DIRECT FROM MIDREX

4TH QUARTER 2007

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Commentary

The Importance of Training and Commissioning

Max Love
Director of Projects

Midrex Technologies, Inc. and our project partners supply equipment, engineering and services for direct reduction facilities. Commissioning and start-up services have been a crucial part of the success of the MIDREX® Process over the years, because of the need to start up plants quickly and reach full capacity as soon as possible. The most important factor in plant profitability over time is reliable, consistent performance and the training and commissioning work we do is a crucial part of achieving that operating success. This can be a challenging task, given that MIDREX® Plants are located on five continents and we face geographical, logistical and climate challenges. In 2006, MIDREX Plants achieved average capacity utilization of 131 percent, a figure that we are most proud of.

Midrex's pre-operational work involves several activities. There is a two-part training program for the client's operators, including classroom studies and hands-on operations at another MIDREX Plant. This enables the operators to actually start up their own plant, with assistance from Midrex personnel. As each system and piece of equipment is installed, it is checked out. When the plant is mechanically complete, cold commissioning begins, which involves equipment and instrumentation checks as well as system operation tests with and without load. The final step is hot operations. The MIDREX Reformer burners are lit and gas is passed through the furnace to dry out the refractory. When all is ready, production of DRI begins and once the plant reaches capacity, a performance test is run.

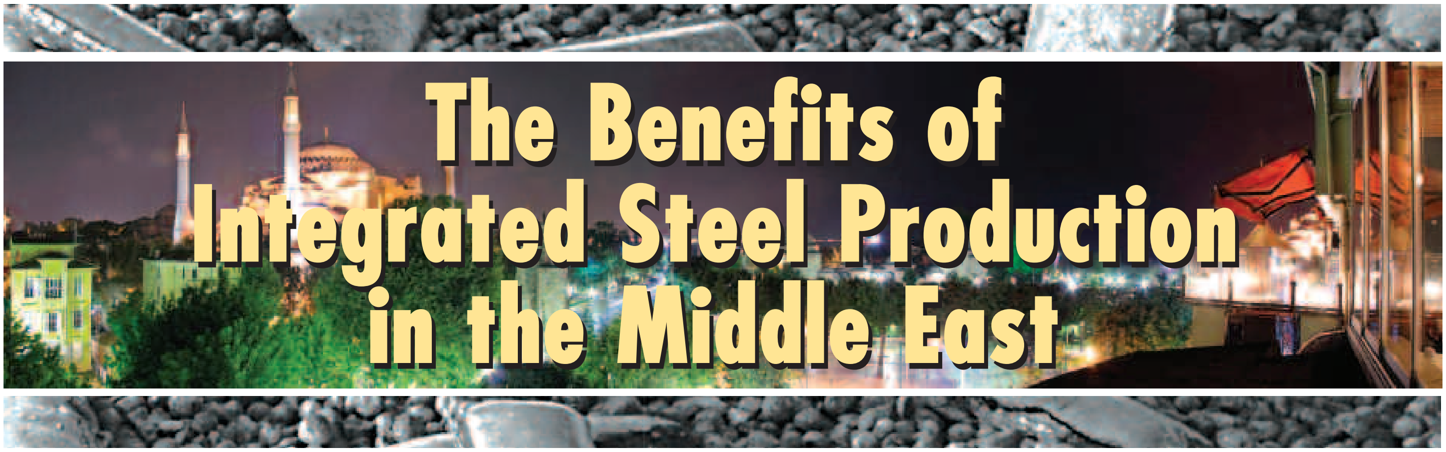
From 2004-2007, Midrex and its partners signed contracts for over 15 million tons per year of rated capacity. These plants include a number of new technologies and equipment, including larger shaft furnaces up to seven meters in diameter, three types of hot discharge/transport systems, centrifugal compressors, larger briquette machines an elevated MIDREX® Reformer and the SIMPAX® Control System. In 2007, six of these facilities started up: Nu-Iron, Acindar Expansion, Al-Tuwarqi Dammam I, Qatar Steel Module II, Hadeed Module E and Lebedinsky GOK II. Nu-Iron, Qatar Steel Module II, Acindar and LGOK II have passed their performance tests. The HADEED Module E performance tests are scheduled for the first quarter of 2008. The Al-Tuwairqi Module did not have a performance test. All plants are operating well and setting new production records. Qatar Steel Module II was the first plant to demonstrate combination hot and cold discharge operation. The plant produced 50 percent HBI and 50 percent DRI at more than 187 tons per hour with an average metallization of 95 percent. HADEED Module E produced over 224 t/h with 96 percent metallization and 3 percent carbon. LGOK II is the largest HBI plant in the world, producing over 194 t/h at 95 percent metallization and 1.5 percent carbon. I want to thank all the personnel from Midrex and our partners for their dedicated efforts to achieve these results. This involves considerable sacrifice, long hours and extended time away from home.

Our commissioning work is not done yet. In addition to the remaining performance tests for the modules that started up in 2007, the Lion and Shadeed Plants will begin operations in 2008. We are confident that our training and commissioning teams will continue doing a great job to achieve quick and successful start-ups and achieve the outstanding performance that has come to be expected of MIDREX Plants.

MISSION STATEMENT

Midrex Technologies, Inc. will be a leader in design and integration of solids and gas processes. We will meet or exceed performance expectations, execute projects on time, enhance existing product lines, and provide value-added design, procurement, logistics and field services to our clients. We will develop new business opportunities that will challenge our employees and maintain the economic vitality of our company. Our employees are the key to our success, and we are committed to encouraging them to grow professionally and personally.

The Benefits of Integrated Steel Production in the Middle East



By Siddhartha Sengupta
Managing Consultant
Hatch Beddows

Editors' note: this article was adapted from a presentation to ***SBB Steel Markets Middle East Conference,*** *September 2007*

INTRODUCTION

The objective of this paper is to look at the production models that steel producers in the Middle East* can adopt. Many steelmakers in the region buy semi-finished steel from the merchant market and roll and finish it. Alternatively, there are steel producers that have set up integrated production facilities, including natural gas-based DRI production, meltshop and finishing facilities. What are the benefits and drawbacks of re-rolling and integrated production?

THE MACROECONOMY OF THE MIDDLE EAST

Although it is not nearly as recognized as the BRIC (Brazil, Russia, India, China) countries, the size of the aggregate Middle East economy is comparable to the individual "BRICs" and is growing faster than global average rates. Figure 1 shows the share of world nominal GDP by the Middle East, BRIC countries and the USA.

The region's economy will continue to be driven by strong oil prices, improved fiscal position and deepening capital markets. There is also the pressure of a fast growing population for which infrastructure like roads, bridges, water and sewage, healthcare and education facilities must be built. The economy in the Middle East is forecast to grow at an average annual rate of 5 to 5.5 percent to 2012.

