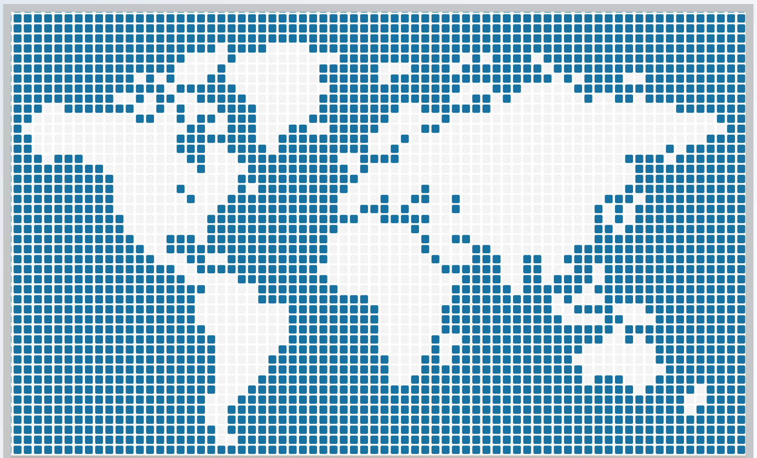

1ST QUARTER 2013

DIRECT FROM MIDREX

CONTENTS

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COMMENTARY

GREAT EXPECTATIONS
A TALE OF TWO TECHNOLOGIES...

By Henry Gaines
Midrex Director of Marketing

We have entered into a new age for Direct Reduced Iron (DRI). Shale gas has opened new territories to the possibility of DRI production. There is increased use of HDRI, CDRI and HBI in the EAF industry and also in integrated mills. DRI Plants offer greater flexibility, more options and better solutions for the modern steelmaker, all of which are leading the steel industry into a new era.

Consumers need technology that can produce at least what it was purchased to produce, its "nameplate capacity", and want the ability to squeeze even more tonnage out it at their discretion. They need the capability to control product form and to adapt best to changing markets.

Consumers want the best and expect more in return for their investment, which is a fair expectation.

Many of our licensees' MIDREX® Plants annually make 200,000 to 500,000 tons more than their original MIDREX® rated capacity. It is, and has been true of MIDREX® Plants built 30 years ago as well as the ones constructed today – Hadeed Mod E has already produced more than 200,000 in one year over its rated capacity of 1.76 mtpy.

This tendency is indicated by the client list below; each of these customers publically lists their MIDREX Plant capacity by at least 250, 000 tons over its "MIDREX® rated capacity".

- The 1.28 mtpy MIDREX Plant in Pakistan built for **Tuwairqi Steel Mills** was listed in the press and press release by TSM as a 1.5 mtpy Plant.
- **NuIron**'s 1.6 mtpy MIDREX Plant in Trinidad is referred to in presentations and in Quarterly conference calls as a 2.0 mtpy plant.
- The **ArcelorMittal Lazero Cardenas** 1.2 mpty MIDREX Plant is listed officially on their website as a 1.5 mtpy Plant

The capability of over producing is the "The MIDREX® Expectation." While this is not in any way a guarantee provided by Midrex, history has proven, and the market has grown to expect a well-run MIDREX Plant to produce more than just the rated capacity. As a matter of fact, just the top 30 operational MIDREX Plants at the end of 2011 had produced 70,000,000 such "bonus tonnes" for their owners over their lifetime!

And unlike our competition, it is our MIDREX® Plant owners who "re-rated" their MIDREX Plants, not Midrex Technologies, Inc.

The more important trend can be seen in the real numbers reflected in tons not percentages.

A MIDREX® Plant sold to produce 1.5 mtpy actually produces more tons of product annually than a DRI plant sold by our competitor to produce 2.0 mtpy. In fact, MIDREX Plants with rated capacities as low as 1.2 mtpy have out produced our competitor's plant designed to produce 2.0 mtpy.

We are in a new age for DRI. Today's demands are greater and consumers expect more.

Our results are based on flexibility and real annual performance, year after year and decade after decade. Our Plants offer more tons, more hours of operation and more value for investment. Our plants are geared for both immediate needs and future expectations.

Simply stated MIDREX® Technology is: **Designed for today, Engineered for tomorrow.**

You expect more and from MIDREX you can get it.

