



Trends & developments in refractory raw materials supply

Focus on dead burned magnesite

Mike O'Driscoll
Editor, Industrial Minerals, UK



Tehran International Conference on Refractories - 3-6 May 2004

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Industrial Minerals

- the authoritative monthly magazine for global non-metallic minerals & their markets
- covering the refractory raw materials market since 1967
- reference books, directories, conferences
- visit the IM stand here at TICR04
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Outline



Big picture

Dead burned magnesite

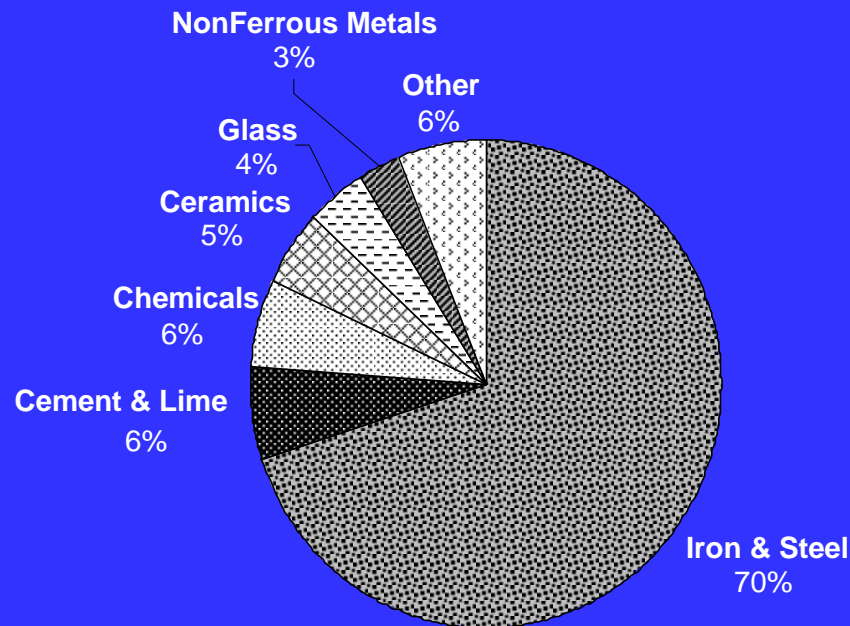
- a. grades
- b. supply market
- c. supply trends & developments