From the historical experience of developed countries like USA, Japan and EU-15, steel consumption per capita follows a fairly predictable "S" curve as an economy develops. Before industrialization, steel consumption, both per capita and in absolute volumes, is very low. When the country starts industrializing, the initial stages of development are very steel intensive due to the need for long steel products for infrastructure such as bridges, roads, airports, ports, railways and utilities. As the country becomes developed and infrastructure

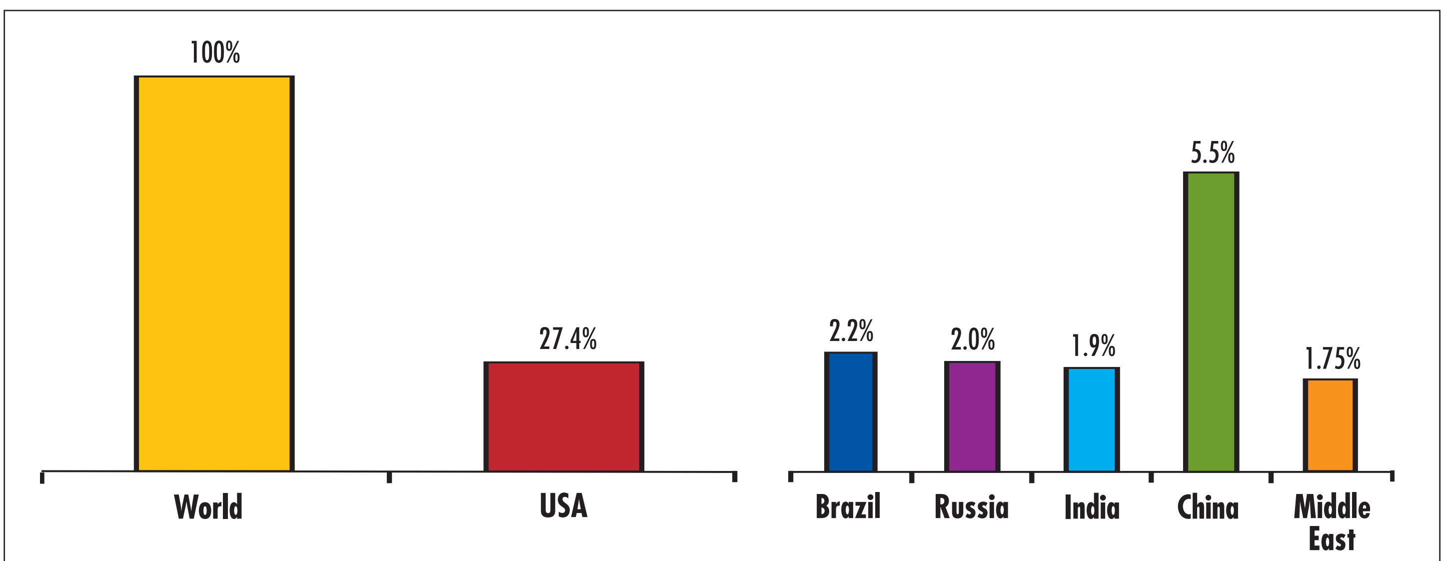


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Figure 1 - Comparison of World Share Nominal GDP ($) by Countries - 2006

Source: IMF Database 2007
Hatch Beddows Analysis

* *Countries include Saudi Arabia, UAE, Bahrain, Qatar, Oman, Kuwait, Yemen, Syria, Jordan and Lebanon*

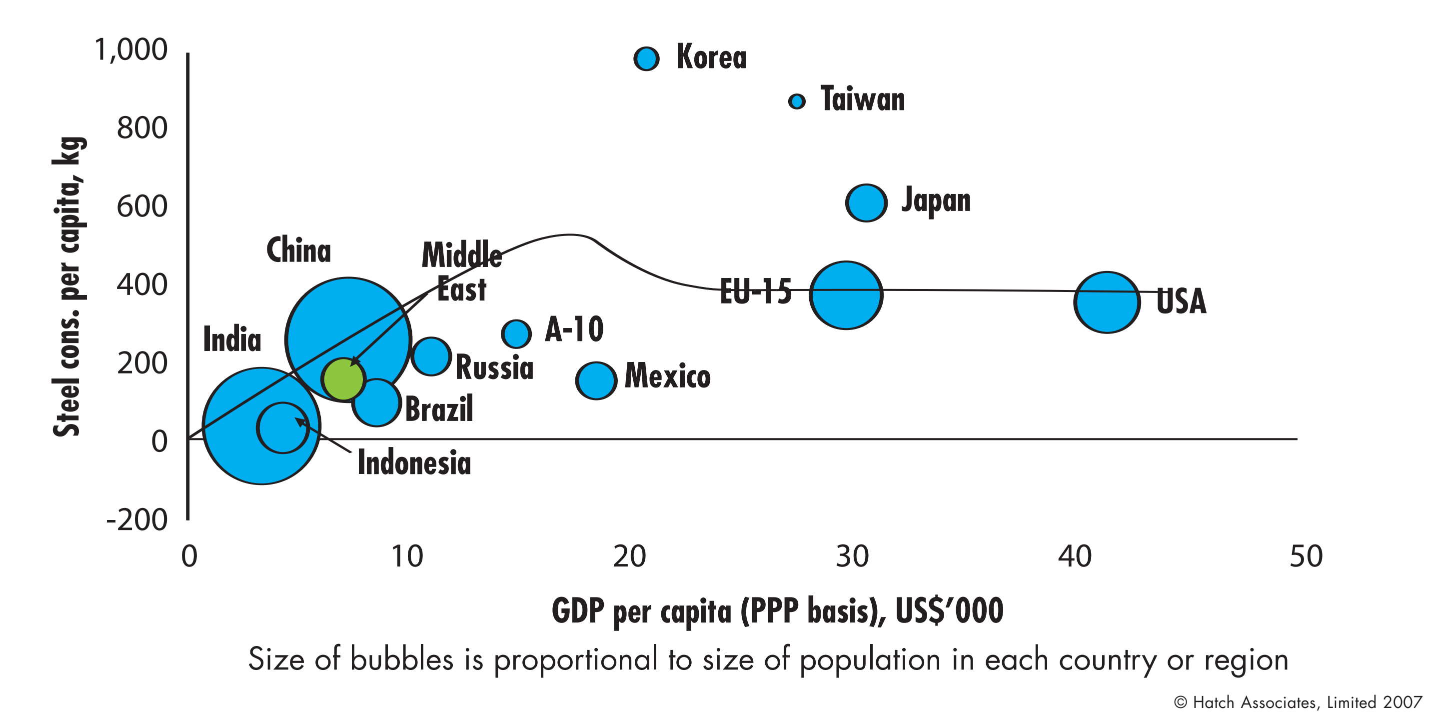


Figure 2 - Steel Consumption and GDP per Capita

Source: Beddows, IISI, IMF, UN. 2005 Data

is in place, the steel consumption intensity falls off. Also, the product mix changes, as less long steel products are needed per capita and flat products grow for needs such as automobiles, furniture and appliances. The Middle East is early in the development process, as shown in Figure 2, which plots steel intensity versus GDP per capita. The Middle East is likely to see substantial rises in steel demand, both per capita and in absolute terms, as it continues its rapid growth.

The steel industry in the Middle East has a much larger capacity of steel rolling and finishing than of primary steelmaking. This structural imbalance has resulted in growing imports of semis. These trends are shown in Figures 3 and 4.

