Magnesia
The changing face of the industry
by
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Overview

- Supply overview
  - Recent changes
- Demand review
  - Trends in end user markets
- Outlook for dead burned, caustic calcined and fused magnesia
Supply
Supply – gradually growing since 2001

Global magnesia supply by product 2001-2012 (000t)

Source: Roskill estimates.
Supply Overview

• Changing face of supply
  • Dominance of China – a shifting position on international trade?
  • Vertical integration – more captive production
  • New capacity & expansions
  • Corporate changes
China – Pattern of trade is changing

Chinese magnesia exports 2000-2012 (t)

Source: Global Trade Atlas
China – Increasing exports of CCM since 2010

China: Exports; Percentage of DBM, CCM and EFM of total DBM, CCM, & EFM Exports (%) 2000-2012

Source: Global Trade Atlas
China – increasing exports of low grade magnesia

China: Low grade magnesia exports against total DBM, CCM & EFM (t) 2000-2012

Source: Global Trade Atlas

Alison Saxby – Magnesia developments  Magmin 2013
China – Five year plan

• China - Five year plan 2012

• The control of output

• Development of a high performance refractory industry

• High tech production sectors in Yingkou and Anshan

• Adjustment of industry structure

• Demand forecast of 16Mtpy magnesite by 2016 (growth rate of 1.3% py)

Source: Industrial Minerals Research
China – Change in emphasis

- Domestic demand is priority – satisfying own steel and other industries as well as production of refractories for export
- Push to production of high value and performance refractories
- Major magnesia producer but exports discouraged by government
  - export licences, trade, quotas
- Availability and cost of export licences has been unpredictable in some years (caused by trades in the export licences themselves)
- Large quotas controlled by a few players
Supply – China Ministry of Industry and Information comments

“For the sustainable and healthy development of Chinese Refractories industry”

Outdated facilities to be weeded out, including magnesia shaft kilns with an effective volumes below 30 cubic metres, and electric melting furnaces with transformer power below 1400KVA –

This will challenge the survival of small-scale Chinese producers

Source: Refwin
Supply – Increased vertical integration by refractory producers

<table>
<thead>
<tr>
<th>Region</th>
<th>Producers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td>RHI, Magneszit, Kumas, Grecian Magnesite, Slovmag, Konya Krom, Minteq Asmag</td>
</tr>
<tr>
<td>Americas</td>
<td>Magnesitas, IBAR Nordeste, Togni</td>
</tr>
<tr>
<td>Africa</td>
<td>Vereeniging Refractories</td>
</tr>
<tr>
<td>Asia</td>
<td>Haicheng Xiyang, Haicheng Huayin, Haicheng Huayu, Fengchi Group, Liaoning Wancheng Magnesite, Liaoning Jinding Magnesite, Haicheng Donghe Taidi, Liaoning Qunyi, Normag (Yingkou) Refractories, Qinghua Refractories, Hongyu, Dalmia Magnesite, SAIL, Salem Refractories.</td>
</tr>
</tbody>
</table>
Supply – New capacity and expansions

<table>
<thead>
<tr>
<th>Country</th>
<th>Company</th>
<th>New capacity (000t)</th>
<th>Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russia</td>
<td>Magnezit CCM (300), DBM (150) EFM (200)</td>
<td>2011-2015</td>
<td></td>
</tr>
<tr>
<td>Netherlands</td>
<td>Nedmag DBM (40)</td>
<td>2014</td>
<td></td>
</tr>
<tr>
<td>Turkey</td>
<td>RHI (MAS) DBM (140)</td>
<td>2012-2013</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kumas EFM (35)</td>
<td>2012</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bommag DBM (15)</td>
<td>2013</td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>Magnesita Refrataros DBM (120) EFM (17)</td>
<td>2012-2013</td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>Huayin CCM (250)</td>
<td>2012-2013</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cosman CCM (200) DBM (100)</td>
<td>2013</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fengchi Group DBM (150)</td>
<td>underway</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Liaoning Jinding EFM (40)</td>
<td>underway</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Liaoning Liaoan Investment 1,300 (CCM) DBM (300)</td>
<td>2013</td>
<td></td>
</tr>
</tbody>
</table>
Current consumption patterns
### Demand - Principal end uses for magnesia

