The changing world of magnesite

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A sea change in the magnesia supply sector finds global consumers substituting Chinese magnesia, while western players race to expand capacity, as demand from growing market applications beckons. This article highlights the key aspects affecting the magnesia supply market, the extraordinary spate of production capacity developments outside China, and market demand trends.

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The tide has turned. Developments in China that have continued to unfold over the last four years or so have now reached a point where the supply market dynamics of certain industrial minerals have changed significantly.

No more is this sea change better exemplified than by the supply market for magnesite, and in particular, its processed derivative grades of dead burned magnesia (DBM), caustic calcined magnesia (CCM), and fused magnesia (FM).

But what has compounded the barrage of influencing factors impacting this sector, which include the widespread effects of energy and freight cost increases, has been rising demand from certain end use markets.

Clearly, the magnesia market is experiencing bittersweet conditions. But those producers which have monitored and responded to this market transformation, stand to taste success in the near and medium future.

State of supply

In a nutshell, while China, as host to a wealth of magnesite resources in Liaoning province, remains a huge producer of magnesia, its supply dominance on the global magnesia market has been considerably weakened. In future, it will mainly aim to supply domestic, and to some extent east Asian markets.

Magnesia consumers outside China are now scrabbling for alternative, “western” sources of supply. At the same time, magnesia producers outside China that weathered the storm of low cost DBM and FM imports flooding their regional markets for the last 20 years (and many did not), are busy investing in production capacity increases to meet not just demand from falling Chinese supply, but also demand from end use markets which is picking up (see later).

And it is not just a matter of expanding capacity of existing magnesia product lines. In the face of plentiful lower cost DBM and FM substitutes from China over the last couple of decades, many western magnesia producers started to switch their focus to the non-refractory markets (eg. environmental, specialities) which promised lucrative opportunities (and still do) and crucially, a lessening of sales revenue dependence on the DBM refractories market.

Now we have the likes of Baymag, Bonmag, and Kumas not only expanding capacities but seriously considering diversifying into DBM and FM production. Perhaps DSP, having ceased its famous high purity DBM activity as recently as 2005, might even reconsider a return to the “other side”.

But its not all DBM and FM. The CCM and specialities markets are also demanding a response, and so Baymag, DSP, Martin Marietta, Premier Chemicals, Qmag, MGR, and Magnifin are also stepping up to the market on the non-refractory side.

From most accounts, the situation with regard to Chinese supply has been described as one of turmoil, with prices rising, leading to opportunities for western producers improving.

The majors are conducting huge expansion programmes, such as Qmag, Magnezit, and the new look Magnesita. Even smaller players such as Causmag and Dalmia are looking to increase production. In short, the western magnesia supply sector is witnessing a landmark event in capacity investment and market share penetration (see table for summary of capacity developments).

Merger and acquisition activity

Another response of course has been a raft of mergers and acquisitions in order to secure resources and supply outside China. These have included private equity groups taking over Magnesita and Qmag; Imerys entering the FM business through UCM; Peñoles further consolidating the electrical grade FM market by acquiring Minco; Martin Marietta acquiring Morton Salt’s Specialty Magnesia Group; Bomex entering the market through Calmag (now Bonmag); and Magnezit’s pursuit of Slovakian magnesia, with Slovmag aboard while currently wooing SMZ.

Interestingly, RHI has gone “the other way”, and has invested in a state of the art joint venture operation at Dashiqiao, Liaoning, with which it aims to secure high quality feedstock for its Chinese refractory plants.

Naturally, there is now renewed interest from several parties in the idled 50,000 tpa DBM/10,000 CCM Jormag facility, Jordan, and the commercially undeveloped Zhargat project, Saudi Arabia.
Elsewhere, there will no doubt be suitors for stakes in SMZ, in Slovakia, and Magnohrom, in Serbia, whose respective ownerships are on the block.