The finished steel consumption in the region was about 26 million tons in 2006. With a forecast growth rate of seven percent per annum, steel consumption is expected to grow to 40 million tons by 2012. If no new primary capacity were to be built, and only

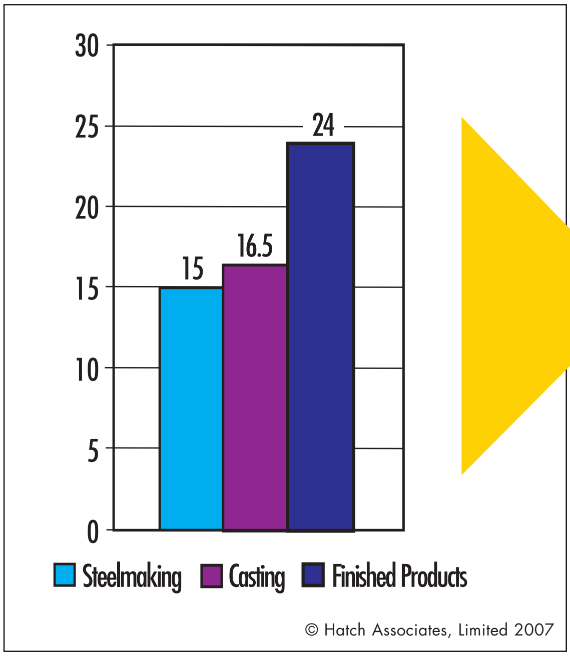


Figure 3 - Middle East 2005 Steel Capacities (Mt)

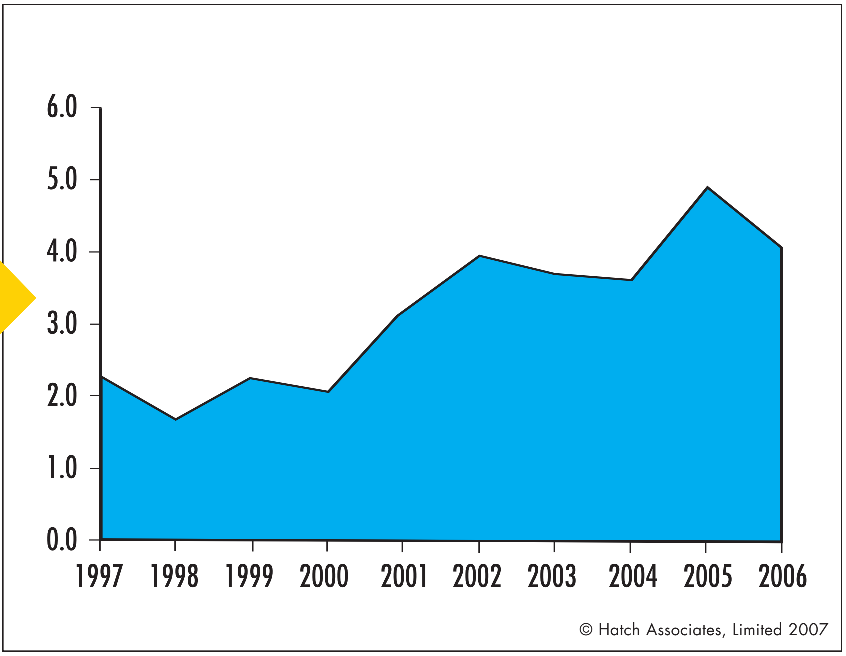


Figure 4 - Middle East Semi-Finished Steel Imports (Mt)

Source: ISSB, James King, World Plantfacts, Hatch Beddows Analysis

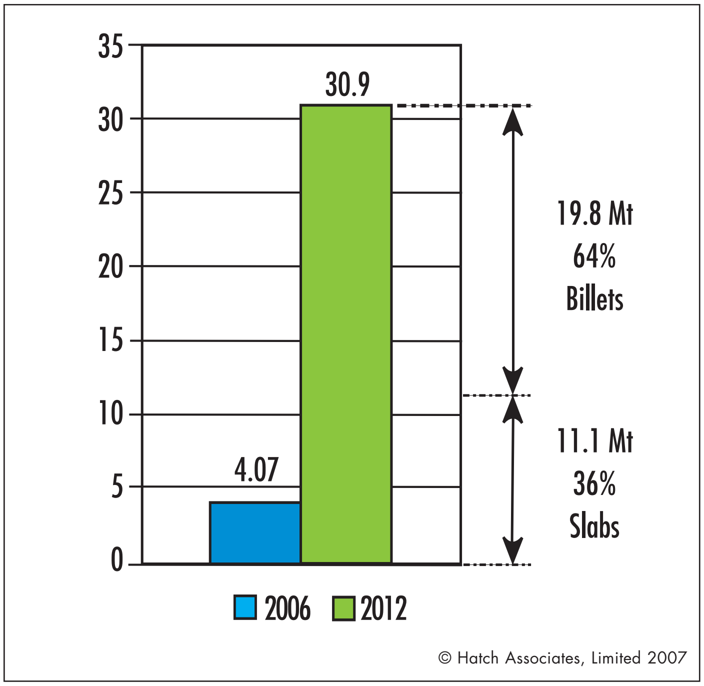


Figure 5 - Middle East Semi-Finished Steel Imports (Mt)

re-rolled imports were used to meet the forecast consumption, semis imports would increase seven-fold in 2012, as shown in Figure 5. The chart also shows the split between long and flat product imports.

AVAILABILITY OF SEMIS

Figures 6 and 7 show the volume of semis exports by region. In the future, availability of semis could become tight as countries' domestic steel demand grows, strategic supply agreements with steelmakers in other countries are signed and governments restrict steel exports. Table I on the following page shows Hatch Beddows' analysis of current and future semis export capabilities.

Therefore, if the steel industry in the Middle East depends on import of semis for rolling, it becomes very vulnerable to tight supplies. The forecast semis imports in 2012 accounts for 70 percent of global merchant billet supply and 31 percent of global merchant slab supply.

It may be difficult for the present semis suppliers to the Middle East and potential new ones to satisfy a growing requirement. Two of the biggest suppliers, Turkey and the CIS, have strong, growing domestic consumption and supplies of semis are likely to get tighter in the medium term. Producers in this region are likely to build more finishing facilities to tap the growing domestic markets. New greenfield projects in the CIS are being conceptualized and planned, but these are likely to be replacement capacities. Another factor is the type of semis produced. Most of the greenfield projects under consideration in the CIS and Brazil will produce slabs, not billets, which makes the supply issue even more difficult.

THE DYNAMICS OF THE SEMI-FINISHED STEEL BUSINESS

There are very few producers in the world that have built facilities specifically to target the semis market. Trade in semis usually occurs because of structural mismatches between steelmaking, casting and finishing capacities. For example, CIS producers tend to be long on steelmaking capacities but short on finishing facilities; hence, they have become large exporters of billets and slabs. Turkey is also long on steel making and billet casting capacities but short on finished long products capacities. Semis trade tends to be inherently more dynamic than the production of iron ore and coking coal. Producers of tradable semis tend to build or acquire finishing facilities in the long term.