Changing times

- a. Refractories market
- b. Sourcing minerals

The Big Picture

Refractories market share*

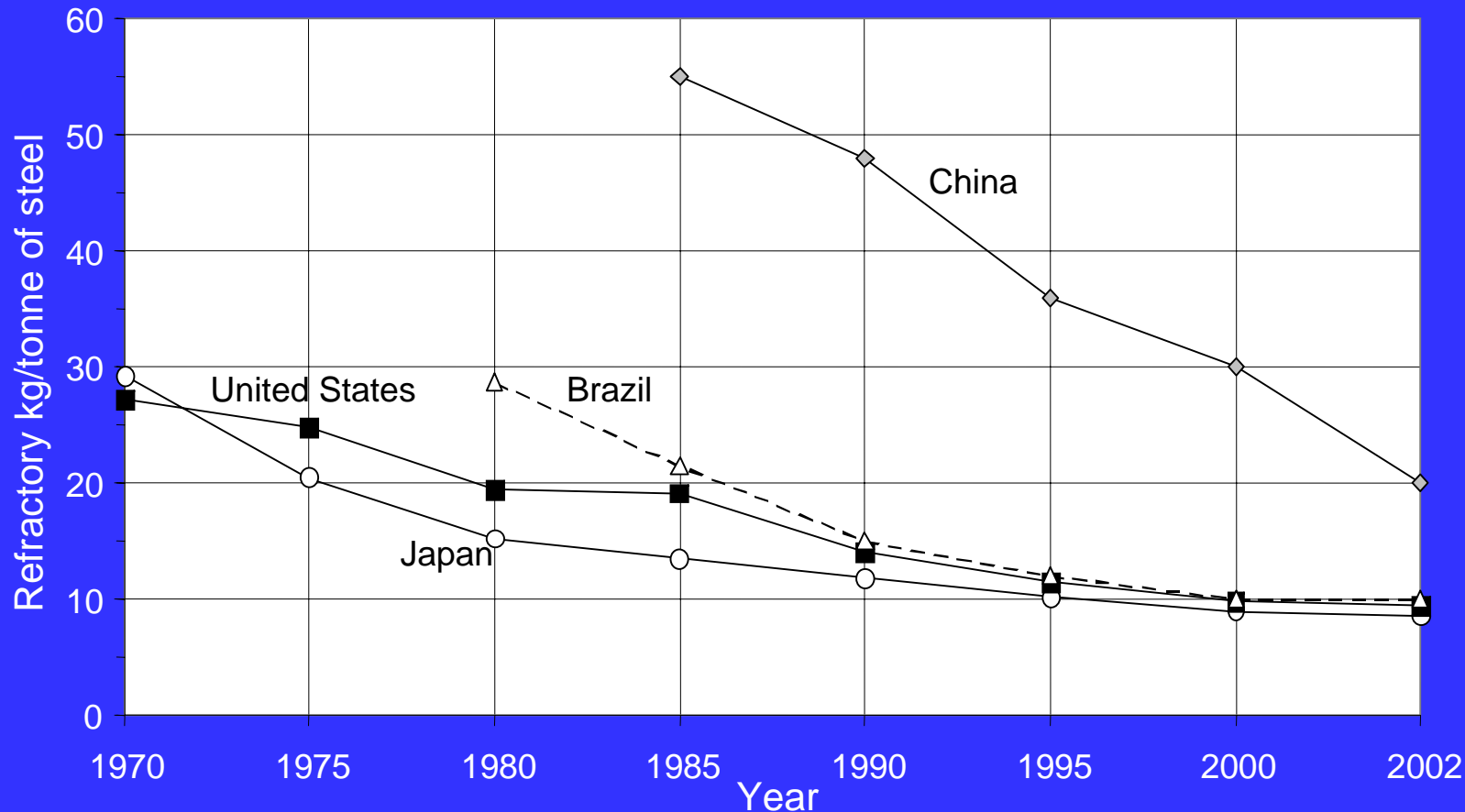


*Mosser and Karhut, UNITECR'99, Berlin



The Big Picture

Specific refractory consumption in steelmaking



C. Semler
IM17 Congress,
Barcelona,
March, 2004



The Big Picture

Specific refractory consumption in non-steel sectors

Cement

1970 – 1.2 kg/tonne of clinker

2000 – 0.6 kg/tonne of clinker

Glass

1970 – 11 kg/tonne of glass

2000 – 5 kg/tonne of glass

Copper

1997 – 4 kg/tonne of copper

2000 – 2 kg/tonne of copper



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The Big Picture



“The point that is too frequently lost...is that the world’s human civilisation as we know it, cannot exist without refractories.”

William McCracken, Letter to Editor, 2002
retired refractory materials consultant, USA



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The Big Picture



“The refractories industry plays a critical role, although silent and mostly unrecognised, in supporting all industrial manufacture of steel, cement, glass, chemicals, and other essential commodities around the world.”

Charles Semler, IM17 Congress March 2004
consultant, Semler Materials Services, USA



