Iron ore supply – reports on recent conferences

This article reports on two recent ore mining conferences: The SME 85th Annual Meeting – Minnesota Section AIME, held concurrently with the 73rd University of Minnesota Mining Symposium held April 17-18, 2012, at Duluth, Minnesota and Metal Bulletin's 18th International Iron Ore Symposium which took place in Amsterdam, June 25 - 27, 2012. By J J Poveromo*

MUCH of the remaining iron ore in Minnesota is low grade taconite typically containing 25-30% iron content. Taconite is mined from the Mesabi Iron Range near Hibbing, Minnesota. The ore is crushed, concentrated by magnetic separation of the iron bearing mineral and processed into pellets containing around 65% iron content. These are then sent from Duluth or other centres by train or ship to steel mills around the Great Lakes region. This makes the USA largely self-sufficient in ore supply.

SME 85th Annual Meeting & 73rd University of Minnesota
The Society for Mining, Metallurgy and Exploration (SME) Annual Meeting is held each year in Duluth, Minnesota, USA. This year, saw the 85th SME meeting reflecting the long heritage of mining in the region and its activities today. These meetings in particular attract operators of the taconite mines and pellet plants in Minnesota and Michigan and the vendor base which supplies these plants. The meeting is the only international meeting held annually which addresses iron ore pelletizing so it also attracts participants from outside the USA. Conference attendance was a record 305 reflecting a strong local mining economy and the fact that Duluth is a good location for concurrent disposal dispose of tailings and mine waste rock to provide environmental risk mitigation in Manitoba, Canada.

The conference itself was preceded by a tour of the Duluth Iron Ore Dock and ME Foundry. Other pre conference activities were short courses on High Pressure Grinding Rolls (HPGR) and the ‘Geology and Mineral Potential of Northern Minnesota as Conveyed in Geologic Maps’.

University of Minnesota
Held concurrently with SME, the University of Minnesota Mining Symposium has reached its 73rd event. Sessions covered a wide range of subjects related to the mining industry from mining technology, to concentration and pelletizing, and, of course, mitigating the environmental impact of operations.

Airborne Emissions Session:
Five North America discussed reducing NOx emissions from pelletizing furnaces. The latest advances will be incorporated into the burners being installed at the new Essar Minnesota pellet plant, as detailed in a follow up paper with Barr Engineering.

The CN Railroad and the Arcadis Company outlined dust suppression at a bulk product rail site for the USA. The pellet plants of Essar and Magnetation, currently under construction, will feature such dust suppression. Kemira, a new entrant in the mineral binder area, outlined their laboratory studies. Metso outlined the latest advances in Grate-Kiln pellet indurating technology including efforts to retrofit existing plants.

Pelletizing Session:
The Tyler Screening Group outlined dust suppression at a bulk product rail site for the USA. The pellet plants of Essar and Magnetation, currently under construction, will feature such dust suppression. Kemira, a new entrant in the mineral binder area, outlined their laboratory studies. Metso outlined the latest advances in Grate-Kiln pellet indurating technology including efforts to retrofit existing plants.

Mining Session: Cummins Company and Caterpillar each made comprehensive presentations on Tier 4 Final Diesel Emission reduction for new equipment, technology and operator practices. The Minnesota Department of Natural Resources reviewed metallic (nonferrous) mineral exploration in Minnesota. This was followed by the Laurentian Vision Partnership providing an outline of what the Mesabi Range might look like in a post mining era.

The SHE Group provided a detailed look at the geology and processing of frac sands in Wisconsin and Minnesota. Frac sands are needed for the rapidly emerging shale gas processing market. Both Canada and Sweden presented novel methods for concoridous disposal of tailings and mine waste rock to provide environmental risk mitigation in Manitoba, Canada.

Safety and Legal:
This diverse session started with a general presentation on leadership and management of safety programmes followed by specific papers on oil spills and asbestos reclamation in demolition projects. The session concluded with two very detailed legal presentation.

Diary Date
The 86th SME Annual conference 16-17 April 2013 Duluth, Minnesota, USA http://www.d.umn.edu/ce/learningopportunities/conferences/sme/index.html

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Fig 1 Locations of the five Magnetation concentrator plants in Minnesota, potential sites for new pellet plant and steel plant sites of AK Steel

Maintenance Session: In the session on Maintenance, AMG Mining outlined the cultural and organisational changes needed to improve maintenance performance followed by Xtrak which provided details on increasing gearbox power and load capacity through upgrading of selective components. The Donaldson Company outlined the benefits of bulk filtration of diesel oil for mining trucks. Martin Engineering described how to use sonic horns to prevent build-ups and to improve the efficiency of bag houses and fans.