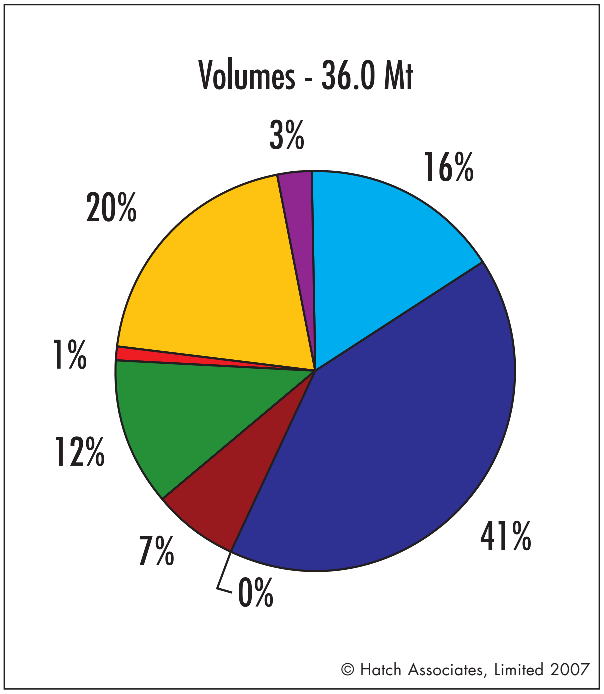
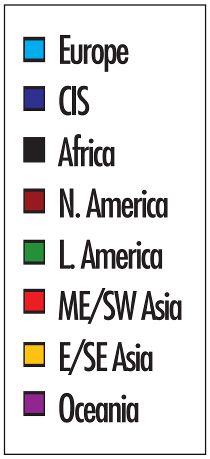


Figure 6 - Global Exports of Slabs by Origin - 2006



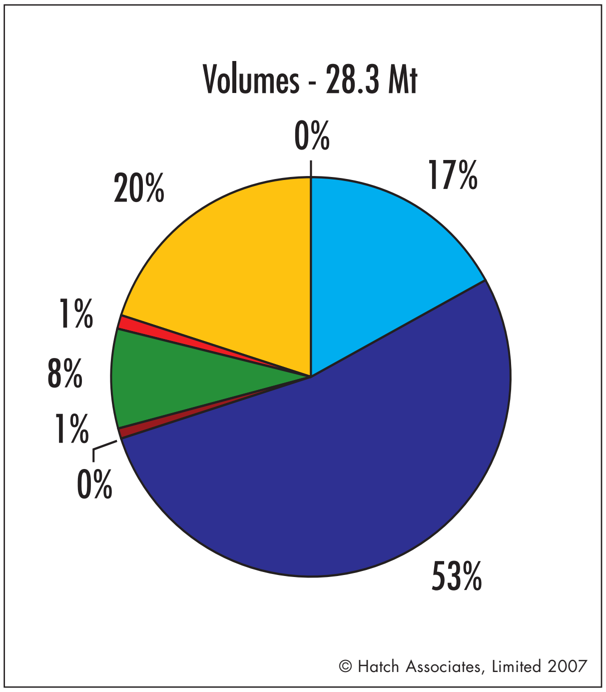


Figure 7 - Global Exports of Billets by Origin - 2006

Country	Semis Availability (Mt)		Additional Merchant Capacities (Mt)		Remarks
	Billets	Slabs	Billets	Slabs	
Russia	4.5	10.5	0	– 4.0	Strategic supply agreements for slabs signed
Ukraine	6.0	6.5	0	0	Strategic supply agreements for slabs signed
Turkey	2.2	0	– 2.2	0	Strong domestic rebar markets, additional capacities for domestic markets
Other CIS	0.6	0.3	0	0	
China	4.0	4.0	2.0	2.0	Government is discouraging semis exports

Table I - Semis Export Capabilities

With regard to the slab market, slabs are usually produced to specific customer requirements; therefore, volumes must be large to justify the economics of tailor-made requirements. The contractual conditions in slab purchase agreements are tougher and limit the choice of chemistries and sizes available to a buyer. Thus buyers usually end up maintaining strategic reserves of semis, which increases holding costs and erodes margins.

THE ECONOMICS OF RE-ROLLING VERSUS INTEGRATED PRODUCTION

For a Middle East steel producer facing the risks and economic drawbacks of importing semis and rolling them, an option is to backward integrate into production of DRI and EAF steelmaking. This is a classic "buy versus build" decision cross roads. The increased capital cost and complexity of the integrated option

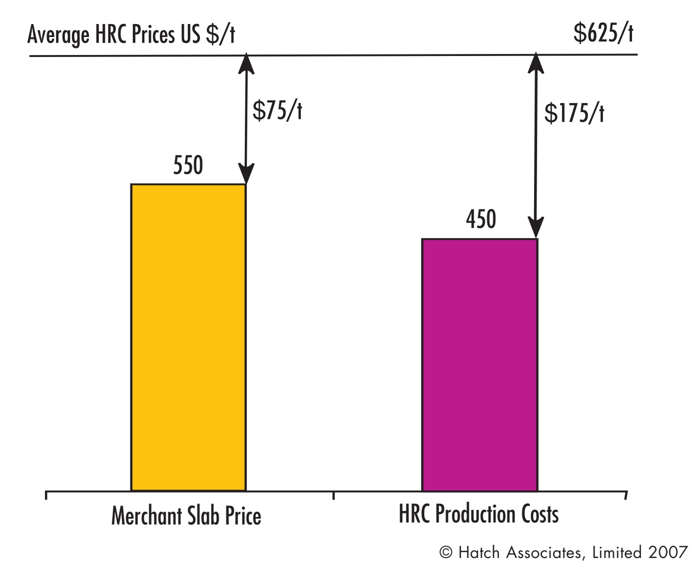


Figure 8 - HRC Gross Margins: Re-Rolling of Imported Slabs vs. DR/EAF Production

must be weighed against the benefits from greater control of feedstock supply. The tremendous benefit of natural gas-based direct reduction and EAF steelmaking in the Middle East is the availability and low price of natural gas in many countries. This results in a very low conversion cost from iron ore to DRI and then to finished steel versus buying merchant semis and rolling them to finished steel. Figure 8 shows typical gross margins for the two routes. Hatch Beddows' calculations show that the DR/EAF integrated steel making approach has a $100/t gross margin advantage that can result in an attractive payback on the increased investment.

Production of DRI and the electricity required for the entire complex from natural gas is a way to diversify the regions' economies and "monetize" the gas. Given the outstanding performance of many of the Middle Eastern economies due to high oil prices, financing is available to build a DR/EAF/casting/rolling facility. Gas-based, shaft furnace DRI production, EAF steelmaking, casting and rolling are well proven in the region. The technologies continue to improve with higher productivities, lower energy consumption and greater flexibility.

CONCLUSION

There are strategic and economic rationales for adopting an integrated (DR/EAF) steel production route in the Middle East. Because of the region's strong economic growth, the steel industry is at supply risk by importing large and growing quantities of semi-finished steel. By adopting a rolling-only model, a steelmaker is exposed to the risk that the semis producer builds finishing facilities, or otherwise is unable to continue exporting. The economics of an integrated production model show that the profit margin for hot-rolled coil is considerably higher than for re-rolling of semis. While the integrated approach is more capital intensive and complex, these are manageable risks, and the rate of return on the additional investment can be attractive.

MIDREX and SMS Demag Technologies

The Shortest Route from Iron Ore to Hot Strip

Editor's note: Midrex Technologies, Inc., Kobe Steel, Ltd. and SMS Demag AG recently signed a strategic alliance agreement for the supply of ironmaking and steelmaking facilities incorporating the MIDREX® Direct Reduction Process and CSP® for the production of high quality hot strip.

In June 2007, Midrex Technologies, Inc., Kobe Steel, Ltd. and SMS Demag AG signed an alliance agreement for the marketing and implementation of projects based on the MIDREX® Direct Reduction Process and SMS Demag's ARCCESS® EAF and Compact Strip Production (CSP®) Technologies. This will provide for an integrated steelmaking facility from iron ore through hot strip that is not only the shortest production route, but also ensures low costs and high quality. This cooperation agreement matches the expertise of Midrex and Kobe Steel in supplying the world's leading direct reduction technology with the global capabilities of the SMS group. Figure 1 is a conceptual flowsheet for the integrated mini-mill concept.

