Iron ore and DRI – An old and new conference topic

In this article Dr Joe Poveromo reports on two recent iron ore related conferences organised by Metal Bulletin: The 1st World DRI & Pellet Congress held in Abu Dhabi, and the 19th International Iron Ore Symposium held in Munich.

IT was the inaugural meeting of Metal Bulletin’s 1st World DRI & Pellet Congress, held in Abu Dhabi, April 29-30, 2013. Previously, this topic had been covered marginally at both the large MB Middle East Steel Conference usually held in December in Dubai and the MB Iron Ore Symposium usually held in Europe in May or June. The Conference Organiser collected input from key players in this area and put together an outstanding programme. Attendance of over 250 well exceeded the expectations of the organisers and included all major DR pellet suppliers and Middle East DR plant operators as well as key technology providers in pelletizing and DRI production along with traders, shippers and consultants.

Supply & demand of DR pellets

A presentation by LKAB – the Swedish state-owned company that accounts for 90% of the EU’s iron ore production and is a major supplier of DR grade ore pellets to the MENA (Middle East North Africa) region, said their deliveries in 2012 totalled 26.3Mt of which pellets – both blast furnace and DR grade – were 22.0Mt. They supply about 40% of the EU’s annual blast furnace pellet consumption. On the likely impact of shale gas developments on DRI production – as evidenced by the return of production in the USA; the development of shale gas based projects can massively accelerate growth. Projections showed that pellet supply will grow at 7.7% CAGR noting that key suppliers can readily switch between blast furnace (BF) and DR grades of pellet.

Table 1 Global shale gas reserves (trillion cubic meters)

<table>
<thead>
<tr>
<th>Region</th>
<th>CAGR 2013-2017</th>
<th>CAGR 2013-2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle East</td>
<td>5.5</td>
<td>6.1</td>
</tr>
<tr>
<td>India</td>
<td>6.7</td>
<td>7.6</td>
</tr>
<tr>
<td>North America</td>
<td>29.3</td>
<td>14.6</td>
</tr>
</tbody>
</table>

Table 2 Forecast growth of DRI production by region

A presentation by GIIC (Gulf Industrial Investment Co), Bahrain, outlined the company which operates two pellet plants with a total capacity of 1.1Mt that mainly feed the Gulf region and also a steel plant based on Midrex DRI technology. All ore is imported and the Minas Rio project in Brazil operated by Anglo American will be the leading future source of pellet feed.

Session two dealt with DR pellets and DRI in the context of the wider steel and iron ore markets.

Gavin Montgomery of Wood Mackenzie provided an excellent overview of the iron ore market and the trends which are driving increased pellet demand including:
- Productivity (furnace performance, ease of handling),
- Mine depletion (need to upgrade lower grade ores),
- DRI demand (lack of scrap in key growth regions such as MENA),
- Environmental (threats to sinter plant operations).

Existing pellet plant capacity, led by China at over 200Mt/y, is focused on BF grades, but growth will come from the DR sector, led by growth of the DRI-EAF route in the MENA region as well as growth in India and the shale gas revolution in the USA. The role of DR grade ore in the global iron ore market is shown in Figs 1 & 2. In summary:
- China has large magnetite resources but declining run-of-mine ore grades;
- India underutilises BF and DR pellet capacity;
- Middle East – Iran is second to India in DRI production and also has merchant DR pellet using imported pellet feed from Oman and Bahrain;
- South America – Brazil is a major exporter to Europe and Asia, also to Chile and Peru.

