

DIRECT FROM MIDREX

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COMMENTARY

DEFINING AND REDEFINING DRI

An Evolving, Enduring Relationship with Steelmakers

By Frank Griscom
DRI Consultant



Some form of direct reduction ironmaking has been around for nearly 3000 years, yet today ask a group of steelmakers, “What is direct reduced iron?” and you will receive a variety of answers. Go a step further and ask, “How does DRI relate to scrap,” and likely each one will also have a different response.

Alternative Iron or Scrap Supplement...

Just don't call it a Substitute!

DRI, in the modern era (1946-present), has been closely identified with scrap. Initially, it was an alternative source of metallic iron used in electric arc furnaces (EAFs) to produce commodity-grade steel products in areas where sufficient scrap was not readily available. Beginning in the 1970s, the combination of a DRI plant and an EAF steel mill provided the foundation for national industrialization programs throughout countries in the natural gas rich Middle East & North African (MENA) region.

Meanwhile, leading EAF-based steelmakers in other industrialized countries, most notably the USA, were intent on moving from producing basic grades of steel to competing with traditional integrated producers in the quality and special steel grades. The introduction of technologies, such as continuous casting and its further refinement, thin slab/strip casting, provided the means to make these products.

At this point, even the most progressive EAF operators were saying they could compete with traditional integrated mills in the higher-grade steel grades using premium scrap alone. However, increased demand for premium scrap was putting a severe strain on supplies, which in turn was pushing prices higher. DRI emerged as a means to moderate scrap prices and increase the supply of iron units available to EAF mills.

Meanwhile, the effect of DRI's chemical characteristics, especially the extremely low residual levels, was being noticed throughout the global steel industry. DRI/EAF mills in gas-rich countries were making exceptional quality

billets and USA mills, such as Georgetown Steel Corporation were producing the highest quality wire rods.

Today, EAF operators are blending DRI products and scrap to produce steel grades of all descriptions and specifications in the most economical manner. DRI has become a versatile scrap supplement allowing various scrap to be used by EAF steelmakers while still achieving product spec.

Advent of Merchant Iron

With the increased demand for high quality iron units in the EAF charge, concern for the availability and price of premium scrap mounted. DRI was regarded as a material that could compete with premium scrap and help moderate prices. However, natural gas prices in the USA precluded the production of DRI, so a market was created for merchant iron. The idea was to produce DRI in countries where natural gas associated with petroleum extraction was flared and therefore, priced low. If the country also produced iron ore, the value of making and selling DRI as a merchant product was greatly increased – case in point, Venezuela.

The volume of merchant DRI shipments increased from four thousand metric tons/year (t/y) to almost one million t/y between 1970 and 1984; however, there were several incidents involving shipments of DRI that caught fire and damaged the vessels and their cargoes. This resulted in stricter guidelines by the United Nations maritime body now known as International Maritime Organization (IMO). A form of DRI that was safer to ship over open oceans was needed.

Hot briquetted iron (HBI) was the response by the direct reduction industry.



COMMENTARY

Continued from page 2

HBI is significantly denser than traditional DRI, which in some circles is still known as “sponge iron,” making it much more resistant to reoxidation and overheating. FIOR de Venezuela built and operated the first HBI plant in 1976; however, it was not until Sabah Gas Industries began marketing and shipping HBI from its Malaysian plant in 1984 that the product gained wide recognition. In 2016, almost five million tons of HBI were shipped.

The introduction of HBI, and its acceptance by IMO as a preferred form of DRI for ocean shipping, brought the benefits of DRI to a broader iron and steelmaking audience, including blast furnace (BF) operators. DRI, in pellet and lump form, was not suitable for use in the BF due to its limited strength. HBI has the mass to blend well with other charge materials and increase the metallization of the BF bed so less coke is consumed, thus reducing CO₂ emissions and increasing hot metal production.

Throughout the 1990s, HBI was marketed as a replacement or substitute for scrap. It was promoted as a higher quality material than scrap and priced accordingly. The HBI and scrap industries tried to convince buyers to pay more for their products while buyers purchased both products whenever the price was “right.” After several price cycles, HBI promoters and scrap suppliers began to realize their products were commodities; i.e., basic inputs used in the production of finished products, which added more value when used together in the production of steel.

DRI & Scrap – Better Together

Scrap and the different forms of DRI – cold DRI (CDRI), hot DRI (HDRI) and HBI – today are used together in various percentages, depending on the products being made and the operating practice in use. Forward-looking EAF steelmakers, such as Nucor, have invested in their own strategically located DRI plants.