ARCCESS

ARCCESS EAF technology utilizes SMS Demag's superior design capabilities and its operating expertise. The design features include a logistically optimized plant layout, modularized furnace concept, customized furnace shell and optimized panel design and construction. Advanced process know-how comprises productivity maximization by injection, combustion, and oxygen technologies; and optimized energy utilization via superior electrode control systems and a novel slag foaming practice.

The technology includes a novel process control system known as ARCCESS® X-MELT® FEOS that was developed in cooperation between SMS Demag and the University of the Federal Armed Forces, Hamburg, Germany. FEOS stands for **F**urnace **E**nergy **O**ptimizing **S**ystem and it represents an integrated, closed-loop solution for all materials and energy flows of the electric arc furnace.

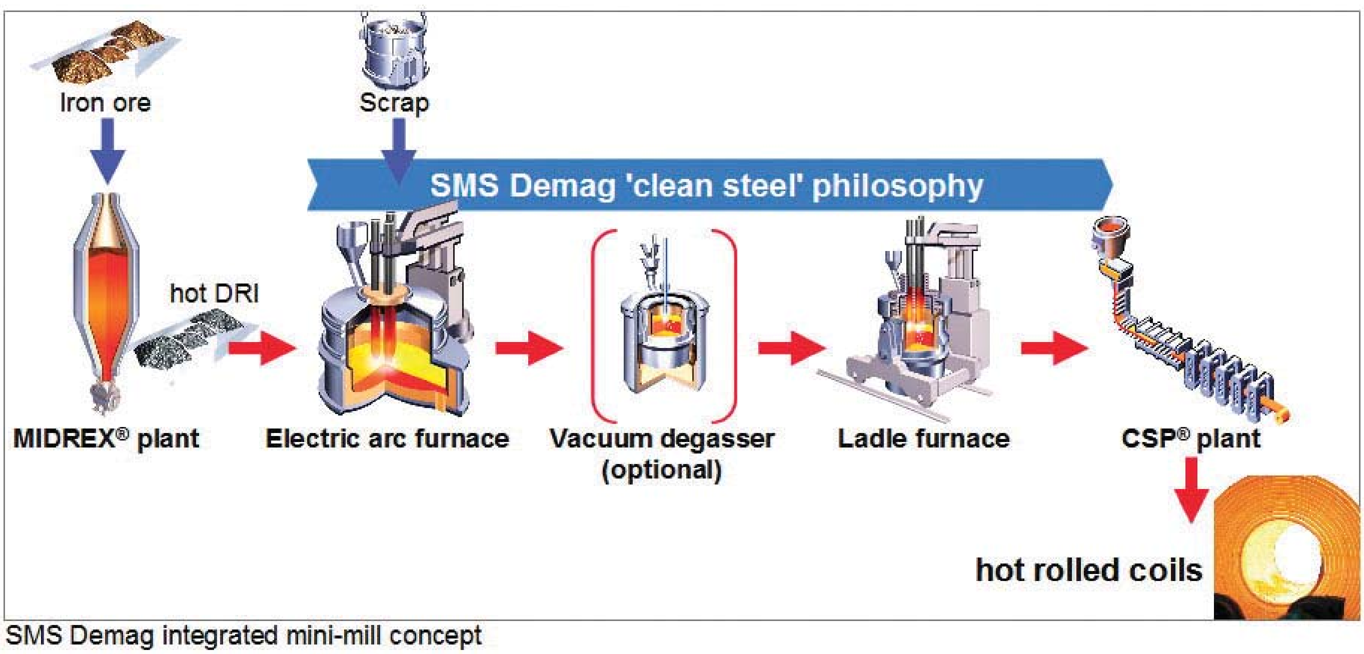


Figure 1 – Integrated Mini-Mill Concept

Plant	Location	Start-up	EAF Capacity (t)
Kaptan Demir Celik	Turkey	2000	100
Nucor Texas	USA	2003	80
Celsa Manufacturing UK	Wales	2004	140
OAO Seversky Tube Works	Russia	2006	135
OAO KEMZ	Russia	2006	120
Pervouralsky Novo Trubny Works	Russia	2006	120
Forpost Management	Russia	2007	120

Table I - ARCCESS® Installations

The system consists of three hardware elements and its implemented software. Using a PLC as exclusive interface, it is easy to integrate in an existing furnace environment. The system contains controls for the transformer tap, the reactor tap and the impedance set-point. Further controls for burners, post-combustion-oxygen injectors, fine-coal injectors and DRI feeding are implemented. Additionally, the industrial PC provides an HMI (human machine interface) for process engineering use, allowing for process analysis, adjustment and optimization. For trial and easy adjustment of the control parameters, an offline version is implemented. The offline version uses previous process data to simulate the behavior of the EAF.

The ARCCESS system minimizes the total cost of ownership (TCO) and provides outstanding value. Direct investment in the EAF is optimized by cost-effective design, accelerated lead time and commissioning and the shortest ramp-up time, including performance guarantees. Operating costs are reduced through maximized yield, minimized tap-to-tap time, the lowest energy consumption, reduced downtime and maximized plant availability. Table I lists ARCCESS installations.

CSP®

Compact Strip Production (CSP) Technology was developed by SMS Demag in the 1980s and commercialized at Nucor Crawfordsville, USA, in 1989. CSP is a continuous process in which liquid steel is directly processed into thin or ultra-thin hot strip, 1.0 mm or thinner, and in semi-endless operation with slab lengths of more than 260 meters.

The key to its success is state-of-the-art technology that keeps the steel within a precisely defined window of temperature. Included in the package are the patented CSP mold with hydraulic oscillation, LCR liquid core reduction, the CVC plus® technology applied during the rolling process, as well as process models for strip flatness and thickness control. Their smooth meshing due to X-Pact® automation provides first-class strip qualities. Figure 2 shows the flowsheet.

The economics of the CSP Process compared to a conventional integrated hot strip mill can be outstanding. Savings of up to 70 percent in energy costs, 25 percent in production costs and 50 percent in investments are possible.

Today, there are 28 facilities worldwide, including North America, Europe, Africa and Asia, with a total capacity of approximately 50 Mtpy. Locations are shown in Figure 3 on the following page. The CSP technology today accounts for about 10 percent of total world production of hot-rolled flat products. The actual production figures of most facilities exceed their design capacities.

