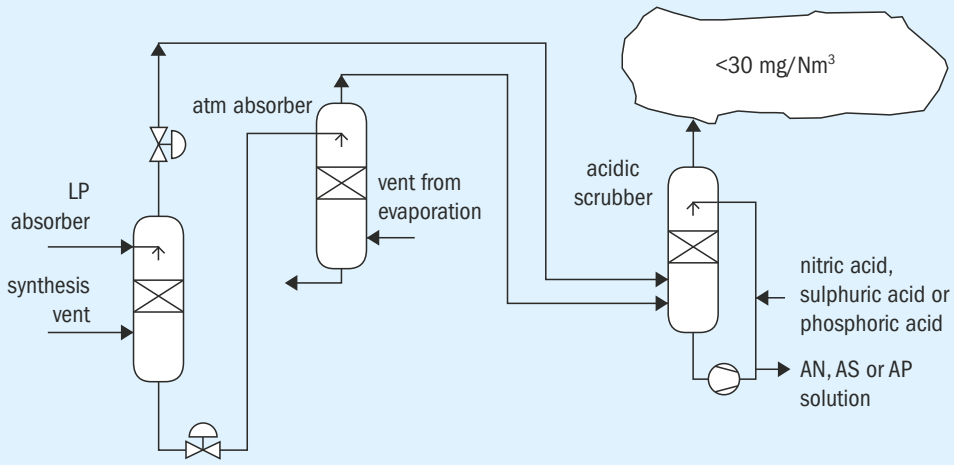
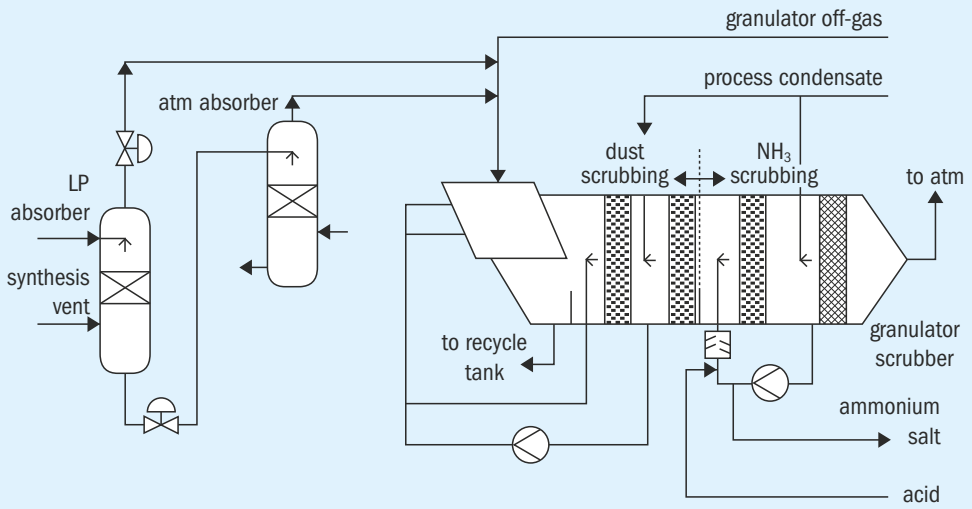


Fig. 4: **Ammonia emissions from sources in the melt plant treated with acidic scrubbing**



Source: thyssenkrupp Uhde

Fig. 5: **Common treatment of the off gases from the melt plant and granulator in a state-of-the-art horizontal type scrubber**



Source: thyssenkrupp Uhde

Which option is selected depends on the current plant emissions achieved with the old scrubber system, the total new pressure drop, and whether changes are required to the air system. New scrubber pads, due to their lower pressure drop, can be installed without needing to replace the exhaust fan. Instead, in many cases the use of a small booster fan or a larger impeller is sufficient.

Scrubbing technologies installed in new plants built by Uhde in the US comply with local standards (Table 1). These scrubbers achieved ammonia emissions of 11.1 mg/Nm³ (EPA 9 method) and dust emissions of 0.86 mg/Nm³ (EPA 5 method).

Acidic scrubbers are now established and well known due to their use in many new-build plants. Three types of acid – nitric acid, sulphuric acid and phosphoric acid – are all proven to be effective for ammonia reduction.

Soluble ammonium salts are formed when gaseous ammonia comes into contact with these three acids. These leave the scrubber as either ammonium nitrate, ammonium sulphate or ammonium phosphate solutions. Valuably, ammonium nitrate solution can be used in a urea ammonium nitrate (UAN) or ammonium nitrate plant.

If sulphuric acid is chosen, the resulting ammonium sulphate solution can be concentrated and sent to the granulator. When granulated together with fresh urea, the resulting granules have a small but significant sulphur content (0.1 wt-%) while their fertilizer-grade nitrogen content (> 46 wt-%) is maintained.

316/316L must be used as the granulator construction material if sulphuric acid is used due to its corrosive nature. This is not usually an option as most plants are built of 304. In these situations, a crystalliser unit can be used to produce an ammonium sulphate fertilizer from the resulting solution.

Finally, diammonium phosphate or monoammonium phosphate (DAP/MAP) can be produced from solution if phosphoric acid is used. Ultimately, the choice of acid is mainly influenced by three factors:

- Acid availability
- The ability to process the resulting ammonium salt solution
- The construction material of the granulation plant.

Improving plant availability

In addition to overhauling systems that have reached end of life, revamps can increase plant availability by replacing selected equipment with modern items based on new design concepts. One example is the replacement of the melt pump supplying the granulator with a self-regulating pump. The main feature of this pump is that it can be operated with almost zero suction head (NPSH = 0 m). This enables it to be installed just below the second stage evaporator in the melting plant.

The fact that the self-regulating pump does not require a NPSH leads to a couple of advantages. For example, because the pump can be installed above ground level, it can be directly connected to the granulators melt header. This also keeps the pipe length short as it avoids the need to route the pipe up and down. This configuration prevents build up on the pump's suction side and minimises biuret formation.

A further advantage of self-regulating pumps with zero suction head is that no level control or pump protection is necessary. This avoids downstream plant shutdowns triggered by low suction levels. This can be a specific issue for those plants – with a granulation, and UAN and/or a DEF unit, for example – where the volume of solution sent to the evaporator varies.

Uhde holds the patent rights to apply this pump in a urea synthesis plant.

Input of the contractor – detail engineering

It is often assumed that the revamp is essentially fixed once the process concept is selected and the process design package (PDP) has been supplied by the licensor. However, an experienced engineering contractor can adapt the process design package by contributing valuable detailed engineering concepts – as shown in the following two examples.

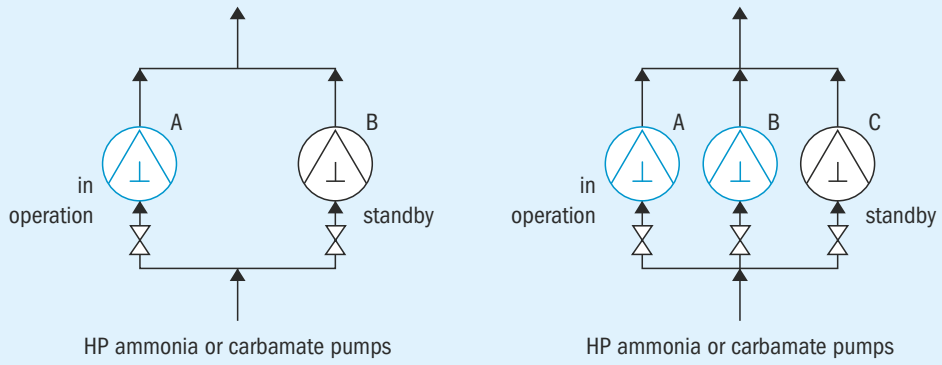
The contractor is expected to come up with a suitable spare parts philosophy. A perfect example in urea plants is the philosophy for the high-pressure pumps. These are quite expensive and it is therefore important to work with the customer to find the best spare parts philosophy for their opex and capex needs.

The specifications for different pump capacities in the PDP do allow for various possible spare part concepts – enabling the contractor to develop the most suitable solution. For a typical arrangement of high-pressure pumps in a urea melt plant (Figure 7, left), the following three revamp philosophies are possible:

- **Keeping existing pumps without modification**. Both pumps must be kept in operation to achieve the required flow after the revamp. No spare pump is available. This option has the lowest capex costs but has high opex.
- **Replacing the two existing pumps with new ones** – each being capable of handling the increased flow after revamp. This provides redundancy as only one pump will be in operation at any time while the other remains on standby. This solution has the highest capex cost but the lowest opex cost.
- **Installing a third pump alongside the existing pumps** capable of handling the entire flow during operation (Figure 7, right) has distinct advantages. Operating either the new pump, or the two old pumps in parallel, is the lowest capex solution for achieving redundancy, as only one new pump needs to be ordered. This solution also has a low opex when the newly installed pump is in operation, with higher operating costs incurred when the two existing pumps are in operation. This solution does, however, require the availability of a sufficient installation area for the additional pump.

Another example where the contractor can contribute is the detail engineering of the cooling water loop.

Fig. 7: **Standby philosophy for high pressure pumps**

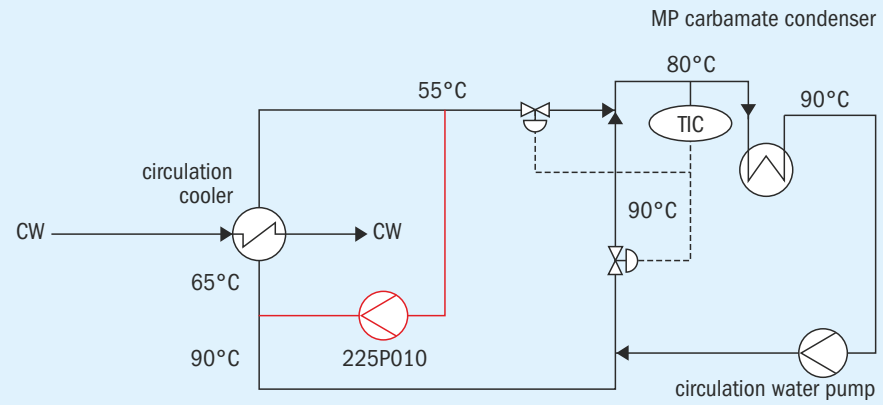


Original setup before revamp with two pumps

Two existing pumps in operation with one new installed pump providing redundancy

Source: thyssenkrupp Uhde

Fig. 8: **Closed cooling water loop of the medium pressure (MP) carbamate condenser with additional circulation loop (red) to reduce fouling**



Source: thyssenkrupp Uhde

In a revamp with a so-called medium-pressure (MP) add-on, an additional section is added to the existing plant and operated at a pressure of approx. 20 bar. The unreacted carbamate removed in this section, because it is gaseous, is condensed in the MP carbamate condenser and then pumped and recycled back to high-pressure (HP) synthesis.