Designed for Today, Engineered for Tomorrow

NEXT GEN SIMPAX

From Product Quality Prediction based on First Principles to an Expert System

Greg Hughes, *Midrex Technologies, Inc.*
Angelika Klinger, Thomas Kronberger, Christoph Schönegger, Alois Altendorfer, *Siemens VAI Metals Technologies*

INTRODUCTION

SIMPAX® is an integrated process optimization system for MIDREX® Direct Reduction Plants introduced by Siemens VAI and Midrex Technologies, Inc. to aid in plant state evaluation as well as prediction of product carbon content and metallization. This article highlights the stages of development and the main features of the Next Generation **SIMPAX** system – a newly developed solution using an innovative approach based on "First Principles" that uses basic mathematics to solve mass and energy balance equations using the chemical and physical properties of the input and output gases and solids.

The value of such a system to predict is that it helps to eliminate the need for product analysis through sample testing- a method that suffers from lag time due to time elapsing from product entering the Shaft furnace until discharge as well as the duration of laboratory testing.

This article reviews the significant improvements compared to the old configuration and the benefits for MIDREX Plant operation as obtained by interaction between operator and SIMPAX.

PRODUCT QUALITY PREDICTION MODELS

Metallization and Carbon Prediction: The metallization as well as the carbon-content of the product are essentially completed when the material leaves the Reduction Zone of the shaft furnace. The retention time in the Reduction Zone depends on the production rate and material bulk density. The DRI then has to pass through the Transition Zone and the Cooling Zone (CDRI) or hot lower cone (HBI/HDRI) before it leaves the shaft furnace and a product analysis can be taken. After the sample is taken, it is sent to the laboratory to be analyzed. As a consequence of the time lags created by these events, the operator is informed of the actual condition of the product several hours after the reduction has been completed in the furnace. Since the samples are not always taken continuously, the worst case lag time on confirming the product quality can be as long as 7 to 9 hours.

In addition, the plant operator will typically not change process set-points based on only one sample result. Often there are requests for additional laboratory samples to provide more data to eliminate or reduce the possibility of laboratory error. This can further delay any corrective action that an operator may wish to take to alleviate any product quality deviations.

SIMPAX Metallization and Carbon Prediction Models bridge this delay by cyclically calculating the metallization and carbon content based on process measurements and raw material quality parameters. The operators can then adjust process parameters based on metallization/carbon forecast to achieve a more consistent DRI quality.

The new approach used for the product quality prediction is based on First Principles, which means that basic mathematics is used to solve mass and energy balance equations using the chemical and physical properties of the input and output gases and solids. A big advantage of this approach is that the impact of even small changes is immediately reflected in the results of the calculations.

PROCESS INFORMATION SYSTEMS AND PROCESS MODELS: NEXT GEN SIMPAX

The Next Generation SIMPAX is a package unit configured to be easily integrated into an existing or new basic automation system of a MIDREX® Plant. It has been designed to assist the operators and engineers in reaching specific targets in the MIDREX Plant and was created based on intensive analysis of the process by MIDREX and Siemens VAI experienced engineers.

The system is configured using state-of-the-art technology with regard to both, hardware and software platforms, as well as advanced process model technology. The software platform utilized, VAironment, was developed from proven automation solutions for the whole iron and steel production route (Blast Furnace and BOF Level 2 systems).

The MIDREX® Superdata model is fully integrated into the Next Generation SIMPAX System. The model runs cyclically and performs calculations using online-measurements, feed materials and product analyses (MIDREX Superdata is a model that has been painstakingly developed through the processing of data of various MIDREX® Plants over decades of operation in a variety of situations and locations).

Technological calculations are carried out to provide further data and open information to the operators, especially data concerning quality of the different gas streams and operation of the shaft furnace and reformer.

The development of an integrated process optimization system for MIDREX Plants began several years ago with an approach using neural networks and the implementation of this prototype in two operating DR plants. After the analysis of the results, this approach was deemed unacceptable. A completely new approach was developed using the proven VAironment platform of Siemens VAI as the foundation and the Product Quality Prediction Models based on First Principles.

The advantages are as follows:

- Noise in the input data can be easily handled by the basic VAironment system.
- Small changes in the process data are immediately reflected in the results obtained by the basic mathematical principles. In other words, the model does not require a base set of data to tune the predicting algorithm.
- The VAironment system provides an abundance of useful features for a complete process optimization system of a MIDREX Plant.

FEATURES AND BENEFITS

SIMPAX provides several features designed to establish a consistent approach to control the key parameters of furnace operation.

In *Figure 2* on the next page, the balance boundary can be seen. Simply speaking a system of equations is obtained by carrying out carbon, oxygen and hydrogen balances within the red marked area.