Since the introduction of CSP technology, SMS Demag and its clients have steadily reduced the minimum final strip thicknesses attainable during hot rolling. Today, stable rolling of strips down to 1.0 mm is routine - as demonstrated by the 28 CSP ref-

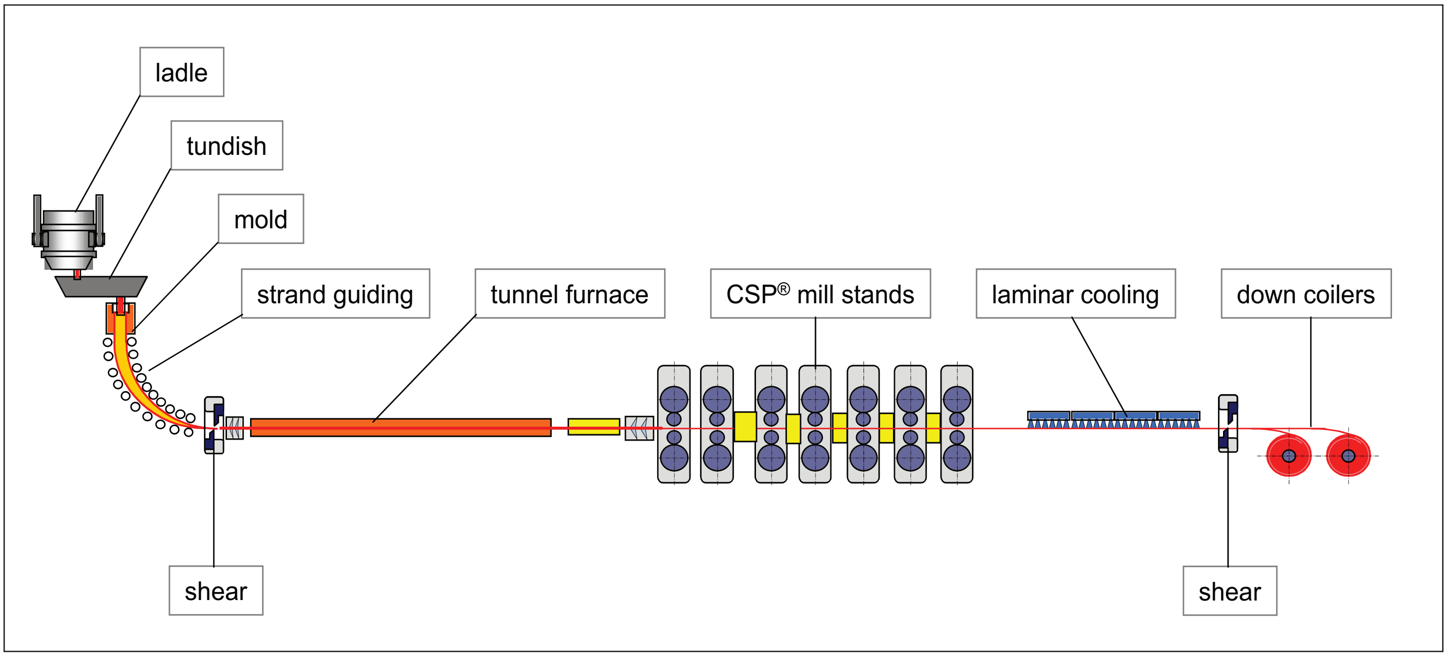


Figure 2 - CSP® Flowsheet

erences. The latest milestone reached was the production of 0.78 mm-thin hot strip in semi-endless operation at Lianyuan Iron & Steel Group Co., Ltd. (Lysteel), PR China.

As a rule, CSP plants consist of:

- Ladle turret or turrets
- Tundish treatment facilities
- Oscillating CSP mold
- Strand guide
- Withdrawal and straightening units
- Pendulum shear
- CSP soaking furnace (with swivel ferry for two strands)
- Hydraulic shear, descaler and roller side guides
- Multi-stand CSP rolling mill
- Laminar cooling section
- Coiler station
- Other transport and marking devices

The product mix of the first CSP plant at Nucor Crawfordsville during the initial operation period consisted only of simple steel grades such as low and medium carbon. In the course of its continuous development, the advantage of the CSP technology began to be fully realized. The high temperature homogeneity allows reliable production of strips of 1.0 mm and below. The product mix was continuously expanded and now includes micro-alloyed grades and silicon grades, as well as ferritic stainless steel. CSP technology is also used to produce advanced, high-strength steels for the automotive industry, including dual phase and TRIP steels. Figure 4 shows the advancements in production of higher grade steels using CSP that were driven by needs for enhanced mechanical properties and surface requirements

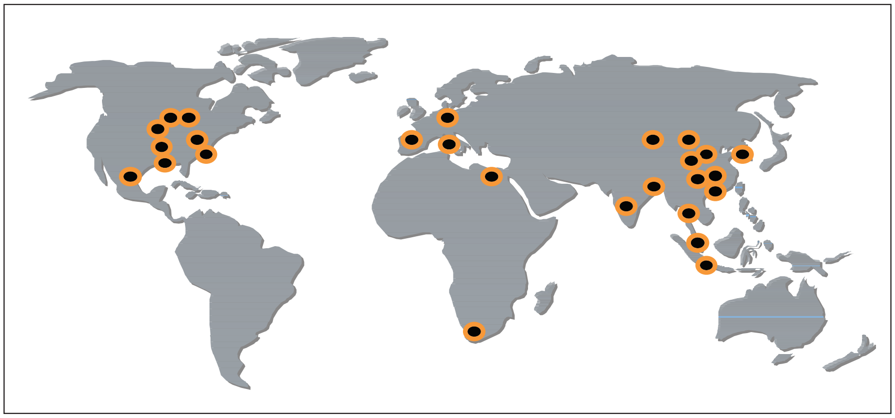


Figure 3 - CSP® Installations

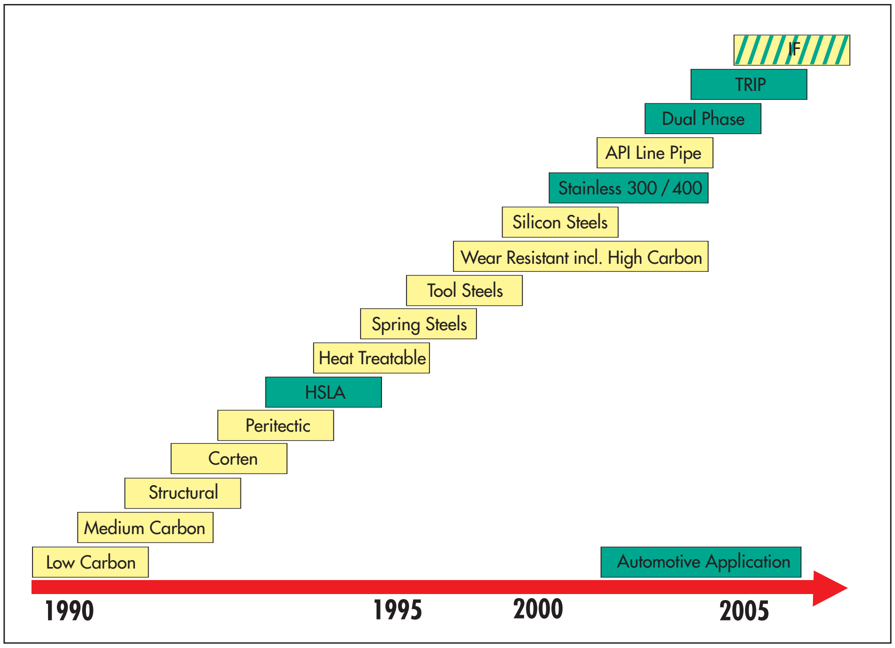


Figure 4 - Evolution of CSP® Products

SMS Demag is now developing even better steels for automotive uses. One important group is HSLA for internal parts of car bodies. A CSP plant in the USA is producing nearly 600,000 tpy for this application. The production of hot-rolled DP- and TRIP-grades with excellent mechanical properties was introduced in recent years in several CSP plants. Also, stainless steel (ferritic grades) are used for automotive parts, like catalytic converters. New CSP plants intend to produce a high share of multiphase steel and material for exposed parts, including IF-grades via the EAF/ladle furnace/vacuum degassing route, using a high percentage of virgin material in the charge mix. The tendency for the future is that more and more automotive grades will be produced by CSP technology.

