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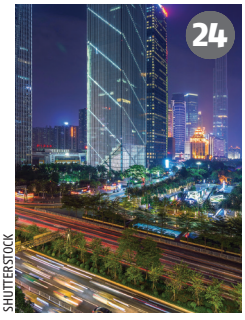

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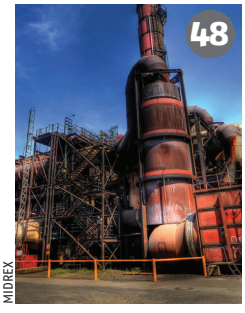

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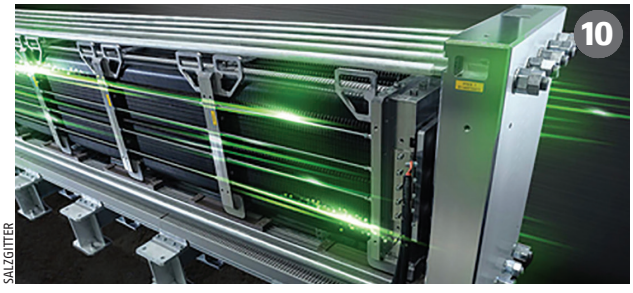

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Comment

A new decade commences

As the year turns from 2019 to 2020, this issue of *Metal Market Magazine* is in forward-looking mode.

Our exclusive cover profile interview with Severstal CEO Alexander Shevelev provides a fascinating account of his rise from work on the mill floor to the top of a large steel and mining business, as well as the transformational strategy that the Russian company is implementing.

A wide range of metals and mining outlook features ponder global prospects for non-ferrous metals as well as international steel and scrap markets. Our usual wide selection of ferrous and non-ferrous features cover topics running from mining, smelting and refining, through casting, rolling, extruding and forging to multiple end-use markets, as well as recycling.

As a new decade begins, we welcome a new set of Industrial Minerals readers, who join our existing international Metal Market subscribers across the global supply chains for steel and metals. In addition to the multiple end-use markets in steelmaking and foundries that industrial minerals serve, each issue of *Metal Market Magazine* will now include a feature section covering a specific core industrial mineral sector.

"As a new decade begins, we welcome a new set of Industrial Minerals readers"

For this first issue of the year, that topic is refractories. That section includes an in-depth feature on the refractories industry as a whole, and the challenges it is facing now during a bearish start to 2020. It also looks at the outlook for magnesia from China, including how new capacity is affecting prices. Prospects for the calcined alumina market and its closer connection with met grade alumina are also considered.

Our market spotlights include articles about developments in India's iron ore and scrap sectors. The development of Midrex's DRI processes for hydrogen-based steelmaking and a profile of a large hot-dip galvanizing plant in the UK contribute to our ferrous coverage, as does an in-depth look at the advantages of duplex stainless steels.

Multiple examples of the latest technology developments – and a look at the aerospace industry as a metal consumer – are complemented by our regular innovations and end-user pages.

And Fastmarkets expert analysts give their views on drivers and prospects for steel, steelmaking raw materials and base metals markets.

Find us online at www.metalbulletin.com and www.amm.com

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Fastmarkets

News review: non-ferrous

Glencore revises cobalt output guidance for 2020

Glencore has cut its production guidance for cobalt in 2020 to 25,000-33,000 tonnes, down by about a third from 2019's 41,000-45,000 tonnes, the Swiss miner-trader said.

In an investor presentation on December 3, the company said that for 2021 and 2022 it expects to produce 28,000-36,000 tonnes of cobalt.

It said the decline in production was mainly as a result of losing 25,000 tonnes per year in cobalt output due to the earlier-than-expected closure of its Mutanda copper-cobalt mine in the Democratic Republic of the Congo (DRC) in late November.

News of the shutdown came after cobalt prices hit a 34-month low after falling for 13 consecutive weeks.

US injured by Chinese Al wire and cable imports

Imports of Chinese aluminium wire and cable have "materially injured" the United States' industry, the US International Trade Commission (USITC) said in a final affirmative vote on November 20.

The ITC ruling follows an earlier determination by the US Commerce Department that imports of Chinese aluminium wire and cable are "subsidized and sold in the United States at less than fair value."

Commerce will now issue anti-dumping and countervailing duty orders on imports of the products from China, the ITC said.

Umicore completes purchase of Kokkola from Freeport Cobalt

Belgian battery-materials manufacturer Umicore has completed its purchase of cobalt refining and cathode precursor activities in Kokkola, Finland, from Freeport Cobalt for $203 million.

SHUTTERSTOCK

The discharge of ferrous scrap imports in Indonesia is now restricted to a limited number of ports

The purchase is on a debt and cash-free basis and includes about $50 million of net working capital. It is anticipated that the acquisition will be earnings accretive from 2020 and value accretive from 2021, Umicore said on December 2.

The purchase was announced in May this year.

TCI grows US Midwest warehouse space

Ta Chen International (TCI) at the start of 2020 will begin using a newly constructed warehouse in the midwestern United States to store aluminium coils and carbon fittings, company president Johnny Hsieh told Fastmarkets on November 26.

Some of the floor space will be used to store aluminium coils produced at TCI's Texarkana aluminium plant, which was acquired from Arconic Inc in October 2018, Hsieh said. The space will also be used to store carbon fittings produced elsewhere by TCI.

The 204,797-square-foot building in Pleasant Prairie, Wisconsin, anticipates two to 10 truck trips per day, the town's planning commission said in a report dated November 25, noting that Ta Chen is expected to begin utilizing the space on January 1, 2020.

Secondary copper smelter being developed in US state of Ohio

A new secondary copper smelter that will produce copper cathode and other elements from scrap raw material is in the works in the US state of Ohio.

Middletown, Ohio-based Cohen Recycling will be the main supplier of this "metal recovery facility," a source close to the project confirmed to Fastmarkets on November 22.

Scrap traders juggle Indonesia transship ban

Traders are scrambling to divert their transshipped containerized cargoes of ferrous scrap bound for Indonesia to other destinations and find new supply sources in response to new import restrictions issued by the country's trade ministry.

Regulation 84/2019 as seen by Fastmarkets stipulates that ferrous scrap imports must be shipped directly from the exporting country, and cargoes are not allowed to be transhipped through other countries. The registered seller also must be in the same country where the ferrous scrap is exported from. Any shipment landed by way of transshipment has to be re-exported.

The discharge of scrap imports is now restricted to just the ports of Tanjung Priok in Jakarta, Tanjung Emas in Semarang, Tanjung Perak in Surabaya, Soekarno Hatta in Makassar, Belawan in Medan, Batu Ampar in Batam, Teluk Lamong in Surabaya and Merak in Cilegon.

Copper scrap eligible for import into China could be renamed – CMRA

Over 90% of copper scrap products currently allowed into China could be eligible

for renaming as recyclable copper raw materials next year, a senior representative of China Nonferrous Metals Industry Association's (CMRA) recycling metal branch told delegates at Asia Copper Week in Shanghai.

Wang Ji-Wei, Secretary General of CMRA, said he is optimistic that the vast majority of current copper scrap imports could be identified as merchandise rather than scrap when the renaming policy, under which the term "scrap" for certain copper scrap products would be officially renamed as "recyclable copper raw materials", takes effect.

Since the beginning of this year, China has totally banned the import of category 7 scrap, which requires dismantling and is being blamed for land pollution.

Currently, only category 6 copper scrap and brass scrap are being allowed into the country, including No 2 birch and cliff scrap with over 90% of copper content. There has also been a quota system in place since second half of the year to restrict inflows of high purity scrap.

SPMP produces first commercial grade antimony in Oman

Strategic & Precious Metals Processing's (SPMP) antimony and gold processing facility in Sohar, Oman, has produced its first commercial grade 99.65% antimony metal and has met keen interest from potential buyers looking to diversify their supply sources, parent company Tri-Star Resources said on November 19.

The producer is now focused on achieving full-scale commercial production and is targeting a production capacity of 20,000 tonnes per year of antimony metal and antimony trioxide when fully ramped up.

More Cu mines needed to meet demand: Anglo

Assuming stable growth in copper demand, the world is lacking investment in new mine projects amid expansion in smelting capacity, with a large gap seen in the mined copper balance over the next decade, according to Anglo American's base metals chief.

While copper consumption is expected to grow by an annual rate of around 2-3%, there will be demand for 7 million tonnes of refined copper emerging by 2030, Ruben Fernandes said at Fastmarkets' Asia Copper Conference in Shanghai on November 20. The conference is part of Asia Copper Week (ACW), which ran from November 19-22.

To meet soaring demand for refined copper and a rising appetite for copper smelting raw materials, the world will have to build more copper mines, Fernandes said.

SDI La Farga to expand Indiana plant

SDI La Farga is investing $16 million to expand its facility in New Haven, Indiana, adding a second furnace that will increase its finished copper products output by 250 million pounds per year, the company confirmed to Fastmarkets on November 20.

The copper rod and wire maker currently produces 180 million pounds of finished products annually by employing one furnace to melt and refine copper.

The second furnace, which will be added to the existing facility, will allow SDI La Farga to produce copper products 24 hours a day – boosting its capacity to 430 million pounds of finished products per year, the company said.

Glencore Canada to shutter lead smelter

Glencore's Canadian unit will decommission its "uneconomic" lead smelter in Belledune, New Brunswick, but the company has said the permanent closure is not linked to a labor dispute at the plant that began in April this year.

The smelter, which mainly supplied the North American market, had been losing about Canadian $30 million ($22.6 million) on average every year for the last three years, Alexis Segal, head of governmental relations, corporate affairs and communications at Glencore Canada, told Fastmarkets.

Wieland hikes alloy tags, ends pre-paid freight

Wieland Rolled Products North America and Wieland Metals will increase the price of their high-performance and complex alloy products, and eliminate pre-paid freight on full-truckload quantities, German parent company Wieland Group told Fastmarkets on November 21.

Wieland's base fabrication charges will increase 5-15% for high-performing and complex alloys and 10-20% on proprietary alloys effective immediately on new orders.

The price changes will allow Wieland to continue investing in its complex alloy business.

Wieland, a supplier of semi-finished copper and copper alloy products, is passing on the price increase to the market because revenue alone is not always enough to cover operational costs, a company executive told Fastmarkets.

WIELAND

Supplier of semi-finished copper and copper alloy products, Wieland Group will increase the price of its high-performance and complex alloy products

News review: steel

Salzgitter will build hydrogen plant for reduced-carbon steelmaking

German steelmaker Salzgitter will build an electrolysis plant as part of its hydrogen-based steelmaking project in order to reduce its carbon output, joining a new industry-wide trend, the company said on November 18.

Salzgitter Flachstahl GmbH (SZFG) has awarded the contract to build a 2.2 megawatt (MW) PEM (proton exchange membrane) electrolysis plant to Siemens Gas and Power.

The Salzgitter Low CO_2 Steelmaking – or Salcos – project aims to achieve low-carbon steelmaking by incorporating renewable hydrogen into its existing integrated steelworks.

The plant is due to start operations in the fourth quarter of 2020 and provide all of SZFG's demand for hydrogen. The containerized plant will be erected at Salzgitter and will produce 400 Nm^3 per hour of hydrogen at full capacity.

EU targets Indonesia ban in WTO complaint

The European Union has launched a complaint to the World Trade Organization (WTO) against Indonesian export restrictions on raw materials used in the production of stainless steel, the European Commission said on November 22.

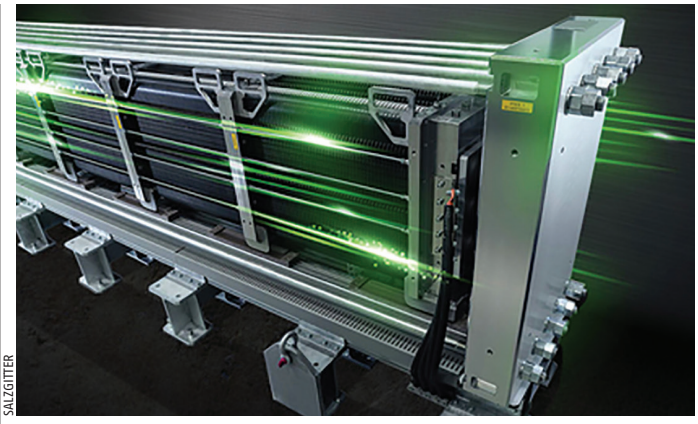
The commission claims that the restrictions unfairly limit European stainless steel producers' access to raw materials, including nickel in addition to scrap, coal and coke, iron ore and chromium.

Usiminas delays Ipatinga BF revamp to 2022

Brazilian steelmaker Usiminas has decided to postpone a revamp of the No3 blast furnace at its Ipatinga mill in the southeastern state of Minas Gerais by 12 months, to mid-2022, the company said on November 28.

"Our analysis showed that the blast furnace is able to keep going for another year, so our board of directors approved the delay," Usiminas chief financial officer Alberto Ono told analysts and investors at a meeting in São Paulo.

The revamp was expected to cost 1.23 billion Reais ($290 million) when it was announced on May 28. Most of the investment will be made across 2021 and 2022, Ono said.



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Salzgitter's PEM electrolysis technology is ideally suited to exploiting the generation of wind and solar power

Gerdau buys long steel producer Silat

Brazilian steelmaker Gerdau has agreed to buy 96.4% of Siderúrgica Latino-Americana (Silat) shares from Spanish group Hierros Añón for $110.8 million, in a shift from its divestment strategy of the past four years.

Silat is located in Caucaia, a city in the northeastern Brazilian state of Ceará, and has capacity of 600,000 tonnes per year of long rolled steel. The company mainly produces rebar and wire rod.

"The acquisition is part of Gerdau's strategy to provide better customer service in the Brazilian market," the steelmaker said on November 27.

Canada sets coated coil dumping duties vs trio

The Canada Border Services Agency (CBSA) has announced estimated dumping margins on certain corrosion-resistant steel sheet from Turkey, the United Arab Emirates (UAE) and Vietnam under an anti-dumping investigation initiated on November 8, 2019.

The estimated dumping margin for Turkey was set at 7% of the export price, 22% for the UAE and 20% for Vietnam, according to the agency.

CBSA also estimated subsidies for the period spanning July 1, 2018, to June 30, 2019, at 21.3% of the export price for Turkey, 12.1% for the UAE and 4.7% for Vietnam.

An initial decision will be made on February 6, CBSA said, noting that the investigation was initiated following a complaint filed by Hamilton, Ontario-based ArcelorMittal Dofasco GP on September 20 of this year.

Cliffs-AK combo to resurrect Ashland Works

Cleveland-Cliffs' acquisition of AK Steel Holding will forge a more cost-efficient steelmaking partnership in the US Midwest, with new plans to produce pig iron at the shuttered Ashland Works in Kentucky.

The companies announced the $1.1-billion all-stock merger on December 3, in a transaction scheduled to close in the first half of 2020.

The 172-year-old Cleveland-based iron ore miner would own steel mills for the first time in its history and boost its participation in end markets for high-value-added automotive and electrical steels.

The operations of West Chester, Ohio-based AK Steel would benefit from the vertical integration and greater financial stability.

EC clears acquisition of Evraz Palini & Bertoli by Marcegaglia Plates

The European Commission (EC) has approved the acquisition of Evraz Palini & Bertoli, currently owned by Russia's Evraz, by re-roller Marcegaglia Plates, the EC said on November 20.

Evraz Palini & Bertoli and Marcegaglia Plates are both located in Italy and re-roll heavy plate from imported steel slab.

The EC concluded, under its EU Merger Regulation, that the proposed acquisition would raise no competition concerns because the companies' combined share of the market for heavy quarto plates was limited.

The deal was expected to be finalized in early December 2019, according to market sources.

Clean energy key to waste-free EAF production

Steelmaking in electric-arc furnaces (EAFs) is already a good example of a waste-free circular economy since more than half of global steel output is being recycled, even if higher-quality material is still produced from virgin product and fossil-fueled processes, one executive said.

EAF steelmaking represents 25-30% of global steel

MMK

Russia's MMK will keep export sales low next year due to higher domestic steel demand and the reconstruction of a hot rolling mill

production, but this is expected to grow to 50% in 2050 and to 70% by the end of this century – representing "a new area in the steelmaking industry," Carl de Maré, president of the European Steel Technology Platform (ESTEP), said last week at a workshop in Bergamo, northern Italy.

The workshop, titled "Green Steel by EAF Route: a sustainable value chain in the EU circular economy scenario," was held on November 13-14.

MMK to remain focused on domestic market in 2020

Russia's Magnitogorsk Iron & Steel Works (MMK) plans to keep export sales low next year due to higher steel consumption in the local market and the reconstruction of a hot rolling mill, according to chief executive officer Pavel Shilyaev.

Speaking at the company's capital markets day at the London Stock Exchange on November 15, Shilyaev said that, so far in 2019, domestic sales were up by 7%.

"That is higher than the percentage of the steel consumption growth in Russia [as a whole]," he said, "[And] that means we are substituting [for] imports and that is one of the factors [that has] led to a reduction [in MMK's] exports."

TimkenSteel to shut material services facility

TimkenSteel plans to close its material services facility in Houston in the first quarter of 2020, the company announced on November 19.

The 100,000-square-foot operation – which currently employs approximately 100 workers – provides precision value-added and finishing services to customers that service the energy market, the company said.

"We plan to close this facility in the first quarter of 2020. Therefore, employees at this facility would be affected by the closure," a company spokesperson confirmed to Fastmarkets via email on November 19.

TimkenSteel expects to realize approximately $6-8 million in annual savings as a result of the closure.

Brazil's steel usage to jump in 2020: execs

Brazilian apparent steel use is showing signs of recovery and will increase significantly starting next year, said ArcelorMittal Long Carbon Latin America chief executive officer Jefferson de Paula in mid-November.

Brazil's steel consumption reached an all-time high of 28.02 million tonnes in 2013, according to national steel association Instituto Aço Brasil, De Paula told delegates at the annual conference of Latin American steel association Alacero, held in Buenos Aires on November 13.

While the recovery will begin in 2020, usage will not return to the 2013 record level until 2024, he added.

Tata Steel to cut up to 3,000 jobs in Europe

Tata Steel has outlined proposals to build a stronger and more sustainable business in Europe, which include cutting up to 3,000 jobs, the company said on November 18.

The program is needed to "ensure the business can thrive despite severe market headwinds which have led to a sharp decline in profitability," the company said.

In the first six months of its current financial year, which commenced in April 2019, Tata Steel Europe reported a drop of 90% in its earnings before interest, taxes, depreciation and amortization (Ebitda) to £31 million ($40 million).

JFE, Baowu affiliate to tap China auto demand

JFE Steel Corp and an affiliate of China's largest steelmaker Baowu Steel is setting up a joint venture to tap into demand for high-grade special steel bar from the Chinese automotive sector.

The move will see JFE Steel take a 50% share in Baosteel Special Steel Shaoguan Co, while the latter's existing parent Guangdong Shaoguan Iron & Steel Songshan Co (SGIS) will hold the other half of the stake, JFE Steel said on November 19.

AK halts Ky coating line after nearly 100 years

AK Steel has stopped operating the coating line at its Ashland Works in Kentucky ahead of the steel mill being shut for good at the end of 2019, a company spokesperson said on November 14.

The closure ends nearly a century of steelmaking in northeastern Kentucky.

AK's predecessor, American Rolling Mill Co (Armco), announced plans to build the mill in 1920. It was completed on October 19, 1923, according to the *Northern Kentucky Tribune*.

Iranian semi-finished steel exports up 43% on massive sales to China

Iranian semi-finished steel producers have benefited from the growing demand for such materials in China, where domestic prices have surged due to government policies that have led to cuts in steel production because of environmental concerns.

News review: steel

While customers in Southeast Asia, the Middle East and Europe became more cautious about purchasing billet and slab from Iran, fearing the consequences of the sanctions re-imposed against the country by the United States in August 2018, China ramped up its imports.

The volume of semi-finished steel products exported from Iran in the first six months of the current Iranian year (March 21-September 22) was 4.02 million tonnes, up by 43% year-on-year, according to the latest report from the Iranian Steel Producers Association (ISPA). This growth was mainly a result of billet sales.

Billet and bloom exports totaled 2.96 million tonnes over the six months, an 88% rise year-on-year, while slab exports came to 1.05 million tons, down by 15% year-on-year.

Nucor's Sedalia mill to feature auto shredder

Nucor Corp's 450,000-ton-per-year steel reinforcing bar micro-mill in Sedalia, Missouri, is nearing completion, the company confirmed; the facility is vertically integrated and includes an automotive shredder.

The mill is slated to start up by the end of this year, according to the Charlotte, North Carolina -headquartered steel producer.

The shredder will have an input total of 180,000 tons of shredder feed per year, according to documents filed with the Missouri Department of Natural Resources.

If the shredder processes the maximum monthly input of 15,000 tons of shredder feed, it will produce an estimated 12,000 tons of shredded scrap each month, according to a southeast shredding source.

Eurofer calls for tougher steel safeguards

Eurofer has called upon the European Commission (EC) to re-review its steel safeguard measures to protect a market that is still "flooded" by imports, the European steel association said on November 20.

It requested that the measures be reworked to reflect the fact that the quota volumes were set far above traditional EU import levels and to reflect that market conditions have considerably deteriorated.

The EC had already approved several adjustments to its safeguards; these tougher rules came into force on October 1 this year.

The EC opened the safeguard case in an attempt to prevent steel shipments being redirected to the EU after the United States imposed import tariffs as part of its Section 232 investigation.

TENARIS

Drilling activity in the oil and gas market has waned, resulting in Tenaris laying off more than 90 workers at its Arkansas site

CEG venture targets recycling in Thailand

Chiho Environmental Group Ltd (CEG) has entered a joint venture with Thailand's Hidaka Yookoo Enterprises Co Ltd and Japan's Suzuki Shokai Co Ltd that will focus on metals recycling in the motor dismantling sector in Thailand.

The venture – Hidaka-Chiho Metal Recycling (HCMR) – was established on November 5, Hong Kong-based CEG said on November 22.

Changing dynamics in the metals industry as a result of China's National Sword and Green Fence initiatives have negatively affected scrap exports from such countries as the United States, but opened up the growth of recycling in other countries.

Tenaris to cut 90 jobs at Arkansas ERW mill

Tenaris will lay off more than 90 workers at its electric-resistance welded (ERW) mill in Hickman, Arkansas, the company said.

The company, which did not specify when the layoffs would occur, cited deteriorating market fundamentals affecting its North American energy customers, who are purchasing fewer oil country tubular goods (OCTG) and line pipe.

"Drilling activity in the oil and gas market has been steadily declining," the Luxembourg-based company said in an email to Fastmarkets AMM on November 25. "This has had a direct impact on tubulars, which has been further compounded by a significant level of unfairly traded OCTG imports despite the low demand."

The pre-layoff Hickman headcount is 481, Tenaris said.

CSI closes January flat-rolled order books

California Steel Industries (CSI) has closed its flat-rolled order book for January.

"Your support has allowed us to achieve our planned capacity for flat-rolled products," the company said in a letter to customers dated November 21.

The move comes approximately one month after the slab re-roller opened its January flat-rolled book.

It also comes amid an upward trend in hot band pricing.

Nippon Steel acquires interest in Grosvenor coal mine

Anglo American has sold a 12% interest in the Grosvenor coal mine in Queensland, Australia, to a consortium of Japanese companies, including steelmaker Nippon Steel, it said on November 27.

Under the terms of the agreement, which is subject to a number of conditions prior to completion, Anglo American will receive cash proceeds of approximately $141 million in respect of the 12% minority interest in the Grosvenor mine.

The value of Nippon Steel's acquisition is A$86.4 million ($57.3 million), the steel maker noted, adding that the move was part of its strategy to secure medium and long-term stability in raw materials procurement.

The mine has been producing high-quality coking coal with competitive mining cost since 2016, the steel mill added.

AQS starts steel output; to reach full capacity in early 2020

Algerian Qatari Steel (AQS) started its own steel production last week, the company told Fastmarkets at the sidelines of the Arab Iron & Steel Union (AISU) annual summit in Tunisia on November 27.

The company used to import steel billet, but a source at the company told Fastmarkets: "We have stopped importing semis some time ago, continuing with re-rolling billet, from stocks imported earlier."

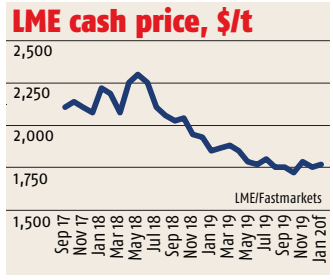
In January-September, Algeria imported 759,951 tonnes of billet, mainly from Ukrainee, Russia and Turkey, according to data from the International Steel Statistics Bureau (ISSB). That was up from 701,895 tonnes over the same period in 2018.

Market analysis

Aluminium

Waiting for the next lower low

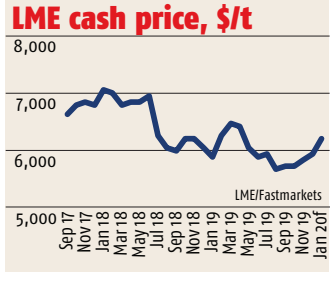
LME aluminium has traded in a large descending triangle pattern this year, defined by a series of lower lows (the last in October at $1,705 per tonne) and lower highs (the last in November around $1,820 per tonne). Weak demand caused by slowing global growth due to US-China trade uncertainties is the main force. Other themes, such as the odd supply disruption or exchange stock flows, are just noise. During the 2019 downtrend, there have been periods when prices have tried to work higher, but have been turned back, and at progressively lower levels. Prices have been trying to recover again since October's low, attempting to firm up a base here and prevent the next lower low in the series, but the strength of the price action has been unconvincing. In the absence of significant positive changes to the macros, aluminium risks reverting to the trend to set a new lower low in the coming weeks, possibly beneath $1,700.



Copper

Price recovery to continue

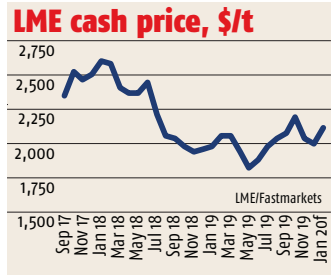
Copper prices have been working gradually higher since their 2019 low point of $5,518 per tonne in early September, but they have yet to break back above the $6,000 landmark. In fact, November produced a 'lower high' beneath this level, confirming significant resistance. But the upward trend reflects copper's tight fundamental dynamics starting to take a dominant role over the still-unsupportive macroeconomic environment in determining price direction. With speculative positioning in both LME and CME copper still overly stretched on the short side, a significant wave of short-covering could ensue, pushing copper prices much higher, especially in the first quarter of 2020 when a restocking phase is likely to emerge. The latest manufacturing activity indices for China lend some support to this view as they indicate the sector may have bottomed. Our price outlook for end-2019 and Q1 2020 therefore remains bullish for copper; our base case average cash price forecast for the period is $6,200 per tonne.