Modern DRI plants are designed to produce multiple product forms “on demand,” providing operators the flexibility to quickly respond to changing market situations. DRI can be transferred to the meltshop while hot to take advantage of the sensible heat. Plants with hot discharge furnaces are equipped with briquetting machines to provide a product option when the meltshop is down or steel market conditions are not favorable.

Building an Enduring Relationship

The DRI-scrap relationship is not unlike a human relationship. It starts with passion, each party focused on satisfying its wants, needs and desires. Next comes *adjusting to reality*, realizing and learning to cope with things that don't go as expected. After having to adjust to reality, the parties feel vulnerable and are afraid of giving too much. Each wants the other to change and a *power struggle* ensues. This is the first major test of a relationship.

In the aftermath of the power struggle, the parties separate to reflect and gain perspective. At this point, a *re-evaluation* of expectations and willingness to contribute takes place. This provides the basis for *reconciliation*, when each party recognizes and respects that the other will remain an individual

while part of the relationship.

The final stage in a committed relationship is complete *acceptance*. There is an integration of the need of the self and the needs of the relationship. Each party takes responsibility for its own needs, as well as for supporting the other party. A balance between autonomy and union is maintained. When conflicts arise, the parties know how to resolve them relatively quickly. Resentments are few. There are few surprises because they know what to expect. They accept reality for what it is with no denial or fantasy involved. They work together as a team while maintaining separate identities. The need of the self and the needs of the relationship are integrated and mutually respected.

Researchers are said to estimate that less than 5% of relationships ever reach acceptance. So far DRI and scrap are proving that former adversaries not only can coexist – they can be more valuable when working together. ■

(Thanks to the Relationship Institute for the free article, “The Stages of Committed Relationships,” posted online January 14, 2015)

EDITOR'S NOTE:

Frank Griscom is a noted figure in the DRI industry and a former VP of Sales and Marketing for Midrex. He has also served as Executive Director and Secretary of HBIA (Hot Briquetted Iron Association) and IIMA (International Iron Metallurgy Association), respectively, over the past decade.



HOT BRIQUETTED IRON

Steel's Most Versatile Metallic

PART 1 - STARTING WITH THE BASICS

By Christopher Ravenscroft & Robert Hunter

EDITOR'S NOTE:

The 4th quarter 1982 issue of *Direct From Midrex* first mentioned a new direct reduced iron (DRI) product from Midrex called hot briquetted iron (HBI). Midrex was not the first to produce a hot briquetted form of DRI (Fior de Venezuela had produced and shipped a product in the late 1970s), but we did help establish HBI as the steel industry's most flexible iron source.

Here we are almost 36 years later, and what was old is new again. Two of the most recent DRI plants to start up in the past few years are HBI facilities and at least one more is on its way. Thus we thought this was the perfect time to revisit HBI with a series of articles to explain the basics of the product and how its technical and commercial development has responded to the changing landscape of the global steel industry. Part one, of course, starts at the beginning...



What Is HBI? HBI is a compacted form of DRI that is manufactured with well-defined, consistent chemical and physical characteristics. HBI is manufactured to be shipped over great distances and melted in a variety of iron and steel processes. It is available throughout the year unlike scrap, which tends to have a collection season. The chemical composition of HBI is certified by the producer, and ISO quality standards are strictly followed.



TYPICAL CHARACTERISTICS OF HBI ARE SHOWN IN TABLE I.

Fe total (%)	90 - 94
Fe Metallic (%)	83 - 90
Metalization (%)	92 - 96
Carbon (%)	0.5 - 3.0
P* (%)	0.005 - 0.09
S* (%)	0.001 - 0.03
Gangue* (%)	2.8 - 6.0
Mn, Cu, Ni, Cr, Mo, Sn, Pb, & Zn (%)	trace
Bulk Density (Kg/m ³)	2400 - 2800
Bulk Density (lbs/ft ³)	150 - 175
Apparent Density (g/cm ³)	5.0 - 5.5
Product Temperature (°C)	Less than 80°C
Typical Size (mm)	30 x 50 x 110
* depends on iron ore source	

TABLE I. Typical characteristics of HBI

Physical characteristics are typically credited with why HBI was created. Its greater mass allows rapid penetration of the furnace slag layer. HBI is 100 times more resistant to reoxidation than conventional DRI and will pick up 75% less water. HBI also generates fewer fines, which provides greater value to users and reduces safety concerns during handling and shipping. Its size and shape are compatible with standard materials handling equipment, and HBI can be batch charged or continuously fed to a melting furnace.

ADVANTAGES OF HBI

HBI is a modern charge material for use in combination with scrap or as an alternative to scrap in steelmaking furnaces or as an addition to blast furnaces in ironmaking applications. Because it is made directly from iron oxides without melting, HBI contains none of the impurities in smelted iron resulting from coke, limestone and scrap inclusions. Depending on the chemistry of the iron oxide used in its production, HBI is low in residual metal elements (copper, nickel, chrome, molybdenum and tin), as well as sulfur and phosphorus.