The “China factor”
The “China factor” has been key to magnesia’s market change, and has significantly influenced prices and availability of material to global markets.
Chinese magnesia export smuggling via the South Korean port of Kunsan, which emerged again this year en route to Rotterdam, has supposedly run its course, ie. this “source” has apparently been stopped by government authorities, but not without ramifications.
It is believed that the smuggling clampdown alone has been the biggest influence on shortages and prices of late and is estimated to have taken about 700,000 tpa out of the market. This has driven up prices significantly and has had a major impact on demand for export licences.
In July, the Chinese magnesia export licence was reported at RMB1,400-1,500($205-219)/tonne and DBM90315 stood at $450/tonne. By August, reports indicated that the export license had pushed through RMB2000($292)/tonne or more, and DBM90 was over $500/tonne, and expected to rise above $600/tonne by December.
The views of some traders are that export licences will run out by September/October 2008, and the government will not issue any additional licences for 2008.
But it is not China alone that is forcing prices up. In the USA, natural gas prices at record highs have forced surcharge situations on all calcined products, while export costs and delivery times are up due to tight container and ship space availability.
Japanese producer Ube Material Industries was forced to make two price revisions this year amounting to a total price increase of more than 40%.
Many Chinese magnesia plants have had to close or partially close owing to a lack of fuel, power, and raw magnesite feedstock. They have also been hindered by the restrictions on drill and blast mining imposed as a result of Olympic “controls”.
Other factors include the quality deterioration of Chinese DBM and FM over the past two to three years, particularly with regard to 97% MgO DBM. It is understood that this has been due to a combination of limited investment in exploration, poor mine planning practices, high grading the deposits, pressures to reduce cost, and a greater focus on the domestic refractory/steel industry.
The upshot is that the cessation of smuggling, restriction of export licences and export volumes, declining quality and reduced production, more focus on domestic market supply, will together translate to even tighter magnesia availability from China.
However, despite these overwhelming issues, the longevity of this trend has been questioned.
Some observers have warned that a risk still exists that Chinese MgO price may collapse in future, since today’s price does not reflect the production costs in China.
That said, it is clear that western producers and consumers are responding by reducing their reliance on Chinese supply, increasing their capacities, and/or securing supply for the future.

Capacity developments summary
The accompanying table highlights some of the magnesia industry’s production capacity developments, which are expected to come on stream in the near future.

Interest in Chinese sources
Liaoning RHI Jinding
As the global market leader in the refractory industry, as well as a significant captive producer of magnesia in Austria and Turkey, RHI AG, based in Vienna, decided that investment into a high quality magnesia production facility was a priority in order to secure long term supply of the highest quality refractories for its customers.
After careful analysis, RHI decided to invest in Dashiqiao, China, Liaoning province, a region renowned for its 2,600m. tonne magnesite reserves, accounting for 20% of global magnesite deposits.
RHI has formed a j-v with Liaoning Jinding Magnesite Group Co. Ltd., (JDMG), of Dashiqiao, which operates one of the largest magnesite mines in Liaoning (the Huaziyu mine). RHI is to invest more than $50m. in a raw ore beneficiation and magnesia production plant to produce
100,000 tpa of the highest purity magnesia grades from middle grade raw magnesite. The j-v is called Liaoning RHI Jinding Magnesia Co. Ltd.

Most of the highly pure magnesite will be calcined in a new multiple hearth furnace (MHF) possessing an inner diameter of 8 metres and comprising 18 hearths. It will be the largest furnace of this type in the magnesia industry worldwide.

The final product, 98% MgO, is aimed principally at magnesia carbon refractory bricks for severe applications in the steel industry. A proportion of the calcined powder will undergo a special grinding process, followed by briquetting and sintering at approximately 2,100ºC in a RCE 160 tpd shaft kiln. Using these conditions a final product density of more than 3.40 g/cm³ can be achieved. This high purity and high density sintered magnesia will then be used for special applications in the steel and cement industries.

**Tata Refractories Ltd**

Tata Refractories Ltd (TRL), part of Tata Steel, was reported to be in the process of signing a memorandum of understanding for a magnesite mining lease in China. The mine will make its operations in that country even more cost-effective. Up to now, TRL has bought raw magnesite from Chinese magnesite producers.

 Apparently, in August 2008, TRL was invited by the mayor of Bayuquan to sign a memorandum of understanding. The mine is located near Bayuquan, Liaoning, in the same district as TRL existing refractories plant.

TRL has a 64,000 tpa magnesite-based refractory plant in Bayuquan, which commenced production in January 2007. The plant recently completed the second phase of its capacity expansion. The plant’s original capacity was 30,000 tpa.

