2002 - The Electronic Revolution...

With the 1st Quarter 2002 issue of Direct From Midrex, you will notice several changes, the most obvious of which is the change to PDF format. We have moved away from the traditional print medium and have adopted a new electronic form that will grow and evolve with Midrex. It's a move that we are not alone in making. Recently several industry trade publications have announced similar decisions.

For Direct from Midrex subscribers, this decision means informative articles and news will be delivered straight to your computer desktop. The PDF format will make it easier to share and store your favorite articles. The change allows us to incorporate features that will enrich the publication such as full color charts and illustrations that will make complex graphs easier to read and to comprehend. Over the long-term, Direct From Midrex will continue to evolve in step with the evolution of the Company's technology products.

In other words, the changes in Direct From Midrex are a reflection of the new spirit of Midrex.

It began in late 2000, with the birth of Midrex Solutions™, a unit dedicated to assisting MIDREX® Process Licensees get the most from their plants (see story on page 10). Other changes have been initiated to address the challenges of a turbulent business environment. We have taken actions intended to better position Midrex in its traditional business niche, as well as to expand into other process-related industries. This year we expect to reach decision points on projects and opportunities in both our traditional business and in new market segments.

For instance, Midrex is offering educational seminars and customized training to users of DRI, HBI, and other forms of alternative iron. We have championed for years the idea that no single source of iron units is right for everyone. The true art is matching the available iron sources with the steel products you want to make in the most cost-effective manner. Our metallurgists speak the language of steelmaking with a direct reduction accent, which means they are uniquely qualified to help narrow the distance between iron and steel.

As part of Midrex Solutions, we have provided personal customized training for MIDREX Process Licensees downstream of the DR plant. Also, we are presenting various technical papers throughout 2002, both in the U.S. and around the globe to help steelmakers understand the different characteristics and chemistries of the various forms of alternative iron and how to mix and match them for the most positive effect on your steelmaking costs.

We haven’t forgotten the MIDREX® Process, the technology that started it all, when it comes to changes. A recently concluded agreement with Siemens will take process control to the next level. The featured article in this issue introduces SIMPAX™, a first-of-a-kind advanced control package specifically developed by Siemens for MIDREX® Plants (see page 3).

Midrex is busy preparing itself for when business times are better, when creative ironmaking solutions will be needed to answer the production needs of the steel industry. One way is to be a more diversified technology company. Another is to continue providing timely and credible facts, figures and opinions in Direct From Midrex.

So we hope you enjoy the new Direct from Midrex and you take advantage of all that Midrex has to offer.

Winston L. Tennies

MISSION STATEMENT

Midrex Technologies, Inc. will be a leader in design and integration of solids and gas processes and will supply to our clients superior quality services that provide value. We will meet or exceed performance expectations, execute projects on time, enhance existing product lines, and develop or acquire new technologies. Our employees are the key to our success, and we are committed to encouraging them to grow professionally and personally.
Development of Process Automation for the MIDREX® Process

By Dr. Franz Görner - Product Manager, Siemens
Frank Bacon - Chief - Electrical/Instrumentation Engineering, Midrex

[Editor’s Note: The Siemens Industrial Solutions and Services Group (I&S) and Midrex Technologies, Inc., USA, have recently announced joint development and marketing of the SIMPAX™ process control system for the MIDREX® Direct Reduction Process. See News & Views for more information. This is a continuation of a themed article that ran in 1st Quarter of 2001 Direct From Midrex, “Control Innovation in MIDREX® Plants: An Introduction.” Copies of this article are available at www.midrex.com.]

INTRODUCTION

Efficiency. In today’s economy it is critical. Plants running at their production limit seek ways to squeeze more production from the same resources. Plants without the market demand to run at full capacity seek ways to make the same production with fewer resources. Qualitatively, improved control returns the same benefits regardless of the choice of method, because improved control generally means a more-efficient use of resources. The end result is that production will increase, quality will increase or costs will decrease. [The details of how and why improved control can help is explained in greater detail in 1st Quarter of 2001, Direct From Midrex, “Control Innovation in MIDREX® Plants: An Introduction.”]