THE USE OF HBI CAN BENEFIT THE STEELMAKER IN EITHER OF TWO WAYS:

1. It allows the production of high quality steel products that could not be made consistently due to high residual elements levels inherent in most obsolete scrap.
2. It allows the use of less costly, lower grades of scrap to make basic grades of steel products.

HBI is used primarily in the electric arc furnace (EAF) for its diluent effect; i.e., to lower the overall level of metallic residuals and sulfur. In addition, HBI shares these operational advantages with other forms of DRI:

- Blends with other metallics for best total charge economics
- Can be continuously fed to maximizes power-on time and increase bath weight
- Promotes foamy slag and reduces EAF nitrogen level
- Shields refractory to reduce damage
- Equally effective in AC or DC furnaces, long or short arc operation
- Compatible with injected fuels and oxygen
- Predictable mass and heat balances

These unique characteristics of HBI provide other benefits:

- High density (5.0 g/cm³) allows for rapid penetration of the furnace slag layer
- Increased thermal and electrical conductivity for faster melting
- Less fines generation during handling, shipping and storage
- Easy to handle, store and transfer in all types of weather and with standard materials handling equipment
- Safer and less costly for ocean transport



MIDREX® PROCESS HOT BRIQUETTED IRON FLOWSHEET

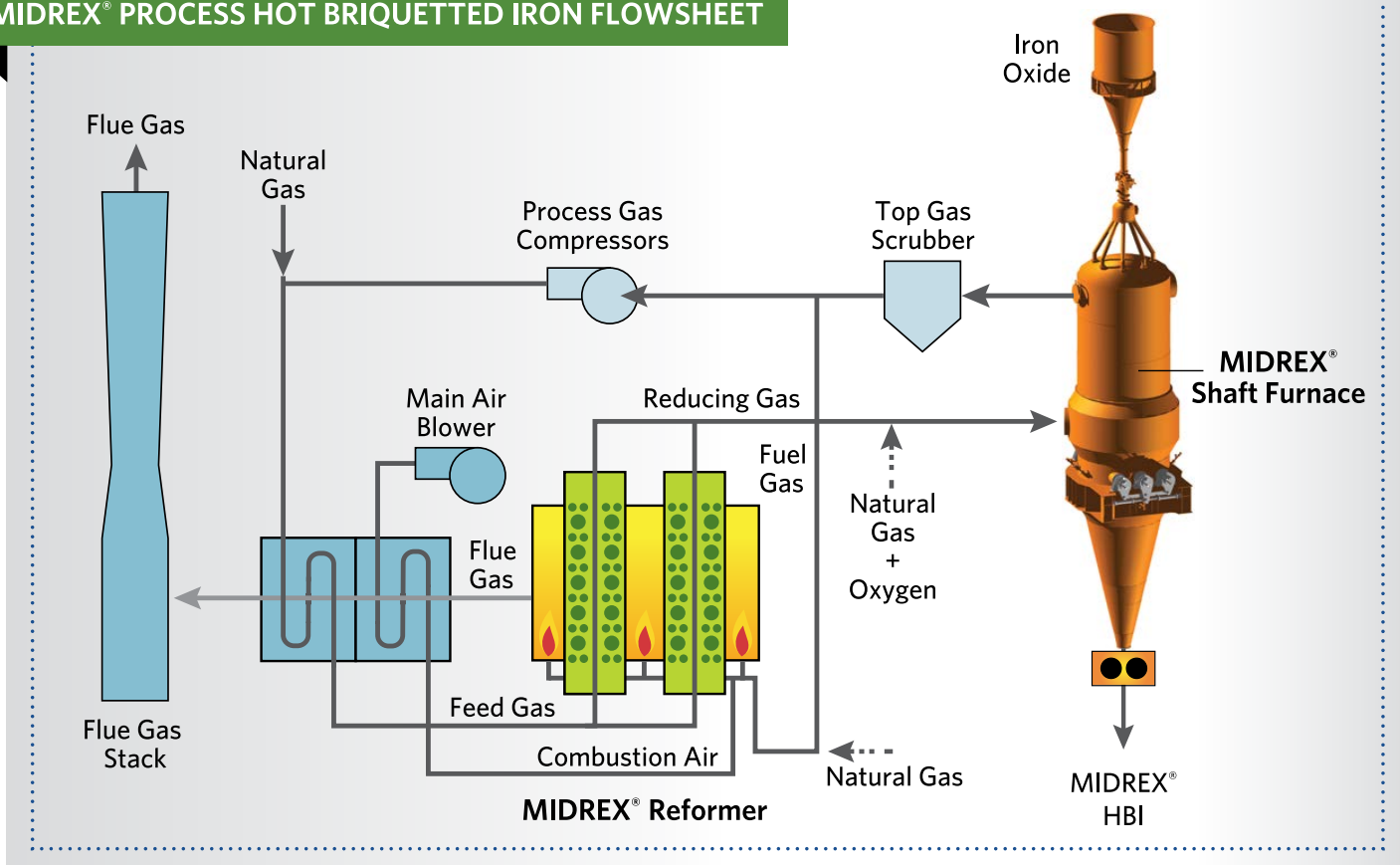


FIGURE 1 MIDREX® HOT BRIQUETTED IRON FLOWSHEET

MIDREX ADDS HOT BRIQUETTING

When Midrex announced its intention to include hot briquetting, the MIDREX® Direct Reduction Process was in its fifth generation of operational design. Building on a basic flowsheet that was well proven in over 15 years of operation at the time, Midrex, in cooperation with its Construction Licensees, designed and optimized a hot discharge/hot briquetting system that required only minor process changes and incorporated commercially available equipment.

As shown in *Figure 1*, the most significant process modification was the elimination of the cooling gas circuit. The cooling zone in a cold discharge plant is used only for adjusting carbon content and cooling the DRI (in pellet/lump form) prior to it being discharged.

