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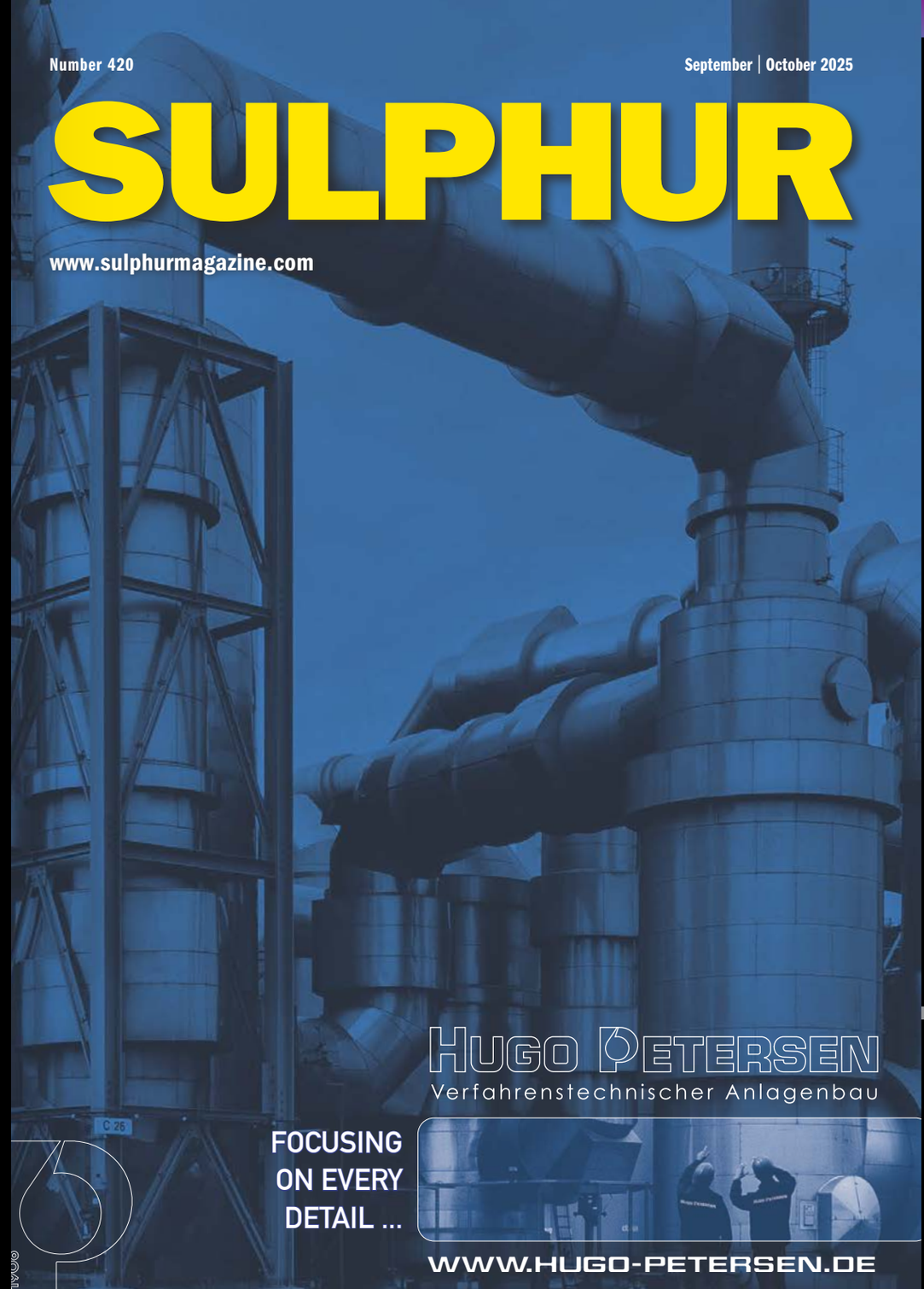

SULPHUR
ISSUE 420
SEPTEMBER-OCTOBER 2025

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North American sulphur

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Sulphur atomisation

Introducing a new generation of atomisation technology

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REGULARS

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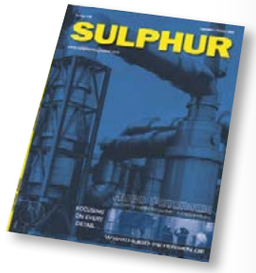
Running the gamut



This issue of Sulphur magazine contains a preview of CRU's Sulphur + Sulphuric Acid conference in Woodlands, Texas, which is being held from November 3rd to 5th this year, giving delegates the opportunity to meet and discuss some of the trends which are continuing to change the sulphur and sulphuric acid industries. Some of this is echoed in our editorial coverage this issue; the rise of electric vehicles and the continuing electrification of society is changing demand for metals and impacting upon both sulphur and sulphuric acid markets alike. As CRU's principal analyst Peter Harrison discusses on pages 36-37, battery demand for nickel is leading to a surge in new nickel leaching capacity in Indonesia which is drawing in greatly increased volumes of sulphur, while rising demand for copper is leading to additional volumes of smelter acid from China, India and Indonesia which are impacting the merchant market for acid, as detailed by CRU's Viviana Alvorado on pages 38-40. In the United States, new lithium mines will require additional sulphur (see pages 22-23). Rare earths and battery metal recovery will form a major topic on the first day of the Sulphur + Sulphuric Acid conference, with speakers from Lithium Americas, one of the pioneers of the new US lithium industry.

Elsewhere, Morocco's phosphate expansions are also drawing in large tonnages of sulphur, as described on pages 18-21, and all of this rapidly increasing demand is leading to a significant shortfall in sulphur supply over the next couple of years, which has so far been made up for via the melting down of sulphur stockpiles, particularly held by sour gas processors in Canada and Central Asia. With acid from base metal smelters likely to rise, there may be lower operating rates for sulphur burners until the imbalance is resolved.

Politics of course also continue to play their role, with US trade policy and tariff regimens leading to uncertainty across a number of markets, particularly in the metals sector. A keynote panel on the afternoon of the first day of the conference will also tackle deglobalisation and the regional policy and regulatory landscape, global trade challenges and sanctions, and risk identification and mitigation.

But whatever the economic and regulatory framework, the meat of the conference, as of this issue, are the technical papers which cover all aspects of the sulphur value chain, from sulphur recovery units and amine treatment, to sulphur storage and sulphuric acid plant operation, both sulphur burning and metallurgical off-gas treatment. Emissions, efficiency and reliability are particular topics this time, as well of course as reducing environmental footprints and managing sulphur in biorefineries.

We look forward to welcoming you to Woodlands, and hope to see you there.

> **"This rapidly increasing demand is leading to a significant shortfall in sulphur supply..."**

Richard Hands, Editor

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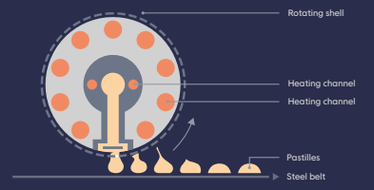

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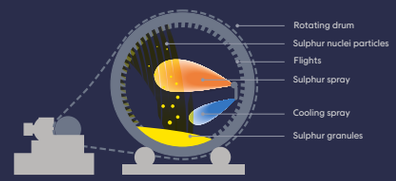

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Price Trends

SULPHUR

The global sulphur market registered price increases during August as a result of demand in Asia and North Africa, while supply has tightened due to limited supply from the FSU and Saudi Arabia, as well as logistical constraints in both Iranian ports and railway capacity to Black Sea ports.

Sulphur prices in Indonesia increased in the latest transactions into the country, which included a PT Lygend tender. Delivered prices into Indonesia were assessed up at $315-318/t c.fr at the start of September, with as many as three cargoes purchased during one week within the newly published range. The cargoes are understood to be of primarily Middle Eastern material, although some market participants indicated the possibility of one cargo being of Canadian material. Demand is expected to remain robust in the short-term, according to market participants, but some of the bullishness has subsided, as China has not reported import purchases in the last two weeks. Indonesia's sulphur imports increased by 74% year on year from January through June, reaching 2.59 million t/a for 1H 2025, according to Global Trade Tracker (GTT).

Delivered prices in China were unchanged, as transactions of international material have been absent. Phosphate producers' operating rates, fewer fresh seaborne arrivals during August, and Indonesian purchases are driving the current market sentiment. Port spot prices were reported at $312-314/t c.fr, lower than current offers of international material of around $320/t c.fr. Still, Chinese buyers have become cautious due to the price difference between new international cargos and port products. Domestic prices have been rising, however, and have reached a delivered price around $314/t c.fr. At the start of September, Sinopec's Puguang, China's largest sulphur producer, with an output of around 5,500 t/d, increased its prices at both port and its Dazhou factory. The seller's price at Wanzhou port is currently reported at $359/t, increasing by $8/t from the previous week. The factory price at Dazhou for truck volumes is $344/t, up $11/t, while rail volumes were priced at $352/t ex works, up by $8/t compared to last week. Total sulphur port inventories in China were unchanged at 2.31 million tonnes by September 3rd. The volume at Yangtze River ports increased by 18,000 tonnes to 1.12 million tonnes, while the Dafeng port inventory was unchanged at 296,000 tonnes.

In the Middle East, the latest Indonesian purchases have been reflected in higher indications that place the price at around $290-300/t f.o.b. Despite the release of the September monthly prices this week by KPC at $284/t f.o.b. and ADNOC at $285/t f.o.b., following QatarEnergy's previous posting of $284/t f.o.b., the spot market was moving higher, with spot transactions at those levels considered no longer viable, according to multiple industry sources. Offers have increased in China where, as noted, they have been reported at around $320/t c.fr.

In Brazil, the latest CMOC tender is understood to have been awarded at a price level of $320/t c.fr., although the origin of the material could not be verified at the time of writing. Market talk suggested it was likely the FSU, in spite of earlier reports suggesting a very limited presence of FSU offers during the tendering process. Still, the transaction also supported prices in the US Gulf, which have now risen to levels at the $275-285/t f.o.b. level. The Brazilian market is likely to retain some bullishness in the short-term after having to compete with North African, Indonesian and Chinese demand, but activity is likely to remain subdued until October with prices expected to decrease around the same time, according to market participants.

In Europe, Mediterranean sulphur prices were assessed up at $275-280/t f.o.b. and $310-315/t c.fr. Availability in the market is understood to be limited, which has increased the bid level, with the latest transaction understood to have taken place within the newly published c.fr level. The price level saw a steady increase on three tenders in the span of a week, with the latest one, an NOC tender, understood to have been awarded within the newly published f.o.b. range. The market is bullish and limited availability is likely to see prices increase in the short-term, although prices are likely to soften towards the beginning of Q4, according to industry sources.

Although prices were assessed unchanged in Vancouver at $270-279/t f.o.b. at the start of September, local market sentiment is bullish, with expectations of the price entering the $280s/t f.o.b. in the next transaction, according to market participants. Although exports to Asia were limited, demand in Indonesia is likely to be robust or at least constant in the weeks ahead, according to market participants.

Price Indications

Table 1: **Recent sulphur prices, major markets**

Cash equivalent	April	May	June	July	August
Sulphur, bulk ($/t)					
Adnoc monthly contract	280	290	290	265	265
China c.fr spot	300	305	280	280	285
Liquid sulphur ($/t)					
Tampa f.o.b. contract	270	270	252	252	252
NW Europe c.fr	274	274	274	290	290
Sulphuric acid ($/t)					
US Gulf spot	143	150	155	163	163

Source: various

SULPHURIC ACID

Current sulphuric acid availability in Europe has exerted downward pressure on prices as offers decline across delivered markets, while the latest tender in China also registered a price decrease. Acid prices in Europe decreased further at the end of August, down at $85-85/t f.o.b. from a previous weekly figure of $105-115/t f.o.b., with ample availability. Volumes in Europe have been offered across delivered markets, but demand had remained subdued in recent weeks with prices at higher levels, according to market participants. Bearish market sentiment persists, and expectations points towards the market consolidating at the $80s/t f.o.b. level in the near-term, according to multiple industry sources.

The latest tender in China also registered a decrease, with the award understood to have taken place at the high $70s/t f.o.b. price level. Decreasing offers of European material have put downward pressure on China's export market, with demand quickly becoming subdued and losing interest in Asian material at higher price levels, according to industry sources. The export price range for sulphuric acid in China was assessed down to $76-79/t f.o.b. from a previous figure of $93-98/t f.o.b. Although the domestic market remains a possibility for sellers in the region, more material is expected to enter the international market, leading to a slightly bearish sentiment. China's sulphuric acid exports during January-July 2025 increased 103% year on year to 2.6 million tonnes , while imports decreased 21% on year, according to data via Global Trade Tracker (GTT).

Demand in North Africa remains limited. Sulphuric acid prices into North Africa were assessed down at $120-140/t c.fr from a previous level of $150-170/t c.fr. With prominent buyers in the region reportedly now covered for the remainder of the year, the price floor was not immediately clear, with activity likely to be limited until at least Q4, when buyers re-enter for 2026 Q1 purchases, according to industry sources.

Spot sulphuric acid prices for import into the US Gulf were assessed down at $120-130/t c.fr, from previous levels of $150-155/t c.fr. Firm offers into the US Gulf fell and the latest transaction, although unverified, is understood to have taken place within the newly published range. Demand is low and a healthy domestic market has limited the purchases of imported material recently, although buying interest has reportedly grown as offers continue to fall. The US imported 1.65 million tonnes of sulphuric acid during January-June 2025, decreasing by 6% compared to the volumes imported during the same period in 2024, according to data via Global Trade Tracker (GTT).

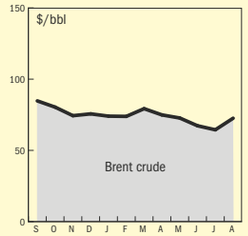
Buying interest in Chile has also remained subdued even as offers declined. Sulphuric acid prices into Chile were assessed down at $165-170/t c.fr, after having spent five weeks assessed at a level of $175-182/t c.fr. Even so, a number of transactions on an FCA basis took place this week, according to market participants, at levels suggesting CFR prices that fall within the newly published range. Current availability in Europe has put downward pressure on prices, and buyers are waiting for the start of annual contract negotiations, and are limiting themselves to opportunistic purchases in the meantime, according to industry sources. Chile's imports of sulphuric acid from January through July 2025 increased by 19% to 2.33 million tonnes, compared to the volumes imported during the same period in 2024, according to Global Trade Tracker (GTT) data.

The delivered price of sulphuric acid into Brazil was assessed lower at $140-150/t c.fr from last week's $175-180/t c.fr. The decrease in prices reflects the sentiment in Europe, with volumes from the region being offered within the newly published range, according to market sources. The market is bearish and offers are expected to decrease further but demand is likely to be muted in the coming weeks with most of the market reported to be already covered. Still, offers have kept a downward trend with the latest firm offers within the newly published price range and prices above consider no longer viable, market sources said. Brazil's imports of sulphuric acid for January-July 2025 were down 11% year on year at 263,000 tonnes, according to GTT.

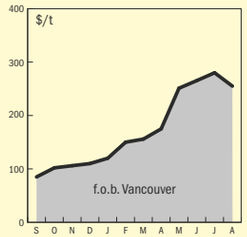
Prices into Turkey were assessed down at $110-130/t c.fr from last week's $140-150/t c.fr. Domestic availability is reported stable and there is little demand for imported material, according to multiple market participants.

END OF MONTH SPOT PRICES

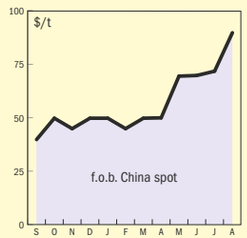
oil



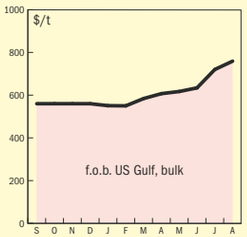
sulphur



sulphuric acid



diammonium phosphate



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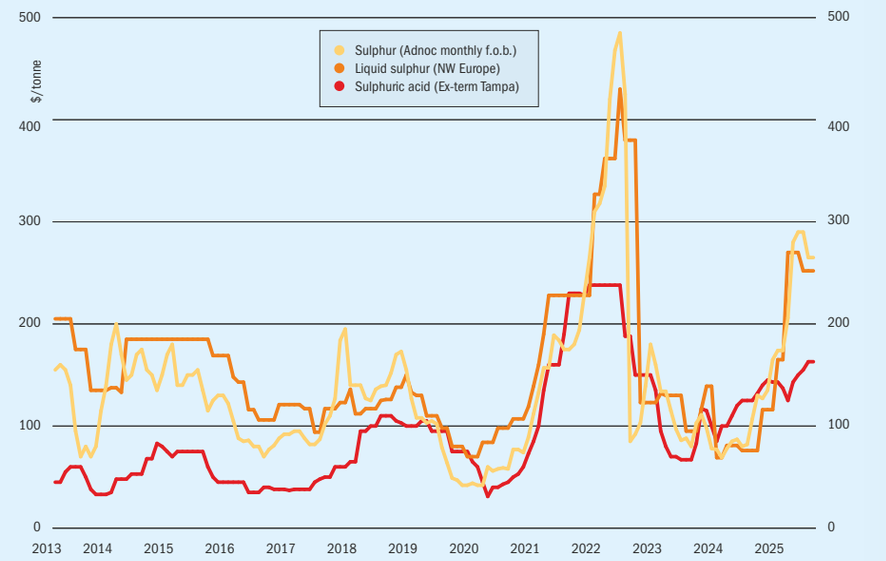
Market Outlook

Historical price trends $/tonne



Source: CRU

SULPHUR

- The global sulphur market is forecast to enter a downward trend as supply from Saudi Arabia normalises following the summer months, while demand decreases alongside demand for phosphate fertilizers. The price is expected to fall towards the end of the year, with a low of around $220/t by May 2026.
- Prices in Canada are expected to follow a similar trend driven by demand in Asia. The forecast sees this downward trend holding until April 2026 at a level close to $210/t f.o.b.
- In China, sulphur prices have been increasing domestically as the announcement of a second round of phosphate export quotas alongside requirements for the autumn application season were met with volumes that had been purchased previously at higher price levels. Offers of imports into the country have also been increasing and the forecast now expects the price to average $315/t c.fr during September but decreasing towards November as demand becomes subdued with most requirements for the Autumn application season met.
- Brazil has seen limited activity and has as of late purchased predominantly US Gulf material. The latest CMOC tender is understood to have received a reduced number of offers of FSU material due to the limited availability in that region. With this supply limitation anticipated to continue, it is likely that prices will increase.

SULPHURIC ACID

- Prices in the global sulphuric acid market are expected to decrease further in the coming weeks. Demand is likely to remain opportunistic leading to a market of overall limited transactions. The outlook forecasts that prices in both Europe and Chile will trend downwards and expected to decrease from September through April 2026, possibly as low as $60/t by early 2026.
- European volumes are being offered across delivered markets amid subdued demand but uncertainty regarding a potential return of a buyer in Morocco for Q4 has proven sufficient to limit the pace of the fall this month. We also expect the number of transactions to be relatively limited through September before the downward trend is cemented as Q4 steps in.
- Purchases in Chile over the last two months have been limited despite firm offers for material in the market, as sufficient inventory levels capped need for spot tonnes. With negotiations for annual contracts soon to kick off, the market is likely to limit spot purchases through September.
- The domestic sulphuric acid market in China has stabilised on healthy availability. As a result, some material has been introduced to the export market, which has helped cover some of the supply missing from Japan/South Korea. Offers of Chinese material were heard in the $80s/t even high $70s/t f.o.b., but current time frames see material available for October loading.

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SAUDI ARABIA

BlackRock signs $11 billion deal over gas processing plant

The Jafurah Gas Plant, Saudi Arabia.

Saudi Aramco has signed an $11 billion lease and leaseback deal involving its Jafurah gas processing facilities with a consortium of international investors, led by funds managed by Global Infrastructure Partners (GIP), a part of BlackRock.

Jafurah is the largest non-associated gas development in the Kingdom of Saudi Arabia, estimated to contain 229 trillion scf of raw gas and 75 billion barrels of condensate. It is a key component in Aramco's plans to increase gas production capacity by 60% between 2021 and 2030, to meet rising demand. As part of the transaction a newly-formed subsidiary, Jafurah Midstream Gas Company (JMGC), will lease development and usage rights for the Jafurah Field Gas Plant and the Riyas NGL Fractionation Facility, and lease them back to Aramco for a period of 20 years. JMGC will receive a tariff payable by Aramco in exchange for granting Aramco the exclusive right to receive, process and treat raw gas from Jafurah. Aramco will hold a 51% majority stake in JMGC, with the remaining 49% held by investors led by GIP. The transaction, which will not impose any restrictions on Aramco's production volumes, is expected to close as soon as practicable, subject to customary closing conditions.

Amin H. Nasser, Aramco President & CEO, said: "Jafurah is a cornerstone of our ambitious gas expansion program, and the GIP-led consortium's participation as investors in a key component of our unconventional gas operations demonstrates the attractive value proposition of the project. This foreign direct investment into the Kingdom also highlights the appeal of Aramco's long-term strategy to the international investment community. As Jafurah prepares to start phase one production this year, development of subsequent phases is well on track. We look forward to Jafurah playing a major role as a feedstock provider to the petrochemicals sector, and supplying energy required to power new growth sectors, such as AI data centers, in the Kingdom."

Bayo Ogunlesi, Chairman and CEO of GIP, said: "We are pleased to deepen our partnership with Aramco with our investment in Saudi Arabia's natural gas infrastructure, a key pillar of global natural gas markets. Today's announcement builds upon BlackRock and GIP's longstanding relationship with Aramco to serve growing market needs for cleaner fuels, energy security and energy affordability."

KAZAKHSTAN

Agreement signed for gas separation complex

A formal signing ceremony has been held between senior company executives from KMG PetroChem, Tecnimont and the Kazakh government for the construction of the new Tengiz Gas Separation Complex (GSC) project. The ceremony was held at KMG PetroChem headquarters, in the Atyrau region of Kazakhstan. The Tengiz GSC project's scope of work includes engineering, procurement, construction and commissioning works, with Tecnimont mainly responsible for the EPC works. Completion is expected by the first quarter of 2029. Once completed, the gas processed by the GSC will feed the Silleno petrochemical plant, another project currently being executed by Tecnimont in the region. The GSC is designed to recover at least 98% of ethane from dry gas, while the Silleno complex is expected to deliver high-quality petrochemical products. KMG PetroChem is a fully owned subsidiary of Kazakhstan's national oil and gas company KazMunayGas.

Alessandro Bernini, Chief Executive Officer of MAIRE, commented: "We are honoured to take part in this landmark initiative with KMG Petrochem. The Tengiz Gas Separation Complex represents a strategic milestone for us, reinforcing our long-term commitment to Kazakhstan and the broader Central Asian region. This project not only showcases our technological and execution capabilities but also accelerates Kazakhstan's industrial development through next-generation, large-scale gas and petrochemical plants".

UNITED STATES

Topsoe technology selected for Indiana refinery

Topsoe has been selected as the renewable diesel technology partner for CountryMark's Mount Vernon, Indiana refinery. Located in southwestern Indiana, the refinery processes 35,000 bbl/d of crude oil. With the addition of Topsoe's HydroFlex technology, CountryMark aims to produce up to 250,000 barrels of renewable diesel annually. The new unit is expected to enable an emission avoidance of approximately 84,500 t/a of CO_2e. CountryMark, a farmer-owned cooperative, will use local soybean oil as the primary feedstock to produce renewable diesel, helping create a locally sourced renewable fuel economy in Indiana.

Henrik Rasmussen, Managing Director of Topsoe Americas, said: "Our collaboration with CountryMark goes back many years. With demand for renewable diesel continuing to grow, we're excited to partner with CountryMark on their journey to produce cleaner fuels and contribute to America's low-carbon energy future."

Matt Smorch, CountryMark President and CEO, added: "We saw this as an opportunity to deliver increased value to CountryMark diesel fuel buyers, increase the demand for Indiana agricultural products, and add value to our refining assets."

Lyten acquires Northvolt

Lyten, a global leader in lithium-sulphur batteries has entered into a binding agreement to acquire Northvolt's assets in Sweden and Germany. The acquisition includes Northvolt Ett and, Northvolt Labs in Sweden and Northvolt Drei in Germany. Additionally, Lyten is acquiring all remaining Northvolt intellectual property. The financial terms of the agreement were not disclosed. In total, Lyten's acquisition includes assets valued at approximately $5 billion, including 16 GWh of existing battery manufacturing capacity, more than 15 GWh of capacity under construction, the infrastructure and plans to scale to more than 100 GWh, and the largest and most advanced battery R&D centre in Europe.

Lyten plans to rehire a significant portion of the previously laid-off workforce at these facilities and will assess staffing needs site by site. The company says that it sees substantial value in retaining local expertise and is committed to building long-term employment opportunities as we restart and scale operations.

"This is a defining moment for Lyten," stated Dan Cook, Lyten CEO and Co-Founder. "Lyten's mission is to be the leading supplier of clean, locally sourced and manufactured batteries and energy storage systems in both North America and Europe. The acquisition of Northvolt's assets brings the facilities and Swedish talent to accelerate this mission by years, just at the moment when demand for Lyten lithium-sulphur batteries is growing exponentially to meet energy independence, national security, and AI data centre needs."

The acquisition is being funded through equity investment into Lyten from private investors. Lyten expects the acquisitions to close in the fourth quarter of this year. The company says that it is also committed to pursuing the acquisition of Northvolt Six in Quebec, Canada, which is constructing a 15 GWh Phase 1 battery manufacturing facility. Lyten currently manufactures lithium-sulphur batteries in Silicon Valley and is selling commercially into the rapidly growing drone and defence markets.

