MIDREX

DIRECT FROM MIDREX

2ND QUARTER 2023

MIDREX® PLANTS PRODUCE 73.56 MILLION TONS OF DRI IN 2022

Pictured: Cleveland-Cliffs HBI Plant

COMMENTARY

TECHNOLOGY SHARING :

Technology Transfer the Midrex Way

By David Durnovich
Director – Global Solutions

Following World War II through the 1960s, technology was typically developed by companies with research & development staffs and/or operating experience and "transferred" to other countries through direct investment, foreign subsidiaries, or majority-controlled joint ventures. This arrangement allowed multi-national corporations, especially those involved in extracting and processing minerals, to retain direct management and close control of how their technologies were used.

However, newly emerging economies in the 1970s, particularly those in the oil-rich Middle East, found that this method of technology transfer did little to enhance national economic development and gave foreign companies too much influence. As a result, a new way of doing business emerged with the primary objective of developing industrial self-reliance through local and regional ownership, operation, and management of companies and plants.

The timing was right for a different type of technology transfer – technology sharing, which Midrex has championed from its earliest days. It involves the direct sale of technical know-how along with related services, such as training, equipment procurement, plant start-up and commissioning, operating assistance, and even product marketing. In return, the licensee shares the expertise it develops from plant operations with the licensor, who incorporates it into the body of technology to share with other licensees and use in designing new plants.

The Midrex approach to technology transfer is based on four pillars:

1. Keep plant equipment designs and operating procedures as simple as possible
2. Provide hands-on training for Midrex engineers and plant operators
3. Empower local management and staffs to take responsibility for plant operation and performance
4. Encourage open, two-way exchange of technical improvements and operational know-how

What makes Midrex technology sharing so effective is the close cooperation and mutual respect of our engineers and the skilled operators of MIDREX® Plants. From the start, Midrex has recognized the value of first-hand feedback from those involved in plant operations. How else could the first MIDREX Plants have been built and put into production while the process was being fine-tuned at the prototype plant in Portland.

Midrex interacts with its licensees on two levels – technical services and aftermarket solutions. Our Technical Services Group is the "eyes and ears" of the plants, serving as an information clearinghouse and providing feedback on technical questions throughout the year and during the annual International Conference on MIDREX® Technology (a.k.a., Operations Seminar).

Our dedicated aftermarket solutions group, known as Global Solutions (GS), works with plant operators to design and implement improvements to equipment, systems, and methods that optimize operations, enhance product quality, extend plant life, and protect assets and resources. GS projects can range from debottlenecking studies to water systems upgrades, complete shutdowns turnkey, and iron-to-steel (I2S) optimization.

To better serve our global family of operating plants and the growing number of new customers, we have opened a Midrex Gulf Services office in Dubai and an engineering center in India, and our parent company, Kobe Steel, has a group dedicated to the MIDREX Process in Japan. We can now say that "Midrex never sleeps" because someone is always available no matter the time day-or-night.

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This issue includes a report of test work at the Midrex Research & Technology Development Center that compared the physical strength of HBI produced using natural gas and hydrogen as the reductant source, and a summary of the operation and achievements of MIDREX Plants in 2022. In addition, News & Views contains noteworthy industry-related events occurring during 2Q2022 and recognizes the 50th anniversary of the initial start-up of ArcelorMittal Canada 1.

Is HBI Physical Strength Affected By Hydrogen vs. Reformed Natural Gas?

By VITA A. DEAN, *Chemical Laboratory Manager Midrex Technologies, Inc.*

INTRODUCTION

It is known that the iron and steel industry is the second largest industrial carbon dioxide (CO_2) emitter, and it accounts for around 10% of the global emissions.

In recent years, the steel industry has been putting a major effort into reducing CO_2 emissions. Several approaches and technologies are being considered. One of them is direct reduction of iron ore with hydrogen. Pure hydrogen gas (H_2) can be used in the direct reduction process. This paper will discuss the quality of hot briquetted iron (HBI) produced with pure H_2 compared to HBI produced with reformed natural gas (NG).