Recently Midrex introduced ACT™ [Adjustable Carbon Technology], which can be included in new plants and retrofitted

into existing plants to increase carbon content up to 4.0%* while maintaining the physical integrity of the HBI. (See the article in 3Q2017 DFM or download the ACT brochure from www.midrex.com.)

The reliable and low cost dynamic seal gas system used in all MIDREX® Plants was also modified to accommodate the hot discharge of DRI for briquetting. The seal gas system is a closed loop gas circuit which dedusts, compresses and reheats the seal gas. It allows optimum control of product temperature and furnace atmosphere.

After the iron oxide is reduced, the hot DRI (HDRI) is continuously discharged at 650°C or higher into a product discharge chamber (PDC), which purges any combustible gases from the HDRI bed and smooths out any production surges. The purge gas is externally heated to keep the HDRI at the proper briquetting temperature.

**Note: At carbon levels over 3.0%, it may not be possible to meet the apparent density of 5.0 (g/cm³) for IMO code DRI(A).*



The PDC equally distributes the HDRI among feed pipes to each of the briquetting machines, where a screw feeder introduces the material into pocketed briquetting rolls, which compress and compact it into a continuous strand of pillow-shaped briquettes. The strands are fed through a device that mechanically separates the briquettes, after which they are cooled to reducing oxidation and typically stored in outdoor piles to await further use or transportation.

The MIDREX® Hot Briquetting System is shown in Figure 2.

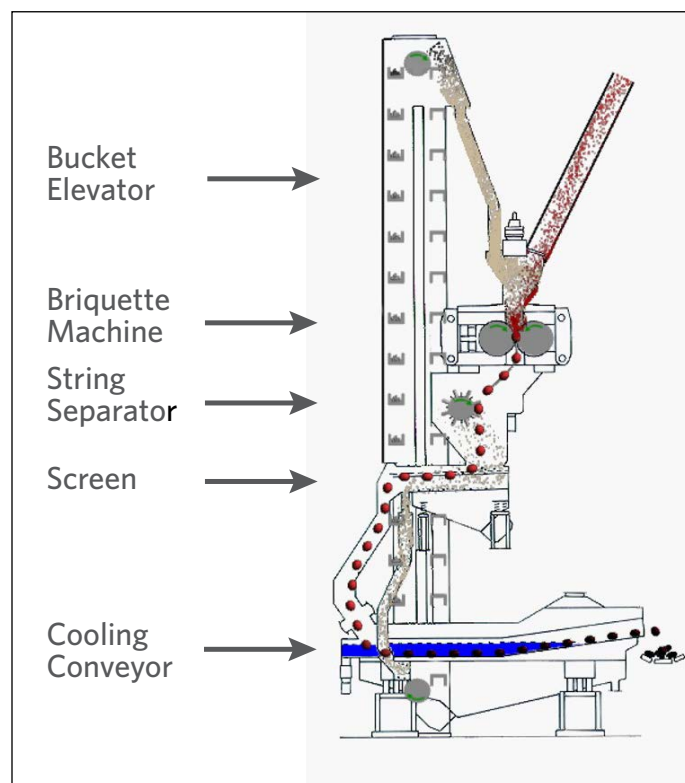


FIGURE 2 MIDREX® HOT BRIQUETTED IRON SYSTEM

THE DECISION FOR HBI

In 1980, steel industries based on the electric arc furnace (EAF) were developing in ASEAN (Association of South East Asian Nations) and the MENA (Middle East North Africa) Region. EAF steel mills could be sized to a specific market and were less capital-intensive than traditional integrated mills. However, EAF-based mills melted scrap and the amount of scrap that could be generated in these emerging economies was extremely limited.

