MIDREX

DIRECT FROM MIDREX

3RD QUARTER 2023

THE NEW AGE OF **HOT BRIQUETTED IRON (HBI)**

HOW WILL THE STEEL INDUSTRY TRANSFORM?

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Pictured: ArcelorMittal Texas HBI Plant

COMMENTARY

FINDING THE RECIPE FOR HYDROGEN HEATING

By John Teeters
Director – Engineering

Occasionally serious challenges come our way; not the kind that require a little extra effort, but the kind of challenges that require a new way of thinking. That's exactly where our Engineering team is today, as we have been asked to design the world's first full-scale 100% hydrogen-based iron reduction plant. Iron reduction with hydrogen has been done in a lab, and it's been done with a very small-scale pilot plant, but no one to date has produced anywhere close to 2 million tons per year (Mt/y) of direct reduced iron (DRI) utilizing hydrogen as the sole reductant. H2 Green Steel is not far from doing just that in Boden, Sweden, with a first-of-a-kind "green steel" facility that includes a MIDREX H2™ Plant.

The challenges of engineering this first-of-its-kind DRI plant are numerous and analogous to those that the early Midrex trailblazers faced in designing the first commercial MIDREX® Process plant in Portland, Oregon, in the late 1960s. They did not have the luxury of the depth of knowledge, expertise, and experience that we have today when they engineered those "miniscule" 0.15 Mt/y DRI modules. They also did not have the backing of our state-of-the-art Research and Technology Development Center that is located about 20 minutes away from the Midrex corporate headquarters. Our R&TD team has worked through many tests and trails to validate the assumptions that serve as the design basis for our approach to direct reduction utilizing a hydrogen-only reductant. The outcome of their work serves as a critical input to the multi-discipline team that is engineering the MIDREX H2 Plant.

Similar to the challenge of the development of the stoichiometric reforming system in the 1960s, one of our key challenges has centered around how to heat such an enormous flow of hydrogen reductant through a "green" energy source. Heating the hydrogen reductant through a hydrogen combustion system would be an obvious option, and a heating system similar to the design of a MIDREX® Reformer would be a new application of a familiar and proven technology. But the combusted hydrogen would require additional electrolysis, and the loss in energy efficiency of the electrolysis process simply to burn the hydrogen product to produce heat begs for a better thermal solution.

Direct electrical heating provides the most efficient means to heat the hydrogen reductant. But a design for an electrical heater system with the capacity required for a 2 Mt/y MIDREX H2 Plant has only been a "high-class" wish, that is until Midrex and TUTCO SureHeat formed a partnership to jointly develop the world's largest electrical heating system. Over the past year, Midrex and TUTCO SureHeat have been "in the kitchen" together, utilizing the expertise of both companies to design, analyze, and test a heater system. Our collaborative effort is proceeding to completion, and fabrication of the largest capacity electrical heating system in history will soon be underway.

Midrex made a giant "leap of faith" with the commissioning of the protype production plant in Portland, Oregon, to demonstrate the feasibility of producing DRI through a continuous, natural gas-based reforming process. When we start up the Boden plant with H2 Green Steel, we will be making another giant leap by demonstrating the capability of producing DRI without the by-product of carbon dioxide. Though similar, these processes have distinct differences, with the electric heating system being one of the biggest differentiators. It is truly exciting to see what Midrex and TUTCO Sureheat have conceived become a key ingredient in such a monumental change in steelmaking technology.

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This issue includes a report on the collaboration of the Midrex Research & Technology Development Center and TUTCO Sureheat to design an electrical heater system for use in MIDREX H2 plants to prepare the hydrogen reducing gas, and an article by Primetals Technologies on the role of low-CO_2 hot briquetted iron (HBI) in helping to decarbonize steelmaking. In addition, News & Views announces the *2022 World Direct Reduction Statistics* published by Midrex and the new office location of Midrex India and recognizes MIDREX Plants with start-up anniversaries in the third quarter.

THE NEW AGE OF HOT BRIQUETTED IRON (HBI)

HOW WILL THE STEEL INDUSTRY TRANSFORM ?

By JOHANNES ROTHBERGER
Head of Sales, Direct Reduction
Primetals Technologies

By ROBERT MILLNER
Head of Tech, Direct Reduction
Primetals Technologies

By WOLFGANG STERRER
VP, Direct Reduction
Primetals Technologies

As the reality of carbon neutrality as a global trend unfolds and pressures of net-zero carbon initiatives increase, it is evident that, despite these developments, the global economy cannot do without the versatile material of steel. In 2020's "Iron and Steel Technology Roadmap," the International Energy Agency (IEA) projected global steel demand to rise by 10 percent by 2050, noting how deeply engrained steel is in our society, from construction to infrastructure and transportation. The report also pointed out that many technologies of a net-zero energy transition rely heavily on steel, such as wind turbines, solar panels, as well as carbon capture and storage technologies.

Given this projected increase in demand, coupled with rising pressure to reduce carbon emissions, the industry is searching for efficient, adaptable, low-carbon solutions on its path to net-zero emissions by 2050. As these projections confront the status quo of the iron and steel industry, several aspects of future-proof strategies emerge:

- decrease in integrated steel production (using the blast furnace and basic oxygen furnace)
- increase in electric steelmaking (using the electric arc furnace)
- increase in scrap usage
- increased use of direct reduction, producing direct reduced iron (DRI), and especially, hot briquetted iron (HBI)

LOW-CARBON INNOVATIONS

As the steel industry moves toward carbon neutrality in response to increasing pressures to decarbonize, the application of DRI and HBI will see immediate benefits for steel producers. HBI is an exceptionally flexible product as well. Taking the place of traditional pig iron for primary steel production, HBI can also supplement lower-grade scrap, enabling higher grade steel products. The supplement of HBI for lower-grade scrap dilutes the metallic impurities often found in scrap-based steelmaking and can even allow, for example, for the production of flat products, which have been an exclusive product offered by the integrated steel production route using virgin materials.