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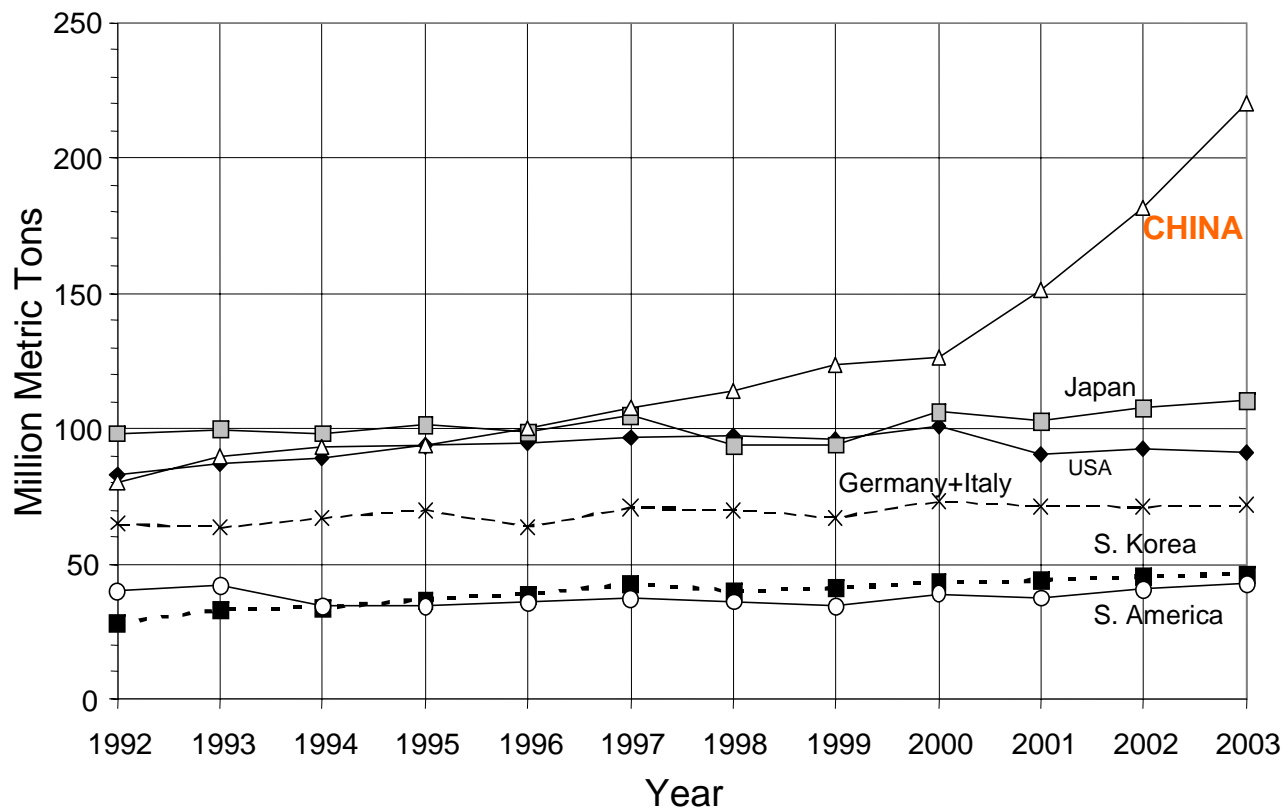
“Refractories are not going out of business. Someone will always be around to produce them, somewhere,...and someone is always going to be consuming them – in the foreseeable future in increasing amounts. .”

William McCracken, Letter to Editor, 2002
retired refractory materials consultant, USA



The Big Picture

Annual Steel Production: 1992-2003



The Big Picture

Refractory raw materials

<i>Refractory classification</i>	<i>Industrial mineral (incl. synthetic minerals)</i>	<i>Main chemical component</i>
Basic	Dead burned magnesias	85-99.8% MgO
	Fused magnesias	97-99.8% MgO
	Calcined dolomite	56-62% MgO, 36-40% CaO
	Chromite	32-50% Cr ₂ O ₃
	Sintered & fused spinel	66-80% Al ₂ O ₃ , 21-33% MgO
	Olivine	40-50% MgO, 35-45% SiO ₂
High alumina	Calcined aluminas	>99.5% Al ₂ O ₃
	Fused aluminas	94-99.5% Al ₂ O ₃
	Sintered mullite	72-75% Al ₂ O ₃
	Calcined bauxite	85-88% Al ₂ O ₃
	Mullitised kaolin, bauxite, kyanite	50-70% Al ₂ O ₃
	Andalusite, sillimanite, kyanite	60-65% Al ₂ O ₃
Fireclay	Refractory clays, fireclay	20-45% Al ₂ O ₃
	Pyrophyllite	20-30% Al ₂ O ₃
Silica	Quartzite, quartz sand	>97% SiO ₂
	Fused silica	>99.8% SiO ₂
Specialised	Zircon	66% ZrO ₂ +HfO ₂
	Zirconia	>99% ZrO ₂
	Silicon carbide	>93% SiC
	Graphite	75-99% C
Insulating	Diatomite	>75% SiO ₂
	Perlite	65-80% SiO ₂
	Vermiculite	45% SiO ₂

