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Refractories in steelmaking: still a buyers' market

Refractories demand is recovering at a snail's pace following some years of decline. But lower usage rates mean the uptick is unlikely to halt a tide of m&a and consolidation

Consolidations among refractories producers have been thick and fast in recent years amid rife competition in a flagging market. In a sector dominated by China, steel and metals producers elsewhere have scrambled to secure supplies of refractories and their raw materials, also entering the merger and acquisition fray.

The trend to consolidation and rationalization, very steady since the late 1990s, may even be gathering pace. Within the last two years OYAK, the pension fund parent of Turkey's largest steelmaker, Erdemir, bought Almatis Group, supplier of premium alumina for the refractory and ceramic industries; China's Shanxi Fangxing Minerals acquired Switzerland-based international mineral processor Imerys' Newell, US, refractory bauxite plant; Austria's RHI announced purchase of a controlling stake in Brazil's Magnesita Refratarios; Japanese anode material manufacturer Showa Denko bought SGL Carbon's synthetic graphite business; and Imerys bought Greece's Kerneos (a world leader in refractory cements) adding to its Calderys refractory arm, as well as announcing acquisition mid-February of Japan's Nippon Power Graphite (NPG).

Further consolidation is considered inevitable due to broader industrial trends: the main end-use sectors for refractories

(continued on page 2)

Forthcoming merger: Magnesita's vast Pedra Preta magnesite mine, near Brumado, Bahia, Brazil, which provides more than 1 million mt/year feedstock for dead burned and caustic calcined magnesia production, could be joining RHI's equally impressive magnesite resources in Austria. (Ibar Nordeste's magnesite mine is in the background, soon to be exporting its DBM production). Photo courtesy of IMFORMED

EDITORIAL COMMENT

The steel industry is the main consumer of refractories -used in furnace linings and other heat-resistant applications – accounting for 60-70% of a global market with production of some 35 million metric tons/year. The slowing pace of new capacity investments in steelmaking has taken its toll on the refractories sector in recent years: this is a buyers' market where overall production has been shrinking. Moreover, the intensity of usage – the number of kilos of refractory materials used per ton of crude steel produced - has declined by a massive 75% worldwide since the 1960s on more efficient steelmaking processes. As steelmakers' fortunes begin to look up, the refractories sector is edging towards recovery, but at a snail's pace, with consolidations and merger and acquisition activity still quite the order of the day. Some refractories capacity is now under the control of steel and metals producers aiming to minimize volatility in their raw material supply prices and, in some cases, their dependence on Chinese suppliers.

"The bottom line is that the refractories market follows the performance of steel and cement markets generally," says Mike O'Driscoll, director of industrial minerals research company IMFORMED, noting also that policy changes in China occasionally pepper up trends in Chinese refractory mineral supply. In January the Chinese government abolished export quotas and taxes on major refractory minerals magnesia and graphite (previously set at 10% and 20%, respectively), immediately leading prices for these minerals from China to slump. Consultancy Roskill says the removal is thought to be linked to World Trade Organisation moves against China's policy of high export taxes/quotas on some raw materials. China essentially controls global graphite prices. Concerns persist that a pollution tax could be slapped on mineral plants in China, again inflating mineral prices following introduction of a resource tax in mid-2016.

A brighter point for producers of refractory minerals is that demand for graphite is now growing from the lithium-ion batteries sector, which could potentially pressurize supplies of this key material. Refractories recycling is meanwhile emerging as players strive to improve their environmental footprint. Recycled refractories now account for 7% (1.6 million mt) of total world refractories consumption, put at 23 million mt, according to industry research. — *Diana Kinch*

Refractories in steelmaking: still a buyers' market

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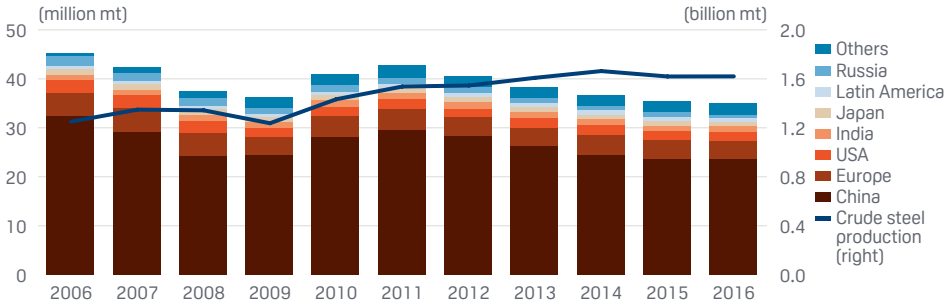
are global heavy manufacturing industries which have also consolidated in similar fashion across the world: steel, cement, ceramics, glass, lime and nonferrous metals.