BACKGROUND

Among heavy industries, the iron and steel sector ranks first when it comes to CO_2 emissions: around 2.6 gigatonnes of carbon dioxide (2.6 Gt CO_2) annually.[1] To meet global energy and climate goals, steel industry emission must decrease by at least 50% by 2050. Achieving this target will require new technologies. Hydrogen-based direct reduced iron (DRI) is one of them. However, that leads to the question of whether the HBI produced from zero carbon DRI, resulting from using pure H_2 as the reducing gas, will reach the same targeted parameters, such as product density and strength when compared to HBI produced from DRI produced with reformed NG.

Tests were conducted at the Midrex Research & Development Technology Center (RDTC) to compare physical and chemical properties of HBI made with H_2 versus reformed NG. A typical DR-grade oxide feedstock was selected for the tests, which was reduced with H_2 and NG in the RDTC's large reduction furnace (LRF). Both batches of DRI were then briquetted in the RDTC's commercial-scale briquetting machine.

DISCUSSION

Chemical composition of the oxide feedstock used in the tests is summarized in ***Table 1***. Typical DR-grade oxide pellets with total iron above 67% were used.

Approximately 400 kg of oxide pellets were used to produce each batch of DRI. Either H_2+CO syngas simulating NG base reduction or H_2/N_2 mixed gas simulating H_2 reduction was used to produce each batch of DRI. The LRF temperature was controlled at ≈800-850°C depending on the clustering tendency of the oxide pellet. The reduced material was cooled down under N_2 atmosphere, and the DRI was unloaded from the LRF.

It was observed that the bed temperature drop for H_2 reduction was larger than for NG-based reduction, but the H_2 case took less time to complete the reduction process than the NG case.

The resulting DRI from each trial (around 300 kg) was reheated above 750°C and subsequently briquetted in a commercial-scale briquetting machine ***(see Figure 1)***. The briquettes were approximately the size of commercially available HBI (116 cc, volume), and each briquetting run was approximately two (2) minutes in duration.

Oxide Pellet Analysis	
Fe_Total (%)	68.02
Fe++ (%)	0.32
SiO2 (%)	0.90
Al2O3 (%)	0.19
CaO (%)	0.89
MgO (%)	0.64
C/S	0.99

TABLE I. *Oxide Feedstock Analysis*

FIGURE 1. *Commercial-scale briquetting machine at Midrex RDTC*

The briquetting machine was set up as follows for both runs:

Screw feeder speed	60 – 90 RPM (adjusted per monitored roller gap & torque)
Roller average gap	4 mm
Roller speed	4 RPM
Roller hydraulic pressure	140 bar
Roller accumulator pressure	90 bar

An example of briquettes produced during the tests is shown in ***Figure 2***.

Chemical analysis of the DRI and HBI was conducted on samples submitted to the analytical laboratory.

DRI and HBI chemical analysis for NG- and H_2-reduced materials is summarized in ***Table 2***. It should be noted that reduction time was different for the NG and H_2 runs.

The HBI made from DRI reduced by NG and H_2 was evaluated for density, tumble strength, and drop strength.

Apparent density was measured for both types of HBI ***(see Figure 3)*** in accordance with ISO 15968:2016 by submerging briquettes in water and measuring the weight of HBI before and after soaking. The calculations were applied to determine the density and water absorbency of HBI.

HBI produced with NG had density of 5.1 g/cc, while HBI produced with H_2 had density of 5.4 g/cc. Both materials achieved IMO required density of greater than 5 g/cc. The water porosity was measured to be 22.0% for NG-HBI material and 18.9 % for H_2-HBI.

Therefore, it appears that HBI made with H_2 has higher density and lower porosity than HBI produced with NG.