The heat of condensation is removed by cooling water. The cooling water is also temperature controlled to 80°C to prevent the carbamate from crystallising.

As part of the revamp, the design of the closed cooling water loop can be improved by adding an additional circulation loop (Figure 8). Installing an additional pump generates a secondary circulation around the plate heat exchanger. This reduces the inlet temperature to the plate heat exchanger by mixing the hot return water with water from the outlet of the heat exchanger. This significantly reduced the tendency for fouling

In this specific example, the same modification was made to the cooling water loop of the high-pressure scrubber and the low-pressure carbamate condenser. Better performance and higher availability of the entire plant was achieved as a result.

Summing up

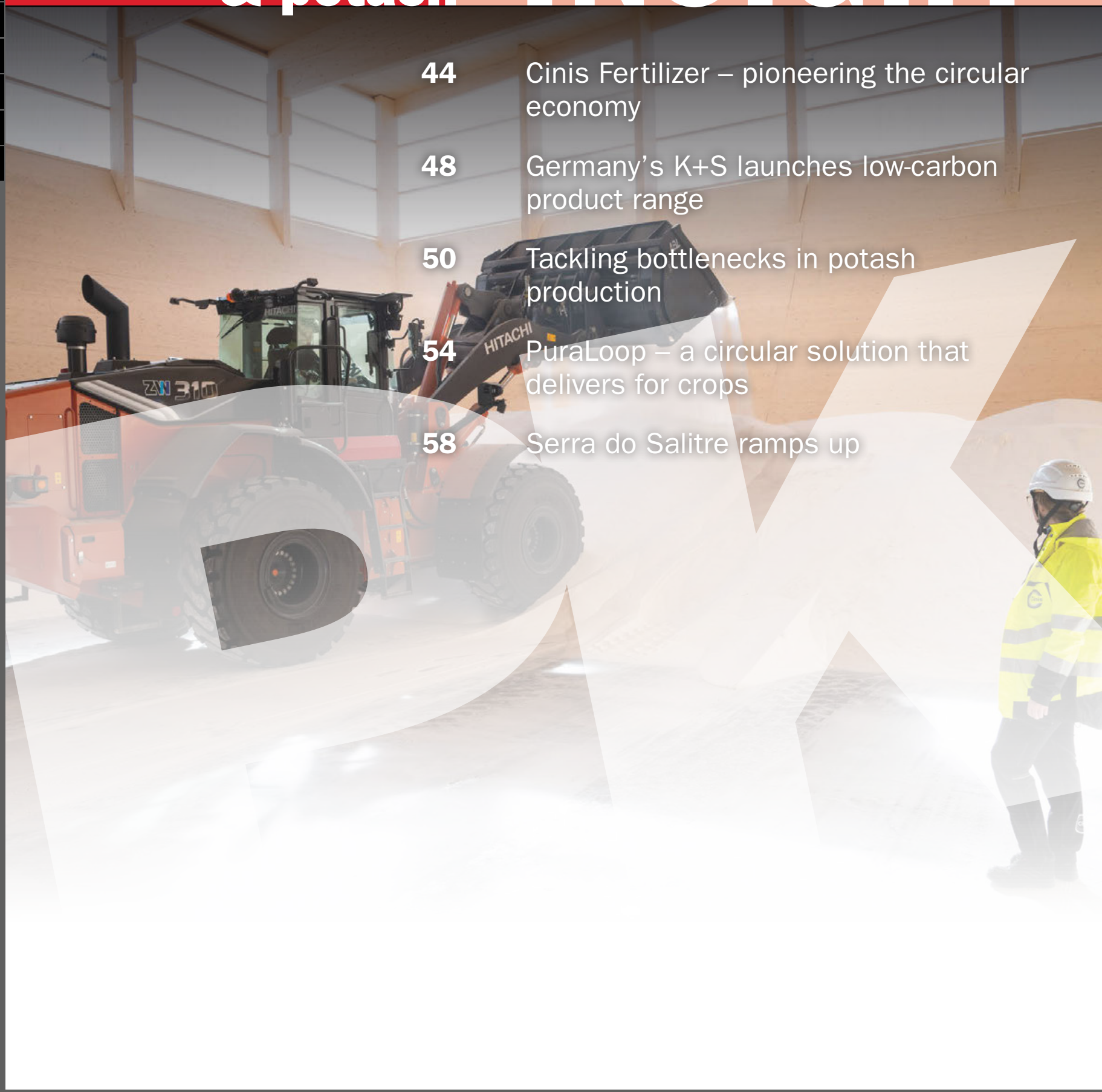
There are different ways to conduct a urea plant revamp. Ideally, as a starting point, the licensor should provide reliable consumption data for raw materials and utilities in the initial phase of the revamp project. The contractor can then provide further detailed engineering input and evaluate the commercial feasibility of the revamp at an early stage.

Based on reliable emission figures for the urea plant, revamp contractors can check if any changes to existing environmental permits are required. They can also consider and provide engineering detail changes.

It is essential that all parties involved in revamps work together closely and exchange important information during all phases of the project to achieve the best possible outcome for the customer. ■

May-June 2025

phosphates & potash INSIGHT



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Cinis Fertilizer – pioneering the circular economy

PHOTO: CINIS FERTILIZER

In this exclusive interview, *Fertilizer International* talks with **Jakob Liedberg**, the CEO of Cinis Fertilizer, a recent entrant to the European potassium sulphate (SOP) market, ahead of the International Fertilizer Association's Annual Conference in Monaco in mid-May.

Cinis Fertilizer's 100,000 t/a capacity potassium sulphate (SOP) production plant in Örnsköldsvik, Sweden, opened in June 2024. It is powered by renewable electricity and is able to manufacture high-quality water-soluble SOP by upcycling sodium sulphate sourced from industrial waste.

Background

Cinis Fertilizer started production at its inaugural 100,000 t/a capacity potassium sulphate (SOP) plant at Örnsköldsvik, Köpmanholmen, Sweden, in May 2024. The plant can also produce 65,000 t/a of sodium chloride as a co-product. The plant has taken around 15 months to construct following groundbreaking at the site in February 2023.

This Örnsköldsvik plant is powered by fossil-free energy and can upcycle industrial residues – including sodium sulphate (Na_2SO_4) from electric car battery manufacturing and ashes from pulp mills – to produce SOP using patented technology based on the glaserite process. This first-of-its-kind production method uses half as much energy as conventional SOP production, according to Cinis.

The company quotes an energy consumption of 50,000 MWh for its production process versus 100,000 MWh for conventional manufacture, based on a 100,000 tonnes of SOP production. The result, says Cinis, "is a fertilizer with low carbon footprint, a unique and circular contribution enabling sustainable agriculture".

The SOP obtained at Örnsköldsvik is sold and marketed by Van Iperen International as GreenSwitch Potassium Sulphate, a pure and fully water-soluble SOP product, with significantly reduced CO_2 emissions, approximately 300 kg CO_2 per tonne of SOP produced, that is suitable for foliar and fertigation applications.

Cinis has positioned itself as an offtaker of sodium sulphate waste from battery makers. Originally, the company had secured a 200,000 t/a offtake agreement with Northvolt, for example, for the sodium sulphate generated from precursor cathode active material (pCAM) production at its proposed Skellefteå battery manufacturing plant in Sweden. These plans were dashed, however, when Northvolt filed for bankruptcy in March this year and its plans to transform a closed paper mill in Sweden into a new gigafactory collapsed.

More positively, in an agreement with Ragn-Sells Group signed in September last year, Cinis is being paid to handle and upcycle sodium sulphate generated as industrial residue. Receiving payments for waste-derived sodium sulphate underscores the value of the company's circular business model, according to Cinis.

In the US, Cinis also has a ten-year supply agreement in place with Ascend Elements for its proposed SOP plant in Hopkinsville, Kentucky. This commits Ascend Elements to supplying up to 240,000 t/a of sodium sulphate from an under-construction battery materials manufacturing plant in Hopkinsville, starting in 2026.

In February, Cinis Fertilizer signed a cooperation agreement with WA3RM to develop and finance circular economy projects, starting with the planned Hopkinsville SOP production plant in the US. Malmo-headquartered WA3RM helps to fund and bring to market industrial-scale projects that reuse waste materials and energy.

Fertilizer International got together with Jakob Liedberg, Cinis Fertilizer's CEO, in March to talk about the company's pioneering approach to fertilizer manufacturing and its commitment to low-carbon production technology, industrial symbiosis and capturing nutrients from waste streams.

Jakob Liedberg, Cinis Fertilizer's CEO.

European market game changer

It's a pleasure speaking, Jakob. Cinis Fertilizer is close to celebrating its first year as a European SOP producer. **Could you share with our readers the story of how the company started and take us on the journey from the early days of the business to its market entry last summer?**

"In 2010, I started working with the Swedish pulp industry on an environmental project to reduce cadmium emissions into the Baltic. That's actually where the idea to combine sodium sulphate together with potassium chloride (MOP) to produce potassium sulphate (SOP) first came from – seeing how this industry, at that time, disposed of a lot of sodium sulphate in wastewater.

"The solution to pollution is dilution – that's how the chemical industry worked in the old days. If it's an effluent disposed to a drain, you dilute and stay below certain approved levels.

"The moment when it really changed from just a concept to become reality – into something tangible that we could launch as a company – was in 2022. That was when the electric battery industry started emerging in Europe, especially [our business] connecting with [the electric vehicle (EV) battery manufacturer] Northvolt, and with that a much larger sodium sulphate effluent problem from precursor Cathode Active Material (pCAM) production.

"That was the turning point for us, when Cinis really took off, as we could build a company and launch it on the stock market to bring in equity and debt finance. From then on, it went really fast.