Yet, HBI has also made a name for itself beyond its ability to reduce carbon emissions and its versatile applications, namely in its ability to be shipped far and wide. For HBI, re-oxidation is not an issue. This means that regions rich in raw materials with low energy costs can readily produce HBI and ship this valuable material to steelmaking facilities worldwide ***(see Figure 1).*** However, countries have begun establishing barriers to compensate for carbon emissions through carbon prices on selected imports, such as the E.U.'s "Carbon Border Adjustment Mechanism" to tackle climate change. Thankfully, since natural gas-based HBI has a significantly lower carbon footprint than traditional blast furnace-based hot metal, these new trade regulations should not impact HBI as a global commodity. Moreover, carbon pricing schemes coupled with carbon border taxes will only make merchant DRI more competitive worldwide.

The global growth of annual DRI output already reflects the future competitiveness and impact of these developments. In 2019, DRI production hit a record 108.1 million tons (Mt), which was 7.3% more than the previous year. In 2021, DRI production reached 119.2 Mt, up by 10.2% from 2019 ***(see Figure 2).***

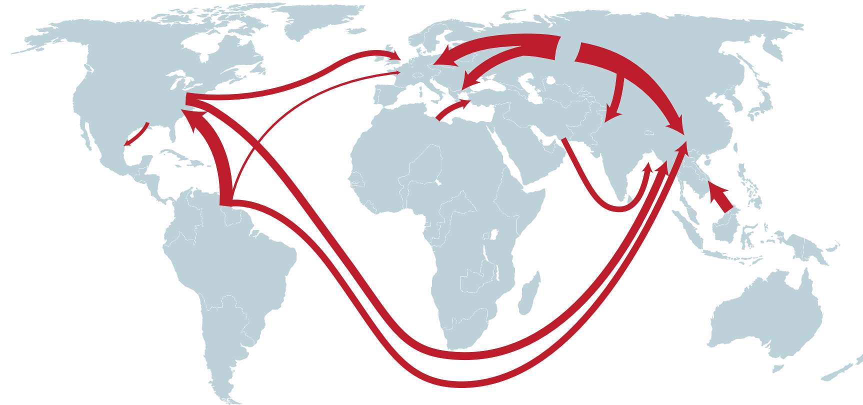


FIGURE 1. *DRI/HBI trade map (from Midrex Technologies 2020 World Direct Reduction Statistics)*

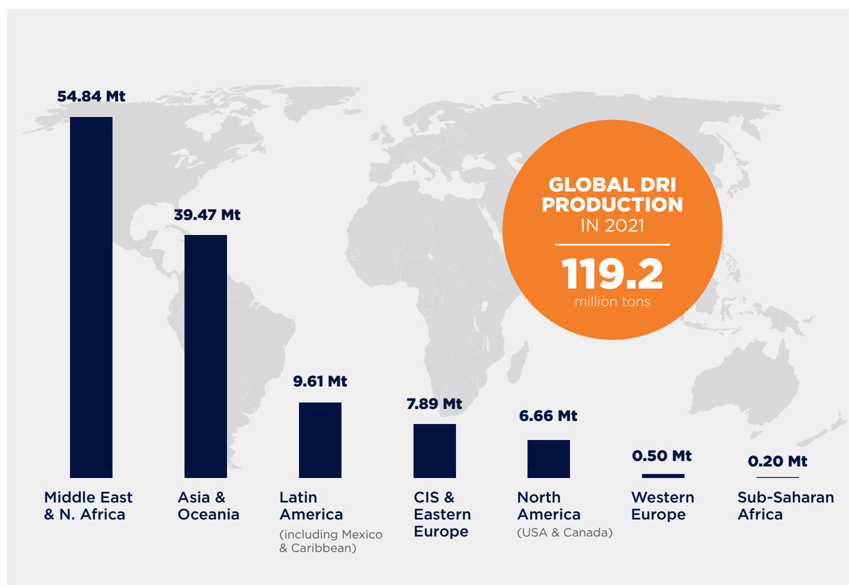


FIGURE 2. *Map showing world DRI production by regions (courtesy of Midrex Technologies' 2021 "World Direct Reduction Statistics").*

According to estimates in its "sustainable development scenario," the International Energy Agency (IEA) projects the market for commercial DRI to continue its growth from 115 Mt per year in 2019 to 157.3 Mt by 2030 ***(see Figure 3, following page).*** At the same time, the IEA expects that gas-based DRI will account for 8% of steel production by 2030.