Research and Education Session: This session was mainly focused on the efforts of local community colleges and universities to train and educate the workforce for the mining sector. The final paper was an overview of the NRRI (Natural Resources Research Institute). This laboratory, once operated by US Steel but since taken over by the University of Minnesota, offers a full range of laboratory services and pilot testing in mining and mineral processing mainly for the taconite industry but also for the nonferrous and value added processing areas.

Fig 2 Development of Iron Ore Benchmark price (Carajas fine ore) Salzgitter

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Iron ore

Fig 3 Sea freight costs benchmarked to Tubarao – Rotterdam
Capesize 150kt) Salzgitter

Fig 4 Chinese steel demand model to 2020
McKinsey

tions on mining rights, surface rights, mineral leases, title searches, etc.

Sulphate Session: The Minnesota Pollution Control Agency led off the session with a comprehensive overview of this issue that affects mainly the growth of wild rice (special to Native Americans) in the eastern end of the Mesabi Range. Further details on the distribution of sulphates were provided by the Minnesota Department of Natural Resources. Barr Engineering then outlined studies on the oxidation rate of sulphide minerals. Tetra Tech compared nanofiltration (NF) or reverse osmosis (RO) membrane vs chemical treatment to remove mine water contaminants that include sulphates. Golder Associates outlined a passive treatment system for removing sulphates from mine water.

Ore Beneficiation: Humboldt Wedag presented a tutorial on HPGC (High Pressure Grinding Rolls) including its applications at CAP in Chile, Kudremukh in India, Cliffs Empire in the USA and Vale at San Luis in Brazil. Steinert Australia provided details on the dewatering of magnetite concentrate. Metso outlined the effects of cavity level on cone crusher performance. Siemens presented an overview of the application of medium voltage switchgear in mine processing. The venue moves to the Great Lakes (Fig 1). The first plant started up in February 2009 and now produces 550kt/y of concentrate. The larger Plant 2 (800kt/y) started up this year along with Plant 3, the 80-20 JV with SDI. These plants are supplying Mesabi Nugget and AHMSA, in Monclova Mexico. An ambitious JV with AK Steel includes a 3.0Mt/y pellet plant to be built in Indiana, along with Plants 4 and 5 to help feed this pellet plant.

Essar Minnesota Mine/Pellet Plant: This project will add 7.0Mt/y of pellet capacity with the potential for future expansion. Start-up is scheduled for 2013. These pellets will eventually supply the blast furnaces of Essar Algoma Steel in Canada along with other blast furnaces and possibly some DRI producers. The project is capitalizing on technology developments in taconite processing over the past 60 years, these being:
- Two-stage crushing/scalping system, with dry cobbing, to allow very high feed-rates in the concentrator;
- Compact autogenous milling which reduces capital and operating costs;
- A single very large furnace with best in class pollution control equipment for induration;
- Complete additive grinding/mixing facility to allow the company to tailor its product for specific customers.

Steel Dynamics, Minnesota Operation: Jeff Hansen of Mesabi Nugget outlined the history of SDI, a company created in 1993 to build an EAF that rolled minimill and now expanded into a multi plant steel, natural resources and recycling company. The Mesabi Nugget Plant, produces iron nuggets for EAF feed with a target composition of 94-97%Fe, 2.5-3.0%C and below 0.1%Si. The nuggets are in the size range 80x6x16mm. The plant which uses Kobe Steel’s 737,000tK/MK rotary hearth furnace process is in expanded ramp up, producing 150kt in 2011 vs a planned capacity of 500kt/y. The plant is presently fed with Magnetation concentrate as it is still trying to obtain an environmental permit to re-opening the former Erie Mine. In the interim, SDI is starting up a 1000kt/y Magnetation concentrate plant in an 80-20 JV with Magnetation, with SDI holding the larger share.

Polyemon: This is a planned nonferrous project to produce copper, nickel cobalt and precious metals.

The meeting, as expected, included little discussion of the global iron ore supply/demand and pricing, topics that dominated the Metal Bulletin event to be described next. The North American steel and iron ore sectors continue to be more insulated from global iron ore developments although the major merchant pellet supplier, Cliffs, is now modifying contracts to reflect changes in global pricing. Major steel producers such as US Steel and ArcelorMittal still benefit from strong iron ore/pellet plant equity positions.