FIGURE 2. *Example of HBI produced during the tests*

Chemical Analysis Data Summary		
Reducing Gas	**NG**	**H_2**
Reduction Time	2-4 Days	≈ 24 Hours
DRI Analysis		
Fe_Total (%)	94.75	95.85
Fe_Metallic (%)	93.97	92.55
Metalization (%)	99.17	96.56
C (%)	1.04	0.02
HBI Analysis		
Fe_Total (%)	93.53	93.78
Fe_Metallic (%)	89.49	86.87
Metalization (%)	95.69	92.63
C (%)	0.79	0.02

TABLE 2. *Chemical Analysis Data Study*

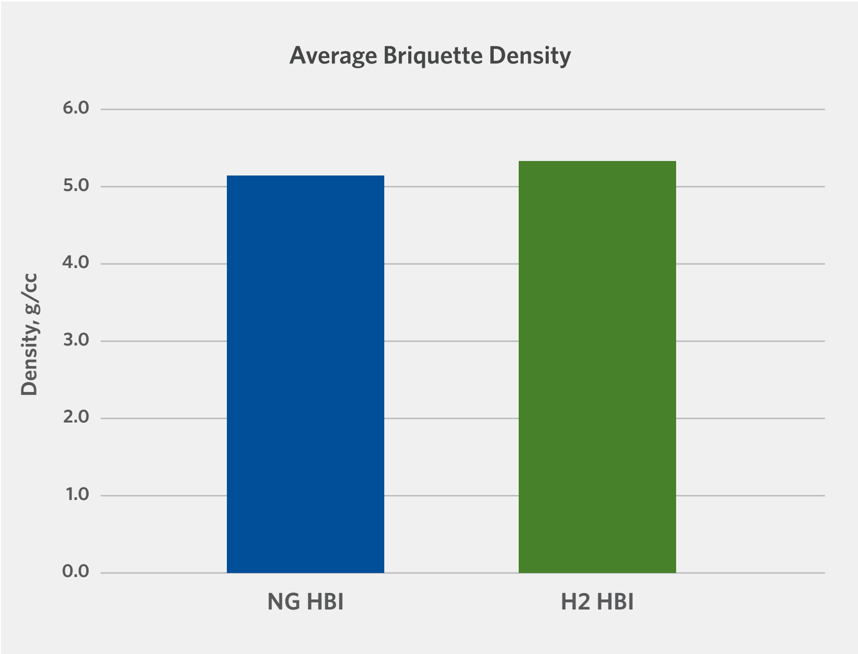

FIGURE 3. *Average briquette density NG-HBI vs. H_2-HBI*

The tumble and abrasion indices for both types of HBI were measured in accordance with ISO 15967:2007 in an ISO-style lifter tumble drum with a counter set for stopping at 200 revolutions (N=25 rpm). Sample size was 15+/-0.5 kg of briquettes, and the screen structure was measured and reported.

The drop strength of both types of HBI was evaluated after four (4) drops. The drop height was five (5) m, and the screen structure of the HBI after the drops was reported.

The physical strength for HBI produced with H_2 was found to be equivalent to or slightly higher than HBI produced with NG. The results for both tests are summarized in ***Table 3***.

Reducing Gas	NG	H_2
HBI Tumble Strength		
+38mm	90.32	92.21
+19mm	90.64	93.34
+6.7mm (tumble index)	96.36	96.23
Drop Strength (wt %)		
+38mm after 4 drops	88.9	98.1
+19mm after 4 drops	97	98.1

TABLE 3. *Data summary for tumble and drop strength of NG-HBI and H_2-HBI*

CONCLUSION

To meet global energy and climate goals, steel industry CO_2 emissions must be decreased by at least 50% by 2050. Reducing CO_2 emissions from ironmaking process can significantly contribute towards achieving that goal. Shifting from blast furnace-produced iron to reformed NG-produced DRI/HBI can significantly reduce CO_2 emissions, and using DRI/HBI produced with pure H_2 can reduce emissions even further.

These tests demonstrated that the physical properties of HBI produced from DRI reduced by H_2 are very similar to HBI made from NG-reduced DRI. Both HBI types achieved IMO required density of >5g/cc. When comparing HBI made from H_2-reduced DRI to the HBI made from NG-reduced DRI, it was observed that the density of H_2-reduced material is slightly higher. H_2-reduced HBI demonstrated acceptable physical strength, with tumble and drop test results similar to or slightly higher than NG-HBI. Therefore, H_2 ironmaking using direct reduction technology is a viable first step toward carbon-free steelmaking.