TRL is planning a third phase expansion of the plant that will take capacity to 100,000 tpa.

**Market trends**

While the Chinese situation might be somewhat of a frustrating driving force for the western magnesia market, the positive demand trends in some of magnesia’s end markets must surely be a welcome sign, and another reason for capacity investment. Most markets in all world regions are performing strongly.

**Refractory markets**

The DBM market is driven by refractories performance, mainly in the steel market, but also for cement, glass, non-ferrous metallurgy and other applications. It has historically been the mainstay of the magnesia market, but in recent years, not all producers have wanted to have their magnesia product eggs in the one DBM refractories basket. However, with steel markets buoyant, demand is up and this market will remain an important consumer for DBM.

Global demand for refractory materials is expected to grow by 7-8% annually until 2012, shifting from developed to developing countries. Growth is anticipated by further expansion of steel and cement output, primarily from new capacity in Brazil, India, Russia, and China.

Dutch producer Nedmag reports that refractory demand has grown steadily through increasing steel and cement consumption worldwide. As a consequence, Nedmag’s sales of DBM (nedMag 99) in mag-spinel bricks have increased from 60,000 tonnes in 1993, to 145,000 tonnes in 2007. Together with its sales to mag-carbon bricks, Nedmag has annual sales of 165,000 tonnes DBM. The company has identified that demand for high grade magnesia is increasing because of the increasing usage of alternative fuels in cement rotary kilns.

On specific grades, owing to price increases it has been reported that steelmakers have stopped using DBM90 as a slag conditioning material in the USA, and there is a reduction in DBM95 consumption. However, DBM97 is enjoying an increase in demand from major refractory producers worldwide, and is expected to increase further in the future.

Owing to expansion projects of iron and steel and also cement plants in Iran, the consumption of magnesia based refractories is growing in this region, along with demand for magnesite raw materials for refractory manufacturers.

India’s refractories industry is experiencing a range of challenges. Demand is promising with India’s cement and steel industries growing at around 10% per annum, but DBM supply from China and from domestic sources is short (see *IM* July ’08, p.40).
Russia’s Ogneupor Komplekt Group uses DBM and FM from China for the manufacture of gunning mixes (for tundish) and concretes (for steel ladles – see IM June ’07, p.102 for profile). The group has witnessed increased demand for its refractories and thus rising demand for its refractory magnesia requirements. However, like many refractory producers, it is assessing its options on future magnesia raw material since the quality of magnesia sourced from China has been dropping.

Certainly, Magnesita in Brazil is looking forward to pursuing opportunities in the refractory DBM markets in the future, even though it consumes DBM for its own refractory production. Magnesita holds a strong position in South America’s refractories market, accounting for about 65% of the steel market. South American demand for refractory materials is expected to grow by 40-50% until 2012.

Non-refractory markets
The non-refractory markets for magnesia have been seeing strong demand for some years now, in particular environmental and certain speciality markets, such as flame retardants. But there are also new growth areas emerging, such as in hydrometallurgy.

Industrias Peñoles reported that although its 2007 magnesia production was down on the previous year, this was more than offset by higher prices driven by growth in demand for high value products in the global market, notably in the rubber industry and for the production of flame retardants for plastics (see IM February ’08, p.53).

From 2005 to 2007 Magnifin, in Austria, doubled its MgO and Mg(OH)₂ capacities to meet increasing demand for its flame retardant grades. DSP in Israel, likewise, is continuing to increase its speciality magnesia capacity, which includes supplying the food and pharmaceutical markets.

During 2007, magnesium led the growth in the food supplement minerals category in the USA, with 13.1% growth on total sales. Magnesium sales seems to be benefiting from growing research showing that the mineral reduces both systolic and diastolic blood pressures, yet also represents one of the most common nutritional deficiencies for people who eat a Standard American Diet.

The environmental market remains a good prospect for CCM. Ube Material Industries is developing magnesia based products for applications in algae removal, improving water quality and bottom sediment for rivers, lakes and marshes, and in soil stabilisation. Other developments by the Japanese producer includes special additives for electrical and electronics applications. Japan’s total CCM market is about 700,000 tpa, of which Ube’s share is 30%. For the domestic refractory market, Ube accounts for 25%, and for FGD, 50%.

