

DIRECT FROM MIDREX

2ND QUARTER 2008

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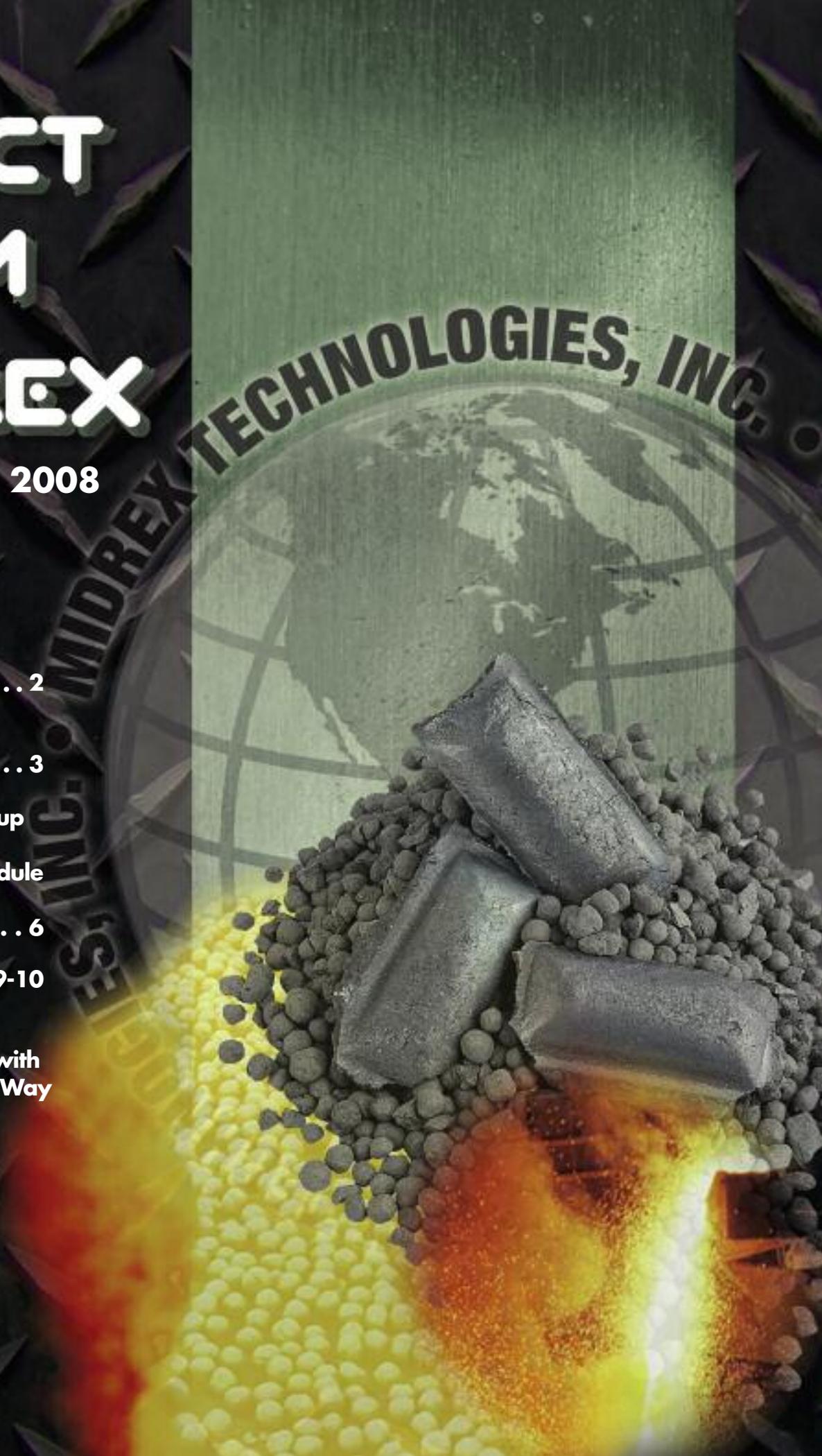
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ES&S INC. • MIDREX TECHNOLOGIES, INC.