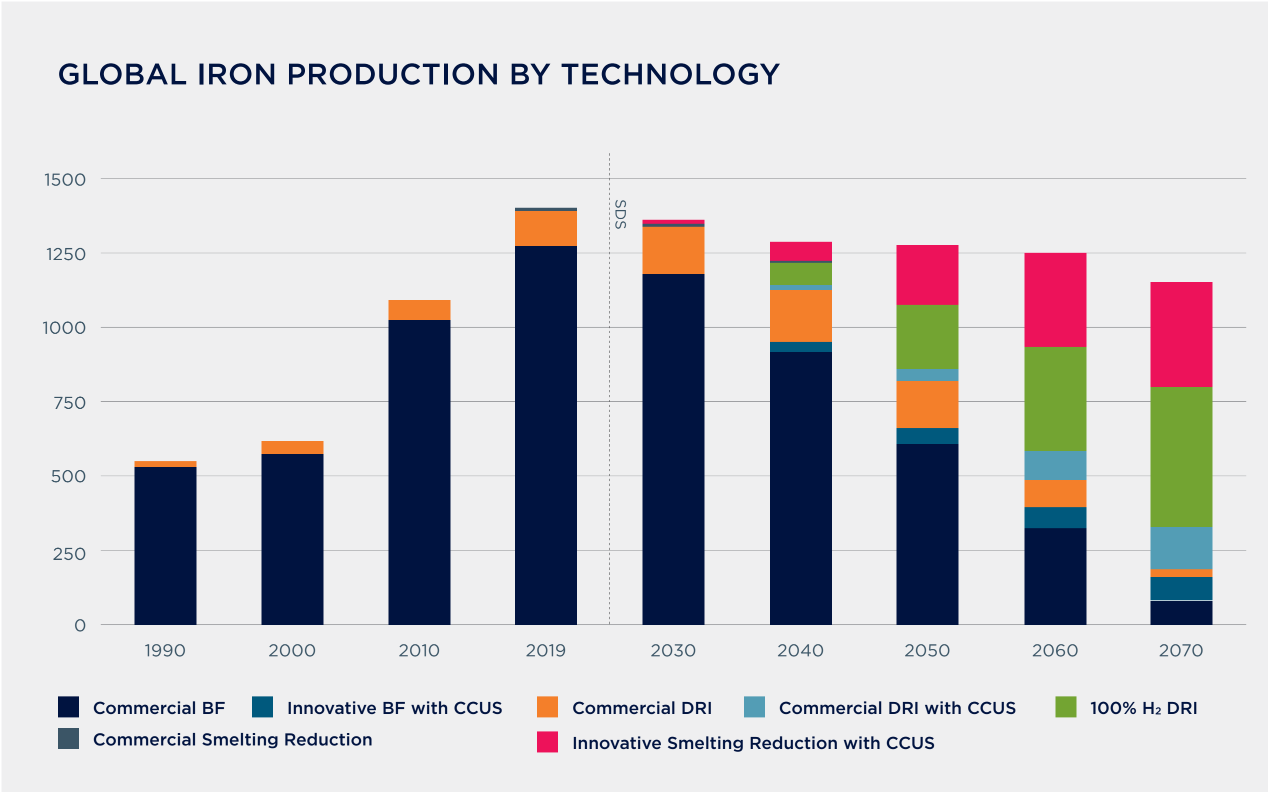


FIGURE 3. *Global iron production by technology in the "sustainable-development scenario" (SDS) from 2020 onward, according to the International Energy Agency (BF: blast furnace; CCUS: carbon capture, utilization, and storage; DRI: direct reduced iron)*

Access to natural gas and iron ore deposits is vital for developing new direct reduction capacities. But access to energy for clean hydrogen production will become even more relevant in the future.

REGIONS WITH GREAT POTENTIAL

To fully harness the potential of DRI, it will take production increases that only an entire fleet of new HBI plants can handle. New HBI plants should be situated in areas with access to iron ore and natural gas, or hydrogen. Regions such as Canada, Sweden, and Western Australia, with vast ore deposits and a high potential for renewable energy, seem to be exceptionally well-placed in this regard. The regions' policymakers and industry leaders have also identified this potential and acted accordingly. Primetals Technologies has also recognized this potential and joined the Heavy Industry Low-Carbon Transition Cooperative Research Centre, established by the Australian Government, to explore the tremendous opportunities in this field.

Meanwhile, the U.S.A. and China are two countries that stand out for different reasons in the race toward carbon neutrality and HBI capacities. These countries have significant EAF steelmaking capabilities but little HBI capacity. Although there are now two HBI plants in the U.S.A., China has no HBI plants, despite investing heavily in its EAF capacity over the last few years. Additionally, China has announced a 2060 net-zero target. As the largest steel producer globally, China will not meet its goal by solely relying on scrap, which is already in short supply. Instead, investment and expansion in electric steelmaking require an increase in merchant HBI.

Some steel producers in regions with high energy costs, such as Europe, are increasingly looking for new solutions. For example, in 2016, Austrian steel producer voestalpine began operating an HBI plant near Corpus Christi, Texas (Editor's note: ArcelorMittal acquired 80% interest in July 2022 and now operates the plant as ArcelorMittal Texas HBI) to import the HBI back to Austria. By signing off-take agreements with HBI producers or even building their own HBI plants in areas with lower energy prices and transporting the HBI for use in their domestic operations, these producers have found solutions to meet current demands. Despite some promising increases in HBI production in 2021, including Cleveland-Cliffs' HBI plant in Toledo, Ohio, the demand for HBI will undoubtedly multiply over the coming decades. Thus, current production capacities will struggle to meet the growing demand.

THE HBI PLANT: H2-READY

While global growth in the area of HBI production is undoubtedly on the horizon, producers looking to increase capacity run the risk of increasing their carbon emissions. However, as renewable technologies expand in adoption worldwide and alternative energy sources contribute to a growing hydrogen economy, HBI has one key advantage, namely, the possibility for future hydrogen-based production.

According to the IEA's projections, fully hydrogen-based DRI will account for 3.9 Mt of global production by 2030 and 212.6 Mt by 2050. Based on these projections, hydrogen-based DRI and smelter reduction coupled with carbon capture and storage will continue to grow until they dominate ironmaking by the 2070s. The IEA's projections are not just theoretical dreams but reflect an international trend toward low-CO_2 HBI and DRI systems that are hydrogen-ready today.

As carbon pricing and other regulatory measures impact ironmaking, the reality of competitive hydrogen-based production in the global marketplace may be closer than we assume. Still, access to (or at least a long-term perspective for) low-carbon or green hydrogen from renewable energy will be decisive for industry leaders.

MIDREX HBI PLANT: CORPUS CHRISTI, TEXAS, U.S.A.

Annual capacity:	2 million tons
Input material:	100% DR grade pellets
Furnace type:	MIDREX MEGAMOD®
Inner diameter of reduction furnace:	7.15 meters
Number of reformer bays:	20-bay reformer with 600MA-1 reformer tubes (250 mm)
HBI metallization:	93%
Carbon content:	1.5%

Other plant features:

- Environmentally friendly burners for NOx reduction
- Flue-gas hot fan to reduce electric power consumption
- Hot-fines recycling system
- Level 1 & Level 2 automation, including the DRIPAX® DR Optimizer

While carbon neutrality and hydrogen technologies become more than mere talking points, some analysts now expect the price of hydrogen to drop much sooner than anticipated. Additionally, increased production capacities for green hydrogen from electrolysis—using electricity to obtain hydrogen from water with renewable energy—and turquoise hydrogen from pyrolysis—using natural gas to yield both hydrogen and black carbon and produce fewer carbon emissions—will drive down the cost of hydrogen-based production.

With ironmaking technologies that anticipate carbon neutrality, Midrex Technologies and Primetals Technologies are paving the way for the new age of HBI.

GREEN METALLURGY AND THE FUTURE

With an eye toward the future, Midrex Technologies and Primetals Technologies can produce high-quality HBI with the most environmentally friendly technology for ore-based ironmaking. The natural gas-based MIDREX® Direct Reduction Process releases 50% fewer carbon emissions than blast furnace ironmaking. Combine this technology with green hydrogen, and there is potential to decrease carbon emissions even further.

