

# MAGNESITE/MAGNESIA

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**A**fter a relatively optimistic period of strengthening demand and improved prices during 2000 and first-half 2001 the magnesia industry subsequently took a turn for the worse and is back in the doldrums. Indeed, certain parts of the industry appeared to be haemorrhaging as demand - particularly from the steel industry - has shown a steep fall from the mid-year point in 2001. The world's largest refractories group, RHI, appeared to be falling apart as a result of asbestos litigation hitting its US interests, and the second largest group, Vesuvius, announced a series of plant closures in the second half of 2001. RHI America has been separated from the parent company in Austria as the former businesses of Narco, Harbison-Walker, and A P Green all sought Chapter 11 bankruptcy protection. The current administration at RHI America has made it clear that the aim is to preserve the group in restructured form rather than break it up and sell remaining assets.

## World Production of Natural Magnesite ('000 t)

	1999	2000	2001e
Australia	367	350	540
Austria	749	726	700
Brazil	868	1,007	1,100
Canada	200	200	200
China	9,500	10,000	10,000
Greece	495	500	500
India	360	365	360
North Korea	800	650	650
Russia	2,400	2,500	2,600
Serbia	31	11	36
Slovakia	918	1,001	1,000
Spain	500	500	500
Turkey	1,725	2,672	2,000
Others*	200	200	200
<b>World Total</b>	<b>19,113</b>	<b>20,682</b>	<b>20,386</b>

Source: USGS, BGS and author's estimates.

\* Includes the US, Colombia, South Africa, Zimbabwe, Poland, Pakistan and Iran.

## Raw Magnesite Production

World production of magnesite was estimated to be of the order of 20 Mt in 2001 of which around 12.5 Mt, or more than 60%, was produced in China and Russia. Over 98% of this raw ore production is converted to magnesia for commercial application. At present only 0.4 - 0.5 t/y is used as direct feed for conversion to nitrate (for fertiliser application) or to chloride (for the production of magnesium metal). However, this latter proportion is set to grow (Table 1).

## Magnesia Production

Magnesia (magnesium oxide) is produced on a large scale both from magnesite and from magnesium hydroxide or chloride prepared from brines and seawater. Total magnesia production in 2001 was around 8 Mt, of which 6.6 Mt was from natural magnesite and 1.2 Mt from seawater and brines.

An approximate production breakdown of the three main magnesia types was 5.7 Mt (71%) dead-burned, 1.7 Mt (21%) caustic-calcined and 0.6 Mt (8%) electrofused.

## World Magnesia Production by Type 2001 ('000 t)

	Natural	Synthetic	Total
DBM1	300	700	1,000
DBM2	4,600	100	4,700
CCM	1,350	350	1,700
EFM	550	50	600
<b>Total</b>	<b>6,800</b>	<b>1,200</b>	<b>8,000</b>

## Dead-burned Magnesia

Dead-burned magnesia (DBM) is obtained by high temperature conversion (usually in the 1,500-1,800°C range) of natural magnesite or magnesium hydroxide, or in the case of DBM1 grades, by high temperature firing (in the 1,800-2,200°C range) of calcined magnesia. DBM is used exclusively in refractories for the

**Table 2. World Magnesite & Magnesia Production 2001 ('000 t)****Natural - from Natural Magnesite**

<b>Country</b>	<b>Magnesite</b>	<b>Magnesia</b>	<b>Companies</b>
Australia	540	155	Qmag
Austria	700	350	Radex
Brazil	1,100	310	Magnesita
Canada	200	90	Baymag
China	9,000	3,500	Liaoning Mag, Pailou, Xiyang, Qinhu
Greece	500	150	Grecian Magnesite
India	360	100	Dalmia, Burn Std, Tanmag, Almora
North Korea	650	180	NK Magnesite
Russia	2,500	1,100	Magnezit Satka
Slovakia	1,000	320	Slovmag Lubenik, SMZ Jelsava,
Spain	500	170	Mag Navarras, Mag Rubian
Turkey	2,000	350	Kumas, Manyezit, Comag
Others	300	110	Incl. US, Iran, Poland, S Africa
<b>Total Natural</b>	<b>19,350</b>	<b>6,885</b>	

**Synthetic - from Seawater and Brines**

UK	85	Britmag
Ireland	70	Premier Periclase
Netherlands	150	Nedmag
Italy	80	Cogema
Norway	10	Norsk Hydro
Israel	95	Dead Sea Periclase
US	300	Marietta, RHI, Premier Services
Mexico	85	Penoles
Japan	150	Ube
S. Korea	50	Sam Hwa
<b>Total Synthetic</b>	<b>1,075</b>	

<b>Total Natural</b>	<b>6,885</b>
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<b>Total Synthetic</b>	<b>1,075</b>
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<b>Total Magnesia</b>	<b>7,960</b>
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lining of furnaces used for the melting of steel, non-ferrous metals and glass, and in kilns for the manufacture of cement.