Since the start of its magnesium chloride flake production in 1996, Nedmag’s capacity for this product has expanded nearly every year. In 2007 the annual output exceeded to 50,000 tonnes which was used in a range of applications including: the production of flame retardants, textile finishing, feed additives, de-icers, and dust suppressants. Through the introduction of magnesium chloride pellets in 2008, Nedmag is aiming to expand its position in the de-icing and de-dusting market in the USA and Europe further.

The Dutch producer also supplies CCM for cements, fertilisers, feed additives, and water treatment products; and Mg(OH)₂ for paper, fertilisers, acid neutralisation of waste streams. The use of magnesium hydroxide in flue gas desulphurisation and wastewater treatment is growing rapidly in Europe.

The main target markets for Qmag’s recent expansion plans are the hydrometallurgical markets (nickel/cobalt and copper/cobalt processing) and agriculture. Qmag has already signed long term contracts for 45% of the expanded capacity and expect the new capacity to be fully sold before end 2008.

Qmag maintains that the CCM market is showing much stronger growth, showing equivalent, and in some cases better, margins than DBM and EFM markets.

New high pressure acid leach processing technology for Ni/Co and Cu/Co require CCM as a reagent in neutralisation/precipitation. It seems that Qmag has certainly nailed this growth market (demand for the metals is booming), where the main application areas are the lateritic Ni and Cu/Co deposits in Australia, Indonesia, Philippines, Brazil, and the Congo (see IM April ’08, p.7).
Of course, CCM use in the agrimarkets (animal feed, fertiliser) remains a core market for magnesia. Chief influencing factors include the performance of organic raw materials in animal feed, such as wheat, corn, and soya. Faced with instability of the markets, such as the soaring cost of wheat, European animal feed production can be variable, and is further impacted by strong competition from countries exporting white meat, such as Brazilian poultry.

CCM use in fertiliser also suffers from a fluctuating market. At present, worldwide demand for cereals and biomass production has driven up demand and prices for the fertilisers TSP and DAP. These products use the basic ingredients of phosphorus, potassium, and nitrogen. The cost of creating specific fertiliser formulae which include magnesia is often too expensive.

The challenge for producers of agricultural magnesia is on the actual identification and ability to develop new mining capacities in a more cost effective way, working jointly with DBM and FM producers for the obvious reasons of sharing costs and industrial expertise.

Summary

While China’s magnesia industry will remain an important and active sector of China’s industrial minerals business, it will increasingly be focused on supplying domestic markets. Without doubt, Chinese magnesia producers will become more efficient and upgrade their facilities over time, and an improvement in grade quality will return. However, when this material will return to the global markets in volumes seen over the last two decades remains to be seen, and in the near to medium term (even long term), appears remote.

Meanwhile, magnesia consuming markets continue to hold promise for a period of high demand – particularly in environmental, hydrometallurgical, and speciality markets for CCM; and steel and cement markets in Brazil, Russia, eastern Europe, and India for DBM and FM.

In response to this market demand, and especially in order to take up any share of the market from declining Chinese magnesia supply, western magnesia producers are busy investing in capacity expansions and diversifying, and in some cases returning to, DBM and FM production. These are very much interesting times for the world magnesia market.
## Magnesia capacity developments summary (outside China)*