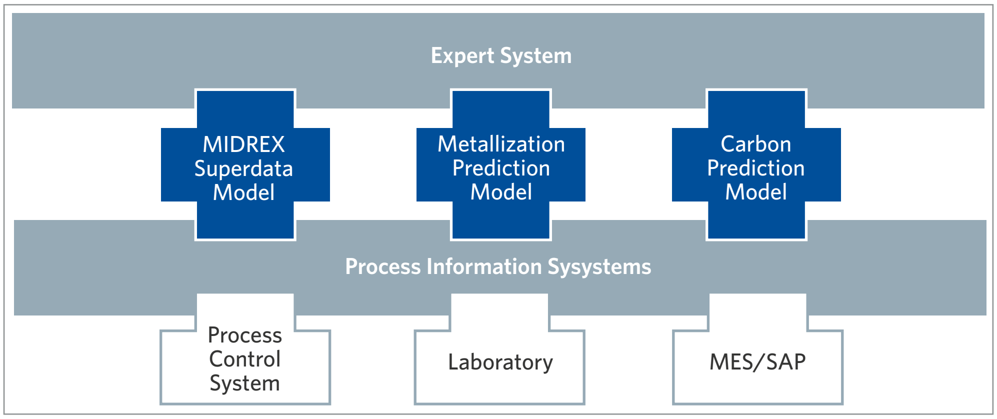

FIGURE 1 *Next Generation SIMPAX Application Software Structure*

MATERIAL TRACKING

Material can be tracked through the entire plant by using: feed material and product properties; feeding and discharging rates; technological knowledge about the changes in the material properties during the reduction process; and other data.

Knowing the position of the materials in the plant is essential for the process data in the balance equations. Additionally for each new product analysis, the material is back-tracked in order to find out when the reduction was essentially finished. The respective predicted values at this time are displayed together with the measured analysis data. Trends of measured and predicted values indicate the accuracy of both – the models as well as the laboratory results. Deviations in the results are compared with process target values set for plant operation and help operators make better operational decisions.

HARDWARE CONFIGURATION

The Next Generation SIMPAX system consists of a Server-Client Architecture with a link to an arbitrary process control system via the worldwide standardized communication interface.

COMMUNICATION INTERFACE

SIMPAX provides a communication interface to other platforms such as SAP/MES systems as well as to the laboratory. A link to the laboratory has the benefit that all material analyses are read automatically, checked for plausibility and used immediately in the model calculations. In addition, the received analyses are displayed in a Human Machine Interface (HMI) and can be added in certain reports as well.