Fig 1 The DR pellet market in the context of the global iron ore market

Source: Wood Mackenzie Iron Ore Market Service

Fig 2 Existing pellet capacity focused on the blast furnace sector (Mt/y)

Source: Wood Mackenzie Iron Ore Market Service
The HBI/DRI market in 2012 was 70Mt/y and an informative overview of world metallics includes a pipeline leading to a coastal shipping port. The scope includes a mine, beneficiation plant and opportunities (high growth and size) and challenges (infrastructure, labour, taxes, and land rights) of building in Brazil were noted. The project (infrastructure, labour, taxes, and land rights) was noted. The project will produce 26.5Mt/y of high quality (68% Fe) pellet feed upon completion next year with ultimate expansion possible to 90Mt/y, backed by vast reserves. This ambitious project will produce 26.5Mt/y of high quality (68% Fe) pellet feed upon completion next year with ultimate expansion possible to 90Mt/y, backed by vast reserves.

Ample pellet feed capacity is coming on line, leading to a problem of potential oversupply so expensive pellet feed projects might not offer good financial returns. The focus of pellet supply and the potential overhang in pellet feed supply is shown in Fig 3.

The next Anglo American presentation focused on their Minas Rio project in Brazil. This ambitious project will produce 26.5Mt/y of high quality (68% Fe) pellet feed upon completion next year with ultimate expansion possible to 90Mt/y, backed by vast reserves. The opportunities (high growth and size) and challenges (infrastructure, labour, taxes, and land rights) of building in Brazil were noted. The project scope includes a mine, beneficiation plant and a pipeline leading to a coastal shipping port.

Hadi Hami, a consultant in the UAE, provided an informative overview of world metallics (scrap and ore based: pig iron, HBI, DRI) markets.

HBI/DRI market in 2012 was 70Mt/y and the world’s production capacity was 90Mt/y of installed capacity and 20Mt/y under construction.

7Mt/y of international trade in DRI/HBI took place in 2012. The main exporters were Trinidad & Tobago, Venezuela, Russia, Malaysia, Libya, Qatar, Oman & Iran (recently). The major importers were NAFTA, China, South Korea and Turkey.

Turning to the pig iron market in 2012, Mr Hami said there was 105Mt/y of international trade and 60Mt/y of domestic trade including Chinese merchant pig iron. The main exporters of pig iron were: China, Russia, Brazil and Ukraine.

The major importers were: USA, Italy, Spain, China, Japan and South Korea.

Considering all metallics trades (DRI, HBI, pig iron) the sub total for global trade is about 90Mt/y.

Addressing the scrap market, the forecast scrap supply is expected to increase by 60Mt between 2010 to 2015 and probably by another 100Mt by 2020. Major exporters of metallics are USA, Japan, EU, CIS and the main importers are Turkey, China, Korea, EU.

Some countries depend on scrap imports for more than others. In Turkey, Belarus, Egypt, Malaysia, and Thailand 30-35% of steel production capacity is from imported metallics.

He presented an interesting scorecard of factors promoting competitiveness of each steelmaking route: BF/BOF and DRI/EAF on a global basis concluding that China and India come out on top for the BF/BOF route while MENA, CIS, and NAFTA are favoured for DRI/EAF production (Fig 4).

He believes that steel scrap exploitation globally will lag behind USA largely due to environmental concerns. He also believes that China’s future huge scrap potential will retard DRI production growth there while looming scrap shortage will promote DRI growth in CIS.

Metalloinvest outlined their iron ore, DRI/HBI and steel assets in Russia. Ore is mined at Lebedinsky GOK and Mikhailovskiy GOK (Table 3).

Their steelmaking arm consists of Oskol Electro-Metallurgical Co, (OEMK) integrated steel works, based on DR technology and has a DRI capacity 2.8Mt/y and a steelmaking capacity 3.3Mt/y. It produces Special Bar Quality (SBQ) long products. Their other works is Ural Steel, an Integrated works using BF/BOF technology which has an ironmaking capacity of 2.1Mt/y, and a crude steel capacity of 2.3Mt/y. It produces flat and long products.