Production of high-purity, high-density grades — generally referred to as first-grade magnesias or DBM1 products - was around 1 Mt in 2001. About 30% of this production was derived from natural magnesite (in Turkey and Australia) and 70% from seawater/brine

producers in Europe, North America and Asia. DBM1 products are used predominantly for magnesia-graphite (mag-carbon) bricks for use in steelmaking (to line oxygen converters, electric arcs, ladles) and for magnesia-spinel bricks used for lining rotary cement kilns.

The 4.6 Mt production of second-grade DBM2 products was dominated by production from China (2.4 Mt) and Russia (1.0 Mt). Major

Western producers include Austria, Slovakia, Greece, Brazil and India. DBM2 products are used for the production of magnesia/chromite (mag-chrome) bricks used in linings for cement kilns and furnaces used in melting glass and non-ferrous metals, and for monolithic refractories (castables, mouldables, gunning mixes, maintenance materials, etc).

### **Caustic-calcined Magnesia**

Caustic-calcined magnesia (CCM) is obtained by low-temperature conversion (usually in the 700-1,000°C range) of natural magnesite or magnesium hydroxide from seawater and brines.

The bulk of CCM production (around 80%) is based on natural magnesite and destined largely for agricultural applications such as feedstuffs and fertilisers (involving grades in the 85-90% MgO range) or for bulk industrial applications such as construction and paper processing (involving grades in the 90-95% MgO range). Major producers of natural CCM are China, Greece, Spain, Austria, Slovakia and Brazil. The Greek company, Grecian Magnesite, has strengthened its influence in this market

The remaining 20% of CCM production based on seawater/brine includes both high (+99% MgO) and medium (+96% MgO) purities for specialised industrial applications ranging from chemicals, pharmaceuticals, anti-scorch agents in rubber, steel coating, and environmental uses. In the latter area, demand for CCM and magnesium hydroxide in water and effluent treatment has been a major growth area in recent years.

### **Electrofused Magnesia**

In Western countries, electrofused magnesia (EFM) is obtained by fusing CCM in an electric arc furnace at temperatures of 2,800-3,000°C. However, Chinese EFM producers use natural magnesite as feed which is less efficient in terms of energy consumption and product recovery. Nevertheless, the Chinese EFM products are of acceptable quality and are

sold at low price and now account for around 80% of total world consumption.

The EFM market is divided into two distinct sectors - refractory and electrical. The refractory EFM market is now around 550,000 t/y worldwide and is served primarily by producers in China (Dashiqiao Shifo, Haicheng Pailou, Haicheng Huayu, Yingkou Dayi), Australia (QMag), Canada (Baymag) and Israel (Tateho Dead Sea). Applications are similar to DBM1 and indeed EFM and DBM1 products are often blended in mag-carbon brick formulations.

Meanwhile, the electrical EFM market, where fused magnesia is used as an insulating material in heating elements for electrical goods (kettles, immersion heaters, cookers, grills, irons, etc), is of the order of 50,000 t/y worldwide. The world's major producer is the UCM Group with production in the UK and the US. Other producers include Tateho Chemical in Japan, TSL (Saint Gobain) in the UK, and Minco in the US.

China is set to make a greater impact on this sector in the future as both UCM and Tateho have set up plants to produce electrical EFM in China. The Tateho plant in Dalian was scheduled to enter production in March 2002 and was designed to produce 10,000 t/y of electrical EFM. Meanwhile, the UCM Group has entered into a deal with the Chinese fused magnesia producer, Yingkou Tianhu Magnesite Industries, to manufacture electrical EFM in an expansion of its facilities in Liaoning Province.

### **China**

China is estimated to have produced around 3.75 Mt of magnesia products in 2001 from over 10 Mt of raw magnesite ore. An approximate breakdown by type would be 2.4 Mt DBM, 800,000 t CCM, and 550,000 t EFM. The five major producers of DBM and CCM are: Yingkou Qinghua, Haicheng Huayu (Huaziyu), Haicheng Pailou, Haicheng Houying, and Haicheng Xiyang. They have a combined output approaching

1.5 Mt/y DBM and 500,000 t/y CCM. Meanwhile, the once-dominant Liaoning Magnesite Corp. now concentrates on the production of high grade double-burned DBM and fused magnesia. A large number of medium- and small-sized companies make up the remainder of production.