DRI was gaining attention as an effective alternative and supplement to scrap in the EAF. Global production of DRI in 1980 was little more than seven million metric tons, almost all

of which was being consumed by steel mills adjacent to the DRI plants. In the same period, Asian countries alone were importing approximately eight million tons of scrap, mostly from the US and Europe.

A merchant DRI plant fit perfectly into the development plan of Malaysia's Sabah Gas Industries (SGI), which was created in 1981 to manage the use of natural gas associated with the Erb West and Samarang offshore oil fields off the north coast of Borneo. With gas expected to be available to Labuan Island near Kota Kinabalu by 1984, a turnkey contract was awarded to voestalpine AG (VA), a Construction Licensee of Midrex, on May 19, 1981, to construct a merchant DRI plant. Site work began in November 1981, and start-up was scheduled for early 1984.

However, in October 1982, The Inter-Governmental Maritime Consultative Organization (IMCO, today known as IMO – International Maritime Organization) developed and adopted a code for shipping DRI due to its propensity to heat up and evolve hydrogen gas when exposed to water, especially saltwater. The new IMCO BC (Bulk Cargoes) Code* made the provision that ships' holds containing DRI should be maintained under inert atmosphere conditions unless the DRI was manufactured or treated in a manner approved by the competent authority to provide protection against corrosion and oxidation by water and air.

Therefore, SGI needed a method to make its DRI more resistant to oxidation and safer to ship, especially because the plant would be located in a tropical region where significant rainfall occurred 4-6 months of the year (average annual rainfall on Labuan is 4000 mm/160 inches). After comparative studies of several passivation techniques and hot briquetting by an outside consultant, SGI made a decision for hot briquetting and the plant supply contract was amended in August 1982. Mechanical construction of the plant was completed in January 1984. Plant commissioning began in June 1984, and the plant produced highly metallized HBI during the first week of August 1984, with the first shipment of 5,000 tons taking place in December 1984.

**Following multiple incidents involving DRI cargoes which were deemed to have been "manufactured or treated in a manner approved by the competent authority to provide protection against corrosion and oxidation by water and air," the subsequent International Solid Bulk Cargoes (IMSBC) Code issued by IMO stipulated that only HBI or "hot-moulded briquettes, DRI (A)", as it is known in the Code, is not subject to inerting for ocean transport.)*



LEGACY OF THE LABUAN PLANT

Producing value-added products from associated natural gas was one of the goals of SGI. Equally important was educating and training people from the local population to develop

a sustainable industrial infrastructure that would stimulate economic and social growth. Similar thought processes have given rise to the majority of the direct reduction projects throughout the world.

Likewise, the optimization phase of the SGI plant produced improvements and innovations that have been assimilated into the body of MIDREX® Technology, such as furnace modeling tests that led to improved product flow and discharge. SGI plant operators also demonstrated that the life of briquette machine segments could be as much as 100,000 tons when initial estimates were for only 60,000 tons.

On the commercial side, SGI made a lasting impression in how it approached the market. The practice of offering trial shipments with on-site application assistance introduced by SGI was highly successful and has been adopted by merchant HBI plants since then. Today, most HDRI plants are designed with the option for briquetting machines to provide an additional income stream with merchant HBI.

Plants capable of producing more than 25 million tons of HBI have been installed or is under construction worldwide; 18 using MIDREX® technology, 3 HYL/ENERGIRON® and one each FINMET®, CIRCORED® and FIOR® (TABLE II).

Plant	Location	Rated Capacity (Mt/y)	Product(s)
MIDREX® PROCESS			
Antara Steel Mills	Labuan Island, Malaysia	0.65	HBI
Essar Steel I & II	Hazira, India	0.88	HBI/HDRI
FMO	Puerto Ordaz, Venezuela	1.00	HBI
VENPRECAR	Matanzas, Venezuela	0.82	HBI
Essar Steel III	Hazira, India	0.44	HBI/HDRI
LISCO 3	Misurata, Libya	0.65	HBI
COMSIGUA	Matanzas, Venezuela	1.00	HBI
Essar Steel IV	Hazira, India	1.00	HBI/HDRI
Essar Steel V	Hazira, India	1.50	HBI/HDRI
LGOK HBI-2	Gubkin, Russia	1.40	HBI
Qatar Steel II	Mesaieed, Qatar	1.50	HBI/CDRI
Lion DRI	Banting, Malaysia	1.40	HBI/HDRI
Jindal Shadeed	Sohar, Oman	1.50	HBI/HDRI
voestalpine Texas	Corpus Christi, TX, USA	2.00	HBI
LGOK HBI-3	Gubkin, Russia	1.80	HBI
Persian Gulf Saba	Bandar Abbas, Iran*	1.50	HBI
Makran, Chabahar	Sistan-Baluchestan, Iran*	1.60	HBI
Cleveland Cliffs	Toledo, Ohio, USA*	1.60	HBI
MIDREX Total		21.88	