Commentary

A Major Shopping Spree

With the increase in steel prices beginning in the second half of 2004, Midrex has realized an unprecedented surge of interest in direct reduction facilities. There is currently over 15 million tons of MIDREX® Plant capacity either newly started or under construction. These plants are located throughout the world, including Trinidad, Russia, Egypt, Oman, Qatar, Saudi Arabia, Pakistan and Malaysia. For these projects, Midrex will typically supply a technology package that includes equipment, engineering, field advisory services, training and start-up assistance.

Equipment is a crucial part of the success of these ventures, especially the proprietary equipment Midrex designs and supplies. This includes the MIDREX® Shaft Furnace and internals, the catalyst, tubes and burners used in the MIDREX® Reformer, the heat recovery systems, specialized alloy components, compressors, refractory and the process control system. Other supply that may include all the equipment required for a MIDREX Plant is provided based on specific contract requirements.

Midrex procures equipment worldwide, based on price, schedule, quality and other factors such as shipping, which is becoming a major consideration impacting both project cost and schedule. Over the years, Midrex has developed relationships with a select group of suppliers for all MIDREX equipment, but especially for the critical items. In most cases, suppliers have equipment with a proven performance record in operating MIDREX Plants and must continue to meet certain standards to remain as suppliers. Potential new suppliers are evaluated against similar standards. Some of the relationships have developed to the level of supplier agreements where Midrex and the vendor will work together to improve specifications and designs to maintain a state-of-the-art supply.

The procurement effort for the recent projects has been quite challenging, as almost all industrial equipment manufacturers are extremely busy and have incurred unanticipated and sometimes sudden increases in material, labor and energy costs, resulting in higher prices and longer deliveries. Lead times on some equipment used in MIDREX Plants are now as long as 12 -14 months and price increases of 30 percent and more during this period are not uncommon. Working with a select group of known suppliers does

not totally eliminate these problems, but will always help in finding the best solution with the least impact on project price and schedule.

Historically, the geographic “center of gravity” of MIDREX projects was toward the Western Hemisphere, but it has shifted east. This has required Midrex’s

Procurement Department to find new equipment suppliers and fabricators that are located closer to the job sites in the Middle East, North Africa and Asia. Developing new supplier relationships in India and the Pacific Rim countries has demanded a greater amount of oversight than is typically the case for our established suppliers. However, the cost benefit from just the wage differentials and transportation has made the effort worthwhile.

Midrex has a full service, in-house procurement organization of over 30 personnel to handle both new project requirements and spare parts and replacement orders from existing plants. This includes professionals with expertise in all procurement disciplines, including purchasing, expediting, document control and logistics. Our staff includes degreed engineers, along with purchasing agents fluent in Spanish and Japanese. Tools used include integrated computer-based systems for purchasing, accounting, cost control and monitoring of manufacturing schedules, as well as shipping plans and progress. We also have in-house software to control project documents that include MIDREX drawings and vendor submittals. Our logistics requirements are handled by our in-house licensed freight forwarding subsidiary with an experienced staff trained in shipping MIDREX equipment and material shipments to worldwide locations.

The last four years have been a major shopping spree for us. Midrex's procurement group is continually enhancing its capabilities to meet today's challenges and projected future demands.



*Paul Carter
Director - Procurement
and Logistics*

Qatar Steel Company:

30 Years of Success



Figure 1 - Qatar Steel: DRI-1 MIDREX Plant

By Dr. Khalid Butt
Qatar Steel Company

Editor's note: This paper was adapted from a presentation given at the Arab Iron & Steel Union 8th International Conference, held in March 2008 in Doha, Qatar.

INTRODUCTION

Qatar Steel Company was the first steel producer in the Middle East to employ the natural gas-based direct reduction process plus electric arc furnace (EAF) steelmaking route. This year, Qatar Steel is celebrating 30 years of operation of a MIDREX® Direct Reduction Plant, EAF meltshop and casting and rolling facilities. The complex now includes two MIDREX DRI Plants, four EAFs and associated facilities for casting and rolling.