With a proven history in HBI plant construction, Midrex Technologies and Primetals Technologies have successfully implemented plants worldwide to meet the increased demand for merchant HBI. With a reputation for future-oriented innovation, the newest plants can be adapted to use hydrogen as a reducing agent in any range up to 100% once this green energy source becomes economically viable.

DIRECT REDUCTION: TECHNOLOGY THAT EXCITES

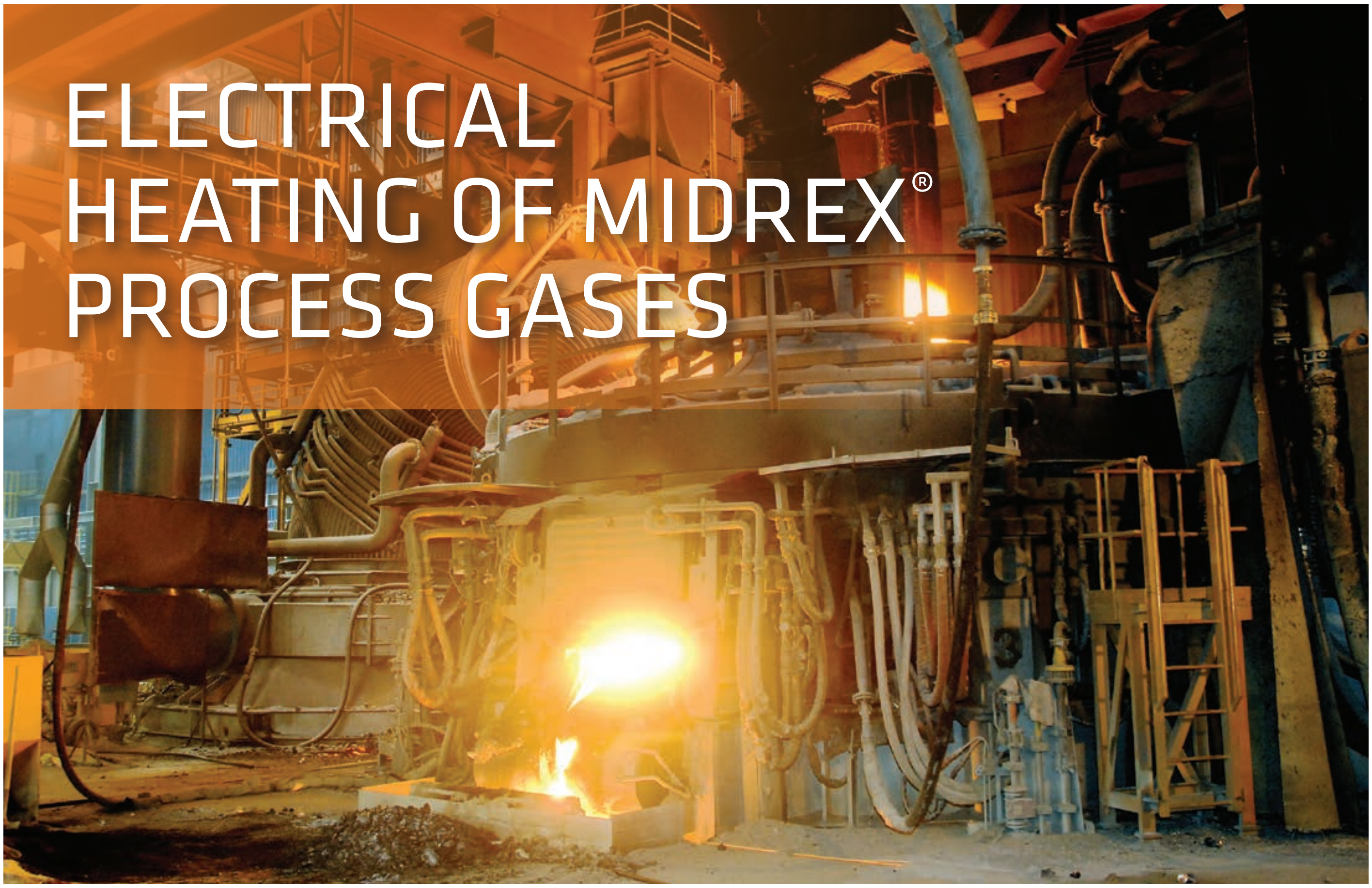
WOLFGANG STERRER
VP, Direct Reduction
Primetals Technologies

What makes direct reduction fascinating?
Unlike other processes, direct reduction is a unique technology thanks to its ability to use natural gas and hydrogen as a reducing agent. By implementing direct reduction, iron and steel producers are able to reduce CO_2 emissions significantly.

What makes the global transformation of the iron and steel industry so exciting?
In my view, the current transformation is unparalleled because it represents a global approach and multi-national cooperation of various stakeholders toward the goal of reducing CO_2 emissions. As metal producers explore new frontiers by adopting new technologies, the viability and consideration of new regions—including those rich in natural gas or areas primed to produce green hydrogen—will create new opportunities for partnerships and frontrunners in the industry.

What makes H2-ready technologies so essential to the iron and steel industry?
Using hydrogen and green electricity as primary energy sources is the steel industry's ultimate goal. Natural gas-based direct reduction, which is H_2-ready, responds to the challenges steel producers face today. For the future of the metals industry, Primetals Technologies offers and develops technologies that can considerably reduce CO_2 emissions throughout the iron and steel production chain.

(This article is based on an article published in Primetals METALS Magazine and posted online on February 28, 2023)



ELECTRICAL HEATING OF MIDREX® PROCESS GASES

TODD ASTORIA
Research & Technology Development, Midrex

MATTHEW HARGREAVES
General Manager, Tutco SureHeat

INTRODUCTION

The iron and steelmaking industry is experiencing rapid market change and technology developments. One of the key drivers for the market change is the need to improve the environmental impact of the processing routes. The reduction of CO_2 emissions is one of the most important environmental goals facing the industry.