Metal Bulletin’s Ore Symposium
Metal Bulletin’s 18th International Iron Ore Symposium; is now held on an annual basis, it previously having been held every two years for the past three decades. The venue moves around Europe. Attendance at around 240 was down from the 300 plus before the fiscal crisis when representatives of nearly all iron ore producers and European steel producers attended. Attendance is still led by iron ore producers (25%) but with traders (20%) now the second largest group while steel companies (15%) are less prominent. Financial companies (15%) are a growing group while the balance of the attendees include engineering companies, shippers, consultants, lawyers and journalists. Few came from the Asia-Pacific region.

Keynote Presentations featured two of the Big Three’ iron ore producers: Rio Tinto and Vale, and the leading North American producer, Cliffs. Alan Davies of Rio Tinto presented: “Strategies for development in the uncertain economic times: will iron ore business continue to thrive?”. He said Chinese steel production is expected to continue to grow supporting Rio
Tinto production growth. Expansion of output of the Pilbara mines in Western Australia will grow from 283Mt/y by Q4 2013 to 333Mt/y in H1 2015 with further increases to at least 2016. The wide gap between new project announcements by other miners and actual project completion will help to avoid iron ore over supply, he believes. Rio Tinto continues to pursue the Simandou project in Guinea, W Africa, expansion at IOC (Labrador, Canada) where over 2bn t of ore is inferred of around 38-39% Fe content, and new project development at Orissa in NE India. Fidel Blanco gave Vale’s perspective on the iron ore market. The company is bullish on continued economic growth and steel production increases in China, but, according to Mr Blanco, growth of iron ore production will be hampered by:

- ‘Easy discoveries’ are gone,
- lack of large scale world-class projects,
- new frontiers lacking basic infrastructure,
- environmental permitting,
- lack of skilled labour,
- higher capex costs,
- natural resources nationalism, and
- technological challenges.

Vale’s approved iron ore projects are listed in Table 1 along with annual capacities.

Vale is also toasting major infrastructure and logistics initiatives: expanding the Carajas Railroad, building or leasing extra-large Valexpress vessels and establishing an iron ore distribution centre in Malaysia.

Cliffs’ Joe Carrabba presented ‘Developing new iron ore deposits – is there still room for expansion?’ He covered much of the same ground as the earlier presenters with a bullish view on China and iron ore demand, challenges facing new iron ore projects, but he did present the following summary of geopolitical challenges:

- Indonesia: Prohibition of provincial government from issuing new mining permits.
- Australia: Recent enactment of Minerals Resource Rent Tax (MRRT).
- Brazil: Environmental licensing process has become more time intensive.
- South Africa: Continued power constraints with Eskom and threat of nationalisation and new carbon tax.
- India: Ministry of Mine’s looming threat to ban iron ore exports.

An incisive analysis of major expansion plans is presented in Table 2.

However, Cliffs projects a sea borne demand growth of 885Mt by 2020 so implementing of projects by smaller companies) will surely lead to growth of 885Mt by 2020 so implementing of projects by smaller companies) will surely lead to

Ore Price – evolution or revolution?

A Panel Discussion addressed the topic of ore prices. It comprised members of steel companies, iron ore producers, traders and financial organisations and provided the following perspectives:

Steel producers such as Erdemir and Emirates complained about the disconnect between steel prices and iron ore prices, while financial players such as Credit Suisse noted that volatility is a fact of life in the pricing of steel raw materials; for example 95% of all iron ore is now linked to price indices; and all involved in the value chain are encouraged to use hedging to ensure predictable costs.

Following the panel discussion attendees were subjected to a number of presentations by steel companies on steel company iron ore users) shamelessly flogged their products. These included iron ore trading platforms, iron ore value-in-use assessments, iron ore price indices, etc. Credit Suisse did offer a good tutorial on the financial side: price indices, swaps, cost structures, forward curves, raw material indexation vs finished steel product indexation, etc.

This was followed by some interesting presentations by steel producers and customers of steel products.

Salzgitter, a high end flat rolled steel producer in Germany with a steel plant producing 4.6Mt/y uses 10,2Mt/y of raw materials made up annually of iron ore 6.1Mt, coking coal 2.6Mt; steel scrap 0.45Mt, lime 0.93Mt and alloys 0.09Mt. The raw material cost, as a proportion of total steel cost, has increased from 60 to 80% in the past 10 years as both miners and customers of steel enjoy higher financial returns than steel producers. The dramatic rise in iron ore prices is shown in Fig 2 while the changes in freight rates is shown in Fig 3. Fortunately, the latter are returning to pre boom levels. Salzgitter also complained about excess EU regulation, unreasonable CO₂ targets and the high costs of electricity.