ARGENTINA

Desulphurisation unit installed at Luján refinery

YPF says that its modernisation of the Luján de Cuyo refinery has taken a step forward with the installation of a hydrodesulphurisation reactor, designed to remove sulphur compounds from diesel fuel by means of a catalytic process using hydrogen. The installation forms part of the refinery's New Fuel Specifications (NEC) project, intended to produce of fuels with a lower environmental impact. The new reactor was built in Mendoza by IMPSA. With a length of 38 meters and a weight of 456 tons, it was moved from Godoy Cruz to the YPF plant in a logistic operation that involved Vialidad Nacional, Mendoza Police and local authorities. It will now be integrated into the HDS II unit, designed to reduce sulphur content in diesel to 10 parts per million, in line with current environmental requirements. The NEC plan includes new process units, such as H2 II and SE33, the adaptation of existing facilities and the improvement of auxiliary services. The project, already 85% complete, will allow all the diesel oil produced in Luján de Cuyo to comply with the highest emission requirements.

UNITED ARAB EMIRATES

ADNOC Gas posts record profit

ADNOC Gas PLC has reported $1.39 billion in net income for 2Q 2025, up 16% year on year and a quarterly record for the company. Last year, the gas processing and sales arm of Abu Dhabi National Oil Co. logged its highest annual net earnings - $5 billion - due to rising natural gas demand in the United Arab Emirates. In particular, revenue from ADNOC Gas's sulphur sales more than doubled to $96 million from $43 million.

Earnings before interest, taxes, depreciation and amortization (EBITDA) for Q2 2025 totalled $2.26 billion. Domestic gas contributed $920 million, up 32% from Q2 2024, driven by better commercial terms and a higher sales volume. Export and traded liquids accounted for $982 million, down 10%. Sulphur EBITDA climbed to $81 million from $30 million, and is expected to generate a further $180-200 million net income for the full year.

Fatema Al Nuaimi, Chief Executive Officer of ADNOC Gas, said: "We are pleased to report the highest quarterly net income in ADNOC Gas' history, fuelled by our strong local market business and improved operational efficiency. This performance shows that we are well on our way to achieving our ambition of over 40% EBITDA growth between 2023 and 2029*, as outlined in our strategy update last November. With healthy cashflows and robust margins, we remain well-positioned for long-term growth, and our resilient business model continues to deliver strong returns."

In the near and medium term, the Company expects to deliver the Integrated Gas Development Expansion – Phase 2 (IGDE-2), Maximizing Ethane Recovery and Monetization (MERAM), and to take the investment decision on the remaining two phases of the RGD project. Total investments are expected to be around $3 billion in 2025, representing a substantial increase against the prior year as the MERAM project reaches peak activity ahead of start-up.

CANADA

Gas plant startup delayed

CSV Midstream Solutions says that startup of the Albright gas plant in Alberta is likely to be delayed due to issues with the sulphur recovery plant. Commissioninf began in June 2025, with expectations of full-scale operations to commence in July 2025. However, a faulty valve at the SRU has necessitated a root cause analysis for its failure. The plant will process 150 million cfd of sour gas once operational.

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CHILE

Marimaca to acquire acid plant

Marimaca Copper Corp. says that it has recently executed a binding asset purchase option agreement to acquire a used sulphuric acid plant in Chile from CEMIN Holding Minero. Sulphuric acid is one of the key input costs for the Marimaca Oxide Deposit, and the ability to produce a significant amount of its own supply will reduce exposure to a volatile acid market. The agreement has an exclusivity period of three months to allow further detailed technical and engineering reviews including capital and operating cost estimates for the installation and operation of the 150,000 t/a sulphuric acid plant, whose output would represent approximately 30-40% of total acid consumption at the Marimaca Oxide Deposit, depending on the phase of development. Marimaca says that, based on market research and quotations received, the estimated equipment cost of a new sulphuric acid plant of similar capacity is approximately $35-40 million, with a total installation cost of $50-60 million. The cost of breaking down and relocating the plant to the site at Mejillones and the start-up costs of the used plant are expected to be materially lower than cost of new equipment. Indicative operating costs show the potential for an approximately 30% reduction in acid cost relative to current long-term forecast and normal historical spot and contract acid prices delivered to Mejillones.

Marimaca says that it will also simplify the company's acid storage strategy due to the relative ease of storing elemental sulphur as compared to concentrated sulphuric acid. The company has completed initial engagement with industrial operators in Mejillones with respect to the installation of the acid plant.

Hayden Locke, President and CEO of Marimaca Copper, commented: "The Marimaca Oxide Deposit is forecast to be a mid-level acid consumer in the context of Chilean heap leach operations, and we continue to recognise acid cost as one of our most important drivers of profitability. We have numerous operational levers we can utilize to reduce acid consumption, if necessary, however, lowering the volatility associated with one of our key consumables was a logical step for the company.

"Based on current projections from Comision Chilena del Cobre (Cochilco), which provides industry forecasts for long term acid supply and demand in the Chilean market, the expectation is for acid prices to normalize at around $95/tonne in Mejillones from 2028 onwards. Our analysis indicates, based on today's elemental sulphur price, a company owned acid plant could produce sulphuric acid for approximately $70/tonne, excluding by-product credits from heat generation. This represents an approximate 30% reduction from the current long-term acid price forecasts from Cochilco. This discount is even more significant if you consider current spot prices, which are artificially elevated by H2SO4 seaborne freight rates and strong demand from the global fertilizer industry."

"In addition, while the elemental sulphur and global sulphuric acid markets exhibit reasonably strong price correlation, the underlying volatility of the final acid cost via a sulphur burner is reduced. This is due to the stoichiometric relationship of reacting one tonne of elemental sulphur to produce approximately three tonnes of concentrated (98%) sulphuric acid."

Codelco warns Chile's copper output could stagnate

Copper production in Chile may stall at around 5.5 million t/a because of the growing challenges mining companies face, according to Maximo Pacheco, chairman of state-owned Codelco.

Deeper mining operations, falling ore grades and rising costs all reduce the chance of overall output increasing, he told an industry conference. Nevertheless, Codelco is pressing ahead with a multi-billion dollar investment programme with the goal of returning to a historic production rate of 1.7 million t/a, compared to the current 1.35 million t/a or so.

Pacheco's comments, reported by sector journal Mining.com, coincide with the company having evacuated workers from El Teniente in recent days due to an earth tremor (see below), a month after an earthquake caused a rockfall which killed six workers and injured nine. Following that incident, Codelco revised its 2025 production guidance downwards to between 1.34 - 1.37 million tonnes of copper, from a March estimate of 1.37 - 1.40 million tonnes.

Upcycle launches potassium sulphate project

Upcycle Minerals Inc. has launched a brine to potassium sulphate fertilizer with carbon capture project in south-central Saskatchewan. The company says that it plans to use its mineral assets, including the Tuxford potash mineral permit and the Whiteshore and Lydden Lake Alkali Leases as feedstock for its patented process. Along with the production of potassium sulphate (SoP), the process also generates two co-products with established markets; ammonium sulphate fertilizer and precipitated calcium carbonate. Upcycle says that it intends to become an ecologically conscious, low-cost producer of SoP with low net CO_2 emissions.

Upcycle has retained Stantec Consulting Ltd to carry out preliminary engineering assessments and review activities in a multi-phased approach to project development. Stantec offers technical expertise in exploration programs across Western Canada, with experience in potash and brine-hosted mineral resource development within the Western Canadian Sedimentary Basin, including the Prairie Evaporite formations. Their Mining, Minerals and Metals group supports clients throughout the full mining life cycle, from target generation to closure, with a multidisciplinary team of geologists, engineers, and environmental specialists ready to support Upcycle's long-term vision.

Operations halted at El Teniente mine

The El Teniente mine, located in the O'Higgins region, suffered a collapse on 31 July. The collapse in the Andesita sector of the mine is understood to have been as a result of seismic activity that registered 4.2 on the Richter scale. It remains unknown whether the seismic activity was caused by the mining operations or natural activity, according to industry sources. Underground operations are to be halted for an unknown period of time while the open air sector, which represents around 10% of the total production, will remain open, according to industry participants.

The El Teniente is the world's largest underground copper mine, spanning over 4,000 km. Copper production during 2024 was around 355,000 t/a while its yearly sulphuric acid production is estimated at around 1 million t/a.

UNITED STATES

Copper output begins at Rio Tinto-backed project

Gunnison has started producing pure copper cathodes at its Johnson Camp Mine (JCM) in southeast Arizona, United States, from a solvent extraction-electrowinning (SX-EW) circuit and using leaching technology from Rio Tinto-owned Nuton. As well as giving Gunnison exclusive rights to deploy the proprietary process on run-of-mine ore, Nuton is a financial partner of the Phoenix-headquartered mine developer which has restarted copper production at past-producing JCM. The company's next goal is to ramp-up to nameplate plant capacity of 25 million lbs/year (11,300 t/a) of finished copper.

Nuton owns a portfolio of proprietary leaching technologies with the potential to economically unlock copper from what is often viewed as hard-to-leach ores, including primary sulphides. Nuton describes itself as a Rio Tinto venture.

BULGARIA

Aurubis completes major maintenance at Pirdop plant

Aurubis says that it has successfully completed scheduled maintenance at its Pirdop plant on time. The two-month operation marked the largest planned maintenance shutdown at the site in the past 30 years. With an investment of €115 million, Aurubis says the work ensures the long-term reliability and performance of the facility. Key upgrades included a full overhaul of the flash smelter, replacement of two electrostatic precipitators, and a major modernisation of the sulphuric acid production line. This modernisation involved installing a new converter and replacing six heat exchangers.

With the plant now fully back online, the improvements are expected to extend the interval between maintenance cycles from two to three years while also reducing the duration of future downtime. Sulphuric acid production at Pirdop is estimated at around 1.3 million t/a. It remains unclear whether these recent upgrades will result in a production increase at the site.

JORDAN

JPMC and APC expand fertilizer production

Jordan Phosphate Mines Company (JPMC) and Arab Potash Company (APC) have signed an agreement to develop an integrated industrial complex for the production of phosphoric acid, purified phosphoric acid, and specialised fertilisers. The facility will span sites in the Aqaba Special Economic Zone and Al Shediyeh, and represents a strategic collaboration between two of Jordan's largest mining companies. The project aims to shift the country's fertilizer sector from raw-material exports to value-added manufacturing, aligned with Jordan's Economic Modernisation Vision. The complex will focus on high-purity phosphoric acid used in specialty fertilizers, as well as in food, pharmaceutical, and cosmetics applications. It is also expected to create

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both direct and indirect employment opportunities, with plans for training programmes for local engineers and technicians.

INDIA

CIL to increase BMCC stake

India's Coromandel International (CIL) is set to increase its stake in phosphate rock producer Baobab Mining and Chemicals Corporation (BMCC) in Senegal further to 71.51% from 53.8%, according to local press reports. CIL is reportedly paying $7.7 million for an additional 17.69% equity stake, after previously raising its stake from 45% in September 2024. CIL originally announced it would take a stake in BMCC in 2022, when it paid $19.6 million for a 45% stake, along with a loan of $9.7 million into BMCC for capital projects and expansion. CIL plans to use the stake to ensure long term supply security of phosphate rock.

MOROCCO

OCP Nutricrops surpasses 5 million tonnes of TSP

In late July, OCP Nutricrops announced that its triple superphosphate (TSP) production capacity now exceeds five million tonnes, thanks to the commissioning of the first two TSP production lines – each with a capacity of 500,000 t/a – as part of the strategic 'TSP Hub' programme at OCP's massive Jorf Lasfar complex. This initiative is led by the OCP Group's Manufacturing Special Business Unit (SBU) in coordination with OCP Nutricrops, OFAS and JESA. These flexible production lines can manufacture tailored fertilizers that integrate nutrients and additives to match specific soil and crop needs, OCP Nutricrops said.

OCP Nutricrops plans to expand its TSP production capacity further by adapting existing nitrogen fertilizer units. This is expected to increase the company's annual TSP capacity to more than seven million tonnes by the end of 2025. Welcoming the launch of the TSP Hub, Youssef El Bari, the CEO of OCP Nutricrops, said: "The TSP Hub strengthens our ability to deliver high agronomic value fertilizers tailored to specific soil and farmer needs, while enhancing industrial precision and capacity."

OCP Nutricrops has also signed a commercial agreement to supply the Bangladesh Agricultural Development Cooperation (BADC) with 1.1 million tonnes of fertilizers. The deal was signed in in early July during an official visit by a Bangladeshi delegation to Morocco.

"By providing tailored fertilizers and promoting their responsible use, this partnership reflects a shared vision to strengthen the foundations of a self-sufficient agricultural future for Bangladesh, grounded in science, innovation, and sustainable collaboration," BADC and OCP Nutricrops said in a joint statement. Commenting on the partnership with BADC, Youssef El Bari said: "This agreement reinforces a long-term strategic relationship and paves the way for new collaborations in research, training, and innovation."

BANGLADESH

BADC signs import deals

In addition to the above deal with Morocco, the Bangladesh Agricultural Development Corporation (BADC), part of the Bangladesh Ministry of Agriculture, has signed a contract to import both triple superphosphate (TSP) and di-ammonium phosphate (DAP) fertilisers from Malaysia. The agreement was signed on 17 July 2025 in Kuala Lumpur by Mohammed Ruhul Amin Khan, chairman of BADC, and representatives of Selcra Niaga. Under the contract, BADC will import 280,000 tonnes of TSP and 280,000 tonnes of DAP from Malaysia. According to BADC officials, this landmark deal is expected to play a crucial role in ensuring the timely delivery of non-urea fertilisers to farmers. The move aims to strengthen Bangladesh's efforts toward building an efficient and sustainable agricultural system.

BADC has also signed a similar deal with Saudi Arabia's Ma'aden to import DAP. BADC will import 40,000 tonnes of DAP fertilizer from at $795/tonne. It also signed a deal to import 35,000 tonnes of potassium chloride (MoP) fertilizer from Russia's JSC Prodintorg at a unit price of $361/tonne.

INDONESIA

Deal signed for new HPAL plant

Indonesia's sovereign wealth fund Danantara has signed a heads of agreement with Shenzhen-based GEM Limited to jointly develop a high-pressure acid leach (HPAL) nickel facility with a capacity of 66,000 t/a of nickel. The project carries an estimated value of $1.42 billion. GEM is a global leader in green metallurgy and circular economy solutions, known for its large-scale recycling of electric vehicle batteries and electronic waste.

Danantara CEO Rosan Roeslani said the partnership marks a significant milestone in the fund's mission to deliver strategic investments that accelerate Indonesia's socio-economic transformation. "By working with a global pioneer in green metallurgy, we can advance the government's priority agenda of sustainable downstream mineral industrialisation," he said.

GEM processes more than 10% of used EV batteries and e-waste in China each year and employs over 11,000 staff across China, South Africa, South Korea, and Indonesia. In Indonesia, the company has invested heavily in nickel-based new energy materials, high-tech nickel industrial parks, joint research labs with local universities, and scholarship programs producing master's and doctoral graduates in metallurgy. It has also invested $30 million in a joint metallurgical research laboratory with the Bandung Institute of Technology (ITB), aiming to strengthen Indonesia's role as a hub for green metallurgy research and development.

EGYPT

Sino-Egyptian phosphate cooperation deal

Egypt's Mineral Resources and Mining Industries Authority (MRMIA) has signed a memorandum of understanding with China's Asia-Potash International Investment (Guangzhou) Co., Ltd. The MoU is designed to strengthen joint cooperation in exploring and assessing phosphate ore reserves. The objective is to maximise the added value of this crucial resource.

Karim Badawi, Egypt's Minister of Petroleum and Mineral Resources, says that this initiative aligns with the Ministry's vision to develop the mining sector, aiming to increase its contribution to Egypt's Gross Domestic Product (GDP) from less than 1% to 5-6% by attracting substantial investments, offering new opportunities, and implementing an integrated system to maximise the added value of mineral resources.

The MoU further aims to foster cooperation in scientific research for the exploration and confirmation of phosphate ore reserves, enrichment and processing operations, and studying the establishment of a modern plant for the production of phosphate fertilizers.

SWEDEN

Lyten to buy lithium sulphur assets


PHOTO: LYTEN

The Northvolt Ett battery factory in Skellefteå, Sweden

Lyten, a leading producer of lithium-sulphur batteries, has agreed to acquire Northvolt's remaining assets in Sweden and Germany. The acquisition includes Northvolt Ett and Ett Expansion (Skellefteå, Sweden), Northvolt Labs (Västerås, Sweden), and Northvolt Drei (Heide, Germany). Additionally, Lyten is acquiring all remaining Northvolt intellectual property (IP), and multiple members of the current Northvolt executive team plan to join Lyten. The financial terms of the agreement were not disclosed by any parties.

AUSTRALIA

Glencore prepares to idle Queensland smelter and refinery

Mining giant Glencore says it has no choice but to start work on placing the loss-making Mount Isa copper smelter and Townsville refinery in Australia into care and maintenance until market conditions improve. The company expects to report a A$2.2 billion (US$1.44 billion) loss from the operations between 2025 and 2031.

"To date Glencore has been absorbing losses hopeful that a viable solution could be found," interim chief operating officer Tony Wilson wrote in a memo to staff and quoted by local media. "However, we are fast reaching the point at which Glencore cannot continue to absorb these losses." As many as 17,000 jobs are said to be at risk.

Talks with the state and central governments have failed to produce a support package which the Switzerland-based company considers as acceptable. However, senior executive Suresh Vadnagra said shutting down would be a last resort and the company is open to taxpayers taking a big equity stake in the operations.

"Time is running out. We have been engaging with the government for the past five months. We need to know in the coming weeks whether there is a viable solution on the table from governments or whether we start planning to transition the copper smelter and refinery into care and maintenance," he said.

The separate, planned closure of Mount Isa copper mine is taking place this year. Glencore announced in 2023 it would end mining after 60 years of operation because the remaining mineral resources are no longer economically viable due to low ore grades and challenging geological conditions making safe extraction impossible to achieve with current technology.

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People

bp Plc has appointed **Albert Manifold** as its new chairman and non-executive director, effective from 1st September 2025. He will replace outgoing chair **Helge Lund**, who leaves on October 1st this year. "His impressive track record of shareholder value creation at [building firm] CRH demonstrates that he is the ideal candidate to oversee bp's next chapter," said Amanda Blanc, the senior independent director who led the search for BP's new chairman.

The move comes at a time of some turbulence at the top of bp, with poor performance figures and pressure for a change in the company's direction from activist shareholder Elliott Investment Management. CEO Murray Auchincloss announced a refocusing of the company in February, away from the company's 'net zero' strategy back towards a focus on its oil and gas assets, along with divestments in its portfolio to reduce debt and improve the balance sheet, including a likely $8-10 billion sale of its lubricants business Castrol.

Other recent oil and gas focused appointments at bp have included **Simon Henry**, former CFO of Shell and a board member of Rio Tinto Plc and Harbour Energy Plc, as well as a former director of Lloyds Banking Group Plc and PetroChina Ltd. In May the company also appointed oil industry veteran **Dave Hager** to the board, who has 40 years of experience in the oil sector, recently leading US shale producer Devon Energy Corp. as chief executive and then executive chairman.

Dangote Petroleum Refinery has appointed David Bird as CEO of its petroleum and petrochemicals business, effective from July 2025. A former Shell executive with over 20 years' experience, Bird steps in as the refinery pushes through operational challenges and scales up plans for nationwide fuel distribution. Chairman **Aliko Dangote** will continue in his current role while overseeing the group's wider operations across cement, fertiliser, and sugar.

The Board of Rio Tinto has appointed **Simon Trott** to succeed **Jakob Stausholm** as Chief Executive, with effect from 25 August 2025. The company says that Trott, currently Iron Ore Chief Executive, has a track record of exceptional delivery over 25 years in roles across a wide range of commodities and geographies, with a strong focus on values-based performance culture and strengthening partnerships with stakeholders. As Chief Commercial Officer, he established the Group's Commercial operations, unlocking efficiency and deepening strategic customer relationships. Prior to this he held Managing Director roles across multiple Rio Tinto commodities and geographies.

Rio Tinto Chair Dominic Barton said: "Simon is an outstanding leader with a deep understanding of mining and a track record of delivering operational excellence and creating value across our business. Simon and the Board are aligned that Rio Tinto's next phase is about unlocking significant value for shareholders from our portfolio, driven by operational performance, and cost and financial discipline.

"Simon came into our Iron Ore business at a time of significant challenges and has been instrumental in rebuilding culture, strengthening external relationships and setting us on a pathway for growth. Under his leadership, Iron Ore has become a centre of innovation for the Group, driving operational excellence, technology and operating model optimisation – levers Simon can now bring to Rio Tinto at scale.

"I want to again recognise Jakob's significant contribution to Rio Tinto at a critical time in its evolution. Under his leadership we have rebuilt relationships with key stakeholders, aligned our portfolio with the commodities where demand growth is strongest, and set a compelling growth trajectory."

Rio Tinto Chief Executive Designate Simon Trott said: "It is a privilege to have the opportunity to lead Rio Tinto, and I am excited about our future. The progress we have made over recent years gives us a foundation to build on with discipline and focus to deliver improved performance. With our outstanding assets and people around the world, we are well positioned to grow value for shareholders and the communities who host us.

Matt Holcz, currently Managing Director, Pilbara Mines at Rio Tinto, will be providing interim support in the Chief Executive Iron Ore role until a permanent appointment is made.

Calendar 2025

SEPTEMBER

8-15

Sulphur Experts' Amine Treating and Sulphur Recovery Technical Training Course, KANANASKIS, Alberta, Canada
Contact: Jamielynn Russell, Sulphur Experts
Tel: +1 403 215 8400
Email: Jamielynn.Russell@SulphurExperts.com
Web: SulphurExperts.com/Courses

9-12

Brimstone Sulphur Symposium, VAIL, Colorado, USA
Contact: The Brimstone Group LP
Email: info@thebrimstonegroup.com
Web: https://www.thebrimstonegroup.com/symposium/

10-11

Oil Sands Expo, CALGARY, Alberta, Canada
Contact: Bruce Carew, EventWorx
Tel: +1 403 971 3227.
Email: marketing@eventworx.ca

29-OCTOBER 2

Brazilian Sulphuric Acid Congress (COBRAS), GRAMADO, Brazil
Contact: Clark Solutions
Tel: +55 (11) 3472-3315
Email: marketing@clarksolutions.com

OCTOBER

1-2

TiO_2 World Summit 2025, NASHVILLE, TN, United States
Contact: Smithers
Tel: +44 (0) 1372 802000
Email: eventseu@smithers.com
Web: https://www.smithers.com/en-gb/services/events/2025-conferences/tio2-world-summit-us-2025

6-17

Sulphur Experts' Sulphur Recovery Technical Training Course, NOORDWIJK, Netherlands
Contact: Jamielynn Russell, Sulphur Experts
Tel: +1 403 215 8400
Email: Jamielynn.Russell@SulphurExperts.com
Web: SulphurExperts.com/Courses

NOVEMBER

3-5

CRU Sulphur & Sulphuric Acid Expoconference 2025, WOODLANDS, Texas, USA
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PHOTO: HARTLEY TRAVEL

Phosphate production in North Africa

North Africa remains a major centre of global phosphate production, with significant production in Algeria, Tunisia and Egypt as well as Morocco, and sulphur and sulphuric acid consumption continuing to increase.

Jorf Lasfar port, Morocco, OCP's main export terminal.

North Africa is one of the world's largest phosphate producing regions, and contains nearly 85% of the world's phosphate reserves. Because of the lack of domestic sulphur recovery or smelter acid production, this means that the region's phosphate industry is a major consumer and importer of sulphur and sulphuric acid, and hence expansions in the region's phosphate industry continue to be a major driver of new sulphur consumption.

Table 1 shows North Africa's phosphate rock production over the past decade. While the region represents only around 21% of global phosphate rock production, that output has grown by 10 million t/a of phosphate rock over the past decade, at a time when global production has only increased by 20 million t/a, making North Africa the fastest growing region for new rock output. Still more notable is that even though only about 35% of the region's rock production was exported, North Africa nevertheless represented almost half of all internationally traded phosphate rock in both 2014 and 2024. But also notable is that the remaining 65% of mined rock was processed domestically, though this varied widely between Algeria, which processes a negligible fraction of its rock production, to Tunisia, which processes almost all of it. The largest producer is of course Morocco, and here the proportion of rock production which is processed domestically has risen from 68% to 82%, at a time when that total rock output has risen by 30% in a decade, as OCP continues to expand its production and builds more processing capacity to capture more of the value chain. Morocco represents 8 million t/a of the additional 10 million t/a of new phosphate production over the past decade.

Morocco

Morocco remains the dominant nation not just in North Africa but in the global phosphate industry. The country's phosphate business is almost entirely in the hands of state-owned Office Cherefien des Phosphates (OCP). OCP represents a major sector of the country's economy, employing 21,000 people and accounting for 20-25% of Morocco's exports by value and about 5% of its GDP.