Lead

Expect a rebound after November's sell-off

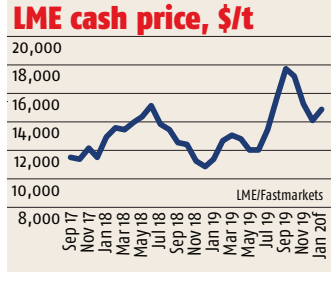
LME lead prices spent November in retreat and started December dipping below $1,900 per tonne for the first time since July and down 16% from the October peak of $2,265. At this level, lead had given back 75% of the May-October rally that was triggered by the supply disruptions at Nyrstar's Port Pirie smelter in Australia. Having broken technical support at $1,950 per tonne the next support area is around $1,860. Fundamentally, while we forecast the refined market swinging into surplus in 2020 after three deficit years, at 103,000 tonnes the projected surplus is small in a 12 million tonne-per-year market, especially with visible stocks low, so we would not be overly bearish. Moreover, Glencore will close its Belledune smelter in Canada, softening the effect on market sentiment of Port Pirie's restart. The Northern Hemisphere winter (with cold weather killing off older lead-acid batteries increasing), should provide support for lead. The next move after this sell-off could be a sharp rebound.



Nickel

Prices may have room to work lower still

Like lead, nickel prices also declined throughout November, correcting overbought conditions brought about by the speculative reaction to supply disruption news. In nickel's case, the $13,300 per tonne level it reached in early December represents a fall of 29% from the early-September peak of $18,850. Although the nickel price correction has run a little deeper than we had expected in our base case forecasts for Q4, we are not surprised given nickel's tendency to overshoot. But the relatively high level of cancelled warrants and low level of exchange stocks mean the market could tighten if off-market inventory remains tightly held. If exchange stocks do rise significantly though, then prices may stay under pressure for longer, in which case we would look to the technical charts for downside targets where support could be found. Currently, that looks like it could be around $12,000, defined by the uptrend line from the 2016 lows. That remains in our low case scenario for H1 2020.



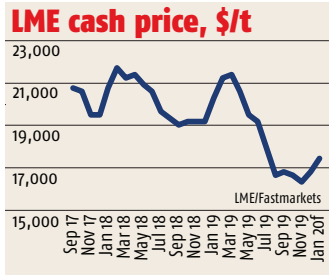
Fastmarkets MB

In this regular section, Fastmarkets MB's research team summarize their in-depth reports to highlight key factors driving the markets and their short-term price forecasts. The weekly service, Base Metals Market Tracker, provides independent analysis and forecasts for base metal markets and prices.

Tin

Firmer fundamentals likely to support prices

LME tin traded sideways for most of November, having been the worst performer so far this year (declining by around 15%). But we continue to think that the price is undergoing a bottoming-out process, driven by tighter refined market conditions in a regime where the fundamentals have come to matter more in the price formation in recent months. Tighter refined market conditions are proxied by global exchange inventories dropping from around 15,000 tonnes late in June to below 10,000 tonnes in November. This decline (concentrated in the SHFE tin) points to a tighter refined market, at least in Asia. We expect a steeper upward path

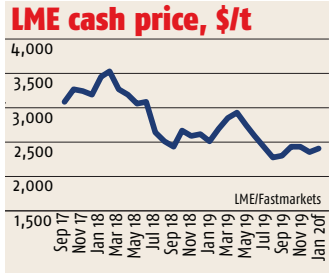


for tin prices in the months ahead as refined tin supply becomes tighter still due to refined production cuts in Asia taking a toll. Tin demand may rebound. Downstream buyers have a tendency to de-stock in Q4, and the semiconductor industry is reported to be close to under-stocked. This could stimulate a wave of restocking in Q1 2020.

Zinc

Threatening new 2019 lows

Unlike lead and nickel, zinc's retreat did not come off an impressive rally to multi-month highs, so as of early December it is already threatening to rechallenge September's year-to-date low at $2,190 per tonne. And given the descending triangle pattern formed on the chart this year, a new 2019 low could be on the cards. For now the market's underlying fundamentals remain supportive. The latest ILZSG data pegged the global deficit at 155,900-tonnes in January-September, on course for a fourth consecutive annual deficit, which we forecast at 257,000 tonnes. But 2020 will be a balanced year at best, amid soft demand and a



recovery in supply now that mines are ramping up. More will come on stream in 2020. The weak performance of prices reflects the market pricing in the end of the big annual deficits and searching for a level in equilibrium with this less-bullish outlook. That is not to say there will not be counter-trend moves, but the sideways-to-lower drift will prevail.

Analysis by **Andy Cole**, Fastmarkets MB

Steel

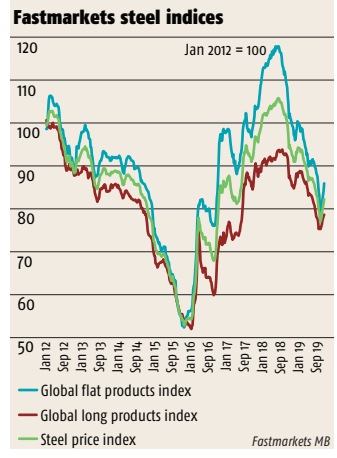
Restricted supply supports flat steel prices in Europe

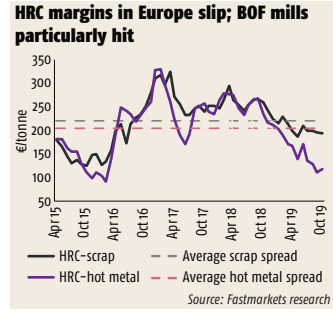
2019 was a challenging year for European flat steel producers as end-user demand retreated, leading to a downtrend in prices that lasted from September 2018 until the end of October. According to estimates from Fastmarkets MB's research team, demand for hot-rolled coil in the European Union fell by 3.7% year on year in the January-June period in 2019, while steel demand has generally retreated by 2.7%.

One of the main drags on demand for flat steel in Europe has been a recession in the automotive sector. Automotive production in Germany fell by 9.2% year on year in the January-September period, while in Italy the contraction reached 20.2%. The automotive sector is the largest user of flat steel in the EU, accounting for 43.2% of mills' direct shipments in the region last year.

The negative impact that poor demand had on prices was amplified by a rise in imports at the end of 2018 through the start of 2019, which was partly a result of the introduction of the "first-come-first-served" safeguarding quota system, introduced by the European Commission in 2018. This led to a rise in stock levels in the supply chain and depressed demand for local European material later in the year.

A downward trend in European HRC prices resulted in a sharp decline in producer margins. Margins of European electric-arc furnace (EAF) and basic oxygen furnace (BOF) HRC producers traditionally moved together, with the HRC-scrap and HRC-hot metal spreads averaging €220 and





€204 per tonne respectively over the past five years. But a jump in iron ore prices earlier this year meant that hot metal costs rose significantly. By September the estimated HRC-hot metal spread tumbled to just €110 per tonne – a level last seen at the end of 2015-early 2016, the period when most European producers reported financial losses. Scrap-based producers performed better this year due to a downward trend in scrap prices, but since June even scrap-based HRC production has been unprofitable because the spread has been consistently below €200 per tonne.

In such conditions, European steelmakers were forced to ▶

Market analysis

cut their output, trying to tighten the supply-side of the equation. ArcelorMittal was the first producer to announce cuts of 4.2 million tonnes on an annualized basis for the second half of 2019. Other mills followed the lead, either shutting furnaces or scheduling maintenance outages for the end of the year. Market participants were uncertain if these cuts would be sufficient to lift flat steel prices and although the downtrend was halted in late October, prices were lingering near the floor level.

The situation was radically changed in early November when ArcelorMittal unexpectedly announced that it will pull out from the agreement to buy the Ilva plant in Taranto, Italy, and that it will start shutting down production there immediately. Although the original end-of-January shutdown deadline has been postponed while the company negotiates with the Italian government, output has been reduced and the mill has been absent from the spot market.

European producers took advantage of the market tightness in a period when buyers needed to place their first-quarter orders, announcing coil price increases in late November-early December. Spot prices started to move up, and we expect that the trend will continue through the first quarter of 2020.

But longer-term, if the ownership of Ilva changes hands, there is a small risk that the mill – under state control – will start selling HRC at prices below market value to secure cashflow, which it allegedly had previously done, and thus drag European coil prices down again.

Analysis by **Marina Maliushkina**, Fastmarkets MB

Steel raw materials

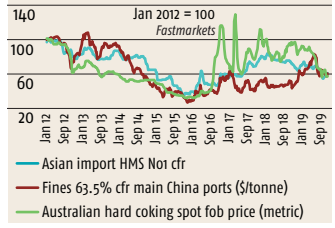
Raw materials prices firm up as a rollercoaster 2019 comes to an end

The year 2019 has been a dramatic story for raw materials prices, and at no point has this description been truer than in the past couple of months. After iron ore prices moved downwards through September-October, more lenient Chinese steel output restrictions allowed prices to rise again in late November to December. Ferrous scrap prices in major markets such as the US and Turkey spent much of the year underperforming 2018 – in line with our expectations – but they too are ending 2019 on an upward note. The bullish winds of change have also blown into coking coal markets, where improved Chinese mill margins allowed prices to first stabilize and then to rise in November-December.

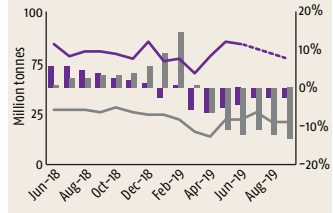
The raw materials market of 2019 presented a startling and tragic beginning to the year with the Vale tailings dam collapse in January. A loss of iron ore supply from the Brazilian mining behemoth led to a price spike for 62% iron ore fines, peaking at $216 per tonne cfr Qingdao in March – tightening basic oxygen furnace (BOF) margins. The price jump also startled certain trading houses, who diverted resources to their iron ore desks to stem positional losses and maximize opportunities.

The 62% Fe iron ore fines prices fell to their lowest point since the Vale disaster on November 11 amid recoveries in supply and a slowdown in purchases. But cumulative supply from Brazil and Australia still remains far below 2018 levels, as the chart shows. Ore prices then came roaring back close to $90-per-tonne by late November. This was amid continued lower supply and also due to China's government imposing targets on limiting small air particle levels rather than on cutting BF output, helping to support iron ore demand.

Fastmarkets MB steelmaking raw materials indices



Australian and Brazilian iron ore supply remain below 2018 levels



Source: Fastmarkets, ISSB, MDIC

The iron ore price spike in early 2019 also inflated the prices of more heavily processed raw materials. In the Middle East, steelmakers relying on direct reduced iron (DRI) for their electric arc furnaces (EAFs) were hit by elevated DR pellet and DRI prices in the second quarter of the year. At Fastmarkets' DRI and pellet event in Dubai in June, Middle East mill sources told us that relatively cheap ferrous scrap prices were making them consider using more scrap and less DRI, with one producer in particular looking at importing large scrap volumes for the first time.

But even prices for scrap moved upwards toward the end of 2019 – largely driven by a higher appetite from Turkish mills after they underbought material in the July-October period. A resurgence in US hot rolled coil (HRC) pricing – which correlated closely with movements in US scrap rates in 2019 – has provided further support to US domestic scrap prices, while both Turkish import and US domestic rates are also being inflated due to seasonally lower collection rates.

At the end of 2019, we are gearing up for a fascinating 2020 in the steelmaking raw materials markets. Despite its strong performance of late, our iron ore outlook remains bearish as we believe crude steel production growth in China will slow in the coming months. Combined with a growth in seaborne shipments from Australia and Brazil, this should eventually push prices further down.

2020 will also be a weaker year on average for coking coal and ferrous scrap prices, despite supportive factors for both in the first quarter, while capesize freight rates will be inflated by January 2020 legislation banning the use of high-sulfur fuels. But though these are our expectations at the time of writing, we also note that if 2019 has taught us anything, it is that one should never bet against a twist in the plot of these markets.

Analysis by **Lee Allen**, Fastmarkets MB

Alexander Shevelev

'I am going to transform our company'

Alexander Shevelev, CEO of Russian steelmaker Severstal, says that the company has changed its culture quite quickly and substantially to focus on being a solutions provider. Richard Barrett asked him to explain that mission and to recall his path from the shop floor to the top of a company that employs 50,000 people

First, a few key numbers. Russian steelmaker and mining company Severstal produces 12 million tonnes of crude steel per year, 17 million tonnes of iron ore products – half as pellet and the rest as concentrate – and 4.8 million tonnes of coking coal concentrate. It is a vertically integrated producer from steelmaking raw materials through to finished products. The company has a key advantage of low-cost production that places its cost of slab output at less than $250 per tonne.

Core strands of Severstal's strategy now include increasing the share of high-value-added (HVA) products, with an associated goal of becoming more of a solution- rather than simply a product-provider to customers. HVA products already account for 45% of its output.

Projects to increase steelmaking raw materials production are well under way, together with a continuous drive to keep costs low. Meanwhile, multiple digital initiatives and investments in modern plant and e-commerce support the business aims.

Five years ago, Severstal still owned mills in the United States, but nowadays most of its assets are in Russia, with two-thirds of its sales in the domestic market. Europe is the steelmaker's main market for exports.

Alexander Shevelev, CEO, sees Severstal's focus on its domestic market and concentration on its assets in Russia as another advantage now, given the current global geopolitical and macroeconomic outlook and uncertainties for international trade. "I think it is a good strategic decision because, speaking about Russia and our local market, where we sell about 70% of our sales, we will have the opportunity to grow more," he said.

He added that Severstal's sales in Russia are made at a premium to the export market, which he said is sometimes quite good, especially as the export market price is currently slowing down, but in Russia pricing is at a relatively stable level. At present, "It allows us to earn additionally approximately $80/tonne because in Russia the market for flat products is quite concentrated and three players have more than 75% of this market, and the market is quite well balanced," he explained. The premium in the Russian market is above its typical level of $40-50 per tonne, but Shevelev said that it looks likely to remain positive for the coming months.

In Severstal's major export market of Europe, the company sells to Scandinavian, central European and East European countries in particular. "Our logistical position, at Cherepovets, is very good for us and for exports, especially in Nordic countries," Shevelev added. The company's flagship mill is based at Cherepovets, about 500 km to the north of Moscow.

"Speaking about our strategy and our main competitive advantages, it is cost leadership through vertical integration when we have more than 100% of ▶

SEVERSTAL

self-sufficiency in iron ore products [130%], and about 78% in coking coal," he explained.

"Considering the cost curve, we are in the left [very low] position globally. That has given us the opportunity to sell our exports in any market in the world, but we are focusing on Russia because it is a more profitable market for us," he noted.

"Customers in local markets for us are more understandable and more predictable. And currently we are changing our strategy by focusing on end-customers to deeply understand real customer needs and to be ready to provide not only product – and not only service as usual which we have done before – but also the products that we cannot produce yet," he added.

He gave the example of a partnership that Severstal has with Evraz, another major steel and mining company, "we created a common sales platform in Russia to complete our range portfolio and provide some customer needs and solutions." Severstal is looking for discussions for more joint ventures and partners.

"I am sure that through this strategy, when we are focusing on real customer needs – and we are solving their business needs, not problems – their business needs and business opportunities give us an additional push forward," Shevelev explained.

He confirmed that Severstal wants to become so well integrated into its clients' supply chains that it becomes indispensable to them.

Severstal's multiple strategic initiatives

Metal Market Magazine's exclusive interview with Severstal CEO Alexander Shevelev was in London, UK, at the beginning of Severstal's capital markets day 2019, held on November 7. With several senior members of his management team, he also gave a media briefing that illustrated the range of the company's strategic initiatives and projects.

Shevelev himself summarized the big picture. "We had positive results in 2018 with an Ebitda of $3.1 billion. Our Ebitda margin was highest globally," he said, quoting an Ebitda margin of 37% for that year and 35% for the first 9 months of 2019.

He explained that Severstal updated its strategy a couple of years ago to focus on several strategic directions. "First of all, cost leadership. Our task is to have cost advantages compared with our peers in rolled steel. Currently we have good result. In 2019, our cost advantage is approximately 20% in rolled steels. A huge advantage from my point of view," he stressed.

"A second priority is the creation of great customer experience. For this, we divided our sales team to focus on customer needs, investigation of special niches and segments in the construction industry, the energy industry and machine engineering industry," he said. He added that the company has many projects to use the opportunity provided by digital initiatives in areas including marketing, product development and R&D.

"A certain priority for us is new opportunities. It means for us that we are looking for a new business model and try to be open… I mean that we create an accelerator for start-ups and currently we have 15 projects for external start-ups within our company."

The company has invested in two foreign companies through its Severstal ventures capital fund. "We try to be open and create new partnerships of mutual interest for both parties," said Shevelev.

International tube & pipe business Tenaris has formed a joint venture with Severstal for OCTG production in Russia. Severstal also has a joint venture with Rusnano and Windar Renovables to produce the towers for wind turbines.

"We have changed our culture quite quickly and substantially. We launched a number of agile teams that are working with customers. We work with cross-functional teams with short periods focusing on results, and we have a lot of programmes receiving new skills etc. So there have been a lot of changes in our company now and all of them have achieved quite a good result," he summarized.

Investments

Severstal has multiple investment projects and organization projects in order to provide cost advantages in its upstream activities. "Most of our projects are linked with volume. We have several projects undergoing ramp-up," noted Shevelev. One example is the Yakovlevskiy mine – one of Severstal's assets for iron ore production – where it will triple output to about 5 million tonnes in iron ore concentrate in 2023, compared with current production of 1.5 million tonnes per year.

Production will also increase for coal concentrate at Vorkuta. In 2018, the output of coking coal concentrate there was 3.4 million tonnes, but Severstal's forecast this year is about 4.8 million tonnes, and 5.4 million tonnes by 2023.

Investment in Severstal's blast furnace No. 3 will see hot metal production increase by 3 million tpy, starting from the fourth quarter of 2020. After that, the company will have a total capacity of 12 million tonnes of hot metal and its decisions will depend on the market situation – to close old furnaces or maintain them so that the company has flexibility for hot metal production.

"Our strategy is to produce high-value-added products while at the same time producing greater volumes of raw materials and semis. Also, we have investments projects in capacity to increase the volume of production of high-value-added product. We have invested in a pickling line and hot rolling mill, cold rolling mill and zinc-coating lines," Shevelev added.

"That means that all of our additional volume in steel will be going to reproduce or use for more high-valued-added products also. We are not going to increase dramatically slab sales because our strategy is more to meet new products and high-value-added product and service for our customers," he explained.

Construction and infrastructure

Head of corporate strategy, Maxim Semenovykh, said that Severstal is seeing more clarity about projects in the pipeline for the Russian National Project for infrastructure development, given the framework for government spending. Three main initiatives that are most attractive for Severstal are sea-ports, connections between urban areas in Russia and railroads. "Railroads is one of the best financed programmes because most of that will come from the state Russian Railways," said Semenovykh.

Nevertheless, they are seeing some obstacles and time lags on some of the project realisation. "We estimate that in

"Absolutely, it's why we are sure that our target for additional Ebitda – that is $2.1 billion additionally for the period 2018-2023 – is doable."

He said that for the company's results in 2018 and 2019, Severstal has already earned about an additional $700 million, or about 27% of its five-year target. "Our target is to add 10-15% annually to Ebitda and our result for 2018 and 2019 says that is possible and doable for us in the time and within the budget," he stressed.

Route to the top

Shevelev has held multiple roles on his path to become Severstal CEO, each of which have added valuable experience for him to lead a business that employs 50,000 people as well as to execute the company's over-arching vision to become "the leader of steel industry of the future".

"I was born [in 1974] near Cherepovets. I finished state education and studied to become a mechanical engineer. My second education was about economics and management, and the third was a general MBA," he recalled

Shevelev started work on the shop floor 22 years ago, in 1997, in a Cherepovets steel rolling mill that is a subsidiary of Severstal's steel plant there. He recalls the steps from working on the shop floor to the boardroom well.

"I built my career in this plant. After I was a worker, I became a supervisor, the head of the shop floor; then head of the strategic department, the technical director and then the executive director ▶

terms of steel consumption, if all this complex infrastructure development will be completed in time it will mean that there will be an additional 2.6 million tonnes of steel demand in 2023. Realistically, we believe that it will be about 50% of that in terms of the additional steel demand – that is our estimate," he added.

Evgeny Chernyakov, Severstal's director for sales and business development for the construction sector, said there are two areas where Severstal is analysing modular solutions. The first is for bridges. "In Russia, there are very traditional types of building bridges, which can take two or three months," he noted.

Severstal has a partner in France, which he said has a unique technology to produce a bridge in 3-5 days by using a modular approach. He said that Severstal is exploring the possibility of deploying the technology in Russia. It will probably start production in 1-2 years, but is now under discussion.

In a second example, the steelmaker is looking to their partnership with one of the biggest constructors in the Moscow region, where they have started 20 projects together to reduce welding operations inside buildings. They are going to use modular construction for car parking, for example, based on steel framework produced by Severstal.

The steelmaker also produces and markets branded roofing products for individual housing projects.

Digital developments

Shevelev is enthusiastic about digital technologies and Severstal is investing heavily in them.

"We have made good progress from our point of view. We believe that digital initiatives should contribute to us additional Ebitda of not less than $300 million annually," he said. "We are focusing on several directions. First is on quality. We have a number of digital systems already: for example, automated cameras with neural net systems that allow us to fix some kinds of defects and to make decisions without human intervention."

The second is predictive maintenance to decrease downtime. "We also have several projects in the safety area that allows us to track the movements of our employees [to check they are operating in safe areas, including underground in the company's mines]," he added.

Severstal is also introducing remote-controlled mining equipment in their Yakovlevskiy mine. "We believe it could be a good direction for us." The workers operating it can work from safer locations and the equipment will increase productivity.

Shevelev said that Severstal's capex for digital projects and IT for 2020 will be about 6 billion roubles – a four-fold increase on equivalent capex last year. "It is a huge sum compared with our competitors," he said.

Investment in digital technology "is one reason why we are going also to increase our volume in steel without launching [more] new equipment." Severstal has estimated that the implementation of digital projects will enable the production of as much as an additional 1 million tpy of steel by using their existing equipment.

Supply chain too

Maria Shalina, marketing director, said that Severstal has plenty of digital projects in the supply chain too.

The company needs a differentiated approach for different industries, whether for automotive or construction for example, she explained. For the construction sector, for example, it needs to be addressable in regional stores, rather like retail, with a fast supply chain implemented. For this aspect of the business, a very important part of investment is digital.

"For communication with clients, we are investing in new self-service channels with clients because we see huge strengths when a client wants to communicate with us through messaging, through a web application etc. This is a trend, and clients want to receive the same service levels as they receive from the B2C market," said Shalina. "This is a challenge for us, but also an opportunity to do this and to have client satisfaction."

"Now that we understand that we are keeping our domestic market in Russia, we understand that we need to have warehouses in each geographical zone because our end-clients want to receive their metal not in the next two weeks, but in just two or three hours," she explained. "It is like the B2C level and we should change a lot in our engineering processes, our supply chain and production to address these huge customer needs. We are consequently changing our distribution model."

On-line sales have already reached 30% of Severstal Distribution's total sales.

Severstal is expanding its distribution system not only through its own facilities, but will use a low-capex model – an easy entrance and exit model – where it rents facilities or space from its partners.

Severstal's own on-line store is not only for the sales of its own products, but is also a marketplace for those of its partners, such as its partnership with Evraz, launched in 2019. The company is broadening its number of different partners and product range by these means.

of the Cherepovets site. Then I became CEO of Severstal's metalware businesses, which produce finished products from steel, such as ropes, mesh and fasteners.

"This post gave me the opportunity to feel [what it is like to be] a customer of the steel industry, because we bought product from the metallurgical plant at Cherepovets – but not only from Cherepovets but also from the market."

He was free to choose what products he purchased: "from Cherepovets steel mill or from the [external] market because the relationships between assets in our company is a market. If I could buy more efficiently from the market, I could if I wanted to."

He explained that it gave him the opportunity from the customer side to interact with his colleagues from the metallurgical plant. "I had a lot of difficult conversations and discussions over quality, volume and pricing issues etc. I tried to understand better metallurgical technology and the metallurgical business model and how we can use them."

From the role of CEO of Severstal's metalware businesses, he received an offer from the local government to become first deputy mayor of Cherepovets city. "It was very exciting for me and it was an absolutely different way and track for me but, because I had already experienced more than 15 years in the steel business, it was really interesting for me," he recalled.

Severstal's majority shareholder and chairman, Alexey Mordashov, agreed with Shevelev about the merits of him accepting the role. "I went to town, where I was responsible for development, economic strategy of the town, construction, architecture and working with business connections. I was in that post for a year or so and it was a very interesting period of my life, because I received lots of different experiences working with other parts of the government and the political side and citizens' needs."

He recalled holding regular meetings with the people to hear about their needs, issues and problems. "I had to be focused on solving these problems because, in business, I have to demonstrate results. I was quite effective there because I received an offer from the regional government, which was a high position to be deputy governor."

SEVERSTAL

"I think that we make the right decisions in the right way because our engagement level grows constantly" said Shevelev

He accepted that offer too and moved from Cherepovets to Vologda, which is the region's centre. But after working for only three months in that position, he received another offer from Alexey Mordashov to go back to Severstal.

Business and community

Wherever they are located, it is common for large integrated steelworks that employ thousands of local workers to also have links and responsibilities to the communities in which they are based. Severstal is no exception, as Shevelev explained.

"Cherepovets is quite a small town of only 315,000 citizens and Severstal is the biggest employer there. It is very responsible for society, the environment and the business environment there. We have many social programmes in the town. We have a lot of social investment into the hockey team, sport, and some special social programmes such as the "Road home" program for children who do not have a family.

"We support a lot of these things and it means that the local government and the Vologda government and the Cherepovets government work closely with the Severstal management team. We decided and resolved absolutely that to increase the effectiveness of the town we needed to care about and increase the engagement of citizens and the corporate culture with the town."

He said that it was quite simple and comfortable for him to work in the government team too, because he had a constant connection and link with business people, not only from Severstal, but also from other businesses.

"After receiving the offer to come back to Severstal at a higher position, I accepted it and came back to Severstal as the CEO of hardware businesses." After three years in that role, he was promoted to other Mordashov businesses, in plywood, "which were also very interesting – they have a big market share globally because Russia is a big player in plywood business."

He worked in the hardware business for 6 months and, after that, following changes in the management team at Severstal, he became CEO of AO Severstal Management in December 2016. "Of course, I accepted immediately because it is a huge business in the Severgroup." Severstal creates 70% of the gross revenue and 75% of the profit of the assets held by Severgroup – the investment company for Mordashov's multiple businesses.

Communication is key

In support of all of Severstal's strategic initiatives (*see panel*) that Shevelev ultimately takes responsibility for as CEO, he highly values systems and opportunities to communicate with the company's staff, managers and customers.

He prizes working with many different people, with multiple emotions. "Each of us has emotions – there are your own emotions and the emotions of other people, and if you are a manager working with a number of people you should understand these emotions and take them into account and use it in a positive way for a result, and not to destroy something but to create something," he said. "It is a way

that I constantly investigate and try to use and improve," he added.

The question arises of about how he achieves that in an organization employing tens of thousands of people. He explained that over the whole company there is a lot of focus on communications and channels, such as through video conferences with management teams to enable staff to ask questions.

"Some years ago, it was really formal conversation with some special questions that were prepared before, but now with a constantly changing [dynamic] situation, I give a short speech about our results and our challenges, our trends and our position compared with our competitors, and about our main tasks for everybody.

"Then I have more than half of my meeting for a Q&A session and we use an electronic system to allow people to ask questions confidentially from on-site. But at the same time if somebody asks me a significant question, everybody has the opportunity to mark, or rate, each question." That effectively gives employees the opportunity to vote on which questions are of most importance to them and for Shevelev to answer those from the top of the list.

"It is good, because during these quarterly meetings, I have the opportunity from my side to send a message to everybody, but at the same time receive feedback, questions and further information through this channel."