The Direct Reduction (DR) – Electric Arc Furnace (EAF) route is one of the most promising technologies to achieve the CO_2 reductions. In order to achieve the reduction, the DR plants are extending their fuel options to include green hydrogen. Hydrogen has great promise for the direct avoidance of CO_2 from the DR route when used as the process fuel; however, hydrogen has drawbacks when applied as a fuel for heating the process gas in the conventional combustion-based heating unit operation.

Generally, green hydrogen is produced from electrolysis. If hydrogen is used as a fuel in a combustion system, then it can reduce the CO_2 emission compared to a typical fossil-based fuel. However, inefficiencies are introduced when electricity is used to produce hydrogen, which must then be transported to the facility. In order to overcome the inefficiencies, it is advantageous to use electricity to directly heat the process gas.

An electric heater works by passing electricity through an element made of resistive wire. As current passes through the wire, it generates heat which is transferred to the medium being heated. The medium can vary from air and other inert gases to syngas, hydrogen, liquids, and steam. Electric heaters are used in many industries with various applications. Pressures greater than 200 bar and temperatures greater than 1000° C can be achieved with thermal efficiencies greater than 95%. Power ratings can range from several hundred watts to several hundred megawatts, as the technology is extremely scalable. As total system power requirements increase, typically the number of heaters increases as well. Depending on the pressure of the system, it is feasible to have a single heater capable of greater than 10 megawatts arranged in parallel with as many heaters as necessary to reach the system power requirement. Each of these heaters is controlled via a control panel using closed loop feedback with built in protection in case of a low or no flow condition or any condition where the element wire temperature might exceed the design limit.

Considering that direct electric heating is already demonstrated at the required scale, then it remains to demonstrate the performance in the field of heating process gases for a MIDREX® Plant.

This article will address the current state-of-the-art for electric heating of gases for DR applications, and development work on thermal cycling of electric heaters in the DR application.

DISCUSSION

There are several operating conditions of importance when considering the design of an electric process gas heater for a MIDREX H2™ Plant. The focus of this article is the thermal cycling of the electric heater.

A state-of-the-art MIDREX Plant will normally operate in excess of 8,000 hours per year. The balance of the operating time is a combination of scheduled maintenance and unscheduled plant stoppages. The concern associated with these stoppages is due to the nature of the materials and normal operating temperature.

Figure 1 shows the flows in a MIDREX H2 Plant that incorporates an electric heater (CO_2-Free Gas Heater). The stream

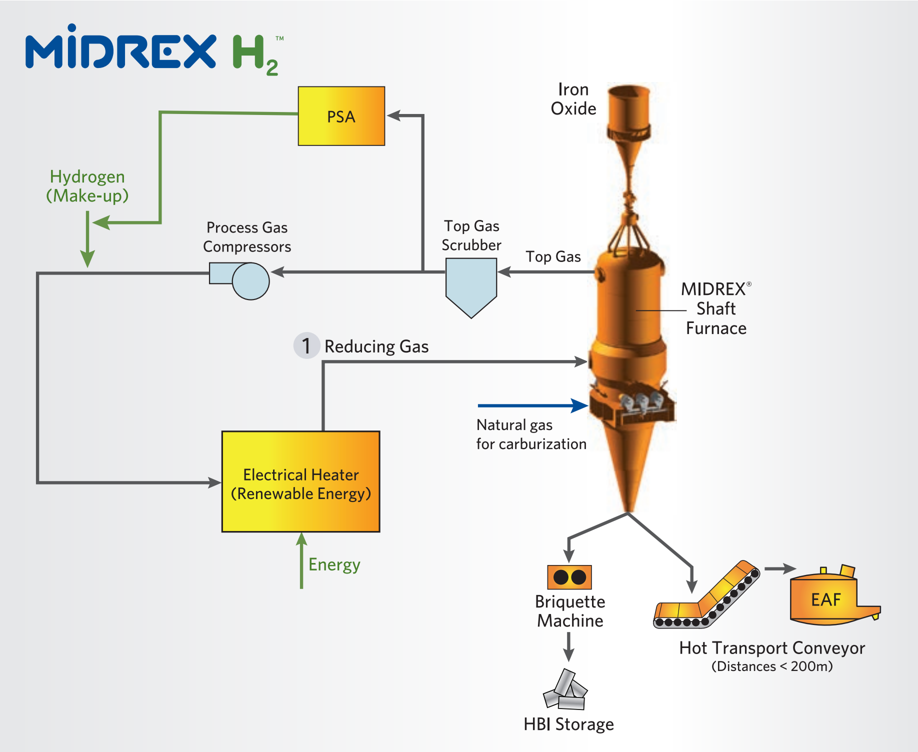


FIGURE 1. *Process Flow Diagram for DRI Production using Hydrogen*

identified as 1 corresponds to the hot reducing gas that is to be introduced to the shaft furnace. The exact requirement of Stream 1 depends on the application; however, for industrially relevant examples it is most common to find temperatures of more than 900 degrees C. At these elevated temperatures, the mechanical properties of the metal components become of interest. When a heating unit operation is shutdown from normal operating temperature to ambient temperature, it is referred to as a 'thermal cycle'.

Thermal cycling can be observed in the various alloy reformer tubes and heater tubes from the traditional natural gas-based direct reduction technologies. From these references it is readily observed that thermal cycling is generally a negative factor to the overall life of the components. Thermal cycling can result in changes in the equipment geometry due to thermal expansion of the components, possible microstructure changes, or other stresses on the material related to operating the components near to their operating limits and then rapidly changing the condition.

Since the possibility to have these shutdown is related to areas of the MIDREX H2 technology outside of the heater unit itself, then we should assume that the electric heater will be subjected to similar conditions as the conventional reformer and heater unit operations.

In order to investigate this phenomenon, an experiment was run to measure the effect on an electric heating element over the course of repeated thermal cycles.

TEST SETUP

The block flow diagram for the test apparatus is shown in *Figure 2*.

Figure 2 shows a gas recycle and conditioning loop that is designed to supply an electric heater with a gas flow similar to what is required for the normal operating condition of a hydrogen-based MIDREX Plant.