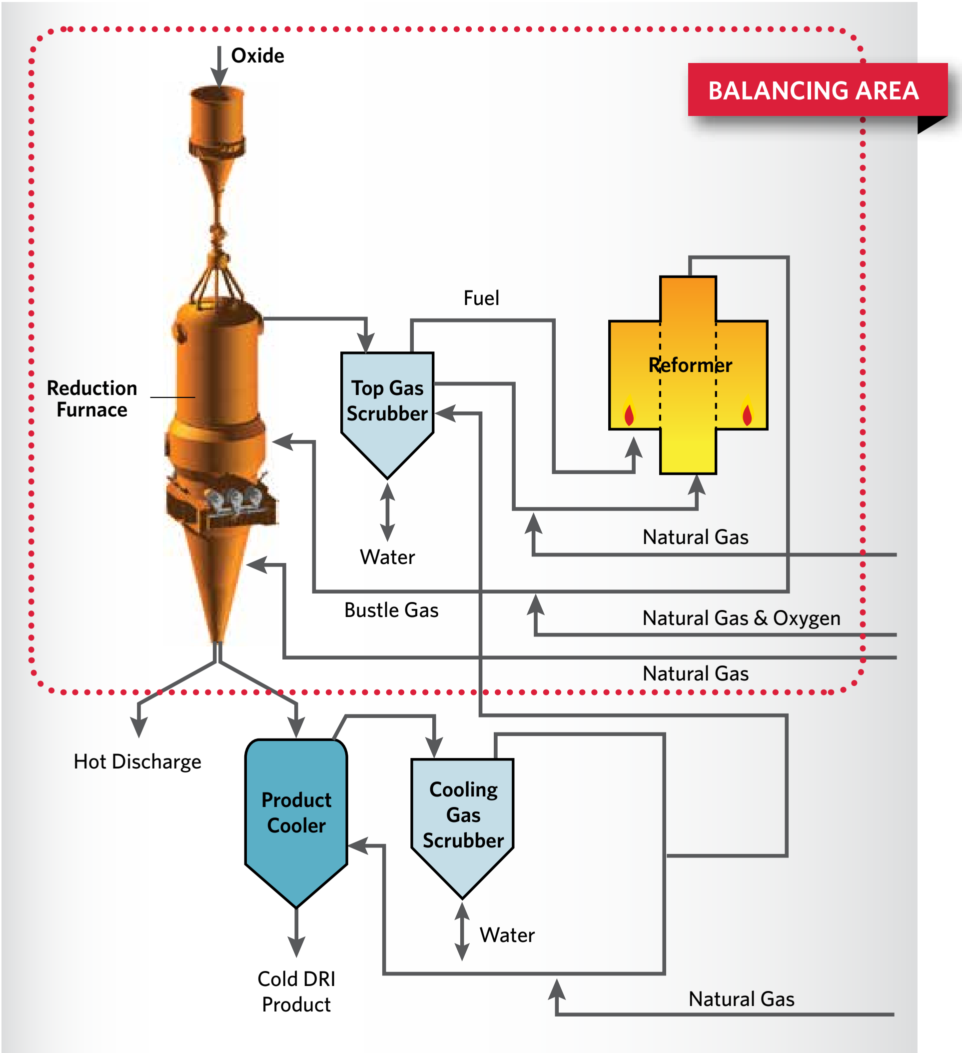

FIGURE 2 *Balancing boundary within red marked area*

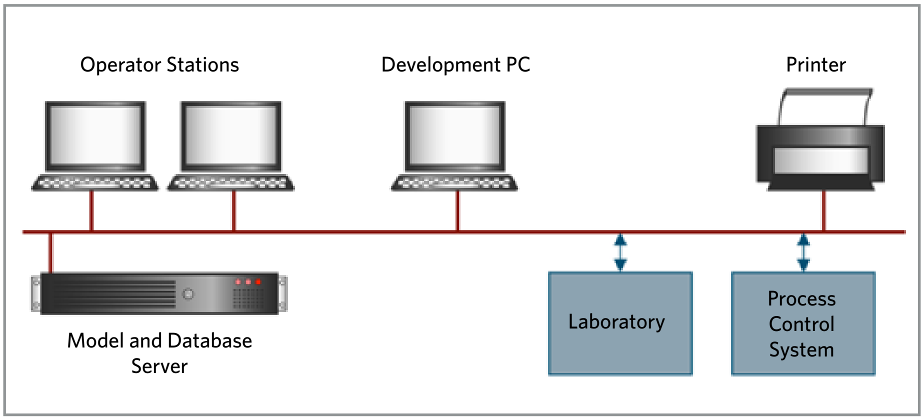

FIGURE 3 *Hardware Configuration*

PROCESS INFORMATION SYSTEM

VAironment is the platform for all Siemens VAI process optimization systems in the field of iron and steelmaking.

The management information system prepares process data and production results suitable for further evaluations by the plant management. VAironment provides the ability to export management related data either automatically and/or on request.

The data is visualized graphically using advanced techniques for user machine interfaces. The process visualization is run under the Windows operating system.

Microsoft Windows applications like Microsoft Office Products can be connected to the process optimization system to perform studies, evaluations and presentations of the MIDREX DR Plant data.

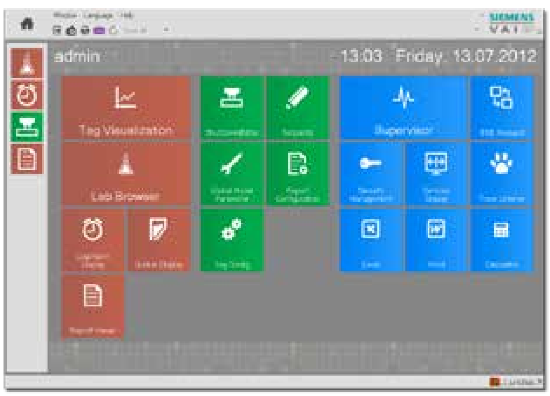

FIGURE 4 *Process Explorer Home Window*

PROCESS VISUALIZATION

The Process Explorer is the backbone of the Human Machine Interface acting as a container for all provided applications of the process optimization system.

From a set of multiple HMI's, two examples are given:

- The **Tag Visualization** is an advanced trending tool to observe time-based data. This can be done online (graphics are updated continuously) or offline (data are read from the process database).
- **Lab Browser**: In normal operation, all material analyses (raw materials, HBI, DRI, HDRI/CDRI) are transferred from the laboratory and no manual input is necessary. Nevertheless, the user interface can also be used to create, modify and delete analyses. The Lab Browser is completely configurable.