DIRECT REDUCTION PROCESS

In 1978, the company installed a Series 400 MIDREX Plant, shown in Figure 1, with a rated capacity of 400,000 tons per year (tpy). It was the first such unit in the Arabian Gulf Region

and is designated as DRI-1. The MIDREX Plant was selected for its utilization of the abundant natural gas in Qatar.

Through excellent operating practices and plant improvements, Qatar Steel has continually increased its DRI-1 production rate. By 1980, the facility exceeded 400,000 tons production. The annual production capacity of the unit is now considered to be 750,000 tpy, with a record of 877,000 tons production in 2006. Since start-up, the plant has produced over 23 million tons of DRI. All of the product is used in the adjacent EAFs.

With the continued growth in the Gulf region and the strong need for construction steels, Qatar Steel decided to expand its DRI output. In February 2005, the company contracted Kobe Steel, Ltd. to supply a MIDREX MEGAMOD® Direct Reduced Iron/Hot Briquetted Iron Combo Plant with a rated capacity of 1.5 million tpy. This is almost double the capacity of the first module. The DRI-2 plant started up in July 2007 and is shown in Figures 2 and 3 on the following page. It is the world's first MIDREX Combination Plant, designed to produce either DRI for use in steelmaking or HBI for sale or storage.



Figure 2 - Qatar Steel: DRI-2 MIDREX Plant



Figure 3 - Qatar Steel: View of DRI-2 MIDREX Plant at night

This strategic expansion employs modern technology and has been taken to ensure high quality products meeting all international standards. The new MIDREX MEGAMOD consists of a reduction shaft furnace, reformer, process gas system, heat recovery system, hot DRI briquetting machines and a product cooler. The core plant is integrated with all necessary facilities including an iron oxide stacker re-claimer, material handling systems, dust collection facilities, one 1,000 ton per hour ship loader for HBI/DRI, as well as electricity, utility and auxiliary services. The equipment within the battery limits is designed to match the rated production capacity. The entire new plant was designed and constructed using state-of-the-art processes and is the first new, advanced generation plant in the Gulf region.

DRI-1 and DRI-2 are fed with high quality iron oxide pellets from Bahrain, Brazil and other areas. Qatar Steel has a long-term agreement with GIIC and it has invested in a new iron ore mine and pelletizing project in Mauritania that will supply feedstock in a few years time.

EEF MELTING PROCESS

The plant is comprised of four UHP electric arc furnaces of 80 tons capacity each. EAFs No. 1 and No. 2 use conventional launder-type tapping, whereas No. 3 and No. 4 are EBT (eccentric bottom tapping) type. Details of the meltshop are shown in Table I. The combined capacity of the units is 1.5 million tons of liquid steel per year. Other major facilities installed are two 80 ton ladle furnaces, a fume treatment system and SVC.

ITEM	EEF1	EEF2	EEF2R	EEF3
Make	NKK, Japan (upgraded by Qatar Steel)	NKK, Japan (upgraded by Qatar Steel)	Danieli, Italy	SMS Demag, Germany
Year of Commissioning	1978	1978	2007	1999
Transformer Rating (MVA)	50/62.2	50/62.2	78/93.6	70/84
Average Heat Size (tons)	79	79	80	80
Average Tap-to-Tap Time (minutes)	115	115	56	85
Rated Liquid Steel (tons)	210,000	210,000	666,000	385,000
Average No. of Heats-per-Day	12	12	24	17

Table I - EAF Details

Figure 4 shows tapping of a heat at EAF2R. The typical charge includes DRI, HBI, heavy scrap, shredded scrap, ferro vanadium, silico manganese, ferro manganese and burnt lime.

CASTING AND ROLLING

Qatar Steel has four continuous casting machines with four strands each. The latest was installed in 2007. The No. 1 and No. 2 machines are straight mould type and No. 3 and No. 4 are curved mould type. Figure 5 shows CC2R.