"Consolidation will help companies to prosper in the hard times ahead. Larger companies have also taken advantage of the lean times and acquired struggling producers," said consultant Roskill's senior analyst Suzanne Shaw.

Production falling

The refractories industry is extremely competitive and overall production has been shrinking for a number of years, Shaw points out. Roskill forecasts production of refractories will now grow by just 0.5-1.0% per year to 2026, just below that of global crude steel production. Performance has in recent years consistently lagged behind expectations. Global demand for refractories was approximately 45 million mt in 2012, reported consultancy Smithers Apex, with most demand coming from the growing economies of the Asia-Pacific region, especially China and India, with the Americas also showing considerable growth potential. At that time demand was expected by some

WORLD REFRACTORIES PRODUCTION BY REGION AND CRUDE STEEL PRODUCTION



Source: Roskill, Prodcom, Refwin, Indian Minerals Yearbook, PRE, ALAFAR

WHAT ARE...THE GRAPHITE MARKETS?

The main graphite markets include synthetic graphite electrodes, refractories, foundry sand castings, batteries, friction products, lubricants and recarburising. Electrodes are used in electric arc furnaces for the production of steel (mainly from steel scrap). Electrodes are the largest application for synthetic graphite (around 0.8 million mt in 2016). Synthetic graphite is manufactured from pet coke.

The largest application for natural graphite is refractories (around >0.4Mt in 2016, almost all natural flake). Graphite is used mainly in magnesia-carbon and alumina-carbon bricks, as well as in alumina-magnesia-carbon and silicon-carbide-graphite refractories, crucibles, nozzles and retorts.

Recarburising (the improvement of molten iron and steel through the addition of carbon) is a major application for lower quality synthetic and natural amorphous graphite. >0.3Mt of graphite is used in this application.

Rapid growth is forecast in the lithium-ion battery market which will result in increased demand for both natural and synthetic graphite. However, natural graphite used in batteries is mainly small to medium size flake. Natural graphite used in steel applications is typically large flake (refractories) or amorphous (recarburising). There is only a small amount of competition with medium size flakes in refractories. Synthetic graphite is produced directly for the customer and the market for electrodes does not directly compete with batteries. Source: Roskill.

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market sources to reach 46 million mt in 2017, but has fallen far short of this. Roskill estimates 2016 global refractory production at 35.2 million mt, a -2.5% annual decline since 2006. And consumption is seen to be considerably lower.

China accounts for around 67% of total refractories production, Europe 11%, the USA 5% and India and Japan 3% each. The only regions seeing growth are India and Latin America. Indian refractory production grew by 28% over the last decade but is still only around 1.1 million mt.

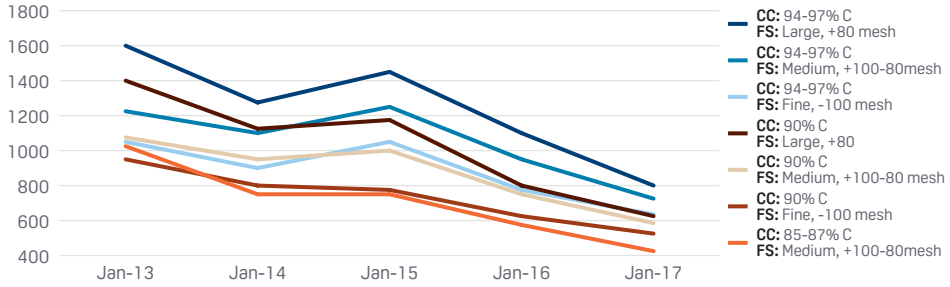
Chinese steel output forecast to fall

Established refractory markets such as Europe and the USA are in decline. Production in China has fallen with slowing demand as specific consumption of refractories falls, according to the consultancy.

"Chinese crude steel production has been slowing for a number of years and fell for the first time in 2015 by around 19 million mt to 811 million mt," Roskill's Shaw said. "Although Chinese production recovered slightly in 2016 (by around 7 million mt), it is expected to fall again in 2017 and to remain low throughout the next decade."(see chart).

The electrode market is meanwhile suffering because of low steel production and because of a shortage of steel scrap in China which has lowered the percentage of steel made in China via the electric arc furnace route. "Recarburising is very competitive and there graphite is losing out to the many other forms of carbon on offer such as petroleum coke," the Roskill analyst says.