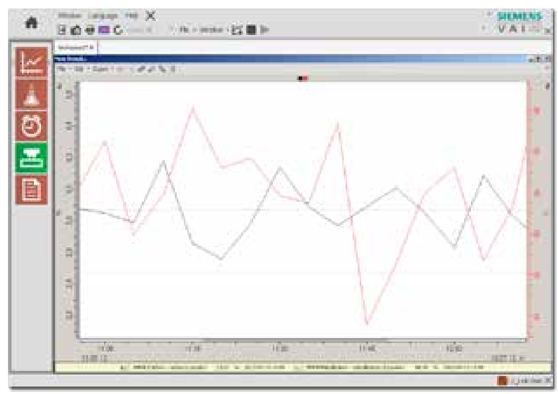

FIGURE 5 *Tag Visualization*

REPORTING

VAironment offers a flexible reporting system based on Microsoft Excel. Reports are generated cyclically, e.g. every shift, daily, monthly or generated on demand.

For each report there is one template. Templates contain configurable data sections allowing for easy modification or extension of existing reports. Microsoft Excel knowledge is sufficient to perform these modifications. The full functionality of Microsoft Excel can be exploited to generate reports and easily modify their appearance.

By copying templates it is also easy to generate new reports. A dedicated HMI is available to include new reports into the system. With that HMI it is possible to assign a report cycle time, the location where the report is to be stored, and other report properties.

NEXT GENERATION SIMPAX IN PRACTICAL USE

The Next Generation SIMPAX is the process optimization solution for future MIDREX Plant installations. It will be installed at the MIDREX Plant being erected at ESISCO which will start up in the near future and at the HADEED DR Module E which has been operating since 2007.

The Next Generation SIMPAX can be easily adjusted to various plant configurations due to a high system flexibility. Therefore its application is not limited to new MIDREX DR Plant erections. It is also most suitable to upgrade existing MIDREX Plants with a new advanced process optimization system.

EXPERT SYSTEM – NEXT DEVELOPMENT STEP

The **MIDREX Superdata Model** and the **Quality Prediction Models** evaluate the state of the process and the expected product quality. In case of undesired process conditions or product quality it is the operator's duty to perform corrective actions.

Siemens VAI has many years of experience with closed-loop expert systems for blast furnaces and sinter plants. The basic idea of these expert systems is an evaluation of the actual state and the generation of corrective actions to alleviate the undesired conditions. The knowledge base of these expert systems consists of operational rules and knowledge of metallurgical experts.

The next step in the development of the Next Generation SIMPAX shall be the implementation of an expert system for MIDREX plants. It will cover the shaft furnace and the reformer area. MIDREX contributes the process and operation know-how and Siemens VAI creates the knowledge base for the existing expert system shell. Using this proven shell, the SIMPAX Expert System will provide closed-loop and semi-automatic operation mode: in semi-automatic mode, suggestions made by the expert system will be executed automatically after acceptance by the operator. In closed-loop mode, even operator acceptance is not required for the execution of corrective actions.

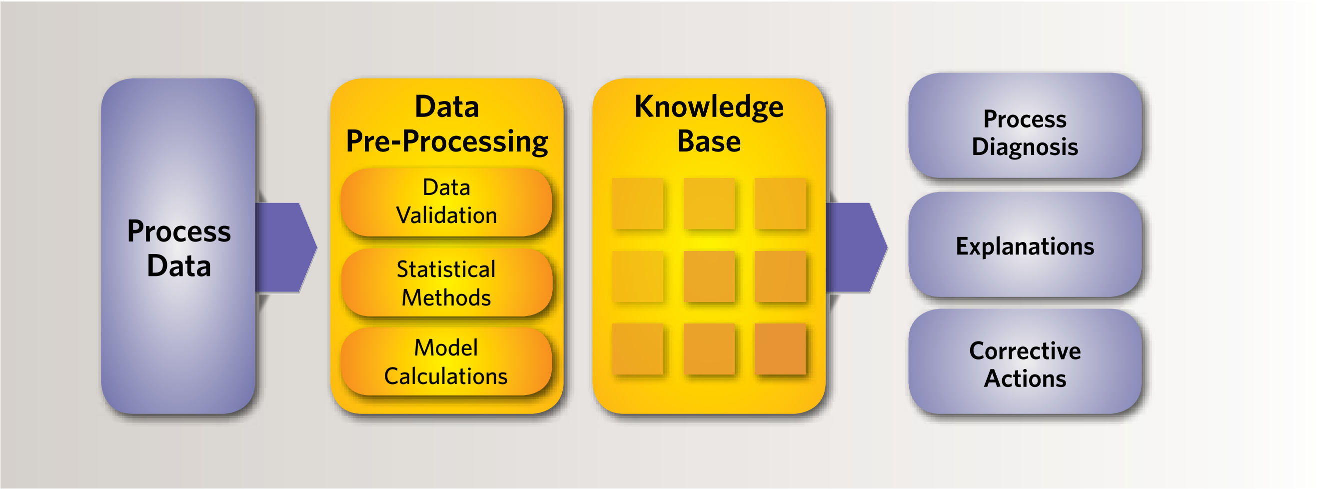

FIGURE 6 *SIMPAX Expert System Structure*

The knowledge base of the SIMPAX Expert System is principally defined by MIDREX specialists. Nevertheless, special operational rules and control philosophy of the individual customers will also be included in the knowledge base. In this sense, each customer will get a tailored expert system perfectly fitting to his needs.