### Table 3 Ore and HBI production by Metalloinvest in Russia

<table>
<thead>
<tr>
<th>Main products</th>
<th>Million tonnes 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ore</td>
<td>101.0</td>
</tr>
<tr>
<td>Concentrate</td>
<td>38.2</td>
</tr>
<tr>
<td>Pellets</td>
<td>19.0</td>
</tr>
<tr>
<td>HBI</td>
<td>2.5</td>
</tr>
</tbody>
</table>

### Shipping

Phoenix Bulk Carriers, provided details on the dangers, costs and precautions needed when shipping DRI, as opposed to HBI, and noted the reluctance of shippers to transport DRI and even HBI due to fears of spontaneous combustion should the cargo become wet.

Clarksons Dubai, provided a comprehensive overview of the global shipping market by vessel type noting that freight rates are under pressure due to over ordering of new shipping

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**Iron ore**

![Fig 3](source: Company Reports, Wood Mackenzie)

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**Fig 4 Key factors impacting cost competitiveness in crude steel production, BF & EAF routes, major regions, 2012**

Source: Hatch

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2 – September 2013 – Steel Times International
Iron ore

capacity prior to the financial crash, but over-
building has now peaked and is headed down-
ward.

DR pellet procurement
In the session on DR pellet procurement, Emi-
irates Steel, UAE described how they blend
pellets of different strengths to achieve good
overall pellet properties. GILC, Bahrain is cur-
cently sourcing DRI pellet feedstock globally
while awaiting the start-up of Minas Rio as its
main future pellet feed source.

RMI Global Consulting, USA, outlined DR
pellet quality requirements and value-in-use in
DRI/EAF applications; noting that MENA
operations typically use 3-4 pellet brands at one
time; also the MENA market is attractive for
pellet producers due to both its reliance upon
100% pellet charge and its high growth rate.

Gohar Zamin Iron Ore Co, located in south-
ern Iran, is currently producing 4Mt/y of con-
centrates and is aiming for 10Mt/y of concen-
trate by 2015 and 10Mt/y of DR pellets by 2018.
It is using flotation and HPGR to reduce ore
sulphur levels; otherwise their quality is very
good: 67.1%Fe, SiO2 + Al2O3 of 2.3%.

Pelletizing technology
Outotec, with works in Finland and Germany,
is a global leader in pellet plant installations.
Their straight grate technology dominates glo-
ally especially for haematite ore applications
(Fig 5).

Siemens VAI, Austria & Germany has intro-
duced a circular pellet plant for small scale
(about 1.0Mt/y) applications; the first plant is
being built in India.

Miguel Sabanero of Danieli, Italy provided
an excellent technical presentation emphasising
the importance of maintaining permeability
during pelletizing and provided much detail on
key technologies: carbon addition, double-deck
roller screens, deep beds, and the hearth layer
bin.

Metso Minerals Industries of USA, is now
able to offer both straight grate and grate kiln
technology. They compared the two methods
and provided some details of new projects.

Global game changers
A representative of India’s Ministry of Steel
provided an overview of the Indian steel indus-
try including forecasts outlining how the gov-
ernment mining and export restrictions are
affecting the domestic market while also listing
planned pelletizing increases.

Amit Chatterjee, formerly technical director

Table 4 Indian crude steel production by process (%)

<table>
<thead>
<tr>
<th>Process Route</th>
<th>2005-06</th>
<th>2009-10</th>
<th>2010-11</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOF</td>
<td>86.1</td>
<td>88.9</td>
<td>86.8</td>
</tr>
<tr>
<td>EAF</td>
<td>5.8</td>
<td>6.3</td>
<td>7.9</td>
</tr>
<tr>
<td>Induction Furnace</td>
<td>8.1</td>
<td>4.8</td>
<td>6.3</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 5 Midrex plant OPEX (US$/t)