The original Rolling Mill (RM) capacity is 600,000 tons per year of plain and deformed bars. In 1999, a new High Speed Finishing Bar Mill (HSFBM) was commissioned, which increased rolling mill capacity to 740,000 tons per year. The new HSFBM produces from 8 mm to 14 mm plain and deformed bars. A new Bar Rolling Mill has been installed during May 2007 to roll 8 mm to 40 mm diameter plain and deformed bars. Total product capacity is now 1.44 million tons per year of bars, with an option to produce wire rod in the future of 650,000 tons per year. RM2 is shown in Figure 6.

PRODUCTS

With the recent DR, meltshop, casting and rolling expansions, Qatar Steel now has the capability to supply the following products:

- Plain and deformed bars: 8 to 40 mm
- Billets (excess of meltshop needs):
130 X 130 mm and 150 X 150 mm
from 3 to 12 m
- Hot Briquetted Iron (HBI)

CONCLUSION

As the first direct reduction/EAF steel company in the Middle East, starting operations in 1978, Qatar Steel Company has become a pioneer in the industry. The success of the first MIDREX Plant, meltshop, casting and rolling facilities encouraged Qatar Steel to expand to meet the region's growing needs for construction steels. With the new facilities, including the world's first MIDREX Combination Plant (DRI and HBI), the company is now well positioned to continue its leadership role.



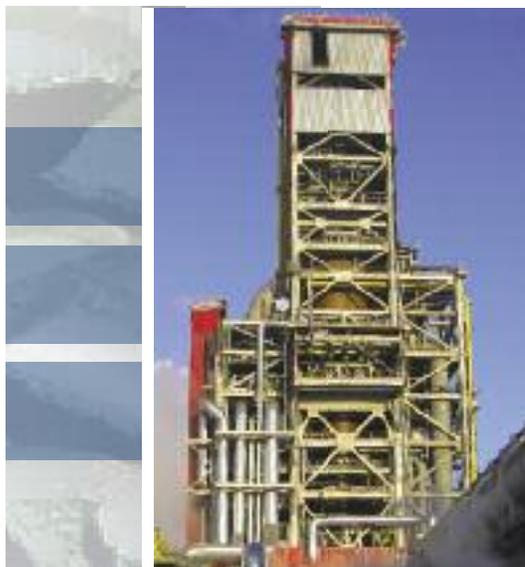
Figure 4 - Qatar Steel: Molten Steel Tapping at EAF2R



Figure 5 - Qatar Steel: Billet Caster (CC2R)



Figure 6 - Qatar Steel: View of New Rolling Mill (RM2) Building and Shop



Construction and Start-up of the World's Largest Hot Briquetted Iron (HBI) Module at Lebedinsky GOK, Gubkin, Russia

By Henry Gaines

Ken Joyner

Midrex Technologies, Inc.

Günter Peer

Siemens VAI Metals Technologies

Editor's note: This article was adapted from a paper given at the Metal Bulletin Russian Steel Summit, held in May 2008 in Moscow, Russia.

BACKGROUND

Russia is blessed with abundant and high quality iron ore, metallurgical coal and by far, the world's largest reserves of natural gas. Because of this, Russia now plays a significant role in the world steel industry, and in the near future with the increasing development of its vast iron ore reserves, will be a major player, if not the leader.

Lebedinsky GOK (LGOK) is a producer of high quality iron ore concentrates, pellets and HBI for the domestic and international markets. LGOK's parent company is Metalloinvest Holding, the largest mining group in Russia, which also owns direct reduction plants with total capacity of HBI and DRI of over 4.5 million tons per year (Mtpy). The group's stated goal is to become the world's largest HBI producer, planning for 8.8 million tons of HBI by 2015. Metalloinvest also has steel production facilities.