"A year after, in February 2023, we had the groundbreaking [to start construction at Örnsköldsvik] and 15 months later this greenfield project was [complete and] ready to start up. Then, three months on from that, we actually delivered the first SOP product. As an engineer, I've never actually experienced a faster paced project, to be honest.

"Things did not progress [exactly] as planned. So, today, we don't rely on [the supply of] sodium sulphate from Northvolt. Right now, the [Örnsköldsvik] plant is producing potassium sulphate based on sodium sulphate primarily sourced [commercially] from industry and waste streams supplied by Ragn-Sells. But the plan is still to phase this out and replace it with sodium sulphate from industrial waste or by-product materials.

"I see a [great] fit for our technology in the chemical industry's future value chain. Our situation right now is a temporary phase – because [only] we can produce SOP in a context totally disconnected from the oil & gas industry.

Disruptive market entrant

Cinis clearly has a very different, innovative and disruptive business model, compared to a conventional SOP producer. **How has the company been able to profitably produce high quality SOP with a low carbon footprint using a novel process from industrial residues?**

"This is kind of a funny story. Originally, because the idea came from pulp industry, the first thing that dawned on me was that producing SOP using sodium sulphate and MOP, the glaserite process, must be a new invention.

"But I then realised this process stems from the 1950s and, as with many things, had already have been discovered a long time ago. In the 1980s, I think, there were two commercial plants operating in the world producing SOP via the glaserite route.

"The reason why the glaserite process did not get a foothold previously is because, traditionally, oil & gas by-products needed to find their way into the chemical value chain. [For example,] huge amounts of sulphur are produced when you de-sulphurise oil & gas and, of course, all that sulphur finds its way into sulphuric acid.

"For a 100 years, SOP production via the Mannheim process has been one outlet for this sulphuric acid. That's why I believe the technology was chosen as the standard way for producing SOP – and also because SOP doesn't exist naturally in many parts of the world.

"Mannheim production of SOP is a natural choice if you have a lot of energy from cheap oil & gas and you have fossil fuel industry by-products you need to find an outlet for. But the industry is changing and, to fight global warming, we're going to consume less fossil fuels in the future. So, we need to find ways of designing chemical production plants that do not rely on oil & gas with electricity as the energy input instead.

"We have to rethink how we produce chemicals and how we source input materials to increase circularity – that means using what we wasted yesterday as a resource today. That's really the whole idea behind Cinis Fertilizer and our plan to utilise waste resources, such as those from the pulp industry that are traditionally sent down the drain."

A circular economy pioneer

The Örnsköldsvik production plant is a rare example of industrial symbiosis in action. **Has it proved difficult to successfully secure the necessary raw materials and sourcing agreements needed to help Cinis turn its circular economy principles into a reality?**

"First of all, you're spot on. Sourcing and offtake agreements [with Van Iperen, K+S, Ragn-Sells, Ascend Elements and others] are actually crucial because without these partnerships with established companies I don't think our industrial project would exist, to be honest.

"They validated our concept and reduced the project risk for investors. The offtake with Van Iperen, for example, was a really crucial step and a very important agreement. It showed investors, who in fairness don't know too much about the industry, that there was an outlet for our production and someone ready to put it on the market from day one.

"I've known the managing director of Van Iperen for more than 10 years. The offtake agreement means we don't need to do the sales and marketing ourselves – building a sales force, our own brand and finding customers – Van Iperen do all that for us. Then, of course, K+S is a great partner to have for sourcing raw materials. A giant in the potash industry with lots of experience from production to markets, you name it. These collaborations truly benefit all parties, something we appreciate a lot.

"In the case of Ragn-Sells, we charge gate fees, which is a normal way of operating in the waste recycling business, because we're actually a solution to a [disposal] problem. There is a value attached to this waste, but you don't just get rid of it for nothing. [Instead,] it actually comes with a cost and industry is prepared to pay that.

PHOTO: CINIS FERTILIZER

Cinis Fertilizer's first bulk SOP shipment to Van Iperen International being loaded at Örnsköldsvik.

PHOTO: CINIS FERTILIZER

Cinis Fertilizer's CEO Jakob Liedberg (left) with Erik van den Bergh (right), the Managing Director of Van Iperen International.

"We like the agreement with Ragn-Sell because it's in both our interests. They're a recycling company focused on circularity and we can find solutions for their different waste streams – that's industrial symbiosis."

"Yes, it's a sad story with Northvolt going bankrupt in Sweden at the moment. [Originally,] the sodium sulphate supply agreements we had with them was an important piece of the puzzle to derisk the project. But if you look outside of Sweden, in Europe, Canada, US, Asia, there are lots of other [pCAM] projects still going.

"Right now, for example, we're planning our next production plant [at Hopkinsville, Kentucky] in the US together with [battery materials manufacturer] Ascend Elements. It's exactly the same setup [as Northvolt]. We're working with Ascend to address the same [pCAM] problem – lots of sodium sulphate by-product that needs to find a use somewhere.

"We can also be an enabler – a way to offload an environmental problem that otherwise could be blocking a project. Because if you present a project application with a solution to a problem, then it often gets granted. We've actually seen that happen with BASF, a company we're working with [on their pCAM plant project at Harjavalta in Finland].

"BASF are a chemical industry giant producing more or less everything that you can think of. But a really circular company too, because their whole business model is built on both primary products and by-products."

A deep partnership with shared values

How important is Van Iperen International to the story of Cinis Fertilizer and the successful start-up of your first SOP plant? Is it true to say there's very much a shared ethos on sustainability, the circular economy and net zero?

"Absolutely, Van Iperen is a fantastic company and an excellent partner. They're actively pushing and driving the switch and change to low-carbon footprint products in the fertilizer industry.

"Our SOP offers clients a lower carbon footprint, if you compare it with Mannheim production and the majority of SOP supply in Europe, because our plant runs entirely on fossil-free electricity. We reduce the carbon footprint by roughly [50% to] 300 kilograms of CO_2 per tonne of SOP. This helps our [agricultural] end-users reduce their own carbon footprint – which in the end is what it's all about.

"We have an alignment of interest with Van Iperen. We want to produce as much low-carbon SOP as we can so they can put it on the market. They have already sold SOP we've produced – under their GreenSwitch SOP brand name – in more than 25 countries. In the year-to-date, that's roughly 40,000 tonnes at least.

The first of many? – projects in the pipeline

Cinis has a project to build a 300,000 t/a capacity SOP production plant in Hopkinsville, Kentucky, in the US. **Could you update our readers on the company's expansion plans please?**

"Yes, US company Ascend Elements are building a large pCAM/'black mass' recycling facility in Hopkinsville Kentucky. We have a supply agreement with them for handling all of their sodium sulphate waste. It's actually a three times bigger project. So, with the projected amounts coming out of that facility, we can actually produce three times [the amount of SOP] compared to what we do at our plant in Sweden. The rough timeline for the start of the production at Hopkinsville is the end of 2026 or perhaps early 2027.

"Our cooperation with WA3RM, announced a few weeks ago, is one way in which we're looking at how to finance future projects. WA3RM did a huge 100,000 square metre greenhouse tomato farming project in Sweden [reusing industrial waste heat], supplying around a tenth of the total domestic tomato market.

"WA3RM's founders actually came from the European Spallation Source [an atomic research centre in Lund] with the idea, basically, of reusing waste heat and waste resources to increase circularity on a big scale. They have an interesting funding model – basically off balance sheet financing – that avoids bringing in equity to finance projects. It's just one way we're looking at executing and financing new projects in future.

Lessons from inaugural production

Have there been clear lessons for Cinis from commencing and ramping-up production at its inaugural plant – ones that can be applied to the other projects in the pipeline?

"Our technology provider is Evatherm a Swiss engineering company. If you look at this industry, you find a handful of companies that know this business, Veolia, GEA, K-UTEC. But we ended up going with Evatherm and recently set out a new plan to ramp up the Örnsköldsvik plant in 2025 and get it running close to nameplate capacity of 100,000 tonnes SOP output per year.

"We've learned a lot. There are some things that you totally cannot plan for or anticipate – for example, bad luck like the power outage in summer of 2024 which set us back quite a bit. But we've overcome that and are constantly increasing our output.

"I don't know any industrial project where the execution goes exactly to plan. So, obviously, like any other project, we've had challenges to overcome. We are producing at high capacity now, considering nominal capacity is 100,000 tonnes, and already reaching quite high output levels.

"We're a totally new company with a plant run by 30 new employees and they've done a tremendous job at learning and just operating the SOP plant. I could not be more pleased with that." ■

Germany's K+S launches low-carbon product range

For the first time, K+S is offering farmers low-carbon potash and magnesium fertilizers to help reduce the environmental footprint of crops and food. The introduction of these innovative C:LIGHT products has been possible thanks to the installation of renewable power-to-heat boilers at three of the company's German production sites.

Potassium – the logical next step in CO_2 reduction?

K+S has launched C:LIGHT, a new product range manufactured in Germany using renewable power. They include low-carbon versions of the following K+S products:

- KALIMOP – a highly concentrated potassium chloride (MOP) fertilizer for chloride tolerant crops
- KALISOP – a highly concentrated potassium sulphate (SOP) fertilizer
- Korn-KALI – a complex potassium, magnesium, sulphur and sodium fertilizer
- ESTA Kieserit – a magnesium sulphate fertilizer.

The product-related carbon footprint (PRCF) of these C:LIGHT versions is up to 90% lower than the conventional K+S product equivalents.

K+S, while describing the world's agricultural system as "essential to survival", notes that one third of total global greenhouse gases (GHG) emissions are attributable to food production, with fertilizer manufacturing and use being major contributors.

PHOTO: K+S

Renewable power-to-heat boiler at K+S's Neuhof site. It can produce up to 26 tonnes of process steam per hour when operating at full power.

"K+S, a pioneer in sustainable and environmentally friendly mining, takes responsibility and, with C:LIGHT, offers CO_2-reduced potassium and magnesium fertilizers for the first time," comments the company.

Potassium fertilizers, says K+S, are the logical next step in CO_2 reduction, after nitrogen fertilizer decarbonisation.

"[Cutting] the CO_2 footprint of potassium fertilizers can make all the difference, especially for crops with high potassium requirements such as sugar beet," says K+S. "This is where our C:LIGHT products come in."