NATURAL FLAKE GRAPHITE: AVERAGE MONTHLY JANUARY PRICE 2013-2017 ($/mt)



Note: CIF European port FCL; CC = Carbon Content; FS = Flake Size
Source: Industrial Minerals

Graphite prices have shown a large decline over the last four years and although poor steel markets have had an impact, there were other important factors at play causing this decline.

Prices have continued to fall from highs in the bubble of 2011/12 when buyers perceived a flake shortage from China that was never realised. This came about from over-optimistic lithium-ion battery forecasts based on electric vehicle uptake that has, in reality, had a much longer lag time. On the supply side, China closed almost all amorphous graphite mines from 2010 and consolidated the industry. Buyers were worried a similar scenario would arise for flake producers. There have been some closures (mainly under environmental improvement legislation) but nothing like that seen for amorphous.

The recent continuation of low prices over the last year or so can be more easily contributed to poor steel markets.
Source: Roskill.

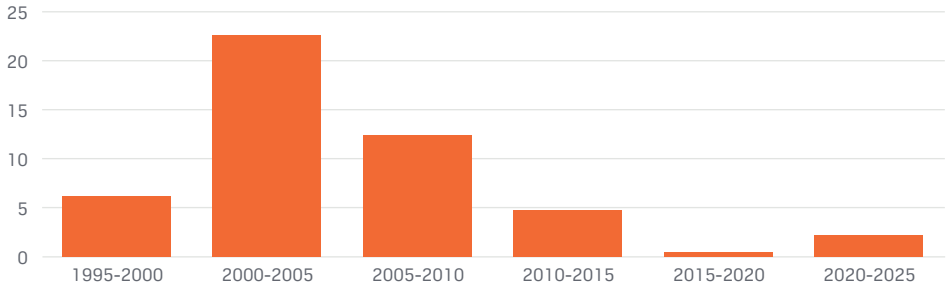
Is consolidation good for consumers?

"With poor performance in the crude steel market forecast to continue, refractory producers have been looking to streamline production, perhaps supply more higher quality/value products and to eliminate competition wherever possible," Roskill's Shaw points out. Refractory product prices have been falling not only due to oversupply but to pressure from cost-cutting steelmakers: prices for some natural flake graphite products have for instance been falling close to 20% a year over the last four years (see chart). Inevitably consolidations reduce the choice of supplier available to these consumers, which may give the refractory producers greater ability to resist these price-reduction pressures. Key producers are now talking about the concept of strengthening "partnerships" with customers, which may help both sides deal with the challenges of an industry where the significant drop in intensity of use is likely to mean extremely low growth rates for the foreseeable future.

On the other hand it is in the customers' interest to have healthy suppliers. Vertical integration where mineral suppliers also produce refractories, for instance in the case of major companies like RHI and Magnesita, has become increasingly necessary for companies outside China to compete, and this is favorable for consumers, the consultants claim. RHI ceo Stefan Borgas told S&P Global Platts that: "We strive to build maximal value for our customers through technological competence and investments in R&D. This is only possible if you have a solid cost position."

"For us to be one of the 'market leaders' means not only best quality for the customers but also a cost position, that allows us to offer attractive prices to our customers," RHI continued. "The combination of RHI and Magnesita allows us to serve our customers well….to offer an even broader product and service portfolio thereby delivering enhanced added value. Additional potential for value creation will be realized through synergies. We have to structure the joint company to serve our customer's needs

CHINA: ANNUAL AVERAGE GROWTH RATE OF CRUDE STEEL PRODUCTION IN FIVE YEAR PERIODS, 1995 TO 2025 (% per year)



Source: World Steel Association, Roskill

best: just-in-time delivery with our specific products and services requested by our customers at competitive prices."

IMFORMED's O'Driscoll claims that refractory customers, such as steelmakers, benefit from m&a among refractories suppliers such as RHI and Magnesita because of the higher global product consistency that can potentially thus be achieved: "From the steel producers' point of view the RHI-Magnesita merger brings both companies a far greater global reach, bringing Magnesita to Europe and RHI to the Americas, as well as complementing each others' operations in China," he says. A further advantage is seen in both players' high level of self-sufficiency - around 80% - in production of key refractory raw materials including dead burned magnesia and fused magnesia.

Current shape of sector

With an emphasis on trimming the costs of sourcing, production, sales and distribution and maximizing logistics potential, (especially in the face of low cost Chinese exports of both refractory raw materials and end products), the refractory industry has shrunk considerably in the last three decades to just a few multi-national players leading the field, followed by a few medium sized companies, IMFORMED says.