DEVELOPMENT OF PROCESS AUTOMATION - SIMPAX™

In a joint cooperation effort between Midrex and Siemens, a Process Automation System has been designed and developed that is now ready for a pilot installation. This new Process Automation System - SIMPAX, is a suite of control software for MIDREX Plants that will provide enhanced optimization and equipment protection. The software will run on its own separate workstation linked to the existing Basic Automation System. The output will be conveniently displayed on new Distributed Control System (DCS) screens for the panel operators. This output can be used to determine the most efficient mode of operation and will be interlocked to the existing control system to provide additional equipment protection. Following are some examples of the features contained within the system:

PRODUCT QUALITY

To predict product quality, SIMPAX uses a data driven approach based on modern methods such as Neural Network application, which can adapt itself to changing parameters. Midrex provided a huge sample of data from a plant for a continuous production period under different operating conditions. These data were evaluated with different mathematical methods and different assumptions in order to find out their influence on metallization and carbon as well as any interrelationships. Several consultations between Midrex and Siemens were held to prove the plausibility of the results.

Now the next step has begun. The model, which has proven the correlation between input and metallization and carbon, can also be used to predict the product quality online. Having the capability to predict the product quality online will eliminate the long time delay for material to exit the furnace and be analyzed by the laboratory. This will allow the plant operator to
respond immediately to process changes (minimizing off-grade product) and will provide more consistent product quality to the steel producer.

The process models used to predict product quality are developed and will be proven in the first installation. The predicted values for product quality will initially be a semi-automatic control loop and later possibly a closed loop control function.

**SIMPAX Product Quality Features**
- Metallic Iron Content of Product (on-line prediction of the percentage of metallic iron in the product)
- Carbon Content of Product (on-line prediction of the percentage of carbon in the product)

Additional features that support the operators in decision making will be provided within the scope of the system. The features of the Midrex Superdata program package provide the following calculations into the online system with the results displayed.

**REFORMER PERFORMANCE**
Several features have been designed to evaluate reformer performance. These parameters can be trended over time to determine the optimum method for operating the reformer in order to maximize the reductant produced and to determine the catalyst activity.

**SIMPAX Reformer Performance Features**
- \((H_2 + CO)/\text{Tube}\) (on-line calculation of the average reductant generated per reformer tube)
- Reformer Heat Duty/Tube (on-line calculation of the average heat required per reformer tube)
- Reformed Gas Quality (on-line calculation of the reformed gas quality)

**CATALYST PROTECTION**
Additional protection against carbon deposition in the reformer can be obtained by implementation of the following features. For example, on-line calculation of feed gas molar ratios can be interlocked to prevent reforming under abnormal process conditions. Also, the normalized differential pressure calculation (independent of flow rates, temperatures, etc.) can be trended over time to detect a pressure rise due to a variety of causes.

**SIMPAX Catalyst Protection Features**
- Feed Gas Molar Ratios (on-line calculation of the critical points for carbon deposition on the catalyst, together with alarm and shutdown set points)
- Reform \(\text{H}_2/\text{CO}\) Ratio Control (uses the actual values for reformed gas hydrogen and carbon monoxide from the on-line gas analyzer to control the water content of the process gas)
- Process Gas Water Content (on-line calculation of the percentage of water in the process gas)

**FURNACE OPTIMIZATION**
SIMPAX has several features designed to provide a consistent approach to controlling the key parameters of furnace operation. Tools for uniformly operating the furnace will yield more consistent product quality and will improve furnace utilization.