As and when needed, Severstal also uses on-line webinars, typically lasting about an hour, for specific topics or targets.

The company undertakes 360 degree research to evaluate employees including top-managers, including Shevelev himself. Customers, suppliers, colleagues, subordinates and superiors are asked for feedback. "To give recommendations and to give open feedback on what I should do better, and what I should keep because it is already good," he explained.

He said that he reflects immediately on the feedback he receives, adding that the process is undertaken at least once each year

SEVERSTAL

Online sales of Severstal's wide product range continue to grow

and that the system provides a constant opportunity to make recommendations or comments. For day-to-day communication, Severstal uses internal corporate social media (Yammer), where Shevelev also has a blog, as well as Facebook to provide a public profile and means of external communication.

"Last but not least, we have engagement research via survey within our company, for which the response rate is very high: 76% of our employees are involved in this research, which is absolutely confidential for the employees responding," he said.

There are about 75 questions, asking what problems need to be addressed, whether there is any need for a change in the behaviour of management, what needs to change, and what employees think about Severstal's NPS (Net Promoter Score) for its products and company.

"A lot of this information is used for focus groups in order to better understand what our employees mean about this: why they evaluate this [particular] topic beyond what we expected etc. I think that we make the right decisions in the right way because our engagement level grows constantly. We started with 47% five years ago and currently we have 78% in Severstal globally."

These percentage scores are for Severstal's engagement level in an independent methodology that many companies use internationally. That also enables comparison with the performance of different companies. "Scoring above 75% means that we are an advanced company in terms of culture and the engagement of people. We have 78%. It is the right way to measure the feelings and engagement in the company," Shevelev stressed.

What next?

Shevelev is just 45 years old, so where next for his career? "I have a great opportunity to move my company from its current position in the local market to be a real leader in the future steel industry," he said.

"I am going to transform our company from a production site to a real customer-centric company that will use not only technology for metallurgy, but implement it and use a modern business model that is digital." He noted that there are many digital business models at other successful companies to emulate.

"We will not only provide products and service, but will be a solutions provider. It is a challenge for me and for my team and I think if I manage it, I will be really happy. It is my target for the near future.

"Alexey Mordashov has delegated to and trusts me to manage this company, and he trusts me to change my company. It is very difficult, but a really interesting way to go," he concluded.

Non-ferrous metals outlook for 2020

The fortunes for base metal markets have been mixed and volatile in 2019. Myra Pinkham asked seasoned analysts and observers to identify key market drivers for 2020 and beyond

SHUTTERSTOCK

While uncertainties prevail, there seems to be growing optimism that 2020 will be at least a marginally better year for non-ferrous metals markets. There is also potential for further improvement in 2021, especially if, as many hope, a US-China trade deal is successfully negotiated and various central banks will be able to successfully stimulate global base metals demand.

Andrew Cole, senior metals analyst for Fastmarkets MB pointed out that across the board demand for non-ferrous base metals has slowed. "For example, we are forecasting copper demand growth of just 1% for 2019, down from a range of 2.3-3.3% in the 2016-2018 period."

Perhaps the weakest of the non-ferrous base metals has been zinc, driven by global weakness in galvanized steel demand, according to John Mothersole, director of IHS Markit's pricing and purchasing service. Mothersole said that the overall decline in non-ferrous base metals demand has been a big disappointment, given the early optimism that the market could possibly get some lift out of China in 2019. "But that never materialized. Instead, base metals demand growth was adversely impacted by a synchronized slowdown in global economies," particularly a softening in manufacturing activity worldwide.

Overall the year was a bit of a mixed bag and was somewhat counterintuitive, according to Sergey Donskoy, a metals and mining analyst with Société Générale, explaining that while the first half was more favorable for copper producers, with higher prices on average notwithstanding pretty weak Chinese demand. "However, the second half was considerably weaker with prices almost lacking any positive momentum even as Chinese demand finally started to show some signs of life."

Infrastructure, construction, automotive and energy developments in China and beyond ultimately drive non-ferrous metal markets

Donskoy described the year as being more disappointing for zinc miners, many of which were barely able to generate cash at current prices, especially given the spike in treatment charges, and for aluminium smelters, given falling LME prices and weak premiums, while it was something of a positive surprise for nickel producers.

Geordie Wilkes, head of research for Sucden Financial, pointed out that miners and primary metals producers alike were negatively impacted when trade tensions intensified in the second and third quarters of 2019. Cole agreed, attributing much of the recent weakening of non-ferrous metal demand to the fallout from the US-China trade dispute and the resulting slowdown in global economic growth. He is, however, forecasting modest rebounds in global non-ferrous metal demand growth in 2020 – for example, 2.1% growth for copper and 2.7% growth for aluminium.

"There appears to be some light at the end of the tunnel regarding trade issues, especially with the US presidential election coming up," Wilkes said, predicting that a US-China trade deal could be completed in the first half of 2020, which would improve market sentiment during the second half of the year. "While it will take a while for that to be seen in the underlying economic indicators, it should help the metals market to be more positive going into 2021, assuming that we manage to avoid a recession," Wilkes said, which he thought is likely despite the fact that there are still some significant headwinds in the global economy.

Cole had a similar view, observing that the US and China seem to be edging towards at least a "phase one" trade deal. "If they can sign a deal and lift some tariffs, then confidence should start to return to both the industry and to consumers, lifting demand," he said, adding that supply chains have probably become quite understocked given all the uncertainty – especially the supply chains tied to the automotive industry, which has been particularly hard hit. "A recovery in confidence could trigger some restocking, which will result in a further boost to metal demand and prices," Cole said.

Long-term outlook

A spokeswoman for the National Mining Association in the United States voiced optimism for the long-term outlook, declaring, "We are living in the most minerals-intensive time in history and demand for minerals is only set to increase in the years to come." She added that US governmental policies will be a key factor in determining whether the domestic mining industry will be able to meet those increasing demands or whether there will be a continued need to deepen its import reliance.

She pointed out that – as a follow-up on a December 2017 US executive order calling for a federal strategy to ensure secure and reliable supplies of critical minerals – in June 2019 the US Commerce Department, in conjunction with the Department of the Interior, Department of Defense and various other federal agencies, issued a report recommending a number of key reforms to ensure a reliable supply of minerals in the US. It included a call to reduce federal permitting timeframes, improve access to domestic critical mineral resources on federal lands and consideration of mining under projects covered by the Fixing America's Surface Transportation (FAST-41) Act, all of which, she said, holds promise for the domestic mining industry.

China is key

Overall, China is where analysts look for the future of non-ferrous metal markets. Mothersole said that is why there is general concern about the general deceleration of growth there. Despite the intention by the government to double its GDP between 2010 and 2020, Mothersole says that Chinese GDP growth averaged about 6.2% in 2019 and is forecast to fall below 6% in 2020. He said that seems to indicate that additional stimulus might be provided to enable it to ensure that its growth meets that pledge target.

'We are living in the most minerals-intensive time in history and demand for minerals is only set to increase in the years to come'

The Chinese construction sector was clearly not performing as well in 2019 as it had in 2018 and the Chinese automotive sector – much like the automotive market in most major regions of the world – was softer than expected.

"There was hope that we would have seen some targeted stimulus to boost infrastructure investment," Mothersole said, adding that, in addition, there were some hints that there would be "dollops" of construction investment in China, "But that really hasn't materialized to the extent that I thought would occur."

Wilkes said that while grid investment was down significantly year to date through September, it is likely to increase in 2020 as people across the globe start preparing for 5G communications, which is more metal- and power-intensive. This could be especially supportive of underlying copper demand, which Michael Widmer, a Bank of America metals strategist, said, excluding the financial crisis, is currently growing at its slowest rate since the late-1990s.

In its October copper market forecast the International Copper Study Group (ICSG) forecast that, partly because of lower than expected "real" demand growth in China, global apparent usage of refined copper only increased 0.3% in 2019.

However, Carlos Risopatron, ICSG's director of environment and economics, said he believes this will just be temporary and that global refined copper consumption growth is projected to increase by 1.7% in 2020, especially given that the Chinese real estate market is using more copper than it did in 2018. Also, he said that while Chinese utility transmission and distribution network spending slowed somewhat in 2019, such investments in the rest of the world have been very healthy, supported by increased demand for electric vehicles (EVs), given that electric motors rely upon copper to operate. In fact, he said that 600,000 tonnes per year of new copper foil plant capacity has come online to support anticipated growth in that market.

Negative sentiment

While negative sentiment is not unjustified, Mothersole said it is masking what appears to be a tightening global copper market. He observed that the market has been, and remains, in a deficit, with very sluggish mine and refined production growth. Even though the ICSG reported that mine production declined by about 0.5% and that refined production was just up by about 0.5% in 2019, the ICSG is forecasting a 2% increase in mine production and a 4% increase in refined production in 2020.

"On the mine side, the copper industry had its usual share of disruptions, leading to an underperformance that we've become used to," Cole said. He observed that on top of some unplanned outages in the copper mining industry, Freeport McMoRan's Grasberg Mine's transition to underground operations has significantly reduced its output at the same time as another major Indonesian copper-gold mine, PT Amman Mineral Nusa Tenggara's Batu Hijau Mine, is also going through a transition phase. This resulted in about a 300,000 tonne loss in mine production in Indonesia alone.

"Also, a big risk for copper miners is in Chile and elsewhere in South America, given the fiscal uncertainty and political unrest there," Wilkes said, especially given the rapidly weakening Chilean peso. He said that while he is hopeful that there will not be an escalation of tensions, it does have the potential to affect mine supply. Another issue, Risopatron pointed out, is the grade of mine production, including higher levels of arsenic and other impurity in copper concentrates.

Cole said, "2019 has been just about as bad for primary copper smelter and refinery production," given a plethora of setbacks, including lengthy plant shutdowns in Chile for environmental upgrades and shutdowns in Zambia because of power supply problems and concentrate duties. He also noted that this was offset by a huge increase

in Chinese primary copper smelting capacity in recent years.

TC-RCs

Wilkes said that, given low treatment and refining charges (TC-RCs) – as well as low prices for byproduct sulfuric acid – some Chinese copper smelters are operating at a loss, and there could be further downward pressure in 2020 as well. Widmer agreed, noting that expectations are that contract TC-RCs will go from $80 per tonne in 2019 to $62 per tonne in 2020, at the same time as additional Chinese capacity continues to come online, which will result in even more pressure being put upon smelters, keeping their capacity utilization rates low despite projections of a good acceleration in copper demand growth.

ICSG is projecting that the global refined copper deficit will move into about a 280,000 tonne surplus in 2020 from a 320,000 tonne deficit in 2019, despite a reduction in refined copper production outside of China. However, Risopatron said he is uncertain whether the Chinese smelter capacity boon is sustainable if copper concentrate production, which has been stagnating at about 10 million tonnes for the past four years, does not grow. In fact, Mothersole said that, given his expectations of continued supply side weakness, he believes that the market could be at the cusp of a sustained price rally that could take LME prices back up to about $6,500-$6,600 per tonne.

Contrasting zinc

"Zinc is an interesting contrast to copper," Cole said, observing that after three years of zero-to-negative growth in both zinc mine and primary refined production, that started to turn around in 2019, marked by a start up of several new mines in addition to the restart of some old mines. This, however, comes as zinc demand is being hit by a "double whammy" of softer galvanized demand for both construction and automotive applications as well as expectations that zinc inventories could increase in 2020.

Widmer observed that while LME zinc prices, which, while volatile, have been overall well supported, have been coming down, falling to

'Even if we see a positive response in both the automotive market and the Chinese property market, aluminium in stocks are greater than the potential Chinese deficit for 2020'

$2,236/tonne as of early December from a peak of nearly $3,000/tonne in April. He said this has taken some of the upside away from zinc miners at the same time as treatment charges have rallied sharply, providing a lot of pain for smelters.

The International Lead and Zinc Study Group (ILZSG) has forecast a 2% increase in global zinc mine production in 2019, to be followed by another 4.7% increase in 2020. It is also forecasting that global refined zinc metal production will rise by 2.5% in 2019 and 3.7% in 2020.

Given the fragmentation in the zinc market, Widmer said that the increased mine output will be coming from a number of operations, but most notably the ramping up of MMG's Dugald River Mine and Glencore's Lady Loretta Mine, as well as the commissioning of Heron Resources' Woodlawn tailing project and Vedanta's Gamsberg operation. According to ILZSG, 2020 mine output increases will come from several new projects and expansions in India, Kazakhstan, Mexico and Portugal.

While in a 178,000 tonne deficit in 2019, ILZSG is forecasting a 192,000 tonne surplus in 2020, which Wilkes said will put downward pressure on zinc prices and spreads.

On the other hand, Mothersole said that nickel has been the standout metal, predicting that nickel consumption was up about 3% in 2019, with stainless steel production holding up surprisingly well much of the year. But he said that it is somewhat uncertain where it will be going from here, given some of that surge in apparent consumption is related to panic buying with the Indonesian ore export ban expected to go into effect in January, which has been assumed to result in a buildup in inventories, especially in China. Mothersole said that while longer term increased demand for EVs would boost nickel demand, he believes that any meaningful movement in that direction is still at least two to three years away.

"At the moment sentiment is on the backfoot," Wilkes says, especially given expectations that some of the nickel taken out of LME warehouses could be returned in 2020, which could put downward pressure upon prices, which have recently been moving down. "We are currently trying to speculate how low nickel prices will go," Mothersole said, stating that after overshooting on the upside at about $18,000/tonne due to the panic buying, he believes that about $15,500/tonne is a defensible average price for 2020. As of the first week of December, the price had fallen to $13,200/tonne.

Challenges for aluminium

Wilkes observed that 2019 has been a challenging year for aluminium, marked by a progressive downturn in underlying aluminium demand as uncertainty took hold of the market, as well as increases in smelter production and capacity and an abundance of finished product inventories. In fact, he noted that it has been reported that there are over 5 million tonnes of off-exchange aluminium stocks in China alone, adding: "Even if we see a positive response in both the automotive market and the Chinese property market, aluminium in stocks are greater than the potential Chinese deficit for 2020."

But for non-integrated companies, Widmer said it is alumina refineries which are under the most pressure given the low alumina prices – under $300/tonne – now that Norsk Hydro's Alunorte refinery in Brazil is bringing 6 million tonnes of capacity back into a market that is already oversupplied.

Mothersole, however, said that he believes 2020 will be a better year for aluminium, especially given that, absent a recession, he is hard pressed to see it getting much worse. He admitted that his forecast for aluminium consumption growth of under 2% is not very encouraging, "But it is better than the 0.5% or less we saw in 2019." He also sees LME aluminium prices, which were $1,750/tonne as of December 6, as being unsustainable, so they need to come up. But to do so there will need to be some capacity rationalization.

While he said it is China that needs to cut the most, he could not say who will make the "painful" cut. But something needs to happen on the supply side to lift pricing. Clearly companies are already studying the situation. For example, Alcoa Corp said during its third-quarter earnings call that it is undergoing a multiyear capacity review that could result in potential asset sales.

Whither steel and scrap markets in 2020?

Major traders share their outlooks on the markets with Paul Lim

What's in store for China?

"Policies in China are key – they will continue to affect the global steel markets. While global ferrous scrap prices aren't directly linked to the Chinese markets, any movements in the Chinese markets will still affect regional prices trends, and hence regional scrap prices.China will carry on importing metallics in 2020 because it continues to be short on ferrous scrap, especially the higher grades. So, many opportunities remain for semi-finished and metallic imports into China, including HBI, DRI, billet and slab," noted a major international trader handling ferrous scrap and steel.

"Do not expect 2020 to be as good as 2019 – and we already know how bad 2019 was towards the end of the year. While China could export steel in the first half of 2019, it turned into an importer of steel in the second half. This was a very bad situation for steel traders. China may not export as much steel in 2020, compared with 2019, and watch out for new capacities in Southeast Asia coming up to eat away at Chinese market share," said a vice-general manager at a major Chinese trading company. "The China steel markets are likely to remain depressed. The majority of the downstream segments are performing poorly, because of the weak economic growth. And together with continual changes in industrial policies, such as lowering pollution and tighter oversight on the steel industry, the Chinese market will not see any significant upticks in demand."

Ferrous markets outlook?

"The market has rebounded from November onwards and may continue to do so for the short term into December. This means that prices for scrap or steel cargoes shipping in January and February will continue to increase. This can be seen from the recent increase in demand for steel billets by China and the Philippines, as buyers restock in light of higher upstream ferrous scrap prices.

"The need for semi-finished steel and ferrous scrap will also continue to increase for this reason, so smaller mills that aren't already running their meltshops will start running their EAFs again, which means they will need more scrap in the short term. What's a little unclear is what will happen after the Lunar New Year at the end of January, and that will depend somewhat on the US-China trade war and how it affects demand and supply.

"Turkey hasn't been affecting the Southeast Asian steel markets much, because of their high scrap prices and corresponding high offers to the region. So a lot of market sentiment will take direction from China again in the first quarter of 2020," observed the general manager at a major Asian trading company

"There has been a lot of price erosion over the past couple of months in 2019. The steel industry as a whole will remain under pressure, until there's a rebalancing of global supply and demand. There are limited signs of any upticks in demand, however. Chinese demand will also slow, so 2020 is currently lacking any firm support. There will have to be some cuts in production, before prices stabilize or go on an uptrend," noted the managing director at an international trading company.

Which markets deserve attention?

"2020 may see a lot of scrap export activity from Japan, putting pressure on competing supply from the United States. However, Japan has typically not been a containerized scrap exporter, so they need to upgrade their port and logistics facilities. For example, Japan is loading ferrous scrap at a rate of 1,000-2,000 tonnes per day, compared with the 3,000-3,500 tpd required by some sellers. Freight and scrap spot prices change very quickly, so such slower loading rates may affect their business," said the general manager at a major Asian trading company.

"Asia is growing as a whole, especially Vietnam. However, the Malaysian and Indonesian markets aren't performing that well. There were some expectations that they would increase their demand after their election but it hasn't happened so far. The one major factor that will drive growth in Asia will be the end of the US-China trade war," noted a major trader.

"Bangladesh is one to look out for, especially with its growing economy. We expect steel consumption in the country to be relatively strong compared with other regions in Asia. And because certain domestic regulations impede the imports of finish steel productions, local steel mills have dominance in that market. So Bangladesh's scrap requirements will continue to grow and it should be a good market for ferrous scrap. It also doesn't have plans for domestic scrapyards yet. The markets in India and Pakistan should also continue to grow in the medium term, but they are facing economic headwinds at the moment," noted the managing director at an international trading company

What's the best way to reduce risk?

"Buyers and sellers should maintain smaller trading volumes and keep short-term shipments. Volatile government policies, such as the ones recently imposed by Indonesia, also pose a significant risk to trading. So another piece of advice is to not increase trading volumes sharply or look to expand market share aggressively in 2020. What's happening in Indonesia now is technically not enforceable, so there will be a shortage of ferrous scrap from now until the policy firms up," said the general manager at a major Asian trading company.

"While demand is stable, it is not great – and supply has far outstripped demand. Market participants must take great care not to take on too much risk and to be more conservative in 2020 as prices are very volatile. The best way to handle ferrous markets will be to not buy too much, as I still feel prices will remain subdued in a bearish 2020. There's a lot of supply in Asia now, and more will come in 2020," noted a major trader.

"Stay very versatile and flexible and expect the unexpected. The world is not one where it is possible to make very accurate predictions, so trading strategies have to adapt accordingly. However, market participants can try to increase their acceptance of derivatives trading, where they can trade underlying commodities without the hassle of physical execution or counterparty performance. There are still some obstacles to overcome and it is not easy to trade derivatives, especially as it can be a partial hedge if there are no physical materials indexed against it," concluded the managing director at an international trading company.

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Aluminium premiums tell the story

Aluminium premiums are a strong indicator of the fortunes and outlook for the metal, report Alice Mason and Justin Yang

Participants are taking a cautious approach to the aluminium market in 2020, with poor downstream demand and low product premiums threatening already-tight margins in the industry. Premiums for downstream products such as aluminium billet in the United States and Europe are both at record lows, forced down by an absence of demand this year – a trend that is expected to continue. The demand drought has primarily been driven by a decline in the global automotive sector, sparked mostly by US-led trade wars.

"The automotive sector remains the key headwind for demand. Transport accounts for 38% of US demand; 31% in Europe; and 48% in Japan. These three markets have all seen contraction in 2019 autos sales – and our global automotive team see further potential downside in 2020," analysts with Morgan Stanley said in December.

Aluminium product premiums have reacted accordingly, with premiums for billet in Europe at record lows. Fastmarkets assessed the aluminium 6063 extrusion billet premium, ddp Italy (Brescia region) at $280-300 per tonne on Friday December 6, down from $290-310 per tonne the week before. This marked the lowest level since Fastmarkets launched the assessment in 2012.

Meanwhile, Fastmarkets' assessment of the aluminium 6063 extrusion billet premium, delivered Midwest US fell to 6-8 cents per lb on November 22 from 6.5-8.5 cents per lb on November 8, with supply continuing to outpace demand. This too is a fresh all-time low since Fastmarkets began assessing the US premium in March 2010.

P1020 premiums

The tepid product premiums have other producers scouring for niche markets that could provide better margins. "Margins don't work for people and of course people will flick the switch. The P1020 is one stage less already and there is still an oversupply of billet and foundry," a trader source said. "The end-user markets for them aren't getting any better, things need to diversify," he added. At current premiums participants expect producers to switch from value-added product production to P1020, where the opportunity cost to produce ingot is lower.

"The thing is when you look at the record-low billet premiums, I don't understand how any producer can argue for producing more. Some people upped it when the Rusal situation happened but how can you sustain that?" a second trader source in Europe said.

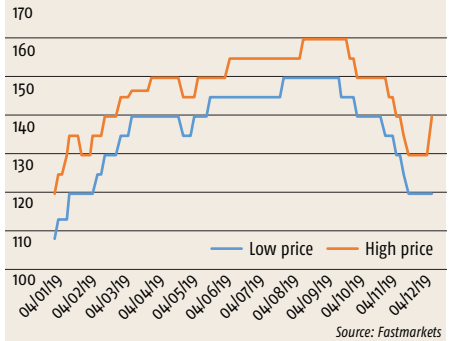
Some point to the recent proposal of a maximum 20% curtailment of Norsk Hydro-majority owned Slovalco, which produces aluminium products, as a symptom of the weak market. "Finally, producers are thinking about shutting down billet production," a producer source in Europe said. Producers Rio Tinto and Alcoa have also launched reviews of their smelter portfolios.

Although currently P1020 premiums remain muted recently due to the persistent backwardation in LME spreads, the premiums have overall had a stronger 2019 than product premiums. Fastmarkets assessed the benchmark aluminium P1020A premium, in-whs dup Rotterdam at $70-80 per tonne on Friday December 6. The midpoint of the premium averaged $81.55 per tonne in November, up by 18% from a monthly average of $69.09 per tonne in January.

"Duty-unpaid material can be easier for producers to manage because there are other ways [cash and carry] to make your money and you are less reliant on the end-demand being strong," the first trader source said.

A rise in P1020 production could theoretically be slightly bullish for the duty-unpaid Rotterdam because an inflow of more P1020 supply into the LME could lead to wider contangos in the forward spreads. Higher contangos are supporting of premiums because they cover the cost of carry for market participants, meaning they need a higher incentive to sell their material. Throughout 2019, the duty-unpaid market was well supported when LME spreads were in wide contangos.

Aluminium P1020A premium, in-whs dp Rotterdam, $/tonne



Source: Fastmarkets

Fastmarkets' aluminium P1020A premium, in-whs dup Rotterdam hit a 2019 high of $105-115 per tonne on September 4, well supported by the $30 per tonne contango in the benchmark cash/three-month spread. "With the [LME contango], the duty-unpaid premiums will recover quite quickly, the duty spread in Europe will continue to be a bit on the tight side," a third trader source in Europe said, referring to the theoretical 3% duty that needs to be paid when taking duty-unpaid metal in for consumption in Europe.

Despite tougher market conditions for duty-paid material this year, the premium has also held up better than billet premiums. Fastmarkets' assessment of the aluminium P1020A premium, in-whs dp Rotterdam averaged a midpoint of $131.11 per tonne in November, up from a monthly average of $123.13 per tonne in January. And in spite of margins being squeezed for value-added product production, some producers remain positive that they can still make their money on products in 2020.

"The numbers are tough right now, very tough. But if too many producers go to primary then we will be in the same situation. There is a market for some products, you can make it work, you just have to have the right customers. Billet is painful but things like slab are good," the producer source said.

The tightness caused in the product market when US sanctions were imposed on Russian producer Rusal in April 2018 meant that several aluminium participants decided to opportunistically trade products. At the height of billet market tightness, Fastmarkets' aluminium 6063 extrusion billet premium, ddp North Germany (Ruhr region) hit a record high of $560-600 per tonne.

"You can make the premiums on the product, producers will still produce both but it is not a shock if people change their percentages to do more primary. People always want to buy that stuff, but we have good contracts and we are able to sign volume," a second producer source said. "People are happy if your billet is good, of course you cannot get good numbers for certain origins. Maybe those people who jumped on our bandwagon [in 2018] will stop now," he added.

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China seeks to export Shanghai copper benchmark and yuan via new contract

More of the world's copper looks likely to be priced in China from 2020, with the Shanghai International Energy Exchange (INE) set to launch a new contract tradable by international market participants, reports Archie Hunter

The decision by the Shanghai International Energy Exchange to launch a new contract tradable by international market participants, pending regulatory approval, would enable market participants based outside China to trade copper based on a Chinese price, sources told Fastmarkets.

China, which is the world's leading consumer of copper and many other commodities, has moved to internationalize the trading of its commodity futures in part to promote the use of the Renminbi beyond its borders.

But an internationally traded Chinese copper contract could also have profound impact on the global copper market by expanding the current Shanghai Futures Exchange price into a regional benchmark and encouraging greater arbitrage with more global contracts, market experts said.

"It's about developing a service so that the producers and consumers in the Asia region can participate in the regional benchmark, which is the Shanghai price," John Browning, managing director of China-focused brokerage BANDS Financial told Fastmarkets. "It's providing a hedging mechanism through which these guys can hedge and hedge in yuan."

Crude oil beginnings

The INE, which is a subsidiary of the Shanghai Futures Exchange, launched several yuan-denominated crude oil futures contracts in 2018, which have built up significant traded volumes.

Rather than having to go through the regulatory steps of setting up a wholly foreign-owned enterprise, staffing it and then applying to trade SHFE commodities futures, international market participants will simply be able to place trades through brokers with domestic entities themselves.

The INE's proposed copper contract will work through a similar process, being physically settled against stocks stored in Shanghai bonded warehouses rather than domestically and with clients able to use US dollars as initial margin.

"The crude oil futures contracts launched by INE have been quite successful, providing China [with] the confidence to start copper contracts. Both crude oil and copper are important to China and having some pricing power in the global markets [will be] beneficial," Donald Lien, distinguished chair in business at the University of Texas at San Antonio, told Fastmarkets.

Having the INE and SHFE so intrinsically linked but with the former focused on trading from abroad and the latter serving domestic customers is a different system from other newly internationalized contracts such as the Dalian Commodity Exchange's iron ore futures.

With the Dalian exchange, international participants beginning to trade the contract were plugging into an already existing pool of liquidity rather than a new derivative being set up.

