MAGNESITE/MAGNESIA

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The year 2002 was another mixed bag for the international magnesia industry where the negatives outweighed the positives. Nevertheless, a year characterised by weak demand, low prices and restructuring ended with some optimism. World steel output reached a record 902.2 Mt, an increase of 6% over 2001. The greatest gains were made by China – output rising from 150 Mt to over 180 Mt – but increases were also recorded in the US and Western Europe. Although there is always a time-lag before growth in steel production translates into demand growth for refractory magnesia there were some signs of increasing demand and some strengthening of prices in early 2003.

The world's two largest refractories groups – RHI of Austria and Vesuvius (part of the UK Cookson group) – are now somewhat reduced in size as result of plant closures and regroupings of assets in 2001 and 2002. Indeed RHI's carefully laid plans to achieve the same dominance in the Americas that it maintains in Europe came unstuck in the face of an explosion of asbestos-related insurance claims made against former products manufactured by subsidiaries of the groups it acquired.

Thus RHI America has undertaken a wholesale disposal of its US assets and the former businesses of A P Green, Narco, and Harbison-Walker have been brought together as ANH Refractories. The former executives now in control of ANH are involved in a major reorganisation to enable the group to emerge from Chapter 11 (bankruptcy) status in a viable form.

Raw magnesite production

World production of magnesite was estimated to be of the order of 20 Mt in 2002 of which around 12.5 Mt (over 60%) was produced in China and Russia (Table 1). Over 98% of this raw ore production is converted to magnesia for commercial application. Around 75% of magnesia in refractory end uses – for lining furnaces used in the production of steel, non-ferrous metals, cement, glass, ceramics. petrochemicals, etc. The remaining 25% is used in agriculture and a wide range of industrial applications ranging from insulation to environmental uses. At present only 400/500,000 t/y of raw magnesite is used as direct feed for conversion to nitrate (for fertiliser application) or to chloride (for the production of magnesium metal).

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 2002 was around 7.8 Mt, of which 6.8 Mt was from natural magnesite and 1.0 Mt from seawater and brines (Table 2).

Some changes to this table can be anticipated before next year's review. The Harbison-Walker plant at Ludington, Michigan, was expected to close in mid-2003 due to the closure of its feed source – namely the Dow Chemical magnesium hydroxide plant (also in Ludington). This will remove 150,000 t/y of refractory magnesia capacity from the market.

Production from Jordan is also expected to grow as the new plant builds up towards full capacity – 50,000 t/y of DBM and 10,000 t/y of CCM. The Safi plant, operated by Jordan Magnesia, started up in early 2003 and is based on magnesium chloride brines, by-products of potash processing operations by its parent company, Arab Potash Co.

An approximate production breakdown of the three main magnesia types was 5.5 Mt (70%) dead-burned magnesia, 1.7 Mt (22%) caustic-calcined magnesia, and 0.6 Mt (8%) of electrofused magnesia (Table 3).

Dead-burned magnesia

Dead-burned magnesia (DBM) is obtained by high-temperature conversion (usually in the 1500-1800^{o}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^{o}C range) of calcined magnesia. DBM is used exclusively in refractories for the 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 900,000 t in 2002. 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 (2.5 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 or 'mag-chrome' bricks (as 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^{o}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, some Chinese EFM producers use natural magnesite as feed, which is less efficient in terms of energy consumption and product recovery and yields a more variable, lower quality product. Thus the more sophisticated Chinese EFM producers have adopted Western practices and use CCM as feed for EFM production. China now accounts for around 80% of total world EFM production.

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 US. Other producers include Tateho Chemical in Japan, TSL (Saint Gobain) in the UK, and Newminco 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 entered production in 2002 with a design capacity of 10,000 t/y of electrical EFM. Meanwhile, the UCM Group has embarked on a joint venture with the Chinese fused magnesia producer, Yingkou Tianhu Magnesia Industries, to manufacture UCM electrical EFM products under licence in Liaoning Province.

China

China is estimated to have produced around 3.6 Mt of magnesia products in 2002 from over 10 Mt of raw magnesite ore. An approximate breakdown by type would be 2.4 Mt DBM, 750 Kt CCM, and 550 Kt EFM. The five major producers of DBM and CCM are Yingkou Qinghua, Haicheng Huayu (Huaziyu), Haicheng Pailou, Haicheng Houying, and Haicheng Xiyang, with a combined output approaching 1.5 Mt/y of DBM and 500,000 Kt/y of 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 also 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

According to Chinas Customs data, total exports of magnesia and natural magnesite have averaged 2.1 Mt/y for the past decade (Table 4). The share of dead-burned magnesia fell from 74% in 1993 to an apparent 42% in 2002.