References:

1. IEA (2020), Iron and Steel Technology Roadmap, IEA, Paris https://www.iea.org/reports/iron-and-steel-technologyroadmap.
2. Midrex Technologies Inc., Direct from Midrex (various publication years).

Acknowledgement

This article was developed from the paper titled “Briquette Strength: Effect of Hydrogen versus Reformed Natural Gas,” by Vita A. Dean, which was presented at AISTech 2023, May 8-11, in Detroit, Michigan. The author thanks her teammates at the Midrex RDTC for their hard work and collaboration in conducting the research on which this article is based.

Pictured: Algerian Qatari Steel (AQS)

MIDREX® Plants produced 73.56 million tons (Mt) of direct reduced iron (DRI) in 2022, which is 3.8% more than the 70.85 Mt produced in 2021. The production total for 2022 was calculated from the 43.42 Mt confirmed by MIDREX Plants located outside of Iran and the estimated 30.14 Mt for MIDREX Plants in Iran, based on production data for Iran reported by the World Steel Association (WSA). Over 10 Mt of hot DRI (HDRI) were produced by MIDREX Plants, which were consumed in nearby steel shops to assist them in reducing their energy consumption per ton of steel produced and increasing their productivity.

MIDREX Plants have produced a cumulative total of more than 1.32 billion tons of all forms of DRI (cold DRI, CDRI; hot DRI, HDRI; and hot briquetted iron, HBI) through the end of 2022.

MIDREX Technology continued to account for ~80% of worldwide production of DRI by shaft furnaces in 2022. At least seven MIDREX Modules* established new annual production records and at least six established new monthly production records. Twelve additional modules came within 10% of their record annual production and 14 operated more than 8,000 hours.

The Venezuelan plants (COMSIGUA, Ferrominera Orinoco, Sidor, and Venprecar) operated during 2022 at reduced capacities, but production details were not made available. No detailed production information has been received from the plants in Iran. The following plants did not operate in 2022 due to commercial or market conditions: ArcelorMittal Point Lisas, ArcelorMittal South Africa, Delta Steel, ESISCO, Lion DRI, and Tuwairqi Steel Mills.

** A MIDREX Plant can include one or more modules*

NEW PLANT CONTRACTS

Midrex and Paul Wurth were selected by H2 Green Steel to supply the world's first commercial 100% hydrogen DRI plant as part of an integrated DRI-EAF facility in Boden, Sweden. H2 Green Steel will produce green steel, reducing CO_2 emissions by up to 95% compared to traditional steelmaking by replacing coal with green hydrogen powered by renewable electricity.

H2 Green Steel's 2.1 million tons per year (Mt/y) MIDREX H2™ plant will be designed to simultaneously produce hot DRI (HDRI) for use in the adjacent EAF as well as hot briquetted iron (HBI) for export. The plant will include the latest innovation from Midrex, an electric heater for the recirculating hydrogen gas, designed and supplied in partnership with Tutco SureHeat of the Flex-Tek Group, a division of the UK-based engineering company Smiths Group plc. The MIDREX H2 plant is expected to begin production in 2025 and ramp up during 2026.

H2 Green Steel will build the first 100% hydrogen DRI plant in Boden, Sweden which will produce HDRI and HBI.

2022 PLANT HIGHLIGHTS

ALGERIAN QATARI STEEL (AQS)

After starting up in March 2021 during the pandemic, AQS continued ramping up production in 2022 to meet its steel shop's requirements. AQS set monthly production records three times throughout the year to reach an average 300 tons per hour (t/h) in November, as well as setting a new annual production record.

ANTARA STEEL MILLS

The first MIDREX HBI Module that started up in August 1984 operated 20% over its annual rated capacity and beat its previous annual production record set in 2004 by almost 1%. Total iron in its HBI was the highest of all MIDREX Plants, averaging 92.56% for the year. All production was shipped by water to third parties.