COMBINING MIDREX AND SMS DEMAG TECHNOLOGIES

The combination of the MIDREX® Process, ARCCESS® and CSP will provide steelmakers reduced energy consumption, lower production costs and efficient production of high quality hot strip. This can be achieved through:

- Efficient production of DRI with low specific energy consumption
- Charging DRI to the EAF at temperatures of 600° C or higher
- ARCCESS EAF with advanced equipment, process control and operating practices
- Process-inherent benefits through direct rolling of hot thin slabs by the CSP process.

Thanks to the high iron and low residual metals contents of DRI produced by the MIDREX Process, even highly demanding steel grades can be produced by this route. The alliance of the market leaders in the fields of direct reduction, EAF steelmaking and thin-slab technology provides technical, commercial and organizational benefits for the world steel industry. The combined experience of Midrex, Kobe Steel and SMS Demag in project implementation, process development, metallurgy and innovation provides an outstanding team.

SHIPPING NEWS:
The Iron Carbide Content of DRI and Its Effect on Reactivity

INTRODUCTION

The desirable carbon content in direct reduced iron (DRI) has been a subject of debate for many years. Recently, there has been resurgence of this discussion revolving around the issue of iron carbide content of DRI and its effect on reactivity for shipping purposes. Midrex conducted a test program to investigate this subject and provide a more thorough explanation. This article is a summation of the test program, as well as a closer look at the carbon issue to provide readers with a more comprehensive understanding of the subject and address the misconception of high carbon products.

(Editor's note: Throughout this article, the term "DRI" is used to describe non-briquetted direct reduced iron only. When referring to hot briquetted iron, the term "HBI" is stated explicitly.)

BACKGROUND

DRI produced in a shaft furnace process using reformed natural gas typically contains 0.5-3.0 percent carbon. Higher carbon content, especially above two percent, can be achieved but there are tradeoffs. Higher carbon content can increase energy released in the EAF during oxidation; however, it also lowers shaft furnace productivity and increases the cost and time required to oxidize the carbon. Another consideration is that carbon can be in the form of iron carbide (Fe_3C) or elemental carbon. Often these factors are overlooked in general comparisons and discussions.

There has been speculation that the reactivity of DRI containing high concentrations of iron carbide is much decreased due to the larger fraction of iron carbide. Some of these claims go so far as to state that DRI with a large fraction of iron carbide can be shipped overseas without any special precautions, similar to hot briquetted iron (HBI). Over the past few months, Midrex conducted a test program to investigate this subject (a description of the reactivity tests is given on the next page).

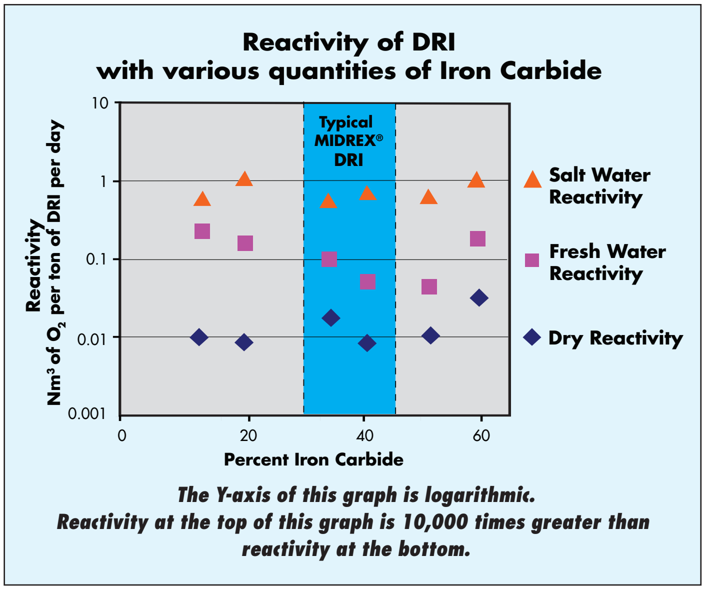


Figure 1 - DRI Reactivity vs. Iron Carbide Content

TEST WORK

There are numerous factors that affect the reactivity of DRI and its measurement, including the type of iron ore used in making the DRI, the temperature at which it is reduced, the gas composition used for reduction and the temperature at which the reactivity test is conducted. A critical aspect of this test program is to hold these factors constant, so that only the effect of iron carbide is measured.

A number of samples of DRI with varying concentrations of iron carbide were prepared from one lot of pellets from a major DR-grade iron ore supplier. For each sample, after reduction, tests were conducted for three scenarios to measure the reactivity when exposed to air: dry reactivity, reactivity when wetted with fresh water, and reactivity when wetted with salt water (with the same chemistry as sea water).

The results are shown in Figure 1 and Table I. Note that the Y-axis is logarithmic.

	% Total Carbon	% Graphitic Carbon (C)	% Carbide Carbon (Fe_3C)	% of C as Fe_3C	% of DRI as Fe_3C	Midrex Reactivity Tests (Nm^3 O_2/ton-day) Fresh Water	Salt Water	Dry Air @ 52° C
Sample A	0.99	0.21	0.78	79.0	11.8	0.22	0.63	0.0104
Sample B	1.34	0.07	1.27	94.8	19.0	0.158	1.12	0.00874
Sample C	2.39	0.13	2.26	94.6	33.8	0.095	0.6	0.0185
Sample D	2.94	0.22	2.72	92.5	40.7	0.05	0.76	0.00904
Sample E	3.60	0.17	3.43	95.3	51.3	0.044	0.66	0.0116
Sample F	4.59	0.62	3.97	86.5	59.4	0.185	1.14	0.03484

Table I - DRI Reactivity vs. Carbon Content

DISCUSSION OF RESULTS

DRI samples with six levels of iron carbide (ranging from around 10 percent iron carbide up to about 60 percent iron carbide) were tested for reactivity. (Please refer to Table I on the previous page). The DRI with 11.8 percent iron carbide is the base case, having undergone reduction only and no carburizing. The other five samples were carburized to varying degrees. The middle two samples (33.8 percent and 40.7 percent iron carbide) are typical of commercial production of MIDREX® Iron where 90 percent to 95 percent of the carbon is contained as iron carbide. For these two samples respectively, 94.6 percent and 92.5 percent of the carbon is contained in the carbide.

The results show that the fresh water reactivity ranges over a factor of five-to-one, but, very importantly, does not correlate to the content of iron carbide. Similarly, sea water reactivity is effectively unchanged by iron carbide content. The dry reactivity also ranges by a factor of about 4:1 but does not show any relationship to iron carbide content.

TEST WORK CONCLUSIONS

Based on these test results, the reactivity of DRI with about 60 percent iron carbide is no lower than typical MIDREX® DRI with 30 percent to 40 percent iron carbide.

This data shows that there is no substantiation to any claims that DRI with a large fraction of iron carbide can be shipped overseas without special precautions.

Midrex Technologies continues to support the position expressed by the Property and Indemnity Clubs (P&I Clubs) and the International Maritime Organization (IMO)*:

"…the only proven method of carrying the low density product DRI (B) (that is, un-briquetted DRI) safely is by maintaining the cargo holds in an inert atmosphere…"

(SKULD circular, August 2006)

Note that HBI has a separate classification in the IMO shipping guidelines because it has been physically modified specifically for the purpose of lowering reactivity (See Figure 2). As a result HBI is able to be shipped without inerting or taking other special precautions that are required of DRI.