OCP mines phosphate rock at three main sites: Khouribga in the north of Morocco, the more central Gantour region (Benguerir and Youssoufia) and Boucraa in the south. OCP divides its business geographically. The company's three main cash-generating units, known as the Northern Axis (Khouribga–Jorf Lasfar), the Central Axis (Benguerir and Youssoufia–Safi) and the Phosboucraa Axis (Boucraa–Laâyoune), reflect the separate centres of mining and processing in Morocco and their associated downstream chemical assets. The largest is the northern axis, where phosphate ore is transported by slurry pipeline to the vast Jorf Lasfar Phosphate Hub complex, where it is processed into phosphoric acid and finished phosphate fertilizers for export.

Moroccan rock production actually took a dip from a peak in 2021 of 38 million t/a to 30.5 million t/a in 2022 in terms of beneficiated rock transported downstream, and mined volumes fell lower still as global demand was impacted by a run of high prices. The fall in production, coupled with a higher proportion of rock being processed domestically, led to Morocco's rock exports falling below Jordan's from 2022, and even by 2024 Jordan was still exporting slightly more rock than Morocco. This was part of a supply management strategy initiated by OCP, aiming to better align the implied value of phosphate contained within its rock, phosphoric acid and downstream fertilizer products.

However, ore production has recovered since, and increased by almost 50% in 2024 to 45 million tonnes of rock (35.3 million t/a was supplied downstream). Furthermore, in 2024, OCP initiated a new development plan to substantially expand its phosphate rock capacity before the end of the decade. In total, it intends to potentially increase its company-wide capacity by 22.5 million t/a, reaching as much as around 70 million t/a. This new plan focuses more heavily on the central Meskala-Gantour axis and, to a lesser extent, the southern Boucraâ-Laâyoune axis. At the former, OCP will expand the Ben Guerir rock mine by 6.0 million t/a to 10.2 million t/a, with construction reportedly already underway. Beyond that, the company intends to construct new mines at Meskala and Louta, potentially adding a total of 14.0 million t/a. However, these are at an earlier stage of development and CRU does not yet include them within its base case. Finally, OCP will expand its southern Boucraâ mine by 1.5 million t/a to 5.5 million t/a.

Further to the rock capacity additions, OCP also has ambitious plans for significant downstream phosphate fertilizer capacity expansions, mostly focused on triple superphosphate (TSP). The company has recently commissioned three 1 million t/a granulation units at Jorf Lasfar; the first in 2023, and the others in 2024. These lines can produce DAP and MAP, but currently only produce TSP. Furthermore, the company aims to establish a further 1 million t/a TSP Hub in Jorf Lasfar. Outside Jorf Lasfar, the company to construct a large complex called the Mzinda Phosphate Hub. This does not appear to have ammonia processing capabilities attached to it and will exclusively produce TSP. OCP intends to open the facility in 2025 at an initial capacity of 2.1 million t/a before adding a further 2.million t/a in 2026.

Over the next five years. DAP and MAP exports are expected to grow significantly more slowly, as new TSP capacity frees flexible plants for DAP and MAP production. The growth of TSP exports will not be dependent on supply, which is plentiful, but on OCP's ability to expand existing markets and create new ones. OCP has pushed heavily for adoption in India, recently signing a 1.2 million t/a of DAP and 800,000 t/a of TSP supply deal. TSP is better suited to some Brazilian soils and could replace some MAP volumes there. OCP is also pursuing purified phosphoric acid (PPA) capacity, announcing in 2023

PHOTO: COMPAGNIE DES PHOSPHATES DE GAFSA

Phosphate mining in Tunisia.

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plans to build four PPA units as part of its strategy to meet growing demand for PPA, technical MAP, LFP cathode materials, and phosphate salts for food and industrial applications. The first phase of the project consists of 200,000 t/a P_2O_5 pretreated phosphoric acid capacity, 100,000 t/a P_2O_5 PPA capacity, and 100,000 t/year technical MAP (tMAP) capacity. The PPA project will be constructed in conjunction with JESA, a joint venture between OCP and African technology, design, and engineering company WorleyParsons. Completion of the four plants is scheduled for 2026-29.

As well as developments in Morocco, OCP has looked to develop partnerships globally, especially across Africa, in the hope of stimulating more demand for its phosphates via its OCP Africa subsidiary. In some countries, including Nigeria, it has invested in blending units where products are customised to suit local soil and crop needs.

Algeria

Algeria has the world's third largest reserves of phosphates after Morocco and China, at 2.2 billion tonnes P_2O_5. Algeria's reserves are mainly the westward extension of Tunisia's Gafsa basin, with several prominent deposits running along the border with Tunisia. The Government-owned Enterprise Nationale de Fer et du Phosphate (Ferphos) manages Algeria's production of iron ore, phosphate rock, and other key minerals, with phosphate mining conducted by its subsidiary Société des Mines de Phosphates SpA (Somiphos). Somiphos' key site is the Djebel-Onk complex, where there are an estimated 2.8 billion tonnes of phosphate rock deposits at 25-28% P_2O_5. Two main mines send phosphate rock to a 2 million t/a capacity beneficiation plant and onwards for export at the port of Annaba. A small amount is consumed domestically, but almost all of Somiphos' production is exported.

Algeria has tried to develop downstream phosphate processing capacity, initially with Indonesia's Indorama, and then with Chinese partners, but there had been little headway until earlier this year, when the Algerian Chinese Fertilizers Company (ACFC) launched a $7 billion integrated phosphate project (PPI) in the country's Tebessa province. ACFC was formed in 2022 as a joint venture between Algerian firms Manal and Asmidal, a subsidiary of Algerian energy giant Sonatrach, and Chinese firms Wuhuan Engineering and Tian'An Chemical. The project aims to develop and exploit the Bled El Hadba phosphate deposit at Djebel Onk, with the two Algerian firms owning 56% of ACFC and the two Chinese companies owning the remaining 44%. The project includes increasing the rock output of the Bled El-Hadba mine from one million t/a to 10 million t/a, with downstream 1.2 million t/a of ammonia production and 4 million t/a of finished phosphates, including MAP and DAP.

Tunisia

Tunisia's reserves of phosphate rock are smaller than its neighbours to the west, but there had been more investment in their development than in Algeria, and by 2010 Tunisia was the world's fifth largest producer of phosphate rock, after China, the USA, Morocco and Russia, producing 8.1 million tonnes of rock, and the industry still represents 15% of national exports and 4% of GDP. Two state owned companies operate Tunisia's phosphate sector; phosphate mining company Compagnie des Phosphates de Gafsa (CPG) and its downstream customer and processed phosphate producer Groupe Chimique Tunisien (GCT).

However, like neighbouring Algeria, Tunisia's phosphate industry has been a casualty of domestic political infighting, with sites blockaded by workers seeking higher wages following the 2011 'Arab Spring', and CPG and GCT the target of public protests and government corruption investigations. In spite of several government attempts to boost production to ease its financial situation, rock output and hence downstream processing has fallen, as Table 1 shows. The latest plan envisages raising phosphate production five-fold to 14 million t/a in 2030, the government said in March 2025, but achieving this remains an ambition rather than a likelihood.

Egypt

Egypt produced 7.5 million tonnes of phosphate rock in 2024, making it the seventh largest producer in the world after China, the USA, Morocco, Russia, Jordan and Saudi Arabia. It is also the world's third largest exporter of rock, after Morocco and Jordan. Egypt has some of the lowest production costs for its phosphate rock, and the government has decided to expand production and, like Morocco, capture more of it via downstream processing of phosphate rock. Egypt's phosphate deposits occur in a wide belt across the centre of the country, stretching from the Red Sea inland through the Nile Valley and into the New Valley in the Western Desert. Mining is in the hands of several companies, but the two largest are the state owned Misr Phosphates and the military-owned El Nasr Company.

Egypt continues to be a major site for investment in its phosphate industry. Last year Misr Phosphates inaugurated a new phosphate rock line at its Abu Tartour site with a capacity of 750,000 t/a. Wilson International Trading has also signed an agreement with El-Nasr Mining Company and Al-Safy Group to build a high-grade phosphate rock mine. Earlier this year the Egyptian Mineral Resources and Mining Industries Authority signed a memorandum of understanding with El Sewedy Capital Investments to establish a partnership for the exploration, exploitation, and production of phosphate rock in the El-Sebaeya region of the Nile valley, with downstream beneficiation and a feasibility study for establishing a factory to produce phosphate fertilizers.

Chinese phosphate and battery chemical producer Chuan Jin Nuo Chemical (KMCJNC) has announced a $265 million plan to build a plant in Egypt to produce a range of intermediates and finished products. Planned capacities for the site are 800,000 t/a of sulphuric acid and 300,000 t/a of ammonium phosphate per year. Egypt has also signed a deal with two Chinese companies to build a phosphoric acid plant in Abu Tartour. The project aims to use domestically sourced rock to build a capacity of 250,000 t/a of phosphoric acid.

Table 1: **Phosphate rock production and exports, North Africa, 2014-2024, million t/a**

Country	2014		2024	
	Production	**Exports**	**Production**	**Exports**
Algeria	1.4	1.3	2.0	1.8
Egypt	5.4	3.4	7.5	4.4
Morocco	27.4	8.7	35.3	6.8
Tunisia	3.8	0.1	3.2	0.1
Total	**38.0**	**13.5**	**48.0**	**15.8**
World	204.1	29.1	224.6	33.0

Source: CRU

Table 2: **North African phosphoric acid production, 2024 (million tonnes P_2O_5)**

Country	Production
Algeria	-
Egypt	0.27
Morocco	7.76
Tunisia	0.42
Total	**8.45**
World total	47.47

Source: CRU

Sulphur imports

Table 2 shows North Africa's overall phosphoric acid production for downstream phosphates processing. This translates to a total of about 29 million t/a of sulphuric acid consumption; around 2.1 million t/a each in Egypt and Tunisia, and 24.7 million t/a in Morocco.

Neither Algeria or Tunisia have any appreciable elemental sulphur production. Morocco has around 100,000 t/a of sulphur, and Egypt slightly higher at 310,000 t/a from its refining sector. The growth of domestic phosphate industries in North Africa thus inevitably requires large volumes of sulphur and/or sulphuric acid imports in order to feed phosphoric acid production. Sulphur imports for 2024 were 430,000 t/a for Egypt, 690,000 t/a for Tunisia, and 8.29 million t/a for Morocco, making the latter the world's largest importer of sulphur, and North Africa the destination for around 25% of all globally traded sulphur.

Over the next five years, as shown in Table 3, this is projected to increase due extra capacity coming onstream in all three importing countries, but particularly Morocco, where imports will rise to just under 10 million t/a. Morocco also imported 2.0 million t/a of sulphuric acid in 2024, although this figure is likely to fall by 2029 as more domestic sulphur burning acid capacity come onstream. At present the new Tebessa project in Algeria is not included in the figures, but if development proves faster than expected, this could also add more sulphur requirements for Algeria.

Table 3: **North African sulphur imports (million t/a)**

Country	2024	2029
Algeria	-	-
Egypt	0.43	0.65
Morocco	8.29	9.92
Tunisia	0.69	0.92
Total	**9.40**	**11.50**
World total	38.90	44.43

Source: CRU

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North America's sulphur industry

Sulphur output in North America continues to decline due to refinery closures and conversions at the same time that acid demand is increasing for metals processing projects.

While Canada continues to be a major exporter of sulphur, declining refinery output in the US and falling sour gas production in North America at the same time as new copper and nickel projects come onstream in the US means that the US is likely to become a net sulphur importer over the next few years.

PHOTO: VANCOUVER PORT AUTHORITY

Sulphur stacks at Vancouver, Canada.

Sulphur production – refining

Thanks to the shale oil boom, the US remains far and away the world's largest oil producer, with an output of over 19 million bbl/d in 2023. It is also the world's largest consumer, and still just about a net importer. Refinery throughputs are also at high levels, although in spite of a couple of boom years in 2022 and 2023, marked by record refining margins and profits, the North American refining industry had to face significant challenges in 2024, including sluggish demand for traditional fuels, especially in North America and Europe, and tightening profit margins due to increased global supply and lower demand growth. Other continuing issues include higher operating costs, aging infrastructure, strict environmental regulations, and a shortage of skilled labour.

At the start of the year, the US Energy Information Administration (EIA) reported that total US refining capacity totalled 18.4 million bbl/d, the same as for the previous year. However, capacity is set to drop by 3% over the course of 2025, the EIA says, with LyondellBasell's Houston oil refinery closing, and the Los Angeles refinery of Phillips 66 scheduled for closure by the end of 2025. More closures are scheduled for the next couple of years, especially in California, where Phillips 66 announced plans last October to close its 139,000 bbl/d Wilmington refinery in the Los Angeles area, and Valero said it would end refining operations at its 145,000 bbl/d Benicia refinery in the Bay Area by the end of April 2026. Other refineries are converting to bio-feeds or other sustainable production. California is leading this shift, in part due to the state's low carbon fuel mandate. At least three of the state's 11 refineries; Phillips 66 in Rodeo, Marathon in Martinez and another refinery in Bakersfield – have completed conversions, or have announced plans to convert, to renewable diesel fuel production since 2022.

While sulphur output from US refineries is expected to decline due to these closures and conversions, another factor has been the disruption in oil supply from Russia due to economic sanctions. US refiners are using more domestic crude, which is often from tight oil fracking and fairly sweet compared to the heavier, sourer feeds from Russia. Overall sulphur content of crude processed in the US has been trending downward since 2018, decreasing from an average of 1.39% to 1.30% in Q1 2025.

US refinery sulphur output is concentrated in the Gulf Coast region (PADD 3), where 60% of sulphur recovery capacity is located. PADD 2 is next, with 20% of capacity, and PADD 5 with 14%. The other two regions each have only about 2.5% each. US refinery sulphur output was about 7.57 million t/a in 2024, but CRU expects this to have fallen to 7.24 million t/a by 2029.

The story is different north of the border in Canada, which continues to be the world's fourth largest oil producer, though it exports more than half of this, much of it to the US. Canadian crude production continues to rise, split roughly 2:1 between oil sands bitumen and conventional oil production. Oil sands output continues to rise, reaching 3.3 million bbl/d in 2024, and expected to rise by another 5% to reach 3.5 million bbl/d in 2025. As oil sands are sulphur rich (about 4-5% by weight), where this production is processed is of vital importance to the sulphur industry.

Downstream, Canada's domestic refining capacity is relatively small; there are 17 refineries operational in Canada (including two bitumen refineries), 1.93 million barrels per day. Refinery capacity is concentrated in the east of the country, especially Ontario, Quebec and the Atlantic coast (Labrador, Newfoundland, New Brunswick). These provinces between them operate 1.24 million bbl/d of capacity, or about two thirds of the total. In Alberta, meanwhile, much of the refinery capacity is geared at processing oil sands crude. Oil sands processing now accounts for the majority of Canada's sulphur output, standing at just under 3 million t/a in 2024, as shown in Table 1. This figure is likely to stay roughly the same out to 2029, with any increased production likely to be exported rather than processed domestically.

Table 1: **North American sulphur balance, 2024, million t/a**

	Canada	United States
Production by source:		
Conventional refining	0.21	7.15
Oil sands processing	2.96	–
Sour gas processing	1.62	0.42
Total	4.78	7.57
Consumption	0.83	6.91
Imports	0.02	1.44
Exports	3.71	2.08

Source: Xxxxxx

Sulphur production – Sour gas

The other significant source of elemental sulphur in North America comes from sour gas processing. US sour gas processing is largely from mature field on the west coast and northern Rocky Mountains area, and has also been undercut by cheaper fracked gas. US sour gas production has fallen by half in the past decade, though there may be some slight recovery towards the end of the decade, with sulphur output forecast to rise slightly from 420,000 t/a to 490,000 t/a.

It is a similar story in Canada, with sour gas wells declining and most new production coming from unconventional (shale gas) production. In spite of some new production from British Columbia, Canadian sour gas production continues to be on a long slow decline, with sulphur output falling from 1.62 million t/a to 1.54 million t/a out to 2029.

Sulphur demand – phosphates

The US phosphate industry has traditionally been the largest consumer of sulphur in North America, to make sulphuric acid for phosphate extraction. North American production of phosphoric acid in 2024 was 5.5 million tonnes P_2O_5. US downstream phosphate production is mainly aimed at mono- and diammonium phosphate, accounting for 2.0 million t/a P_2O_5 and 0.7 million t/a P_2O_5 respectively. Growth in production of cheap finished phosphates elsewhere in the world, such as Saudi Arabia and Morocco, are affecting the North American market, combined with depleting resources at phosphate mines. The fall has seen considerable industry rationalisation and consolidation, with only four producers now still active. US sulphur demand for phosphate production in 2024 dropped by 1.2 million t/a as the US faced production outages in the phosphate sector. Imports mirrored the demand trend, with sulphur purchases dropping to 1.3 million t/a.

Canada has no phosphate capacity at present, though Ariane Phosphates has made considerable progress with developing the La a Paul resource in Quebec and has plans for downstream purified phosphoric acid capacity of around 350,000 t/a of battery/food grade PPA, as well as 220,000 t/a of lower grade acid used animal feeds and specialty fertilizers. There is as yet no firm timescale on this project, however.

Sulphuric acid

In addition to the elemental sulphur, sulphuric acid is also produced from smelting operations within the US and Canada. This is mostly from copper smelting, though there is also some recovery from zinc and molybdenum operations. Acid production was 2.2 million t/a in the US in 2024, and 2.1 million t/a in Canada.

Sulphur demand – metals

Outside of the phosphate industry, there is sulphur demand to manufacture sulphuric acid for metal leaching and other industrial processes, including caprolactam, pulp and paper processing, and especially sulphuric acid use as an alkylation agent in refining – a field in which the US refining industry has been a pioneer. There is also around 2 million t/a of demand from copper leaching projects, mainly in the southwest of the US.

In the short term, additional demand is expected to come from new copper leaching projects, with Florence Copper saying that construction is 90% complete at its operations in Arizona, and targeting first copper recovered by the end of the year, and Excelsior beginning SX/EW operations at Gunnison in August this year. Freeport is also moving ahead with operations at Morenci to recover copper from mine tailings.

Looking ahead to 2028, there are also several lithium projects for battery production, mostly in Nevada and Utah, which could add considerable additional demand for acid. Ioneer and Lithium Americas both have sulphur burning acid plants as part of their operation, and are expected to add 560,000 t/a of demand for sulphur by 2029. Overall US demand for sulphuric acid is expected to rise from 28.3 million t/a in 2024 to 32.1 million t/a in 2029.

Sulphur trade

Lack of domestic demand means that Canada operates a significant sulphur surplus, and while it is no longer the largest sulphur exporter in the world, it is still the fourth largest exporter, with around 3.7 million tonnes exported in 2024. About 830,000 tonnes of this was exported south to the US, mainly as molten sulphur. Sulphur remains not subject to US tariffs for now. Some of this export volume has come from stock drawdowns from sour gas producers. Over the next four years, Canadian sulphur exports are expected to remain at a level between 3.7 and 4.2 million t/a, depending on stock build/drawdown requirements. The stock drawdown will be crucial to maintaining export volumes due to the expected decline from sour gas-based supply towards the end of the period. Reducing molten volumes travelling south to Canada has meant that Canada has had to invest in domestic forming capacity, such as Heartland Sulphur near Edmonton, Alberta.

US sulphur consumption is expected to recover this year, and as sulphur consumption increases over the coming years, it is unlikely that supply will keep up with consumption, leading import requirements to increase from 2025 to 1.9 million t/a. As local availability falls, increased import requirements will be necessary to support future demand. US sulphur exports are also expected to fall.

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PHOTO: WILLIAM LUQUE/ISTOCK

Acid from base metal smelting

Almost one third of sulphuric acid production, and a much greater share of globally traded acid, comes from smelting of base metal sulphides and the recovery of SO_2 from flue gases. Smelter acid production continues to increase, particularly from copper, creating an imbalance in the sulphuric acid market.

Copper cathodes at a production plant, Chile

Base metal smelting makes up about 30% of the world's production of sulphuric acid – 89 million t/a of acid in 2024 out of a global total of 304 million t/a. Because it is involuntary production to avoid emissions of harmful sulphur dioxide, production of smelter acid is driven primarily by the economics of metals markets rather than sulphuric acid prices, and hence it is often produced regardless of prevailing acid market conditions. And while sulphur-burning acid capacity is usually integrated into local downstream uses, especially phosphate fertilizer production, but also copper and nickel leaching etc, this is far less frequently the case for smelter acid production. Domestically and internationally traded acid thus tends to come mainly from smelter acid.

Acid from metal smelting is predominantly (about 70%) generated by the copper industry, with zinc and lead smelting representing approximately another 20% of production and the rest mainly from the nickel industry. These base metal industries are destined primarily for construction and industrial end uses and their consumption is closely tied into general economic and industrial growth.

Copper

Copper demand is mostly for electrical wiring, industrial machinery, electronic products, transportation and similar fields, and so is closely correlated with industrial production. It has also increasingly become linked with the green energy transition, with requirements for electrical transmission wires to connect new wind and solar power to grid, battery storage, electric vehicles etc. For the first two decades of the 21st century incremental demand came mainly from China's industrialisation, and now from China's switch to renewable power and electric vehicles. China represented 58% of world copper demand in 2024, and incremental demand for refined copper is coming mainly from China, helping copper demand grow by approximately 3% year on year for several years running. The green energy transition (GET) is supporting copper use, offsetting weakness in traditional sectors, which are more sensitive to the broader economic cycle. Outside of China, refined copper consumption is expected to grow at 1.4% in 2025, accelerating to 3.5% per annum in the medium-term. China's economic growth momentum has moderated, due to the effects of the trade war, but GDP should grow at 4.6% this year. The slump in residential and commercial property has continued; but energy infrastructure, including the electricity grid, has seen strength. This, together with growth in other copper intensive sectors (even those with some exposure to export markets) means that CRU anticipates that Chinese total copper demand will rise by 3.5% in 2025.

Copper supply comes mainly from smelting of copper concentrate, accounting for around 66% of all copper production according to International Copper Study Group (ICSG) figures. Copper leaching via solvent extraction/electrowinning accounts for another 14% and secondary refining (recycling of scrap copper) about 20%. The latter figure has been pushed up in recent years by a shortage of copper concentrate to feed smelters, leading to higher recycling rates, especially in China. Over the past two decades the smelting industry has moved decisively to Asia, especially China, which now operates 50% of all copper smelter capacity. Japan represents 7%, Chile 5% and Russia 4%, according to the ICSG. Overall, China's share of global

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refined copper production of 27.5 million t/a in 2025 is expected to surpass 2023's record of 47.3%, coming in at 47.4%.

Copper smelters have faced shortages of copper concentrates from mines as China's rapid expansion of smelter capacity has run ahead of the ability of copper mines to supply them. Copper treatment charges - fees paid by copper miners to smelters for processing copper concentrate into refined metal - are currently at record-low levels due to a tight concentrate market, with benchmark charges below $20-$30/t, well below the $80/t benchmark for 2024. Lower treatment charges reduce the profitability for smelters and are a strong indicator of the concentrate market's tightness. This is leading to restrictions on output for Chinese smelters and possibly forcing some shutdowns. Overall, Chinese smelter acid production is expected to remain stagnant in 2025, as the copper concentrate shortage will still weigh on the market with further production cuts. Additional smelter capacity in 2025 is actually mainly coming from outside of China, with the startup of the Amman Minerals and Freeport copper smelters in Indonesia, and the huge Adani copper smelter in India in 2H 2025. However, a rebound in smelter production in China is expected next year as new mine start ups ease the tightness in the copper concentrates market.

Nickel

Nickel is, like copper, closely tied to industrial growth. About two thirds of all nickel (67%) is used in the manufacture of stainless steel, and the rest goes into other alloys (11%), nickel plating (5%), and battery uses (14%). As with copper, China has come to dominate the market, consuming 62% of all nickel in 2024, according to CRU figures. Nickel demand has been boosted by its use in electric vehicle batteries, although nickel demand for batteries has been largely stagnant since 2022 due to the rise of alternative technologies such as lithium iron phosphate, and growth is being driven mainly by stainless steel consumption at present. Nickel demand is expected to grow by 30% over the five years from 2024-2029, split roughly 50-50 between new battery demand and growth in demand for stainless steel.

The nickel smelting sector is a relatively smaller part of the supply chain than for copper, with much of the focus now on cheaper, lower grade laterite (oxide) ores, which are processed either via pyrometallurgical routes to generate ferronickel or so-called nickel pig iron (NPI), or via acid leaching routes, particularly high pressure acid leaching, or HPAL.

PHOTO: PT FREEPORT

PT Freeport's Grasberg facilities, Indonesia, feeding their copper smelter.

Zinc and lead

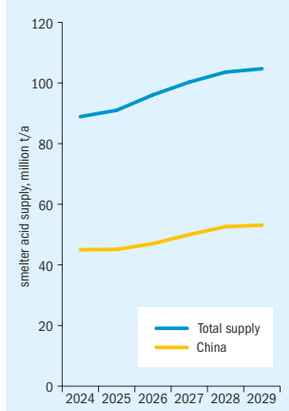
Zinc and lead production produce the remainder of the world's smelter acid. Global lead demand was 13.2 million t/a in 2024, while zinc consumption was 13.3 million t/a last year. China represented 40% of lead demand and 51% of zinc demand in 2024.