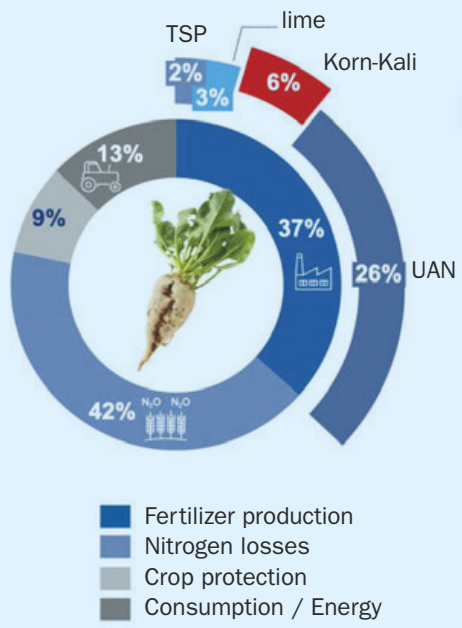
A product such as Korn-KALI for example can contribute around 6% to the GHG emissions from growing potash-hungry crops such sugar beet in Germany (Figure 1 graphic).

Renewable power-to-heat on an industrial scale

C:LIGHT refers to the innovative renewable power-to-heat (PtH) technology that K+S has introduced at its Neuhof-Ellers, Zielitz, and Werra sites production sites (see main photo). These PtH units are based on a simple yet effective concept: they use renewable electricity and water to generate the heat and pressurised steam used in fertilizer production.

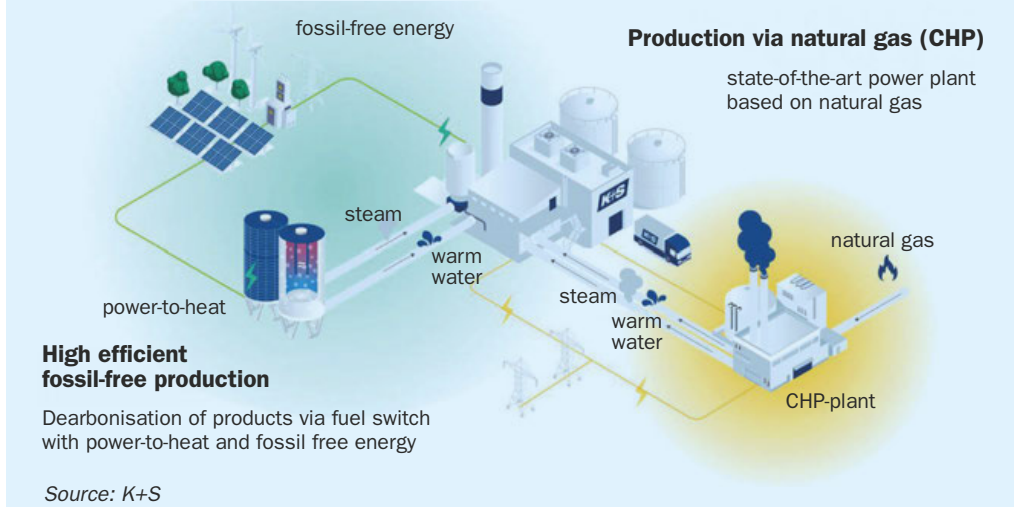
K+S is using the two energy carriers generated in this way, heat and steam, to manufacture low-carbon C:LIGHT products. The installation of PtH boilers has allowed the company to replace the use of natural

Fig. 1: **Fertilizer production accounts for around 37% of the emissions from growing sugar beet in Germany. The potassium and magnesium fertilizer Korn-Kali contributes 6% to this total**



Source: K+S

Fig. 2: **K+S has the option of switching industrial power sources from natural gas combined heat and power (CHP) to renewable power-to-heat (PtH) boilers at several German production sites. By reducing Scope 1 + Scope 2 production emissions, this enables the production of C:LIGHT products with a 90% lower carbon footprint compared to conventional K+S products**



Source: K+S

gas with renewable energy in parts of the manufacturing process (Figure 2, graphic).

K+S says it is committed to using only domestic sources of renewable energy generated within Germany's borders. This has dual benefits, according to the company. "By using PtH technology, we not only contribute to the decarbonisation of our fertilizers – as a major energy consumer, K+S also contributes to grid stability in Germany."

The resulting reductions in Scope 1 + 2 production emissions achieved by K+S are measured against 2020 as the base reference year. These carbon cutting calculations should be credible, being calculated in accordance with ISO 14040 and 14044 standards. The company also uses the German Register of Guarantees of Origin (HKNR) to properly account for the energy it consumes from renewable sources.

Innovative low-carbon potassium and magnesium fertilizers

With its innovative C:LIGHT product line, K+S can now offer low-carbon potash and magnesium fertilizers to help farmers, food manufacturers and retailers reduce the environmental footprint of food.

According to the company, this new product line, by combining innovation with sustainability, is central to K+S's climate strategy.

"With the launch of the C:LIGHT product line, we are doing pioneering work in the field of CO_2-reduced potash and magnesium fertilizers and underlining our role as a pioneer in environmentally friendly and sustainable mining. At the same time, we are helping our customers to achieve their sustainability goals," said Dr. Burkhard Lohr, the chair of K+S.

Strong demand for low-carbon fertilizers?

K+S say demand for low-carbon fertilizers extends far beyond the German market. The company has already completed first deliveries of Korn-KALI C:LIGHT, confirming its emergence as a new player in the green fertilizer market.

K+S plans to further expand the C:LIGHT product portfolio – with long term ambitions to make a decisive contribution to the decarbonisation of agriculture. ■

The C:LIGHT low-carbon version of Korn-Kali stored at K+S's Neuhof warehouse. This was partly produced using renewable energy.

Tackling bottlenecks in potash production

In a volatile potash market shaped by geopolitical risks and supply chain disruptions, operational agility and throughput flexibility are strategic necessities that offer competitive advantages. Unlocking capacity through intelligent de-bottlenecking is a scalable, cost-efficient path forward for potash producers. **Tountzer Ramadan** and **Alexander Krasovsky** of RHEWUM provide a compelling case study to illustrate this.

Introduction

The global potash market is currently experiencing a period of significant growth, an expansion which is projected to increase by over 50% in the next decade to reach a total market value of more than $30 billion.

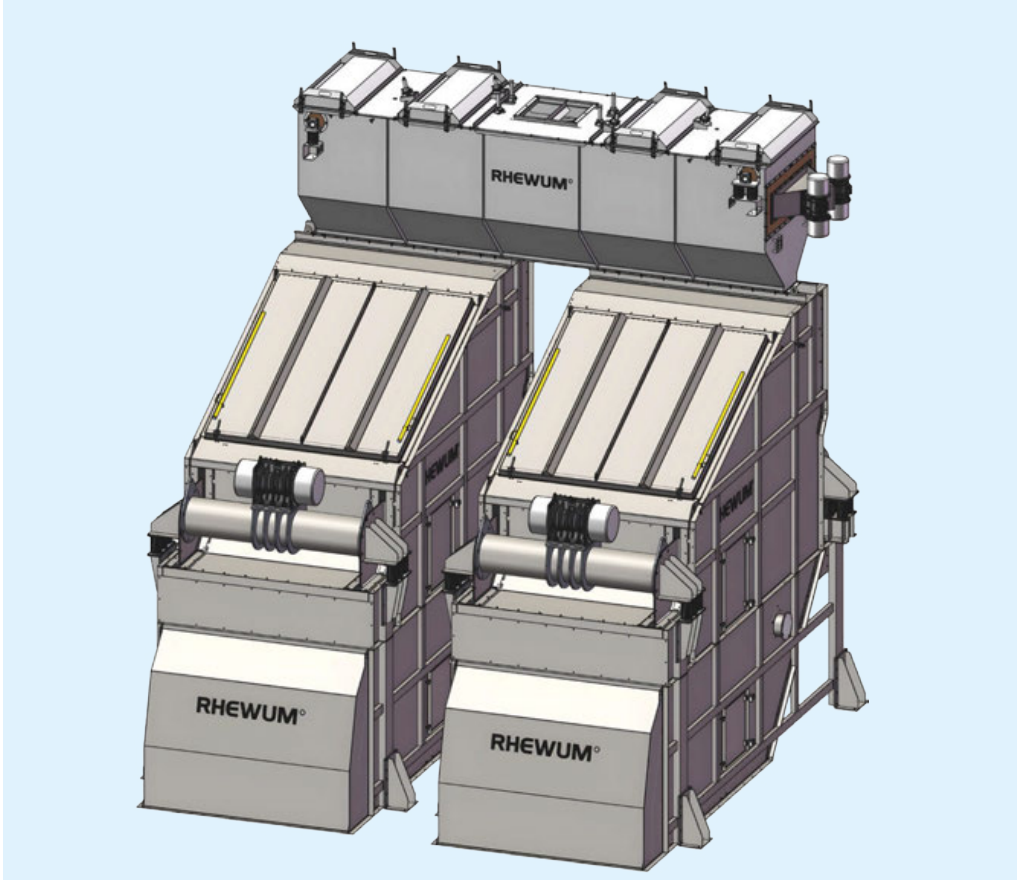
This impressive growth is primarily driven by the crucial role of potash – an essential crop nutrient – in global food security. Looking ahead, the demand for potash is anticipated to rise further due to the intensification of agriculture and the expansion of cash crop cultivation, particularly in countries like China.

However, the global potash market is being reshaped currently, with production from major supply centres, like Canada, Russia, and Belarus, being buffeted by geopolitical events and volatile trade relationships. The ongoing tariff discussions between the US and Canada highlight the complex, unfolding situation facing operators and the potential impacts of trading uncertainties on potash supply chains.

This fast-moving picture also underscores the importance of production efficiency and the ability to adapt to dynamic market conditions. Indeed, in the current operating environment, optimising production becomes paramount. Given that bottlenecks in the production process can significantly limit output and hinder the ability to respond to changing market demands.

This article will focus on the vital role of screening technology in potash production – and, in particular, how strategic upgrades to screening equipment can alleviate bottlenecks, improve product quality, and maximise output. Potash producers, by addressing these critical 'pinch points' in the production process, can unlock their full potential and position themselves for success in the expanding global market.