*under construction

(Continued next page)



OTHER PROCESSES

Plant	Location	Rated Capacity (Mt/y)	Product(s)
HYL/ENERGIRON®			
JSW Steel	Raigad, India	0.75	HBI/CDRI
LGOK HBI-1	Gubkin, Russia	0.9	HBI
BriqOri	Matanzas, Venezuela	1.5	HBI
FINMET®			
Orinoco Iron	Matanzas, Venezuela	2.2	HBI
CIRCORED®			
Mittal - ISG Trinidad	Point Lisas, Trinidad and Tobago	0.5	HBI
FIOR® Process®			
Operaciones RDI	Matanzas, Venezuela	0.40	HBI
Other Processes Total		6.25	
ALL Processes Total		28.13	

TABLE II. Direct Reduction Plants Capable of HBI Production

The latest MIDREX® HBI plant was announced in 2017 by Cleveland-Cliffs Inc. The 1.6 million t/y plant, to be located in Toledo, Ohio, USA, will be the source of high-quality HBI for the EAF steel market in the Great Lakes region when it is started up in 2020.



CONCLUSION

The decision by Midrex to add hot briquetting as a feature of its direct reduction process technology was made initially for operational and marketing reasons. The product's enhanced physical

characteristics proved to be a solution to handling, shipping and storing issues associated with conventional cold DRI. Briquetting HDRI also was found to improve in-plant losses and to expand the potential market for DRI products beyond electric arc furnaces to include blast furnaces.

Today, HBI's popularity as an ore-based metallic is steadily increasing as more capacity comes online. It has become a key element in the environmental strategies of a few traditional integrated steelworks, as well as a valuable secondary product for EAF steelmakers that have their own captive hot discharge direct reduction plant.

All in all, HBI continues to prove that it is steel's most versatile metallic. ■





INTERNATIONAL PROJECT FINANCING

Building DRI Plants through Midrex UK



By John Kopfle

International Project Financing: long-term financial structures and arrangements allowing a buyer to borrow money to fund large capital projects rather than using its own resources. Many buyers now expect and sometimes demand such assistance from their suppliers and contractors. Meeting these client requirements requires planning, a clear strategy, certain expertise and working with the right entities, partners and financial institutions.

INTRODUCTION

One of the most challenging aspects of developing large capital projects can be assisting in, facilitating and helping to arrange long-term project financing with attractive terms – and a MIDREX® Direct Reduction Plant certainly fits that description. Long-term borrowing allows a client to defer paying for a project until it is completed and operating, so that earnings can be used to repay the loans. As a result, financing has become a major consideration in developing international projects. Today's reality is that plant buyers often expect process suppliers, such as Midrex, to include access to financing as part of their proposals.

Financing alone likely will not win a contract; however, being unable to assist with financing can result in the loss of a

project – and financing can play an essential role in effectuating a project contract quicker. Commercial banks are the primary source of international project and contract financing, which can range from simple, straight-forward syndicated bank loans to much more advanced forms of project or limited recourse financing requiring guarantees, project sponsor involvement, off-take agreements and hedging arrangements. However, commercial bank financing can be limited with respect to the terms, conditions and tenor (repayment period) allowed, often not matching what the client requires. Also, overseas lending can be risky, and banks don't like taking long-term political or commercial risks.

One of the principal internationally recognized and much



used long-term financing models, especially for large international projects, is Export Credit Agency (ECA) financing. ECAs are government organizations set up to promote, facilitate and support the export of goods and services and provide support for long-term financing of capital projects. ECAs provide banks with the ability to mitigate the risks of long-term repayment, thus allowing them to provide more advantageous loan financing terms.

Since the financial “crash” of 2008-09, ECA financing has remained the main go-to model for buyers, borrowers and project sponsors wanting to fund and finance large cross border contracts and projects. All the major ECAs and banks involved in this sector continue to be busy working on and closing out increasing volumes of transactions. Many ECAs are expanding and developing the range of products and support they provide to include working capital schemes, bond support and insurance and local currency financing. The Japanese banks are very active in the ECA scene. The total annual volume of ECA supported business is on the order of \$400 billion worldwide.