However, it should be noted from Table 4 the growing presence of a 'magnesia – not elsewhere specified' (Magnesia NES) category, which accounted for 531,000 Kt in 2002 (over 25% of total). An analysis of import data for major importing countries would suggest that a more accurate breakdown for 2002 would read as revised Table 5.

Magnesite for magnesium metal

Until now the amount of raw magnesite consumed in magnesium metal manufacture has been limited to the 150,000/200,000 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 although both Australia and Spain have supplied significant tonnages for trial in recent years.

The next magnesite-based magnesium metal plant will be completed in Australia in 2005 but will be located in South Australia rather than in Queensland. Construction of the Stanwell project in Queensland was halted early in 2003 as a major hole appeared in financing arrangements and the operator Australian Magnesium Corp. entered administration.

Focus has now switched to a rival project in South Australia led by Magnesium International (formerly Pima Mining) which received the all-clear from government and further commitments from key investors after its own financing arrangements were affected by the fallout from Stanwell. The Samag project will be based on the less capital intensive and well tried-and-tested Dow technology and the smelter at Port Pirie will be built in two stages (initial capacity 41,000 t/y rising to 84,000 t/y). Magnesite feed will be provided from the company's own deposits at Leigh Creek in South Australia.

Prices

Prices have remained relatively stable in the 2001-2003 period despite the low level of demand (Table 6). This to some extent reflects the fact that prices were already at a 'basement level' for Western producers but also reflects that Chinese prices appear to have bottomed 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.

Table 1: World Production of Natural Magnesite ('000 t)			
	2000	**2001**	**2002**
Australia	350	605	485
Austria	726	700	550
Brazil	1,007	1,100	1,000
Canada	200	200	200
China	10,000	10,000	10,000
Greece	500	500	450
India	365	360	280
North Korea	650	650	450
Russia	2,500	2,600	2,600
Serbia	11	36	36
Slovakia	1,001	1,000	1,000
Spain	500	500	500
Turkey	2,672	2,000	2,000
Others*	200	200	200
World total	**20,682**	**20,386**	**19,816**

Source: USGS, BGS, and author's estimates

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

Table 2: World Magnesite and Magnesia Production 2002			
Natural (From Natural Magnesia)			
Country	**Magnesite**	**Magnesia**	**Companies**
Australia	540	155	QMag
Austria	550	270	Radex
Brazil	1,000	300	Magnesita
Canada	200	90	Baymag
China	10,000	3,600	Houying, Huayu, Xiyang, Pailou
Greece	450	140	Grecian Magnesite
India	280	70	Dalmia, Burn Std, Tanmag, Almora
North Korea	500	160	Korea Magnesia Clinker
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	inc US, Iran, Poland, S Africa
Total Natural	**19,820**	**6,835**	

Synthetic (from Seawater And Brines)		
UK	50	CJC Chemical
Ireland	70	Premier Periclase
Netherlands	145	Nedmag
Italy	80	Sardamag/Cogema
Israel	100	Dead Sea Periclase
Jordan	30	Jordan Magnesia
US	250	M Marietta, H-W, Premier Chemicals
Mexico	85	Quimica del Rey
Japan	100	Ube
S Korea	40	POSREC
Total Synthetic	**950**	

Total Natural	6,835
Total Synthetic	1,005
Total Magnesia	7,840

Table 3: World Magnesia Production by Type 2002 ('000 t)

	Natural	Synthetic	Total
DBM1	275	625	900
DBM2	4,600	50	4,650
CCM	1,400	300	1,700
EFM	575	25	600
	6,850	1,000	7,850

Table 4: Chinese magnesite and magnesia exports ('000 t)

	2000	2001	2002
Dead-burned magnesia	1,051	907	855
Caustic-calcined magnesia	280	264	218
Electrofused magnesia	325	344	311
Magnesia NES	338	482	531
Raw magnesite	44	109	98
Total	**2,038**	**2,106**	**2,013**

Table 5: Chinese Magnesia Exports 2002 - revised version

	DBM	CCM	EFM	Total
North America	300	100	40	440
Western Europe	250	150	110	510
Japan	180	200	65	445
Other Asia	160	160	55	375
ROW	140	30	60	230
Total	**1,030**	**640**	**330**	**2,000**

Source: BMC estimates from international trade data

Table 6: World Magnesia prices (US$/t cif Europe)

		May 2001	May 2002	May 2003
Dead-burned	First grade DBM1	180-220	180-220	225-250
	Chinese 94-95% Mg0	115-135	115-135	130-145
	Chinese 90-92% Mg0	105-120	110-120	105-120
Caustic	Industrial	180-220	180-240	180-240
	Agricultural	100-120	110-130	110-130
Electrofused	EFM1 (Australia, Canada)	700-800	550-750	550-750
	Chinese 97-98	320-350	320-350	350-400
	Chinese 95-96	290-320	290-320	300-350

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