Lead has a much higher rate of recycling than other metals, especially from old lead-acid car batteries, and actual lead mine production for smelting was only about 4.4 million t/a in 2024, or only around one third of supply, although as electric vehicle power trains become more common, so the supply of scrap lead acid batteries is likely to fall. The lead market – almost 90% of it represented by demand for lead acid batteries - has been in deficit for some years, with demand outstripping supply, but is projected to move into surplus in 2025. Production has been downgraded due to the weaker Chinese market, while demand has also been revised lower on fading GDP forecasts, as well as the influence of a lower outlook for vehicle production and sales, but production is nevertheless expected to be ahead of demand. Looking further forward, the lead market is likely to continue to suffer from competition with other battery metals such as lithium. China and India together will account for two thirds of the rise in Asian demand and over 40% of the global rise out to 2029. On the supply side, most new supply is expected to come from recycling, but reducing availability of scrap lead acid batteries will necessitate more smelter production, especially outside of China, with CRU anticipating additional production from Korea Zinc's Onsan smelter in South Korea, Vedanta's two Indian plants and Glencore's Ust Ust-Kamenogorsk smelter in Kazakhstan.

PHOTO: SUMITOMO METAL MINING

The Toyo copper smelter, Niihama, Japan.

Fig. 1: **Smelter acid supply, 2004-2029, million t/a**



Source: CRU

Zinc is mainly used in galvanising of steel (50%), and the manufacture of brass and bronze alloys and die casting. Global zinc demand has been virtually flat since 2017 due to declining growth in key zinc-consuming industries. Zinc has the lowest recycling rates of most primary metals at only 13%, as most zinc end uses are not in easily recyclable applications like batteries, packaging or wire. In spite of the relatively stagnant market, a surge in new smelter expansions over the period 2024-2029 will increase capacity by more than 1.5 million t/a over the forecast period, with the majority of the expansion coming from China. While this will not affect the zinc price directly, it will keep pressure on treatment charges and is likely to keep them low. It is also likely to mean declining utilisation rates at existing producers and possibly some closures, and may not necessarily lead to much of an increase in acid output.

Smelter acid output

There have been some smelter acid outages this year. In Chile, Glencore's Alto Norte smelter was suspended during April and May 2025 due to a furnace issue. In Peru, Southern Copper's Ilo smelter shut down operations in April due to shortages of copper concentrate feed. The PASAR smelter in the Philippines was put on care and maintenance in May due to challenging market conditions, removing 900,000 t/a of smelter acid supply. The deteriorating zinc market has also forced Nyrstar to reduce output at its Hobart zinc smelter in Australia by 25% from March this year.

Set against this, there will be start-ups for Freeport's smelter in Gresik, delayed due to a fire in the sulphuric acid unit in September 2024. Also in Indonesia, Amman Mineral's Sumbawa smelter is expected to commence operations in 2025 H2, with a capacity of 900,000 t/a of sulphuric acid. India's Adani Group is also commissioning its smelter, with a sulphuric acid production capacity of 1.5 million t/a. In China, the global copper concentrate shortage is still weighing on acid production. Smelter acid output there is expected to remain stagnant in 2025, and balancing the market for copper concentrates will require with market-related smelter cuts for demand to meet supply. Overall smelter output is expected to increase by only 0.9% year on year in 2025 due to this and delays in smelter starts in Indonesia, India, and the DRC.

Looking to the longer term, smelter acid supply is expected to increase by just under 15 million t/a from 2024-2029 (see Figure 1). China will represent 8 million t/a of this increase, with another 1.6 million t/a in India, and 2.5 million t/a in Indonesia, most of the latter in 2025-26. Other smaller increases will occur in Zambia and the DRC and Chile, and 1.1 million t/a in Europe, mainly Germany and Spain. The new capacity in India will help reduce import demand in the short term, though longer term more acid will be needed for phosphate production. In China smelter acid is taking over from sulphur burnt acid on the export market, which may mean that Chinese exports continue in spite of a surplus in the traded acid market. ■

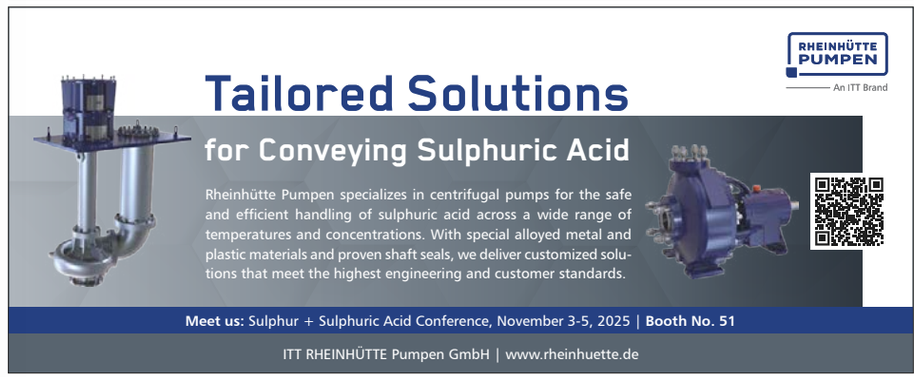


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PHOTO: CRU

2025 Sulphur + Sulphuric Acid Expoconference

The Sulphur + Sulphuric Acid Expoconference continues to be an essential annual forum for the global sulphur and sulphuric acid communities.

Join us at the 2025 Sulphur + Sulphuric Acid Expoconference in The Woodlands, Texas, 3-5 November, for a truly global gathering of the sulphur and sulphuric acid community, where leading market and technology experts and producers will gather to connect, share knowledge, exchange ideas and learn about market trends and the latest developments in operations, technology, processes and equipment.

The 41st Sulphur + Sulphuric Acid Expoconference will be held at the Woodlands Waterway Marriott Hotel and Convention Center in The Woodlands, Texas, 3-5 November. Don't miss the opening session of the main agenda which brings together industry leaders to discuss **Powering the Energy Transition** and **Unlocking Critical Resources**, focusing on the strategic role of sulphur and sulphuric acid in advancing global energy solutions and the recovery of rare earths and battery metal.

Other key highlights of the Commercial and Markets Session include the annual market outlooks agenda featuring expert insights from CRU's analysis teams on major supply and demand markets, including sulphur and sulphuric acid, as well as US policy shifts, global ripples and the road ahead for oil, gas and the sulphur supply chain.

In addition, an executive keynote panel of guest speakers on **Economics, Sustainability and the Future of the Industry** will explore deglobalisation, global trade challenges and sanctions and their impact on the fertilizer industry, risk identification and mitigation for long term resilience and sustained operational performance, capital strategies for financing growth in uncertain markets as well as regional market snapshots providing strategic updates from key producing and consuming regions.

The first day agenda also includes the popular interactive Sulphur and Sulphuric Acid Clinics, offering a unique opportunity for collaborative troubleshooting, shared insights, and practical takeaways from an expert panel and participants.

The comprehensive dual stream technical programme takes place on day 2 and day 3 of the conference, split into parallel streams, a sulphur track and a sulphuric acid track. Leading producers from around the globe, alongside technology and technical experts will provide updates on the production and processing of sulphur and sulphuric acid, with presentations covering new innovations in processes, technology, materials and equipment developments, as well as practical case studies highlighting operational experience and best practices to improve operations.

In addition to the technical presentations panel discussions and technical showcases will extend the opportunities to learn about best practices, lessons learned and the latest technologies and innovations.

Running alongside the agenda over the course of the 3 days there will also be an exhibition of world-class solution providers serving the sulphur and sulphuric acid industries.

Conference Agenda

Monday, 3 November

(Correct at time of going to press)

REGISTRATION & EXHIBITION OPEN – 08:00

SULPHUR TRACK – 10:00-12:00

- **Sulphur Troubleshooting Clinic**
  Elmo Nasato, President, *Nasato Consulting Ltd.*
  Angie Slavens, Managing Director, *UniverSUL Consulting*

SULPHURIC ACID TRACK – 10:00-12:00

- **Sulphuric Acid Troubleshooting Clinic**

NETWORKING LUNCH – 12:00-13:20

SULPHUR AND SULPHURIC ACID TECHNICAL SHOWCASES – 12:30-13:00

- **Innovations in sulphuric acid production technology**
  Dr. Ben Egelske, Senior Chemical Engineer, *Recalibrate*
- **A 500kt/a sulphur-burning acid plant in africa**
  Wylton (China) Chemical Co., Ltd

COMMERCIAL AND MARKETS SESSION – 13:20-15:10 Session Chair: **Willis Thomas**, Principal Consultant, *CRU*

- **Welcome address**
  Lisa Connock, Managing Editor, Sulphur Magazine, *CRU*
- **Industry at a crossroads: US policy shifts, global ripples, and the road ahead for oil, gas and sulphur supply chain**
  Maria Garcia, Economist, *CRU*
- **Opening keynote panel**
  - **Powering the energy transition: Sulphur and sulphuric acid strategic role in advancing global energy solutions**
  - **Unlocking critical resources: Rare earths and battery metal recovery**
    Andrew Nissan, Ph.D., P.E., Senior Director: Battery Strategic Sourcing, *LYTEN*
    Rene LeBlanc, Vice President, Growth and Product Strategy, *Lithium Americas Corporations*
    Christopher Larson, Vice President of Operations, *Lithium Americas Corporations*
    Frank Nikolic, Vice President, Base & Battery Metals, *CRU*
- **Industry keynote address**
  Guest Speaker

NETWORKING AND REFRESHMENT BREAK – 15:10-15:40

COMMERCIAL AND MARKETS SESSION – 15:40-17:30 Session Chair: **Dr. Peter Harrisson**, Principal Consultant, *CRU*

- **Market intelligence briefing: global sulphur market outlook**
  Dr. Peter Harrisson, Principal Analyst, Sulphur and Sulphuric Acid, *CRU*
- **Executive keynote panel – Economics, sustainability and the future of the industry**
  - **Is deglobalisation the key? Policy and regulatory landscape shaping regional independence**
  - **Global trade challenges and sanctions – Impact on fertilizer industry**
  - **Risk identification and mitigation. Driving long term resilience and sustained operational performance**
  - **Capital strategies – Financing growth in uncertain markets**
  - **Regional market snapshots – Strategic updates from key producing and consuming regions**
    Craig Jorgenson, President and CEO, *The Sulphur Institute*
    Andrea Vaccari, Vice President, Responsible Production Frameworks and Sustainability, *Freeport McMoRan*
    Dan Deaver, Vice President – Manufacturing, *Georgia Gulf Sulfur Corporation*
    Jay Davis, Sulfur Technology Leader, *Chevron*
    Aleksandr Benke, Strategy Director, *EuroChem Brazil*
    Steven M Puricelli, Senior Technical Director, *InterAcid*
- **Forecasting the future: Sulphuric acid market outlook 2026 and beyond**
  Viviana Alvarado, Analyst, Sulphuric Acid, *CRU*

NETWORKING WELCOME RECEPTION – 17:30-19:00

SULPHUR
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71 High Holborn
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www.bcinsightsearch.com

Tuesday, 4 November

(Correct at time of going to press)

REGISTRATION & EXHIBITION OPEN – 08:00

SULPHUR TRACK – 8:30-10:00

SULPHUR PLANT: TECHNOLOGIES AND STRATEGIES FOR EFFECTIVE H_2S REMOVAL

- **Unlocking hidden potential: A success story in existing facilities with proprietary amines**
  Rodolfo Gonzales, Technical Market Manager, *BASF*
- **Rate-base simulation of extractive liquid Treatment**
  Prashanth Chandran, Technical Development Lead, *Optimized Gas Treating*
- **Panel discussion – Sulphur plant: Technologies and strategies for effective H_2S removal**
  Q&A Session

SULPHURIC ACID TRACK – 8:30-10:00

SULPHURIC ACID PLANT OPERATIONS: BEST PRACTICES AND EQUIPMENT DESIGN

- **Maximising the ROI of your sulphuric acid plant**
  Benjamin Senyard, Process Engineer, *Worley Chemetics Inc*
- **A circular economy approach within the Petrokimia Gresik complex: Byproduct silica as a cost-effective and environmentally superior alternative to diatomaceous earth for sulphur filtration in sulphuric acid plants**
  Jawad Farisi, Vice President, *PT Petrokimia Gresik*
  Faizal Alianto, Junior Assistant Vice President, *PT Petrokimia Gresik*
- **Safe and reliable production of high purity sulphur trioxide (SO_3) for the semiconductor industry**
  Justin Thiems, Process Licensor, *Elessent Clean Technologies*

NETWORKING AND REFRESHMENT BREAK – 10:00-10:30

SULPHUR TRACK – 10:30-12:30

NOVEL APPLICATIONS AND BREAKTHROUGH SOLUTIONS IN SULPHUR INDUSTRY

- **Hybrid water-based absorption and membrane for deep desulphurisation of Claus Unit tail gas**
  Sebastien Duval, Senior Research Consultant, *ARAMCO*
- **Sulphur plant catalytic incineration – Carbon reduction**
  Elmo Nasato, President, *Nasato Consulting Ltd.*
- **Flexible low temperature sweetening of sour gas: An ultra-low emissions process to monetize low CO_2 & NGL containing sour gas**
  Joseph Weiner, Research Engineer, *8 Rivers Capital, LLC*
- **Maximising energy efficiency in refineries through WSA technology**
  Samuel Scherman Johansson, Technology Manager - Concepts and Studies, *Topsoe A/S*
  Jenny Hedenblad, Senior Licensing Manager, *Topsoe A/S*
- **Panel discussion – Novel applications and breakthrough solutions in sulphur industry**
  Q&A Session

SULPHURIC ACID TRACK – 10:30-12:30

SULPHURIC ACID PLANT OPERATIONS: BEST PRACTICES AND EQUIPMENT DESIGN

- **Advanced molten sulphur spraying: Ensuring operational reliability through precise temperature and droplet management**
  Ashwin Patni, Director Process Technology Division, *Lechler, Inc.*
- **Keeping a 40-year-old converter going**
  Stuart Hinze, Senior Process Engineering Manager, *J.R. Simplot*
- **Design innovation to eliminate corrosion Failures in adiabatic coolers**
  Ethan Schrader, Product Manager, AirBTU VPRR, *CG Thermal*
- **A tale of two towers**
  Steve Puricelli, VP of Technologies and Process, *EXP OG&C Group*
  Guy Cooper, Director Marketing and Sales, *EXP OG&C Group*

NETWORKING LUNCH – 12:30-14:00

SULPHUR TECHNICAL SHOWCASE – 13:00-13:15

- **Protection of primary and secondary concrete containment structures**
  Stephen Streich, Sales Manager North America, *ErgonArmor, Division of Ergon Asphalt and Emulsion*

SULPHURIC ACID TECHNICAL SHOWCASE – 13:15-13:30

- **Corrosion resistant weld overlay and thermal spray coating solutions in wet H_2S and sulphuric acid environments**
  Pete Sanders, Director of Technology & Business Development, *WSI*

SULPHUR TRACK – 14:00-15:30

SULPHUR PLANT: RELIABILITY-CENTERED OPERATIONS AND MAINTENANCE

- **Making it to the turnaround: Making the best of a bad situation**
  SGS Sulphur Experts Inc.
- **SRU-TGTU hydrogenation catalyst lifecycle best practices**
  Abdulrahman Muabber, Associate Process Operations Engineer, *ARAMCO*
- **Reusing existing amine and sulphur plant for SAF project**
  Tammy Chan, Principal Process Engineer, *Worley Comprimo*
- **Panel discussion – Sulphur plant: Reliability-centered operations and maintenance**
  Q&A Session

SULPHURIC ACID TRACK – 14:00-15:30

SULPHURIC ACID PLANT: OPTIMISING OPERATIONS

- **Improving the performance of Ilo's copper smelter sulphuric acid plant reactor**
  Alvaro Jara, Metallurgist, *Southern Peru*
- **Maintaining acid quality and plant efficiency in metallurgical offgas operations**
  Collin Bartlett, Director, Business Development, Metals & Chemical Processing, *Metso*
- **Optimising turnarounds in sulphuric acid plants: Integrated maintenance strategies for conveying systems and vessel refurbishment**
  Michael Labbe, Executive Director/Prokurist Business Development, *REMA TIP TOP*

Tuesday, 4 November

(Correct at time of going to press)

NETWORKING AND REFRESHMENT BREAK – 15:30-16:00

SULPHUR TRACK – 16:00-17:30

SULPHUR PLANT: RELIABILITY-CENTERED OPERATIONS AND MAINTENANCE

- **Operational and safety considerations for SRU shutdowns due to tail gas thermal oxidizer trips: A case study from Motiva Port Arthur Refinery**
  Ron Pitman, Manager of Technology for Crude, Sulfur, Energy, and Utilities, *Motiva*
  Rustin Heflin, Lead Applications Engineer, *Zeeco*
- **Simulation-based thermohydrodynamic analysis of a Claus process catalytic reactor**
  Elmo Nasato, *Continuum Engineering Inc.*
- **Operational excellence in SRU turnaround and smooth start-up – A case study from HPCL Mumbai refinery**
  Hindustan Petroleum Corporation Ltd
- **Panel discussion – Sulphur plant: Reliability-centered operations and maintenance**
  Q&A Session

SULPHURIC ACID TRACK – 16:00-17:30

SULPHURIC ACID PLANT OPERATIONS: DEBOTTLENECKING

- **Sulphuric acid plant debottlenecking and equipment replacement: Lessons from a recent project**
  Nesho Plavsic, Senior Project Manager, *NORAM Engineering and Constructors Ltd.*
- **Spent acid decomposition furnace decarbonisation and emission reduction**
  Messer
- **Hydrogen generation and mitigation strategies in sulphuric acid plants**
  Payton Wanstreet, Senior Process Engineer, *PegasusTSI, Inc.*

DRINKS RECEPTION – 17:30-18:30

Wednesday, 5 November

REGISTRATION & EXHIBITION OPEN – 08:00

SULPHUR TRACK – 8:30-10:00

REDUCING THE ENVIRONMENTAL FOOTPRINT OF SULPHUR RECOVERY: ENERGY AND EMISSIONS CONSIDERATIONS

- **ENAP Bio Bio Refinery – Resolving high SO_2 emission events**
  Marco van Son, Technology Director, *Worley Comprimo*
- **Panel discussion – A holistic take on sulphur plant emissions**
  Angie Slavens, Managing Director, *UniverSUL Consulting*
  Elmo Nasato, President, *Nasato Consulting Ltd.*
  Frank Scheel, Senior Vice President, *Worley Comprimo*
  Rustin Heflin, Lead Applications Engineer, *Zeeco*
  Johann Le Touze, Lead Sulphur Recovery Technology Engineer, *AXENS*

SULPHURIC ACID TRACK – 8:30-10:00

SULPHURIC ACID PLANT PERFORMANCE: CATALYSTS

- **Wylton CHP75B catalyst comprehensive performance optimisation**
  Wylton (China) Chemical Co., Ltd
- **Platinum promoted honeycomb catalysts – A versatile instrument for acid making**
  Johannes Hofer, Senior Vice President Catalysts & Analytics, *P&P Industries AG*
- **Fertilizer producer and Topsoe partner to boost acid production**
  Martin Alvarez, Solution Specialist, VK Catalyst, *Topsoe A/S*

NETWORKING AND REFRESHMENT BREAK – 10:00-10:30

SULPHUR TRACK – 10:30-12:30

REDUCING THE ENVIRONMENTAL FOOTPRINT OF SULPHUR RECOVERY: ENERGY AND EMISSIONS CONSIDERATIONS

- **Innovating sulphur recovery process for net zero: Breakthroughs in acid gas processing, energy efficiency and reliability**
  Hindustan Petroleum Corporation Ltd
- **Sulphur recovery versus removal – Compliance and capex**
  Romesh Sharma, Head – Energy Business, *Nuberg Engineering Limited*
- **Panel discussion – Reducing the environmental footprint of sulphur recovery: Energy and emissions considerations**
  Q&A Session

SULPHURIC ACID TRACK – 10:30-12:30

SULPHURIC ACID PLANT: MONITORING AND CONTROL, INDUSTRY #4.0

- **AI-Troubleshooting in sulphuric acid production: A modern upgrade for a mature process**
  Omar Talib, President & Co-Founder, *ControlRooms.ai*
- **Update on sulphuric acid dew point monitoring – Applications and case study**
  Cal Lockert, Senior Program Director, *Ohio Lumex*
- **Inline, in control: Next-gen measurement for sulphuric acid and oleum**
  Emanuel Hofer, Product Manager, *Anton Paar GmbH*

NETWORKING LUNCH – 12:00-13:30

SULPHUR TECHNICAL SHOWCASE – 12:15-12:30

- **Optimisation and common mistakes in sulphur melting and filtration process**
  Mathijs Sijpkes, Project Engineer, *Sulphurnet*

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Wednesday, 5 November

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SULPHUR TRACK – 13:30-15:30

SULPHUR PRODUCT HANDLING: SAFE AND RELIABLE OPERATIONS FROM SRU TO FINAL DESTINATION

- **Molten sulphur storage design practices to manage and mitigate environmental, health, and safety risks of sulphur storage system vapours**
  Darshan Sachde, Senior Process Engineer, *Trimeric Corporation*
- **A case study of SRU condenser plugging**
  Divakar Singh, Manager – Operations, *Hindustan Petroleum Corporation Limited*
- **Cleaning gas streams from molten sulphur sources**
  Doug Hall, Process Engineer, *Elessent Clean Technologies*
- **Panel discussion – Sulphur product handling: Safe and reliable operations from SRU to final destination**
  Q&A Session

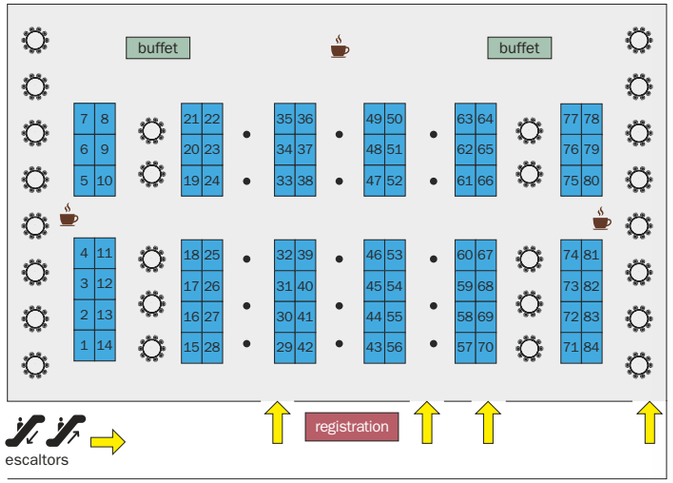
SULPHURIC ACID TRACK – 13:30-15:30

SULPHURIC ACID PLANT: CATALYSTS AND SAFETY BY DESIGN

- **Catalyst screening in Southern Africa – A case study**
  RADS Engineers & Projects
- **Unlocking a new level of catalyst performance with 3D printed geometries**
  Allison Belgard, Technology Manager, *BASF*
- **Strategies for safely recovering heat from strong sulphuric acid streams**
  Nelson Clark, Technical Director, *Clark Solutions*
- **Sealless magnetic drive pumps: Delivering unparalleled safety and efficiency in molten sulphur handling**
  Joseph Acevedo, Area Sales Manager, *CP Pump Systems*

CLOSE OF CONFERENCE – 15:30

Exhibition floorplan



1. CRU
2. Sulphur Magazine
4. Matrix Service Company
5. WSI
7. Düchting Pumpen Maschinenfabrik, GmbH & Co. KG
8. Gouda Refractories
9. Rema Tip Top
10. Duiker Clean Technologies
11. ErgonArmor, a Division of Ergon Asphalt & Emulsion
12. Advect Process Systems USA, LLC
13. CERE China Technical Engineering, Jiangsu Co., Ltd.
14. MECS / Elessent Clean Technologies
15. Fluor
16. Southern Heat Exchanger
17. FIMA Maschinenbau GmbH
18. Lone Star Turbo
19. Steam Solutions
20. Voovio Technologies, S.L.
21. Messer
22. Knight Material Technologies, LLC
25. Delta Controls Corporation
26. BASF
27. Clark Solutions
28. OHL
30. Socemo Group
31. Christy Catalytics, LLC
32. Wylton
33. Industrial Ceramics Limited
35. Recalibrate
36. Sulphurnet
37. CP Pumpen AG
39. Boldrocchi
40. Daily Thermetrics Corporation
41. Anton Paar
42. Optimized Gas Treating, Inc.
43. WEIR
44. SBS Steel Belt Systems
45. Emerson
46. Lechler, Inc.
47. Axens
48. Kalfrisa SAU
49. JRS (J. Rettenmaier & Söhne)
50. Metso
51. ITT RHEINHÜTTE Pumpen GmbH
52. Sulzer
53. Worley Comprimo/ Worley Chemetics
54. STEULER-KCH GmbH
55. CG Thermal
56. JH Pumps
58. Ohio Lumex Co., Inc.
59. Acid Piping Technology
60. European Filter Corporation
61. AMETEK CSI
62. Aecometric Corporation
63. Kimre
64. Blasch Precision Ceramics
65. Rhodius KMS, a Gerard Daniel Worldwide company
66. SmartSCOPE
67. NORAM Engineering and Constructors Ltd
68. HEC International INC
69. Howden Turbo GmbH
70. Begg Cousland Envirotec Limited
72. Pacific Refractories Limited
74. Topsoe
75. P&P Industries AG
77. PegasusTSI
78. AGRU Kunststofftechnik GmbH
80. Zeeco
81. Central Maintenance and Welding
83. Global Environmental & Industrial Response

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Exhibitor Spotlights

Aecometric Corporation — Stand 62

For more than 50 years Aecometric has been a trusted name in providing industrial combustion equipment. The Aecometric High Intensity Burner technology stands alone in performance, quality and reliability. The Aecometric burner design lends itself perfectly to the combustion needs of the Sulphur and Sulphuric Acid industry by providing maximum contaminant destruction, exceptional reliability and a high level of operational flexibility.