The Big Picture

Refractory raw material consumption in Japan 2001-2003 ('000s tonnes)

Refractory raw material		2001	2002	2003
Chrome ores	domestic	5.3	2.7	1.3
	imported	17.7	10.7	8.3
Magnesia clinker	domestic	129.7	110.2	108.6
	imported	132.2	124.4	109.2
Fused magnesia		51.8	47.2	46.2
Synthetic mag-dolo clinker		1.2	0.6	0.4
Dolomite clinker		4.1	3.7	2.9
Spinel		13.3	11.8	11.5
Silica ores		9.8	9.4	7.7
Bauxite		32.0	27.5	24.8
Sillimanite, kyanite, andalusite		9.6	9.9	10.5
Synthetic mullite		10.2	9.4	9.3
Fused alumina		127.1	117.3	118.2
Sintered alumina		46.1	46.1	38.4
Calcined alumina		28.4	24.6	27.5
Fused silica		2.7	2.7	2.2
Alumina shell		93.4	78.7	62.1
Boshan & Fuzhou clay		54.9	50.7	42.3
Pyrophyllite	domestic	69.2	64.2	57.9
	imported	11.5	9.7	8.1
Chamotte (low grade)		6.7	4.1	6.2
Pottery stones		0.5	0.3	1.3
Other clay	domestic	60.5	58.6	45.6
	imported	49.3	68.7	39.1
Silicon carbide		44.6	41.8	39.8
Crystalline graphite		21.3	19.0	17.4
Amorphous graphite		1.9	1.9	2.1
Insulating bricks		19.7	19.1	15.5
Zircon sand, flour & zirconia		24.5	21.3	20.3
Alumina cement		44.3	36.5	30.2

Source: Japan Refractories Association



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DBM - grades

Source & processing

- **Natural - magnesite, serpentine**
- **Synthetic - Mg-rich brines, seawater**
- **Calcination - shaft, rotary kilns**
- **low to high purity**
 - **% MgO**
 - **bulk density**
 - **periclase crystal size**
 - **calcia:lime**



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DBM - grades

High & low purity

- **High**
 - **>97% MgO**
 - **BD 3.40 g/cm³**
 - **PCS >120μ**

- **Lower**
 - **<90-97% MgO**
 - **BD 3.00-3.40 g/cm³**



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DBM - supply market

- **5-6m. tpa DBM world production**

- **0.9-1.0m. tpa >97.0% DBM - mostly synthetic**

Australia, Brazil, Ireland, Israel, Japan, Mexico
Netherlands, (South Korea), USA

- **4.5m. tpa <97.0% DBM - all natural**

(Austria), Brazil, China, Greece, (India), (Iran), North Korea,
(Russia), Serbia & Montenegro, Slovakia, Spain, Turkey



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DBM - supply market

Captive producers

		<i>Prod. cap. '000s tpa</i>
Austria	Veitsch-Radex GmbH	200
China	Yingkou Qinghua Group	200
India	Almora Magnesite	24
	Burn Standard	36
	Dalmia Magnesite	72
	Tamil Nadu	30
Iran	Iran Magnesite Co.	30
Russia	JSC Kombinat Magnezit	2,400
Slovakia	Slovmag a.s.	n.a.
South Korea	POSREC Refractories	40
Turkey	Konya Krom Magnesit	75