<table>
<thead>
<tr>
<th>Cost</th>
<th>Consumption</th>
<th>Unit Cost</th>
<th>US$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screened Pellet</td>
<td>1.4-1.42 t</td>
<td>1.70</td>
<td>241</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>2.3 (m3/mg)</td>
<td>0.18</td>
<td>10.00</td>
</tr>
<tr>
<td>Electricity for production</td>
<td>110 (kWh)</td>
<td>0.03</td>
<td>3.80</td>
</tr>
<tr>
<td>Oxygen</td>
<td>15 (Nm³)</td>
<td>0.1</td>
<td>1.50</td>
</tr>
<tr>
<td>Make-up water</td>
<td>1.3 (m³)</td>
<td>0.5</td>
<td>6.80</td>
</tr>
<tr>
<td>Labour &amp; Mgmt</td>
<td>0.12 man-hrs</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td>Manpower</td>
<td>0.12 man-hrs</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>262.3</td>
</tr>
</tbody>
</table>

*Gas prices based on MENA region

Tata Steel and now Chief Editor Steel Tech,
India, summarised the status of global steel
production and opportunities for growth in
steel production in India. He emphasized the
strengths of India: iron ore and coal (but small
coking) reserves. He expects DRI production
based on local iron ore and coal or gasified coal
to increase in India. DRI production decreased
from a peak of 27 to 20Mt from 2011 to 2012
due to ore shortages and the economic slow-
down, but India remains the world’s largest
producer of DRI. In 2010-11, 17.06Mt of DRI
production was from coal based kilns and 16.9Mt
from gas based shaft furnaces.

Dr Chatterjee summarised the changing steel
process routes in India as increasing use of electric
steelmaking (by arc and induction furnaces) and
decreasing use of the BF-BOF route (Table 4).

India is unusual in relying heavily on small
induction furnaces used to melt coal based DRI
and scrap, the only refining possible being by
blending the charge mix.

A presentation by Cliffs Natural Resources
(USA) outlined the dramatic recent and future
projected growth of shale gas in the USA indi-
cating how low natural gas prices increase both
the competitiveness of steel producers (EAF
and BF/BOF) as well as sparking a comeback in
USA manufacturing that increases steel compa-
y customer base. Cliffs is trying to produce DR
grease pellets to capitalise on growth of gas
based DRI production in USA.

Iran’s activity was summarised in an informa-
tive joint presentation by Gol-e-Gohar Mining
and Mobarakhe Steel. The Golgohar Mining
and Industrial Company produces 9Mt/y of
concentrate while the Pelletizing Plant pro-
duces 5Mt/y of DR and BF pellets. They are
located in southern Iran around 340km from
the Persian Gulf. By 2030 they expect to pro-
duce 22 and 20Mt/y of concentrate and pellets,
respectively.

Seneca HyL and Danioli outlined the merger of
Danioli’s DRI technology with long standing
HyL technology to form the current EnergIron
suite of techniques that include HyTemp
(pneumatic conveying of hot DRI to EAF),
reformer-less shaft reduction using a self-
reforming technique to ‘crack’ the nature gas
within the shaft furnace and a range of module
sizes (MegaMod and micro module) with and
without reformers. The first micro module is
operating at Gulf Sponge Iron in UAE produc-
ing 200kt/y. EnergIron has captured a number
of new contracts including some high profile
tones: Nucor Louisiana, Emirates Steel UAE,
Suez and Eazi Steel in Egypt and Jindal Steel &
Power Ltd at Angul in NE India, where a set of
four modules is to be fed by coke-oven gas and
gasified coal. Here, JSPL are also building
Midrex modules to use synagas and a Lurgi coal
gassifier which could supply synagas to both
projects. They cited the benefits of hot charging
to DRI of the EAF as a 20% reduction in elec-
trical energy consumption and a 21% decrease
in tap to tap time.

The presentation by Midrex outlined current
Midrex projects including new plants in Pak-
stan, Egypt, Russia, Bahrain, India – the
latter a plant for Jindal Steel & Power at Angul,
Odisha state, fed with gasified coal – and a
plant for Jindal South West (JSW) fed with
Corex off-gas, and, most recently, a plant in
Texas, USA to produce BF grade HBI to ship to
voestalpine in Austria. They emphasised higher
utilisation of the Midrex process as compared
to the competing technology (HyL Energron)
in the MENA region. Typical Midrex Plant
OPEX are given in Table 5.