To move toward the goal, on February 18, 2005, LGOK signed a contract with Midrex Technologies, Inc. and Siemens VAI for the engineering and supply of a 1.4 Mtpy Midrex® HBI Plant. This is LGOK's second HBI plant, with the first being a 1 Mtpy HYL Module. MIDREX® Technology was chosen for the second HBI Plant due to proven larger commercial size, operating simplicity and increased briquette strength, providing better performance of the product in multiple handling long shipments.

The Midrex and Siemens VAI relationship goes back more than 25 years with the two companies involved in the world's first HBI plant in Labuan, Malaysia in 1984. Together, they have pioneered many of the milestones in direct reduction, such as HBI and the first MIDREX Plant using a conveyor for transfer of hot DRI directly to an EAF.

With Midrex supplying the proven core plant technology and Siemens VAI as the world's leading company for metallurgical plant building with substantial experience in Russia, the partnership ensured the successful and smooth implementation of the LGOK project. Add to this, the aggressive and knowledgeable personnel from LGOK in the areas of iron ore mining, pelletizing and iron reduction technology, and the three-way partnership provided outstanding capabilities to build the world's largest HBI plant, shown in Figure 1.

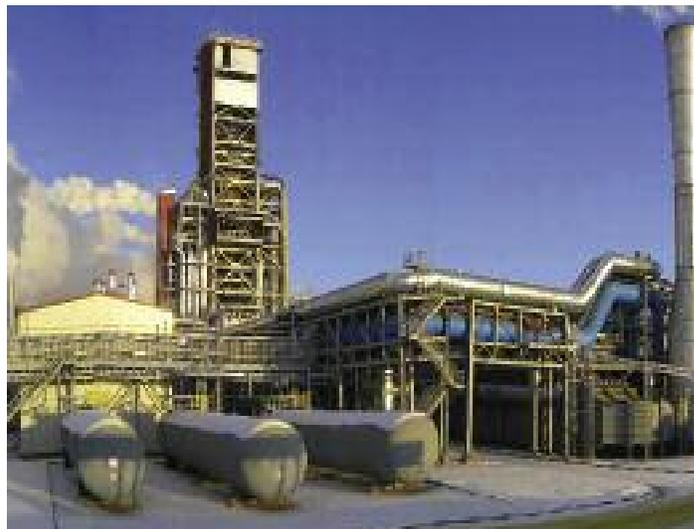


Figure 1 - A View of LGOK

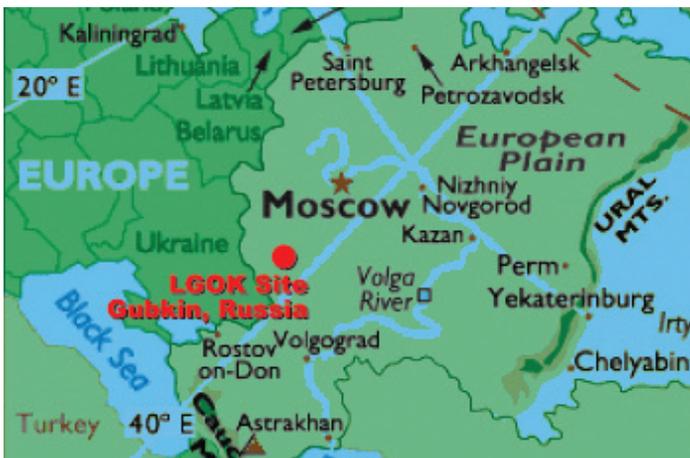


Figure 2 - Location of LGOK

IMPLEMENTATION OF THE PROJECT

The plant is located in Gubkin, Russia at Lebedinsky Mining and Processing Integrated Works (LGOK), approximately 700 kilometers south of Moscow, in an area rich in iron ore (see Figure 2). In negotiating the project, the emphasis was placed on each partner providing what they could best bring to the “project table.” For Midrex, the world’s most proven direct reduction process and HBI production expertise; for Siemens VAI, its 25 years of working with Midrex and vast experience in metal processing technology, as well as its extensive experience in the implementation of metallurgical plants in Russia; for LGOK, iron ore mining, pelletizing, specific Russian knowledge in reducing and handling domestic ores and knowledge of the briquetting process. Thus, all three partners had their specific roles. The scope split was defined and a proposal became reality.