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DBM - supply market

“Western” players

>97.0% MgO

Prod. cap. '000s tpa

Brazil	Magnesita SA	200
Ireland	Premier Periclase Ltd	80-90
Israel	Dead Sea Periclase Ltd	90
Netherlands	Nedmag Industries	160
Mexico	Quimica del Rey SA de CV	100
USA	Martin Marietta Magnesia	90

<97.0% MgO

Brazil	Magnesita SA	200
Greece	Grecian Magnesite SA	60-70
Serbia/Mont.	Magnohrom Kraljevo	160
Slovakia	SMZ	375
Spain	Magnesitas Navarras SA	75
Turkey	Magnesit AS	140
	Kumas-Kutahaya	180



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DBM - supply market

Asia Pacific players

>97.0% MgO

Prod. cap. '000s tpa

Australia	QMAG	110
Japan	Ube Material Industries	250*

<97.0% MgO

China	Haicheng Houyin Magnesite	600*
	Haicheng Magnesite Refractory	6,000*
	Haicheng Huayu	550
	Haicheng Xiyang Refractories	470
	Yingkou Huachen	300
	Haicheng City Pailou	150
North Korea	Korea Magnesia Clinker Industry	1,100

* combined with CCM production



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DBM - supply trends & developments

- **Chinese exports**
- **Others - “changing times”**



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DBM - supply trends & developments

China's exports of dead burned magnesite 2000-2002						
	2000		2001		2002	
	tonnes	\$/t	tonnes	\$/t	tonnes	\$/t
Japan	113,648	117	56,283	131	19,929	136
S Korea	49,194	132	16,759	135	10,407	129
Taiwan		-		-	187,000	-
India	21,452	133	23,490	147	19,378	133
Thailand	11,228	118	8,996	141	3,235	121
Indonesia	14,423	130	5,553	139	2,138	94
Saudi Arabia	3,310	113	14,500	126	6,354	149
Iran	9,025	135	32,500	140	23,650	142
Turkey	2,022	125	2,746	127	6,334	122
Netherlands	227,561	112	246,293	127	201,297	107
Belgium		-		-	19,178	258
Germany		-		-	10,359	88
Italy		-	3,999	-	8,634	91
Spain	10,932	100	9,514	104	12,086	95
France		-		-		-
Ireland	14,508	98	26,168	135	28,811	113
Russia	59,259	144	55,726	146	28,667	150
Ukraine	50,943	114	41,141	122	32,429	116
Poland		-		-		-
Romania	5,138	91		-	6,185	166
USA	309,009	107	266,177	116	326,983	100
Canada		-		-		-
Mexico	25,218	121	12,400	126	25,081	108
Brazil		-		-		-
Venezuela	7,023	135	15,973	134	8,379	127
S Africa	47,071	110	44,089	118	37,101	106
Total	1,050,807	115	906,565	126	854,532	113

Chinese exports

- China dominates export market of <97.0% MgO; just under 1m. tpa
- 35.5% EU imports 2002
- Impact of low cost Chinese fused magnesite exports = blending
- Export licence: RMB450(US\$50)/t; 780,000 tonnes for 2004
- EU a/d duty to expire Feb 2005 pending review

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DBM - supply trends & developments

EU imports, 2001- H103; tonnes

Source country	2001	2002	2003*
Australia	54,697	35,678	26,818
Brazil	8,989	4,067	0
China	258,721	249,256	165,576
Greece	13,933	19,188	6,952
Ireland	12,160	29,279	13,877
Israel	9,073	5,657	2,715
Italy	15,184	15,439	7,620
Mexico	1,958	453	8,152
Netherlands	145,098	158,526	77,659
North Korea	70,859	33,430	26,779
Russia	3,168	20	40
Serbia & Montenegro	117	49	24
Slovakia	55,442	56,663	33,557
Spain	13,068	5,913	2,237
Turkey	40,463	33,446	5,891
USA	20,836	8,946	1,666
Total ***	787,788	701,205	471,269



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DBM - supply trends & developments

US DBM & FM imports, 2001- 02; tonnes

Source country	2001	2002
Australia	55,600	55,700
Austria	14,000	13,100
Brazil	9,500	0
China*	256,900	303,800
Greece	0	4,630
Israel	11,700	6,830
Other	15,400	9,880
Total	363,000	394,000

US Census Bureau



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DBM - supply trends & developments

- **New China MgO export group 1 February 2004:**
“China Magnesite Self Disciplined Association”

Haicheng Xiyang Corp.