A purchasing perspective from auto manufacturer Peugeot noted that 60% of a typical automobile is composed of steel and suggested that steel plants and steel customers should share the risk in volatility of raw material inputs, noting that iron ore and hard coking coal comprise about 35% and 30%, respectively, of the cost of hot rolled coil.

Steel product customer MAN SE is a producer of commercial and industrial vehicles and power engineering products. They presented the following comparison of hedging raw materials vs hedging finished steel products through various financial instruments:

- Financial hedging of steelmaking inputs (Iron Ore, Coking coal, Nickel etc.)

Benefits

- Better mapping to the real raw material costs;
- High liquidity for most of the relevant commodity markets (eg Iron ore);
- Existing hedging possibilities via financial products;
- Same raw materials for all steel products.

Disadvantages

- Different material surcharges in one purchasing contract needed;
- Hedge ratio of the steel costs approximately 60-70%.

Table 1 Approved iron ore projects for Vale

<table>
<thead>
<tr>
<th>Mine</th>
<th>Location</th>
<th>Capacity (Mt/y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carajás Serra Sul S11D (Brazil)</td>
<td>(mine + processing plant)</td>
<td>90</td>
</tr>
<tr>
<td>Carajás Additional (Brazil)</td>
<td></td>
<td>40</td>
</tr>
<tr>
<td>Carajás Serra Leste (Brazil)</td>
<td>(new processing plant)</td>
<td>6</td>
</tr>
<tr>
<td>Simandou phase 1 – Argita (Guinea)</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>Conceição-Radiani (Brazil)</td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>Vargem Grande Rabitios (Brazil)</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Fertilizing Plant Trabauco VII (Brazil)</td>
<td></td>
<td>7.5</td>
</tr>
<tr>
<td>Fertilizing Plant Samaco IV (Brazil)</td>
<td></td>
<td>8.3</td>
</tr>
</tbody>
</table>

Table 2 Major expansions of iron ore mines

<table>
<thead>
<tr>
<th>Mine</th>
<th>Location</th>
<th>Capacity (Mt/y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BHP Billiton Port Hedland</td>
<td>Outer Harbour 1 &amp; 2</td>
<td>110</td>
</tr>
<tr>
<td>BHP Port Hedland</td>
<td>Outer Harbour 3 &amp; 4</td>
<td>100</td>
</tr>
<tr>
<td>Vale Serra do Carajas</td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>Rio Tinto Cape Lambert</td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>FMG Port Hedland</td>
<td>Inner Harbour (infrastructure)</td>
<td>100</td>
</tr>
<tr>
<td>Total already approved</td>
<td></td>
<td>324</td>
</tr>
<tr>
<td>Vale Serra do Carajas</td>
<td></td>
<td>90</td>
</tr>
<tr>
<td>Rio Tinto Cape Lambert</td>
<td></td>
<td>70</td>
</tr>
<tr>
<td>Approval in 2012</td>
<td></td>
<td>160</td>
</tr>
<tr>
<td>Conditional (sensitive to ore price in next 4.5 years)</td>
<td>BHP Port Hedland</td>
<td>110</td>
</tr>
<tr>
<td>BHP Port Hedland</td>
<td>Outer Harbour 1 &amp; 2</td>
<td>100</td>
</tr>
<tr>
<td>BHP Port Hedland</td>
<td>Outer Harbour 3 &amp; 4</td>
<td>100</td>
</tr>
<tr>
<td>Vale Saimbahu</td>
<td>IOX expansion</td>
<td>25</td>
</tr>
<tr>
<td>Rio Tinto Simandou</td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>FMG beyond 155Mt/y</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>505</td>
</tr>
<tr>
<td>Speculative (needs sustained high ore price)</td>
<td>BHP Nimbura</td>
<td>50</td>
</tr>
<tr>
<td>Rio Tinto Pilbara</td>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>

Fig 5 Location of iron ore clusters in India
Iron ore

The closing session for Day 1 featured papers by two consultancies and still another iron ore pricing paper. Magnus Erickson of the Raw Materials Group in Sweden focused on iron ore mining in India where 169Mt was produced in FY2012.