**SIMPAX Furnace Optimization Features**
- Burdenfeeder Speed Control (allows operators to control individual Burdenfeeder speeds by using a tooth/pellet ratio (TPR) setpoint)
- Bustle Gas Flow (on-line calculation of the bustle gas flow rate)
- Bustle Gas Quality (on-line calculation of the bustle gas quality)
- Bustle Gas Reductant Flow Per Ton (on-line calculation of the amount of reductant to the furnace per ton of Direct Reduced Iron (DRI) being produced)
- Burden Temperature Control (maintains the average lower burden temperature at the desired set point)
- Center Bed Temperature Control (maintains the lowest center burden temperature at the desired set point)
- Cooling Zone Upflow (on-line calculations of the upflowing gases from the cooling zone)

Integration Into Existing Plants
The requirements of the plant for the installation of a SIMPAX automation system are not high. A Level 1 Control System (DCS/PLC) has to be available as well as an online gas analysis
Improved process control in the DR plant through a SIMPAX™ system can have far reaching benefits by supplying an adjacent melt shop with DRI that has less variability in quality (specifically, metallic iron and carbon content).

In order to allow a Simple integration into an existing plant, SIMPAX uses a standard PC. The PC will be linked to the existing DCS or PLC System via network or serial link according to the capabilities of the existing automation system. Data communications will be in both directions: plant data from the automation system and data for visualization and later on, in closed loop operation, setpoints to the automation system.

**COMMISSIONING**

From the overall configuration we expect a smooth commissioning. The communication links to the PC can be programmed offline and be put into operation very quickly. As soon as the data link is established, the PC will receive the process data and do the averaging and storage according to the model strategy. As soon as enough data samples are available, the model parameters will be evaluated and first operating recommendations will be given. These recommendations will be discussed with the technologist of the customer and the model will be tuned step by step for each of the main working points.

For the reference plant the efforts will be higher, of course, but after the installation of the first plant we expect 6-8 weeks for commissioning and tuning. During this period the operator training will also be carried out.

**THE FUTURE - CONTINUING DEVELOPMENT OF SIMPAX**

What we have described is the beginning of SIMPAX development, which will be continued step by step and project by project. At first we want to consolidate the ideas and functions described above in a reference plant and when our customer's expectations are fulfilled we will develop the next steps on a project specific basis which will then be integrated as options to the standard features of the system.

SIMPAX™ is a Trademark of Siemens AG, Germany.

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**SIMPAX™ and HOTLINK- Future Success**

Improved process control in the DR plant through a SIMPAX™ system can have far reaching benefits by supplying an adjacent melt shop with DRI that has less variability in quality (specifically, metallic iron and carbon content).

When SIMPAX is combined with the patented MIDREX HOTLINK™ hot DRI delivery system, the next generation of mini-mills will benefit from even greater efficiencies and reliability to produce high quality liquid steel at the lowest operating and capital costs of any integrated mills in the world.

In addition, data from the SIMPAX system can be integrated into the melt shop control system for improved efficiency and predictability.

Ultimately, SIMPAX will be used in the development of an Expert System and a Closed-Loop control scheme (Level II control), providing operators with the ability to choose setpoints for automatic process control and most efficient operation.
World DRI production slipped to 40.5 million tons (Mt) in 2001, a decrease of 7.5 percent relative to 2000. This was the first decline in nearly two decades of rapid growth. Despite the adverse global economic conditions, many MIDREX® Plants had a good year, and for the 23rd consecutive year MIDREX® Plants produced more than one-half of the world’s DRI, with 66.3 percent of the 40.5 Mt produced.

ACINDAR
During the past calendar year, ACINDAR operated above rated capacity for the tenth consecutive year but continued to be constrained by market demand.

Amsteel
Amsteel operated in excess of their rated capacity, almost reaching record monthly production levels, but limited by market demand.

ANSDK
ANSDK’s modules II and III broke annual production records, while module I exceeded its rated capacity. All three modules broke their previous monthly production records. In addition, oxygen use commenced in module I this year.

Caribbean Ispat Ltd
Module III broke its previous monthly production record on three opportunities throughout the year, and broke its previous annual production record by 13 percent through increased plant productivity and availability. Oxygen use is planned to commence in 2002.