With the introduction of the SIMPAX Expert System a first step will be taken in the direction of fully automatic quality control and equipment protection. The application of an expert system helps to foster uniform operator decisions over all shifts and early detection of undesired process conditions resulting in small corrective actions that have a positive impact on the overall plant performance and efficiency. ■

SHALE GAS AND ITS IMPACT ON THE WORLD:

(Part 2) Scenarios for the Global Steel Industry

By Robert Hunter

Editor's Note: *This article is a continuation of a report on **Shale Gas** that ran in the "**4th Q 2012 Direct from Midrex**." Part one "Musings on a revolution in the energy sector" introduces the world of shale gas, providing a foundation for the reader by delving into the phenomenon that is "**Shale Gas**." The article examines the technology improvements in the petroleum industry that are making the production of shale gas possible. It also describes some of the environmental questions associated with shale gas development and some of the economic benefits to the United States, especially to the U.S. steel industry. Part two further discusses the remarkable turn of events in the field of natural gas exploration, development and production. This article will look more to the international arena, specifically where is shale gas being developed, what effects is it likely to have in those areas where this development is underway, and how this will directly affect the steel industry.*

INTRODUCTION

The spread of shale gas technology is moving at markedly different velocities in various regions of the the world, primarily due to regulatory differences in different countries. Were it merely a question of economics, it is likely that every coal producing region would be moving forward at the break-neck speed as seen thus far in the United States; however, other factors, especially political requirements are weighing on the decisions whether to drill or not.

SHALE EXPLORATION UPDATE (EUROPE)

Excellent data is available from the International Energy Agency (IEA) regarding the shale gas industry in Europe. There are the well-publicized incidences of nations banning the hydraulic fracturing of reservoir rock containing oil or gas. It is widely reported that François Hollande, President of France, stated he will not allow fracking as long as he is President (at least through mid-2017). Similarly, Bulgaria recently refused all permits for fracking. Two of the Low Countries, Netherlands and Luxembourg do not allow it, and a new moratorium on fracking was announced by the Czech Republic.

Out of the twenty-three other nations that contain sedimentary basins believed to hold gas, seventeen have already permitted drilling and fracking and six allow it, but have yet to issue any permits. Within those nations; however, some areas do not allow it. For instance, the heavily populated province of North Rhine-Westphalia in Germany rejected the technology even though the national government accepts it.

Costs are also playing a role in planning. In some locales, initial drilling projects have proven more expensive than previously estimated. The first attempts to drill in Poland were two to five times more expensive than similar projects in the United States, primarily because the industry infrastructure is not in place. There are approximately 1200 suitable drilling rigs in the U.S., whereas there are only six in Poland. Other, prerequisite equipment is also difficult to source; however, given time and continued drilling, the equipment will be purchased, the necessary infrastructure will be developed and these costs will come down until they are similar to U.S. costs.

Europe will eventually produce large quantities of shale gas, but the growth route at least initially will be much slower than in the U.S.

Effects of the developing shale gas industry are apt to be not only economic but also geo-political. The previous article noted that the flow of funds from the United States to energy supplying nations had grown to $0.4 trillion per year by mid-2007 and has been declining rapidly ever since with the expectation that it will be down to zero within four years. Similarly, nearly $100 billion per year of natural gas are sold from the CIS westward into non-Russian Europe. How much this will decline and how swiftly is a matter of conjecture, but there is no question that the flow of money will slow. Where the prices settle will be a major factor as well. For the past seven years, the average gas price at the eastern border of Germany where the pipelines come in from Russia, has been slightly over $10 per million btu, a bit more than four times the average price of the 1990's. The question is "how long can such pricing be sustained once Germany, Poland, the Baltic nations and the Balkan countries are all producing large volumes of gas?"

Another interesting outcome is that the newfound resource is under-pinning decisions to halt/delay construction of new nuclear power capacity; decisions made in the wake of the Fukushima disaster. Shale gas may fill the gap left by shuttered nuclear power plants.