Contact: Sany Cao
Email: sales@aecometric.com
Tel: +1 905-883-9555
Web: www.aecometric.com

Begg Cousland Envirotec — Stand 70

Begg Cousland Envirotec specialises in mist elimination for sulphuric acid and fertilizer plants as well as designing state-of-the-art gas scrubbers for tank venting duty, sulphur melting tank fumes and for the abatement of other chemical emissions. Based in Scotland and with production in the UK, Italy and under licence, in India and China, the company has over 70 years' experience and technology in the field of sulphuric acid.

Contact: Graeme Cousland
graeme.cousland@bcenvirotec.com
Tel: +44 141 5562289
Web: www.beggcousland.com

Boldrocchi — Stand 39

Boldrocchi is an international engineering and manufacturing firm with over 100 years experience. Its wide-ranging portfolio of solutions includes fans, blowers and compressors, heat exchangers and coolers, environmental solutions, noise protection, heavy-duty dampers and diverters and power generation/gas turbine ancillaries. Boldrocchi's systems can be found in several SRU projects worldwide, including API 672/617 compliant customised centrifugal compressors, and single and multi-stage blowers with special alloys and steam traced casings for acid gas applications.

Contact: Pietro Accurso
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Tel: +39 0392202511
Web: www.boldrocchigroup.com

CERE China Technical Engineering Jiangsu Co., Ltd. — Stand 13

CERE China Technical Engineering Jiangsu Co., Ltd., founded in 1992, specialises in energy-saving and environmental protection technologies, providing waste heat recovery, emission reduction, and cost reduction solutions. In 2017, CERE jointly established Jiangsu SOPO-CERE Equipment Manufacturing Co., Ltd. in partnership with Jiangsu SOPO Corporation (Group) Ltd. To date, CERE and SOPO-CERE have completed more than 70 engineering projects (EPC, including 1,200 sets of boilers and 1,500 types of pressure vessels).

Contact: Wills Wang
Email: wangbo@cerechina.com
Tel: +8613761752381

Christy Catalytics LLC — Stand 31

Established in 1922, Christy Catalytics manufactures and supplies inert bed supports for fixed beds of catalyst and adsorbents as well as a complete range of tower packing to the chemical, petrochemical and refining industries worldwide. For sulphuric acid customers, Christy Catalytics offers PROX-SVERS® ceramic balls for converter vessels; Christy® Pak ceramic saddles and Christy® Pak Cross Partition rings for absorption/drying towers as well as thermoplastic packing for gas cooling towers.

Contact: Vernon Christensen
Email: vjchristensen@christyco.com
Web: www.christycatalytics.com

CP Pump Systems — Stand 37

Founded in 1948, CP Pump Systems is a global leader in sealless magnetic drive pump technology. Trusted in more than 70 countries, CP specialises in heated, hermetically sealed designs that deliver safe, efficient, and reliable performance in molten sulphur and other demanding services. Each pump is engineered for its application. Backed by decades of proven performance, CP remains a trusted partner for long-term reliability in critical sulphur applications.

Contact: Joseph Acevedo
Email: joseph.acevedo@cp-pumps.com
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PHOTO: CRU

Discover new innovations in process technologies, equipment and instrumentation in the exhibition hall.

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Duiker Clean Technologies — Stand 10

Duiker is a specialised combustion engineering and contracting company based in the Netherlands, providing advanced thermal process solutions, related equipment, and after-sales services for applications such as sulphur recovery, ammonia-to-hydrogen, and ammonia-to-heat conversion. With extensive experience in designing, supplying, and servicing sulphur recovery burners and associated equipment, Duiker integrates proven engineering with innovative features that enhance plant performance, safety, reliability, and overall operation.

Contact: Ernst van Koert
Email: vankoert@duiker.com
Tel: +31 174 282 764
Web: www.duiker.com

Howden, a Chart Industries Company — Stand 69

Howden specialises in the design, application and manufacture of customised turbo blowers and compressors for both sulphur production and recovery applications. As the leading global supplier, Howden works closely with customers to offer a unique range of mutually compatible compressors and drivers. In addition, Howden offers robust and reliable steam turbines for waste heat utilisation in sulphur and sulphuric acid plants.

Contact: Wolfhard Kiefer
Email: Wolfhard.Kiefer@chartindustries.com
Tel: +4915115142952
Web: www.chartindustries.com/Businesses-Brands/Howden

JH Pumps — Stand 56

Kunming Jiahe Technology Co., Ltd. is an international leading manufacturer of industrial pumps. Founded in 1988, Jiahe has provided pumps for more than 500 sulphuric acid plants. Jiahe pumps have over 30 series and 1,000 specifications, covering a wide range of industrial fields. As a leading China manufacturer of sulphuric acid pumps and sulphur pumps, Jiahe provides reliable, safe and worry-free services to chemical industries and non-ferrous smelting industries.

Email: sales@jhpumps.com
Tel: 00-86-871-67425766 00-86-871-67413111
Web: www.jhpumps.com

Lechler, Inc. — Stand 46

Lechler is a global leader in precision spray technology, providing engineered solutions for the sulphur and sulphuric acid industries that improve plant efficiency and compliance. Lechler nozzles and systems support critical applications such as gas cooling, quench processes, emissions control, and corrosion prevention. With certified in house welding, nozzle refurbishment, and custom fabrication, Lechler ensures high performance in the most demanding environments.

Contact: Ashwin Patni
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Tel: +1 630 715 9553
Web: www.lechlerusa.com

FIMA Maschinenbau GmbH — Stand 17

For nearly 80 years, FIMA Maschinenbau GmbH has delivered high-performance blowers and compressors for the world's toughest conditions, including sulphuric acid and sulphur recovery. Proven worldwide, FIMA offers custom designs up to 100 bar, 650 °C, and 10 MW, built to DIN EN/API standards. Engineered and tested in Germany, our durable, efficient machines keep operations running when uptime matters most.

Contact: Lucas Baldo
Email: l.baldo@fima.de
Tel: +1 639 994 3536
Web: www.fima.de/en

ITT RHEINHÜTTE Pumpen GmbH — Stand 51

ITT RHEINHÜTTE Pumpen GmbH a full range of vertical and horizontal pumps in metal, plastic, and ceramic materials for the chemical, petrochemical, fertilizer and related industries. An expert in corrosion and wear resistance, RHEINHÜTTE Pumpen leads the field with highly sophisticated know-how in many specific areas. The company specializes in chemically resistant centrifugal and axial flow pumps for handling molten sulphur, sulphuric acid, and phosphoric acid.

Contact: Hani Tello
Email: hani.tello@rheinhuette.com
Tel: +49 611 604-100
Web: www.rheinhuette.de

Knight Material Technologies — Stand 22

Founded in 1910, Knight Material Technologies (KMT), Canton, OH, (formerly Koch-Knight) engineers, manufactures, installs, and services acid-resistant linings for vessels/towers in the sulphuric acid industry worldwide. KMT produces industry-leading brick, mortars, PYROFLEX® membranes, internals, FLEXERAMIC® structured and random packing media. Subsidiaries Electro Chemical and Superior Dual Laminate Products specialise in fluoropolymer lining for the chemical processing industries. In North America, KMT has manufacturing and lining facilities in Houston, TX, Canton, OH, Emmaus, PA, and BC, Canada.

Contact: Mark Golla
Email: mark.golla@knightmaterials.com
Tel: +1-234-255-0320
Web: www.knightmaterials.com

P&P Industries AG — Stand 75

With over 20 years of global experience, P&P Industries delivers advanced industrial solutions, from waste gas treatment to sulphuric acid production, processing diverse sulphur-containing feedstocks to produce high-purity sulphuric acid. The company's portfolio includes sulphur oxidation, spent acid regeneration, and sulphur concentration plants. At the heart of innovations is its platinum honeycomb catalyst for SO_2 conversion with high activity, durability, low pressure drop, and a long-term lifespan.

Contact: Paul Piantino
paul.piantino@pp-industries.at
Tel: +43 316 26 97 97 – 601
Web: www.pp-industries.at

CONFERENCE + EXHIBITION PREVIEW


PHOTO: CRU

Network with industry peers and make connections with global industry experts and solution providers at Sulphur + Sulphuric Acid 2025.

Recalibrate — Stand 35

Recalibrate aims to transform sulphuric acid production with a patented technology that eliminates SOx and NOx emissions. As global demand for food, energy, and infrastructure grows, so does the environmental cost. Recalibrate's breakthrough technology offers a scalable, economically competitive solution that makes clean manufacturing a core feature, not an add-on. The company's mission is clear: protect air and water without compromising human progress.

Contact: Lee Mitchell
Email: contact@recalibrateco.com
Web: www.recalibrateco.com

Smart SCOPE GmbH — Stand 66

Smart SCOPE is a provider of engineering services for sulphuric acid and industrial gas cleaning plants. With its innovative concepts and the experience of its engineers in plant design and operation, Smart SCOPE addresses the specific needs and challenges of its customers and provides tailor made solutions. Focusing on plant revamps and optimisation we identify ways to maximise plant performance and provide process and equipment design for reliable operation.

Contact: Torsten Weber
Email: torsten.weber@smart-scope.de
Tel: +49 2171 5820001
Web: www.smart-scope.de

Sulzer — Stand 52

Sulzer has 190 years of experience in developing pumping solutions for production processes involving corrosive or abrasive media and offers a complete range of horizontal and vertical pumps, as well as agitators, tailor-made to customer specifications for molten sulphur and sulphuric acid. Since joining forces with Ensival-Moret the company now has an even deeper process understanding for demanding applications covering the petrochemical, chemical, fertilizer and metal industries.

Contact: Fouad Aâribbouch
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Tel: +33643553051
Web: www.sulzer.com

Topsoe — Stand 74

Topsoe is a global leader in development and supply of technologies, catalysts and services for the sulphur and sulphuric acid industry. With its Smarter Sulfur Solutions portfolio, which includes the Topsoe developed WSA™ technology, Topsoe works to provide a highly efficient and reliable solution, while complying to the most stringent emission requirements. Topsoe's high-activity catalysts enable higher conversion and energy efficiency, while simultaneously reducing pressure drop and improving production stability.

Contact: Marie Vognsen
Email: MAVO@topsoe.com
Tel: +45 22754714
Web: www.topsoe.com

Worley Chemetics — Stand 53

Worley Chemetics is a leading provider of technology, solutions and equipment fabrication for sulphuric acid, chlorine chemicals and other specialty chemical facilities, servicing worldwide customers in the chemical, oil and gas, fertilizer, pulp and paper industries with specialised design and fabrication of proprietary and non-proprietary equipment, engineered systems and plants since 1964. With its CORE-SO_2™ Sulphuric Acid Plant technology Worley Chemetics unlocks green fertilizer and sustainability goals across industries.

Contact: Irina Gushan
Email: Irina.gushan@worley.com
Web: www.worley.com

Zeeco — Stand 80

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Battery materials driving sulphur consumption growth

PHOTO: RALF HAHN/ISTOCK

Electric vehicle charging station

In this CRU Insight, **Peter Harrisson** reports on how battery materials have become a powerful driver of sulphur consumption growth. Battery materials – especially nickel via HPAL and, to a lesser extent, lithium clays and phosphate-based chemistries – have rapidly increased sulphur demand from a negligible share in 2000 to a meaningful and rising portion by 2025–2030, with future growth hinging on battery chemistry mix and extraction routes.

From the beginnings of the modern sulphur industry, fertilizer and industrial markets have been the primary drivers of demand. However, over the last 25 years metals have accounted for an increasing share of consumption. More recently, metals with a direct end-use in battery production have driven consumption in the sectors at a rapid pace.

In 2000, fertilizer and industrial markets accounted for 98% of global sulphur demand, with the balance made up of small volumes consumed to make sulphuric acid for nickel and uranium leaching. In 2025, metals-based sulphur demand has climbed to account for 9% of total global demand, with the volume of sulphur consumed having climbed from 0.72 million tonnes in 2000 to 6.89 Mt in 2025 (see Fig. 1).

The upswing in sulphur consumption for metals production has been predominantly driven by the nickel industry with the first wave of projects commissioned in the early 2010s. The nickel industry is similarly responsible for the most recent surge in demand with growth focussed in Indonesia. The impact that the battery materials industry has on sulphur demand is a function of the size of the finished product required and the intensity of sulphuric acid demand required to make it. There is also the consideration that several metals industries, such as copper and lithium, consume sulphuric acid from smelter sources which limits their contribution to sulphur demand (see Fig. 2).

For nickel HPAL and the processing of lithium clays, the demand intensity for sulphuric acid is the major consideration for onsite consumption of sulphur over the purchase of sulphuric acid.

An operation with 60,000 tonnes/year of nickel production in Indonesia would have a 1.5 million t/y demand for sulphuric acid, with a corresponding sulphur consumption of 0.5 Mt/y. Indonesia is expected to have nickel HPAL production of nearly 875,000 t/a by 2030, which corresponds to a sulphuric acid consumption of approximately 22.8 Mt, resulting in a sulphur demand of around 6.75 Mt.

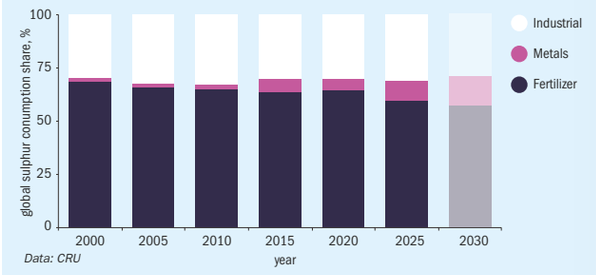
Lithium clays, such as those being developed in the US in Nevada, have sulphuric acid consumption of between 25-30 tonnes of acid per tonne of lithium output. These projects are the dominant share of sulphur consumption in the sector, despite being a minor contributor to total lithium supply. US sulphur consumption in the sector is expected to climb to around 0.5 Mt in 2030, but with the capacity to consume up to 0.7 Mt when planned capacity is fully operational.

Phosphate-based battery technology has emerged as a direct competitor to nickel-based batteries for automotive applications. This has driven a surge in demand for phosphoric acid and technical MAP as inputs into this sector. China is currently the dominant location for the industry, but there are plans to develop supply in the rest of the world. The phosphate-based battery industry in China has provided support to the wider industry, but only accounts for around 1.0 Mt/y of sulphur consumption. The growth in the industry to 2030 is only expected to increase this sulphur consumption level to around 1.5 to 1.8 Mt/y. Long-term growth will likely drive further demand, but the sector is still expected to remain a minor component of the total phosphate industry.

Sulphur demand growth is dependent on where, what and how materials are extracted.

The future of sulphur demand in the battery materials industry is almost certain to remain on an upward trajectory, but the end point will be significantly influenced by the exact materials and extraction process route that is required. The nickel and manganese content in batteries is a major driver of sulphur consumption growth. The lithium industry remains focussed on brine and spodumene processing, which has low acid consumption requirements, although projects such as those in the US can meaningfully add to sulphur consumption. The popularity of phosphate-containing batteries poses a risk to future requirements for nickel, which could similarly limit future demand for sulphur.

Fig. 1: **Metals industries account for a growing share of sulphur demand**



Data: CRU

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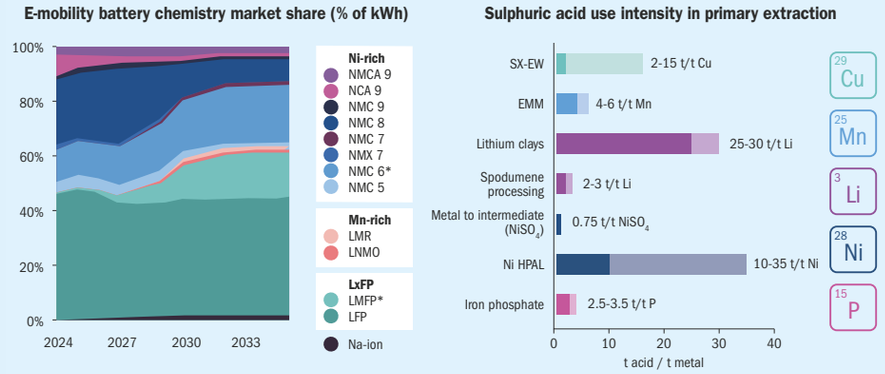
Fig. 2: **Sulphur demand driven by route of extraction**



Data: CRU

Note: Based on battery installations in vehicle production. "NMC X" indicates the approximate nickel content relative to manganese and cobalt. e.g. NMC 8 is 80-85% nickel. Other prospective chemistries not shown (e.g. NMA, LNMFP). LMFP encompasses a family of variants, including composites with NMC. NMC6 includes medium-nickel high-voltage variants.

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Smelter disruptions reshape 2025 traded acid market

Smelter outages and maintenance, alongside a copper concentrate shortage, tightened sulphuric acid supply and supported high prices in early 2025, but new smelter capacity in China, India, and Indonesia is set to boost acid availability and reduce import needs in 2025 Q4 and 2026. As Chinese exports fill global gaps and Asian capacity ramps up, sulphuric acid prices are likely to move lower, predicts **Viviana Alvarado**, CRU analyst.

Supply disruptions have impacted the sulphuric acid trade dynamics and the price outlook in 2025. As smelter availability is anticipated to increase with the start-up of new capacity additions in Asia, import requirements are likely to decline in 2025 Q4 and 2026. Reduced import demand is expected to result in lower acid prices, which will place further pressure on smelter's revenues amid persistently low treatment and refining charges (TC/RCs).

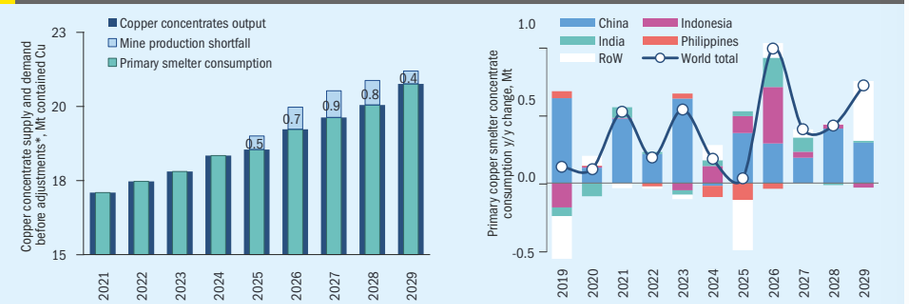
Smelter consumption set to grow despite copper concentrate deficit

Several fundamental and temporary factors have caused disruptions at smelters, including extended maintenance periods, closures, and reduced operating rates. The copper concentrate shortage has been a significant issue, as the global increase in smelter capacity has outpaced mine supply, pushing TC/RCs into negative territory since early 2025. Despite consumption cuts in 2025, shortages have persisted, with further demand adjustments required to balance the market. In 2025, a mine production shortfall is estimated at 0.5 Mt Cu, with global concentrate consumption growth of only 0.2% y/y in 2025 (see Fig. 1).

The copper concentrate shortage will affect consumption patterns differently across countries. The most significant decline in consumption is expected from the Philippines, as Glencore announced in May 2025 that it will put its PASAR copper smelter plant under care and maintenance. Namibia will also play a role in rebalancing the market due to the halt of operations at the Tsumeb smelter starting in June 2025. Japanese smelters will address the deficit by reducing utilisation rates or processing more secondary material in 2026. By contrast, smelters in China, India and Indonesia are expected to ramp up new capacity additions. Particularly, the start-up of operations at Adani's copper smelter in India, as well as at Amman Mineral's and Freeport's smelter in Indonesia, will push concentrate demand and acid supply higher.

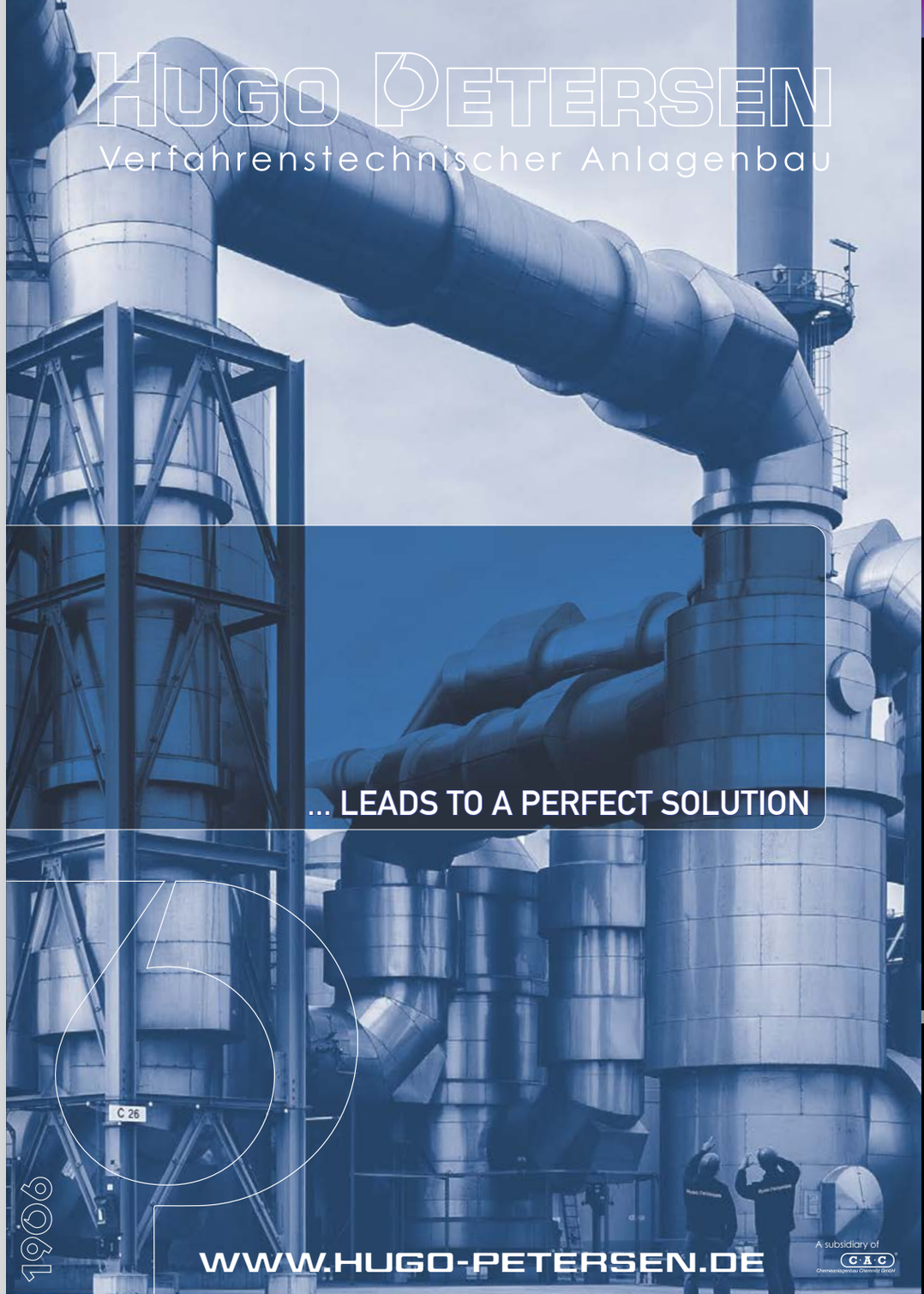
In South America, smelter disruptions have also taken place but driven by

Fig. 1: **Concentrate consumption will still grow in 2025**



** Adjustments due to lack of concentrates for smelting*

Source: CRU, Copper Concentrate Market Outlook service



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technical issues. Glencore suspended operations at its Altonorte smelter for one month in April 2025 due to a furnace issue. Similarly, Coldelco's Potrerillos smelter halted operations in June after a stack collapsed and has yet to restart operations.

Chinese smelter availability to fill the supply gap

The smelter supply outages have a direct impact on the sulphuric acid traded market. The unplanned outages at the Altonorte and Potrerillos smelters are expected to reduce the 2025 supply by around 0.3 Mt of acid. The Altonorte issue prompted buyers to commit to new imports, which pushed 2025 Q2 arrivals to a six-year high. The collapse of the stack at Potrerillos has not led to a further increase in buying activity, as Mejillones is currently experiencing port congestion, with buyers remaining well supplied.

In Asia, the halt of operations at the PASAR smelter in the Philippines will reduce regional production and export availability by around 0.4 Mt in 2025. However, in the opposite direction, the start-up of Freeport's Gresik operation and Amman Mineral's smelter project will increase acid capacity by 1.4 Mt/y and 0.9 Mt/y, respectively. Likewise, the start-up of Adani's Copper smelter project in India, with a capacity of 1.5 Mt/y, will further rise supply in the region. As India and Indonesia are the Philippines' major trade partners, a surge in local availability from both countries will partially offset the lack of supply from PASAR.

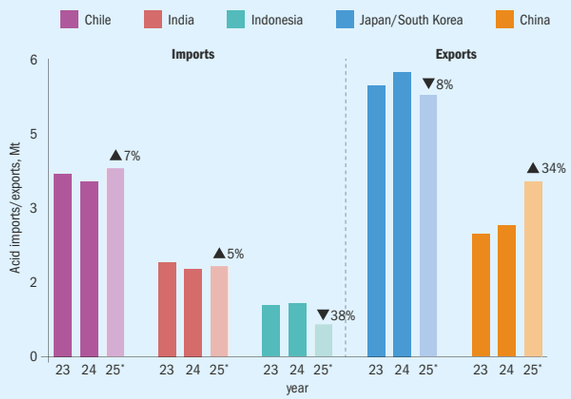
PHOTO: ISTOCKPHOTO

Smelter availability is anticipated to increase with the start-up of new capacity additions in Asia.