The loop includes:

1. An electric heater that is the subject of investigation
2. A recycle loop consisting of a gas cooler, recycle compressor, and preheater
3. A make-up gas skid to control the gas composition
4. A system pressure control, and flare
5. A gas analysis system and various other instrumentation

The fundamental test concept was to operate the electric heater with a suitably high exit gas temperature, and then simulate an unexpected plant stoppage by simply turning the electric heater off. The procedure was repeated 50 times and the heater element was inspected after the trial. Considering that a typical MIDREX Plant will experience a cold shutdown event between three and five times per year, the 50 cycles represent between 10 and 15 years of plant operating conditions.

RESULTS

Figures 3 and 4 show the gas inlet temperature and gas outlet temperature, as measured in the testing apparatus. *Figure 3* shows the data from the initial series of thermal cycles and 4 shows the data from the final series of thermal cycles.

The operation shows that the gas temperature was heated up at a controlled rate, kept at the target temperature for a short

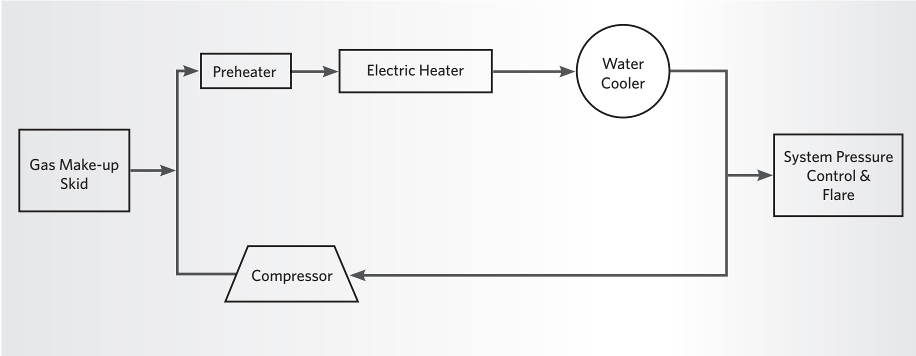


FIGURE 2. *Block Flow Diagram of the Test Apparatus*

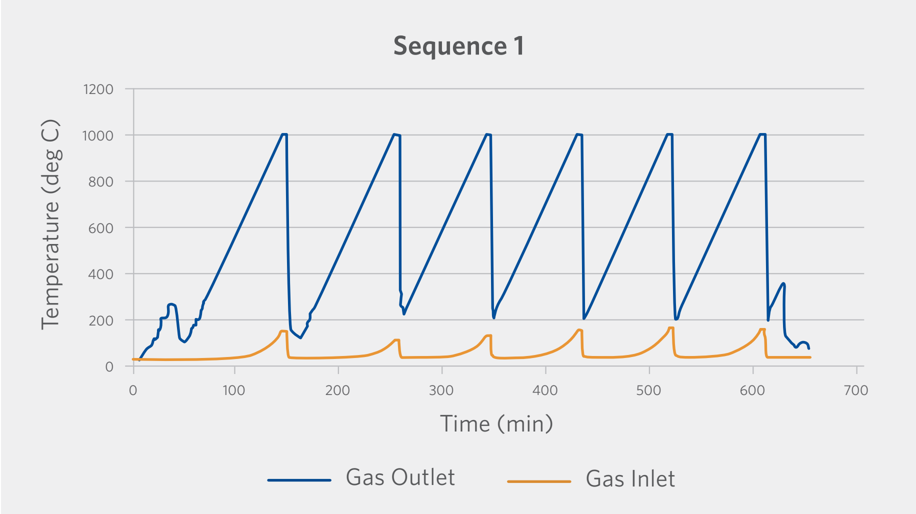


FIGURE 3. *Thermal Cycling Test showing the Gas Inlet and Outlet Temperatures for the initial operation.*

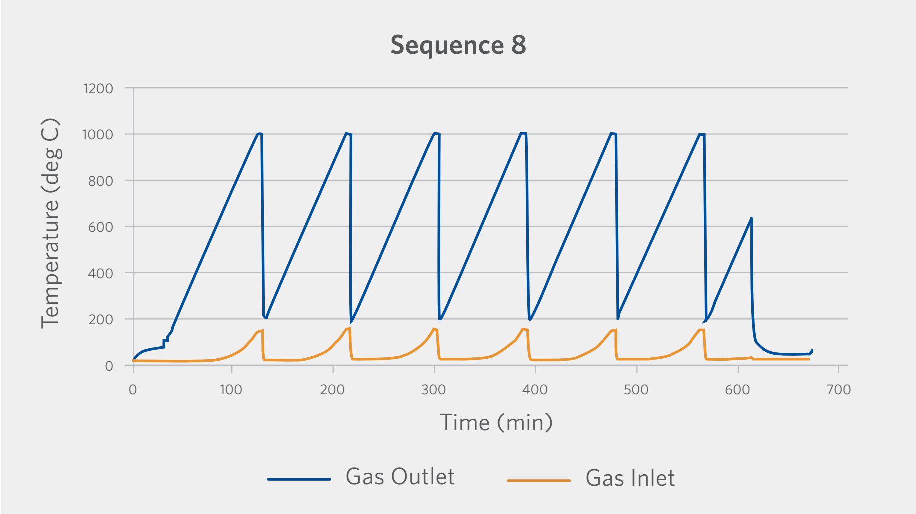


FIGURE 4. *Thermal Cycling Test showing the Gas Inlet and Outlet Temperatures for the final operation*

period, and then abruptly cycled. The final cycles show no difference in the operation compared to the initial cycles. In ***Figure 4*** the final peak does not reach to 1,000 deg C because that is the 51st cycle and the test was stopped.

Figures 5 and 6 show the measured electrical current and voltage corresponding to the same thermal cycles shown in ***Figure 3 and 4***. The electrical response of the heater is consistent across the 50 thermal cycles. This indicates that there is no change in the electric heater's electrical properties.

Figures 5 and 6 also indicate that there was no mechanical failure that would cause a change in the heater electrical resistance or performance.

CONCLUSION

An electrical heater was tested for thermal cycling under gas compositions and temperatures relevant to the direct reduction or iron for hydrogen-based operating conditions. The number of thermal cycles that were demonstrated is consistent with the number of cycles expected for between 10 and 15 years of plant operation. There was no observed change in the electrical heater performance or electrical properties over the 50 thermal cycles.