Each of the top four refractory groups based outside China are the resultant amalgamations of massive mergers and acquisitions during the 1990s and 2000s: Vesuvius (Hepworth, Foseco); RHI (Veitsch-Radex, Didier Werke); Magnesita (LWB Refractories); Calderys (owned by Imerys: Plibrico, Lafarge Refractories). It is noted that in 2012 Imerys bought Vale's refractory bauxite reserves in Para, Brazil, while in Greece Kerneos took a 54% stake in refractory bauxite producer Elmin in 2012, going on to buy S&B Greek refractory bauxite assets in 2015. Other companies have also followed the trend to consolidate, including Krosaki/Harima and HarbisonWalker International (formerly ANH, the collective of AP Green, North American Refractories, and Harbison Walker Refractories).

In the case of Pittsburgh-based HarbisonWalker, the largest supplier of refractory products in the US, and with 19 manufacturing plants in North America, Europe and Asia, consolidation has led the company to a position where it is now planning new investments: it announced mid-February plans to build a $30 million monolithic refractories manufacturing facility along the Ohio River Valley in the northern Kentucky/ southern Ohio area. The company expects the plant will have an 80,000 mt/year capacity and will be operational in early 2018. The facility will implement packaging technology that's new to the North American market, HWI said. "Monolithics are a growth area, and the new plant will enable us to further elevate product quality and consistency," Carol Jackson, senior vicepresident and general manager, said in a statement.

Steelmakers consulted declined to comment on whether recent consolidations between their refractories suppliers had been beneficial to their operations. Tata Steel described this as a "commercially sensitive" area.

RHI Magnesita: a formidable alliance

Of the recent consolidations, the most significant is Austrian RHI's takeover of 46% of Brazil's Magnesita for around EUR118 million and 4.6 million new shares, expected to be approved by competition authorities and completed in 2017, involving a new listing on the London Stock Exchange and establishment of the combined company, RHI Magnesita, in the Netherlands. The new entity will merge the world's second and third largest refractory groups, creating a new number one in the production league that will overtake UK-based Vesuvius, currently the largest player. RHI Magnesita will have an impressive stable of refractory producing facilities and considerable refractory raw material resources, dominated by magnesite and dolomite. Following completion, a mandatory tender offer will be launched by RHI Magnesita or one of its affiliates for the remaining shares in Magnesita.

Based on 2015 numbers the combined company would generate EUR2.6 billion revenue on a pro forma basis. RHI and Magnesita's combined raw material

KEY REFRACTORY MINERALS

About 35 million mt/year of some 24 different industrial minerals are consumed in world refractories production

Industrial mineral (incl. synthetic)	Main chemical component	Primary source country
Basic		
Dead burned magnesia	85.0-99.8% MgO	China
Fused magnesia	97.0-99.8% MgO	China
Dead burned dolomite	56.0-62.0 MgO, 36.0-40.0% CaO	USA
Chromite	>46.0% Cr_2O_3	South Africa
Sintered/fused spinel	66.0-80.0% Al_2O_3, 21.0-33.0% MgO	China
Olivine	40.0-50.0% MgO, 35.0-45.0% SiO_2	Norway
Acidic		
Calcined alumina	>99.5% Al_2O_3	China
High alumina		
Fused alumina	94.0-99.5% Al_2O_3	China
Calcined bauxite	85.0-88.0% Al_2O_3	China
Sintered/fused mullite	40.0-75.0% Al_2O_3	USA
Low alumina		
Andalusite, sillimanite, kyanite	60.0-65.0% Al_2O_3	South Africa
Refractory clays	20.0-45.0% Al_2O_3	China
Pyrophyllite	20.0-30.0% Al_2O_3	South Korea
Silica		
Quartzite, sillica sand	>97.0% SiO_2	Regional
Fused silica	>99.8% SiO_2	USA
Specialized		
Zircon	66.0% ZrO_2+HfO_2	Australia
Zirconia	>99.0% ZrO_2	China
Silicon carbide	>93.0% SiC	China
Graphite	75.0-99.0% C	China
Insulating		
Diatomite	>75.0% SiO_2	USA
Perlite	65.0-80.0% SiO_2	China
Vermiculite	45.0% SiO_2	South Africa

Source: IMFORMED

production reaches some 3.2 million mt/year of refractory minerals and their refractories output in 2015 was some 2.8 million mt in various countries.

Back in 2011 the prospect of a consolidation between RHI and Magnesita was already viewed as a possibility: "both groups were preying on each others' home turf – Magnesita grabbing ThyssenKrupp steel contracts in Germany, RHI building a refractory plant in Brazil (subsequently placed on hold in the face of punitive antidumping import duties)," said O'Driscoll in an IMFORMED report in October 2016. "Nevertheless, the news still arrives with some impact, as the merger of these two giants of magnesia and refractory production brings under one roof a significant array of refractory raw material assets, as well as refractory manufacturing plants worldwide."