"You could probably get most of the liquidity pool already active in the SHFE copper contract [to trade the INE contract, thereby] probably getting a very good chance of kick-starting liquidity in the market," according to Peter Zaman, a partner at law firm Reed Smith, who has advised several international players on accessing the Chinese commodity markets.

Adding international participants to the liquidity of Chinese commodity contracts will increase the use of the yuan, which China has a stated aim of boosting as a major global reserve currency. Institutional investors settling trades on the INE contracts, by necessity, need to hold yuan to make any trades.

"The overall mission is two-fold: first, they want the underlying commodity to be priced in yuan instead of US dollars; and second, by requiring the settlement of the offshore contract in yuan by foreign investors, they are helping with the internationalization of the currency," Zaman said.

Arbitrage opening

The other exchanges with benchmark copper contracts – the LME and CME – will hope that a successful launch encourages higher volumes through trading arbitrage differentials between a China price and their own contracts.

"Having a more freely accessible market for traders to trade the arb between the different centers would in the short term certainly be an extremely positive development for the CME," its senior director for metals, Sachin Patel, told delegates at the Asia Copper Conference on November 21 when asked about the potential for the then-unreported internationally traded Chinese copper contract.

While market participants can already trade the difference in these markets, sometimes it must be done in roundabout ways. Domestic Chinese physical traders have long profited by taking LME-priced copper cathodes out of the bonded zone and moving them to SHFE-priced China when there is a large differential between the two. New contracts could be a venue for non-physical market participants to target such price movements.

"If you have the ability to arbitrage between Comex, the LME and the INE, that's just going to encourage more trading on all those respective markets," Reed Smith's Zaman said. "However, you're probably looking to attract a slightly different group of market participants – hedge funds or pure proprietary traders."

Steel market woes are weighing on refractories

Pressure is continuing to mount on the refractories sector while its main market – the steel industry – suffers from overcapacity, trade tensions and emissions reduction targets, Rose Pengelly finds

The refractories industry has had another testing year. According to US-based procurement intelligence firm Beroe Inc, trade in refractories in 2019 was largely a buyers' market, due to supply surpluses and strong rivalry between around 1,500 refractory suppliers globally, effectively giving consumers the power to dictate prices for some products.

Given that the steel industry, the biggest market for refractories, is generally experiencing entrenched difficulties with low prices and overcapacity, this picture is unlikely to alter significantly in 2020. Consequently, competition to sell refractories to steel producers has never been fiercer.

Stefan Borgas, former president of the World Refractories Association and chief executive officer of Austria-headquartered refractories producer RHI-Magnesita, fears that rather than driving refractories companies to differentiate products through quality and performance, competition is making the market more concentrated. "The refractory industry must finally have the courage to make a turn toward the future," Borgas said at the Unified International Technical Conference on Refractories (UNITECR) in Yokohama, Japan, in October 2019. "If we keep following a set route, the industry will shrink, consolidate and commoditize," he added.

SHUTTERSTOCK

The fortunes of steelmakers and foundries are having an impact on markets for refractories

The risk of commoditization, where refractory products essentially become fungible and are treated as equivalent to each other, regardless of who produced them, is not new, but remains one of the refractories industry's biggest concerns. This is because it weakens the power of producers to set prices and allows market forces to determine the value of products, with potentially crippling consequences in oversupply situations.

Some parts of the refractories market, particularly at the raw materials end, have already accepted commoditization, partly in response to demand from buyers for recognized standards across certain product types.

India's Carborundum Universal (CUMI) refers to its electro minerals division (EMD), which produces refractory mineral products including

brown and white-fused alumina, silicon carbide and zirconia materials, among others, as operating in a "commoditized" segment of the market, describing it as "market-driven… where the volatility comes up and where price increases can be pretty quick, depending how the market is moving."

Refractories producers fear that handing more bargaining power to struggling buyers, especially in the influential steel sector, will set pricing precedents that will prove extremely tough to shake. The risk of losing ground in price negotiations is exacerbated by the fact that specific consumption (the amount of refractories consumed per tonne of steel produced) is falling and the World Steel Association (Worldsteel) has hinted that it expects the number of steel producers globally to shrink in response to structural overcapacity. "Excess capacity is a global problem requiring coordinated global solutions," an association spokesperson said.

In 2019, the Organisation for Economic Co-operation and Development (OECD) put global excess capacity at around 425 million tonnes, which Worldsteel notes is significantly less than the 737 million tonnes calculated by the Global Forum on Steel Excess Capacity (GFSEC) in 2017, but still requires drastic cuts to bring the market back into balance.

"Worldsteel's position is that governments should promote a swift and timely restructuring of the steel industry by advancing policies that ensure market forces play a decisive role in determining the future of the industry. Market-oriented approaches should ensure survival of the fittest producers," Worldsteel said. If policymakers follow the association's recommendations, then refractory demand is likely to be hit severely.

Unsurprisingly, the jostling among refractories suppliers for steel customers means that refractories procurement ranks low on the list of concerns for most steel producers. "It's not an issue our members raise, either as an innovation challenge or an ongoing capital investment challenge," a spokesperson for UK Steel, the trade association that represents British steelmakers, said. "At the heavy end of the blast furnace side, refractories' lining and re-lining of blast furnaces is a big element and a huge capital outlay when it does come up. But it's not something we're worried about in terms of access to the best technologies. It's not a specific challenge for the sector," they added.

'Dumping continues to be an issue, as do trade wars and the 25% tariffs in the US'

Similarly, Worldsteel does not highlight access to refractories as a problem for steelmakers. "[A much bigger] technological challenge for the industry is climate change," the spokesperson for the association said. "We estimate that the steel industry accounts for between 7% and 9% of global carbon emissions," they added, noting that the industry's major focus is on finding technologies that help cut CO_2 emissions in steelmaking.

Another unrelenting issue for steelmakers, according to UK Steel, and one that also affects refractories, is increasingly unfavorable international trade relations and, for British steelmakers especially, the United Kingdom's pending departure from the European Union.

"Dumping continues to be an issue, as do trade wars and the 25% tariffs in the US. Given the UK exports half the steel it produces and 70% of that goes to the EU, anything that impacts on our ability to trade with the EU is going to have a major impact," the spokesperson said. "Because of the trade wars, there are a lot of protectionist barriers that have gone up. We will get caught in the middle of that if we don't have an orderly Brexit," they added.

Trade wars

While steel has been at the center of trade disputes between China, the United States and the EU, refractories have flitted in and out of the firing line, with the US ultimately deciding not to penalize imports of refractory materials deemed critical to US steelmakers. The threat of tariffs nevertheless creates uncertainty in the refractories industry, especially for Chinese companies and international refractories producers with Chinese operations.

In their results statements for the first half of 2019, both UK-based refractories manufacturers Vesuvius and RHI-Magnesita cited potentially disruptive effects on global trade from increasing geopolitical tensions and the adoption of new trade barriers and tariffs by several countries as principal risks and uncertainties for their businesses. Added to this risk is the fact that it is becoming increasingly difficult to resolve trade spats.

Until recently, trading nations could appeal to the World Trade Organization (WTO) on behalf of unhappy industries to arbitrate disputes. But recently, mounting frustration with this approach has come to a head. In December 2019, The WTO's appellate body, the highest authority in its dispute settlement system, was suspended after the US' policy of blocking judicial appointments because of what it believes is the body's tendency to overreach its remit left the panel short of the required number of judges.

The suspension is a blow to the concept of rules-based international trade, at a time when the US' policy of using punitive tariffs as a negotiating tool, and China's willingness to exploit gaps in the WTO's rule book, threaten to create an increasingly aggressive trading environment for steel and refractory products.

WTO archives show that the body has dealt with 33 disputes concerning steel (excluding steel pipes and stainless steel products) and advised on 16 issues involving refractories since it was founded in 1995. The EU, Japan and Canada have expressed particular anxiety about the fate of the WTO,

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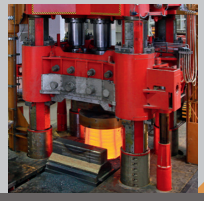

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fearing it could become irrelevant if a compromise is not reached soon.

Andrew Hood, a trade lawyer at European law firm Fieldfisher, said that while suspension of the appellate body is concerning, the international trade system is not at risk of imminent collapse. "Although the appeal body could cease to operate, for a short time at least, the rules it oversees will continue to be in place and countries should continue to observe those rules," he said. "Any disputes over international actions in breach of WTO rules will still have to go through the preliminary WTO procedures to try to be resolved. In theory, therefore, there should be little immediate impact, even on sensitive raw materials like steel."

Like worried national trade officials, however, Hood believes that if the suspension continues for some time and trade tensions rise to fill the vacuum, there could be increasing fragmentation of the international trade order which he says "could well see countries stretch – if not break – WTO rules".

The EU, some international organizations and national governments are looking at potential stop-gap measures that can be put in place to ensure resolution of any disputes that occur while the WTO appellate body remains suspended are dealt with.

But given that any interim measures would merely be a less robust alternative to the WTO, its proponents hope that this latest crisis will focus minds of its members and encourage necessary reforms to bring powerful countries like the US back on side.

Innovation in refractories

While the refractories industry is used to reacting to shifts in demand among its end-user industries, which aside from steel includes cement, glass and foundry, some, such as Borgas, think this inclination to follow rather than lead has made industry too reactive when it should be proactively innovating to anticipate structural changes in its core end-markets.

'New technologies being trialed include sensors and monitoring for improved control and instrumentation, big data and use of artificial intelligence'

Professor W E "Bill" Lee Freng, co-director of the Institute for Security Science and Technology at Imperial College London who also sits on the technical advisory boards of RHI-Magnesita and UK-based Morgan Advanced Materials, says refractories companies do try to keep ahead of their markets. "A small group of international experts [who make up the technical advisory boards] meet the companies' senior technical teams about twice a year to look for where innovation will appear and guide their future research and development programs," he said.

New technologies being trialed include sensors and monitoring for improved control and instrumentation, big data and use of artificial intelligence and machine learning to analyze outputs. "I really see a future for complex quaternary and higher order non-oxide systems with application of machine learning to design new compositions [of refractory materials] with improved properties," he said.

Some companies have an apparent preference to fund industry-based R&D, often close to major production hubs. In its 2019 half-year results statement released in July, Vesuvius said that accelerating R&D efforts at its research facility in Suzhou, China, was a key priority for the company.

Vesuvius said it is also planning six waves of new product launches in the space of 18 months and that it spent nearly £15 million (about $20 million) on innovation in the first six months of 2019 (although this was down from nearly £17 million in the same period in 2018).

RHI-Magnesita, meanwhile, has committed to spend 2.2% of annual revenues on innovation, which equated to around €31 million in the first half of 2019. Other smaller producers have more modest innovation budgets, but a significant chunk of refractories R&D spending is necessarily focusing on how refractory materials perform from an emissions perspective, rather than strictly on the benefits they impart to the end products they are being used to make, according to Worldsteel and Professor Freng. "Clearly, efforts are focused on improved energy efficiency, reduced pollution and application of new technologies to refractories processes," Freng noted.

"There is no technological silver bullet that will work for steel producers in different contexts all over the globe, but rather there will be a suite of technologies which will help dramatically reduce CO_2 emissions in primary steelmaking," Worldsteel said, pointing to renewables-powered hydrogen projects in Sweden, carbon capture in United Arab Emirates and bio-ethanol operations in other steelmaking locations as evidence of the steel sector's efforts to decarbonize.

Outlook

There is a general sense in the refractories market that conditions will get worse before they get better.

Vesuvius said in July that it had "experienced challenging end markets in H1 2019" and did "not expect a recovery in H2 2019." More optimistically, the company added that "in the medium term and beyond, our core end-markets in both steel and foundry are structurally growing."

Other refractory manufacturers made similarly somber near-term forecasts with slightly more positive long-term horizons.

What the predicted restructuring of the steel sector will mean for the size and shape of the refractories industry remains to be seen, but in spite of Borgas' plea for the refractory industry to have the courage to make a turn toward the future, many expect there to be further shrinkage and consolidation, if not commoditization.

China's magnesia recovery slows

Overcapacity in China's magnesia sector and shrinking international demand have roiled the domestic market this year, dragging prices to a two-year low and prompting producers to lower output, reports Carrie Shi

Fastmarkets' price assessment for magnesia, fused, 97% MgO, Ca:Si 2:1, lump, fob China was $550-650 per tonne on November 26, down by around 65% from $1,600-1,800 per tonne at the end of 2017.

Magnesia prices were low for many years until 2017 because of uncontrolled domestic competition for market share against a backdrop of excess capacity. Capacity was around 20 million tonnes per year at its peak, according to market participants. Prices subsequently surged to a historical peak two years ago due to the government's imposition of mining controls and a ban on extracting magnesite by using explosives at that time, creating a short-term shortage of material.

Unable to operate with explosives to access deep-lying high-quality ores, producers turned to using drilling equipment to source magnesite or added more flotation lines that can process low-grade ore to produce qualified magnesia. This caused supply to drop, triggering the sharp increase in prices.

From a very low base, combined capacity at the magnesia flotation production lines – built and planned since the mining controls were introduced in 2017 – in Liaoning province has ballooned to 6 million tpy, Liaoning Special Resources Industry Development Center said in September. The Center is a subsidiary of Liaoning Provincial Committee of Industry and Information Technology, which is responsible for the protection and management of magnesium, boron, talc, bentonite, jade and other industrial special resources in the province.

Total capacity for all types of magnesia in Liaoning province – the country's magnesia production hub, accounting for more than 90% of total domestic capacity – exceeds 28 million tpy, but the utilization rate there is currently below 50%. Market participants estimate that 2019 production will be around 14 million tonnes, including caustic calcined magnesia, dead burned magnesia and fused magnesia. China's magnesia output typically accounts for more than 60% of global production.

"Increasing flotation production lines for magnesia has brought more stock to the spot market," a Chinese magnesia producer told Fastmarkets. "Our operating rate is around 50% now and it is quite hard to sell under current sluggish market conditions."

Environmental regulations

The Liaoning government has aligned its efforts to regulate the local magnesia industry with central government targets on controlling pollution and promoting the healthy development of markets. In the production hub of Haicheng in the state, strict mining controls from 2017 to 2018 prohibited the extraction of magnesite using explosives. As well, all magnesite mining was suspended for more than 18 months during 2017-2018 while environment inspections and safety checks were carried out.

In 2019, although some major producers received explosives earlier in the year, their use was limited to rock stripping. And between August 1 and October 31, the government enforced another three-month halt on magnesite mining to coincide with a national holiday in China.

Still, prices were pressured lower by the presence of stocks that had accumulated previously. As well, Daishiqiao and Xiuyan – two other magnesia production hubs in Liaoning province – did not ban magnesite mining outright, given producers there easy access to raw magnesite ore for processing.

"Due to sufficient supply and inventory, the stoppage of magnesite mining in Haicheng had a limited effect on supporting magnesia prices. We have no choice but to lower prices to secure deals in such a quiet market," a second producer said. "I heard talk about stopping all magnesite in Liaoning province – not only in the Haicheng region – but I'm not sure whether it will officially be carried out next year," the second producer added.

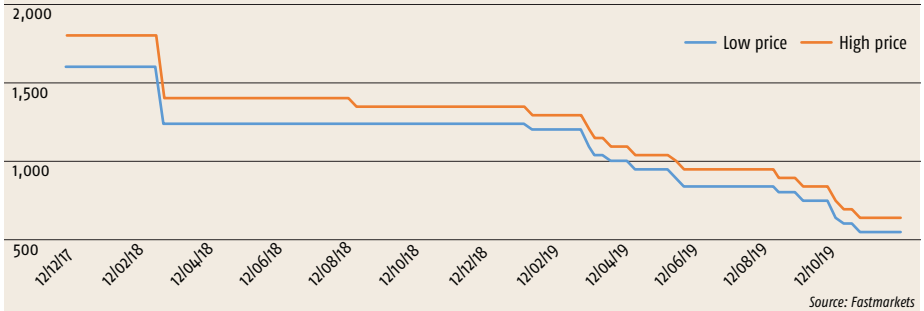
Outlook

Accumulated overcapacity will continue to put downward pressure on prices alongside weak demand – especially for fused magnesia – from sluggish end-use sectors such as steel, cement and glass. According to official Chinese customs data, China exported 304,898 tonnes of fused magnesia in the first 10 months of 2019, down 30.2% from 436,722 tonnes a year earlier.

Any recovery in the magnesia market will take some time to emerge, market participants agree. "With the approach of the Christmas holiday in December and Lunar New Year in January 2020, the magnesia market will not recover in the short term," a third Chinese producer said. "I don't think a recovery will happen in the first quarter of 2020."

"Because most producers are still suffering from high stocks and reduced buying from downstream buyers, I think it will be hard for the whole magnesia market to pick up in the first half of next year," a buyer added.

Magnesia, fused, 97% MgO, Ca:Si 2:1, lump, fob China, $/tonne



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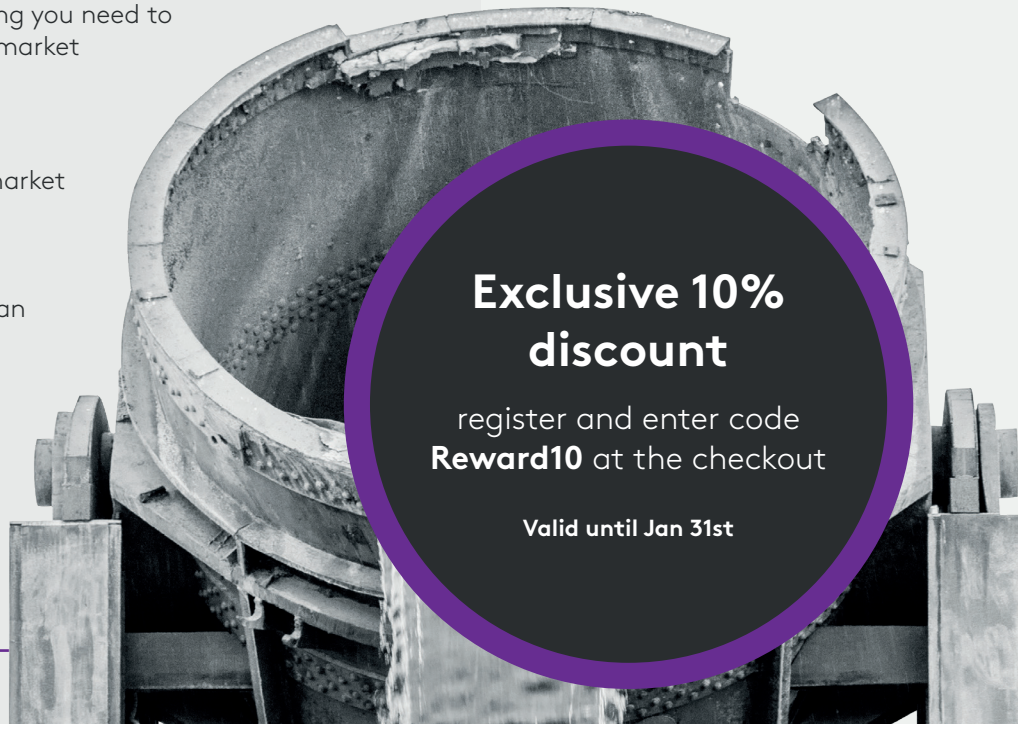

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Calcined alumina outlook

Suppliers debate whether calcined alumina can break the oversupply wall in a bearish 2020 scenario, writes Davide Ghilotti

Market participants active in calcined alumina have been debating whether the sector has slid into oversupply because of bearish end markets or if the previous overstocking phase has a little life left in it – and how that may play out in a slow 2020.

Availability of calcined alumina volumes has improved drastically compared with the 2016-18 period, during which material was scarce and prices rose steadily. Following two years of tightness, the market then turned in a matter of months into 2019. The smooth running of operations over the past year led to improved timeliness of output and deliveries to customers after a 2018 characterised by delays, production problems and insufficient volumes.

Demand, meanwhile, slowed in the first half and took a sharp hit in the second half, affected by the woes of the refractories and steelmaking end markets. "Europe is very weak but demand in China is also down a lot," one seller said in mid-November, noting how the decline in trade to China is exacerbating the stock situation elsewhere.

Cost and prices

As a result, market prices during 2019 gradually came off the highs set at the beginning of the year.

Fastmarkets assessed the price of alumina, calcined, ground, 98.5-99.5% Al_2O_3, bulk, exw US/Europe, long-term contract at $740-900 per tonne on December 5, down from $860-1,000 per tonne in January – a drop of 12% on average. Fastmarkets' price assessment for alumina, calcined, unground 98.5-99.5% Al_2O_3, bulk, exw US/Europe, long-term contract fell to $670-800 per tonne in early December from $750-850 per tonne in February, down by 8%.

For both grades, the low end of the range is now lower, or very close to, where it was at the start of 2018 while the top end remains slightly higher.

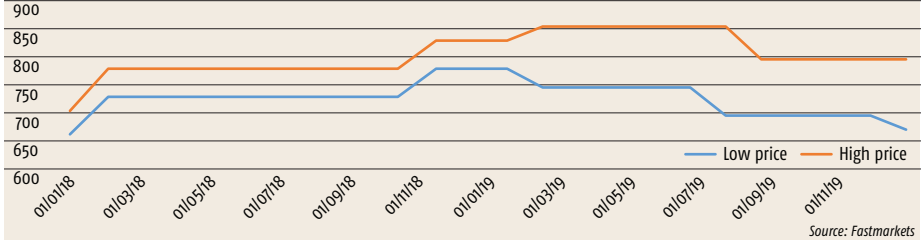
Suppliers had to give in to lower prices while consumers pressured for discounts. By the time of writing, both the sell and buy side tell Fastmarkets there is no rush to close new-year contracts. Negotiations are proceeding slowly and will probably extend into the first quarter of 2020. Some producers believe the sector is still facing the tail end of a previous overstocking situation, which was exacerbated throughout the year by worsening end markets rather than chronic oversupply.

"We could still be seeing a lag due to overstocking previously. If that's the case, it could balance out at some point, even amid bearish [end market] conditions," one producer said. "Oversupply is a different kind of animal."

Suppliers have called for output to be curbed at this time to reduce flow of material into the market at a time of continued destocking. This, they argue, would help cushion against the hardest price drops. "We're not running [at] full [capacity]. I don't expect anyone is right now," a second producer said. "We should adjust production instead of drastically reduce prices."

On their part, buyers conceded that inventory levels remain high despite users having sought to de-stock for most of the year. One refractories producer that had a strong year despite the widespread slowdown, owing to its exposure to non-steel markets including glass and petrochemicals, said in December: "We still have plenty of stocks, even considering the increased order book. We are not looking to lock new supply right now."

Alumina, calcined, unground 98.5-99.5% Al_2O_3, bulk, exw US/Europe, long-term contract, $/tonne



Source: Fastmarkets

Another refractories manufacturer in Europe added that the tightness of the previous years had all but dissipated, giving way to high availability and unsold material sitting in warehouses. "We feel the oversupply is evident, as in other refractory raw materials. Until end markets do not improve, we cannot see how this would change. There will be more bearish price pressure," he said.

Cost structures for suppliers have eased somewhat compared with previous years. One major producer told Fastmarkets that energy costs in 2019 have fallen, caustic soda sourcing has not been problematic and the smelter grade alumina (SGA) feedstock price has dropped. SGA or alumina hydrate (ATH) are the main feedstock for speciality calcined non-met alumina products.

The Fastmarkets daily alumina index, fob Australia, fell to below $280 per tonne on December 10, after losing 30% since January's levels of close to $400 per tonne. This has allowed producers to contain costs in a bearish market scenario, although those sellers with particular exposure to SGA may be able to exploit it more than others.

Connection to SGA market

Participants note how a closer connection than before is being formed between the speciality calcined alumina industry and the metallurgical SGA market. Recent corporate moves, including Almatis' divestment of its Burnside alumina refinery in the US to Arthur Metals last July, have supported this. "With Almatis selling off Burnside, only very few of the main players are still vertically integrated, with their own refining facility," one producer said. "Everyone else sources third-party feedstock, mainly SGA or ATH."

Crucially, this means that calcined alumina producers are more exposed to the volatility of the SGA market at times of increasing met grade prices and have more leeway to exploit lower SGA prices on the way down. "Now that the alumina price is down, the companies who don't produce SGA themselves have more ability to drop their market prices and can go lower compared with a vertically integrated producer who has fixed costs," one said.

As a result of a higher share of the market sourcing third-party feedstock, participants expect closer correlation between the SGA price and the prices for speciality calcined alumina, potentially creating higher volatility in the non-met space.

Will aluminium prices be lower for longer?

Aluminium prices fell during 2019. Dan Smith analyses the reasons for their decline and assesses the outlook for 2020

There is little doubt that 2019 was a tough year for aluminium producers. LME prices have been on a steady downward path since the middle of 2018 and by early December 2019 were down by 11% from a year earlier – making it one of the worst performing base metals.

One of the biggest surprises has definitely been demand – and more specifically the weakness of Chinese demand, which currently accounts for over half the global total. Over the past couple of decades aluminium consumption has nearly always been a bright spot within the base metals complex, as the light metal has gained market share at the expense of heavier materials, such as copper, zinc and steel, in industries such as automotive and construction. Aluminium producers have consequently become accustomed to decent growth rates of around 3% per year in the past few years. With aluminium demand likely to fall in 2019 for the first time since the 2008/2009 global financial crisis (GFC), the pressure is building on the major producers to retrench quickly or face even lower prices.

Aluminium is particularly exposed to the transport and automotive sector, which in the past has been a blessing, but this has turned into a curse. Global car sales are likely to drop by around 4% this year, according to Fitch Ratings, which is similar to the declines experienced back in the dark depths of the GFC. One significant difference is that China boosted car sales during the GFC due to a massive stimulus package, whereas this time around the government is treading cautiously and the country is helping to lead the way down. Chinese passenger car sales were down by an alarming 10% for the first ten months of the year, according to LMC data, and down by 4% year-on-year in October alone. The automotive sector accounts for around 30-40% of global aluminium consumption.

So why is China so weak, and more importantly will these problems extend into 2020? There is both bad and good news on this front.

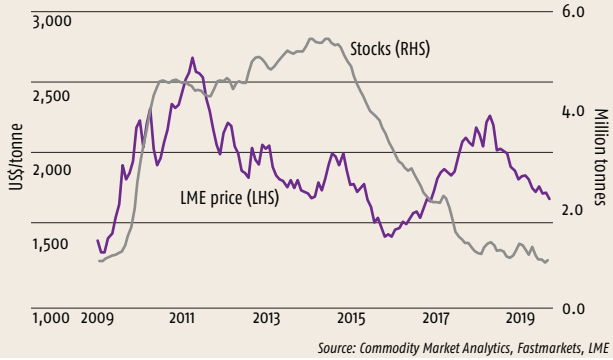
Anybody looking for bad news will focus on the global trade war and slowing macroeconomic data to support their argument. GDP growth slowed from 6.6% in 2018 to 6% in Q3 2019 and industrial production growth (IP) has slowed more sharply from 5.9% to 4.5% over the same period. It is certainly possible that falling car sales are indicating that the economy is already in trouble and the rumbling debt problem could worsen in the next 12 months. Indeed, the country's central bank has been warning in recent months about high levels of household debt in particular, as repayments could adversely impact consumer spending and the broader economy in the near future. However, while a credit crunch in 2020 is a risk to the economy and the aluminium market, it looks to be only a minor one. More likely the trade war with the US will slowly ease ahead of the US elections in late 2020, and the Chinese economy will benefit from a better environment for trade.