China consumes a significant share of its own production of EFM and DBM in the production of refractory bricks and monolithics, not only for its own steel industry usage but increasingly for the export market. A number of Western refractory manufacturers - RHI, Shinagawa, Krosaki, Orissa Industries - are involved in refractory plant joint ventures in China.

### Exports from China

Total exports of magnesia and natural magnesite have averaged 2.1 Mt/y for most of the 1990s. The share of dead-burned magnesia fell from 74% in 1993 to 43% in 2001. Exports of EFM doubled during this period (to a current 16% share) and CCM exports also rose and now commands a 24% share, as follows:

### Chinese Magnesite and Magnesia Exports ('000 t)

	1999	2000	2001
Dead-burned magnesia	1,187	1,051	907
Caustic-calcined magnesia	305	280	264
Electrofused magnesia	220	325	344
Magnesia NES	380	338	482
Raw magnesite	33	44	109
<b>Total</b>	<b>2,125</b>	<b>2,038</b>	<b>2,106</b>

### Production update

Earlier this year, Jordan Magnesite Co. began production of magnesia from a new plant at Safi on Jordan's Dead Sea shore. The plant will use magnesium chloride brines produced as a by-product of potash processing operations from the operations of its parent company, Arab Potash Co. Capacity is 50,000 t/y DBM and 10,000 t/y CCM, and sales will be handled by the Greek office of the Possehl group.

In Western Australia Westmag announced plans to construct a 50,000 t/y magnesia plant at Port Hedland using magnesium chloride from salt bitterns which will be converted to magnesium hydroxide and magnesia using local dolomite. The main focus is to produce CCM for the treatment of laterite nickel ores in the Pilbara region of Western Australia. However, delays to the nickel projects have put the Westmag magnesia developments on hold.

### Magnesite for Magnesium Metal

Until now the amount of raw magnesite consumed in magnesium metal manufacture has been limited to the 150-200,000 t/y requirement to feed Norsk Hydro's Becancour plant in Quebec, Canada. This plant has operated for the past 10 years or so using high-purity natural magnesite from China. Over the next five years the quantity of magnesite consumed in magnesium metal manufacture is expected to increase rapidly as two advanced projects in Australia come on stream around 2004.

Construction has already begun at the Stanwell project in Queensland based on the Kunwarara magnesite deposits in central Queensland. The Stanwell plant will be designed to produce over 90,000 t/y of primary magnesium and magnesium alloys and will be operated by Australian Magnesium Corp. (formerly Queensland Metals), which already produces DBM, CCM, and EFM through its QMag subsidiary. The magnesite requirement for the plant will be of the order 400,000 t/y.

Meanwhile, the SAMAG project in South Australia was in the process of completing financing in mid-2002 in the second half of the year 2000. The SAMAG project involves a 72,000 t/y magnesium metal plant to be built at Port Pirie and will be based on the Leigh Creek magnesite deposits. The project is being led by Pima Mining and will use the well-tried-and-tested Dow Chemical technology. The magnesite requirement for the plant will be of the order 300,000 t/y.

**Table 3. World Magnesia Prices - US\$/t cif Europe**

		<b>May 2000</b>	<b>May 2001</b>	<b>May 2002</b>
Dead-burned	First grade DBM1	200-300	180-220	180-220
	Chinese 94-95% MgO	130-150	115-135	115-135
	Chinese 90-92% MgO	120-130	105-120	110-120
Caustic	Industrial	300-375	180-220	180-240
	Agricultural	110-140	100-120	110-130
Electrofused	EFM1 (Australia, Canada)	600-800	700-800	600-800
	Chinese 97-98	350-500	320-350	320-350
	Chinese 95-96	270-330	290-320	290-320

*Source: Industrial Minerals, author's estimates.*

### Prices

Prices have remained relatively stable in 2001/2002 despite the low level of demand. This presumably reflects the fact that prices were already at a 'basement level' for Western producers but also reflects Chinese prices apparently bottoming out after years

of free-fall. This in turn is being attributed to stricter controls by the Chinese authorities to prevent traders from circumventing the export licensing system, and to the formation of export syndicates by major producing and exporting groups to maintain minimum price levels.