ARCELORMITTAL ACINDAR

In its 44th year of operation, Acindar's module operated the whole year below maximum capacity due to local market conditions in Argentina, averaging over 95% metallization in its product. Acindar has achieved the most production from a 5.5-meter MIDREX Shaft Furnace to date, with over 33 Mt of CDRI produced.

Algerian Qatari Steel (AQS)

Antara Steel Mills

ArcelorMittal Acindar

ARCELORMITTAL CANADA 1 & 2

In its 45th anniversary year, Module 2 produced over 1 Mt, operating 8,326 hours in the year. The combined production from both modules was over 90% of their 2018 production record.

ARCELORMITTAL HAMBURG

The longest-serving MIDREX Module operated at reduced capacity through September and was shut down for the remainder of the year due to high natural gas prices in Europe.

ARCELORMITTAL LÁZARO CARDENAS

In its 25th anniversary year, AMLC produced 19% over its annual rated capacity of 1.2 Mt using mostly oxide pellets made in the adjacent pellet plant. Its 6.5-meter reduction furnace has produced a total of over 37.5 Mt of CDRI, the most by a single module to date.

ARCELORMITTAL POINT LISAS

All three MIDREX Modules remained shut down throughout the year.

ARCELORMITTAL SOUTH AFRICA (SALDANHA WORKS)

This COREX® export-gas-based MxCol® Plant was idled in January 2020 and remained shut down throughout 2022.

ARCELORMITTAL TEXAS HBI

The ArcelorMittal Texas 2.0 Mt/y HBI module located near Corpus Christi, Texas, USA, established a new annual production record in 2022, as well as a new monthly production record in April. In July 2022, ArcelorMittal completed the acquisition of an 80% stake in the HBI plant from voestalpine AG (Austria).

ARCELORMITTAL/NIPPON STEEL INDIA

In the 30th anniversary year for Module 3, AM/NS India's Modules 1, 2 and 3 operated above rated capacity, and Module 2 surpassed the 15-Mt production milestone. More than 91% of the output from the four HDRI/HBI modules was in the form of HDRI. Modules 1 and 6 produce CDRI exclusively. All six modules combined have produced over 86 Mt of HDRI, HBI, and CDRI since start-up of the first two modules in 1990. Modules 5 and 6 operated using CO_2-scrubbed off-gas from AM/NS's COREX Plant for over 22% of their energy input.

ArcelorMittal Canada

ArcelorMittal Lazaro Cardenas

ArcelorMittal Hamburg

ArcelorMittal Texas HBI

ArcelorMittal/Nippon Steel India

CLEVELAND-CLIFFS

In its second full year of operation, Cliffs continued to increase production and set a new annual production record that was 6.4% over its rated capacity, with annual average metallization levels exceeding 95%. Utilizing oxide pellets from its own mines, the 1.6 Mt/y plant located in Toledo, Ohio, produces HBI mainly for consumption by internal Cleveland-Cliffs steel plants.

COMSIGUA

The MIDREX HBI plant operated during 2022 at reduced capacities, but production details were not made available.

DELTA STEEL

The two modules in Nigeria did not operate in 2022.

DRIC

In their 15th anniversary year, both DRIC modules in Dammam, Saudi Arabia, operated above rated capacity and set a new combined module production record of 1.15 Mt. Module 2 set a new annual production record operating 8,600 hours, and output from Module 1 was within 2% of its annual production record. Both modules set new monthly production records.

ESISCO

After shutting down in early March of 2020, Beshay Steel's MIDREX Plant remained shut down throughout 2022.

EZDK

In its 25th anniversary year of operation, EZDK's Module 2 operated 8,595 hours with over 95% metallization in its product. Production was above rated capacity in all three modules and higher than in previous years, within 6% of their multi-module production record set in 2011. Module 3 surpassed the 20-Mt production milestone, and the three modules combined have produced over 70 Mt to date. The average hours of operation for all three modules was 8,261 hours in 2022.

FERROMINERA ORINOCO

The MIDREX HBI plant operated during 2022 at reduced capacities, but production details were not made available.