COMSIGUA
Comsigua set a new annual production record that is 5 percent higher than their previous record thanks to a significant increase in productivity. A new monthly production record was also set.

Essar Steel
All three of Essar Steel’s modules produced over rated capacity but were restricted by market conditions.

Georgetown Steel
GSC’s MIDREX Plant restarted in October after being shut down at the end of 2000 due to escalating natural gas prices.

Hadeed
Hadeed exceeded rated capacity for the 17th consecutive year in modules A and B, and for the 10th consecutive year in module C (essentially since startup).

IMEXSA
IMEXSA handily exceeded rated capacity this year, but was affected by market conditions and increased natural gas prices. A remarkable spike in natural gas prices in North America,
which for a short span was nearly 400 percent above the customary rate), led to the shuttering of nearly all NAFTA DR capacity until the gas prices moderated. The MIDREX® Module at IMEXSA was the only DR plant in all of North America that continuously operated throughout the year.

Ispat HSW
After an extended shutdown in the middle part of the year, Ispat HSW restarted at full capacity, boosted by the use of oxygen.

Ispat Industries
IIL of India, exceeded rated capacity this year for the seventh consecutive year.

Mobarakhe Steel
Module C beat its previous record by almost 24 percent. Module B and D production exceeded their previous year’s record. The 5 modules produced 3.0 million tons this past year, exceeding their previous year production through increased productivity. Three modules (A, B, and E) broke their previous monthly production records.

OEMK
All four of OEMK’s modules narrowly missed breaking annual production records, but handily exceeded their rated capacity. On average the four modules exceeded 8000 hours of operation this year. Module I narrowly set a new monthly production record.

OPCO
After shutting down in March due to poor market conditions, production reinitiated in December.

QASCO
QASCO broke their previous annual production record set in 1998 by 3.7 percent, through increased productivity and very good plant availability (8396 hours in the year). Product metalization averaged 95.9 percent for the year, also a record high for their plant. In the process, QASCO broke their monthly production record three times in the year.

Saldanha Steel
Saldanha Steel’s DR plant set a new annual production record through increased productivity and availability.
SIDOR

SIDERCA exceeded rated capacity but was affected by market conditions.

SIDOR
Afer expansion work carried out in the year 2000, two of the four MIDREX Modules at SIDOR broke previous annual and monthly production records even though they endured a four-week strike in May, with all four modules producing over 2.7 million tons. Module IIB produced a record 875,000 tons for 2001, more than double its original rated capacity, with its 5-meter diameter MIDREX™ Shaft Furnace, expanded reformer and the use of oxygen.

VENPRECAR
After record-breaking production in the year 2000, VENPRECAR’s production levels were affected by the general market conditions for HBI.
Fond Farewell to Midrex Pioneers

Midrex Enterprises, Inc. recently announced the retirement of Dave Meissner, culminating a career with its ironmaking subsidiary, Midrex Technologies, Inc., and its various predecessors that spanned almost 40 years. Dave is one of the eight pioneers of the MIDREX® Direct Reduction Process and holds 24 patents related to direct reduction of iron ores.

A chemical engineering graduate of the University of Toledo in 1963, Dave began his remarkable professional career with the R&D division of the Surface Combustion Company (SCC) in Toledo, then a division of the Midland-Ross Corporation, and a predecessor of Midrex Technologies, Inc. His work at SCC, and later the Midrex Division of Midland-Ross Corporation, focused on shaft furnace technology and stoichiometric gas reforming, which are the heart of the MIDREX® Process.

Dave played a key role in the initial development and commercialization of the MIDREX Process and has been intimately involved in the subsequent innovations and improvements to the technology. Today, Midrex leads the world direct reduction technology market, with plants using the MIDREX Process accounting for approximately two-thirds of all direct reduced iron (DRI) and hot briquetted iron (HBI) production.