For Midrex, the ability to assist its clients in this area is a vital ingredient in the services it provides. Working with and through its United Kingdom subsidiary, Midrex UK Ltd, Midrex actively assists its clients in accessing ECA supported long-term financing.

THE DECISION FOR LONDON

Midrex UK was established in 2009 to assist Midrex clients in accessing the financing expertise and abilities offered by the UK and the City of London. These include international project and commercial bank financing expertise and accessing ECA support through UK Export Finance (UKEF) - formerly known as the Export Credits Guarantee Department (ECGD).

Midrex UK was the first permanent Midrex office located outside the USA. A team of Midrex sales, marketing and procurement professionals, in coordination with Midrex’s owner, Kobe Steel Ltd., helped establish the office and recruit Mike Jasper to head the operation. Jasper was selected for his experience in financing cross border capital equipment sales and projects while working for international banks based in London. As Director of Midrex UK, he has transitioned from being a banker providing export financing to an exporter who works with global suppliers and buyers of capital equipment and the banks which finance them.

UKEF provides both sovereign guarantees for commercial





bank loans and direct lending. The guarantees enable banks to provide very attractive lending terms. There are two major requirements for accessing UKEF support: the exporter must be a UK registered company and there must be a scope of supply from UK manufacturers and vendors. Midrex UK, a registered UK company with offices in London, fulfills the first requirement and is the mechanism for satisfying the second one by sourcing a UK scope of supply. Thus, Midrex UK works with UKEF in assisting clients in obtaining UK ECA guarantees and loans.

LGOK HBI-3 – THE FIRST PROJECT

ECA financing processes and arrangements often follow a separate, although parallel route to a project's commercial and technical negotiations. This was the case with the LGOK HBI-3 Project in Russia. In 2009, Midrex UK notified UKEF of the potential for the project and kept them informed of developments. UKEF supported Midrex UK with letters of support, indications of terms and conditions, general advice and direction and direct communication with the client, Metalloinvest. In addition, UKEF and Midrex UK worked with the appointed agent bank, SMBC, and with the Austrian ECA, OeKB. Midrex's project consortium partner, Primetals Technologies, headquartered in Austria, was seeking OeKB support.

In 2012, Midrex and Metalloinvest signed the plant supply contract. Subsequently, UKEF approved a guarantee for Metalloinvest's loan from a consortium of banks. The loan tenor and interest rate were very competitive. LGOK HBI-3 was started up in March 2017 and has performed well. As the first project to utilize Midrex's financing capabilities, it has proven to be a success. The concept, model and modus operandi worked; Metalloinvest accessed what it considered to be vitally important long-term ECA support and significant supply orders were placed with UK companies. The UKEF loan facility proceeded relatively smoothly and now has moved into the repayment phase.

A WIN-WIN SCENARIO

The UK government is very supportive of Midrex UK's work in securing ECA support. Success in securing MIDREX contracts and UKEF support results in orders placed for UK goods and services. As part of the due diligence leading to start-up of the London office, Midrex worked with various UK suppliers to ensure that the right scope of goods could be procured from the UK and that they would be of the required quality standards.



Midrex UK now has an established group of trusted, reliable UK vendors which will continue to grow and expand.

As a direct result of the financing of LGOK HBI-3, led by Midrex UK and supported via UKEF, purchase orders worth tens of millions of US dollars were placed with UK-based manufacturers, suppliers and service providers across several different sectors and industries.

Those companies – and other UK companies subsequently identified – are now on the Midrex qualified and approved vendors list, meaning that they are likely to be used for other global projects independent of ECA support. UK vendors have bid on and secured Midrex purchase orders on other, non Midrex UK-related, DRI projects, such as Tosyali and AQS in Algeria. This further demonstrates how UKEF and Midrex working together benefits the UK, as well as Midrex and its clients.



Three UK vendors provided equipment for the shaft furnace, reformer and heat recovery system. Four other companies provided services including packing, freight forwarding and engineering inspections. The contracts ranged from \$15,000-\$50,000 for the services to \$8-12 million for the large equipment packages.

The Midrex purchases helped some of the UK companies to maintain their existing workforces. One of UK sub-contractors said that the Midrex purchase order was of a sufficient value and for an amount of work that, when combined with other orders on its books, allowed it to hire several additional staff and increase the number of apprentices it takes on each year. For another of the smaller service provider companies, the order for packing and boxing led to them receiving additional, stand-alone business from one of the main UK sub-contractors with which they worked on the Midrex order.