<table>
<thead>
<tr>
<th>Company (parent)</th>
<th>Plant location</th>
<th>Existing capacity (tpa)</th>
<th>Development (tpa)</th>
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<tr>
<td><strong>Americas</strong></td>
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<tr>
<td>Baymag (Refratechnik Holding GmbH, Germany)</td>
<td>Exshaw, Alberta</td>
<td>50,000 CCM 14,000 FM mothballed</td>
<td>New 50,000 CCM MHF, start up H2 2009; considering FM plant restart &amp; high purity DBM production</td>
</tr>
<tr>
<td>Magnesita Refrátarios SA (GPI, 47%; Gavea, 12.5%, others 40.5%)</td>
<td>Brumado, Bahia, Brazil</td>
<td>320,000 DBM (150,000 &gt;94% MgO; 180,000 &gt;95% + &gt;98% MgO) 60,000 CCM 34,000 FM</td>
<td>Plans to triple DBM production by 2010 (and double refractories production, currently 590,000 tpa).</td>
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<tr>
<td>Martin Marietta Magnesia Specialties LLC (Martin Marietta Marietta Materials Inc.)</td>
<td>Manistee, Michigan, USA</td>
<td>275,000 tpa CCM, DBM, + Mg(OH)(_2)</td>
<td>Hydration system capacity expansion planned to come on stream early 2009</td>
</tr>
<tr>
<td>Premier Chemicals LLC</td>
<td>Gabbs, Nevada, USA Port St. Joe, Florida, USA</td>
<td>150,000 CCM + Mg(OH)(_2) 75,000 tpa Mg(OH)(_2)</td>
<td>Gabbs CCM plant recently started up 3rd Herreshoff furnace</td>
</tr>
<tr>
<td>Quimica del Rey SA de CV (Industrias Peñoles)</td>
<td>Coahuila, Mexico</td>
<td>84,000 CCM + DBM 15,000 Mg(OH)(_2) started early 2008 5,000 FM</td>
<td>26,000 CCM expansion for early 2009. New 1,750 tpa FM fusion furnace in 2008.</td>
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<tr>
<td><strong>Asia Pacific</strong></td>
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<tr>
<td>Liaoning RHI Jinding Magnesia Co. Ltd (RHI, 80%; Jinding Magnesite Group Co. Ltd, 20%)</td>
<td>Dashiqiao, Liaoning, China</td>
<td>under construction</td>
<td>100,000 tpa DBM</td>
</tr>
<tr>
<td>Queensland Magnesia Pty Ltd (Resource Capital Funds)</td>
<td>Rockhampton, Queensland, Australia</td>
<td>210,000 CCM, DBM, FM (120,000 DBM; 30,000 FM; 60,000 CCM – capacities flexible)</td>
<td>Additional 15,000 with debottlenecking by 2010; brownfield expansion to 325,000 total by end 2009, incl. 135,000 DBM, 30,000 FM, 160,000 CCM</td>
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<tr>
<td><strong>Europe/Middle East</strong></td>
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<tr>
<td>Bommag Ltd (formerly Calmag; Bomex Holding, Serbia)</td>
<td>Tavanli, Turkey</td>
<td>12,000 rotary kiln 7,200 CCM shaft kiln</td>
<td>35,000 DBM shaft kiln on stream spring 2009; assessing 7,500-15,000 FM plant</td>
</tr>
<tr>
<td>Kumaş-Kutahya Magnesite Works Corp.</td>
<td>Kutahya, Turkey</td>
<td>180,000 DBM</td>
<td>New DBM kiln; assessing FM production</td>
</tr>
<tr>
<td>Magnesia Products SBU – DSP (Israel)</td>
<td>Mishor Rotem, Israel</td>
<td>35,000 CCM, Mg(OH)(_2), MgCO(_3)</td>
<td>35,000 expansion under construction,</td>
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<tr>
<th>Company</th>
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<th>Magnesia Capacity and Composition</th>
<th>Remarks</th>
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<tr>
<td>Magnesitas de Rubian SA (Naviera Fierro SA; Promotora de Minas de Carbon SA; Inversione Terrales SA)</td>
<td>Monte Castelo, Lugo, Spain</td>
<td>75,000 CCM &gt;83% MgO 5,000 CCM 60-65% MgO 40,000 MgCO$_3$ 5,000 Mg(OH)$_2$</td>
<td>New kiln under construction for 18,000 CCM &gt;80% MgO of very fine particle size</td>
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<tr>
<td>Magnezit Group</td>
<td>Satka, Chelyabinsk ; Krasnoyarsk krai</td>
<td>800,000 “periclase powders” – CCM, DBM, FM (20,000)</td>
<td>150 tpd DBM shaft kiln at Satka recently commissioned; 2 x 300 tpd MHF for 2009; 95,000 CCM at Goluboye 2008-10 mostly earmarked for FM; aiming for 60,000 FM by 2010; most output for captive refractories use</td>
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*ie. selected known or reported planned magnesia capacity developments to existing operations
CCM caustic calcined magnesite; DBM dead burned magnesite; FM fused magnesite