Cleveland-Cliffs

DRIC

EZDK

HADEED

In its 40th anniversary year, Module B operated over 8,650 hours, and Module A operated just under 8,600 hours, within 5% and 6.5% of their record annual productions respectively. With over 25.5 Mt produced, Module E has attained the most production from a 7.0-meter MIDREX Shaft Furnace to date. Combined, the four modules surpassed the 105-Mt production milestone in 2022 and were within 9% of their multi-module production record set in 2013. Hadeed also owns an HYL plant (Module D).

Hadeed Module E

JINDAL SHADEED

Jindal Shadeed's HOTLINK® Plant established a new annual production record of 1.82 Mt, which is 21.4% over its rated capacity of 1.5 Mt. Of the 1.82 Mt, 1.75 Mt (96.1%) were consumed as HDRI in their steel shop that is physically attached to the DR Plant. Jindal Shadeed operated 8,315 hours in the year and over 8,200 hours per year on average for the full 12 years since its initial start-up. The single module plant, located in Sohar, Oman, is designed to produce mostly HDRI, with HBI as a secondary product stream.

Jindal Shadeed

JSPL (ANGUL)

In 2022, Jindal Steel and Power Limited's (JSPL) MxCol® Plant in Angul, Odisha State, India, came within 9% of its annual production record set in 2021, during its eighth year of operation. This is the first MxCol Plant using synthesis gas from coal gasifiers to produce both HDRI and CDRI for the adjacent steel shop. HDRI production was 55% of total production, and Coke Oven Gas (COG) use in the DR plant continued throughout the year, averaging ~19% of the plant's energy requirements.

JSPL (Angul)

JSW STEEL (DOLVI)

JSW Steel's module producing CDRI handily exceeded rated capacity and operated over 8,200 hours. Approximately 10% of this plant's energy input is Coke Oven Gas (COG) injected into the shaft furnace to reduce Natural Gas consumption. JSW Steel (Dolvi) has averaged 8,032 hours of operation per year since its initial start-up in 1994, and 8,168 hours per year in the last seven years.

JSW Steel (Dolvi)

JSW STEEL (TORANAGALLU)

JSW Steel's HDRI/CDRI module in Toranagallu, Karnataka State, India, using COREX export gas as energy input, operated 8,072 hours and increased its production compared to 2021, although limited by the availability of COREX export gas.

LEBEDINSKY GOK

In the 15th anniversary year of Module 2 and 5th anniversary year of Module 3, LGOK's MIDREX HBI Modules located in Gubkin, Russia, both operated above rated capacity, with Module 2 breaking its annual production record through increased production rate and 8,128 hours of operation in the year. Module 3 holds the record for the highest annual production by an HBI module and from a 7.0-meter MIDREX Shaft Furnace, with over 2.0 Mt, set in 2020. Having started up in March 2017, with a rated capacity of 1.8 Mt/y, Module 3 surpassed the 10-Mt production milestone in April 2022, averaging just under 2.0 Mt/y. LGOK HBI-1 is an HYL plant.

LION DRI

The Lion DRI module, located near Kuala Lumpur, Malaysia, remained shut down throughout 2022 due to competition from foreign steel products.

LISCO

Production by LISCO's two DRI modules and one HBI module in Misurata, Libya, showed improvement but continued to be restricted by factors outside the company's control. In its 25th anniversary year, Module 3, producing HBI mainly for export, ramped up production to ~75% of capacity, reaching within 4% of its monthly production record in December.

NU-IRON

Nucor's module in Trinidad and Tobago reported production of CDRI that exceeded 1.4 Mt in 2022, despite downtime caused mainly by outside sources. Average metallization for the year was the highest of all MIDREX Plants at over 96.3%, with 2.73% carbon in the DRI.

JSW Steel (Toranagallu)

LGOK HBI-2

LGOK HBI-3

LISCO

Nu-Iron Unlimited

OEMK

Thirty-five years after the start-up of Modules 3 and 4, OEMK's four MIDREX Modules surpassed the 80-Mt production milestone in the first quarter of 2022, with Modules 1, 3 and 4 averaging over 8,400 hours of operation. Modules 1 and 4 came within 1% of their respective annual production records, and Module 2 set a new monthly production record in March.