ONLY THE BEGINNING

The success of the ECA financing of LGOK HBI-3 will produce further opportunities for Midrex UK and UK vendor involvement. Many clients see ECA financing as an integral part of their internal project planning and bid processing and reviewing procedures. Therefore, the ability of Midrex to assist clients with such matters is more important than ever before. Midrex UK's assistance and the availability of UKEF support help Midrex compete with very large international process technology suppliers.

Several past projects and current ones throughout the world have shown interest in possible ECA financing support. Some have been just inquiries; some have been detailed and involved lengthy discussions; and on one or two occasions, only the deferral of the project itself has precluded another UKEF supported contract being concluded. LGOK HBI-3 was Midrex UK's first ECA project, but it certainly won't be the last.

CONCLUSION

The Midrex UK team in London works closely to support Midrex and Kobe Steel, most notably in the areas of sales, contracts, project financing and risk mitigation. It also continues to develop and expand relationships with providers of project, commercial bank and ECA financing to better utilize their skills, knowledge and expertise. This enables Midrex to continue to be the world leader in all things related to direct reduction: technology development, plant supply and aftermarket support. ■



Midrex UK was Midrex's first permanent overseas location established to assist potential MIDREX Plant owners in developing and financing their projects. In 2011, Midrex opened an office in Shanghai, China, followed in 2012 by an office near Delhi, India. With these strategically-located sites, Midrex is well positioned to further expand the reach of direct reduction.



MIDREX News & Views

Jindal Shadeed Makes Over 10M Tons With Record Production Year in 2017



Jindal Steel and Power Limited (JSPL) has announced that its Jindal Shadeed MIDREX® Plant, located at the Sohar Industrial Port area of Sohar, Oman, surpassed the 10 million tons cumulative production milestone in 2017 with a most impressive 8,642 hours of operation. The combination hot DRI (HDRI)/ hot briquetted iron (HBI) plant, which started trial production of HBI on 5 December 2010, four months ahead of schedule, becomes one of five MIDREX® Direct Reduction Plants to reach 10 million tons in 7 ½ years or less.



Jindal Shadeed features a 1.5 Mtpy MIDREX HOTLINK® Plant (elevated hot discharge furnace for feeding HDRI to a nearby melting furnace) with HBI capabilities.

JSPL, through its 100% subsidiary Jindal Steel & Power (Mauritius) Ltd., Mauritius (JSPLM) acquired Shadeed Iron & Steel Co. LLC (Shadeed) from the original project owner, Al-Ghaith Holdings UAE and completed the plant. The Shadeed acquisition was a major step in the international strategic holdings of JSPL, which includes coal and iron ore mines located in Africa and Asia.

The plant started commercial production four months ahead of schedule in December 2010, which was achieved by the well-coordinated, collective efforts of Jindal Shadeed, its contractors and sub-contractors along with the strong support of the local community and the Omani government. JSPL has plans to expand Jindal Shadeed, with goals of producing 2 million tons/year of finished steel in the second phase and 4-5 million tons/year of steel in the third phase. ■

OTHER MIDREX® PLANTS THAT HAVE REACHED 10M TONS (7.5 YEARS OR LESS)

PLANT

ArcelorMittal Lazaro Cardenas (Mexico)
Hadeed E (Saudi Arabia)
Qatar Steel Mod 2
LGOK HBI-2

TIME TO REACH 10M TON

6 years, 7 months and 6 days
6 years, 1 month and 15 days
7 years, 1 month and 1 day
7 years, 4 months and 29 days





MIDREX News & Views

Kobe Steel Board Names New President



Kobe Steel, Ltd., has announced that Mitsugu Yamaguchi will replace Hiroya Kawasaki as President, CEO and Representative Director on April 1, 2018.

The Kobe Steel Board of Directors adopted a resolution to appoint Mr. Yamaguchi at its meeting on March 9, 2018. The Board adopted several other resolutions on March 5 to address the business improprieties that took place within the Kobe Steel Group.

In a written statement, Kobe Steel said the resolutions of the Board "reflect our Company's taking to heart the substantial troubles we have caused our customers, suppliers, shareholders and many other people. Kobe Steel intends to fulfill its



Mitsugu Yamaguchi,
New President, CEO of Kobe Steel

responsibilities with regard to the series of misconduct ... and move forward with fundamental reforms to the organization and its corporate culture." The statement went on to express a commitment to restoring trust as soon as possible.

Mr. Yamaguchi is a graduate of Hokkaido University School of Law and joined Kobe Steel in 1981. He has served in various corporate and business planning executive positions, as well as in senior executive leadership roles in the Machinery Business of Kobe Steel.

Christopher M. Ravenscroft: Editor

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