The IMO regulates international shipping and the P&I clubs provide insurance for shipments.

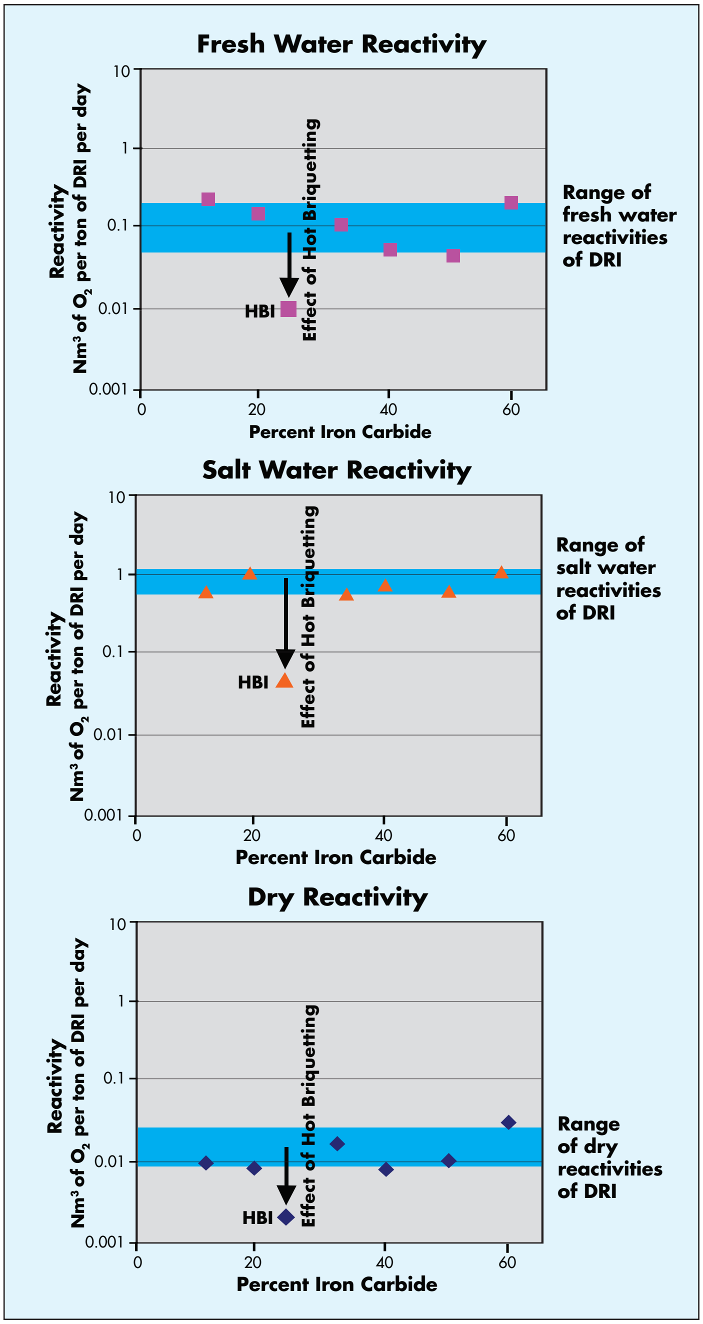


Figure 2- Comparison of HBI Reactivity to the Reactivity of DRI (containing various quantities of Iron Carbide)

Reactivity Tests

Midrex has standard DRI reactivity tests that have been used for the last thirty-plus years. The procedures are as follows:

- ***Dry Reactivity*** - Approximately 1.4 kg of DRI is placed in a metal container. Air is injected into the container; it is sealed and placed in an oven. The temperature is maintained at 52° C and the pressure is monitored over a 24 hour period.
- ***Fresh Water Reactivity*** - Approximately 1.4 kg of DRI is thoroughly wetted with fresh water, and then it is placed in a metal container. Air is injected into the container; it is sealed and left at room temperature (nominally 25° C). The pressure is monitored over a one-to-two hour period.
- ***Salt Water Reactivity*** - Approximately 1.4 kg of DRI is thoroughly wetted with salt water (with a chemical composition similar to sea water), then it is placed in a metal container. Air is injected into the container; it is sealed and left at room temperature (nominally 25° C). The pressure is monitored over a 30 minute period.

In all the reactivity tests, the pressure of the container of DRI decreases, which is a direct result of oxygen being consumed. The rate of pressure change with time, along with the amount of DRI and the void volume, is then used to calculate the reactivity, usually as Nm^3 of oxygen per day per ton of DRI.

Midrex News & Views

World's Largest HBI Plant Begins Operation; Siemens and Midrex Start Up a 1.4-Million Mtpy MIDREX® Direct Reduction Plant at Lebedinsky GOK, Russia

Siemens Metals Technologies and consortium partner Midrex Technologies, Inc. started up the world's largest production facility for hot-briquetted-iron (HBI) at Lebedinsky Mining and Processing Integrated Works (Lebedinsky GOK) near Gubkin, Russia. The new plant has a rating of 1.4 million metric tons of HBI per year. The contract was awarded to Siemens Metals Technologies and Midrex in February 2005.

The new direct-reduction facility, Lebedinsky GOK II, was built near the city of Gubkin, located about 500 kilometers south of Moscow in the Belgorod region. The project was completed within 30 months and the plant started up in late October 2007. Performance guarantees were achieved in December on schedule.

Description of Plant Process and Product

In the DR plant the iron ores, comprised mostly of magnetite, are first concentrated and processed to DR-grade pellets. These pellets are then fed into a MIDREX® Shaft Furnace where they are reduced to metallic iron followed by discharging into hot briquetting machines producing HBI with a metallization degree exceeding 93 percent. The briquettes have an apparent density exceeding 5.0 g/cm3 and are well suited for transport due to the low quantity of fines generated during handling.

Project Details

The consortium was responsible for the supply of the material handling system for the iron oxide (including day bins and screening equipment), the MIDREX Shaft Furnace (including inserts and refractories), the 17-bay MIDREX® Reformer with recuperator, the hot-discharge system (including product discharge chamber and briquetter feed legs), the hot-briquetting system (including briquetting machines and HBI-cooling system), process gas compressors, the power stack system, the product-screening station, electrics, instrumentation, automation and utilities, as well as for advisory services and training. Briquetting machines were supplied by Maschinenfabrik Köppern GmbH & Co. KG.

MIDREX Lebedinsky Works Plant

Lebedinsky GOK is a company of Metalloinvest Holding – the biggest mining group in Russia. The company is a producer of high quality iron-ore concentrates, pellets and HBI for the domestic and international markets. The feed for the new HBI plant consists of 100 percent pellets produced from Lebedinsky GOK iron ore.

Hot Briquetted Iron

Hot briquetting of direct reduced iron (DRI) has been practiced on an industrial scale for over 30 years and is the preferred method of preparing DRI for storage and transport. The characteristics of HBI constitute important advantages as compared with the results of other passivation processes for DRI. For this reason, the advantages of HBI have become part of the International Maritime Organization (IMO) Shipping Regulations.

Additional information on the MIDREX® Direct Reduction Process is available at http://www.siemens-vai.com/direct-reduction and http://www.midrex.com

Further information on solutions for steel works, rolling mills and processing lines is available at http://www.siemens.com/metals

Christopher M. Ravenscroft: Editor

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The publication is distributed worldwide by email to persons interested in the direct reduced iron (DRI) market and its growing impact on the iron and steel industry.

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