QATAR STEEL

After being shut down since March 2020, Qatar Steel's dual product (CDRI/HBI) Module 2 was restarted in January 2022, due to improved but limited demand for its steel products. In its 15th anniversary year, Module 2 operated 8,188 hours, exceeded its rated capacity, surpassed the 20-Mt production milestone, and exported some CDRI and HBI. Module 1 was shut down for most of 2022. Qatar Steel's Module 1 has produced over 28.3 Mt of CDRI since its initial start-up in 1978, the most for a 5.0-meter shaft furnace..

SIDOR

No production information was made available.

SULB

SULB's 1.5 Mt/y combination module (simultaneous HDRI/CDRI production) in Bahrain operated at 95% of rated capacity, with over 150,000 tons of CDRI exported by sea, and 87% of the DRI consumed by the adjacent steel shop delivered in the form of HDRI.

TENARISSIDERCA

TenarisSiderca's CDRI module in Argentina operated the entire year (with the customary shutdown in winter due to Natural Gas supply restrictions) to satisfy the DRI demand from its steel shop. The module's average DRI metallization percentage for the year was the second highest of all MIDREX Plants at 95.50%.

OEMK

Qatar Steel Module 2

SULB

TenarisSiderca

TOSYALI ALGERIE

Tosyali Holding's 2.5 Mt/y combination (HDRI/CDRI) module, located in Bethioua, near Oran, Algeria, produced just 4% less than its annual production record set in 2021, and set a new monthly production record in November 2022. Over 71% of production went to the adjacent steel shop as HDRI. Together with Algerian Qatari Steel (AQS), this is the largest capacity MIDREX Module built to date, with a 7.5 m diameter shaft furnace.

TUWAIRQI STEEL MILLS

The 1.28 Mt/y combination module of Tuwairqi Steel Mills, located near Karachi, Pakistan, did not operate in 2022 due to market conditions.

VENPRECAR

The MIDREX HBI plant operated during 2022 at reduced capacities, but production details were not made available.

(Editor's note: all tons are metric tons)

Tosyali Algérie

Midrex News & Views

The full news articles are available on **www.midrex.com**

Midrex Commemorates 40 Years As Part of Kobe Steel Group

Former and current Midrex managers and executives and Kobe Steel representatives recently participated in a question & answer session commemorating the 40th anniversary of the acquisition of Midrex by Kobe Steel. The six former Midrex employees represent more than 200 years of direct reduction industry experience.

Shohei Manabe, who joined Kobe Steel in 1978, has been closely involved in the operation and management of Midrex since 1993, and was instrumental in restructuring the working relationship of the two companies and optimizing the Midrex Construction Licensing Program.

This year marks the 40th anniversary of Midrex becoming a member company in the Kobe Steel Group. Throughout 2023, we will hold several events to commemorate the acquisition of the assets of Midrex Corporation by Kobe Steel, Ltd. (KSL) from Korf Industries, Inc. in 1983. The first of these took place on June 5, when representatives of KSL and former Midrex teammates joined in a Q&A session at Midrex Headquarters to share their experiences with current teammates and later visited the Midrex Research & Technology Development Center to tour the upgraded facilities.

The purchase of Midrex was the first time Kobe Steel had obtained outright ownership of a foreign company. It resulted from KSL's first-hand experience with the MIDREX® Process in designing, building, and managing an integrated electric arc furnace-direct reduced iron (EAF-DRI) steel mill for Qatar Steel Company in 1978.

Kobe Steel saw the potential of direct reduction and the role of Midrex in its growth, which was evident in the decision to acquire "the assets of Midrex" – the people with the knowledge and experience in developing, engineering, and implementing the technology on the global stage.

At the time of the acquisition of Midrex, Kobe Steel Vice Chairman Taisuke Mori said, "The technical excellence of the MIDREX Direct Reduction Process is testimony to the research & development and engineering capabilities of Midrex people. We see Midrex as our marketing and engineering arm in the United States."