The Midrex and Siemens VAI scope of the project was to supply proprietary equipment, detail design of the core area and the detail design of the water treatment systems, structural systems, electrical/instrumentation systems and the plant operating system. Midrex and Siemens VAI sourced equipment worldwide, including the United States, Germany, Austria, Canada and Russia. The furnace casing of the 6.65 meter diameter MIDREX® Shaft Furnace was designed by Midrex and supplied by the Siemens Russian affiliate. It was fabricated in Russia and shipped to the site by truck over 400 kilometers in five major sections. The largest component was the furnace bustle area that is approximately 4.5 meters high and over 9 meters in diameter. This gigantic section was delivered to the site in one piece, ready for erection, as shown in Figure 3.

Other equipment and services supplied by the consortium included:

- Basic engineering for oxide material handling
- Hot discharge system including product discharge chamber, briquetter feed legs and hot valving for operation with DRI at temperatures 700° C and above
- Hot briquetting system including five briquetting machines and briquette separators
- A system for slow cooling of the HBI so that the briquette strength would be increased versus quickly quenched briquettes

- The two stage Process Gas Compressor system, including all instrumentation and operating hardware and software
- MIDREX® Reformer with 17 bays, 510 tubes of 250 mm diameter and catalyst
- The Heat Recovery System, which uses hot flue gas from the reformer to preheat natural gas, feed gas to the reformer tubes and top gas and combustion air to the reformer burners to allow the plant to operate at maximum gas consumption efficiency
- Power stack system including the fan and motor
- Product screening station
- Electric, instrumentation and automation detail engineering and supply
- Utilities
- Basic engineering and documentation for the equipment to be supplied by LGOK (LGOK contracted the majority of the local work)
- Plant start-up and operation training
- Commissioning and start-up advisors

The scope assumed by LGOK was critical and was deeply tied to the project's success. LGOK took responsibility for the following areas of the project:

- Construction management responsibilities, including qualifying, hiring and supervising all construction activities
- All site works, including levelling, underground works and utility supply to tie-in points
- All detail design and installation of piling and foundations
- Detail design and supply of some oxide and HBI material handling equipment
- Supply of all structural components, including the reformer and heat recovery structure and casings
- Supply of all local materials, including piping, wiring, cable trays, pipe supports, etc.
- Most importantly, coordination of the three partners in ensuring success.

As with all international projects, there were challenges. Challenge number one was language, given that the partners were located in Russia, Austria and the United States. The language issue entailed both spoken and written communications.



Figure 3 - Shaft Furnace Casing Being Delivered

Midrex and Siemens VAI hired translators and specialists to assist in this area and LGOK provided a staff of competent technical translators. The end result was that the language barrier became a non-issue.

There were other challenges. For Midrex, this was the first Russian project executed from the United States. The climate conditions were extreme and the design standards and engineering specifications were unknown. Design criteria, document submittals, equipment quality verification and even the details of road layout requirements were challenging.

How did the partnership manage all these issues? The answer is teamwork. LGOK provided Midrex and Siemens VAI with the documentation and information needed. Midrex and Siemens VAI then coordinated with the engineering institute selected by LGOK. The end result is a plant designed in Russia, the United States and Austria that meets all the Russian design requirements.

The completed MIDREX® Module, shown in Figure 4, has a rated capacity of 1.4 Mtpy of HBI, making it the world's largest HBI module.

START-UP AND OPERATIONS

At the LGOK MIDREX Plant, Lebedinsky iron ores, comprised mostly of magnetite, are concentrated and then processed to direct reduction-grade pellets. In the MIDREX Shaft Furnace, the pellets (100 percent of the feed) are reduced to metallic iron, with a metallization degree exceeding 93 percent. The next step is to hot compact the pellets at 680° C to produce a densified iron product in the form of pillow-shaped briquettes. These briquettes, known as HBI, are the preferred product for shipping, enjoying favorable regulations by international transportation authorities.