Fig. 1: **RHEduo® triple-deck screening machine with RHEmid**



Source: RHEWUM

Potash and screening machines

At the beginning of the production process, screening machines are used for size control of mined potash ore after the primary and/or secondary crushing stages. Depending on plant layout, they can also be used downstream for:

- The removal of large pieces of material after compaction/granulation
- Wet classification
- Dewatering
- Screening of the finished product
- Protective screening before product dispatch.

Encouragingly, the de-bottlenecking of screening-related processes offers a rapid near-term opportunity to increase potash production by 10–20%. Optimising the potash granulation circuit, immediately prior to the final product stage, is one example of a quick win. This mainly involves upgrades to the compactor/granulator and the screener.

Modern potash industry compactors/granulators are handling ever larger volumes. The product is compacted, crushed and then screened for usable on-size particles – which are fed to the next step. Oversized particles, meanwhile, are re-crushed, dust is returned to the circuit, and the process is repeated. This whole cycle is energy-intensive, as powder is pressed into flakes, crushed again, and reprocessed.

Applying modern and improved screening technology at this stage, additional to efficient potash compaction/granulation, can reduce the recirculation of material and boost output and profit. This type of process optimisation can also be implemented at a potash plant within just six months.

Quick profits in a brownfield environment

Currently, RHEWUM is receiving numerous enquiries from potash producers around the world looking to increase their production capacities. What is driving these requests?

The main reason is that screening machines are the frequent cause of bottlenecks in potash production. Many of the existing machines installed in compaction/granulation, for example, do not reach manufacturers' specifications and their anticipated output.

Consequently, choosing a screening machine especially designed for this task can deliver a significant capacity increase at potash plants of 20-30% per line or 100-150 tonnes per hour – and achieve a much higher throughput capacity at the required product purity.

Two strategies are suggested to address production limitations caused by ineffective screening at potash plants:

1. Replacement of undersized screening machines with larger ones of adequate size.
2. Providing additional surface area for screening by installing screening machines upstream or downstream to relieve overloaded existing machines.

To illustrate the practical implementation of these strategies, and their measurable benefits, the following case study presents a real-world example of a de-bottlenecking project in a potash production plant producing MOP (muriate of potash) granules.

De-bottlenecking case study – background

A comprehensive feasibility study was conducted to evaluate the technical potential and operational viability of a capacity expansion and de-bottlenecking initiative for a potassium chloride (KCl) production plant generating MOP granules. The aim was to increase the throughput of the compaction and screening line from a total feed capacity of 400 t/h to 696 t/h (design capacity 900 t/h).

The existing installation is characterised by a rigid structural layout that precluded any modifications to the building infrastructure. Moreover, pervasive dust accumulation at the facility exacerbates wear and complicates equipment maintenance. Product specifications require precise particle size separation at 10 mm, 4 mm, and 2 mm, where the 4–2 mm fraction constitutes the final product. Oversized fractions (>10 mm and 4–10 mm) are recirculated via milling stages.

The de-bottlenecking project focused on overcoming process limitations and eliminating inefficiencies — particularly those arising in the screening section, as this was identified as the primary bottleneck. The two major project tasks are described below.

Task 1: primary product screening – size separation

The current setup involves four third-party product screens operating at 100 t/h each, these being tasked with the classification and recovery of the 4–2 mm product fraction. However, the existing screening technology suffers from severe operational drawbacks.

Maintenance procedures, for example, are labour-intensive, involving manual screen cleaning that takes up to 8 hours per month. The mechanical knockers, necessary for screen deblinding, also degrade due to high temperatures and require replacement every three months due to the wear. Additionally, the feed conveyor belt to these units requires frequent replacement (every three weeks) due to wear. Uneven distribution of feed across the screens further hampers screening efficiency.

To address these shortcomings, RHEWUM proposed replacing the four existing screens with two RHEduo® triple-deck screening machines (see photo), each capable of handling a feed capacity of 348 t/h (design capacity 450 t/h). Material distribution would be managed via RHEmid feeders to ensure uniform material loading on the screens.

The targeted throughput of both machines is 696 t/h (design capacity 900 t/h), providing a final product output of approximately 138–155 t/h in the 4–2 mm range. The RHEduo® screening machines are equipped with integrated chain-based screen cleaning systems, eliminating the need for high-maintenance bouncing balls and drastically reducing manual cleaning efforts.

Screening trials confirmed the system's capabilities, demonstrating a product purity of 77.6% and a yield of 90.6% for the critical 4–2 mm fraction. The detailed trial results are shown in Tables 1 and 2.

The RHEduo® screening system stands out due to its ability to reliably process a very high throughput on a single machine, thanks to its high-capacity inlet and outlet design. The machine's steep inclination, by preventing screen flooding, reduces the likelihood of unplanned production downtimes. Furthermore, its static housing permits the use of fixed flange connections, a design feature which eliminates the frequent replacement of compensators.

With drives mounted externally, the system can also withstand product temperatures up to 450°C. Importantly, its low-vibration footprint obviates the need for an anti-vibration frame. The incorporation of an innovative chain cleaning mechanism also ensures consistent deblinding

Table 1: **Particle-size distribution of the potash feed material**

Particle size range (mm)	Distribution (%)
10-16	14.3
4-10	42.6
2-4	19.1
0-2	24.1

Source: RHEWUM

Table 2: **Results of RHEduo® screen trials a potash plant**

Feed Rate, t/h		348		
Fraction, mm	<2	2-4	4-10	>10
Mass, %	24.15	22.30	29.00	24.60
Mass, t/h	84.0	77.6	100.8	85.6
Oversize, %	4.6	19.5	2.8	0.0
Product Purity, %	95.4	77.6	94.5	54.7
Undersize, %		2.9	2.8	45.3
Yield, %	95.7	90.6	64.3	94.4

Source: RHEWUM

performance, this makes periodic replacement of the bouncing balls typically used in cleaning unnecessary.

Task 2: control screening – dust separation

The final screening step involves a single third-party unit designed to remove dust (<2 mm) from the 4–2 mm product stream. This unit was identified as underperforming and was therefore also slated for replacement. RHEWUM proposed installing a RHEflex® linear vibrating screen (see photo). This was optimised for the separation of fine particles from granulated product, with a capacity rating of 146 t/h.

The following test results from trial operation of the RHEflex® unit demonstrated its precision and efficiency in potash screening:

- <2 mm fraction: product purity of 98.6%, yield of 35.31%
- 2–4 mm fraction: product purity of 78.9%, yield of 99.97%

The RHEflex® screening machine features a high-frequency, linear vibration driven by unbalanced motors. This enables accurate particle separation even at tight cut sizes. The machine's compact, modular design allows its integration within tight plant layouts, while its minimal dynamic load enables installation without structural reinforcement.

Fig. 2: **RHEflex® linear vibrating screen**

Source: RHEWUM

In this case study, installation of the RHEflex® significantly enhanced final potash product quality, while addressing the critical dust contamination issue, thereby contributing to both operational reliability and environmental compliance.

Conclusions

This case study illustrates the significant impact targeted upgrades to screening technology can have on potash production efficiency. By replacing outdated, maintenance-intensive equipment with high-capacity, precision-engineered solutions, such as the RHEduo® and RHEflex®, bottlenecks in the compaction and screening stages were effectively eliminated. The result was a measurable increase in throughput of up to 696 t/h (design capacity up to 900 t/h), with consistently high product quality across all critical particle-size fractions.

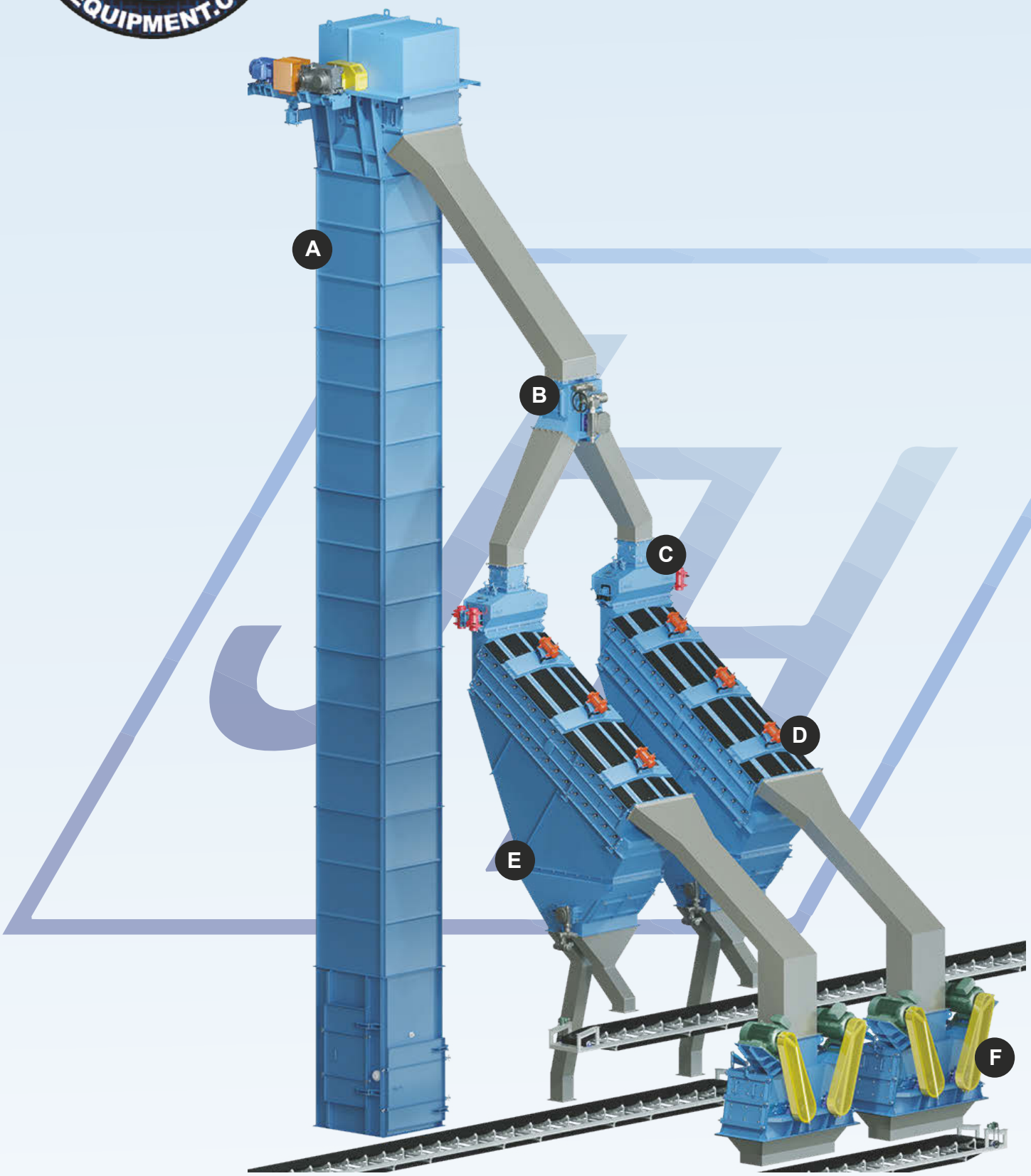
Equally important is the improvement in operational reliability. The robust design of RHEWUM screening systems – featuring externally mounted drives, static machine housings, and maintenance-free screen cleaning mechanisms – translates into fewer production downtimes, reduced maintenance intervals, and significantly lower lifecycle costs.