What about the good news? Certainly, part of the problem is that one-off headwinds are creating temporary problems for the automotive sector and once these dissipate China (and the world) will see car sales improve.

There are three potential headwinds in China (although similar problems apply to other parts of the world) – VAT changes, emission standards and electric vehicles. First the Chinese government cut VAT on small cars back in 2016 and 2017. This dragged sales forward as consumers rushed to take advantage of lower prices, and a return to normal VAT levels has created a hangover for the industry.

The second headwind has been the chaotic introduction of new emission standards this year as cars will soon need to meet Euro VI standards, rather than Euro V standards. Many car producers were told by local governments in mid-2019 that they would need to stop selling the old models earlier than expected, leaving them with a large amount of unsold stock. Shanghai, for example, moved to the tighter standards a year ahead of the original deadline of July 2020. Other cities and regions have moved early to implement the change. While this is good for the environment, many car makes have been caught out by it.

Aluminium searching for a floor once more



Source: Commodity Market Analytics, Fastmarkets, LME

The transition towards electric vehicles (EVs) is also creating a dislocation in the Chinese car industry and reduced incentives have caused EV sales to plummet in recent months. New energy vehicle sales were down by 46% year on year in October.

At least some of these headwinds for Chinese vehicle manufacturers will reduce in the year ahead, creating a more stable environment for car sales and potentially helping aluminium demand. Furthermore, while the problems in 2019 have been significant, more important is to focus on the longer-term dynamics. Vehicle ownership in the country is still low by international standards at 18 cars per 100 people. The US, by comparison, is at 95 cars per 100 people. This shows that there is still potential for significant growth in China in the years ahead, assuming that incomes continue to rise and roads can be built to accommodate greater traffic volumes.

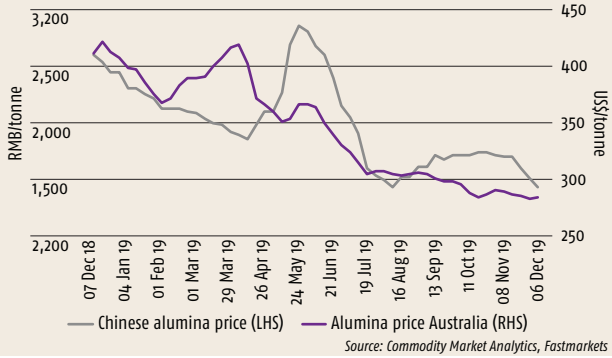
Will low margins force cuts?

The next key issue when thinking about the outlook for aluminium is whether Western producers be forced to cut output due to low margins in 2020? When considering this, alumina prices will inevitably help to determine where the cost floor should be for the smelting industry.

Not surprisingly, the metal and raw material price have tracked each other lower for the past 18 months. In April 2018 alumina prices briefly soared above US$700 per tonne, as the Alunorte refinery in Brazil was forced to halve production due to environmental regulations. The refinery can produce around 6 million tonnes per year of alumina, which is equivalent to 5% of global aluminium output. Through most of 2019, alumina prices fell and by end-November were down to US$374 per tonne – down by 61% from their peak.

Generally speaking, the industry view is that alumina prices will face more downward pressure in 2020, as the situation at Alunorte appears to be stable and buyers burned by recent volatility look to expand supply from internal sources. Emirates Global Aluminium (EGA), for example, is ramping up production at its Al Taweelah plant in Abu Dhabi, which should produce around 1 million tonnes per year of alumina by the end of 2019. By the end of 2020 refinery output should double to 2 million tonnes per year and meet 40% of EGA's alumina needs. Other buyers such as Press Metals have moved upstream, injecting capital into Bintan Alumina Indonesia to fund a 1 million tonne per year alumina expansion.

Alumina prices slump, as famine turns into feast



Source: Commodity Market Analytics, Fastmarkets

The Chinese alumina response will also be important. Spurred by the Alunorte-induced price spike, the country boosted output and created a large oversupply in the country's domestic market, which continues to overshadow sentiment. While there was an improvement in domestic prices over the summer, as major producer Xinfa was hit by its own environmental problems, even this proved to be a temporary blip. Industry leaders in the country are now pushing for rationalisation and cutbacks, but for now surplus capacity is still dominating the outlook.

Local analyst SMM estimates that 11 million tonnes of capacity was closed in China in 2019, of which 74% was for economic reasons, showing how price-sensitive supply has been. However, SMM are forecasting a 6.2 million tonne per year rise in alumina production in 2020 and the capacity pipeline is estimated at a bloated 10 million tonnes per year. Smelters downstream certainly will not support this level of growth, so many of these plants/projects are not viable.

Outlook

China will again be a key element for the outlook for aluminium, but will the country really boost output significantly, given the backdrop of low aluminium prices and lackluster demand? New, cleaner smelters are coming on stream, but to what extent will older inefficient plants be closed?

This is a conflict that has simmered away for decades, as the country tries to balance rapid economic growth with environmental challenges. There will also most likely be a recovery in output from one-off problems at key smelters globally in 2019 (including typhoons, flooding and other incidents).

Looking ahead, Western analysts seem to favour a bearish story, with leading commodity consultancy firms predicting 5-7% growth in 2020. Interestingly though, Chinese analysts are more cautious, with SMM predicting just 2% growth in 2020. Given that China now accounts for a chunky 56% of global output, these different forecasts inevitably give a different bias to the outlook, although few analysts think the market will be tight any time soon. The most important factor to bear in mind is that China will head into 2020 with a massive overhang of capacity to produce both aluminium and alumina, which will mean that any rally in prices in either market will be quickly followed by a supply response.

In summary, the aluminium industry faced a wave of bearish drivers in 2019 – weak demand, oversupply in the alumina market and a global economy being hit by trade wars and political uncertainty. Certainly, major producers do have the ability to underpin prices through significant cutbacks, but most likely this will just slow the decline, rather than boost prices. Besides, mothballed smelters generally hang around for a long time in the background in the hope that market conditions will improve. This limits the upside for prices even if demand takes an unexpected upturn.

While some of these bearish factors will fade in 2020 and demand prospects look brighter, LME prices look set to drift downwards for some time to come and low margins across the supply chain look set to persist for the near term at least. Christmas 2019 looks grim for producers, but 2020 probably will not be much better.

Dan Smith is managing director of Commodity Market Analytics Ltd, London, UK

Low-carbon credentials

Increasingly aware of customer demand for low-carbon-emission aluminium, major smelters have developed brands to satisfy it. Seema Chaudhary describes several leading examples

Major aluminium producers are keen to offer sustainable brands with a transparent carbon footprint to customers along the value chain. These products are aligned with the objectives of the Paris Agreement on climate change, which challenges businesses worldwide to reduce carbon emissions.

The role of major aluminium producers in the move to a low-carbon economy is particularly pertinent, given the demand for aluminium's lightweight properties and recyclability, and its potential to shape the supply chain.

While primary aluminium smelting is an energy-intensive business, which often uses coal-fired electricity production in China and Asia, and natural gas in the Gulf, it also makes widespread use of hydroelectric power and can tap into other sources of renewable energy, such as hydro, solar or wind power.

Hydro's Circal and Reduxa

Having launched Hydro 4.0 and 75R in December 2017, Norsk Hydro has now commercialized two families of brands, called Circal and Reduxa, making it "easier to communicate the benefits and the qualities of low-carbon aluminium," explained Stig Tjøtta, vice-president, head of technology, Hydro Aluminium Primary Metal, Commercial.

He said that the products are seeing healthy and growing demand. "For Circal [which at present has 75R as its one product] we must expand capacity as we are currently not able to meet the demand in the market," said Tjøtta. Hydro will launch more Circal products with other post-consumer scrap contents.

"Reduxa is the family of low-carbon primary aluminium, with currently 4.0 as the only product." Hydro will launch new versions of this as it lowers the emissions from its primary production.

Future transparency for its customers is a hallmark of the Hydro brands' strength, Tjøtta added. "In Hydro we believe we must help our customers create a market for greener materials and products. Today there is limited demand from the consumers when it comes to the CO_2 footprint of the products they are buying in the stores. This is normal as it is currently almost impossible to obtain this information for the customer." Hydro is helping to create this market by helping its customers to visualize and tell the story that "it matters where and how aluminium is produced."

Hydro is keen to empower customers' choice, said Tjøtta. "We have also created a visual universe of what we call 'tags'. So, if our customers, or customers' customers, like to showcase what is inside their aluminium suitcase or building façade, they can add a tag to the product with the CO_2 footprint." In this way, Hydro hopes to help educate the market to make purchasing decisions based on the footprint of the production of a product. "So, when you walk into a store tomorrow to buy your stroller for your new-born you select the one with Reduxa from Hydro on the tag," he elaborated.

Reduxa 4.0 has a guaranteed carbon footprint of below 4.0 kg CO_2Eq/kg Al, while Circal 75R averages 2.3. Tjøtta stressed that for Hydro a full and transparent picture of the carbon footprint is essential for long-term market trust. "Hence, in both cases we include the full picture, i.e. scope 1, 2 and 3 (direct emissions from own production, indirect emissions from energy production, and indirect emissions from extraction/production of all supplies)."

HYDRO

The aluminium-reinforced concrete structures presented by Hydro at a trade fair in Trondheim, Norway, can use Circal products

The company has environmental product declarations (EPDs) available for both products. In Hydro's view, EPDs are the most comprehensive and thorough third-party-developed, fourth-party verified, environmental impact analysis of a product. "Also important for us is to clearly distinguish between process scrap and post-consumer scrap. It is the recycling of post-consumer scrap that gives a carbon footprint benefit, and it is also here the aluminium industry needs to develop product, technologies and solutions to drive increased recycling," said Tjøtta.

A strength of the Hydro brands lies in the carbon footprint being traceable to a production batch level (50 tonnes) by tracking the raw materials and associating a carbon footprint per raw material. "This is done fully automatically and documented in our IT systems," said Tjøtta. "In the case of Reduxa, the actual carbon footprint is also stated on the certificate of analysis and weight, while in the case of Circal we state the percentage post-consumer scrap content."

The largest interest in Hydro's sustainable products has come from the building and construction sector. "We believe this is due to a combination of factors like government-installed initiatives such as green public procurement, established standards such as LEED/BREEAM, and a sustainability awareness among architects/decision makers," Tjøtta noted.

For transportation, the focus has been on tail-pipe emissions, where aluminium plays a role in light-weighting. "As tail-pipe emission reduces, the production phase including raw materials gets more important from a life-cycle perspective," he added.

For consumer goods, consumers are now often well aware of the environmental impact of packaging materials and some adjust their purchasing choices with sustainability in mind. "Suppliers of packaging materials/consumer goods adjust accordingly with greener solutions and materials," said Tjøtta. "We have even seen examples of suppliers stating the CO_2 footprint on the goods."

Tjøtta noted that a risk for aluminium is that consumer choices could favour other materials if customers are not fully aware of the range of alternatives. "Green products choices we believe will strengthen

aluminium competitiveness versus other materials in these cases," he observes.

Rusal's ALLOW

Part owned by London-listed EN+, Rusal has an ambitious ethos for net zero-emissions. Rusal is keen to empower its customers to reduce the carbon footprint of their products and has set its aim high with a goal of 95% carbon-free power by 2025. The company says that it strives to be 'simple and visible' in these aims. Currently, 90% of Rusal's production capacity is powered by renewable hydropower to promote 'clean' products.

Jerôme Lucaes, director of marketing and sustainability at Rusal pointed out that progress in the production process is ongoing to reduce emissions, and the company is on track in reaching its goals: "We have continuous improvement programs to reduce our process emissions, -15% at our smelters between 2014 and 2025."

Lucaes noted that end-use markets, especially consumer-facing brands, are taking proactive steps to reduce the carbon footprint of the products they sell, which depends in turn on the materials they contain, for which aluminium is an important component in many applications such as automotive, building, food and beverage, cables or consumer products. As pressures mount to reduce carbon emissions in industry, "ALLOW, low-carbon aluminium from hydropower, is part of the solutions for a lower-carbon economy," he said.

The ALLOW brand is integral to Rusal's vision, with manufacturing demanding more ductile, durable and corrosion-resistant aluminium for consumers in the future. Moreover, Rusal's natural river reserves in Siberia, with access to renewable hydropower, are able to facilitate the aluminium smelting process.

With carbon rating becoming a differentiator along the supply chain, manufacturers are keenly aware of their 'green' credentials, sometimes requesting a carbon footprint statement with third-party verification, traceable to a single smelter, for them to perform lifecycle assessment of their own products.

The traceability and assurance of verification statements for low-CO_2 aluminium smelters is clearly relevant for Rusal, to assure its customers and verify ALLOW's low-carbon footprint, according to Lucaes, who said: "The footprint is assessed using a robust management system, including data collection and management, calculation methodology in accordance with industry standards (including IAI technical guidelines and GHG protocols from the World Business Council for Sustainable Development (WBCSD). In addition our numbers are audited annually by an external independent verifier, which provides the necessary assurance of transparency and accuracy for our customers."

RIO TINTO

Rio Tinto's Isle-Maligne hydroelectric power station in Quebec, Canada, helps to deliver "largely carbon-free" aluminium

Lucaes highlighted the low level of carbon emission for Rusal ALLOW products, in contrast with other primary producers: "Our ALLOW is produced at smelters which achieve a carbon footprint of less than 4 tons with an actual average at 2.5 tons per ton of aluminium produced (for a global industry average at 12.5)," he stressed.

Lucaes also pointed out that there are a number of different means of carbon-footprint measurements in the industry, which can cause confusion. "The indicator used above is referred to as level 1 according to the technical guidelines of carbon footprint evaluation for primary aluminium. The same indicator is also used by ASI (Aluminium Stewardship Initiative)," he noted.

Rio Tinto's RenewAL

Rio Tinto's RenewAL certified low-CO_2 primary aluminium product was launched to cater for its customers that wanted to know how, where and when the product was made in a culture where recycling was deemed 'no longer enough', according to the company.

RenewAL, launched in 2016, utilizes Rio Tinto's advanced AP Technology™, offering certified CO_2 content, which is largely carbon-free, from its Canadian smelters. The company delivers worldwide 2.5 million tonnes of production from its RenewAL sites; 1.3 million tonnes is delivered to North America, 0.5 million tonnes to Europe and 0.7 million tonnes to the Asia-Pacific, says the company.

The brand's strength further rests on the fact that RenewAL's energy carbon footprint equates to four tonnes of CO_2 emitted per tonne of aluminium produced. The industry average is a hefty 11.5 tonnes of CO_2 per tonne of aluminium produced.

"Across our company (so not only for aluminium, but for all product groups), 71% of the electricity used is now from renewable energy: hydro, wind and solar power," noted Simon Letendre, director, media relations – Canada & US, at Rio Tinto. In Canada, seven hydropower plants supply 100% of the electricity we use there, Letendre added.

"Since its upgrade in 2015, our Kitimat smelter in British Columbia has produced twice as much aluminium with half the emissions," he added. "And, across our global aluminium operations, our greenhouse gas footprint is 60% lower than the global industry average."

A further strength for Rio Tinto is that it now offers independently certified responsibly produced aluminium from all its Canadian operations, with the extension of the Aluminium Stewardship Initiative (ASI). Rio Tinto points out that, in 2018, it received the ASI's first Performance Standard certification. By using ASI-certified aluminium, manufacturers and end-users are able to demonstrate their commitment to a sustainable supply chain. Customers can be assured that the aluminium purchased through Rio Tinto's Canadian operations have been produced to environmental, social and governance standards. Rio Tinto is now working with the ASI on audits and certifications for other sites in its global aluminium business.

"This certification continues Rio Tinto's leadership on responsible production. It increases the availability of ASI-certified aluminium in a range of markets, giving customers the ability to offer end-consumers products made with aluminium that meets the highest sustainability standards," Rio Tinto Aluminium vice president sales and marketing, and ASI board member, Tolga Egrilmezer said.

Rio Tinto has helped to drive responsible production standards for the aluminium industry alongside customers and a broad range of stakeholders. The certification follows an independent third-party audit and covers a range of operations across the aluminium value chain, from bauxite mining to alumina refining, aluminium smelting, the creation of value-added products, transformation and recycling, and associated activities.

The movement towards 'green' aluminium is further recognized in the company's first climate change report, published in 2019, when discussing CO_2 emissions and the demand for sustainable products, reporting that: "The absolute emissions from Rio Tinto's global operations have reduced by 43% since 2008."

Rising concerns about Indian iron ore supply

The availability of Indian iron ore in the international market faces uncertainty amid falling seaborne prices and concerns over domestic supply in the country due to the impending expiration of non-captive mine leases in March 2020, reports Deepali Sharma

In 2015, the Indian parliament passed an amendment to its mining legislation, stipulating an expiry date of March 31, 2020 for all existing non-captive mining leases in the country and March 31, 2030 for captive mines. The 2020 expiry will affect some 80 million tonnes of annual iron ore capacity mainly located in the Indian state of Odisha.

Under the amendment, new leases will have to be secured via an auction. This process began in October for the leases due to expire next year and the first round of bids was submitted on November 18. The final phase of the auction process is expected to be concluded by January 17.

Indian iron ore supply is expected to fall somewhere between 20 million tonnes and 60 million tonnes as a result of these developments, with a number of factors including, but not limited to, domestic demand, the ability of unaffected miners to ramp up production, the smooth transfer of mining leases, and international prices for the steelmaking raw material playing a role in determining the actual number.

Important supply

India, the world's second-largest steel producer, accounting for over 100 million tonnes of output annually, is largely self-sufficient when it comes to iron ore, amid ample domestic supply. The country also has a 30% export tax on products with an iron content of 58% and above.

This self-sufficiency does not preclude Indian steel mills and pellet producers from turning to the overseas market for raw materials on a need basis, however. Iron ore concentrate from Anglo American's South African mines is regularly sold to the Indian market, where it is used to produce low-alumina pellets. Iron ore fines from Australia's Fortescue Metals Group also gained traction in India last year as a result of demand from a major steelmaker.

India has – in the last few years – established itself as a major pellet supplier to China's spot market, particularly as supply from producers elsewhere in the world dried up and seaborne prices proved attractive enough to Indian producers.

Apart from pellets, low-grade iron ore fines from India are also an attractive option for Chinese buyers looking for cost-effective blends for their blast furnaces, as witnessed during 2019.

China imported 9.72 million tonnes of Indian iron ore in the January-September period, up 41% from 6.89 million tonnes a year earlier, according to Chinese customs data. This increase was facilitated by high seaborne iron ore prices due to disruptions in Brazilian and Australian supply. The bulk of the supply disruptions in the iron ore market in 2019 was concentrated in the mid-grade segment that typically forms the base of Chinese mills' blast furnace burden, which incentivized them to look for alternative blends to manage their input costs.

One approach used to manage costs and maintain efficiency was the use of low-grade iron ore such as Australia's Super Special Fines and Indian materials for blending with high-grade products from Brazil, market sources told Fastmarkets.

A trader in Singapore said that interest for low-grade Indian fines typically emerges from smaller privately owned steel mills because their state-owned counterparts are typically locked into long-term commitments with miners, which makes it more difficult for them to adjust their blends.

A source at a privately owned mill in eastern China told Fastmarkets that the steelmaker was expecting to import up to 800,000 tonnes of low-grade Indian fines this year. Two particular brands of Indian iron ore – 57% Fe Essel fines and 57% Fe Rungta fines, both of which contain 6-7% silica, 5-6% alumina, 0.06-0.08% phosphorus, and 9-10% moisture – were of interest to it. The source said that he had also heard of smaller mills along China's Yangtze River actively seeking low-grade iron ore fines from India in October.

A source at a second mill in eastern China told Fastmarkets that it started to explore the option of importing cheaper Indian fines when margins fell to around 100 yuan ($14) per tonne in July-August, and went on to do so.

Owing to India's rising stature as a steel producer, as the biggest seller of pellets in the spot seaborne market and as a swing supplier of low-grade fines, the future of its domestic iron ore supply warrants attention because any significant change to it has the potential to shake up global trade flows for the steelmaking raw material.

Cause for concern?

The simple answer to the question about whether there is cause for concern about future Indian iron ore supply is 'yes'.

With the auction process for non-captive mining leases still under way, any concern about Indian iron ore supply in the months ahead are well founded.

According to the Federation of Indian Mineral Industries (Fimi), stipulations in India's Mines and Minerals (Development and Regulation) Amendment Act 2015 relating to levies imposed on mine owners in addition to royalties, upfront payments and performance security are "enough to make mining unviable."

The federation also pointed to the high tax burden on the mining sector in India compared with global standards, which raises the cost of producing raw materials and in some cases incentivizes imports. "Since these raw materials result in making intermediate products costly, they will also result in making final/downstream products, many of which are exported, more costly and uncompetitive," it added.

Fimi has said that past experience with auctions related to coal blocks that followed the cancellation of allotments by India's top court in 2014 does not augur well for the current auctions for mining leases expiring next year.

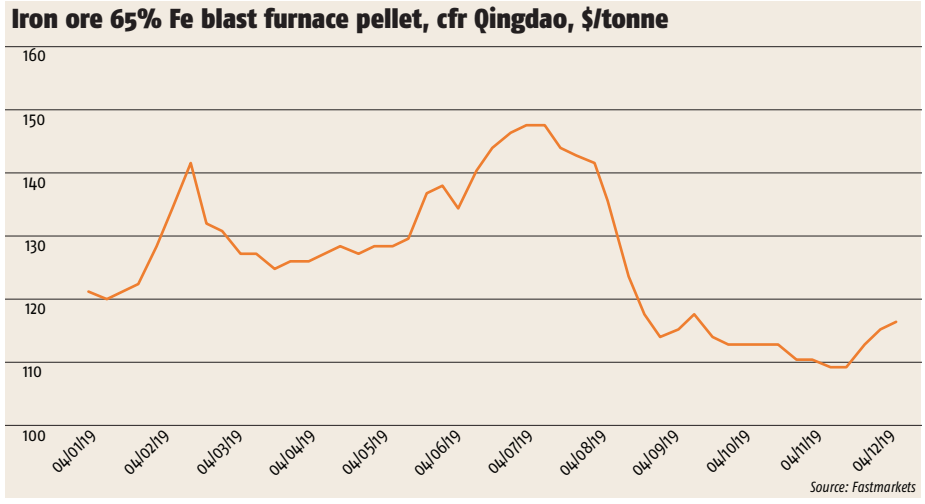
A source at a major pellet producer in India told Fastmarkets that it was expecting a 20 million tonne supply shortfall next year due to uncertainties associated with the auction process, such as potential litigation when ownership changes hands and due to a lack of clear rules on the transfer of assets at mining sites.

"This supply scarcity will affect Indian pellet producers whose cost will be higher than the realized price they get from exports. As such, exports will come down significantly from December onward," the source said. As a result of this, he expected pellet prices to increase.

Cause for alarm?

The overall picture is complicated. A number of steps have been taken already to smooth out any potential supply disruptions as ownership changes hands, some market participants said.

For example, the state-owned Steel Authority of India (Sail) has been given the go-ahead to sell up to 7 million tonnes of iron ore annually and draw down the 70 million tonnes of low-grade iron ore that it has in its stockpiles for this purpose. Previously, the steelmaker was only allowed to consume the iron ore it produces. Sail, which also produces coal, was also heard to have invited bids for a million tonnes of iron ore this month. The outcome of this was expected in December.



A pellet producer source has also pointed out that since the auction process for the mining leases is being carried out in several phases, the transfer of ownership will be done in a smoother manner without creating any significant supply jolts.

The source expected Indian pellet exports to remain linked to prices in the international market and exchange rates. He cautioned that seaborne prices of under $100 per tonne cfr China would make it unviable for Indian pellet producers to export.

"We expect pellet exports to rise by around 10-15% next year because international market prices remain supported and due to more Indian pellet producers looking abroad to realize higher prices," he said. He also noted that pellet prices had showed signs of strengthening in the last few weeks.

The source was also expecting some short-term price gains for pellet in India's domestic market due partially to uncertainties attributed to the mining lease auction process, but for the most part as a result of a shortage of rakes to transport materials domestically and an improving outlook for steel demand in the country.

Another pellet producer source said that domestic iron ore prices were already increasing not just because of the improved steel price outlook but also because of increased demand for the steelmaking raw material amid expectations of supply tightening in the coming months due to the mining lease auctions.

The source added that there were ample stockpiles of 60-61% Fe iron ore in India and mills in the country were exploring the option of blending since they typically prefer grades of 63% Fe and above.

Outlook

Seaborne pellet prices had already started showing signs of improvement in late-November on growing demand from China due to rising steel prices. Mills are also hungrier for high-quality, environmentally friendly raw materials, which is typical during the winter months when steelmaking restrictions are implemented to control emissions.

Fastmarkets' weekly index for iron ore 65% Fe blast furnace pellet, cfr Qingdao stood at $113.06 per tonne on Friday November 22, up $3.26 per tonne from where it was at on November 1.

Even as the outlook for Indian pellets remains uncertain, the silver lining is that the market is equipped with more risk-management tools to navigate the uncertainties.

Many in the market have adopted Fastmarkets' index for iron ore 65% Fe fines, cfr Qingdao as the basis for the settlement of pellet contracts due to its closer alignment with the dynamics of this segment of the market in comparison to references for lower grades. The launch of Singapore Exchange's high-grade derivative contract has also played a role in driving this interest.

While supply disruptions were the defining feature of the iron ore market in 2019, the year 2020 might be another year of similar interruptions.

Alex Theo in Singapore contributed to this article.

Advancing DRI technology to make steel with hydrogen

ArcelorMittal has commissioned Midrex to design a demonstration plant to produce steel with hydrogen at the steelmaker's Hamburg site in Germany. Richard Barrett asks Midrex expert Dr. Vincent Chevrier to explain its advantages.

MIDREX

Midrex is working with ArcelorMittal to design a demonstration plant to produce steel with hydrogen, alongside the steelmaker's existing MIDREX plant in Hamburg

In mid-September 2019, ArcelorMittal announced that it had commissioned Midrex to design a demonstration plant to produce steel with hydrogen at the steelmaker's Hamburg site in Germany. Both companies signed a Framework Collaboration Agreement to co-operate on several projects – ranging from R&D to the implementation of new technologies. They will be governed by a number of project development agreements.

The first of these projects is to demonstrate in Hamburg the large-scale production and use of DRI (direct reduced iron) made with 100% hydrogen as the reductant. It is due to produce about 100,000 tonnes per year of DRI. Initially the hydrogen used will be made from natural gas, but it is envisaged that some – or potentially all – of the hydrogen needed will be generated by equipment powered by renewable energy sources, once it is available in sufficient quantities and at a commercially viable cost.

Carl de Maré, ArcelorMittal vice-president responsible for technology strategy, summarized that the steelmaker is working with Midrex "to learn how you can produce virgin iron for steelmaking at a large scale by only using hydrogen."

He said that the project, combined with the steelmaker's existing projects on the use of non-fossil carbon and on carbon capture and use, is key for the company to become carbon neutral in Europe by 2050. "Large-scale demonstrations are critical to show our ambition," he added, while highlighting that how fast transformation will take place will depend on the political conditions for the region.

ArcelorMittal's Hamburg works already produces steel from DRI made on the site by its existing MIDREX® Plant, which processes about 980,000 tonnes per year of iron ore pellets into DRI by reducing them to 95% metallic iron by extracting oxygen by using natural gas.