The closure of the Tsumeb smelter in Namibia will partially offset the increase in Asian supply, as imports are expected to rise to cover the loss of local supply. However, its impact on the market will likely be minor, as the supply disruption will be less than 0.1 Mt.

From the export side of the market, higher concentrate consumption in China, driven by new smelter capacity, is expected to increase export acid availability from 2.6 Mt in 2024 to 3.6 Mt in 2025. China will play a major role in filling the supply gap in the international market as renewed demand has emerged – particularly in Chile and Saudi Arabia. Additionally, the tight availability from Japan, due to smelters' lower operating rates, will facilitate Chinese export activity (see Fig. 2).

Fig. 2: **China to fill the supply gap in the acid market in 2025**



Source: CRU, Sulphuric Acid Market Outlook service **Forecast*

High acid prices are likely to move lower

Smelter supply disruptions have had a significant impact on acid price trends in 2025. The series of smelter issues in Chile, high domestic acid prices in China, tight availability in Japan and South Korea, and strong demand have all supported acid prices.

The notable decline in TC/RCs values has cut smelters' revenue, and high sulphuric acid prices have partially countered this drop. However, the inherent volatility of sulphuric acid prices makes a move to lower acid prices likely, particularly as import requirements decline. Any decline in acid prices, whilst TC/RCs remain low, would put further strain on smelter economics.

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SulGas® Kuala Lumpur 2025

SulGas® KL, South-East Asia's sulphur recovery and gas treating conference organised by Three Ten Initiative Technologies LLP, made its debut from 2-3 July 2025, at Impiana KLCC, Kuala Lumpur, Malaysia.

PHOTO: 3101

Attendees at the inaugural 2025 SulGas Kuala Lumpur Conference.

Building on the success of its annual SulGas conference in India, Three Ten Initiative Technologies LLP has introduced a new regional event in South-East Asia, SulGas® KL, providing another regular platform where experts can gather for a technical forum on sulphur recovery and gas processing. The event saw participation from over 70 attendees, representing more than 29 companies across various areas of sulphur handling and gas processing, including public and private refineries, the oil and gas industry, petrochemicals, chemicals, and related sectors.

SulGas® KL 2025 provided an ideal opportunity for experts to engage with their peers, share best practices and troubleshooting tips, and discuss advanced technologies and operating procedures with technology providers, vendors, and licensors.

The conference featured 17 speakers in interactive technical sessions, fostering maximum technical exchanges among participants. Additionally, a dedicated exhibition area with full-day access for all delegates was made available.

The agenda was split into seven sessions across the two days with a mixture of presentations followed by detailed panel discussions which sparked valuable dialogue between the audience and speakers.

The main themes at the conference were:

- SRU diagnostics – advanced monitoring and control, troubleshooting, automation
- Amine treating – core principles, design insights, advanced simulation, optimisation
- SRU reliability – technology deployment, opex optimisation, reliability experience
- Dehydration and cold box systems – exchanger protection, reliability experience, performance optimisation
- Emissions management and decarbonisation – reducing CO_2 footprint, SOx abatement.

SRU diagnostics

Jochen Geiger of Ametek Process Instruments started off the programme by sharing insights on how to identify and respond to COS and CS_2 in a sulphur recovery unit using modern process instrumentation. A combination of application-specific analyser designs, tailored sampling systems and strategic technology choices provides a holistic approach to optimise SRU operations. He stressed the importance of knowledge, understanding and awareness training to maintain the instruments and for reliability and safety.

Bob Poteet of WIKA followed up on his presentation from SulGas, India, with an update on WIKA's innovative method for monitoring the refractory condition in Claus units and how to measure the temperature inside without a purge. The challenge has been how many measurement points to install and what technology to use. A proven solution is now available.

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Rounding off the session, Yifeng Liu of Shandong Sunway Chemical Group Co. shared experiences elaborating on the necessity and methods of establishing an early pressure warning system for the sulphur recovery unit to maintain continuous and stable operation. System pressure escalation can originate from multiple factors, including combustion-induced carbon deposition, ammonium salt crystallisation, sulphur blockage caused by cold-hot steam mixing and rupture of heat tracing jackets etc. Implementing optimised design, enhancing control parameters and conducting scheduled inspections of critical components can effectively mitigate or prevent operational anomalies.

Amine treating

Debopam Chaudhuri of Fluor discussed the problem of SO_2 breakthrough in the SRU/TGT and how continuous monitoring of key operating parameters has the potential to reduce and even eliminate the chances of SO_2 breakthrough (see article *Sulphur* 418, p.36).

Attacking amine foaming through enhancement of operation design was the topic of the presentation by Mohd Firdaus Sabturani of Petronas who drew upon his extensive experience of operating an amine based AGRU in an LNG processing plant where the issue of foaming is commonly encountered. Root cause failure analysis conducted on various foaming incidents in Petronas has identified several common root causes and led to recommendation for operational and design improvements which has improved the performance of the amine treating units and reduced foaming issues significantly to achieve a stable AGRU operation.

Dissolved acid gases are usually removed from LPG and various other hydrocarbon liquids using amine solvents in liquid extraction-type columns. Until now, the best one could do to simulate such columns was to treat them as a set of one to three equilibrium stages, then apply an unknowable stage efficiency to arrive at a performance estimate. Prashanth Chandran of Optimized Gas Treating announced a breakthrough in modelling technology for mass transfer rate-based simulation of liquid treaters. For the first time it has been possible to simulate liquid treaters rationally and to relate performance to the treater design and its characteristics.

Wan Ahmad Akram Wan Yaheya of Petronas presented a study highlighting both the advantages of plate frame heat exchangers (PFHEs) and the common fouling and leakage issues they face. Short- and long-term recommendations to improve the performance and reliability of PFHEs, along with suggestions for enhancing filtration capacity to reduce fouling were provided.

SRU reliability

V. Kamesh Jayanti of Engineers India Ltd shared experiences from troubleshooting case studies carried out in various SRUs to improve SRU reliability. EIL has adopted a systematic methodology to diagnose issues and to identify the root cause of the problem. Case studies discussed in detail were: channelling of process gas in a converter, severe pressure drop in a reactor and issues during TGTU commissioning.

Ceramic ferrule and tubesheet lining problems are often the first symptom of a problem in sulphur recovery unit, but failure analysis is a very complicated, systematic process, requiring extensive knowledge and experience in order to reach the proper conclusions. Domenica Misale-Lyttle of Industrial Ceramics presented a blueprint that has proven to be a useful tool for methodical visual tubesheet protection system (ferrule lining) inspection.

Applying monitoring tools to share data near real-time between the operating company and the licensor enables a knowledge exchange between the unit engineer/operations and the technology specialists. Eric Roisin of Worley Comprimo provided an example of the main learnings and improvements with respect to energy optimisation that were achieved by Slovnaft by following this approach (see article *Sulphur* 418, p.41).

A new generation of highly active titania-based tail gas catalyst was developed by Euro Support that offers a significantly improved low temperature performance compared with the alumina-based catalysts that are available on the market. Roelof ten Hooven of Euro Support presented the benefits of using titania in Claus and tail gas analysis.

Optimising reliability at Petronas Melaka's oxygen enriched sulphur recovery unit through operation improvements was the focus of the presentation by Mohamad Azahar Ahmad of Petronas and Jan Kiebert of the SGS Sulphur Experts. Process and operational improvements, tighter operation control and better refractory repairs are some of the activities executed since 2022 which has resulted in reducing existing hotspots caused by refractory failures and in some cases eliminating hotspot occurrences.

Dehydration and cold box systems

Cold box protection is central to efficient operation of any cryogenic gas processing scheme but the compact high efficiency exchangers in the cold box section are subject to fouling form several different mechanisms. Arnab Dutta of Transcend outlined the operational challenges faced by a world-scale facility due to cold box fouling and a separated cryogenic gas processing plant caused by molecular sieve dust filter bypass. Following process contamination surveys and an inspection and review of the filtration equipment, upgrades to the filter vessels were recommended and implemented which successfully addressed the problems.

Sominidevi Veloo of Petronas demonstrated that enhancing the performance and reliability of molecular sieve dehydration units does not always require large capital investments or major equipment changes. Case studies were used to show that incremental improvements through operational excellence, robust monitoring and procedural discipline can lead to significant benefits in terms of energy efficiency, equipment longevity and overall plant reliability.

Emission management and decarbonisation

Refineries offer unique opportunities for decarbonisation efforts. Yulius Rizal of Topsoe explored opportunities to enhance overall energy efficiency, by revamping or replacing existing Claus-based SRUs with Topsoe's Wet Gas Sulphuric Acid (WSA) technology. A gradual carbon footprint reduction of 2-3% per Claus line replaced by WSA SRU offers a financially viable and strategic pathway to achieving industry decarbonisation goals.

Noradnin Hafeeza Haji Nawawi of Petronas presented an assessment of technology solutions to meet the emission limit on SOx emissions for new and existing thermal oxidisers. The evaluation was carried out based on proposals from various technology providers followed by a technology risk assessment. The study identified feasible process technologies such as a caustic scrubber, seawater flue gas desulphurisation and ammonia based desulphurisation to meet the desired emission limit at the thermal oxidiser outlet.

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A small component with a big impact

CS Combustion Solutions introduces the SR-P sulphur atomiser nozzle to the sulphuric acid process, combining the high-quality atomisation of ultrasonic systems with the affordability and simplicity of pressure atomisers.

Sulphuric acid remains one of the most important chemicals worldwide, essential for the production of fertilizers, chemicals, and numerous industrial applications. The efficiency and reliability of sulphur combustion are essential for economics and sustainability of acid production plants. Among the various components in this complex process, one element often appears deceptively small yet has a disproportionate impact on overall plant performance: the sulphur atomiser nozzle. A clean and precise atomisation of molten sulphur is crucial for complete combustion, reliable operation and the protection of refractory linings. In short, nozzle performance defines plant performance.

CS Combustion Solutions is challenging itself to continuously develop and introduce new technologies. The latest in a line of nozzles for the sulphur industry is the introduction of its **SR-P nozzle**, a breakthrough technology that combines the atomisation quality of ultrasonic systems with the cost efficiency of pressure atomisers. Designed to minimise operating and maintenance requirements while ensuring superior combustion performance, the SR-P is set to redefine sulphur burning in modern acid plants.

CS COMBUSTION SOLUTIONS

Nozzles are available in an extensive variety of materials and coatings to extend lifetime (up to 5 years).

The challenge of sulphur atomisation

Atomising molten sulphur for combustion presents multiple challenges. The droplet size must be small enough to ensure rapid conversion from sulphur to SO_2, yet large droplets often survive too long in the furnace, hitting refractory surfaces and causing hot spots or damage. An uneven spray pattern may result in localised overheating, inefficient combustion, and premature wear of expensive lining materials.

Traditional technologies have their respective strengths and weaknesses. Rotary-cup atomisers, while capable of producing fine droplets, involve rotating components in high-temperature environments, which makes them maintenance-intensive and energy-demanding. Pressure atomisers, by contrast, are simple and relatively cost-efficient, but they tend to produce coarser droplets, are prone to clogging, and require frequent replacement of nozzles and tips. Ultrasonic atomisers offer excellent spray quality, but they come at higher investment costs and can be perceived as less economical in smaller-scale or budget-sensitive operations.

Operators are therefore confronted with a trade-off: high efficiency but high cost, or cost-efficiency with compromises in spray quality.

The new solution: SR-P nozzle

The SR-P nozzle was developed to close this gap. It represents a new generation of atomisation technology, combining the high-quality atomisation of ultrasonic systems with the affordability and simplicity of pressure atomisers. This hybrid approach ensures operators no longer need to choose between efficiency and cost.

The SR-P achieves a droplet size of approximately 150 µm, which is fine enough to ensure complete sulphur combustion. This reduces the thermal stress on the furnace refractory linings and improves lifetime. The nozzle supports a broad operating range from 20% to 110% load, offering unmatched flexibility for plants that must adapt to variable production demands. Additionally, the spray pattern is adjustable, allowing operators to optimise the flame geometry for different furnace designs or process conditions.

To further enhance operational reliability, the SR-P is available in a wide range of materials, including stainless steel, high-performance alloys, ceramics, and even tantalum-coated designs for particularly aggressive operating environments. This material flexibility ensures durability and compatibility across different process conditions and plant designs.

CS COMBUSTION SOLUTIONS

The SR-P nozzle represents a new generation of atomisation technology.

Technical and economic advantages

One of the defining advantages of the SR-P nozzle is its minimal maintenance requirement. Without moving parts or highly sensitive geometries, the risk of clogging and wear is significantly reduced. Operators benefit from longer service intervals and lower spare part consumption, directly reducing operating costs.

Because of the fine and uniform atomisation, the thermal load on the refractory is minimised. Fewer hot spots mean less damage and longer service life of expensive lining materials, further reducing lifecycle costs. At the same time, the rapid sulphur-to-SO_2 conversion enabled by the SR-P allows plants to increase capacity without requiring modifications to the furnace. This is a decisive advantage for operators looking to expand production without the need for costly and time-consuming revamps.

Energy demand is also optimised. With no need for rotating motors, as in rotary-cup systems, the SR-P keeps auxiliary power consumption low, aligning with current efforts to improve energy efficiency in sulphuric acid production.

Taken together, these benefits mean that the SR-P nozzle delivers a compelling return on investment: low acquisition cost, minimal maintenance, reduced downtime, extended refractory lifetime, and increased production capacity.

Application areas

The SR-P nozzle is designed for versatility. Its primary application is in sulphuric acid production, where the reliability and efficiency of sulphur combustion directly determine plant performance. But its benefits extend to other critical areas of chemical and environmental engineering.

In spent acid applications, where the combustion of sulphur-bearing residuals presents particular challenges, the SR-P ensures stable atomisation and reliable performance under varying feed conditions. Its robust materials and clog-resistant design make it ideal for this demanding environment.

The SR-P is also suitable for wastewater treatment processes, where clean atomisation of large amounts of contaminated water is a challenge. Here, too, its ability to combine fine atomisation with low maintenance offers plant operators peace of mind and operational reliability.

What It means for operators

For operators of sulphuric acid plants and related facilities, the SR-P nozzle represents more than just an incremental improvement. It is a transformational upgrade that addresses the key concerns of modern production: reliability, cost control, flexibility, and capacity expansion.

Operators will benefit from:

- Lower operating costs thanks to reduced spare part consumption and minimal maintenance.
- Extended refractory life, reducing both planned and unplanned shutdowns.
- Higher flexibility, with a turndown range of 20–110% to match varying load requirements.
- Increased capacity without major furnace modifications, thanks to rapid sulphur-to-SO_2 conversion.
- Improved sustainability, with lower energy consumption and reduced material wear per ton of acid produced.

Ultimately, the SR-P nozzle allows operators to achieve higher productivity with lower risk and lower cost.

Outlook

The future of sulphur combustion is increasingly shaped by the twin goals of sustainability and cost optimisation. As the fertilizer, chemical, and metallurgical industries face growing pressure to reduce emissions, cut energy use, and operate more efficiently, innovative technologies like the SR-P nozzle will play a decisive role.

By combining the strengths of ultrasonic and pressure atomisation technologies, CS Combustion Solutions has created a product that delivers high atomisation quality without compromising on economy. The SR-P demonstrates that even the smallest component of a complex process can deliver the largest impact when designed with precision and innovation.

For plant operators, adopting the SR-P nozzle is more than an equipment choice – it is a strategic decision to secure long-term competitiveness, sustainability, and reliability in sulphuric acid production.

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Best practices in SRU steam and condensate handling

Miles Andrews of QMax Industries explains why effective steam and condensate management is essential to the performance, safety, and reliability of sulphur recovery units, covering how steam is generated and used across key equipment, the importance of steam quality, and the risks of condensate such as water hammer and corrosion.

Steam and condensate handling is a critical part of the sulphur recovery unit (SRU). While attention often centres on Claus reaction kinetics and catalyst performance, thermal management via steam systems ensures the entire process remains stable, efficient, and safe. Poorly managed condensate in a SRU steam system can cause corrosion, water hammer, and process disruptions. In high SO_2 and H_2S environments, poor temperature control can lead to expensive fouling and maintenance problems. This article provides a comprehensive overview of how to handle steam and condensate in SRUs, from tracing and jacketing to the critical roles played by traps and design best practices.

Steam considerations

Steam is used across an SRU for heating process gas, preventing sulphur solidification, and enabling phase change operations. From maintaining reheat temperatures between catalytic reactors to keeping run-down lines above the sulphur freezing point, steam provides the thermal energy needed to ensure stable and efficient operation.

Steam quality is critical. Dry, saturated steam delivers consistent heat, while wet steam (laden with condensate) reduces thermal efficiency and increases the risk of water hammer. This dangerous phenomenon, caused by slugs of condensate moving at high velocity, can damage piping, valves, and traps. It is mitigated through proper trap placement, sloped lines, and the use of steam separators.

Condensate also poses a corrosion risk. When left to stagnate, it can absorb CO_2 and form carbonic acid, which accelerates the degradation of carbon steel. Sloping tracer lines, adding drains, and using corrosion-resistant alloys in critical areas are key strategies to reduce this risk and maintain system integrity.

Steam traps

Steam traps are devices that remove condensate from steam systems while keeping steam in. A well-chosen and properly installed trap is essential to thermal efficiency and system longevity.

There are three main classes of steam traps:

- **Temperature actuated mechanisms:**
  - Thermostatic traps use a fluid-filled bellow or capsule that expands when steam is present and contracts in the presence of cooler condensate. These are best suited for tracing systems and startup venting.
  - Bimetallic traps use two metals with differing expansion rates to actuate the trap. They are durable and well-suited to high-pressure systems but may have slower response times.
- **Velocity/temperature actuated mechanisms:**
  - Thermodynamic traps operate using the difference in velocity and pressure between steam and condensate. When condensate enters the trap, it is discharged. When steam arrives, it creates a pressure imbalance that forces the disc down, closing the trap.
  - Disc traps, a subtype of thermodynamic traps, are rugged, compact, and ideal for outdoor or remote installations.
- **Mechanical mechanisms:**
  - Inverted bucket traps use a buoyant bucket that floats when filled with steam and sinks when filled with condensate, opening a discharge valve. These are most commonly used with steam tracing systems.
  - Float and thermostatic (F&T) traps combine a float for continuous condensate drainage and a thermostatic element for air venting. These are ideal for broad loads like heat exchangers.

Proper trap selection depends on system pressure, condensate load, reliability needs, and installation space. An incorrectly sized or misapplied trap can cause steam loss, condensate buildup, or freeze risk.

Equipment that generates steam in SRUs

The two main outputs of a Claus SRU are steam and sulphur, with the steam produced being substantially more valuable to a refinery than the sulphur recovered. Most of the steam produced is exported to other units within the refinery, and it is generated by a few key pieces of equipment within the SRU.

Waste heat boiler (WHB): Located immediately downstream of the thermal reactor, the WHB recovers intense thermal energy from the high-temperature Claus gas stream (typically over 2,000°F or 1,100°C). This energy is used to generate high-pressure steam, which can be exported or used internally. Proper operation of the WHB ensures energy efficiency and protects downstream equipment from thermal overload.

Sulphur condensers: Primary and secondary condensers condense elemental sulphur from the process gas stream. The heat removed in this process is used to generate medium- or low-pressure steam. These units are critical to maintaining the mass balance of the SRU and enabling downstream catalytic reactions.

Proper thermal integration of these steam-producing units ensures that heat energy from the exothermic Claus reactions is not wasted.

Equipment that uses steam in SRUs

Steam plays a vital role across SRU equipment, both for process heating and freeze protection.

Process gas reheaters (PGRs): Reheaters elevate the process gas temperature between catalytic converters to maintain optimal reaction conditions. This is typically done using shell-and-tube exchangers with high-pressure steam. Undershooting target temperatures reduces sulphur yield, while overshooting can damage catalysts.

Combustion air pre-heaters: Pre-heating combustion air entering the thermal reactor improves combustion efficiency and flame stability and increases the reactor's ability to destroy volatile compounds. These may use steam coils or indirect exchangers and are essential in cold climates or during startup.

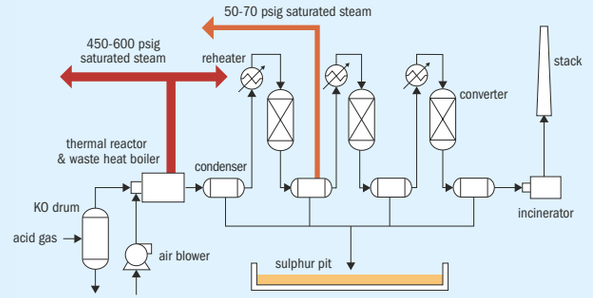
Acid gas strippers and knockout drums: These vessels must be thermally protected, especially in the liquid phase regions, to prevent freezing or hydrate formation. Steam tracing or jacketing is used around nozzles, drain lines, and liquid outlets.

Sulphur run down lines: These lines transfer molten sulphur from condensers to the sulphur pit. If the temperature drops below the freezing point of sulphur, solidification occurs, blocking the line. Tracing or jacketing is a must, with redundancy in many designs to ensure continuous operation.

Sulphur seals and collection pits: Seals prevent backflow of gases, and both the seal leg and pit require steam jacketing or tracing. In some cases, the pit includes submerged coils or external panels for heat maintenance.

Tail gas lines and analysers: Tail gas lines must remain above dew point to avoid condensation and fouling of analyser probes. Steam tracing and insulation ensure the tail gas reaches the tail gas treating unit (TGTU) and analytical instruments safely.

Fig. 1: **Steam generation in a Claus SRU**



Source: Sulphur Recovery Engineering

Thermal maintenance

Several types of thermal maintenance strategies are deployed in SRUs:

Jacketed pipe: Commonly used for high-viscosity or high-solidification-point fluids like sulphur. Jacketed pipes use a secondary pipe (the jacket) around the process pipe, with steam flowing through the annular space. It provides uniform heating with high steam condensing rates and maximum heat transfer, but it is often more expensive and complex to install.

Cross-contamination can be a common issue when unintended mixing of the process and heating medium occur. Leaks are commonly caused by manufacturing defects, corrosion, or stress from thermal expansion between the core pipe and surrounding jacket.

Steam tracing: Cost-effective and flexible products such as QMax FTS (Fluid Tracing System) and QMax CST (Carbon Steel Tracing) are often used for heating liquid sulphur and vapour lines.

QMax FTS is a type of tube tracing that involves installing tubing (usually ½-inch outside diameter), carrying steam along the process pipe with a conductive aluminium tracer. The aluminium transforms the nature of steam tracing from ineffective convective heat transfer to highly efficient conductive heat transfer. It is flexible, relatively easy to install, and delivers high performance for critical tracing applications like sulphur lines.

QMax CST is a 1-inch x 2.25-inch rectangular boiler tube that is custom-fabricated and contoured on one side to match the outside diameter of the process pipe. QMax CST is specifically designed for long-run hot oil tracing but can be used with steam in many applications as well.

For both systems, the quantity of tracers is determined by thermal calculations and the required heat duty.

Electric tracing: Used when steam is unavailable. Electric heat trace cables must be rated for hazardous areas and matched to system heat loss. Because the watt densities needed require the use of MI (mineral insulated) cable, and an entire tracing circuit is usually controlled by only one or two feedback points, electric tracing systems pose risks of both under- and over-heating in sulphur applications.

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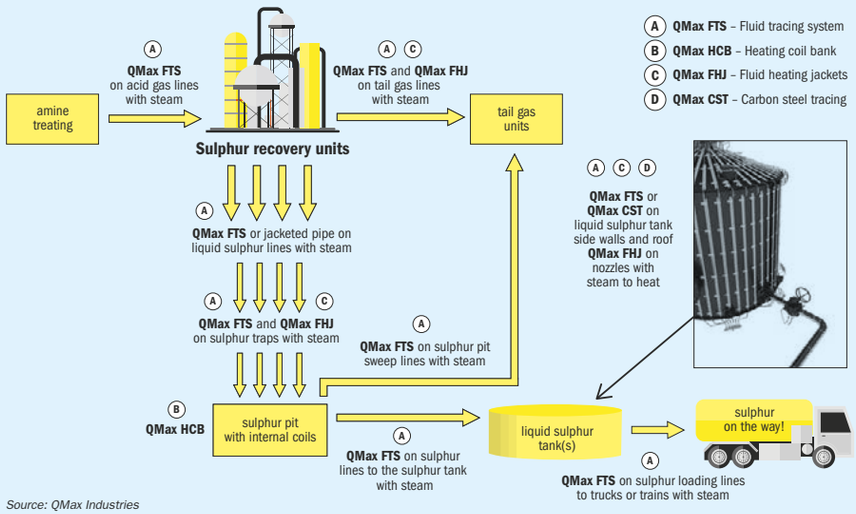
Fig. 2: **SRU heating solutions**



Source: QMax Industries

Equipment jacketing: Ensures uniform heating of valves, pumps, drums, filters, and vessels. Fluid heating jackets such as the QMax FHJ are often used in SRUs to maintain process temperature in various types of equipment. Each jacket is designed specifically for each piece of process equipment, creating a "heat shield" around the component.

Tank heating: Often heated through internal steam coils or external tracing. Design must ensure even heat distribution and avoid underheating/overheating localised zones. Careful consideration should be taken to prevent sulphur vapours from corroding tank walls.