From an investment standpoint, the technical and economic benefits are also compelling. Given the current high market value of potassium chloride and the prevailing demand in global agriculture, the return on investment (ROI) for the modernisation measures highlighted in this article can typically be realised in less than one year – per potash production line or plant – provided that the improved capacity is fully leveraged.

In a volatile potash market shaped by geopolitical risks and supply chain disruptions, operational agility and throughput flexibility are not just competitive advantages – they are strategic necessities. Ultimately, unlocking capacity through intelligent de-bottlenecking is a scalable, cost-efficient path forward for potash producers seeking to capitalise on favourable market dynamics and secure long-term profitability. ■

About the authors

Tountzer Ramadan is Sales Director and Alexander Krasovsky is Sales Engineer, Potash, Salt & Building Materials, for RHEWUM in Germany.



Fertilizer Process & Recycle System

- **A** Severe Duty, Continuous Discharge Bucket Elevator
- **B** Modulating Material Stream Splitter
- **C** Static Body, Vibrating Pan Screen Feeder
- **D** Static Body, Vibrating Wire Screen Machine
- **E** Recycle Control Splitter
- **F** Oversize Crusher

PuraLoop – a circular solution that delivers for crops

ICL has introduced PuraLoop, a new phosphate fertilizer created from recycled phosphorus. This innovative product 'closes the loop' by transforming previously discarded waste into a valuable agricultural resource. ICL's **Patricia Imas** and **Lucas van der Saag** highlight its environmental, economic and agronomic benefits.

Background

Phosphorus is an essential nutrient for plant growth, playing a pivotal role in energy transfer, photosynthesis, and nutrient transport. But transforming phosphate rock, a non-renewable resource, into fertilizer is energy-intensive and requires the large-scale consumption of water and basic chemicals. The production process also generates huge volumes of phosphogypsum waste which require long-term storage and management.

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

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

In response, ICL has developed an innovative process known as PuraLoop to transform sewage sludge ash (SSA) into an efficient phosphate fertilizer and effective crop nutrient source.

Opening of ICL's phosphate recycling unit at its Amsterdam production site, the Netherlands, in 2019.

The company has been operating a first-of-its-kind phosphate recycling unit at its Amsterdam fertilizer (Amfert) production site in the Netherlands for the last five years (*Fertilizer International* 494, p27). This novel unit allows ICL to incorporate recovered phosphorus from secondary sources and reuse this in the industrial-scale production of phosphate-based fertilizers.

The unit, which uses high volume alternative sources of phosphorus such as sewage sludge ash (SSA), was formally opened in March 2019 (see photo). It is helping the company to 'close the loop' and develop a portfolio of fertilizers based on recycled phosphorus, as ICL's Lucas van der Saag explained to delegates at last year's CRU Phosphates conference in Warsaw.

"The idea at ICL, with our current process, is to use this sewage sludge ash as basis for the production of fertilizer," said van der Saag. "We believe that sewage sludge ash, as a raw material, has a huge potential for phosphate recovery."

About 32% of sewage sludge from Europe's wastewater treatment plants ends up being incinerated to create SSA currently. This one source alone could provide around 6% of Europe's phosphate fertilizer demand, according to estimates.

"If we look towards the future, if all of Europe's sewage sludge was incinerated and reused, we could go up to around 20% [of demand]," said van der Saag. "So there is great potential in using sewage sludge ash to replace phosphate ore in Europe."

Table 1: **The heavy metal content of PuraLoop 38, unlike sewage sludge ash (SSA), complies with EU limits.**

Sample	Al (%)	Fe (%)	MgO (%)	As (ppm)	Cd (ppm)	Cd (ppm/P_2O_5)	Cr (ppm)	Cu (ppm)	Hg (ppm)	Mn (ppm)	Ni (ppm)	Pb (ppm)	Zn (ppm)
EU-limit	n.a.	n.a.	n.a.	40	n.a.	60 ppm Cd/P_2O_5	n.a.	600	1	n.a.	100	120	1,500
PURALOOP 38	2.0	2.5	1.9	12	11	28 ppm Cd/P_2O_5	99	400	0	466	49	92	1,338
SSA	5.24	10.4	2.7	17.3	2		69	894	<1	782	63	247	2,432

Source: ICL

Currently, within the EU, around 34% of sewage sludge is directly used in agriculture with (as already stated) a further 32% being incinerated as SSA, while the remainder either goes to landfill (12%), composting (12%) or other uses (10%). Applying sewage sludge directly to soils is not ideal and carries risks, as it can contain undesirable and potentially hazardous soil contaminants such as drugs.

SSA is produced from the combustion of dewatered sewage sludge in an incinerator. Beneficially, the resulting incinerated ash is free from organic contaminants and enriched in phosphorus (10-13%), containing the equivalent of around four million tonnes of P globally, with Europe contributing around 0.3 million tonnes of P to this total.

In theory, although farmers could spread SSA directly on their fields, its phosphorus content is not much use as it is largely unavailable to crops. The heavy metal content of SSA also means it does not comply with EU regulatory limits (Table 1).

The PuraLoop process

By recovering and reusing phosphorus on a commercial scale (Figure 1), ICL's PuraLoop process benefits Europe in several ways, as Lucas van der Saag explains:

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

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

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

A full-scale industrial PuraLoop installation is now up and running at ICL's Amfert production site at the port of Amsterdam. This is capable of producing two products – the phosphate fertilizer PuraLoop 0-38-0 and NPK fertilizer PuraLoop 5-5-22. ICL manufactured 1,000 tonnes of PuraLoop 0-38-0 – known as PuraLoop 38 – during successful production runs at the end of 2023. Production of PuraLoop 38 was 6,000 tonnes in 2024 and is expected to reach 15,000 tonnes in 2025. ICL is also planning to expand the PuraLoop product range by introducing SSA-based PK products this year.

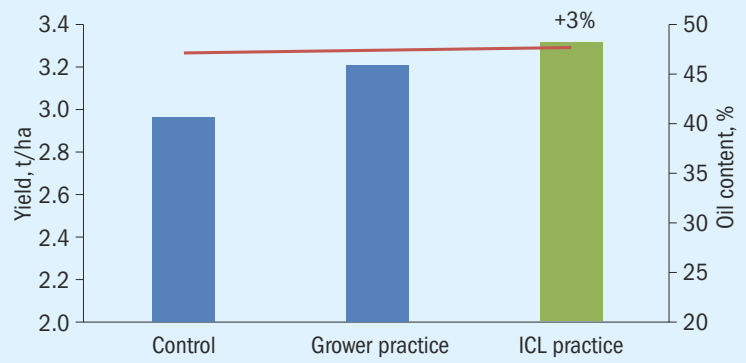
A pure and practical phosphate fertilizer

Unlike unprocessed sewage sludge ash, PuraLoop 38 complies with European regulations governing the reuse of waste

Fig. 1: **ICL's PuraLoop process**

Source: ICL

Fig. 2: **Results for a 2024 rapeseed field trial in France on an alkaline clay loam. Results are shown for control (left), grower practice (centre) and for ICL practice with PuraLoop 38 at an application rate of 150 kg/ha (right). Yield shown by bar, oil content by line.**



Notes: Control: zero phosphorus application.
Grower practice: 171 kg N/ha (ammonium nitrate), 60 kg P/ha (TSP), 60 kg K/ha (KCl).
ICL practice: 171 kg N/ha (ammonium nitrate), 60 kg P/ha (PuraLoop), 60 kg K/ha (KCl).
Sowing date: 21 August 2023. Harvest date: 11 July 2024

Source: ICL

Table 2: **Nutrient composition of PuraLoop 38**

Sample	P_2O_5 WS	P_2O_5 NAC	P_2O_5 Tot	K_2O %	MgO	CaO	SO_3	Free acid	Cl %	pH	H_2O %
PURALOOP 38	20.0	37.7	38	1.2	2.0	10.5	5.8	2.4	0.6	3.3	6.8

Source: ICL

materials in fertilizer. This includes REACH registration with the European Chemicals Agency (ECHA). Overall, PuraLoop 38 is a safe product that meets stringent European standards for agricultural use, with a heavy metal content below EU regulatory limits (Table 1).

PuraLoop 38 is offered to the market as compact, free-flowing granules. These are easy to apply as their highly consistent and dust-free nature ensure uniform spreading in the field. The product is suitable for direct application in fields, orchards and crop plantations. It can also be bulk blended with other fertilizers. ICL recommends incorporating PuraLoop 38 directly into the soil for optimal results.

The phosphorus present in PuraLoop 38 is in phosphate form (38% P_2O_5 total) and is therefore available for plant take up. One of the standout features of the product is its double-action formulation:

- Plants get an initial boost from its water-soluble phosphate content (20% P_2O_5)
- The remaining phosphate content is then released by organic acids in the crop's root zone.

This ensures that around half of the PuraLoop's phosphorus content is immediately available to plants, providing an initial nutrient supply. The remaining phosphorus is then root-activated, offering prolonged and gradual availability throughout the growing season while reducing soil fixation, leaching and runoff.

This dual-release mechanism enhances phosphorus use efficiency by ensuring plants can access P over an extended period to support crop growth and productivity.

In addition to phosphorus, PuraLoop also contains other essential nutrients such as potassium (K), magnesium (Mg), calcium (Ca), and sulphur (S) – as shown in Table 2 – along with small amounts of micronutrients. This broad nutrient profile supports balanced crop fertilization and overall plant growth.