SHALE EXPLORATION UPDATE (ASIA)

In the East, China's early success with shale gas has given them leverage in their negotiations with companies and governments hoping to sell them energy. Expectations are for more than 200 billion cubic feet to be produced in 2015 and for that number to increase nearly ten-fold over the following five years to around 2 trillion cubic feet per year. *(Source: http://why.knovel.com/all-engineering-news/2305-china-pushes-hard-for-shale-gas.html)*. But even that seems small compared to the U.S. Energy Information Agency's current estimate that China has 1.3 quadrillion cubic feet of shale gas available, enough to sustain the two trillion ft^3/year for consumption rate for 650 years. Typically, oil and gas reserves of most nations are on the order of ten to twenty years. China still intends to import energy from major suppliers, but with such reserves available, the bargaining position of those suppliers is substantially weakened. Moreover, each time China agrees to a new supply contract, the bargaining power of each of the remaining suppliers weakens.

It should be noted that thus far, the gas containing shale reservoirs in China that have already been explored contain more clay than what is typical in the U.S. This clay makes the shale less brittle and thus more difficult to fracture. Technological solutions are being tested, but perhaps the shale gas in China will be more difficult to produce than that in the North America.

Oil Country Tubular Goods (OCTG) seamless steel tubing in use

SHALE GAS AND THE STEEL INDUSTRY

So, what is the effect of this gas on the steel industry? The simple answer is a broad one. Shale gas will have impact on the industry as a whole both in terms of increasing product demand and also encouraging additional ironmaking production. In short, accessing gas will mean increased construction, specifically greater seamless pipe usage. Natural gas pricing and availability will also encourage DRI production and interest in the form of HDRI, CDRI and HBI for both minimills and integrateds.

SHALE GAS EXPLORATION AND PRODUCTION: STEEL INTENSIVE!

First and most obvious is the burgeoning need for Oil Country Tubular Goods (OCTG), especially seamless tube. Extraction techniques for producing oil and gas via the new non-conventional techniques is far more steel intense than the old techniques of simply drilling directly through the reservoir. For the old techniques, imagine a hole extending two or three kilometers down. First, it must be drilled using one type of drill pipe.

And then completed, using a second type of drill pipe. Both of these are brought back up to the surface and can be re-used. The well must be cased with yet another variety of tube. The casing does not get recovered. It will be in the ground permanently.

Now, consider an alternate method of drilling whereby the hole goes downward for the same two or three kilometers, but then bends approximately horizontal and runs through the midst of the layer of reservoir rock for an additional few kilometers. From the same surface level drill site, an additional three, or four, of five wells, will be drilled each one turning to a different direction once they get down to the reservoir rock. The current record is 12 wells drilled from one site. As in the conventional case, the drill-pipes used for both drilling and for completion are recovered, but the well must be cased with tubing as in the prior example. The overall length of this well-casing is expected to be five to ten times longer than that used in a conventional well.

Once a well is brought into production, many more pipes are required to connect it and other, nearby wells that were drilled into the same reservoir to collect the oil and gas.

It is also very likely that these wells are in a region previously not producing hydrocarbons, thus additional line-pipe must be installed to bring the product to market. Many of these regions are far from the consumer and large, long transit pipe must be built.

To illustrate the scale of the undertaking, let's examine one field in North America. The Bakken field near Williston, North Dakota, extends into Montana to the west and across the Canadian border into Saskatchewan to the north. Already about 8,000 wells have been drilled into the Bakken, but that is only a fraction of what will be needed. Estimates are that approximately 50,000 wells will be drilled within the next few decades.

Tom Reichner / Shutterstock.com

The Bakken field near Williston, North Dakota

Consumption of OCTG in the U.S. is running at more than twice the rate it was at a decade ago. Steelmakers involved in the manufacture of seamless tube, spiral welded pipe and longitudinally welded pipe are all planning or are already building new capacity. As might be expected the sum of the announced capacities is probably greater than the total that will actually be needed. Whether all of the announced capacity proceeds, or not, a building boom of new plants for OCTG and pipe is underway. This trend will continue to sweep the rest of the world as the shale gas revolution spreads.

SHALE GAS EXPLORATION AND PRODUCTION: IRONMAKING

Other effects on the steel industry can be seen in ironmaking. Ironmaking uses the lion's share of the total energy needed for producing steel. The energy needed to separate the oxygen atoms from the iron atoms is far more than the total of all of the energy needed to melt the iron and to run all of the equipment in a steel works. Thus , ironmaking has been rapidly moving to take advantage of a lower cost and plentiful source of energy.

Shale gas application can be found in two areas, as an alternate fuel for blast furnaces and as the fuel for direct reduction. Last year an internal study at Midrex found the usage of natural gas as alternate fuel in U.S. blast furnaces was approximately 45% of maximum. (Maximum was defined to be the highest intensity application of natural gas in commercial operation in the United States). Since that study was performed, additional blast furnaces have been converted to using natural gas as their alternative fuel in place of pulverized coal and oil. This trend, too, is almost certain to spread worldwide as gas becomes relatively less expensive than other fuels.