"Some relationships define the partners. Others are defined by the partners. In the case of Midrex and Kobe Steel, both of these statements are true," Midrex CEO Stephen Montague observed. "With the backing of Kobe Steel, Midrex has strengthened its commitment to innovation and continuous improvement on which the company was founded."

Midrex News & Views

The full news articles are available on **www.midrex.com**

Kobe Steel & Mitsui Announce DRI Project in Oman

5 Million Tons Using MIDREX® Hydrogen-based Technology

KOBELCO | MITSUI & CO.

Kobe Steel, Ltd. and Mitsui & Co., Ltd. have signed a memorandum of understanding (MoU) with Oman's Public Authority for Special Economic Zones and Free Zones (OPAZ) to manufacture and sell direct reduced iron (DRI) near the port of Duqm. The plant will utitlize MIDREX™ Flex technology, which allows for initial operation on natural gas with transition to up to 100% hydrogen. The Low-CO_2 Iron Metallics Project aims to produce 5 million tons of DRI with a future expansion plan under study.

Oman is a country rich in natural gas and a suitable location for the Low-CO_2 Iron Metallics Project, as the country promotes renewable energies and green hydrogen. While natural gas will be used as a reducing agent in the project for the time being, replacement of natural gas by hydrogen in combination with carbon capture, utilization, and storage (CCUS) will be possible to further reduce CO_2 emissions.

Ivan Simunovic to Lead Midrex Technical Services From Midrex Gulf Services Offices in Dubai


Ivan Simunovic

Midrex has named Ivan Simunovic as Manager of Technical Services to replace Anthony Elliot, who will retire after more than 23 years as the primary technical contact for MIDREX® Plant operators. Simunovic, who most recently served as Midrex Chief of Operations, also has held the positions of Process Engineer and Plant Manager at ArcelorMittal ACINDAR in Villa Constitucion, Argentina. He brings to the key services position a wealth of MIDREX Process know-how and hands-on experience in the operation and maintenance of a MIDREX Plant.

The transition process will begin immediately, culminating at the 2023 International Conference on MIDREX® Technology (a.k.a. Midrex Operations Seminar) in Lisbon. Throughout the first quarter of 2024, Elliot will mentor Simunovic to ensure a seamless transition of responsibilities. As part of the transition, Midrex Technical Services will establish its headquarters in Dubai at the Midrex Gulf Services offices.

Midrex News & Views

The full news articles are available on **www.midrex.com**

MIDREX® Plant with 2Q Anniversary

Midrex is known for designing, engineering, and servicing reliable direct reduction plants, as well as for making certain that these plants have long and successful operating lives. This issue of ***Direct From Midrex*** recognizes the start-up of Arcelor Mittal Canada 1 in Contrecoeur, Quebec, Canada (50 years).

The steel mill in Contrecoeur, Quebec, Canada, began operations in 1972 as Sidbec-Dosco. The first of two MIDREX® Direct Reduction Modules was started up in April 1973 (AM Canada 1), followed in August 1977 by AM Canada 2.

During 2022, ArcelorMittal successfully tested partial replacement of natural gas with green hydrogen in AM Canada's Module 1, replacing 6.8% of natural gas during a 24-hour period, which contributed to a measurable reduction in CO_2.

AM Canada 1 has produced 12,919,490 tons of cold DRI (CDRI) in its 50-year operational career.

Read more about ArcelorMittal Long Products at:
https://long-canada.arcelormittal.com/en

ARCELORMITTAL CANADA 1

ArcelorMittal Canada 1 was started up 50 years ago in the 2Q

Location:
Contrecoeur, Quebec, Canada

DRI plant:
MIDREX (1 of 2 modules)
- Start-up: April 1973
- Flowsheet: MIDREX Flex™
- Product: CDRI
- Capacity 0.65 million tons/year

(AM Canada 1 pictured in background, AM Canada 2 in foreground)

Lauren Lorraine: **Editor**

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