In July 2007, cold commissioning began. The three-party team established a schedule and held daily meetings to review progress.

Hot commissioning started in October 2007 with the lighting of the reformer burners. On October 23, 2007, the plant was ready for operation. DRI material from LGOK's sister company, OEMK, was used to "quick" start the plant. The furnace had been filled with OEMK DRI, the reduction gas chemistries were right, temperatures good, all systems go and the process started. The first briquettes were made that day, after which LGOK pellets were introduced and reduced and briquetted successfully. The time from lighting of the reformer to making briquettes was 22 days.

Since start-up, the plant has performed well, with product density, carbon and metallization all within the guaranteed figures. The tumble index (measure of HBI strength) has thus far surpassed all expectations due to slow quenching and good briquette operating procedures. At times, the plant has operated more than 10 percent above rated capacity.

As with any new facility, there were some initial problems, but the partnership between LGOK, Midrex and Siemens VAI has overcome them. The project and the plant are seen as great successes. The three partners continue to work together to make improvements in plant operations as they gain experience.

CONCLUSION

In conceiving, designing, building and starting up the world's largest HBI plant, the three partners took some risk. LGOK is to be congratulated for seeing the potential advantages of a different technology than the one previously used. Midrex and Siemens VAI took the responsibility of working with LGOK to make the project successful, using an ore previously untried in a MIDREX Plant. Despite these challenges, the result is an HBI plant that has produced above rated capacity on the majority of operating days in its initial operation. The future looks bright for the facility, proving the benefits of the close partnership.



Figure 4 - LGOK MIDREX Plant

Midrex News & Views

LGOK 2 Unveiled

On 30 May, trade press and various guests were treated to a press conference and a site tour of the world's largest HBI single module. Located in Gubkin, Russia, LGOK 2 is a 1.4 million ton per year MIDREX MEGAMOD® HBI Plant situated near the world's largest open pit mine owned by Metalloinvest. Beginning operations last year, the plant is currently producing HBI for export.

Background

Lebedinsky Mining and Processing Integrated Works is a leading manufacturer of iron-ore products in Russia with a 21 percent share of the domestic market. A universally recognized manufacturer of high quality iron ore concentrate, pellets and hot briquettes, Lebedinsky Mining and Processing Integrated Works is the only European mining-and-processing integrated works that employs direct reduction process technology.

In 2005, Lebedinsky GOK (LGOK), Gubkin, Russia, signed a contract with Midrex Technologies, Inc. and Siemens VAI (Austria) for the engineering and supply of a 1.4 mty MIDREX® Direct Reduction HBI Plant. The signing ceremony was held February 18th in Moscow. The project was executed in consortium by Midrex and VAI with five briquetters supplied by Koeppern.

This MIDREX® HBI plant is LGOK's second direct reduction plant; the MIDREX Direct Reduction Process for ironmaking was chosen for the second module. LGOK's first DR Plant began operation in 1999 using the HYL III Process.

LGOK plans to use 100 percent LGOK pellets from its own mines for feed material, taking iron ore off the market in favor of creating a more value-added iron product for export to the European and global steel markets.

Lebedinsky GOK, is owned by Metalloinvest, a Russian holding company that also owns Oskol Electrometallurgical Works (OEMK).



Midrex News & Views

The First Briquette... with Millions More on the Way

After the press tour in Gubkin, Russia, Midrex received a warm welcome and was bestowed a very special honor by our hosts, LGOK and Metalloinvest. Oleg Semenov, Managing Director LGOK, presented James D. McClaskey, President and CEO of Midrex, with the very first briquette produced by LGOK 2. It was a proud moment for Midrex as the briquette represents a true testament of not only the proven HBI technology that Midrex helped to create, but also the dependability and reliability of the LGOK HBI Module that was able to produce high quality product immediately upon start-up.



Jim McClaskey of Midrex receives the first HBI briquette produced by LGOK 2.

Christopher M. Ravenscroft: Editor

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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.