Haicheng Houying Corp.

Jiachen Co. Ltd

Haicheng Huayu Corp.

CMIEC

- **Chinese DBM price rises:**

DBM9001 US\$152/tonne

DBM 9010 US\$162/tonne

DBM9530 US\$190/tonne

DBM9730 US\$210/tonne



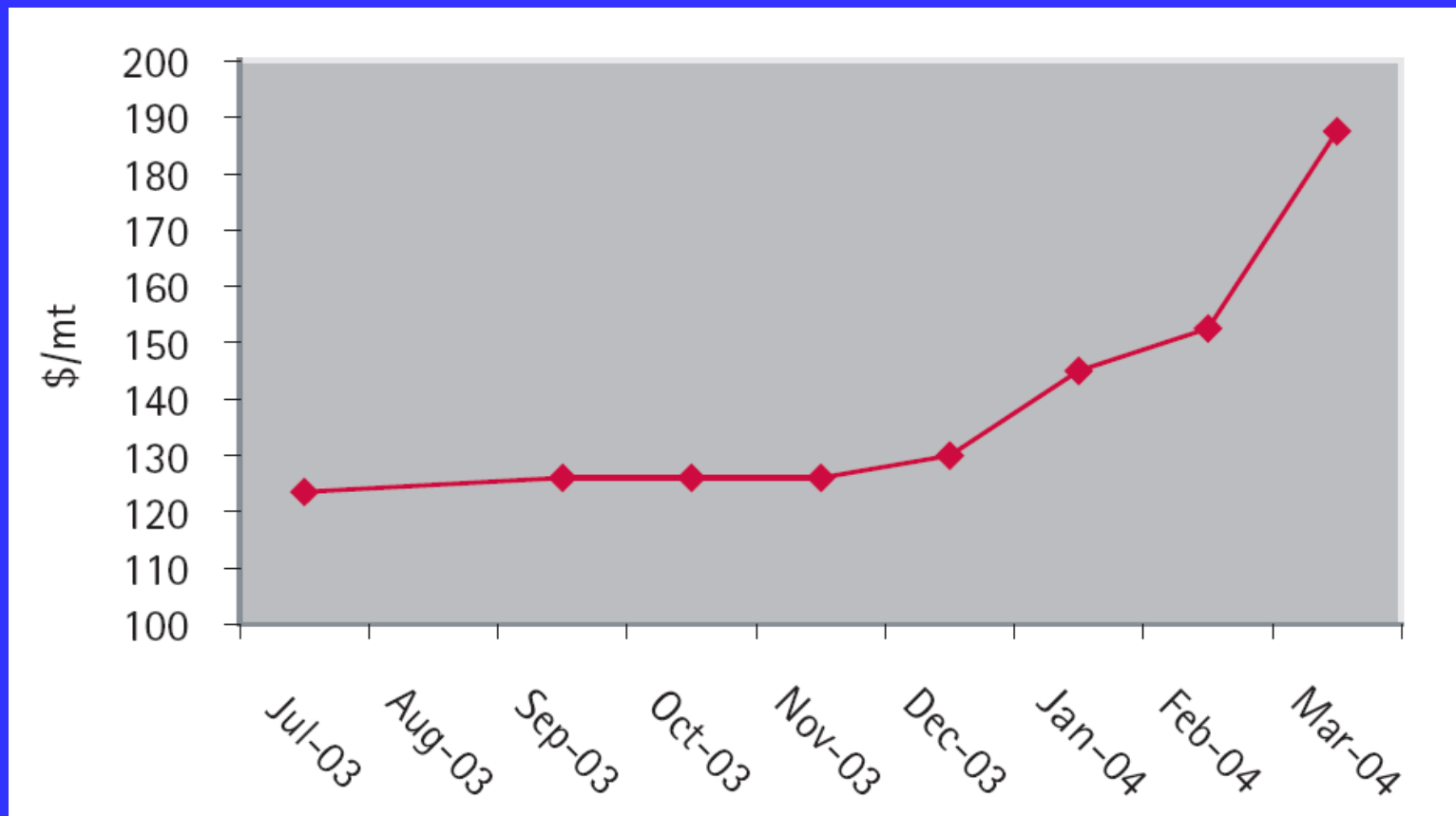
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DBM - supply trends & developments