Best practices include proper insulation selection (calcium silicate or mineral wool, for example), labelling of traced lines, and designing tracer circuits with proper lengths and elevation rises to avoid pressure drop or condensate build-up.

Installation considerations

When installing thermal systems in an SRU, precision matters:

- Steam lines should be sloped to encourage proper condensate drainage.
- Trap stations must be accessible for maintenance and testing.
- Steam tracers should allow for thermal expansion as the system heats up and expands.
- Bolt-on jacketing systems must be properly insulated to avoid heat loss.
- Bolt-on steam tracers should be tightly installed to ensure proper conduction from the tracer to the process pipe.

Poor installation leads to cold spots, corrosion under insulation, and excessive steam consumption.

Design considerations

Designing an effective tracing or jacketing system involves:

- Determining how much energy is needed to maintain minimum temperatures in worst-case ambient conditions.
- Choosing the correct steam pressure and temperature based on heat transfer needs and line length.
- Selecting proper insulation thickness and type, accounting for wind, rain, and ambient temperature variation.
- Ensuring every traced line or jacket segment has appropriate condensate removal.
- Avoiding rises in elevation and ensuring proper steam circuit lengths per the heat loss calculations.
- Avoiding trap placement in high or confined spaces without safe access.

Design should also incorporate redundancy for mission-critical systems like sulphur rundown lines and sour water drain lines. This allows for process heating to continue if a steam trap fails.

Conclusion

Efficient steam and condensate handling is essential for high-performance sulphur recovery units. From process stability and safety to energy conservation and maintenance reduction, thermal systems play a major role in the entire SRU operation. Understanding steam generation and usage, proper trap selection, installation practices, and robust design can prevent downtime, protect assets, and improve overall plant economics.

As SRUs evolve to meet stricter environmental standards and maximise sulphur recovery, so too must their thermal systems. By investing in sound design and maintenance of steam and condensate infrastructure, operators can ensure a reliable, high-performing SRU well into the future.

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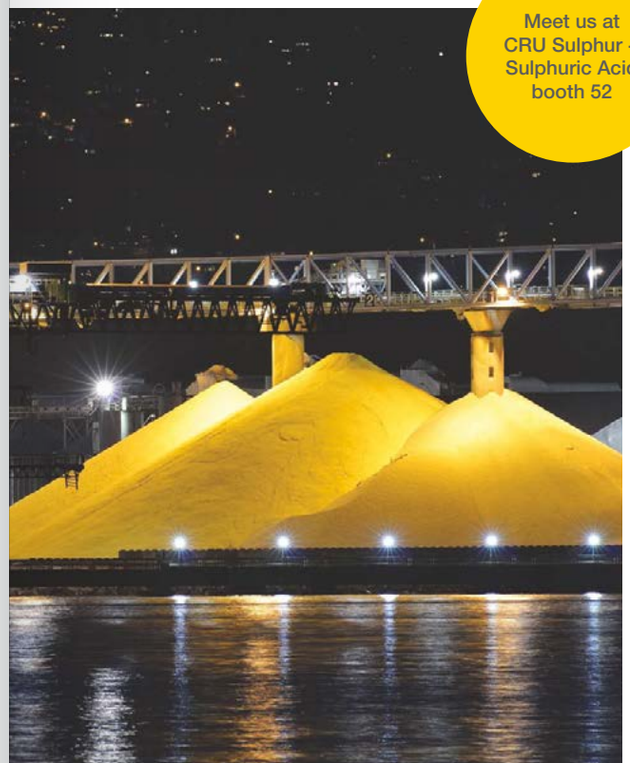

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Unlock the true potential of your SRU

Jyoti Bist, **Debopam Chaudhuri**, **Theresa Flood** and **Michiel Baerends** of Fluor explore the versatile potential of oxygen enrichment for various revamp and debottlenecking opportunities. Oxygen enrichment not only serves as an obvious choice to significantly increase the sulphur processing capability of the unit with minimum plant modifications but also expands the sulphur plants operational flexibility allowing it to process a wide gamut of feed gas cocktails having challenging feed gas compositions, as this article will show via two separate case studies.

All crude oil contains some amount of sulphur compounds. These compounds range from the simplest form, namely hydrogen sulphide found in natural gas, through simple mercaptans compounds (R-S-H), to very complex molecules. These sulphur compounds pass through to the various distillate products in various degrees of concentration. If allowed to remain in the distillates, they have adverse effects on the environment; corrosive to equipment; and deactivate high-value catalysts of downstream processes. Therefore, sulphur treatment and recovery becomes inevitable.

The sulphur compounds present in the crude get displaced from the hydrocarbon phase as H_2S and that is either captured by an amine solvent in the amine treatment units or dissolved in the process condensate. The amine circulates in the refinery in a closed circuit, capturing the H_2S from the hydrocarbon phase in various amine treaters. This "rich" amine (rich in H_2S) is then regenerated in the amine regeneration unit (ARU) to liberate the H_2S gas and regenerate lean amine (lean in H_2S) to be circulated back to the various amine treaters. Similarly, the sour water generated from the various process units in the refinery is treated in the sour water stripping unit(s) (SWSU) to liberate the H_2S and other gases. The combined stream of the H_2S rich gases from ARU and SWSU is then sent to the sulphur recovery unit (SRU). Fig. 1 demonstrates how sulphur travels through the various process units in a refinery starting from the crude oil and ending with recovered elemental sulphur.

The H_2S in the acid gas streams is converted to elemental sulphur utilising the modified Claus process. The typical feed gas streams to a sulphur recovery unit, originating from the amine regeneration and the sour water stripping units, contain varying amounts of H_2S as the sulphur source. The process involves burning the acid feed gas with a sub-stoichiometric amount of air – typically, just enough to combust approximately a third of the H_2S to SO_2. The SO_2 formed then reacts with the unconverted H_2S to produce elemental sulphur.

The main reactions involved are:

$$H_2S + {}^3/_2\, O_2 \rightarrow SO_2 + H_2O + \text{heat} \quad (1)$$

$$2H_2S + SO_2 \rightarrow 3S + 2H_2O - \text{heat} \quad (2)$$

$$3H_2S + {}^3/_2\, O_2 \rightarrow 3S + 3H_2O + \text{heat} \quad (3)$$

Reaction 1 is highly exothermic, while reaction 2 is endothermic, with a net effect of exothermicity for the net conversion described by reaction 3.

Another reaction of importance and of special interest to this discussion is the destruction of ammonia in the presence of air.

$$2NH_3 + {}^3/_2\, O_2 \rightarrow N_2 + 3H_2O \quad (4)$$

The Claus reaction furnace needs to be hot enough to ensure a near complete destruction of ammonia to nitrogen with the target typically 1,260°C (2,300°F) for a standard Claus.

Traditional sulphur plants employing the modified Claus process utilise air as the source of oxygen in the thermal reaction furnace. The major drawback of using air as the oxygen source is the large amount of nitrogen that comes along with the oxygen supply. The nitrogen from air adds to the hydraulic load of the unit, thus "eating up" capacity. The nitrogen also adds thermal inertia, lowering furnace temperatures and increasing the duties of sulphur condensers and reheaters.

Oxygen enrichment has been implemented in many sulphur plants to debottleneck the process and reclaim SRU capacity. Oxygen enrichment is the process where part or full amount of the oxygenate needed for the modified Claus reaction is replaced by pure oxygen. Conventionally, oxygen enrichment is classified as low level, mid-level, and high level; and corresponds to the amount of pure oxygen mixed into the air-oxygen mixture sent to the furnace. Low level oxygen enrichment typically limits overall oxygen concentration to 28 vol-% O_2 in the final mixture of air and oxygen, whereas high level oxygen enrichment is a concentration greater than 45 vol-% O_2. The in-between concentration is categorised as mid-level enrichment.

In this discussion, two case studies are provided to illustrate the ability of high level oxygen enrichment to provide the solution for two distinct issues that existing SRUs will likely face in the future of refining.

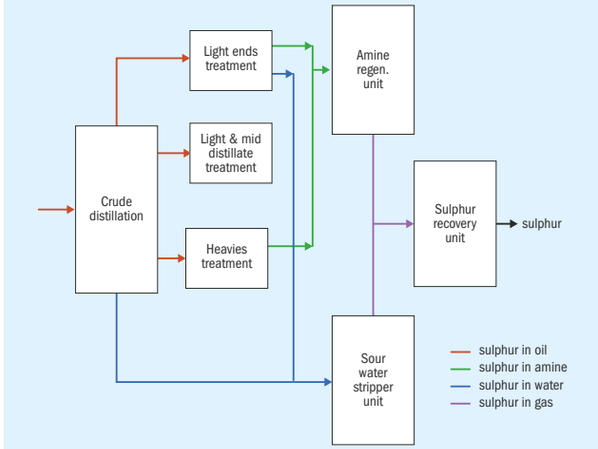
Case study 1 – capacity enhancement

The first case study involves a sulphur plant consisting of three identical trains, designed to process refinery acid gas equivalent to a total of 450 t/d (3 x 150 t/d) of sulphur production. The existing sulphur recovery unit consisted of the following systems:

- three identical Claus sulphur recovery sections including the thermal and catalytic stages;
- a dedicated sulphur pit and ejector for each of the SRU trains;
- a common tail-gas incinerator for all three trains.

The refinery needed to increase its sulphur handling capability to meet the present and future crude operating trends as well as to increase the overall flexibility of operation of the refinery. The owner proceeded to implement Fluor's COPE®II high level oxygen enrichment to increase the sulphur handling capability by 50%. Utilising COPE®II high level oxygen enrichment technology would increase the amount of acid gas equivalent each of the Claus trains can process to 225 t/d of sulphur production while maintaining the same sulphur recovery efficiency. Oxygen enrichment reduces the volumetric flow of process gas and tail gas by reducing the quantity of nitrogen that enters with the combustion air. This reduction in volumetric flow rate allows for a corresponding increase in SRU acid gas feed rate and subsequent increase in sulphur production with the same main equipment in the SRU downstream of the Claus furnace.

Fig. 1: **Simplified sulphur map of refinery**



Source: Fluor

Table 1: **Feed gas composition**

	AGRU acid gas	SWSU acid gas
Component, mol-%		
H_2S	93.5	38.0
NH_3	0.0	38.0
H_2O	4.5	22.0
Balance	2.0	0.0
Total	100.0	100.0

Source: Fluor

The typical composition of the feed gases to the Claus section for the sulphur plant is summarised in Table 1.

The feed gas composition is the same for the both the base case (air only operation) and the revamp case (oxygen enrichment) operations – the only differential between the two cases for the feed gas is quantity.

Table 2 provides a short summary of the flowrates for the various streams marked in the simplified flow diagram shown in Fig. 1 for the two operating cases as defined below:

- Base case – air only operation
- Revamp case – oxygen enrichment

As the table above clearly shows, when the unit operates with oxygen enrichment and processing 150% of the base plant capacity, the process gas flow from the first sulphur condenser is still less than the base case. Hence, there is no impact on the hydraulic load of the unit downstream of the first sulphur condenser even while it processes more acid gas.

Table 2: **Simplified material balance (flowrate in kmol/h)**

	Amine acid gas	SWS acid gas	Oxygen	Process air	Claus furnace outlet	Recycle gas	Process gas from first condenser
Stream no.	1	2	3	4	5	6	7
Base case	183	67	0	558	764	0	742
Revamp case	286	67	136	137	800	152	648

Source: Fluor

The primary drawback of implementing high level oxygen enrichment is that with so little nitrogen diluent in the furnace, the bulk gas temperature achieved via combustion exceeds the allowable limits for any available refractory. Hence special design modifications are needed to provide adequate temperature control in the furnace.

Typically, the major equipment that is replaced/new in the revamp of an existing SRU is the COPE®II ejector, COPE®II burner, amine acid gas preheater (if existing is insufficient), and first sulphur condenser. For this specific revamp, additional updates were required to the existing equipment and piping to accommodate the increased sulphur production capacity.

The specially designed COPE® burner allows for the safe and effective processing of separate feed streams: air, high purity oxygen, acid gases, startup fuel gas, and, when necessary, recycle gas.

The COPE®II ejector is a key component in the system to moderate the furnace temperature. It sends a recycle stream back to the reaction furnace so that, as more high-purity oxygen is added,

SRU REVAMPING

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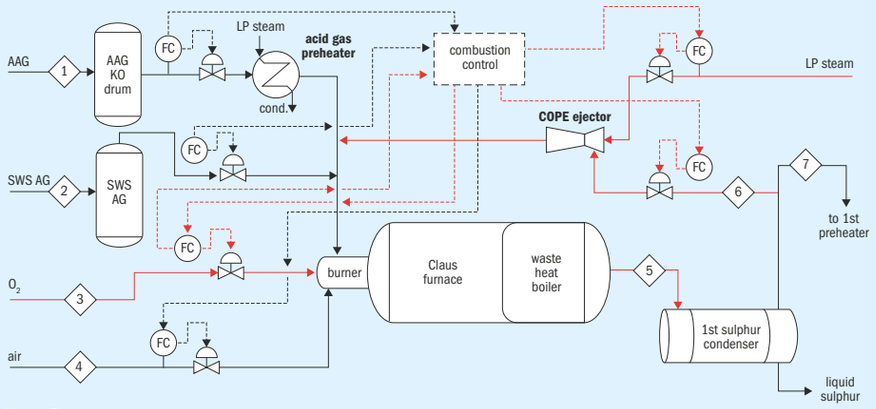
Fig. 2: **Simplified block flow diagram for Case 1**



Source: Fluor

the operating temperature does not rise above the design limit of the furnace refractory. The recycle gas is taken from the outlet of the first sulphur condenser. The flow of recycle gas is controlled to maintain the desired temperature in the reaction furnace.

The following section provides a detailed description of the process and the design modifications implemented in the existing unit. The associated design for this case study has been defined in Fig. 2. This shows the simplified sketch of the front-end section of the SRU through the first sulphur condenser. The items highlighted in red lines are the equipment or equipment sections that are part of the revamp (addition of new equipment and replacement or modification of existing equipment).

COPE®II operation

The amine acid feed gas (AAG) and sour water acid gas first passes through respective, existing knock out drums to remove entrained liquid droplets before mixing. These gases are water saturated and when mixed, create the potential for condensation and salt formation. An amine acid gas preheater is added in the design before the mixing point to preheat the AAG to achieve an outlet temperature of 180°C, using MP steam supplied from the Claus waste heat boiler, avoiding condensation in the mixed stream and preventing potential condensation of elemental sulphur when the COPE®II recycle gas mixes with the feed acid gas. After mixing, the three combined gas streams are fed to the new, high intensity COPE®II main burner.

The main burner ensures high intensity mixing, sufficiently high combustion temperature and adequate residence time. The total O_2 required for combustion is supplied by the combination of pure oxygen and air from the combustion air blower. For this design, the normal oxygen enrichment level at design sulphur capacity is about 55%.

COPE®II operation allows for higher levels of oxygen enrichment without exceeding the temperature limits of the standard refractory linings by recycling process gas from the outlet of the first sulphur condenser to the COPE® burner. The recycle gas flow rate is controlled to moderate the reaction furnace operating temperature. The expected temperature achieved in the reaction furnace is about 1,450°C during oxygen enrichment operation in this design.

The recycle gas is routed to the burner, using a new steam driven COPE® ejector. The recycle gas in COPE®II operation is relatively cool and mostly inert. The recycle gas acts as a heat sink that absorbs the required amount of the combustion heat release to maintain the reaction furnace temperature to within design limits during oxygen-enriched operations. The COPE® ejector motive steam is taken from the steam produced by the WHB downstream of the superheat coil.

The balance of the first sulphur condenser outlet gas is processed normally through the catalytic portion of the SRU train in similar fashion as in the existing SRU train. No further modification of the existing design is needed typically in the rest of the unit.

A new first sulphur condenser is required in this case to provide the necessary duty for processing 225 t/d of sulphur capacity, as well as to manage the higher flowrate of the process gas that now includes the COPE®II recycle gas.

Additionally, a few modifications in the existing waste heat boiler are needed. The expected outlet temperature during oxygen enrichment is higher than the original outlet design temperature. The proposed modification is to add a new layer of castable refractory in the waste heat boiler outlet channel, while the piping from the WHB to the first sulphur condenser is replaced with stainless steel piping.

Condensed sulphur from all sulphur condensers gravity drains through the existing sulphur seal pots and to the sulphur pit. A new pit vent ejector, which sends the vent gases from sulphur pit to the existing incinerator is needed. The new ejector will be designed for the new unit design rate of elemental sulphur and higher amounts of devolving gases.

Summary

For high levels of oxygen enrichment, the COPE®II process offers several advantages. The key features of the process include:

- proven technology with demonstrated operation of high level of oxygen enrichment;
- simple process equipment layout and straightforward process control;
- high level of reliability and flexibility.

The COPE®II process provides the benefit of on-line recycling for normal high-level oxygen-enrichment operation, but also for irregular operations such as start-ups, shutdowns, and feed disturbance rejection.

Table 3: **Feed gas composition**

	Amine acid gas	TGTU recycle	SWS acid gas	Lean acid gas
Component, mol-%				
H_2S	90.0	30.0	33.0	11.0
NH_3	0.0	0	33.0	0.0
CO_2	5.0	65.0	0.0	81.0
H_2O	4.0	5.0	33.0	2.0
Balance	1.0	0.0	1.0	6.0
Total	100.0	100	100.0	100.0
Flowrate, kmol/h				
Base (design) case	192	14	67	0
Post revamp	107	17	60	183

Source: Fluor

Case study 2 – processing lean gas

The second case study looks at a sulphur recovery unit which needed to process appreciable amounts of lean acid gas post a refinery upgrade project. The SRU is a traditional unit designed for the typical amine acid gas and the sour water stripper acid gas from upstream ARU and SWS unit. The unit has a capacity of 150 t/d of elemental sulphur production.

The refinery has multiple Claus units, each with a different capacity and design. All of the individual Claus sections were designed to operate with a common tail gas treatment unit (TGTU) with the TGTU recycle gas shared across all of the Claus plants. The feed gas streams were also shared between the multiple Claus plants. Post the refinery upgrade project, a stream of lean sour gas also will be processed in the existing sulphur block. A single Claus unit was chosen to process this additional new lean acid gas (LAG) stream. The following simplified block diagram presents the configuration of the unit whereby the new feed steam of LAG is introduced in the unit.

Like before, the items marked red are the new equipment or installations implemented as part of the revamp.

Table 3 lists the feed gas flowrates and compositions for the pre and post revamp conditions.

The base case data for 150 t/d sulphur production corresponds to conditions for which the unit had been designed for, while for the revamp case with the lean gas the sulphur load in the unit reduced to 110 t/d.

The major impact of processing lean feed gas in the existing Claus furnace is that it reduces the reaction temperature due to the presence of CO_2 in the LAG. In this case, since the amount of lean acid gas is considerable, thus leading to high amounts of CO_2 in the combined feed stream. Hence, the equilibrium Claus furnace is very low. The furnace temperature is expected to be around 1000°C when the mixture of AAG, SWS, and LAG is processed in the existing unit.

Since the amount of elemental sulphur generated in the unit stays well below the design capacity of the unit, there is no need for any modification to the sulphur handling section, and the only design modification the unit demands is in processing the lean gas.

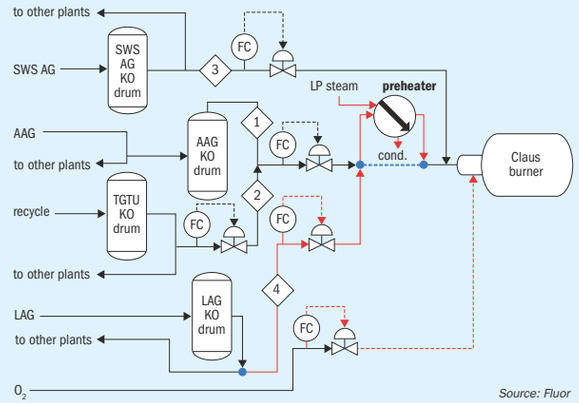
Design options

To manage the lean feed into the unit, design modifications in the sulphur unit are needed so that furnace temperature is maintained at an optimum value, above 1260°C for this operation. To increase the rection temperature, the following design options were considered.

Feed preheat

Feed preheat includes heating up the acid gas streams and/or the air stream supplied to the Claus furnace. Typically, LP steam is used as a heating medium, but under more unique cases, HP steam

Fig. 3: **Simplified block flow diagram for Case 2**



Source: Fluor

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(typically the 40 to 45 barg steam raised from the waste heat boilers in Claus and Incinerator) can also be used. The steam level used defines the extent to which the streams can be preheated – with LP steam it is limited to 120 to 130°C, while with 45 barg steam, preheating up to 230°C can be achieved.

Unfortunately, even using 45 barg steam to preheat both the acid gas and the air streams, the furnace temperature is only 1,100°C. Further preheating implementing electric heaters has not been considering for economic reasons.

Co-firing

Another method of increasing the furnace temperature is to implement co-firing of fuel gas on a continuous basis. The combustion of the hydrocarbons helps increase the furnace temperature to acceptable limits.

For this unit, to achieve a temperature of 1,260°C in the furnace, around 800 kg/h of fuel gas co-firing is required. The available fuel gas is a stream of hydrogen rich gas, having the following typical composition as shown in Table 4.

A major drawback of using co-firing on a permanent basis is that it increases the potential for coke formation and hence rapid deactivation of the downstream Claus catalysts and also increases the process gas and tail gas flowrates beyond the design capacity of the unit – the tail gas flow is more than 130% of the base case design value. Thus, implementing co-firing would require a much larger revamp than just adding the co-firing. For these reasons this option was not implemented.

Oxygen enrichment

Oxygen enrichment would allow for the ability to elevate the furnace operating temperature by way of removing diluent gases. To achieve the required furnace temperature, the optimal oxygen enrichment level was found to be 60%. To achieve the correct combustion and reaction environment with high level oxygen enrichment, a new high intensity burner would be needed.

The option of oxygen enrichment became the chosen option for the client. The client also elected to replace the reaction furnace. The replacement of the furnace was not a mandatory change, but was included as part of the project only because the existing furnace is old and prone to a number of age-related issues.

The acid gas preheater using LP steam is also included in the design because the LAG is colder than ambient temperature, and preheating the stream has a positive impact in optimising oxygen usage.

Table 5 summarises the operating conditions for the unit, post revamp.

Since, the refinery has oxygen available in situ, not depending on outside suppliers or new installations for the post revamp high level oxygen enrichment operations made this the most viable option.

A major advantage of the revamp to process the LAG using high level oxygen enrichment is the fact that even when the feed gas flow of the unit increased due to the increased flow of the LAG, usage of high level oxygen enrichment reduces the overall flow of process gas and tail gas in the unit. The unit remained hydraulically capable of processing the feed gas mixture with no major modifications beyond the Claus furnace, the tail gas flow for the revamp operation is actually less than 70% of the base case. Thus, all equipment downstream the Claus furnace continued to operate at less than design capacity.

The revamp also meant that the unit remained capable of handling the original feed gas composition if needed along with any variation from mixing the rich amine acid gas and the lean acid gas streams. The oxygen enrichment level can be easily fine-tuned based on the expected feed gas compositions, thus allowing this unit to process a wide range of feed gas compositions.

Table 4: **Feed gas composition**

Component	Amount in mol-%
Hydrogen	56
Nitrogen	10
Methane	22
CO_2	5
Ethane	5
Propane	2

Source: Fluor

Table 5: **Unit operating conditions**

Parameter	Value
Amine acid gas, kmol/h	107
SWS gas, kmol/h	60
Lean acid gas, kmol/h	183
TGTU recycle, kmol/h	17
Oxygen, kmol/h	60
Furnace temperature c	>1260
Tail gas flow, % of design	<70
Sulphur production, % of design	<75

Source: Fluor

Summary

Implementing the high-level oxygen enrichment in this project allowed the unit to operate with the revised feed gas composition. Implementing high level oxygen enrichment had the following advantages:

- Minimum revamp needed – existing equipment (burner and furnace) replaced in situ, new exchanger added in available space, no new plot area required.
- Operational flexibility – unit able to operate over a wide range of feed gas compositions by managing the level of oxygen enrichment.
- No impact to the unit beyond the existing Claus furnace – operating sulphur handling capacity post revamp well below design values.

Conclusions

In conclusion, sulphur recovery units across the globe may need to upgrade to meet new demands for the future. The most common requirement is to process higher sulphur loads as refineries across the globe are processing crudes with higher sulphur content and are also implementing residue conversion projects. Other adaptations are frequently required for processing more challenging feed 'cocktails' which may be encountered as there may be the requirement to process lean acid gas streams. Oxygen enrichment proves to be a very successful engine to manage multiple requirements in SRUs, both for capacity enhancements as well as to deal with very changing acid gas streams as the case study data proves. These revamp options provide more efficient and economically viable options instead of adding new plants to cater to the new needs.

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Sulphur management and recovery technologies for LNG production

Advanced SRUs and decarbonisation technologies position LNG for net-zero goals by 2050. **Mahin Rameshni** and **Stephen Santo** of RATE USA review sulphur management strategies for LNG, from ppm-level H_2S scavenging and non-conventional liquid redox to Claus SRUs, and introduces RATE's patented technologies to achieve >99.9% recovery, operational stability, and decarbonisation alignment amid regulatory and market challenges.