Iron ore and China

Fig 6 A longer term perspective – China supplanted by India (and SE Asia) Wood Mackenzie

Table 3 Global Iron ore production costs

<table>
<thead>
<tr>
<th>Type of ore</th>
<th>Efficient open pit</th>
<th>Difficult open pit</th>
</tr>
</thead>
<tbody>
<tr>
<td>High grade DSO</td>
<td>5-12</td>
<td>10-20</td>
</tr>
<tr>
<td>High grade DSO</td>
<td>5-12</td>
<td>15-32</td>
</tr>
<tr>
<td>Benefit necessary</td>
<td>5-12</td>
<td>15-32</td>
</tr>
<tr>
<td>Benefit necessary</td>
<td>5-12</td>
<td>15-32</td>
</tr>
<tr>
<td>Type of mining</td>
<td>Costs (US$/t)</td>
<td>Costs (US$/t)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lump</td>
<td>5-12</td>
<td>10-20</td>
</tr>
<tr>
<td>Fines</td>
<td>15-32</td>
<td>20-30</td>
</tr>
<tr>
<td>Freight to China US$/t</td>
<td>20-30</td>
<td>20-30</td>
</tr>
<tr>
<td>Cost FOB China</td>
<td>30-55</td>
<td>50-85</td>
</tr>
<tr>
<td></td>
<td></td>
<td>80-135</td>
</tr>
</tbody>
</table>

Supply/demand balance

Day 2 started with an excellent session featuring iron ore producer Samaroo, two companies with ore and steel interests: Metalinvest and Essel and the Wood Mackenzie Consultancy.

Samarco, a 50:50 JV between Vale and BHPB, enjoys perhaps the lowest position on the global pellet cost curve due to large mines and a concentrator in Minas Gerais, Brazil, connected by slurry pipeline to three large grate pellet machines.

In 2011 they produced 22Mt of pellets (about 50% each of DR and BF grade). The five market sectors are roughly equal: Americas, Europe, MENA, China and other Asia. Samaroo expects global steel production to grow to 2bnt/y by 2020 while the pellet share of production will increase from 25 to 28%.

Metalinvest, a global company headquartered in Ukraine, has mainly steel and raw material facilities in the Ukraine with some steel facilities in Europe and a coal mine in the USA.

Table 3 Global Iron ore production costs

Annual iron ore production of 34Mt accounts for 46% of Ukraine’s output while 14.4Mt/y of steel capacity represents 41% of Ukraine’s total capacity.

They will expand steel production to effectively utilise all of their iron ore while also maintaining 100% self-sufficiency in ore, coal and coke. Steel production will be modernised with elimination of remaining open hearth furnace steel production. The focus for iron ore will be on quality improvement and value added through pelletizing.

The MD of Essel, T K Mukherjee, (a member of the Aditya Birla mining and aluminium group) provided a comprehensive overview of iron ore mining in India where 169Mt was produced in FY2012.

All ore produced is hemaitite of DSO quality with a lump: fines production ratio of 30:70. The domestic demand is around 139Mt with exports at 60Mt. Merchant miners account for 70% of iron ore production. The map of iron ore activity in India is shown in Fig 5, with production activity dominant in the Eastern and Western clusters. Pelletizing capacity is expected to nearly double to 84Mt/y by 2016 with India expected to be a DR grade pellet exporter. The challenges facing both iron ore production and especially iron ore exporting have been well publicised: export controls and taxes, logistics including internal road and rail and port restrictions on merchant mining and an onerous permitting process.

Ravin Montgomery of Wood Mackenzie provided an excellent, comprehensive overview of global iron ore supply/demand including China and new projects. The Chinese iron ore import scene features a greater presence supply by smaller companies outside the four major exporting countries.

More imports are needed to counter unfavourable trends in Chinese iron ore production (more pellet feed, lower Fe content) (Fig 6).

Imports in iron ore demand will come from other regions (besides China) as shown in Fig 6. Much potential new supply could come from Africa, but challenges (sovereign risk, logistics, and high capex) remain. Chinese steel company investment may be essential.

The conference closed with still another paper on iron ore indexes and the only paper on shipping by Acquavita. The main theme in shipping is low freight rates due to too many new vessels being built – and still contracted for – following the boom in demand from China and record high freight rates.

However, around this theme considerable volatility in iron ore and coal vessels can still be seen due to imbalances in supply and demand on specific routes and for specific cargoes.

The ultimate impact of the super large Valemax vessels is hard to predict as not all ports can handle such vessels.

Following the Symposium a number of attendees joined a tour of the EMO Terminal in Rotterdam. This terminal receives ocean carrier cargoes of iron ore and coal and is connected mainly to rail but also to smaller vessels and barges for transport to interior steel plants.