With 25 years in the iron and steel industry and having worked at Midrex for nearly ten years (in R&D and business development), Dr. Vincent Chevrier is well placed to outline the company's already extensive experience of using hydrogen as a reductant. It is already a component of the reducing gas mixture used in its conventional DRI plant designs. He has also spent several years working on Midrex's technology for using pure hydrogen, MIDREX H_2™.

Building on experience

In a conventional MIDREX Plant, the reducing gas needed to feed the shaft furnace in which iron ore is converted to DRI is generated in a reformer. The reformer itself is usually fed with natural gas.

The reducing gas produced in the reformer typically comprises 55% hydrogen and 36% carbon monoxide. Those reducing-gas constituents are generated by the chemical reaction of the methane (CH_4) in natural gas with carbon dioxide (CO_2) or water (H_2O), both of which are themselves generated by the reduction process in the shaft furnace and are fed in order to be consumed by the reformer (*see flowsheet*).

When paired with an EAF, the existing long-established Midrex technology already results in lower CO_2 emissions than the BF/BOF route to steelmaking – at 1.1-1.2 kg CO_2 per kg of steel, compared with 1.6-2.0 kg CO_2 per kg of steel, respectively, Midrex notes. Midrex adds that its process can lower those emissions even further – to around one-third of typical BF/BOF emissions if a CO_2 removal system is added.

But it is the potential of using just hydrogen as a fuel and chemical reductant in the shaft furnace (without the carbon monoxide that generates the carbon dioxide when it is also used to reduce iron ore, as now) that holds the prospect of

generating much less carbon dioxide in the steelmaking industry.

Three-step transition

Midrex envisages a three-step transition for steelmakers wishing to move gradually towards hydrogen-based steelmaking, with built-in flexibility to proceed through the steps as greater volumes of affordable hydrogen generated by renewable energy sources become available.

Step 1 requires the building of an existing conventional MIDREX NG Plant or being aware that an existing one in itself has the potential to use more hydrogen. In step 2, up to 20% - 30% of natural gas– depending on the desired operating conditions – can be displaced by hydrogen as it becomes available without any modification to the existing equipment. Above 20-30% of NG displacement, some minor equipment needs to be added to compensate for the reduction in chemical reforming. Chevrier said that Midrex's plant is flexible enough to allow changes in energy source over time to accommodate likely fluctuations in hydrogen availability.

The ultimate step requires modification of the traditional Midrex plant fed with natural gas to the company's MIDREX H_2 flowsheet (*see diagram*). This step requires modifications of some of the process equipment as the process duties, such as flow rate and temperature, will change. Most notably, the all-hydrogen concept requires a reduction gas heater to rebalance the energy in the shaft furnace. For an existing plant, the Midrex reformer can easily be converted into the heater by changing its operating conditions, not the reformer itself.

"This approach offers both the ability to buy time and minimal technology risks," noted Chevrier. Midrex is basing its calculations on the assumption of using a standard iron ore pellet feed for DRI production, so the company does not anticipate a need to change that for a plant running with just hydrogen.

Industrial-scale development

While a number of existing DRI plants have already run with a high percentage of hydrogen, but not 100% hydrogen, reducing gas for years, and Midrex has conducted many relatively small-scale R&D trials with very high percentages of the gas (up to 100%), the new project at Hamburg will provide the opportunity for a large-scale industrial demonstration.

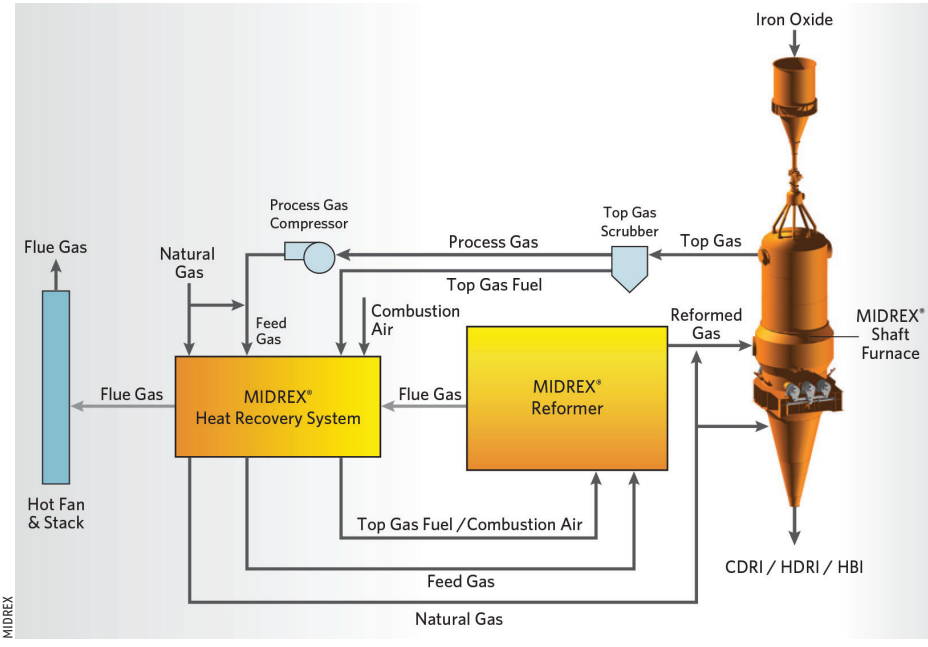
Chevrier explained that the new Hamburg plant will have a freestanding shaft furnace and no reformer of its own. It will use an offtake of spent gas from the existing DRI furnace, which will be cleaned to extract hydrogen. The balance will return to the existing plant.

"It's the only DRI plant in Europe with the capacity to source enough hydrogen [from methane in natural gas] to make it work," Chevrier told *Metal Market Magazine*. He elaborated that Hamburg provides the opportunity to generate enough hydrogen cost-effectively at the rate needed to run the demonstration plant.

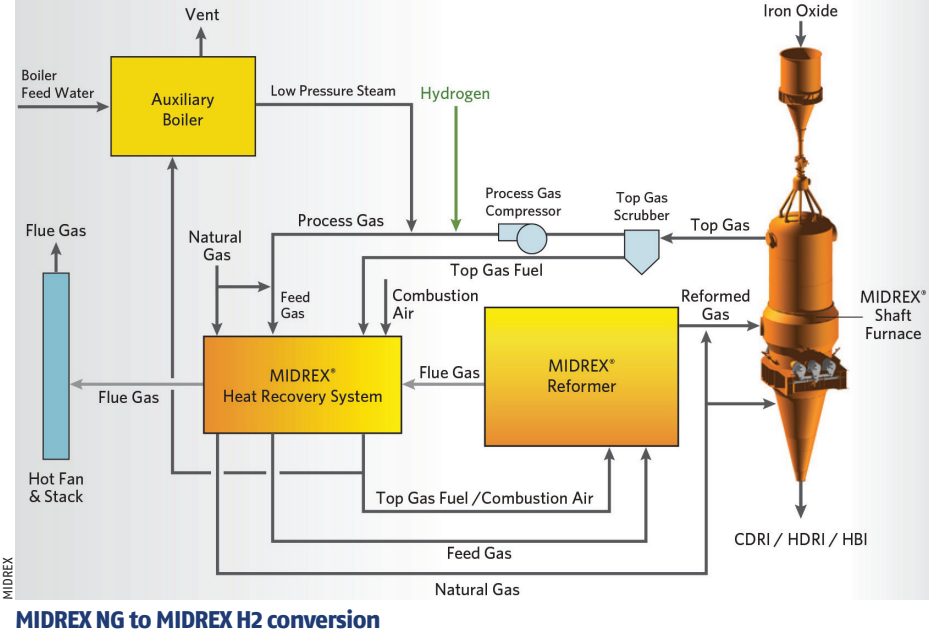
"The fundamental chemistry behind it works," said Chevrier, but he acknowledged that there are a few technical challenges to address, "so we want to make sure we address all of them in the demonstration plant," he added.

One of those potential challenges is what the DRI product made in a shaft furnace running on pure (or nearly pure) hydrogen will look like. Factors such as its physical properties and its melting performance are two key DRI characteristics to be tested.

Low- to zero-carbon content in the product is another factor to consider, which will result in a more reactive product that is susceptible to reoxidization and one that will no longer contribute to the carbon content actually needed in the steels



MIDREX Process® fueled by natural gas



MIDREX NG to MIDREX H2 conversion

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- Steel Producer of the Year: EMEA
- Steel Producer of the Year: Asia
- Ferro-alloy Company of the Year
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produced from it. In other words, where steelmakers have relied on DRI to contribute to the essential carbon content required in their steels, other means will need to be found to add carbon to the steel melt.

"We also want to see how the MIDREX Process can be optimized to handle [pure] hydrogen," Chevrier explained. Up to now, the thermodynamics of the existing reduction process have been held in balance by the fact that iron oxide reduction by carbon monoxide is exothermic (heat-releasing), counterbalancing the endothermic (heat-absorbing) nature of reduction by hydrogen.

Consequently, while the existing reduction of iron ore in the shaft furnace in the MIDREX Process is more or less balanced in energy, the pure hydrogen process will need additional energy input (i.e. heat) to perform the reduction. "We will verify how to do this through a demonstration at a large scale," said Chevrier. "The theory is pretty straightforward. It's an energy rather than an ironmaking problem. If energy is available at a reasonable cost, the process is absolutely doable," he stressed.

The fundamental challenge is that the bonds between iron and oxygen atoms in iron oxide are very strong and consequently need a lot of energy to break. Coal has traditionally been an efficient source of the energy needed and lowers the melting temperature of the iron ore reduction process. "If you are displacing the carbon by something else [to reduce carbon emissions] you need to provide a large amount of energy by other means," he summarized.

Producing hydrogen

Two key questions are where the large volumes of hydrogen that will be needed for hydrogen-based iron ore reduction will come from, and how they will be generated without consequential carbon emissions arising from that process.

Chevrier noted that, just three years ago, 96% of global hydrogen production was from fossil fuels – nearly half of which was from natural gas, nearly a third was from oil, and just under a fifth was from coal. He added that most of this so-called 'grey' hydrogen is generated and consumed on the same site and so is not traded or transported.

Electrolysis of water is another option, which accounted for the 4% balance of global hydrogen production but is rising rapidly. While the basis of electrolysis technology is well established, unless it is powered by renewable rather than fossil-fuel sources of energy, its use pushes carbon dioxide emissions further upstream. Chevrier also pointed out that the cost of hydrogen produced that way is currently too high for many applications at prevailing US electricity prices – about double the cost of hydrogen from steam reforming.

He also noted, however, that many projects are under way to advance the hydrogen economy, given its potential value in many energy sectors. While its production via renewable energy sources is one clear low-carbon route, a pragmatic approach is that when power produced by any means exceeds the immediate demand for it, excess power can be used to produce hydrogen as a form of energy storage. That hydrogen could also be sold as a product for industrial processes like steelmaking or for hydrogen-powered vehicles.

Current modern technologies for hydrogen production, such as proton exchange membrane (PEM), generate about 200 Nm^3 per hour of hydrogen per MW of power. Consequently a 20 MW plant – at the upper end of the size range at present – could generate 4,000 Nm^3 per hour of hydrogen. By contrast, Chevrier indicated that 60,000 Nm^3 per hour of hydrogen can be substituted for about 20,000 Nm^3/h of natural gas in a 2.0 million tonne per year DRI plant, which represents just 30% of the total natural gas consumption.

To summarize, the amount of power needed by electrolysis to produce the volumes of hydrogen needed for DRI production is very big. For example, a large DRI MIDREX Plant producing about 1.8 million tpy of DRI could require the power generated by more than 200 large offshore wind turbines, Chevrier estimated. He also noted that, with its location in Northern Germany, near the coast, Hamburg is well placed to access off-shore wind power.

Addressing challenges

Chevrier emphasized that cost-effective production of 'green' hydrogen will be essential for the three-step process that Midrex envisages will be used for steelmakers to progress to full hydrogen-based DRI production. At 6-12 cents per kWh, energy prices in Europe are about 4-10 times higher than where they need to be for cost-effective hydrogen production as of now, he noted, confirming that the cost of electricity drives the cost of hydrogen. "Both capital and operating costs need to be three to four times lower than they are now," he added.

"Some people say that will never happen," he acknowledged, but "wind power has achieved that in the past 10-15 years," he added. He also stressed that the technology for hydrogen production is improving tremendously, and they can produce larger and larger volumes of hydrogen.

While it has already been established that the MIDREX Process can run with a wide range of hydrogen content, in making the transition from today's typical reductant gas composition to the future's, the question arises as to how swiftly a DRI plant could react to rapidly changing levels of hydrogen availability.

Chevrier acknowledged that, by its nature, renewable energy supply like solar or wind power, for example, can fluctuate in short timeframes according to weather conditions. He also noted that while Midrex has indeed already demonstrated that its technology can work with anything from 0-100% hydrogen – adding that the process can also be turned down from full to nearly half capacity within the period of a day if desired – the company is also looking at its responsiveness to fluctuating hydrogen availability.

He said that a relatively small change of hydrogen content of up to 5% could be made in a matter of hours, and that the process is more than capable of handling seasonal variations of hydrogen generation, or even on a shorter term weekly basis.

The answer to more rapid changes in hydrogen supply is a buffer stock. "Storage will be key to the hydrogen economy," said Chevrier, pointing out that hydrogen is cheaper to store than electricity and that its costs of transportation are similar to the costs of electricity transmission. As a gas that has to be contained for safety, it also has very low yield loss during transmission and transportation.

He added that hydrogen can be added to an existing natural gas pipeline and that, in Germany, the country's extensive pipeline network has potential to store and distribute hydrogen in the transition period.

Outlook

Chevrier observed that the construction of 20 MW electrolysers are in progress and that there are already announcements of building 100 MW electrolysers.

"Commercial hydrogen-based DRI production may be just 5-10 years away where power is already cheap," said Chevrier. "Ultimately, it depends on how you view global energy supplies," he added. He believes that across all forms of energy production, there should be sufficient to provide enough hydrogen.

India's non-ferrous scrap sector under scrutiny

India's non-ferrous scrap and secondary metal sector depends on imported materials and a domestic supply chain that needs better organization. Kunal Bose outlines prospects for the nation's industry

SHUTTERSTOCK

Electronic waste generated domestically is a generally untapped source of raw materials in India

Three Indian primary aluminium producing groups – Vedanta Aluminium, Hindalco and National Aluminium Company – have been the first among all industries to make a representation to the finance minister, Nirmala Sitharaman, to substantially raise the nation's import levy on scrap – the conversion of which into secondary metal is shrinking the domestic market for the indigenously made primary light metal. This has been done in response to the minister inviting industry suggestions for the national budget for 2019-20, which is to be presented in parliament on February 1.

The 4.1 million tonne per year capacity integrated aluminium producers, with most of their capacity located in the bauxite- and coal-rich coastal state of Orissa are "gravely concerned" about secondary metal made in growing quantities eating away into the market for primary metal. In support of their petition for duty revision, they say India's imports of aluminium scrap were up by a substantial 21%, to 1.349 million tonnes in 2018-19 (April to March), from 1.121 million tonnes in the previous year. Scrap had a share of 58% in the country's 2018-19 total aluminium imports of 2.318 million tonnes, costing $5.5 billion.

According to an industry official, "India, where since 2010-11 the compound annual growth rate (CAGR) in aluminium demand was 8% and where customs duty remains ridiculously low, has always been an easy target for scrap exporters from the UK, UAE, Saudi Arabia and Australia. Now, following China charging a duty of 25% on scrap imports from the US and the world's biggest producer and user of the ferrous metal deciding to put progressive restrictions on scrap imports ahead of a total ban, a lot more scrap of US origin is finding its way into India.

As a result of trade skirmishes between the world's two most powerful economies, the US stepped up scrap exports to India by 149% to 259,000 tonnes in 2018-19. In the first seven months of the current financial year till October 2019, our scrap imports on a year on year basis from the US were up as much as 50% to 190,000 tonnes. The China market drying up, some other countries with lots of scrap to dispose of have made India the target market." Government intervention by way of a major duty revision can alone stop "the inundation of our market by imported scrap," said the official.

Besides their continuing loss of market to imported scrap-based secondary aluminium, primary producers have also drawn government attention to large quantities of "sub-standard scrap" finding its way into the country. This is happening in the absence of government notification of standards and proper vigilance at entry points. The official said that aluminium scrap of foreign origin with high levels of impurities finding applications in utensils and consumer durables could cause damage to health and the environment. "There too are many complaints of loss of electricity during transmission when wire made from indifferent quality recycled scrap is used," the official added.

Domestic scrap

Rules are in place for recycling domestically generated e-waste, which contains valuable materials, including aluminium, copper and ferrous metal. The government enacted e-waste management rules first in 2011 and then subsequently

amended these twice in 2016 and 2018 to channel such waste generated within the country to authorized dismantlers and recyclers. But the problem with very low rates of procurement and processing of e-waste is not because of the absence of law, but owing to the lack of public awareness about disposal of all kinds of electronic gadgets after their useful life has ended. Ideally, once users go to replace used electronic goods they should leave those with retailers and get a discount on new items, but that rarely happens in India. In the process, secondary metal makers are denied access to large quantities of quality scrap lying embedded in e-waste.

No wonder then that e-waste has become the country's fastest growing trash stream. Of India's annual generation of about 2 million tonnes of e-waste, only about 5% is recycled. The 15% yearly growth in the market for consumer electronic goods, including smartphones, is adding to the severity of the problem of e-waste management. India is the world's fifth largest generator of e-waste after the US, China, Japan and Germany.

The government claims to be very aware of the need to frame rules to ensure that only clean scrap is imported for recycling. While primary producers are piling on the pressure on New Delhi to introduce strict regulations on scrap imports, the government has for consideration a draft report on 'national materials recycling policy' authored by government think-tank Niti Aayog.

In the formulation of the draft policy, Niti Aayog had KPMG and the Material Recycling Association of India (MRAI) as knowledge partners. Niti Aayog believes that if an efficient infrastructure is created for the collection, sorting and bailing of scrap for remelting without causing any harm to the environment, then recycling will have the potential to generate about Rs10 trillion gross value addition to the economy, create direct employment for 3 million in the organized recycling industry, and up to 15 million jobs in "upstream activities starting from scrap collection to its sorting, processing and delivery to secondary metal production centers."

Lower product quality

In the absence of government rules and monitoring, India continues to lack order in the collection and processing of all types of non-ferrous scrap. If the scrap used in furnaces is of low quality, the secondary metal that will come out will generally not pass quality scrutiny.

The government-owned Hindustan Copper Limited (HCL) chairman Santosh Sharma outlined the quality of copper usually produced by secondary units. "Except for the Vedanta Group owned Sterlite Copper's secondary unit at Silvasa in Gujarat, no other smelter here using scrap and blisters as raw materials is able to make LME grade A copper with purity of 99.9935%. The secondary industry offers copper in a purity range of 92% to 95%, ruling out its use in sectors such as electrical, telecom and transport."

Like copper, product quality is a factor for a major part of recycled aluminium available in India. Since the overall industry is unorganized, data about aluminium recycling based on locally procured scrap is hard to come by. Rough estimates of the aluminium recycling rate in India is between 20% and 25%, compared with about 50% in developed economies.

A guessing game has begun about whether the finance minister will oblige primary aluminium producers by raising the customs duty on scrap from 2.5% to – ideally from primary producers' perspective – 10%, which some aluminium products attract. Import duty on primary aluminium is, however, 7.5%. Commerce ministry officials say the government is aware that primary producers have sufficient capacity to meet the domestic demand, except for some special alloys for which imports are unavoidable at this stage.

At the same time, New Delhi cannot ignore the claim of secondary aluminium producers to easy supply of imported scrap for them to be able to run their factories. Domestic scrap availability being small in the absence of an organized supply chain, large imports are unavoidable, the official argument goes. No one is denying, however, the possibility of Sitharaman considering duty revision of scrap imports. After all, the government is facing the challenge of containing fiscal deficit to below 4% of GDP when both corporate and individual tax collection has slowed due to a sputtering economy.

Organized production

As the owner of Novelis, the world's largest producer of recycled aluminium, it is expected that Hindalco, which has primary aluminium smelting capacity of 1.3 million tonnes, will take the lead in promoting production of secondary metal in an organized way. Hindalco owns a scrap recycling plant at Taloja in Maharashtra with capacity to make 26,000 tonnes of secondary metal. More recently, the country's leading aluminium-to-copper maker signed an agreement with the Gujarat government to build a 300,000 tonne scrap recycling plant in the coastal town of Kutch.

A spokesperson for the Confederation of Indian Industry (CII) said, "In a country where nearly 4 million tonnes of aluminium and 700,000 tonnes of copper are consumed every year, good volumes of scrap of the two non-ferrous metals will be automatically generated. The challenge is scrap collection, its segregation and baling. To the extent the country makes progress in this direction, the secondary metal producers' dependence on scrap imports will fall. The annual demand growth for both aluminium and copper is 8% to 9%. This means scrap generation will continue to rise. The government is coming under increasing pressure from environmentalists and organizations like MRAI to create an atmosphere that will encourage all stakeholders to participate in the drive for scrap collection."

Referring to a recent study by the US-based Zion Market Research, the CII spokesperson said that the global can market will rise to $48.15 billion by 2015, up from from $39.41 billion in 2018, and in that growth India, along with China and Japan in the Asia Pacific region, will make a strong contribution.

The urban middle class in India, with growing disposable income, wants carbonated and non-carbonated beverages from soda, soft drinks and fruit juice to beer in aluminium cans. Environmental research shows a high percentage of urban Indians will not grudge paying higher prices for environmentally friendly packaging of beverages. It is on this basis that the Indian organization of Ball Beverage Packaging has projected an eightfold growth in can use in India by 2030. At just one, India's annual per capita can consumption is way behind China's 40. The higher the use of cans, the greater will be the generation of scrap for recycling.

An Indian Copper Development Centre official said that the generally indifferent quality of remelted copper in India is due to the poor refining facilities available within much of the secondary sector, which gets supplies of scrap and other copper-bearing materials from imports and domestically generated scrap. India imported 79,000 tonnes of copper scrap (excluding copper alloy-based scrap) in 2018-19.

Protecting steelwork of all shapes and sizes

When the Galvanizers Association organized an Open Day hosted by its members across the UK and Ireland in mid-October 2019, *Metal Market Magazine* asked to visit Worksop Galvanizing to see the nation's biggest galvanizing bath in action. Richard Barrett profiles large-scale hot-dip galvanizing at a busy site

At the edge of the extensive stockyard at Worksop Galvanizing Ltd – mainly filled with an array of large steel fabrications – one low and long construction, vaguely resembling a submarine from a distance, caught the eye during the Open Day organized by Galvanizers Association and its members on October 15, 2019. That construction was actually the old galvanizing bath that the company had replaced by a new one earlier in the year.

Of similar dimensions to the old one, the new bath in use now, at 21 meters long, 1.5 meters wide and 2.78 meters deep, or the new "kettle" as it is sometimes called, is the largest in the UK. Since only the surface of the 600 tonnes of molten zinc that it contains is visible, with protective steel screens built around it, a large fume hood above it, and much of the bath surrounded by the heating system below ground level used to maintain its temperature, the old bath that it replaced gave a clearer idea of its scale.

Built from 50 mm thick steel plate, the new bath was manufactured in Germany, where it was joined together with full-thickness welds. It was shipped in one piece and is expected to last for at least ten years.

If the vessel itself has large dimensions, the size of the largest steel fabrications that it is used to galvanize are even bigger. By inserting one end of a structure to be galvanized at an angle before lifting it to reverse the angle and immerse the balance of the fabrication (double dipping), it has proved possible to hot dip a beam as long as 29 meters.

The items to be dipped at Worksop come in many shapes and sizes, but the works typically galvanizes about 1,000 tonnes of steelwork per week, with throughput peaking somewhere between 1,300 and 1,400 tonnes per week at particularly busy times.

"Most galvanizing works serve customers within a 50 mile radius," Paul Robinson, commercial manager, told *Metal Market Magazine*. The exceptional capabilities of the Worksop plant, which is one of 14 owned and run by Wedge Group Galvanizing Ltd across the UK – from Devon in southwest England to Scotland in the north – means that about 20-25% of the work done there comes through fellow plants elsewhere in the country. Those typically handle smaller fabrications in the 5-14 metre range.

Steel fabrications are suspended at an angle for dipping

"All the large items go through Worksop," said Robinson. Work comes from many industries, including architectural, agricultural and railway Sectors. The use of a combination of several gantry cranes has enabled the galvanizing of heavy as well as long components.

For example, structural components for sports stadiums keep Worksop busy at times, while one of the biggest projects already well under way during the Open Day in October required delivery of 7,640 tonnes of structural components for a bridge under construction in Sri Lanka (*see photos*).

Other projects needing large fabrications to be galvanized include road-sign gantries, lighting columns and footbridges. At the end of October, a couple of weeks after the Open Day, the Worksop plant passed the milestone of having galvanized 3,000 tonnes of steel for gantries providing supports for overhead electric cables for an upgrade of part of the Midland Main Line railway, which runs from London to Sheffield.

In a company news release, Robinson said, "The upgrade programme on the Midland Main Line is a massive scheme that includes the electrification from London to Corby with plans to extend further north. We've been

galvanizing sections of steelwork that will support the new cables for more than a year and have now reached a figure of 3,000 tonnes. It's a significant project that's still ongoing and I believe we're only roughly halfway through."

Adey Steel Group is supplying the supporting components for the overhead cable infrastructure. It is sending its fabrications to Worksop for galvanizing.

Several-step process

Batch hot-dip galvanizing at Worksop needs several steps. A heated alkali solution is used to remove any oil and grease from the surface of items to be galvanized. Hydrochloric acid is used to remove mill scale and rust. The immersion time in the acid needed to achieve a clean surface before galvanizing depends on component size and condition. It can be as short as a few minutes, but 10-15 minutes is more typical. A batch of somewhere between 30 and 40 tonnes of components can be cleaned in a very large single pickling tank. After rinsing with water, components to be dipped move to a preparation area, where component suspension angles, drainage holes and areas of potential gas pockets are checked. Slings are replaced by wires or by chains, and zinc ammonium chloride is applied as a flux to help wet the surface of the steel before it is immersed in molten zinc at about 450°C. The very quickest time that a component can be processed from start to finish is about an hour.

The exact bath chemistry is part of the galvanizer's art, or more accurately science, but the composition is at least 98.5% zinc. In Worksop's bath of molten metal, that means there are about 9 tonnes of other metals in the mix. Aside from the 1.4 tonne zinc ingots – a stack of which were sat in Worksop's storage warehouse on the day of *Metal Market Magazine*'s visit – other master alloys and ingredients used include nickel, tin and some aluminium, which is used as a brightener, Robinson explained.

The bath chemistry is sampled every week to ensure that its correct balance is maintained – an important process, given that a change in the molten metal composition by as little as 0.1% can affect the appearance of the coating.

Lead, one element associated with zinc in nature, as well as galvanizing in the past, is absent because Wedge Group Galvanizing provides lead-free coating throughout its sites now. Lead used to have a role in hot-dip galvanizing because it added some useful fluidity to the molten metal coating, but it has been removed over 10 years ago.

Lead also influenced the degree of spangle visible on the finished surface of galvanized steel, but so do other intermetallics formed during the process of galvanizing, such as those containing tin, and the exact nature and composition of the substrate steel coated. For many industrial or heavy engineering applications, the visual appearance of galvanized steel is of little importance provided the coating enables the degree of long-term corrosion resistance needed.