<table>
<thead>
<tr>
<th>Dead burned magnesia</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refractories</td>
<td>Shaped (bricks) and unshaped (monolithics)</td>
</tr>
<tr>
<td></td>
<td>Magnesia-carbon /alumina-magnesia-carbon refractories</td>
</tr>
<tr>
<td></td>
<td>Magnesia alumina spinel refractories</td>
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<tr>
<td></td>
<td>Magnesia-chrome refractories</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Caustic calcined magnesia</th>
<th>Agriculture – speciality fertilizers, dairy farming, Animal Nutrition, Environmental applications, Conversion to Mg(OH)$_2$ &amp; EFM, Hydrometallurgy, Pulp &amp; paper</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Electrofused magnesia</th>
<th>Shaped and monolithic refractories, Mag-carbon bricks, Alumina magnesia carbon refractories</th>
</tr>
</thead>
</table>
Demand – Increase in refractories production driven by China

Global production of refractories by region, 2000-2011 (000t)


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Major trends in the refractory industry affecting dead burned magnesia consumption:

- Fortunes of the steel industry
- Consolidation & vertical integration/partnerships
- Environment
- Decline in specific usage
- Move from shapes to monolithics
- Raw material costs
Demand - Chinese exports steady in 2012

Exports of magnesia based refractories by region 2006-2012 (Mt)

Source: GTA. Note; Refractory Bricks, blocks, etc containing over 50% by weight of magnesia, calcium or chromium

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Demand – Increase in world steel output

Crude steel production and forecast by region, 1980 to 2020 (000t)

Source: World Steel Association; Roskill Estimates

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Demand – world steel production forecast scenarios

World crude steel production and outlook 2000-2020 (000t)

Source: Historical data up to 2012 from World Steel Association. 2012 data includes estimates. Roskill.

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Demand – Caustic calcined end uses

<table>
<thead>
<tr>
<th>End uses for caustic calcined magnesia*</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Feedstock</td>
<td>Fused magnesia/magnesium hydroxide</td>
</tr>
<tr>
<td>Agriculture</td>
<td>Animal nutrition, fertilizer &amp; soil improvers</td>
</tr>
<tr>
<td>Environment</td>
<td>Waste-water treatment, treatment of contaminated soils, neutralisation of acids and pH control, FGD</td>
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<tr>
<td>Flame retardants</td>
<td>Plastics, insulated cables</td>
</tr>
<tr>
<td>Hydrometallurgy</td>
<td>Nickel-cobalt, copper-cobalt</td>
</tr>
<tr>
<td>Chemicals</td>
<td>Magnesium compounds</td>
</tr>
<tr>
<td>Foundries /Metallurgy</td>
<td>Steel fluxing</td>
</tr>
<tr>
<td>Industrial</td>
<td>Rubber, cement, food, toothpaste, pharmaceutical, &amp; cosmetics</td>
</tr>
<tr>
<td>Pulp &amp; paper</td>
<td>Sulphite pulp production, effluent treatment</td>
</tr>
</tbody>
</table>

*Includes uses for magnesium hydroxide sourced from CCM
Summary – Refractory grades

• DBM refractory market forecast at 3.5% CAGR for 2012-2017

• Strong steel production growth in China, Asia & Middle East

• High grade DBM & EFM will see an increase in demand as higher performance refractories required

• Refractory industry still challenged by rising energy costs and poorer than expected demand from the steel industry. Stabilization expected in H2 2013 and recovery from 2014
Summary – caustic calcined magnesia

- CCM growth forecast at 3.7% CAGR for 2012-2017, although this will vary by sector.

- Highest growth rates in MDH in cabling & hydrometallurgy but smaller volumes.

- Agriculture driven by demand in Asia, fairly flat in North America and Europe. Competition from magnesium sulphate in some applications.
Questions?
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