(This article is based on a paper presented at METEC 2023 & 6th ESTAD in Duesseldorf, Germany)

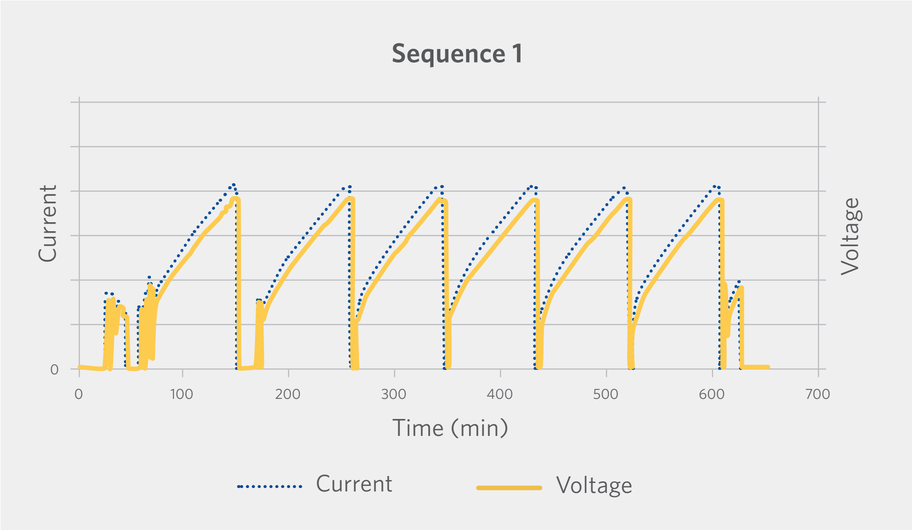


FIGURE 5. *Thermal Cycling Test showing the heater current and voltage for the initial operation.*

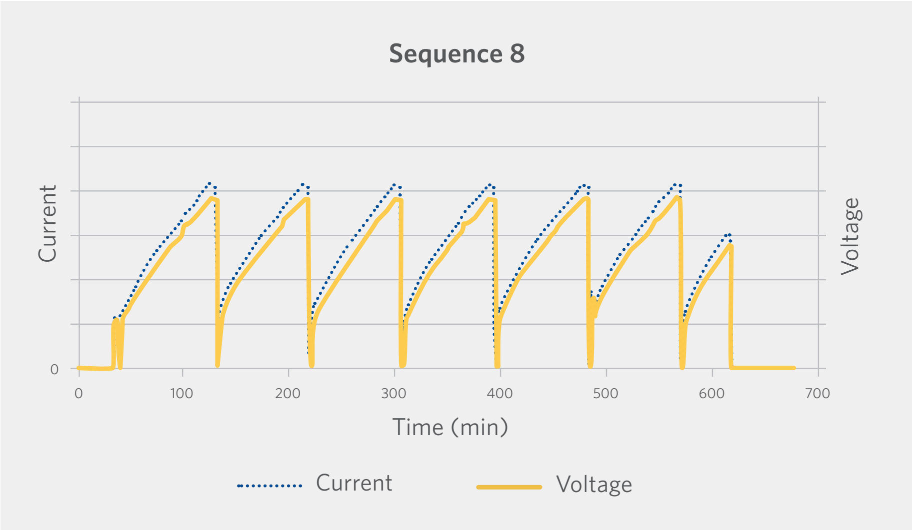
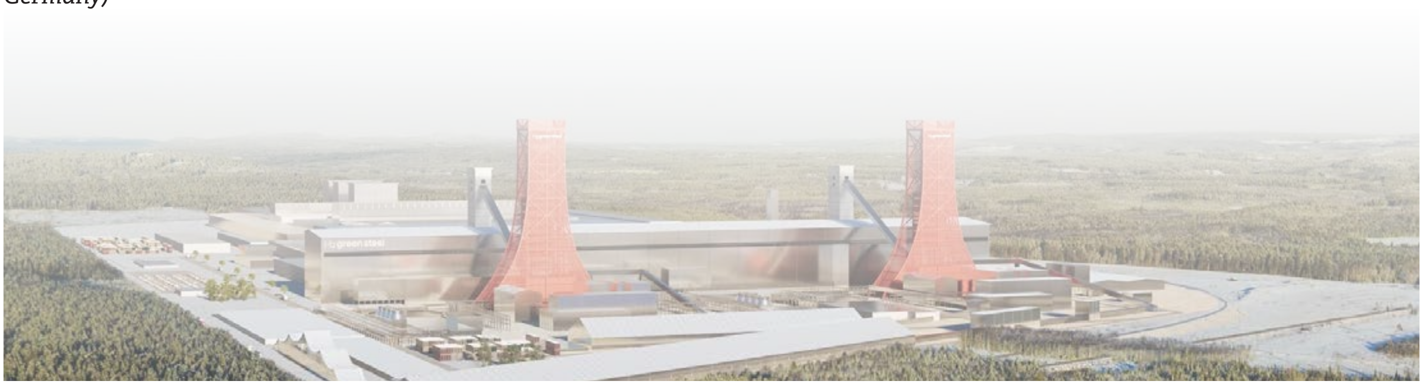


FIGURE 6. *Thermal Cycling Test showing the heater current and voltage for the final operation.*



Midrex News & Views

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

127.36 Mt of DRI Produced Globally in 2022

MIDREX PUBLISHES *WORLD DIRECT REDUCTION STATISTICS*

Global direct reduced iron (DRI) production reached new heights in 2022, totaling 127.36 million tons (Mt), up almost 6.9% from the previous record of 119.2 Mt in 2021, according to data reported in the 2022 World Direct Reduction Statistics published by Midrex Technologies, Inc. From 2016, worldwide DRI output has grown by almost 55 Mt, or nearly 75%.