The Midrex process dominates shaft furnace
production of DRI producing 44.76Mt in 2012 or
79% of the 56.4Mt produced in shaft furnaces.
A further 17.06Mt was produced in rotary kilns
using coal and 530kt in fluidised bed processes.

Emirates Steel introduced its new steel plant
in 2009 with a 1.6Mt HyL Energron HyTemp
plant converting hot DRI to Danioli EAF and a
second module and EAF was added in 2011.
Total DRI production is summarised

Fig 5 Global Pelletising capacity ever built (Mt/y) (China not fully shown) Source: Outotec

Fig 6 Potential African iron ore projects (Mt/y)

Table 5 Midrex plant OPEX (US$/t)
Iron ore

for the first and second phases of the project as indicated in Table 6.

The Schmidt + Clemens Group of Spain provided details on their new alloy generation projects in eight African countries totalling 343Mt/y of new capacity. Some new iron ore projects feature different types of ore. He listed all the potential projects with very few attendees from Asia, the current centre of gravity of the iron ore world. Delegates are still led by iron ore producers (37%) but with traders (21%) now the second largest group while steel producers (15%) are less prominent. Some of the leading European steel producers did not register for the conference but were participating in meetings at the hotel but outside the Symposium meeting area.

Table 6 Emirates steel DRI Production Phases 1 & 2 (Mt/y)

<table>
<thead>
<tr>
<th>Year</th>
<th>Phase 1</th>
<th>Phase 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>1.44</td>
<td>1.20</td>
</tr>
<tr>
<td>2011</td>
<td>1.26</td>
<td>0.89</td>
</tr>
<tr>
<td>2010</td>
<td>1.59</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>0.14</td>
<td></td>
</tr>
</tbody>
</table>

the current event included only three iron ore producers while the consumption side included only a speaker from the German Steel Federation VDEh. Nevertheless, the programme did feature some excellent presentations from analysts and shippers. The former global attendance spread is now European focused with very few attendees from Asia, the current centre of gravity of the iron ore world.

The role of India in the global iron ore trade is a major wildcard. GlobalORE will now offer brands by name. Northern Iron Marketing disclosed that their shareholders dismiss hedging and want full exposure to maximise gains in the iron ore market. Credit Suisse noted that steel producers are not natural hedgers. Christopher Ellis reported that Metal Bulletin started their iron ore fines index in 2008 based on 62% Fe fines; in 2011 they added other products: fines at different Fe levels, concentrates and pellets. He presented an interesting plot showing the evolution of spot iron ore trading; initially dominated by India; now dominated by Australia with Brazil playing a role (Fig 7).

Value in use of iron ore

David Tacker of Hatch provided a method of calculating the impacts of changes in sinter chemistry and/or use of concentrates on the impact on sinter plant, blast furnace and steelmaking costs showing how plant constraints and assumptions affect value in use calculations.

Supply/demand balance

Yuri Mishulin of Metalinvest gave a comprehensive presentation starting with the global iron ore market. He illustrated the high costs of electricity and natural gas in EU versus the rest of the world and complained about the still high iron ore prices while also pointing out global restrictive trade practices (export restrictions on raw materials, import restrictions on steel products) outside of the developed world. In conclusion he extolled the virtues of EU-led technical progress in steel technology and utilisation.

Pricing

The panel moderator for the session on pricing, Benedikt Sobotka of Bryanston Resources, predicted iron ore oversupply starting in 2014 will drive pricing down to $100/t. China will continue to increase traded iron ore consumption as high cost domestic production declines but eventually an increasing scrap reservoir in China will decrease iron ore demand. Global iron ore pricing is moving to shorter indexing periods while quality differentials are decreasing. Some new iron ore projects feature different types of ore. He listed all the potential projects in eight African countries totalling 343Mt/y of new capacity (Fig 6), but acknowledged that delays and cancellations are likely.