A top layer of free (non-alloyed) zinc on the outer surface of the coating provides a shiny appearance, whereas the highly alloyed coating below it is generally matt grey.

The thickness and overall dimensions of the steel dipped also have an impact on its coating, given the effect that those have on heat distribution or, put more simply, the rate at which a fabrication heats up or cools down. Since the growth of the coating metallurgically bonded to the steel during dipping slows over time, the length of immersion has a direct impact on its final thickness.

Most ordinary structural steelwork is coated to a thickness of 85 micrometers (0.085 mm), but thicker coatings of 3-3.5 times that thickness can be achieved for even longer life.

Open Day aims

No less than 32 batch hot-dip galvanizing plants opened their doors to visitors last October 15. Over 500 people took the opportunity to see hot-dip galvanizing in action.

For some participants, such as university students, it was their first chance to witness the industry first-hand. For others, such as attendees from steel fabrication, construction, material specifier, manufacturing, architectural and engineering businesses, it was a chance to ask about the finer details and technicalities of the process. Attendance also qualified for continuous professional development units for members of the Royal Institute of British Architects.

For the host galvanizers, the day reinforced present client engagement and provided outreach to their likely clients of the future. "You learn so much more if you see the process in reality than watching it on a screen," Iqbal Johal, Galvanizers Association's marketing manager, observed, saying that the core aim of the day was to educate and inform. The day also gives an idea of the scale and importance of galvanizing in the steel supply chain, he added.

Johal stressed that a long-established and relatively simple and straightforward process that takes a matter of just a few minutes to a few hours to achieve delivers results that last for many decades in protecting steel from corrosion.

"Visiting a site also gives hands-on experience and a chance to see how things are handled," he added. Those things include the surface cleaning process, and component support and orientation when dipping to allow free drainage of the surplus molten zinc as components emerge from the bath. The location of drainage holes and the avoidance of, potentially dangerous, air pockets in complex component geometry, can also be explained.

"It doesn't matter how complicated a fabrication is, there will always be ways and means to hot dip galvanize it," said Johal.

That is certainly the message that the industry wants to get across to the upcoming generation of designers, architects and engineers. This second industry-wide Open Day followed on from the first held two years ago, but Johal said that the industry is always open to specifiers and to students studying relevant subjects wanting to see the process of galvanizing.

He said that some galvanizing plants supply coated components on a just-in-time (JIT) basis as part of a supply chain and he also identified a couple of current trends that are interesting a centuries-old traditional industry. One is the potential use of exoskeleton technology that aids workers to lift heavy loads. Another is the sustainability of galvanized steel frames and bolts used for construction, which allow buildings to be disassembled and relocated, rather than demolished, when required.

"It is the long-life, robust and tough coating that galvanizing provides that enables that sustainability," Johal concluded.

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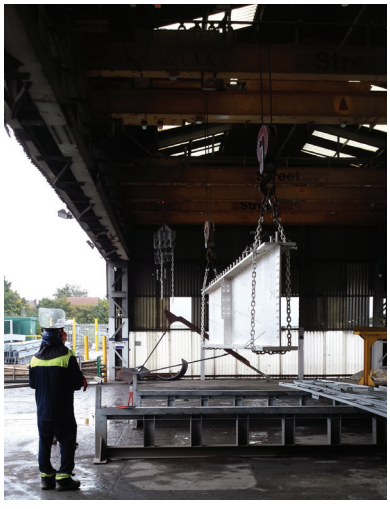


Galvanized structural bridge components to be shipped to Sri Lanka

All general carbon steels produced to Euronorm or British standards can be galvanized. Many high-strength steels can be galvanized too. As a general rule, if the steel used is fit for the purpose of construction, it can be galvanized.

After removal from the kettle, some fabrications are also dipped in a tank of water to control their rate of cooling, while others are air-cooled.

Clients and cost

If a particular aesthetically appealing finish is required, perhaps for an exposed architectural application, extra attention is given to those specialized projects as a premium-priced option. If zinc prices peak, customers pay a surcharge to cover the additional cost of galvanizing.

Most of the work undertaken at Worksop is for protecting finished steel fabrications, but some of the other plants in the Wedge Group coat stock lengths of steel sections or beams for steel stockholders.

The member companies of the Wedge Group work as a network, sharing jobs as far as capacities and the time needed to transfer steel from one site to another allows. For example, a regular weekly truck travelling from Devon, in Southwest England, to Worksop, in northern England, and back the following day – sometimes stopping in Newport, Wales, on the way helps to distribute jobs across those sites.

"In that way, the Wedge Group provides both a local and national service," Robinson explained.

When Worksop suspended work for two weeks to install its new galvanizing bath, other Wedge Group sites helped to cover that period by continuing to coat some of the smaller jobs on behalf of Worksop's clients to balance workload. "We optimize the use of group capacity using our internal systems," said Robinson. "During that period, we had to redistribute 2,000 tonnes of work," he pointed out.

Fully back on line, Worksop Galvanizing works 24/7 on a three-shift basis in a pattern of 6am-2pm, 2pm-10pm and with an overnight shift from 10pm-6am. Specialist work tends to be done on weekend nights

The galvanizing process involves little to no waste. By-products from hot-dip galvanizing include zinc oxide and ashes regularly skimmed by hand from the top of the bath, and particles of iron/zinc dross dredged from the bottom. Given the scale of Worksop's operation, 10-12 tonnes of dross are collected from the bottom of the bath every other week. Once collected the works sell all the materials recovered to specialist processors, from which the materials can be utilised in various products, including cosmetics or be reintroduced back into the galvanizing process.

Planning for the future

At present a forklift truck transfers galvanized structures to the site's despatch area but, as part of a 2-3 year phase of site development, the company plans to invest in a gantry crane to load trucks more efficiently for future shipments.

The sections of bridge destined for Sri Lanka, for example, weigh over a tonne each and are transported to Felixstowe port for shipment in containers in 300 tonne lots. In other projects, galvanized steel roof trusses provide a challenge for their length as much as their weight when it comes to shipment.

The UK galvanizing industry prides itself on its long history and the proven value of the work it undertakes. Wedge Group Galvanizing celebrated 150 years of galvanizing in 2019, tracing its roots back to 1869. In addition to its large-scale operation in Worksop, the group offers centrifugal galvanizing for small parts and the capability to galvanize continuous lengths of marine chain.

Addressing long-term trends, Robinson said that over the past 20 years customer expectations for quality have increased, both in terms of product and service. As for most businesses, that key factor, turnaround time, price and in some cases loyalty are the key parameters that customers use to decide where they will place their orders.

Worksop's large scale and capacity are unquestionably its USP, but some other smaller sites in the Wedge Group also win business by providing a premier service.

Duplex provides another way

Austenitic or ferritic grades of stainless steel are likely to be the first types that many purchasers of the corrosion-resistant product consider for their applications, but many could find duplex grades to be good alternatives. Richard Barrett discussed their merits with Outokumpu duplex expert Bernd Beckers.

It is a fact that not all stainless steels are equal. Their ranges of strength, formability and corrosion resistance are wide.

For example, austenitic grades, which usually have high chromium and nickel content, offer a range of corrosion resistance that extends into some of the most highly corrosion-resistant stainless steels. They are also some of the most formable stainless steels. Given their high alloy content, they are also among some of the most expensive grades and are prone to price volatility.

Ferritic grades are also available in a range of strengths, but are generally less formable than their austenitic cousins. With smaller percentages of alloying ingredients, and consequently usually lower cost, they can be suitable for less corrosive environments than austenitic stainless steels.

These two well-known families of stainless steels are not alone. Duplex grades combine both ferritic and austenitic microstructure. Traditionally they have had a key advantage of very high strength, but low formability.

In recent years, however, Outokumpu has extended its Forta range of duplex grades, which are designed to provide a variety of advantages in terms of properties including strength, weight, machinability and corrosion resistance. For example, one of the most recent additions, Forta FDX 27, has a mechanical strength similar to other duplex grades, but it has formability similar to some austenitic grades (*see chart*). "Conventional duplex grades – before the development of Forta FDX 27 – had good formability, but not excellent," Bernd Beckers, project sales manager, Outokumpu Europe, summarized.

He said that there is "an entire family of duplex grades with a

OUTOKUMPU

Storage tanks are an application for which duplex stainless steel has been found to be well suited

wide range of corrosion resistance, including localized corrosion resistance." He added that they also offer high wear resistance and are good for working environments that could generate stress corrosion cracking. In architectural or infrastructure applications, such as bridges, they offer an advantage in having a similar coefficient of expansion to carbon steels and can thus work well with those in combination.

"They can also take deformation and absorb energy," he explained, a property of general value for road truck construction as well as the low road bridges that they unfortunately occasionally impact by accident.

The generally low levels of nickel and molybdenum content in duplex grades also helps to give them greater price stability than high-nickel austenitic grades.

No steel grade is perfect for all applications of course, so what are the drawbacks? Beckers acknowledged that some stainless steel consumers believe that duplex grades are difficult to fabricate and weld, but he believes that reputation is unfounded. He said that it might be necessary to adjust processing machinery, such as pressing or cutting equipment, because of duplex steels' high strength, but that can be mitigated by the opportunity they offer to use thinner material.

"The higher forces needed can be compensated for by using thinner gauges," Beckers explained, indicating that, subject to exact application, 5 mm thick duplex sheet could be substituted for 6-7 mm gauge. "If your processing equipment is good enough for austenitic stainless steel, then it's usually good enough for duplex," he stressed.

The one property of duplex grades that rules out their use for certain applications is their operational temperature range, Beckers noted. They cannot operate above about 300°C – or below 50°C, at which low temperatures they are subject to embrittlement.

Storage tank design

Outokumpu's Beckers said that end-users of stainless steel "need to like to look at different properties" of the material to see the advantages of duplex grades. He said, for example, that designers of large industrial storage tanks made from steel were some of the first to switch to Forta LDX 2101 duplex, and that they stuck with using that material for projects once they had made that decision.

While, from the outside, large storage tanks to hold liquids usually look perfectly cylindrical, they are built up in circular layers of welded steel plates that are actually progressively thinner towards the top of the tank. The thickest material is at the bottom of the tank shell, which has to withstand the greatest loads in use. Such tanks are typically 20 meters in diameter and can be 20-25 meters high.

Beckers noted that – depending on the exact tank dimensions and design – a standard carbon steel used for their construction (S355) might start at 24 mm thick at the bottom of the tank, but then gradually step down in thickness, 2-3 mm at a time, to a minimum thickness of, for example, 8 mm at the top of the tank wall.

By contrast, for the same size of tank, the greater strength of LDX 2101 enables it to be used in a smaller thickness range, from 19 mm at the bottom of the tank to as thin as 6-7 mm at the top. This enables about a 25% overall weight saving in material used to make the cylindrical shell.

Outokumpu provides a wall thickness and cost calculator for storage-tank designers. Beckers pointed out that realistic calculations also have to take into account the costs of coating and welding. Unlike a stainless steel tank, "a carbon steel shell needs coating inside and outside," he reminded. The thinner gauge of a duplex grade tank also means that less welding filler and less welding labour is needed to build it.

Since the total surface area of such tanks can run into thousands of square meters, coating is a significant expense, which can add about a third to the combined tank material and fabrication cost. That can actually make the initial investment cost of building a duplex tank, which does not need coating, less than a carbon steel equivalent.

Full life-cycle costs of such tanks also take into account the fact that carbon steel tanks could need full recoating once or twice during a lifetime of 30 years, and that estimated relative scrap prices available when they are eventually decommissioned are higher for stainless steels.

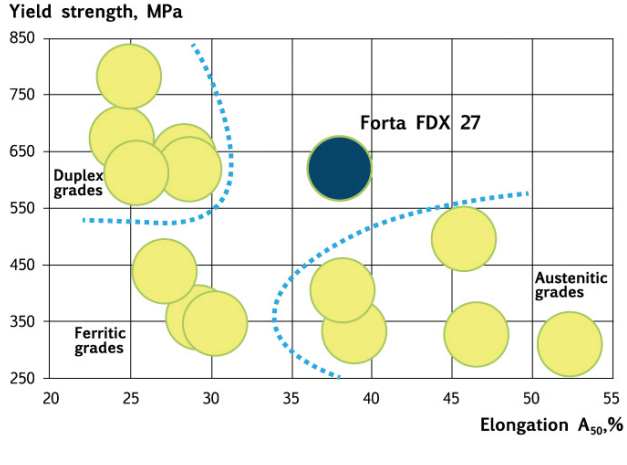
Matching pairs

Beckers explained that, in terms of the key property of corrosion resistance, there is nearly always a corresponding duplex stainless steel to match an austenitic grade. The commonly used austenitic grades 304/316, for example, have their duplex equivalent in Forta LDX 2101 (lean duplex). While 304L contains the classic '18/8' ratio of 18.1% chromium and 8.1% nickel, the Forta equivalent contains a little more chromium, at 21.5%, but much less nickel (1.5%) and a small addition of molybdenum (0.3%) and nitrogen (0.22%) to achieve a superior corrosion resistance.

Similarly, with a significantly higher corrosion resistance level, austenitic grade 904L has substantial levels of alloying ingredients: 20Cr, 25Ni, 4.3Mo. By contrast, its duplex pairing of Forta LDX 2404, with a very similar level of corrosion resistance to 904L, includes 24Cr, 3.6Ni 1.6Mo, 0.27N and 3Mn. In the LDX alloying concept, manganese partly replaces nickel, increasing the solubility for nitrogen in the liquid phase.

"It is cheap but tricky to introduce nitrogen," noted ▶

Forta FDX 27 combines high strength and high formability



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A flexible grade

Forta FDX 27 provides a case study in matching a specific duplex grade to purpose.

Plate heat exchangers are a popular design for industrial applications because of their compact design and efficiency, but if a plate eventually collapses within them during use, there is a risk of leakage – particularly in high-pressure systems.

While the use of higher-strength steels for the plates reduces that risk, a drawback to their application has been a lower level of formability, which has been insufficient to enable production of the complex patterns and contours needed during their production to maximize their surface area and heat-exchanging potential.

Standard austenitic stainless steels have been used for the heat exchanger plates, but a duplex stainless steel with an equivalent formability but higher strength – and which also has an advantage in providing a higher resistance to stress corrosion cracking – would have an advantage. Outokumpu noted that FDX 27 has shown promise for this application. The duplex grade sheet can often be formed by using the same stamping tools previously used for steels with lower strength.

Outokumpu explained that the Transformation Induced Plasticity (TRIP) effect enables the high formability level achieved by FDX 27 – a controlled phenomenon in which some of the austenitic microstructure of the grade is transformed into a martensitic microstructure during plastic deformation. This is said to enhance the strength and formability of the steel without detriment to its corrosion resistance.

Its mechanical properties make Forta FDX 27 suitable for manufacturing components with stretch forming as the primary operation, such as the manufacture of heat exchanger components. In tests on 0.6 mm sheet, to compare the duplex grade with a standard austenitic 316L type stainless steel conventionally used to make heat exchanger plates, Outokumpu found that – while using the same press tooling and lubrication – the overall strength of the duplex grade was about 30% higher. Both steels demonstrated the same functional surface area for the particular complex-pattern heat exchanger plate design used for the tests.

Beckers noted that the duplex grade will also work well for heat exchangers of a shell & tube design, for which it could be used to make either component. He explained that a pressurized tube is the perfect example of a component that benefits from the high strength and corrosion resistance of stainless steel. The formability of FDX 27 in particular is an advantage in enabling tube bending to a suitable radius for use in such heat exchanger designs.

He also explained that 0.6 mm is a typical thickness of steel used to make heat-exchanger plates, but added that for high-pressure industrial heat exchangers 1-1.5 mm, or even 2 mm, thick material is used. Substitution of FDX 27 for conventional austenitic stainless steel could be used to reduce wall thickness and bending radii for the same application, or the same component dimensions could be used to increase the operating pressure for improved heat exchanger performance.

Beckers, but it is worth doing so to obtain good strength and corrosion resistance.

Duplex grade Forta FDX 27 (19.0-22.0Cr, 2.0-4.0Ni, 0.6-1.4Mo, 0.6-1.4Mo, 0.14-0.24N) sits in a "sweet spot" in terms of strength and formability, making it a good choice for applications that require a complex shape, such as the contour patterns of heat exchanger plates (*see box above*).

Price and performance

As recent years have demonstrated, nickel is particularly susceptible to volatile price movements, hitting a peak of over $20,000 per tonne in early 2012 and 2014, but falling below $10,000 per tonne in early 2016 for example. On 16 October 2019, the LME daily official price was $17,005 per tonne.

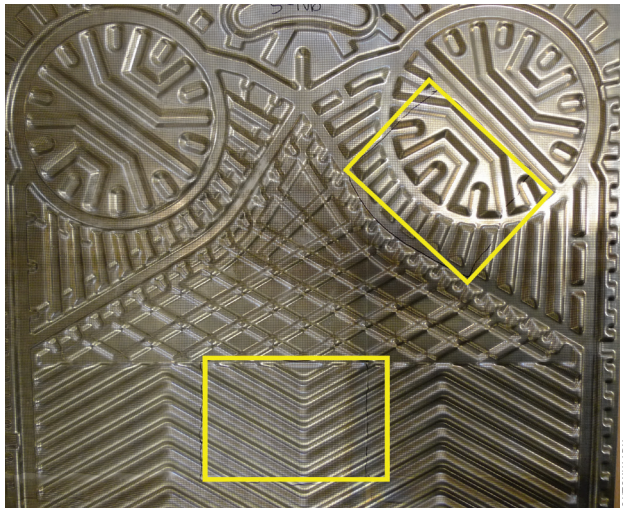
The prices of stainless steels over the past five years have also been volatile, but the span between the maximum and minimum cost of Forta FDX 27 over that period has been little over half the span for grade 316L, Outokumpu noted.

"Our customers like the lower volatility," said Beckers, "they cannot always pass on the price to their customers." There have been occasions when some austenitic stainless steels have been cheaper in dollars per kilo than their duplex equivalent, but, as Beckers pointed out, the higher strength of duplex stainless steels can enable down-gauging and enhance product designs.

Some customers who swapped – for example from 304 to the Forta LDX range when the duplex stainless was cheaper than its austenitic equivalent – chose to stick with it for its performance advantages, even when the duplex grade became more expensive. Some builders of large steel storage tanks were early to make the switch (*see box*).

"Promoting duplex is more about its higher strength and corrosion resistance than lower price volatility, which comes as an additional advantage on top," Beckers noted. In other words, duplex stainless steels are sold more on the grounds of the tailored solutions that they bring to specific projects than on a commodity-grade "price per kilo" basis.

A heat exchanger plate, highlighting areas in which the formability of the stainless steel from which it is made is crucial



Plant innovations aplenty

Plantmakers continue to enhance the scale, scope, capabilities, automation and environmental performance of metallurgical plants – often in co-operation or partnership with their customers. This selection of recent advances provides multiple examples

Coke oven gas injection systems for blast furnaces

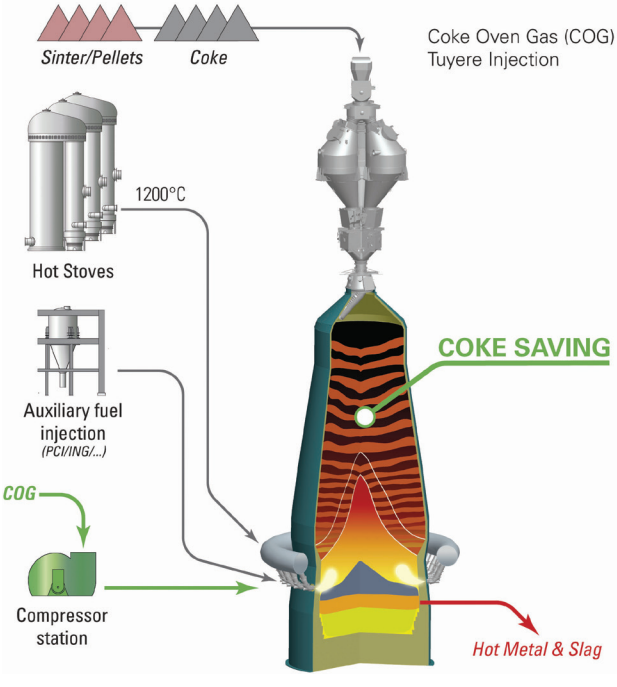
ROGESA Roheisengesellschaft Saar mbH, a joint subsidiary of AG der Dillinger Hüttenwerke and Saarstahl AG, has awarded Paul Wurth with an order to design and supply coke oven gas injection systems for the company's blast furnaces No. 4 and No. 5 located in Dillingen/Saar, Germany.

With this new technology, coke oven gas will become a metallurgical process gas instead of being used for producing energy at a low efficiency level. In its new role, coke-oven gas will partially replace both pulverized coal and metallurgical coke as reducing agents in the blast furnace process, thus contributing to reducing the carbon intensity in the blast furnace as well as the carbon footprint of the overall ironmaking operations. ROGESA, Dillinger and Saarstahl consider the application of this technology to be an important step towards hydrogen-based ironmaking of the future.

In preparation of the project, Paul Wurth accompanied the customer in research work and pilot plant trials. The order is being executed on a turnkey basis and includes design and engineering for the two coke oven gas injection sub-plants, supply of key technological items like flow control and check valves, the supply and erection of vessels, piping and supporting structure, plant automation and integration into the existing process technology and plant configuration.

Coke oven gas injection will start in summer 2020 at half of the number of hot blast tuyeres of the No. 5 blast furnace with the aim to achieve permanent injection at all the tuyeres of both furnaces by the end of the same year.

Within Paul Wurth's strategy to come to a carbon neutral primary metallurgy, coke oven gas injection at tuyere level is a part of the company's range of solutions for stepwise CO_2 emission reduction for existing integrated steel plants.



PAUL WURTH

Fully automated strip processing line

Fives launched its NeoKoil® SmartLine at the China International Import Expo (CIIE) held in November in Shanghai. This fully automatic strip processing line is based on predictive modelling to enable the best quality yield and optimal productivity. Fives developed the technology to help steelmakers meet an increased demand for high-value-added steel grades.

"NeoKoil® SmartLine completely changes the way the operation and process of continuous annealing or galvanizing lines are controlled. For the first time, predictive metallurgical models combining physical laws and artificial intelligence are used with the appropriate IT architecture and machine learning algorithms to automatically achieve the best quality and productivity of the line, as well as flexibility of operation," said Guillaume Mehlman, deputy general manager and president of the Steel and Glass Division at Fives, who introduced the new product at the CIIE. The new technology was also presented during the 'Smart Manufacturing' session of China's Baowu Iron & Steel Ecosphere Forum at CIIE.

Predictive metallurgical models are a key feature of the line. They are developed to take into account the entire processing history of the product. These models consider the effects of upstream slab production, annealing, cooling, galvanizing and the skin-pass reduction process. The NeoKoil® SmartLine enables a shift from predefined set-point management for each steel grade to achieve optimal set-points for the entire process, automatically achieving the steelmakers' desired steel grade properties.

"NeoKoil® SmartLine gives Fives a great competitive advantage in our business. The enthusiastic reaction of our clients during the CIIE confirms how well the solution meets their needs. We have been approached by many steelmakers who want to reap the yield and productivity benefits from fully automatic line control – consistently, every time," said Frédéric Sanchez, chairman and CEO of Fives.

SMS GROUP

Joining the large screw and nut for the SPKA-type press manufactured by SMS group for AVIC Shaanxi Hongyuan Aviation Forging

High-power clutch-operated screw press

SMS group has commissioned "the world's largest clutch-operated screw press" with AVIC Shaanxi Hongyuan Aviation Forging in Xi'an, Shaanxi Province, China.

The SPKA-type press supplied by SMS group has a screw diameter of 1,330 mm, a hard-on-hard blow force of 365 MN, a gross power of 27,000 kJ, and a weight of 2,900 tons. It is the third clutch-operated screw press of this size supplied by SMS group globally and is said by the plantmaker to have achieved the highest performance data of the three delivered to date.

The press offers great flexibility in optimizing the forging process, and requires far less stroke to achieve the pre-set ram speed than a conventional slipping-wheel screw press, SMS group notes. The maximum ram speed is attained after just 10% of the ram stroke, and remains at a constant level until the ram hits the part being forged.

This type of press is particularly suitable for high-energy forging, as typically used for turbine blades or structural aircraft components, for example. AVIC Shaanxi Hongyuan Aviation Forging is one of the largest manufacturers of structural components, aviation discs and turbine blades for the Chinese aviation industry.

By investing in the new press, the company intends to increase its production volume and component portfolio, and supply the aircraft industry with forgings produced on the new press from high-alloy steel, titanium and nickel-based alloys.

Heat-to-coat technology

US steelmaker Nucor Steel Gallatin in Ghent, Kentucky, is using SMS group's "heat-to-coat" technology at its new pickling and galvanizing line. The plantmaker notes that the technology has a compact and operator-friendly U-shape design, a turbulence pickling system, a high-power inductive heating system, FOEN® galvanizing equipment and a Drever after-pot cooling system.

SMS group says that the "heat-to-coat" process, based on its patented technology, provides high profitability as all processes take place in a single facility. The process permits the production of galvanized steel strip with durable corrosion protection, an appealing visual appearance, as well as an increased mechanical load-capacity, while still maintaining low production and investment costs, the plantmaker adds.

Pickling and galvanizing of the first coil in September 2019 marked the production start of the new line. SMS group delivered the whole line as a system supplier and was responsible for engineering, process technology, furnace technology, pickling and galvanizing technology as well as the electrical and automation systems.

The line is designed to produce 500,000 tons of galvanized hot strip per year with a maximum capacity of 180 tons per hour and a large strip cross section of up to 6.35 mm thickness and up to 1,854 mm width. There is a broad area of applications for the material, especially in construction, transportation and in the automotive industry and it is possible to substitute galvanized cold strip with hot strip, SMS group noted.

SMS GROUP

Nucor Gallatin's first pickled and galvanized hot strip coil was produced on its new line in September 2019

Remote commissioning of Level 2 automation

While it is already possible for plantmakers to support their customers online in many ways, the remote commissioning of a replacement automation system generates plenty of challenges. Nevertheless, "for the first time in over 50 years of cooperation," Primetals Technologies and Tata Steel Europe successfully commissioned a Level 2 system for a continuous caster completely online. In mid-2019, the new system from Primetals Technologies replaced the existing, over 20-years-old, automation on continuous caster CC21 of Tata Steel Europe in IJmuiden, the Netherlands.

The plantmaker is also building continuous caster CC23 for Tata Steel Europe in the same location, also equipped with the Level 2 system. Primetals reported that this harmonization of the automation solutions will simplify the control and optimization of the production processes. Primetals Technologies also noted that an advantage of the new solution is that the calculation algorithms and software models have additional potential to improve strand cooling, speed- and width-control, and thus improve production performance and achieve "right first time" casting.

For the entirely remote commissioning of the Level 2 system for continuous caster CC21, the correct coupling to the Level 1 system and the existing IT environment at Tata Steel Europe had previously been tested in several cold runs with on-site support of Primetals Technologies. All 10 hot runs and commissioning were supported on-line, resulting in the successful casting of 140 heats with a total of 1,900 slabs in mid-June 2019.

Primetals Technologies experts were continuously connected ▶

online to the team from Tata Steel Europe in IJmuiden and their system throughout all the hot runs, and they supported the operator at the plant in real time. This successful commissioning was based on defining all relevant interfaces in detail in advance, and the intensive preparations of the experts of both companies.