THE TOP 5 STEEL PRODUCING NATIONS IN 2022

China	1,018 Mt
India	125.4 Mt
Japan	89.2 Mt
USA	80.5 Mt
Russia	71.5 Mt

The production of hot DRI (HDRI), which is fed directly to a nearby melt shop for energy savings and to improve productivity, was 13.9 Mt, a 0.5% increase compared to 2021, and made up 10.9% of the total in 2022. The production of hot briquetted iron (HBI), a compacted form of DRI ideally suited for shipping and for use in the blast furnace, is estimated to have been 11.3 Mt, a 9% increase over 2021.

MIDREX® Plants produced 73.55 million tons of DRI in 2022, which is 3.8% more than the 70.85 million tons produced in 2021. Over 10 million tons of HDRI were produced by MIDREX Plants. The production totals for MIDREX Plants was calculated from the 43.42 million tons confirmed by plants located outside of Iran and the estimated 30.13 million tons by plants in Iran, from data reported by the World Steel Association (WSA).

MIDREX Technology continued to account for ~80% of worldwide production of DRI by shaft furnaces in 2022.

Natural gas is generally the main source of reducing gas in shaft furnace-base processes, and DRI produced using natural gas has significantly lower CO_2 emissions than DRI produced using coal. In 2022, approximately 70.1% of the DRI produced was natural gas-based (i.e., low CO_2 DRI), whereas the balance, 29.9%, was coal-based (i.e., high CO_2 DRI).

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

2022 World Direct Reduction Statistics is available for download at **www.midrex.com**

Midrex Technologies, Inc. compiles and publishes ***World Direct Reduction Statistics*** annually as a resource for the global iron and steel industry. To prepare the annual statistics, Midrex requests inputs from every known direct reduction producer either directly or indirectly through partner organizations. Where plant information is not available directly or indirectly from producers, Midrex obtains the information from publicly available data.

World Steel Dynamics (WSD) audits the data collection and preparation processes used by Midrex to confirm that the methodology and accuracy of the data to be published is representative of the global direct reduction industry in a given year.

Midrex News & Views

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

Midrex India Moves to New Location, Opens Regional Engineering Center

The new address of the Midrex India offices is:

Midrex Technologies India Private, Ltd.
7th Floor, Tower-B, Building No. 8, DLF Cyber City, DLF Phase-II, Sector-24, Gurgaon, Haryana 122002, India

The Management Team of Midrex India includes:

- Aashima Vadhera, *Director-Finance (Asia, Middle East & North Africa)*
- Kedar Palekar, *Director-Marketing*
- Jim Lewis, *General Manager-Engineering Center*
- Amit Jha, *Assistant General Manager-Marketing*
- Varun Singla, *Senior Manager Human Resources*
- Ranjeeta Raha, *Manager-Administration & HR Support*

Midrex Technologies India Private Limited (Midrex India) recently celebrated the relocation of its offices in the New Delhi area. The expanded office space will accommodate the existing commercial and finance/administration personnel, as well as the new Midrex Engineering Center team. Midrex India provides finance/administration support for Midrex offices in Dubai (Midrex Technologies Gulf Services FZCO) and China (Midrex Metallurgy Technology Services [Shanghai] Ltd.).

Midrex opened the original Indian offices in September 2011 to develop sales opportunities in India for MIDREX® Direct Reduction Technology, as well as to provide regional sales and support services for the Midrex offices in in Dubai and Shanghai. In 2022, Midrex announced plans to establish an engineering center in India to position technical resources globally to better serve the growing demand for MIDREX Plants throughout the world.

Midrex News & Views

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

MIDREX® Plants with 3rd Quarter Anniversaries

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 Acindar in Villa Constitución, Argentina (45 years), and Qatar Steel 1 in Mesaieed, Qatar (45 years).

ArcelorMittal Acindar

Started 45 years ago in the 3rd Quarter
Location: Villa Constitución, Sanata Fe, Argentina
DR plant: MIDREX®

- Start-up: August 1978
- Flowsheet: MIDREX Flex™
- Product: CDRI
- Original Capacity: 0.42 million tons/year
- Current Capacity: 0.6 million tons/year

Founded in 1942 as Acindar Industria Argentina de Aceros S.A., it is one of Argentina's oldest steel companies. Acindar merged with Arcelor subsidiary Belgo Mineira in 2001 and became part of the ArcelorMittal Group in 2006. Since 2008, ArcelorMittal has controlled 99.5% of the company.

Acindar produces bars and balls for the grinding of minerals; steel mesh for the mining industry; wires, turnbuckles, and special posts for the wine industry; poles, rods, wires, and accessories for agricultural fencing; and a variety of products for the construction, oil, and metallurgical industries. Acindar also offers technical advisory services, along with cutting, bending and pre-assembling of steel parts according to the client's technical specifications.

The Acindar complex includes a DRI plant based on MIDREX Technology (installed in 1978) and two Tenova electric arc furnaces (installed in 2007).

Read more about ArcelorMittal Acindar at:
http://www.acindar.com.ar

Qatar Steel 1

Started 45 years ago in the 3rd Quarter
Location: Mesaieed, Qatar
DRI process: MIDREX® (2 modules)

- Start-up: August 1978 (module 1), July 2007 (module 2)
- Flowsheet: MIDREX Flex™ (module 1), MIDREX Flex with hot discharge/product cooler (module 2)
- Product: CDRI (module 1), CDRI/HBI (module 2)
- Capacities: 0.4 million tons/year (mod 1), 1.5 million tons/year (mod 2)

Qatar Steel was established in 1974 as the first integrated steel plant in the MENA Region. Commercial production commenced in 1978, with the start-up of Qatar Steel 1, a DRI plant based on MIDREX® Technology. The Company has operated as a wholly owned subsidiary of Qatar Industries since 2003.

Plant facilities include two MIDREX Modules, Qatar Steel 1, which produces cold DRI (CDRI), and Qatar Steel 2, which produces CDRI or hot briquetted iron (HBI) depending on the market requirement, electric arc furnaces with a ladle refining furnace, a continuous casting plant, and rolling mills with the latest automated features.

Production operations are based in Messaieed Industrial City, 45 kilometers south of Qatar's capital, Doha, where Qatar Steel's corporate headquarters are based. The Company also operates a UAE based subsidiary, Qatar Steel Company FZE.

Read more about Qatar Steel at:
https://www.qatarsteel.com.qa

Lauren Lorraine: **Editor**

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