Price trend for Chinese 94-95% MgO DBM



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DBM - supply trends & developments

- **Chinese DBM domestic market demand has soared with steel, non-ferrous (Al/Cu), and cement boom**
- **Leading to:**
 - **shortages in DBM stock**
 - **partial depletion of reserves**
 - **less incentive for DBM exports**
- **Compounded by**
 - **problems in domestic freight transport**
 - **power & coke shortages and price rises**
 - **soaring freight rates & vessel shortages for exports**



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DBM - supply trends & developments

- **With exception of China, most producers working under capacity**
- **Specific refractory consumption in decline**
- **Weakness of US\$ compared to Euro**

- **2003 exits:**

Cogema, Italy	75,000 tpa
Harbison-Walker,	120,000 tpa



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DBM - supply trends & developments

Where does this leave DBM producers outside China?

- **Target basic monolithics**
- **Drive for non-refractory markets**
- **Potential to regain part of former DBM market share lost to China**
- **Possible new players emerging**
 - **Jordan Magnesia Co. Ltd: 50,000 tpa, fine tuning phase**
 - **buyer for ex-Cogema?**
 - **new sources eg. Saudi Arabia?**



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DBM - supply trends & developments

JORMAG DBM/CCM project, Safi, Jordan - production mid-2004



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Changing times

Refractories market

- **1990s consolidation: RHI, Cookson, LWB etc.**
- **2000+ restructuring: closures & cutbacks**
- **specific consumption declining**
- **2001+: US/Europe steel cutbacks/bankruptcy**
- **Impact of continuing asbestos claim issues**
- **China/East Asia: growth market for end products drawn by raw material & market proximity**
- **Global shift of industrial production to the East**



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Changing times

Sourcing refractory minerals

- **end of era for large, global trading houses**
→ **leaner, fitter, flexible traders**
- **port processors → end product producers**
= **added value, “niche trading”**
- **direct sourcing: for raw materials & end products**
- **traders will still have a role**
 - **specialisation in supply chain management**



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Changing times

Sourcing refractory minerals

“By far the most significant change is the shift to China, giving access to cheaper raw materials, such as fused magnesite.”

“While traders still supply the majority [of minerals], we intend to change this to the point where we will use them mostly in co-operation for freight. In ten year’s time, the majority of our minerals supply will be direct sourced”

Andreas Meier, COO, RHI AG, Austria 2002



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Changing times

Sourcing refractory minerals

“I believe the refractories sector can answer the question of whether in such an environment only large companies that have backwards integration all the way into mining operations can survive, and whether companies involved in refining or trading will completely disappear, with ‘no’.”

Andreas Meier, COO, RHI AG, IM17 Congress March 2004



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Conclusions

- **Refractory minerals will remain in demand**
 - **Influenced by: refractory market evolution; sourcing issues**
- **Focus will be on supply of high purity raw materials**
- **Refractory companies will need to assess their dependence on Chinese minerals against alternative supply**
- **DBM: opportunity knocks outside China, while non-refractory markets evaluated and pursued**



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Conclusions

The bottom line:

***Industrial minerals outlook in
the refractory market
depends largely on
developments in China***

Thank you for your kind attention