Proven agronomic performance

ICL has conducted pot and field trials in Israel and Europe to validate the agronomic effectiveness of PuraLoop 38. These have included:

- **Cabbage** – 2022 pot trial, ICL R&D North, Israel, in a low phosphorus, sandy soil.
- **Maize** – 2022 pot trial, Landlab, Italy, in a low phosphorus, sandy soil.
- **Pepper** – 2022 pot trial, Landlab, Italy, in a low phosphorus, sandy soil.
- **Rye grass** – 2023 pot trial, Weihenstephan Triesdorf University, Germany, in a slightly acid silty loam and slightly alkaline sandy loam.
- **Maize** – 2023 pot trial, Weihenstephan Triesdorf University, Germany, in a slightly acid silty loam and slightly alkaline sandy loam.
- **Winter flax** – 2024 field trial, University of Agriculture, Krakow, Poland, on a neutral silty loam.
- **Rapeseed** – 2024 field trial, France, on an alkaline clay loam.

> **"PuraLoop underscores ICL's commitment to sustainability and innovation. Its market entry is a significant step towards making agriculture part of the circular economy.**

All of these trials have consistently demonstrated that PuraLoop performs on a par with traditional phosphorus fertilizers like TSP – in terms of phosphorus availability, and crop growth and yield responses. Example results for the 2024 French rapeseed field trial are shown in Figure 2.

The main agronomic conclusions to date are:

- For all trials, control treatments had significantly poorer development, showing that **soils were responsive to P fertilization**.
- For all trials, **PuraLoop matched the performance** of conventional, fully water-soluble phosphate fertilizers.
- In completed field trials, **Puraloop outperformed TSP** – with ongoing field trials showing similar positive findings.
- While P uptake from PuraLoop was slightly lower than TSP on higher pH soils, it was **sufficient for optimal plant growth**. PuraLoop-treated pepper plants, meanwhile, demonstrated a higher P uptake versus TSP.
- Since PuraLoop has a root-activated phosphorus fraction, unlike TSP, **residual effects for consecutive growing cycles are expected**.

Further agronomic trials are planned in 2025.

Conclusions

PuraLoop underscores ICL's commitment to sustainability and innovation. Its market entry is a significant step towards making agriculture part of the circular economy.

By closing the loop on phosphorus use, and transforming waste into a resource, this innovative product promotes sustainability and resource efficiency. Its proven agronomic performance, ease of use, and circular economy attributes make PuraLoop an ideal choice for farmers looking to enhance crop yields and quality while contributing to a more sustainable future.

The environmental benefits are significant. In particular, by incorporating recycled phosphorus, PuraLoop helps reduce the environmental impacts of fertilizer production. Its substitution for conventional phosphate fertilizers conserves phosphate ore reserves and reduces the greenhouse gas emissions associated with the mining and processing of phosphate rock. Phosphorus reuse also helps to create a more circular economy and sustainable waste management system by diverting waste from landfill.

By offering farmers an affordable, cost-effective alternative to traditional phosphate fertilizers, PuraLoop has economic merits too. In the long term, greater use of products based on recycled phosphorus should also help stabilise fertilizer price volatility by reducing market dependency on fluctuating phosphate rock prices. ■

Serra do Salitre ramps up

PHOTO: EUROCHEM

Following the 2025 Fertilizer Latino Americano Conference in Rio de Janeiro, CRU's **Humphrey Knight**, visited EuroChem's newly opened Serra do Salitre phosphate fertilizer complex in southern Brazil. Interest has centred on EuroChem's ability to produce monoammonium phosphate (MAP) at the complex, given that Brazil is heavily reliant on global import supplies. However, domestic demand and pricing incentives ultimately mean that Serra do Salitre will principally focus on single superphosphate (SSP) production for now.

Above: EuroChem's Serra do Salitre phosphate fertilizer complex in Minas Gerais state includes a phosphate ore beneficiation plant and production units for sulphuric acid, phosphoric acid and fertilizer granulation.

Producing after protracted development

Initially developed by Brazilian producer Galvani, Yara International acquired 100% of the shares in Serra do Salitre in October 2018 to take complete control of the project. Yara's tenure as owner proved short-lived, however, despite the project having successfully commenced phosphate rock production that same year.

The Norwegian fertilizer major sold on Serra do Salitre less than three years later to Russian producer EuroChem in 2021 for $452 million (*Fertilizer International* 507, p58). EuroChem then finished construction

Fig. 1: **Location map for EuroChem's Serra do Salitre integrated phosphate production complex**

Source: Image © 2025 Microsoft Corporation Bing Maps

and commenced fertilizer production at the complex in mid-2024, having invested a figure close to $425 million to complete the project.

Production continues to ramp-up with EuroChem expecting Serra do Salitre to reach the following planned capacities by the end of 2025:

- 1.2 million t/a phosphate rock concentrate – from around 10 million t/a of phosphate ore
- 1.0 million t/a granular phosphate fertilizers – split between single superphosphate (SSP), triple superphosphate (TSP), monoammonium phosphate (MAP) and NP/NPK
- 0.25 million t/a P_2O_5 wet phosphoric acid (WPA)
- 1.0 million t/a sulphuric acid.

Serra do Salitre is located in Minas Gerais state (Figure 1). The phosphate rock mine – located adjacent to Mosaic Fertilizantes' Patrocinio property – extracts highly weathered, friable igneous 'bebedourite' ore (3-5% P_2O_5) using excavators without the need for drill and blast techniques. Ore is moved by 30 tonne trucks to a primary crusher and then conveyed around two kilometres to the run-of-mine storage at the fertilizer complex in readiness for beneficiation. Froth flotation of a conditioned pulp yields a wet phosphate rock concentrate of 30–34% P_2O_5, split into coarse and fine fractions.

The fine concentrate is used to produce SSP, while the coarse fraction is largely used in wet phosphoric acid (WPA) production, although a portion of the coarse fraction is also separated and dried. Subsequently, the WPA obtained is either:

- Reacted with ammonia and then granulated to yield MAP and NPs or
- Reacted with the dry coarse phosphate rock concentrate to make TSP.

Although it has yet do so, Serra do Salitre also has the ability to make NPKs by incorporating standard-grade muriate of potash (MOP) with an on-site blending and bagging unit.

Imporrted sulphur feedstock is burned on site in the sulphuric acid plant – with cogeneration at this plant supplying around 40% of power requirements at the complex. EuroChem also has the option to trade any excess sulphuric acid generated. The site's ammonia requirements, meanwhile, are supplied by Yara from its Cubatao plant near Sao Paulo. All raw materials (other than phosphate rock) arrive and all finished products leave Serra do Salitre via trucks.

Brazil's phosphate industry dominated by SSP

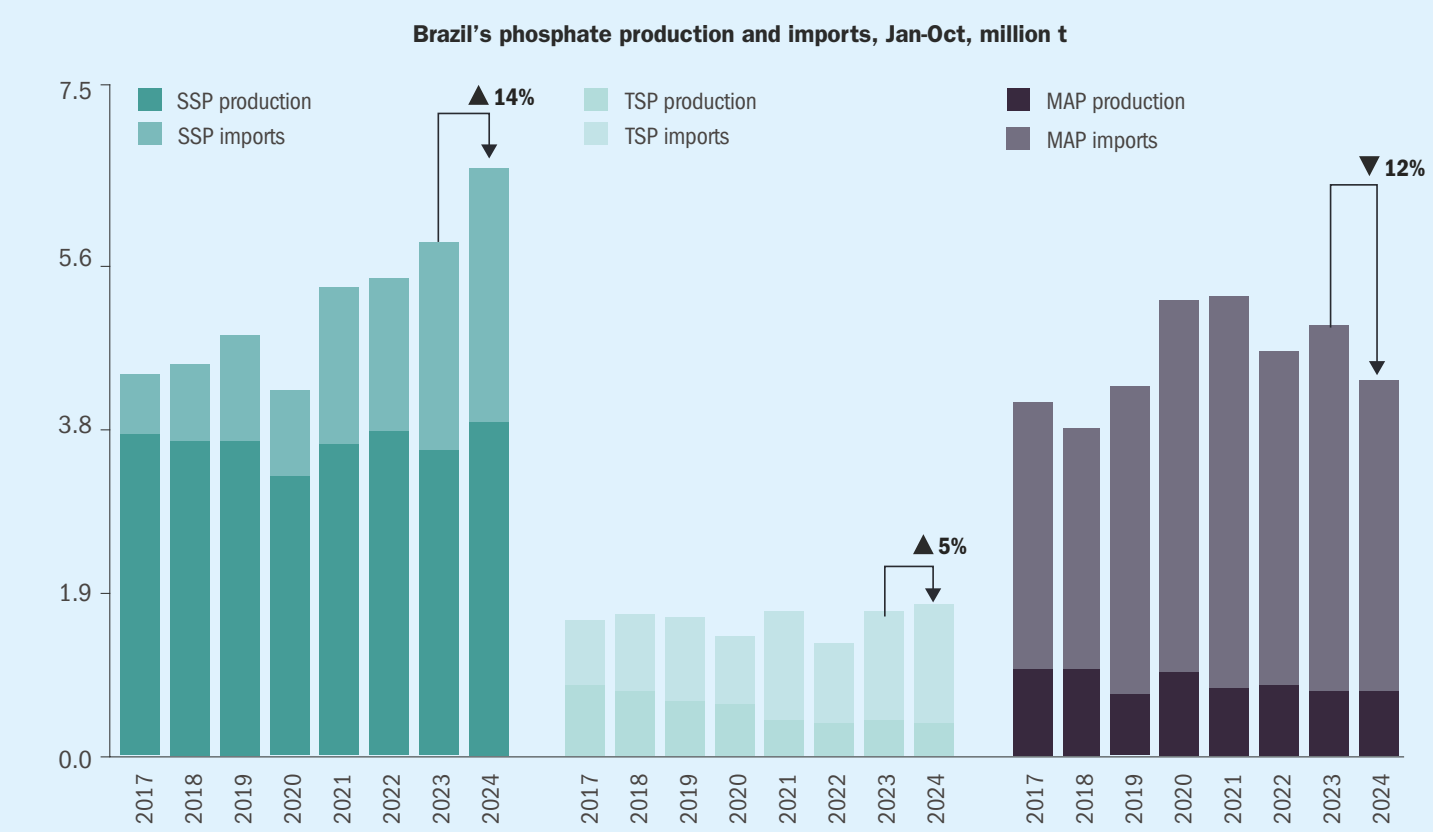
Towards the end of the 2010s, Brazil's consumption of SSP and MAP stood at similar levels, around 4–6 million t/a each. The key difference was that agricultural consumers sourced the vast majority of their SSP requirements from domestic producers, whereas MAP consumption relied primarily on imported supply.