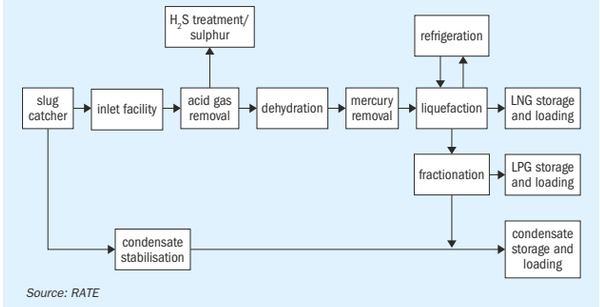
Over two centuries, energy sources have shifted from carbon-intensive wood (~1.25 carbon-to-hydrogen ratio) to natural gas (~0.65). Liquefied natural gas (LNG) involves cooling natural gas to -162°C for easier storage and transportation.

LNG facilitates energy transport from remote areas to consumption centres, increasing global access. However, LNG production requires managing contaminants like H_2S for efficiency and compliance.

Traditionally there have been four basic options considered to utilise offshore and remote gas production and transport it to markets or to another location for further processing or utilisation:

- Gas gathering and transmission to shore, in a gaseous phase, by pipeline;
- Volume reduction through either liquefaction or compression (LNG, CNG) followed by marine vessel Transportation; these types of LNG plants are referred to as 'Base Load';
- Conversion to other products, by changing the "methane" molecule (methanol, synthetic crude), followed by marine vessel transportation to markets;
- Conversion to other energy form such as electric power and transmission by a subsea cable to shore.

Fig. 1: **LNG block flow diagram**



Source: RATE

LNG application and production

LNG is a compact energy carrier that can be transported globally in fleets of dedicated ships. By lowering the temperature of natural gas to sufficiently low temperatures the gas condenses to liquid phase. At atmospheric pressure LNG is formed at -162°C – the boiling point of methane. This liquefaction process increases the energy density (in terms of volume) by a factor of 600 and allows it to be cost effectively transported to market.

An important aspect of LNG production is the effect of the natural gas pressure on the efficiency of the LNG process. As the operating pressure increases equipment costs also increase, however, the refrigerant power required to condense the natural gas will decrease. The optimum is usually found between 40 and 60 barg, depending on liquefaction cycle and arrival pressure of the gas.

An LNG plant typically contains a number of discrete unit operations. These include:

- acid gas removal;
- dehydration;
- mercury removal;
- fractionation;
- liquefaction;
- storage (LNG, LPG, condensate and refrigerant);
- loading.

These units are shown schematically in the LNG block flow diagram in Fig. 1.

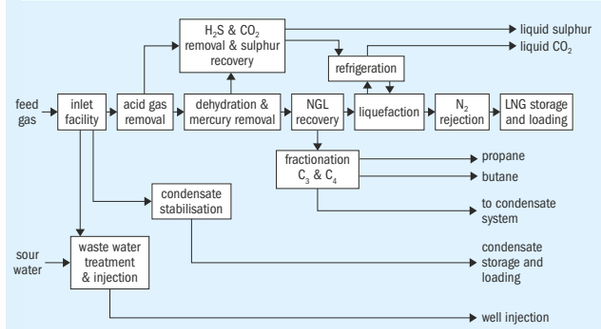
The acid gas removal required depends on H_2S and CO_2 contents of the natural gas and complete technology evaluations are required.

The block diagram in Fig. 2 represents an LNG application with higher H_2S content. However, even though the H_2S content is higher, it is still considered a lean H_2S gas, and acid gas enrichment may be required.

The acid gas removal block is shown in detail in Fig. 2. The schemes used for each unit are listed below:

- Acid gas removal solvent: aMDEA;
- Molecular sieve for dehydration and mercaptan removal;
- Carbon beds for mercury removal;
- Selexol is used as the regeneration unit or polishing unit to treat the fuel gas used in the molecular sieve to absorb the sulphur compounds and heavy hydrocarbons;
- Selexol specification: less than 10 ppmv of H_2S and less than 50 ppm of sulphur compounds;
- Sulphur recovery includes:
  - Acid gas enrichment unit with common regeneration system with the tail gas unit
  - Solvent was selected to meet the tail gas absorber requirement of less than 10 ppmv of H_2S
  - Rich acid gas to conventional Claus unit, and Ti catalyst used in the first catalyst bed
  - Conventional tail gas unit with low temperature hydrogenation catalyst and RATE patented technology hydrolysis reactor after the hydrogenation reactor
  - RATE sulphur degassing with option of inside or outside pit
  - Incineration is a forced draft incinerator with heat recovery system
- RATE CO_2 liquefaction technology.

Fig. 2: **Acid gas removal block flow diagram**



Source: RATE

Carbon dioxide: CO_2 is very common, its concentration and its evolution with time should be well known as a basis for the sizing the acid gas removal unit. It has to be remembered that CO_2 will freeze at the temperature of the cryogenic exchanger and rapidly plug it. It is a similar operational problem as for heavy hydrocarbons as CO_2 is soluble, to some extent, in the LNG. Hence by significantly reducing LNG production, the exchanger can after some hours be cleared of the frozen CO_2. This incident does not need a complete warm-up of the exchanger but should be avoided by proper design.

Mercaptans: The problem with mercaptans (RSH) is similar to that of H_2S but more difficult to solve. The mercaptan specification in LNG is expressed as "total sulphur" content (including H_2S, COS) and is generally around 30 mg of "total sulphur" per Nm^3 of re-gassed LNG. Knowledge of the RSH content in the feed gas allows the design of the mercaptan removal unit(s). The handling of the mercaptans is different according to the chemical nature of the mercaptans. Therefore, a detailed breakdown of the mercaptans by components has to be looked for and not only a total amount.

Aromatics: Aromatics are absorbed in large quantities by active carbon which is the basic constituent of some mercury removal catalysts. Hence if aromatics quantities are too high they saturate the mercury removal catalyst which will then require replacement.

Water: Water can create hydrates in the incoming pipeline and lead to plugging problems. Hence the water dew point of the incoming gas should be known or specified for new installations. Moreover, as most of the acid gas removal units operate with an aqueous solvent (DEA, DGA, K_2CO_3...), the gas downstream of the unit is water saturated. The train inlet water content is important to know to estimate the process water consumption to saturate the gas and consequently its impact on the desalination plants to produce this process water. Contrary to CO_2 or heavy hydrocarbons, frozen water or hydrates have a higher volume in the solid state and therefore trend to damage the main heat exchanger passes by expansion.

Sulphur recovery technologies for H_2S in LNG applications

When hydrogen sulphide (H_2S) is removed from LNG feed gas in sufficient volumes, typically from feeds with higher H_2S concentrations or large gas flow rates, the extracted acid gas can be processed in a sulphur recovery unit (SRU) to convert H_2S into elemental sulphur. This not only mitigates environmental emissions but also produces a valuable byproduct for sale in markets like fertilizers and chemicals. Sulphur recovery efficiencies are often required to exceed 99.9% to comply with stringent regulations on SO_2 emissions.

In liquefied natural gas (LNG) production, feed gas often contains lean hydrogen sulphide (H_2S) concentrations, typically below 10 ppmv, particularly when sourced from pipeline-quality gas. LNG specifications require H_2S to be reduced to less than 4 ppmv to prevent corrosion, toxicity, and freezing during liquefaction. For low H_2S concentrations, conventional large-scale amine units can be inefficient due to low partial pressures, increasing capital and operational costs. However,

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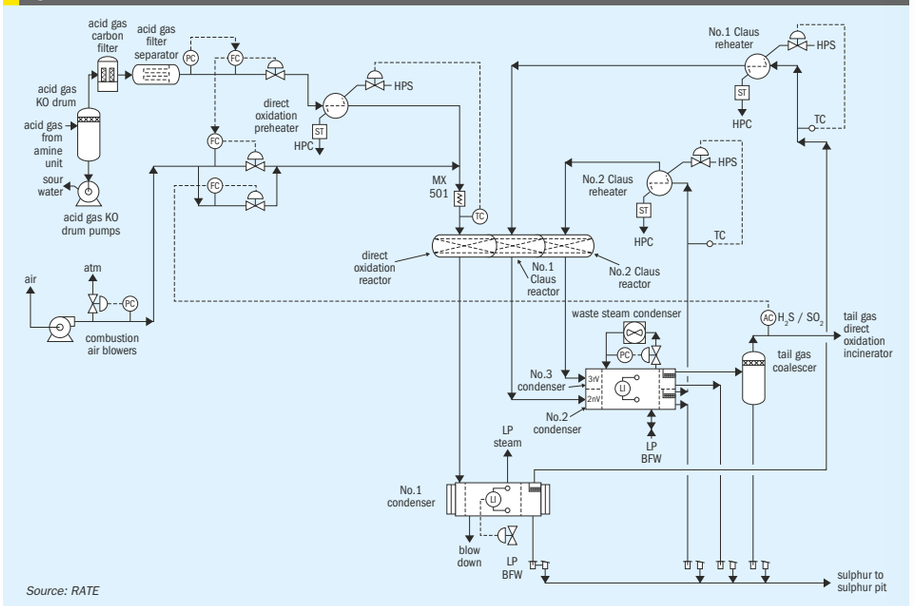
Fig. 3: **RATE direct oxidation scheme with Claus**



Source: RATE

when H_2S volumes are significant due to higher concentrations or large gas flow rates, removal followed by processing in a sulphur recovery unit (SRU) becomes viable.

The choice of H_2S removal method depends on inlet concentration, gas flow rate, co-contaminants, and economic factors. For lean H_2S (<10 ppm) with low to moderate gas volumes, scavengers or adsorption beds are cost-effective, avoiding the need for SRUs. When H_2S concentrations or gas volumes are higher (e.g., large-scale LNG plants processing), amine absorption coupled with an SRU becomes viable, leveraging sulphur recovery to offset costs. A hybrid approach, using scavengers or sieves for polishing and amines for bulk removal with SRU integration, may optimise performance in facilities with variable feed compositions. Future trends may favour compact SRU designs or bio-based methods to enhance sustainability for lean H_2S management.

Technology selection depends on acid gas composition, sulphur production rate and regulatory requirements. For LNG, integration with upstream amine or membrane units ensures efficient H_2S routing to the SRU, with tail gas recycling enhancing overall performance.

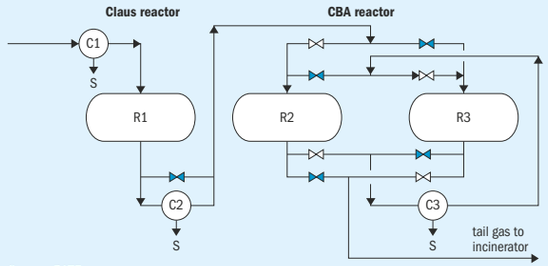
The non-conventional technologies such as liquid redox processes, LO-CAT, Sulferox and Thiopaq, result in the formation of a sulphur cake that has to be disposed.

Lean acid gas in a Claus SRU can result in an unstable flame temperature, an insufficient temperature in the thermal reactor for HC destruction, which can cause plugging, lower sulphur recovery, carbon laydown on the catalyst leading to a shorter catalyst life and finally unscheduled plant shutdowns.

In order to overcome these issues, the conventional Claus-type process can be applied but may require additional features to establish a stable operation.

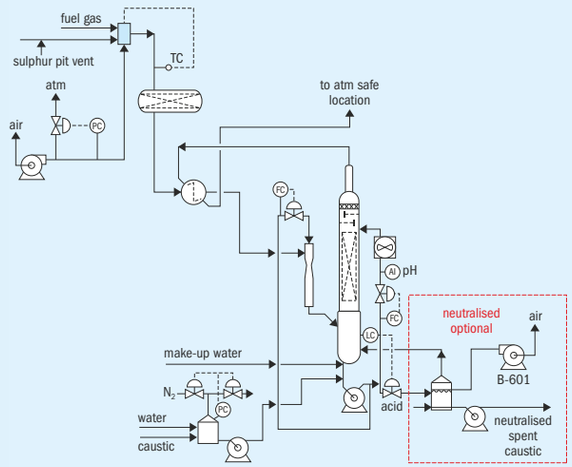
- Direct catalytic stages without thermal section (patented by RATE, Fig. 3) – eliminates the reaction furnace and the burner, with Claus or sub dew point stages up to 30% H_2S concentration.
- Provide acid gas enrichment before the Claus unit – full acid gas enrichment or common regeneration with the tail gas unit;
- Acid gas feed preheat and combustion air preheat – to increase the flame temperature of the Claus reaction furnace;
- Supplemental fuel gas burning – a technique often employed to raise the flame temperature while processing acid gas feed of low H_2S concentrations in a sulphur plant;
- Staged oxygen enrichment technology – oxygen enrichment technology is ideal for raising the flame temperature of the Claus reaction furnace especially for acid gas of low H_2S concentration, if oxygen is available;
- RICH MAX partial acid gas enrichment in the TGU (patented by RATE, Fig. 4) – partial acid gas is sent to TGU absorber;
- Acid gas bypass;
- Hydrolysis reactor after the hydrogenation reactor in the TGU (patented by RATE, Fig. 5).

Fig. 4: **RATE direct oxidation scheme with sub dew point**



Source: RATE

Fig. 5: **Catalytic incineration and caustic scrubbing system**



Source: RATE

Fig. 3 represents the scheme for lean acid gas. The direct oxidation unit becomes the primary sulphur recovery unit. The direct oxidation process efficiently recovers sulphur from gas streams containing from as little as 2% H_2S to over 30% H_2S, whereas Claus plants work best when their feeds contain at least 30% H_2S. The installation of a direct oxidation unit instead of a Claus unit eliminates the need for an upstream acid gas enrichment unit to further increase the H_2S concentration.

The first major breakthrough in direct conversion of H_2S feed streams came with the introduction of a newly developed catalyst. The new direct oxidation catalyst selectively oxidises H_2S to sulphur with air at low temperature without forming SO_3 or oxidising light saturated hydrocarbons.

It is theorised that the direct oxidation reaction, is fast and occurs in the upper few inches of the bed and that the Claus reaction, occurs in the remainder of the bed. Heat released by the reactions raises the temperature in the direct oxidation reactor and sets a limit on the conversion to sulphur, because high temperature is less favourable to complete conversion. The temperature rise, and reduction in equilibrium conversion, is the reason for limiting the feed H_2S concentration.

With 5% H_2S in the feed the outlet temperature is near 700ºF/370°C, which is a reasonable compromise between carbon steel corrosion and reduction in Claus equilibrium. Above 5% H_2S in the feed, the "recycle" mode, is used. The difference in the two flow schemes is the addition of a recycle blower to recycle some of the cool vapour from the direct oxidation reactor condenser to control the temperature rise in the direct oxidation reactor. Note that all combustion air is introduced ahead of the first (direct oxidation) reactor and none is injected ahead of the other (Claus) reactors. This configuration requires the H_2S/SO_2 "tail gas ratio" to be controlled close to 2.0, as in standard Claus units.

The direct oxidation processes are based upon direct oxidation catalysts. These materials catalyse the oxidation of hydrogen sulphide and sulphur vapour to sulphur dioxide. They also catalyse the Claus reaction, the production of elemental sulphur from hydrogen sulphide and sulphur dioxide by the following reactions:

$$H_2S + 3/2O_2 \rightarrow SO_2 + H_2O \quad (1)$$

$$2H_2S + SO_2 \rightarrow 3/xS_x + 2H_2O \quad (2)$$

Overall: $3H_2S + 3/2O_2 \rightarrow 3/x\,S_x + 3H_2O$ (3)

These catalysts do not catalyse the formation of SO_3 and consequently, they do not sulphate during operation, nor do they catalyze the oxidation of hydrogen, ammonia, or light hydrocarbons. Furthermore, because they operate at much lower temperatures than a reaction furnace, they do not produce carbonyl sulphide or carbon disulphide.

In order to achieve higher recovery, the Claus section can be designed with sub dew point reactors as shown in Fig. 4.

The tail gas from the tail gas unit along with the pit vent from the sulphur pit is sent to the catalytic incinerator. The residual H_2S and other sulphur compounds in this gas stream are oxidised to convert all the sulphur compounds to SO_2. The incinerator is a forced draft incinerator, and heat can be recovered.

The incineration section consists of a fired heater, air blower direct oxidation reactor followed by the caustic scrubber.

The effluent gas from the direct oxidation reactor is scrubbed in a venturi scrubber by intimate contact with a 10 wt-% caustic solution. During the liquid vapour contact a portion of the SO_2 is removed from the vapour and the gas is cooled.

The liquid-vapour mixture then flows to the caustic scrubber. The vapour flows up through the packed bed of the caustic scrubber against a counter-current stream of 10 wt-% caustic solution to scrub the remaining SO_2 from the tail gas. The treated gas leaving the caustic scrubber will contain low ppm levels of SO_2.

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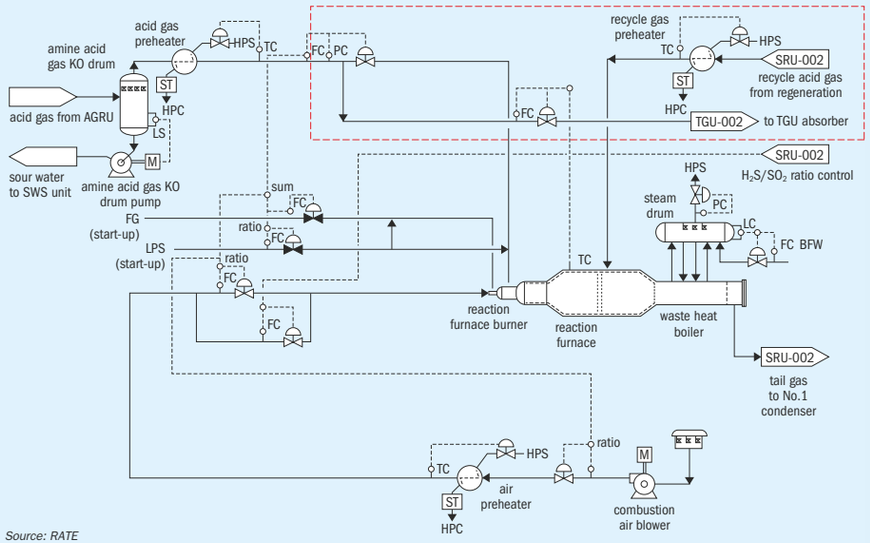
Fig. 6: **RATE partial acid gas enrichment RICH-MAX technology**



Source: RATE

Due to the temperature of the gas leaving the reactor there is a constant vaporisation of water in the caustic scrubber which needs to be made up. This make-up water is added to the column at the upper bubble trays to knock any remaining entrained caustic out of the vapour to minimise caustic loss. The caustic system uses a non-regenerable caustic (NaOH in water) to remove the SO_2 from the tail gas. The SO_2 that is removed slowly decreases the caustic strength of the solution so fresh caustic is added to replace the spent caustic.

Fig. 5 represents catalytic incineration with the caustic scrubber system.

As described above, the direct oxidation scheme can replace the non-conventional scheme by producing high quality sulphur instead of sulphur-cake and without generating another waste stream.

As shown in Fig. 6, RATE's partial enrichment scheme RICH-MAX is a patented process where the H_2S concentration is marginal. It would be too expensive to have independent acid gas enrichment upstream of the Claus unit, but by partially enriching the H_2S, using the TGU absorber, an adequate combustion temperature in the reaction furnace can be achieved. In this scheme a portion of the SRU feed is sent to the TGU absorber to enrich the H_2S and the recycle is reheated and sent to the second zone of the reaction furnace.

As shown in Fig. 7, the lean H_2S gases in the sulphur recovery unit produce COS and CS_2 as unwanted by-products in the thermal section of the Claus unit. Even though, in the first catalytic reactor titanium catalyst is used to hydrolyse COS and CS_2 they are not fully hydrolysed and would have an impact on the overall SRU/TGU recovery. According to operating data and the performance test 50-100 ppm of COS and CS_2 are in the gas leaving the hydrogenation reactor in the tail gas. RATE's hydrolysis reactor technology after the hydrogenation reactor will hydrolyse the remaining COS and CS_2 and the incineration stack would meet the World Bank SO_2 emission of 150 mg/Nm³.

CO_2 liquefaction reinjection

CO_2 recovery reduces greenhouse gas emissions in LNG sulphur plants [Global CCS Institute, 2024].

RATE's CO_2 liquefaction technology manage emissions. CO_2, which risks freezing in cryogenic exchangers, is compressed and liquefied for reinjection

RATE's CO_2 liquefaction technology compresses and liquefies CO_2 from SRU amine units for reinjection, enhancing sustainability.

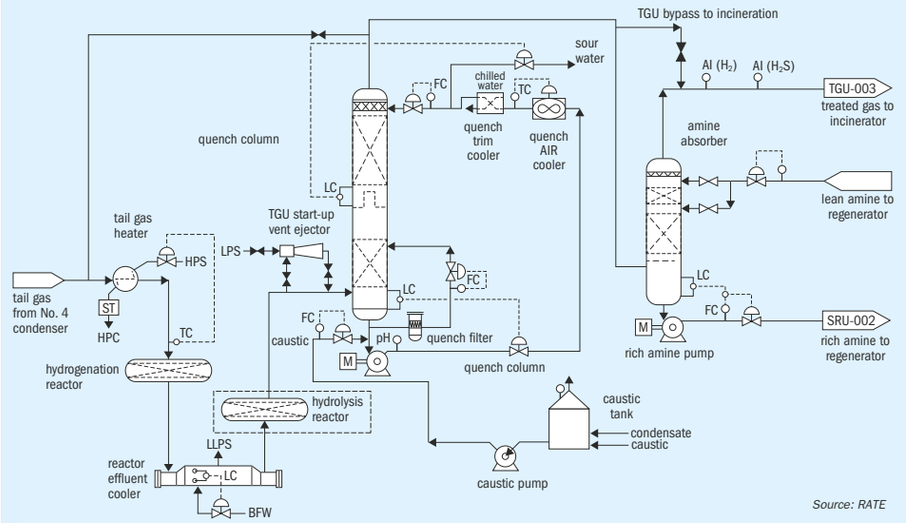
Challenges facing LNG projects

LNG has become a vital component of the global energy landscape, serving as a cleaner alternative to coal and oil while supporting energy security in a transitioning world. LNG projects involve the extraction, liquefaction, transportation, and regasification of natural gas, enabling its trade across continents. Despite its growing importance, LNG projects face significant challenges that impact their development, profitability, and sustainability.

Regulatory and legal challenges

One of the primary obstacles for LNG projects is navigating complex and evolving regulatory frameworks, which create uncertainty for developers and buyers, stalling final investment decisions. These challenges highlight the tension between economic development and regulatory compliance, particularly in regions with stringent environmental standards.

Fig. 7: **RATE TGU with hydrolysis reactor**



Source: RATE

Economic and market uncertainties

LNG projects require substantial capital investments, often costing tens of billions of dollars, and rely on predictable profitability over long timelines. However, fluctuating market conditions pose significant risks. A potential global oversupply of LNG, projected to reach 63 million tons by 2030, could depress prices and reduce profitability. Rising construction costs, driven by tariffs on materials like cryogenic steel and labour shortages, further complicate project economics. For instance, the Golden Pass project in Texas faced delays after a contractor bankruptcy led to cost overruns, pushing its start date to late 2025. Moreover, price sensitivity in key markets like Asia, where demand is strong but buyers are quick to shift to cheaper alternatives like coal, adds uncertainty to long-term demand forecasts. These economic challenges require developers to balance high upfront costs with volatile market dynamics.

Environmental and social concerns

As a fossil fuel, LNG faces scrutiny for its environmental impact, despite emitting less carbon dioxide than coal. Environmental groups and local communities often oppose projects, citing harm to ecosystems and public health.

Additionally, the industry is under pressure to reduce greenhouse gas emissions, particularly methane, which can leak during production and transportation. While technologies like carbon capture and storage (CCS) offer potential solutions, their adoption increases costs and complexity. Balancing energy demands with environmental and social responsibilities remains a critical challenge for LNG developers.

Geopolitical and supply chain risks

Geopolitical tensions and supply chain disruptions add further complexity to LNG projects. Global supply chains for LNG infrastructure are vulnerable to disruptions.

Geopolitical risks, can disrupt supply and increase costs and competition from other LNG exporters, where shorter shipping routes give competitors an edge, make it difficult for developers to secure long-term contracts and maintain a competitive position in the global market.

Conclusion

LNG remains a cornerstone of global energy security, bridging the gap between remote gas resources and consumption centres.

Effective management of lean H_2S through tailored removal and sulphur recovery technologies is critical to meeting stringent LNG specifications (<4 ppmv H_2S) and environmental regulations (>99.9% sulphur recovery). However, LNG projects face multifaceted hurdles, including regulatory complexities, market volatility, and geopolitical risks.

By leveraging advancements in modular liquefaction, digital twins, and low-emission SRUs, the industry can enhance resilience and align with net-zero goals by 2050. ■

References

1. Rameshni M.: "CO_2 recovery options in sulphur plants", Sulphur 404 (Jan-Feb 2023).
2. Rameshni M.: "Sulphur plant revamps to meet future challenges", Sulphur 409 (Nov-Dec 2023).
3. Rameshni M.: "The importance of cryogenic distillation technologies", Sulphur 415 (Nov-Dec 2024)
4. International Energy Agency, World Energy Outlook 2024.
5. Shell, LNG Outlook 2025 (for supply-demand projections).
6. IPCC. Climate Change 2014: Synthesis Report. Geneva: IPCC (2014).
7. Global CCS Institute. Global Status of CCS. Canberra: GCCSI (2024).

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