RHI plans to expand its regional growth with the acquisition. "Europe is not the growth market for our industries, whereas North and South America is much more interesting. Of course our set-up will improve our structural position," Wolfgang Ruttenstorfer, RHI interim ceo until November 30, 2016, said in a recent conference call, adding that the merger will strengthen the group's ability to compete with the Chinese refractory industry, as "the real future competition". The Chinese government has announced plans to consolidate the industry "to support their export ambitions" and the merger would be an answer to that, he added.

"Magnesita's presence in South America and the United States fits well with RHI's presence in Europe and Asia. It results in strengthened geographic clusters of the combined company by adding production facilities in several markets in which RHI and Magnesita are lacking capacity on their own," the company said. Moreover, Magnesita's position in dolomite-based products is highly complementary to RHI's asset portfolio focused on high-quality magnesite products.

Also in October, Showa Denko announced it will acquire SGL GE Holding, a producer of graphite electrodes, from SGL Carbon group for EUR350 million. Through this acquisition, SDK aims to become "a truly global leader in the graphite electrode industry by establishing a cost competitive platform in all three key regions, Europe, the U.S. and Asia," the company stated.

Plummeting specific consumption

It's not only steel market sluggishness which has caused the recent fall in refractories consumption. Productivity gains, automation and more efficient use of quality raw materials have led the specific consumption of refractories in steel production worldwide to decline steadily since the 1960s, slowing down growth rates in the refractories sector as a whole. The numbers are startling. Research from Roskill and Richard Flook shows that in 1960, average global consumption was 50-60kg of refractories per metric ton of crude steel produced worldwide, but this had more than halved to 20-25kg/mt by 2000 (although Chinese consumption continued far above the annual average at 30-40kg/t). The rate of decline has since slowed and average global consumption is around 15kg/mt. Chinese consumption is still amongst the highest in the world, but only around 5kg/mt higher than the global average. The intensity of usage in other major steelmaking areas including Japan, North America, Germany and Brazil has been consistently lower than the average, and was put at less than 10 kg per mt of crude steel in Japan in 2014.

This has taken a toll on refractory producers' results. Francois Wanecq, ceo of Vesuvius, commented mid-2016 that the company's financial results had improved in the first half of the year, reflecting "the strength of our market position and progress in implementing our self-help initiatives and on-going restructuring programme. Our end markets in steel and foundry are showing signs of stabilisation, although we expect them to remain at relatively weak levels for the remainder of the year." Still, revenue in its Steel division declined by 9.6% on an underlying basis over the same period as markets with higher penetration of sales per ton of steel, like North America and Europe, were hardest hit and a number of key customers were idled or shut. "The Group continued with the restructuring programme that was launched in 2015 in response to the declines in the majority of our end-markets. Costs incurred year to date of £5.3m were predominantly on redundancy (£4.9m) and consultancy (£0.4m)," Wanecq said.

Further prospects for consolidation?

Further consolidations are widely expected in the refractories industry. Refractories are a buyers' market despite the current upturn in global steel markets, with low prices a barrier to new project development, both in refractories production and the mining of refractory minerals. Excess capacity is reportedly a market factor, notably in the refractory bauxite sector in China, where environmental controls are also changing production patterns. RHI noted mid-February that apart from its merger transaction with Magnesita, a consolidation process has been on-going in its end-user branches (steel, cement, non-ferrous metals) for many years. Consolidation in China's refractories industry is yet to come, it indicates, and that may lead to further expansion there, despite all the odds.

Graphite market: battery demand may pressure supplies

Graphite has long been an important refractory brick product in steelmaking due to its heat resistance and is also used to make electrodes for use in electric arc furnaces. Rising demand for graphite in the rapidly-expanding lithium-ion batteries sector, where graphite is consumed in greater volumes than lithium, for anode and cathode applications, respectively, is widely expected to lead to pressure on graphite supplies for graphite's traditional consuming markets, such as the refractories and foundry sectors. According to data from Benchmark Mineral Intelligence, refractories accounted for 29% of total graphite usage in 2015, down from 39% in 2012, while usage in batteries leapt to 19% of total graphite supplies in 2015, from a 9% share in 2012. This has spawned a host of new graphite mining projects – no fewer than 150 have been mooted in Canada and Australia in recent years- and a 40,000 mt/year project suspended by Magnesita in Brazil in 2014. "Whether any impetus in reviving the project will stem from RHI Magnesita remains to be seen, although with the emerging battery market consuming more graphite, a second look at this project would not be surprising," IMFORMED commented. — *Diana Kinch*