Since 2020, while the domestic supply of both MAP and SSP has remained reasonably steady – with supply of the former declining somewhat during the past decade – the supply and consumption of SPP from imported sources has risen sharply (Figure 2, left). A similar rise in TSP imports has also offset lower domestic production (Figure 2, middle).

Brazil has, however, struggled to maintain MAP import levels during the tighter trade and higher price conditions that are currently prevailing (Figure 2, right). This has made sourcing sufficient MAP to satisfy demand a challenge, as the country's domestic MAP production is not large enough to make up any shortfalls.

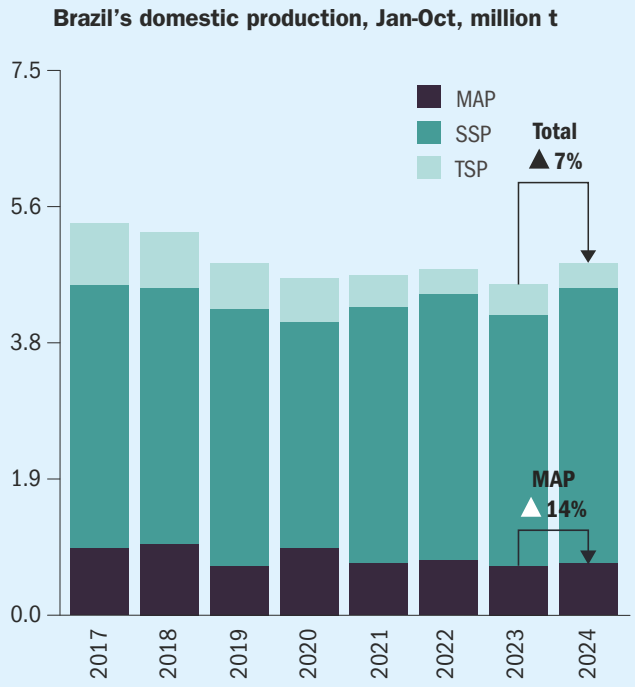
While Serra do Salitre has the capability to produce MAP – with production already taking place – output is unlikely to

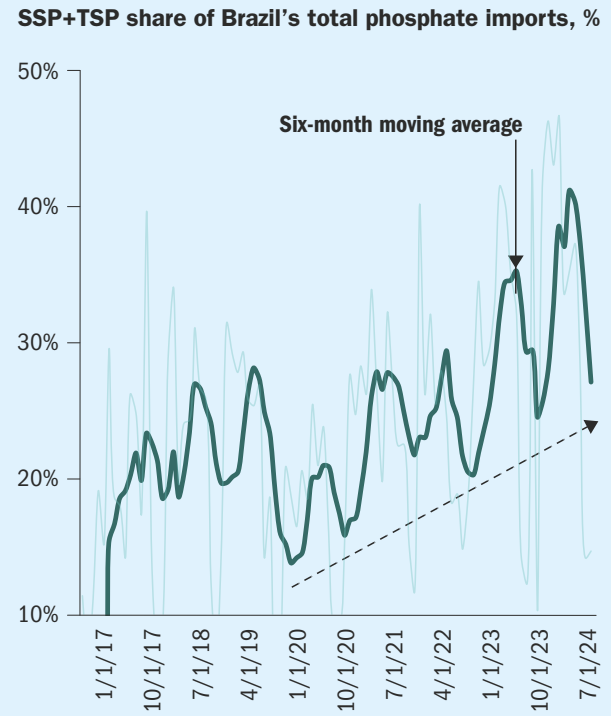
Fig. 2: **Brazil's SSP demand continues to rise while the country's MAP demand, in contrast, is faltering**



Source: ANDA

Fig. 3: **The SSP+TSP share of Brazil's phosphate imports is rising (right) while their domestic output remains steady (left)**





Source: ANDA, GTT

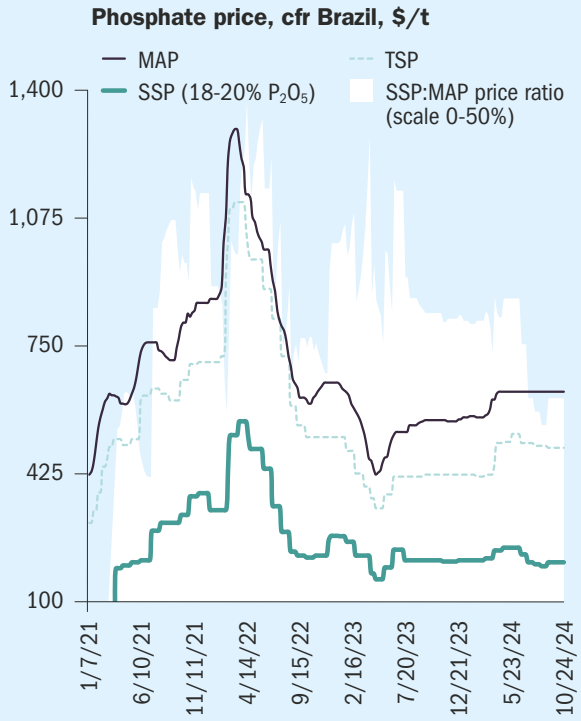
Note: Total phosphate imports include DAP, MAP, NPK, NP(S), SSP and TSP

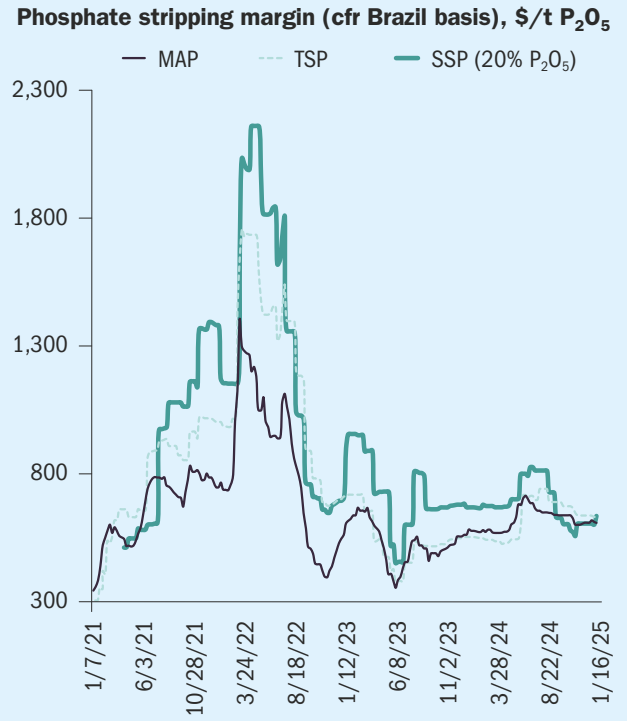
exceed 0.2 million t/a, even when the site ramps up to full capacity.

This is partly due to production limits imposed by the modest WPA capacity (0.25 million t/a P_2O_5) at the complex – and EuroChem's need to produce NPs and TSP from WPA as well as MAP. Consequently, while the top up in MAP output from this new production complex may stabilise Brazil's total domestic production, it will do little to offset the country's major import requirement for MAP or alleviate the current supply tightness, in our view.

Instead, phosphate fertilizer production at Serra do Salitre will focus on SSP, with output of around 0.5 million tonnes expected in 2025, as Brazil's domestic producers still have a commercial incentive to make SSP, despite persistently high MAP prices.

Fig. 4: **Despite SSP prices being at the bottom of the phosphate product basket (left), producer margins are the most lucrative (right)**





Source: CRU

Note: Stripping margins calculated as MAP/TSP/SSP price, less ammonia (f.o.b. Caribbean as a proxy) and sulphur (cfr Brazil) prices and phosphate rock costs (ex-works) at Serra do Salitre.

From a demand perspective, SSP is by far Brazil's most popular phosphate fertilizer product. Bucking the general trend, the country's agronomic requirements for sulphur have maintained buying interest in SSP, whereas in most other parts of the world this product has been largely displaced by ammoniated phosphates such as MAP and DAP.

Indeed, SSP imports have grown rapidly since the late 2010s (Figure 3). January-October import volumes, for example, have essentially trebled since 2017, surpassing 2.8 million tonnes in 2024. Brazil's phosphate fertilizer imports have undoubtedly seen a swing towards superphosphates during the 2020s, as consumers have responded to persistently high MAP prices and faced continued difficulties securing product.

SSP production is also generally the most lucrative option for a domestic Brazilian phosphate manufacturer from a revenue perspective. Even though SSP prices have been hovering at around one third the level of MAP prices since 2021, the avoidance of phosphoric acid production and ammonia consumption significantly reduces production and raw material costs.

High global sulphur prices have brought MAP and SSP producer margins close to parity in recent months. But this is the exception rather than the norm. Since the start of 2023, CRU estimates that a Brazilian domestic phosphate producer on average would have secured an additional \$130/t P_2O_5 on SSP sales compared to MAP (assuming ex-works rock production costs of around \$90 /t).

Clear incentives for SSP production

In conclusion, Brazilian distributors have found it increasingly difficult to secure MAP imports in the 2020s, while consumer demand for MAP has also faltered because of persistently poor affordability. SSP consumption, in contrast, has continued to rise in Brazil, supported in large part by the rapid growth in import supplies.

Significantly lower production costs and raw materials exposure also favours domestic SSP production as this typically generates higher sales margins for Brazilian producers. This is despite SSP prices in Brazil languishing at around one third those of MAP for much of the past four years.

When it comes to displacing Brazil's now substantial SSP imports, new domestic producers such as EuroChem face significantly less competition from incumbent domestic suppliers than was the case a decade ago. The economic incentives also remain compelling, with SSP returning wider margins (per tonne of P_2O_5) for most of the time, versus MAP or TSP. Consequently, EuroChem's rationale for focusing on SSP output as the preferred production pathway at Serra do Salitre is crystal clear – at least in the near term. ■

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