In addition to replacing the outdated system, the main reason behind the modernization was the harmonization of all the caster automation systems (CC21, CC22 and the new CC23) used by Tata Steel Europe in its IJmuiden plant.

PRIMETALS/© FIX MEDIA, THE NETHERLANDS

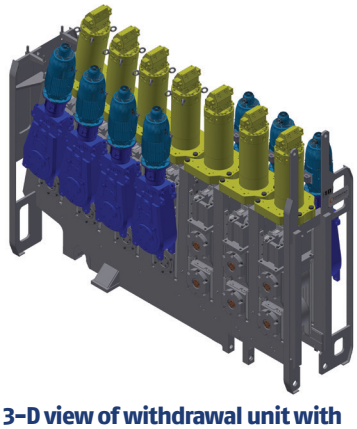
Primetals Technologies and Tata Steel Europe commissioned the Level 2 automation solution on continuous caster CC21 100% online

Individually controlled billet caster rolls optimize quality

In what will be the first billet caster worldwide to be equipped with Primetals Technologies' Single-Roll DynaGap (SRD) segments, the plantmaker is modernizing a 10-strand billet caster in converter steelmaking plant No. 3 for Zenith Steel in Changzhou, Jiangsu province, China.

The SRD segment has been developed for use in the area of final solidification. It enables the upper rolls to be pressed down individually onto the solidifying strand, which enables the final solidification point to be followed precisely. Start-up of the modernized casting machine is expected in March 2020.

The 10-strand billet caster of Zenith Steel in its Changzhou, Jiangsu Province plant has a rated capacity of 2 million tonnes per year. It produces billet with a cross section of 160 x 160 millimeters at a maximum casting speed of 2.4 meters per minute. Steel grades processed include low-, medium- and high-carbon steels as well as tube, spring, cold heading and tyre cord steels.



PRIMETALS TECHNOLOGIES

3-D view of withdrawal unit with SRD segments for hard reduction

Precise knowledge of the final solidification point and the associated soft reduction is needed to reliably produce billets for steel grades that require high internal quality. The new SRD segments can be applied to the final solidification precisely. This enables each individual roll gap to be adjusted dynamically as a function of the steel grade, overheating, cooling or casting speed. Each roll transmits an individual force, which makes even higher thickness reduction rates possible, and reduces the segregation and porosity in the center of the strand. Additionally, thickness reduction of the billet or bloom also after final solidification is possible. This process is called hard reduction and can furthermore reduce the porosity of the cast billet and bloom.

SRD segments are designed for long operating cycles and easy maintenance. Each roll has its own overload protection, which prevents damage to the bearings and surfaces of the rolls. The rolls are embedded in a functional unit so that they can be quickly replaced in a maintenance workshop. The individual roll units can also be tested and calibrated before installation of the segments in the caster.

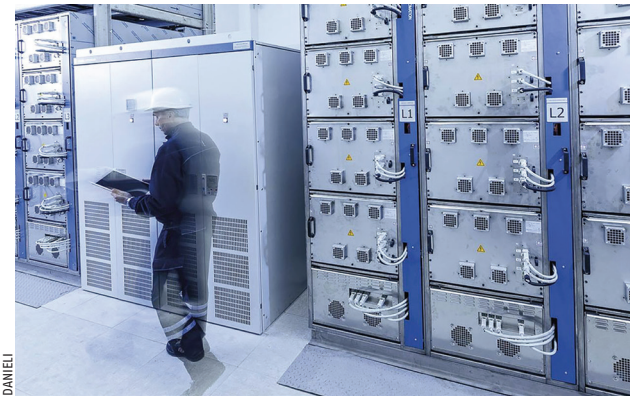
Other technological packages to be supplied by Primetals Technologies for the modernization include process models for soft and hard reduction: DynaPhase, Dynacs 3D and DynaGap SoftReduction 3D. The DynaPhase online thermodynamic phase transformation model calculates material properties like thermal enthalpy, thermal conductivity, density and solid fraction. The Dynacs 3D secondary-cooling model is capable of calculating the full 3D strand-temperature profile at any position along the strand for optimal adjustment of the secondary-cooling setpoints and the determination of the point of final strand solidification. The DynaGap SoftReduction 3D fully automatic roll-gap control system allows for dynamic soft reduction to minimize centerline segregation for improved internal strand quality.

Zenith Steel is privately owned and operates an integrated steel mill in Changzhou in the Jiangsu province of China. The company's steel mill has a production capacity of more than ten million tonnes of steel per year. Zenith Steel manufactures a wide range of end products, including steel pipes, bearing and spring steel, and various structural steels.

Power control system maximizes EAF efficiency

Danieli Automation's Q-One power system installed at the ABS Sisak meltshop for special steel in Croatia achieved an increase of active power availability and EAF efficiency, reports its supplier.

Q-One technology, which powers Danieli's Digimelter system, provides a very stable, low-disturbance effect (flicker and power factor) on the electrical power network, along with an advanced, dynamic, fast, electrode control system, reducing electrode



DANIELI

A new Q-One digital power system in operation at ABS Sisak, Croatia

consumption through its high-performance power unit.

The upgrade of the 78-tonne melting unit with Q-One at ABS Sisak, led to a 20% reduction of electrode consumption and a 10% shorter power-on time. One of the targets of the upgrade at ABS Sisak was to comply with tighter rules applied by the Croatian electrical energy supplier.

Very low network flicker, due to a quick control of voltage and current, and a power factor constantly above 0.96 were achieved, the plantmaker reports.

DANIELI

The Danieli Automation system for hot-dip galvanizing allows the complete control by operators with detailed diagnostic capability

Galvanizing line air wiping equipment

Air knives are one of the most crucial parts of continuous hot-dip galvanizing lines. Danieli Kohler provides wiping systems with air knives to produce high-quality coated products and has invested in intensive R&D, and utilized many years of experience in the technology, to maximize their performance, productivity and zinc-saving capabilities, and to achieve surface-quality improvements.

During the hot-dip galvanizing process, sets of rolls receive the strip being coated, hold it in the pot, establish entering and exiting pass-lines and work together to flatten and stabilize the strip between the air knives. As the strip rises from the pot of molten metal, Danieli Kohler X-JETs meter the coating. The precisely shaped and directed jet of pressurized air they supply leaves a uniform coating of the correct thickness. Non-contact edge baffles reduce the noise generated and provide consistent coating at the strip edges.

The rolls and air knives are precisely and consistently positioned by motorized mounts and fixed supports. Blowers provide air at the required pressure and flow rate. PLC-based automation and an advanced human-machine interface (HMI) aid the operator. An electromagnetic strip stabilizer can be installed to improve strip stability and shape.

Danieli Kohler provides a variety of product solutions. Its X-JET and Compact X-JET (CXJ) products cover requirements for new lines and the modular design, particularly of the CXJ, allows revamping of existing systems with minor modifications. Danieli notes that these technologies, applied for pot equipment revamping, have already demonstrated a payback time between 0.5 to 1 year, depending upon product mix and metal cost.

This is achieved by several factors: zinc consumption reduction, since even and more precise zinc distribution of the coating layer cuts down overcoating; fewer product rejects due to surface defects, since better surface appearance and effectiveness of the wiping action are given by a sharper air jet; and an average production increase, since light coating weight production is possible at higher line speeds.

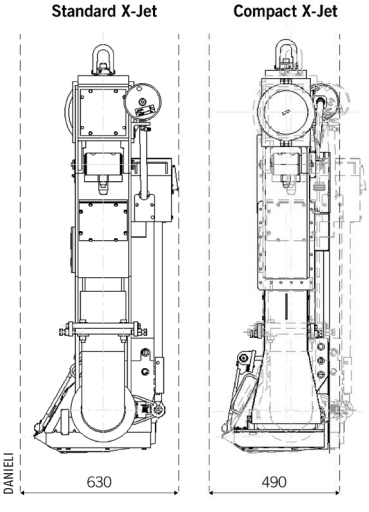
Extensive R&D activity – including the development of fluid-dynamic models for simulating air flow within the air knives and the prediction of the final coating thickness – resulted in the design of the X-JET air knife, which has a more efficient jet, with sharper pressure profile and extended laminar zone. By comparison with earlier designs, the X-JET drastically reduces the minimum coating at high speed, achieving 39 g/m^2/side at 180 mpm.

The X-JET air knives nozzle design with extended laminar zone length improves wiping capability, resulting in lower coating weight at the same speed, same coating weight at higher speed, reduced splashing and spitting, as well as reduced edge overcoating.

Despite the advantages of the X-JET design for revamping projects, crowded pot areas and space constraints can be limiting factors, Danieli notes. Lead-time and cost are increased by the need to modify or replace existing equipment.

To overcome this potential limitation, Danieli's experts developed the CXJ to achieve the same performance in a more compact envelope. The critical dimension perpendicular to the strip is significantly reduced for this version of the X-JET (*see diagram*). It is now possible to fit that design into extremely crowded pot areas with minimal disruption to surrounding equipment.

Closed-loop control for coating weight, including a sophisticated coating model, long-term adaptation functions, as well as precise controllers for air-knives' distance and pressure, supports a tight coating weight accuracy and fast adjustment in case of flying product changes.



DANIELI

Main dimensional comparison between compact and standard X-JET

Competition climbs

The aerospace industry is a high-value market that places stringent requirements on its supply chain. Gregory DL Morris looks at trends for the sector and the materials consumed by it

AIRBUS 2019 (M. SHERBORNE)

The Airbus A-380 double-decker aircraft with the new Airbus A-220 regional jet

For a ubiquitous segment of the global economy, aerospace is counter-intuitive. Making headlines is bad. Uncomfortably packed planes are good. It is a big industry that actually makes relatively few units compared with others. Metals suppliers have been disappointed by the rate of adoption of custom-designed alloys, notably aluminum-lithium alloys (Al-Li), but basic sheets of aluminium are still a mainstay of the industry.

Order books are relatively stable with years of backlog for the most popular models, yet all recent attention has been focused on the troubles of the Boeing 737-Max, which is the latest version of the best-selling passenger jet. Technology originally designed to prevent crashes has actually been implicated in two and so the Max version has been grounded worldwide. Thousands of earlier versions of the 737 continue to fly safely as Boeing and the Federal Aviation Administration (FAA) deal with the consequences of grounding the Max.

The grounding has not yet seriously affected metals demand through the supply chain, but if the grounding drags into 2020 it could. At press time early in December there was no firm indication of when the 737-Max might be allowed back into service by regulators in North America and Europe. Boeing has slowed production of the model significantly but has not stopped, stockpiling finished aircraft for release as soon as it is allowed.

Boeing provides order and delivery information in tabular format. As of October 31, year-to-date deliveries were 301 aircraft, of which 118, or 39% were 737s of all models. A further 113, or 37.5% were 787 Dreamliners. Orders stood at 5,457, of which 4,387, or 80%, were for 737s of all types. Net orders for 737s were reduced by 202, which is only 4.4%.

Airbus orders and range

Meanwhile, the other major global plane maker, Airbus, keeps on producing. "October was a landmark month for Airbus in terms of new business," the company said in a statement, "with orders logged for 415 new commercial jetliners… New transactions were also booked in October for the latest member of Airbus' single-aisle line: the A220."

During the first 10 months of 2019, Airbus made 648 deliveries overall to 92 customers, compared with 584 aircraft over the same period of 2018 – equivalent to 64 more deliveries. Taking the latest orders and deliveries into account, Airbus' aircraft backlog as of October 31 stood at 7,471 aircraft.

Orders and deliveries have reached a relatively stable, if not steady, level. "At the Dubai air show there were a scattering of orders," said Peter Zimm, principal of Charles Edwards aerospace consultancy. "But no one was really expecting big orders, especially for narrow bodies given the existing backlog. If anything we would like to see more of a backlog for wide bodies."

What seems to be hiding in plain sight is a structural shift in the way that the larger airlines run their operations. More efficient aircraft have greater ranges, "longer legs," and so airlines have been able to shift from a strictly hub-and-spoke model to more city pairs connected by long-range narrow-body planes.

"We are seeing that transcontinental and even trans-Atlantic," said Zimm. "The more powerful engines and more efficient with higher bypass ratios make that possible. Slimmer seats are also allowing airlines to put more of them in the cabin. For example, look at the Boeing 787 versus the 767 from 30 years ago. The 787 flies 50% farther with about the same number of seats."

Order books are a bit more slack than in the last few years said Glenn McDonald, senior associate at Aero Dynamic Advisory. "The Paris and Dubai airshows were quiet this year. Discussions were more about reconfirming orders. That left the book-to-bill ratio stagnant, but there is lots of backlog through the middle of 2020."

That steady state lies over a significant consolidation among airframe manufacturers. Bombardier, the major Canadian maker of a popular and strong-selling CRJ regional jet as well as the ubiquitous Dash-8 and Q-400

turboprops, has partnered with Airbus to produce the A220. It also has its successful business jet and railcar operations.

"We think the 220 will be a success," said McDonald. "It fits well with Airbus's line of smaller mainline narrow bodies, the 320 and variants. The 100-seat small mainline jet segment is the exception to the overall industry consolidation. Embraer, of Brazil, has the well-established and popular E-175, with which the A-220 will go head to head. There are also similar planes just entering the market from Mitsubishi, as well as from Russia and China.

"The Mitsubishi plane was originally designed with a composite wing, but that was revised to metal," said McDonald. "Composite has a higher capital cost for manufacturing. The return does not make sense for a few hundred. Only for a few thousand."

For all the initial scramble in the 100-seat segment, the end result may be a little different. "There are a lot of challenges for the Japanese, Russian, and Chinese planes," said McDonald. "What matters most for commercial aircraft is equipment support and customer support. Aircraft break all the time and they need parts and service," he said, noting that Airbus took years to catch up with Boeing in providing such support. "For that reason in particular we are not bullish on the Russian or Chinese planes," he added.

That is one of the factors that led Bombardier to team up with Airbus. McDonald noted an interesting situation in which both Mitsubishi and Embraer have formed collaborations with Boeing for customer support, but full details have yet to emerge.

There was a time when the airframe companies tried to book as many orders as possible, and the backlog stretched in some cases to many years. "More recently there was a big push on to monetize the backlog," said Bill Bihlman president of Aerolytics. "The OEMs want the book-to-bill ratio of greater than one. The historical average has been three to four years. Between the two major commercial types, that has been two to three years for wide-body/two-aisle planes and ran as high as eight and a half years for some narrow-body/single-aisle types."

Workhorse materials

The aerospace industry consumes about 1.8 billion pounds of materials, according to Bihlman. "And in that there are three workhorses. About two-thirds of the whole total is 7000 Series aluminium for airframes. You could add 2000 Series as well. The other two are Superalloy 718 and Titanium 6-4. Those are mostly for gas turbines [jet engines], which are about 30% of the weight of the whole aircraft."

Zimm identified two major trends in his firm's materials forecasts, both driven by composites. Those have such lower buy-to-fly ratios that buy weight for materials overall is trending lower. The other is that "titanium has grown commensurate with composites use. It used to be that titanium was mostly an engine material, now it is mostly an airframe material."

Modern jet engines have a low-pressure stage at the front; those are the big fan blades visible just inside the cowl. Most of that air is driven around the engine core, providing thrust and also dampening noise. A high-pressure stage compresses air for the combustion chamber. That provides more thrust and powers a turbine that drives the compression stages at the front.

There are materials shifts in engines as there are in airframes. "Nickel has moved forward in the engines," Zimm added, "from the turbine section to the high-pressure compressor. Also, titanium aluminides have been introduced by General Electric into the low-pressure turbine. The fan case [on many engines] used to be titanium, but with the higher and higher bypass ratios the fan cases are now composites because they have to be so big."

Zimm explained that Ti-Al has been introduced there because the low-pressure turbine grows in diameter with the the fan diameter at the front of the engine. The turbine historically has been made of nickel which is very heavy, so adding diameter with a heavy material creates challenges. "Hence the desire to introduce a lighter material that is sufficiently heat resistant," he said. "Ti-Al is less than half the weight of nickel."

The lesson for metals makers is not necessarily not to innovate but simply to economize – at the level of the plane maker. "Look at titanium and nickel in the engine," said Zimm. "There are always new markets and new grades. Steel has gone through a long reduction in percentage of content so there is not much of that left to kick off. There will always be demand for new grades that meet very specific needs. That is even true in aluminum. Technological innovation has not gone away, it has shifted."

"The Max slow production has not been a big problem from a raw-materials standpoint, at least not yet," said Zimm. "That is because there is so much lead time in the supply chain and because there is so much backlog for other aircraft. If anything, the engine guys have breathed a sigh of relief because they have been able to catch up on work for other types. That said, the sub-tier suppliers are starting to get a little anxious."

And most broadly the whole crisis has brought renewed regulatory, political, and social pressure on the Federal Aviation Administration. "There is always the possibility of greater regulation," said Zimm.

Spotlight on substitution

Bihlman clarified some important definitions and processes in the aerospace industry. He noted that materials suppliers and others tend to think in terms of "substitution" and how to get new materials "certified." There are only three entities that are certified *per se*, he stressed: airframes, engines, and propellers.

Regulators issue a "type certificate" for the aircraft and power plant designs, then a "production certificate," that a finished assembly matches the design within acceptable variables. Materials are then "qualified" as part of those certifications.

"That is part of the reason that substitution is so difficult," said Bihlman. "New parts, including parts made with new materials have to go through the same specification process. You can't just swap aluminum for titanium or carbon fiber. That would change the design and require new certification."

The other reality that bears mightily on materials suppliers in aerospace is the simple number of machines that are made each year. Order bookings and projections by the manufacturers should be viewed with a degree of caution. "Both Boeing and Airbus are overly optimistic in their projections," said Bihlman.

"There are only about 3,400 turbine [jet] aircraft manufactured in a year worldwide," he noted. "To put that into perspective, that number of units is about two days' production at an automobile plant." That much-lower volume limits economies of scale. That is magnified by complexity. There are 2.3 million parts to a Boeing 787 Dreamliner, Bihlman added. A typical automobile has 30,000 parts.

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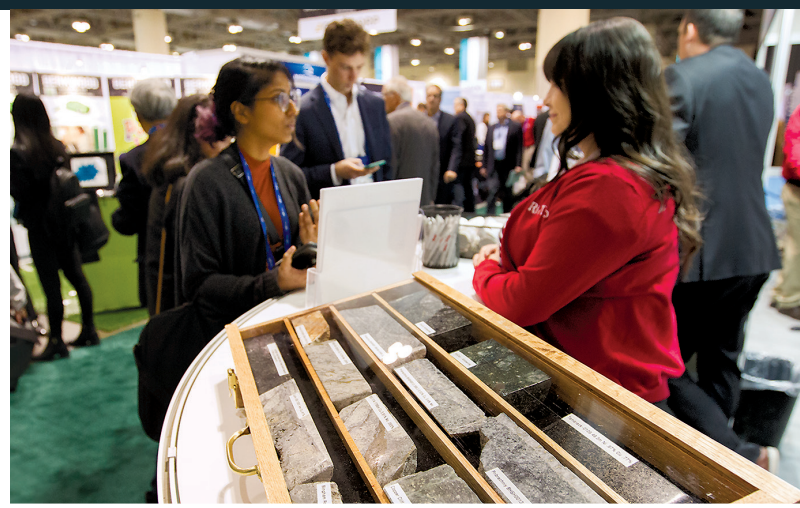

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Boliden investment will grow Aitik electric transport trolley technology

Boliden will invest SEK300 million ($32 million) during 2020-2021 to expand its electric trolley transport pilot project in Aitik's open-pit copper mine, located south of Gällivare in northern Sweden. It will also implement the technology at its Kevitsa open-pit minerals mine in northern Finland.

In addition to their increased productivity and reduced diesel consumption, the electrically powered trucks can run at a higher speed but still incorporate an improved working environment for drivers because of lower noise levels.

Diesel consumption is set to reduce by 5,500 cubic meters per year when the investment is complete, said the company.

The project conducted since 2018 in Aitik has seen 700 meters of electric trolley line installed with the conversion of four mining trucks.

"We are now taking further steps to improve both productivity and climate impact at our two open-pit mines," Mikael Staffas, president and chief executive of the Boliden Group, said.

Aitik will expand the trolley line by another 3 kms, with 10 trucks converted for the electric trolley lines. According to the company this is a sustainable way forward with the investment ensuring greenhouse gas emissions over the transportation life of the mine are reduced by 15%.

In Kevitsa, where 13 trucks are being converted and a 1.8 km trolley line is being built, greenhouse gas emissions over the life of the mine will be reduced by 9%.

BOLIDEN

Boliden's project conducted since 2018 in Aitik has seen 700 meters of electric trolley line installed with the conversion of four mining trucks

Independent testing confirms Hardide–A improves fatigue life

New independent testing has proven that Hardide-A tungsten carbide/tungsten metal matrix composite coating improves the fatigue life of metal components by 4.5% when compared with uncoated substrates, Hardide Coatings reported.

Hardide-A also eliminates the need for the secondary shot peening needed for some other coatings, making the Hardide coating a significant advance in materials optimization for the aerospace and other industries where fatigue debit of surface coated metals is a problem, the company noted.

The tests were conducted by Westmoreland Mechanical Testing and Research Ltd (WMTR), an aerospace-qualified testing laboratory in the UK and USA. WMTR used the Rotating Bend Fatigue test method complying to BS ISO 1143:2010. This test is very sensitive to the effects of surface treatment on fatigue properties. Samples of S99 steel were coated with Hardide-A to a thickness of 63-70 microns and hardness of ~950 Vickers, which are mid-value thickness and hardness properties for this coating type. The test was discontinued after 15 million cycles.

Traditionally, the fatigue debit after hard coatings such as hard chrome plating (HCP) and HVOF coatings have been applied can be as much as 60%, according to Hardide Coatings, and only following shot peening of the coated surface can this be reduced to around a 20% debit. The Hardide-A coating recorded a fatigue life increase of +4.5% after coating without any need for shot peening.

Fatigue debit of surface-coated metals has been a long-standing problem for the aerospace industry, Hardide Coatings notes, adding that Hardide-A was developed specifically to meet the needs of the sector. This replacement for HCP and HVOF coatings provides enhanced protection against corrosion and chemically aggressive media, wear, galling, fretting and fatigue.

Dr Yuri Zhuk, technical director at Hardide Coatings commented: "Metal fatigue is an enduring problem in aerospace as well as for the steam, and industrial gas turbines industries and we recognized the value in commissioning independent testing to verify the fatigue advantages of Hardide-A.

"The positive 4.5% improvement to fatigue life provides the detailed analysis and assurance that our solution is an improved alternative to traditional HCP and HVOF coatings," he added. Hardide-A has no through micro-porosity, so creating an excellent barrier against corrosion as well as improving fatigue performance," he concluded.

ICMM report on managing climate change impacts

A recent International Council on Mining and Metals (ICMM) report shares learning from its members on how to manage the impact of climate change, both for the supply chain and local communities, by integrating climate considerations into existing risk management processes.

The report: *Adapting to a changing climate: building resilience in the mining and metals industry* was released at WWF's Water Summit 2019 in Frankfurt, Germany, on November 18, and offers experience from ICMM members and other experts.

Areas of concern highlighted in the report, both direct and indirect, were identified around water management; damage to fixed assets and mobile equipment; the performance of facilities that have long life spans such as tailing dams, water and waste rock storage facilities; loss of output; and supply chain disruptions.

The ICMM was founded in 2001 to improve sustainable development performance in the mining and metals industry.

ICMM members recognised that changes in precipitation, hydrology, ground conditions (including permafrost) and soil moisture content could have potential implications for the design and management of facilities, and the sustainability of communities and ecosystems.

The report offers guidance on safeguarding business by mitigating CO_2 emissions across the supply chain, recognising that for the mining and metals sector, building operational resilience will rest on businesses' ability to adapt. Mining and metals companies can utilize existing risk management and planning procedures and identify the 'hooks' for climate risk and resilience across the entire asset life cycle, the report highlights.

Constellium wins US Defense $9.5 million grant for cold-rolled aluminium mill

Constellium's Ravenswood, West Virginia, facility has been earmarked for a $9.5 million United States government grant to improve its 144 inch cold rolling mill, which is key to the manufacture of high-performance aluminium plate for ballistic and blast protection of military vehicles.

Constellium will use the funds to improve the mill's electrical, mechanical and hydraulic system and also add automation and process controls to increase throughput, quality and performance.

The funding, which was awarded by the Department of Defense's Cornerstone OTA, and to be administered by the Army Research Laboratory (ARL), will aid Constellium in furthering the company's processes for manufacturing armor plate production at the mill.

"This investment by the Department of Defense will enable us to meet the increased demand for cold rolled plate over the next 5 to 10 years and also significantly improve the performance of armor against constantly evolving threats," Buddy Stemple, chief executive officer of Constellium Rolled Products Ravenswood, said. "We are very excited to have this opportunity to help protect our troops."

Constellium's Ravenswood facility supplies a portfolio of rolled products and research and development capabilities to the Department of Defense and its OEM partners.

CONSTELLIUM

Constellium's government grant will help hone armor plate production at its Ravenswood facility

Sandvik's 316L stainless steel pipes feature in Champs-Élysées fountain restoration

A restoration project of fountains on the Champs-Élysées was implemented by designers Atelier BLAM Lemunier & Meyer (Nantes) and Swarovski Crystal (Wattens), and made possible using Sandvik's high specification stainless steel pipes.

Atelier BLAM incorporated Sandvik's grade 316L pipes with large wall thickness in the construction of the project, which met all the necessary quality requirements. "When it comes to stainless steel, we only work with Sandvik," Atelier BLAM representatives said. "We know that their pipes are worry-free in all regards: mechanical properties, corrosion resistance, tolerances on dimensions and external appearance."

During the restoration, the fountains travelled 3,062 km, in a collaboration of 250 people and many partners, according to Sandvik.

The Paris Fund commissioned the restoration of the six fountains. The artistic concept came from Ronan & Erwan Bouroullec (Paris).

The pipes in the six identical steel designs are laminated with Svarovski crystal links and incorporate an underground water supply system.

The geometry of each piece comprises a supporting central mast made of bronze supporting three angled poles suspended from the top and set with luminous crystals. The water flows vertically from the central mast falling down the lower end of the suspensions into the pool below, with the structure rotating slowly.

LED lights are integrated in the design, with each piece allowing for energy consumption of 4.5 kWh per day. The water is continuously sucked back into the valve construction to create a closed circuit.

XXXXXXXX

The pipes in the six identical steel designs are laminated with Swarovski crystal links

Hitachi unveils lower cost optical emissions spectrometer

A Hitachi High-Technologies Corporation subsidiary manufacturing and selling analysis and measuring instruments has launched a new lower cost optical emissions spectrometer (OES) for verifying the spectrum of elements in metals production.

Foundries and metals producers are under increasing pressure to control tramp and trace elements in the melt quickly along the whole supply chain, and with greater use of scrap metal, said Hitachi.

Hitachi's OE750 wide wavelength range can check low metal detection limits in the lowest ppm range with high precision, according to company.

The analyzer is better able to meet the industry's tight standards and specification requirements, such as the ASTM E415 and ASTM E1086 standard test measures.

The OES is also able to detect alloying elements in nearly all metals, including nitrogen in steel, and incorporates an integrated database. It is now affordable for more metals producers worldwide when once OES analysis was out reach for some companies, said Hitachi.

Hitachi High-Tech Analytical Sciences was created in 2017, and is headquartered in the UK, with operations in Finland, Germany and China.

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