Since the early 1990s, Dave has been involved in reactivating and enhancing the coal-based technology developed by SCC/Midrex in the late 1960s. Renamed FASTMET®, the rotary hearth furnace-based technology has been expanded beyond DRI or HBI production to include processing of steel mill waste streams, production of self-slaging iron nuggets (ITmk3®), and liquid steel production (when combined with Techint’s CONSTEEL system and known as Fasteel). In his capacity as Midrex R&D manager, Dave has been responsible for iron ore application and new add-ons to MIDREX technology such as HOTLINK™ and OXY+™.

Dave has toured the world extensively as an ambassador of MIDREX technology. As one journalist stated, he has “crisscrossed the globe more times than some international pilots” in his past four decades with Midrex.

(Note: As would be expected by anyone who knows Meissner, he intends to be available for special assignments in his retirement years. Once a Midrex “Iron Man”, you can never get it out of your blood. In the case of Dave Meissner, we are very thankful for that maxim.)

Helle Says Goodbye to Midrex After 35 years

Jim Helle has been with the company since the first MIDREX® DR facility in Portland Oregon, in the late 1960s. From Midrex’s Toledo origins to its current Charlotte home, he has traveled domestically and internationally as Midrex has built its modules throughout the world. He has made many friends over the decades with MIDREX® Licensees, clients, construction partners, and vendors. From his early beginnings as a mechanical engineer, Jim, over his 35-year Midrex career, has worked closely with Process Licensees and contractors, and various others who have been associated with Midrex. In the past year he was instrumental in fostering business relationships with Midrex Licensees as Manager of Midrex Solutions™.)
The Iron & Steel Society of AIME has chosen Sara Hornby Anderson to receive its 2002 ISS Distinguished Service Award in recognition of her exemplary service to the ISS through serving on ISS standing and Division committees. The award will be presented at the ISS Electric Furnace Conference in San Antonio, Texas, November 10-13, 2002.

Hornby Anderson, with 30 years of practical steelmaking experience and a PhD in Metallurgy from Hallam University (Sheffield City Polytechnic), Sheffield, England, is the steel-making and melting expert for Midrex Technologies, Inc. In that role, she provides assistance to the worldwide network of MIDREX® Direct Reduction Process Licensees and consults throughout the international iron and steel industry on the benefits to steelmaking when melting DRI, HBI, and other alternative iron sources as well as EAF optimization.

Since becoming a member of ISS in 1982, Hornby Anderson has distinguished herself as one of the first women on the Board of Directors and has chaired the Process Technology Division and the Ad Hoc Committee on International Membership. She also was involved in creating the Society's living Strategic Planning document and in establishing Argentina as the first International Local Section. Currently she serves on the International Affairs and University Relations Committees of ISS.

In the recently published (12/01) ISS membership testimonial, she shared her reciprocal ISS benefits. “When I attended my first Iron & Steel Society Globetrotters meeting in 1986, little did I realize the impact that meeting and my subsequent ISS membership would have on my career and me personally. The more than 15 years of exposure to the extended ISS family has provided me diverse growth opportunities ranging from technology transfer, mentoring and industry knowledge to enduring friendships with national and international members, be they presidents of steel companies, steel industry academics and suppliers, or students.”

Midrex Solutions™ Celebrates One Year-Building Relationships and Improving Plant Operations

The first year for Midrex Solutions™ has been one of building relationships, and providing MIDREX® Licensees with details of technological improvements and services available from Midrex. Although the acts of September 11 disrupted plans for the formal introduction of MIDREX Solutions at the annual Operations Seminar, Midrex Solutions was able to establish very good communications with several plants.

The past year was successful with contracts for studies, engineering, equipment, training and field services. Proposals for recent innovations such as OXY+™, SIMPA X™, thin-wall double bustle refractory, new reformer tubes, etc. were offered, and numerous plants are now planning for their implementation. MIDREX Solutions 2002 results have already surpassed the good results of 2001. This is a strong sign that plant capital and maintenance budgets are being revised to reflect the improving steel industry conditions.
Midrex Technologies, Inc. and the Siemens Industrial Solutions and Service Group (Erlangen, Germany) have agreed to jointly develop an Optimized Process Control system exclusively for the MIDREX® Direct Reduction Process known as SIMPAX™. This marks the first time that Siemens has participated in the joint development of such a system.