The Schmidt + Clemens Group of Spain provided details on their new alloy generation projects in eight African countries totalling 343Mt/y of new capacity. Some new iron ore projects feature different types of ore. He listed all the potential projects with very few attendees from Asia, the current centre of gravity of the iron ore world. Delegates are still led by iron ore producers (37%) but with traders (21%) now the second largest group while steel producers (15%) are less prominent. Some of the leading European steel producers did not register for the conference but were participating in meetings at the hotel but outside the Symposium meeting area.

Keynote presentations

Vale’s Market Outlook was presented by Fidel Blanco who gave an upbeat view of the world steel and iron ore markets, counting on not only continued urbanisation drives in developing countries including China but also evidence of economic recovery in the developed world. He touted key Vale projects: a 40Mt/y expansion of Carajás costing $3.5bn coming on at year end and replacement capacity at Conceição (25.6Mt) of capacity. He illustrated the high costs of electricity and natural gas in EU versus the rest of the world.

Future of European steelmaking

Challenges and Opportunities arising was the topic addressed by Jürgen Kerkhoff of the German Steel Federation VDEh. He reviewed current EuroZone economic problems including increasing disparity between countries with strong steel industries such as Germany and others such as Greece. He advocated revision of EU emissions and CO2 policies based on more realistic benchmarks.
Iron ore

- Ultimately the Vale Carajas S11D project will crowd out expansions by junior miners (Fig 8).
- Junior miners have been successful in Australia but less so elsewhere.
- Around 390Mt of iron ore (Chinese domestic private sector plus seaborne) currently has a cost above Macquarie’s long run price forecast.
- This can be displaced by more competitive sources, but execution of large, low cost projects will lessen this opportunity over time.

China
A session was devoted to China. Ian Roper, CLSA, (Credit Lyonnais Securities Asia) noted that as supply increases in the second half of the year we may see prices test US$100/t for a period in 3Q13, but by 1Q14 he believes supply will tighten again on the lack of Indian exports, sustaining prices above US$100/t through 2Q14. The CLSA long-term view remains unchanged predicting prices falling as low as US$75/t by 2015 when the market sees severe oversupply (Fig 9). Chinese steel demand will remain at around 600Mt/y, but the expansion of supply from State owned mines means China can sustain 200Mt/y of domestic ore output at US$75/t.

Hadi Hami, UAE provided an overview on the scrap and metallics markets similar to his presentation at the DRI-Pellet Symposium but he went on to summarise the main challenges facing the global steel industry including over-capacity and slower than expected economic growth in the developing world and economic stagnation in the developed world. The MENA region faces near term political and stability problems but long term growth prospect look good.

Shipping
In a session on the shipping market a presentation by Simpson Spence & Young, noted that spot capesize rates continue to trend downward from peaks at the height of the boom, and are now at below $20/t, Brazil to China and below $10/t, Brazil to Rotterdam. Given changes in the fleet size, in 2014 they expect to see the rate of growth in sea borne dry bulk trade outpacing increases in carrying capacity, reversing the trend of the past five years. This will add to potential freight rate volatility and increase freight’s share of delivered iron ore prices, all of this is dependent on (1) historically high scraping of ships, (2) slower deliveries to conserve fuel and (3) sustained trade growth. However, the premature ordering of new eco-type vessels has the potential to blunt a recover in the freight market, given the massive overhang of surplus ship building capacity.

The presentation from Swiss Marine showed how earnings of shippers have decreased with increase in fleet size (Fig 10). They plotted increases in the volumes of coal and iron ore movements over the next four years and projected growth to be 8% per year. They also provided insight into methods shippers use to save money such as sailing at slower speeds but these efforts are countered by increased ballasting as fewer backhaul cargoes are available. They expect supply/demand to swing to tightness over the next 1-2 years so freight costs will rise.

Contact
Copies of the presentations are available for £300 for each conference (UK applications should add VAT).
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