The SIMPAX System has been under development since July 2000. Preliminary results have proven the feasibility of such a system to accurately and reliably predict process performance. Final development and joint marketing of the SIMPAX System to existing MIDREX Modules around the world has already begun.

The simple and steady-state MIDREX Process, with its interrelated reduction unit and proprietary gas reformer, makes it an ideal process for the integration of an optimized control system such as SIMPAX. The SIMPAX System will allow operators to view and control the process more closely. The SIMPAX System will deliver information to allow operators to accurately and reliably predict plant performance and take appropriate preventive actions when necessary.

Midrex and Siemens will collaborate to improve the operational reliability and efficiency of the MIDREX Process through application of the SIMPAX System. Midrex will provide process know-how and Siemens will provide knowledge and expertise in developing similar automated control systems. Both companies will cooperate in the installation and support work for each SIMPAX application.

Improved process control in the DR plant due to a SIMPAX System can benefit an adjacent melt shop by producing DRI with less variability in quality (specifically, metallic iron and carbon content). When SIMPAX is combined with the patented MIDREX HOTLINK™ hot DRI delivery system, the next generation of mini-mills will benefit from even greater efficiencies and reliability to produce high quality liquid steel at the lowest operating and capital costs of any integrated mills in the world. In addition, data from the SIMPAX system can be integrated to the melt shop control system for improved efficiency and predictability.

Ultimately, SIMPAX will be used in the development of an Expert System and a Closed-Loop control scheme (Level II control), providing operators with the ability to choose setpoints for automatic process control and most efficient operation.

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Iron & Steel Society's 85th Steelmaking and 61st Ironmaking Conferences

Midrex and Kobe Steel exhibited and presented technical papers on ITmk3® and FASTMET®/FASTMELT® at the Iron & Steel Society's 85th Steelmaking and 61st Ironmaking Conferences held March 10-13, 2002 in Nashville, Tennessee. Technical information was available on the cutting-edge technology to help steelmakers stay competitive.
Corporate Changes Announcement

As our Mission Statement emphasizes, “Our employees are the key to our success” because they bring a wealth of experience and enthusiasm to our company and to clients. With our expanding focus on the direct reduction industry and on promoting new technologies for both traditional and new business, Midrex is pleased to announce the following executive staff assignments.

Winston Tennies President
Frank Griscom Senior Vice President - Corporate Development
Rob Klawonn Vice President - Sales
John Lowe Vice President - Finance & Administration
Dan Sanford Vice President - Operations
John Kopfle Director - New Business & Planning
Don Lyles Director - Business Services
Steve Montague Manager - Engineering

Midrex Calendar of Events

April 8 - 11
2002 SEAISI – Tokyo, Japan
Midrex and Kobe Steel will present papers on Future Green Steelmaking and FASTMET® / FASTMELT®.

April 10, 2002
SME Conference – Duluth, Minnesota
Midrex and Kobe Steel will feature an ITmk3® project update.

April 14 - 16
Metal Bulletin Iron Ore Symposium – Barcelona, Spain
Midrex is presenting its DRI/ HBI Forecast.

May 26-29
7th European Electric Furnace Conference – Venice, Italy
Midrex and Kobe Steel will have two papers including DRI/ HBI EAF Use Downstream and FASTMET/ FASTMELT.

June 17-19
Steel Success Strategies XVII – New York City
Kobe Steel will present ITmk3 in the New Technology Round-table.

Sept 29th – Oct 2nd
AISE Annual Conference – Nashville, TN
Midrex will present and co-author a total of three papers – FASTMET, Impact of Charge Material at Georgestown Steel Corp., and Not All RHF Technology Is Created Equal.

For more information or general comments, please e-mail: info@midrex.com

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