A similar study of European blast furnaces shows that natural gas is already almost fully applied as alternate fuel throughout Eastern Europe (including Russia) where gas has historically been less expensive. It is only barely applied in Western Europe where gas has been and still is quite costly. Even with the shale gas phenomenon, gas prices in Western Europe are not expected to decline rapidly. As noted above, some of the necessary technology is not politically acceptable in some regions, but a greater effect on pricing is the desire to shutter older nuclear energy plants, following the Fukushima disaster. The closure of nuclear plants leaves gas as the cleanest alternative for gigawatt scale generating facilities thereby greatly increasing the demand for gas.

As for direct reduction capacity, there is a stampede beginning to construct additional capacity in North America where the gas prices are already low, and clearly foreseen to stay low. In the past, North American DR plants suffered closure at times when gas pricing rose to multiples of the prior, 'normal' pricing and at the same time prices of scrap steel dropped drastically. These closures led to relocation of the plants offshore, and in one case salvaging of the plant's equipment for use in sister plants.

The big difference today is not just the extraordinarily low gas prices but also the long term futures market in natural gas that provides security for the investor regarding his costs for more than a decade hence.

And so, many companies are looking at the feasibility of building DR. **The following table is an attempt to categorize most of the types of companies:**

- **EAF steelmakers that produce HRC**
- **EAF steelmakers that produce plate**
- **EAF steelmakers that make wire rod**
- **EAF steelmakers that manufacture Special Bar Quality, Forging Grade and other malleable bar**
- **Integrated steel companies considering building EAF shops as expansions**
- **Integrated steel companies considering building EAF shops as replacement**
- **Integrated steel companies investigating use of HBI in their blast furnaces in the U.S.**
- **Integrated steel companies looking to transport HBI**
- **Integrated steel companies looking to transport HBI off-shore**
- **Companies in the energy field seeking investment**
- **Mining companies looking to expand capabilities**

SHALE GAS IRONMAKING: INTEGRATED INTEREST IN HBI

One particularly type of company that is looking at DR more intensely than before is the integrated steelmaker considering use of HBI for their blast furnaces. The benefits of charging HBI to a blast furnace (BF) have been described often in this publication. In summary, for each 10% metallization increase of the

PICTURED: *EAF, Blast & Basic Oxygen Furnaces in Integrated Mills*

blast furnace burden (such as metallic iron being added via HBI) the productivity of the blast furnace is increased by 8%. Simultaneously, each 10% metallization increase decreases specific fuel consumption by 7%.

Now two new forces are coming to bear. In a number of advanced economies, impending closure of BF capacity expected over the next decades, is driving the more forward looking steelmakers to seek out an advantage that can 'leap frog' them ahead of their competition. Simultaneously, pressure to decrease CO_2 emissions is making natural gas based direct reduction look more and more favorable.

Reduction by natural gas generates only one-third of the CO_2 as reduction by conventional blast furnace technology. Further, the use of pre-reduced material, HBI, as part of the BF charge lowers the CO_2 footprint of that iron passing through the direct reduction furnace and the BF to only about one-half of conventional BF-only smelting; this is over the entire cycle, iron mining through finished steel. In essence the HBI becomes "Virtual Natural Gas" for a BF.

HBI, rather than unbriquetted CDRI is the preferred and actually almost the only form of DRI usable in a modern blast furnace. The crush strength of CDRI is simply too low to make it a good choice for large, modern, high production blast furnaces.

SHALE GAS IRONMAKING: MERCHANT HBI

As strange as it might have once sounded, North America's large shale gas reserves could lead the US to become a leader in merchant DRI sales in the upcoming years.

As stated before the use of HBI could make the integrated industries more efficient and viable especially in areas such as Europe, which continue to tighten environmental regulations yearly. The idea of producing DRI in the US and then shipping it overseas may seem far-fetched, but the economics in light of the shale gas factor say otherwise.

In fact prior to press time of this article, Voestalpine AG of Linz, Austria, announced plans to construct a direct reduction iron plant in Texas. The planned facilities will be designed to produce two million tons per year of HBI and DRI.

According to the Voestalpine press release:

"This will provide the Austrian steel production sites in Linz and Donawitz with access to cost-efficient and environmentally-friendly HBI and DRI pre-materials, ensuring their competitiveness over the long-term...Direct reduction ensures the future of sites in Austria and creates options for growth."

Voestalpine maybe the first to attempt this model in the USA, but according to many industry pundits, they will not be the last.

A SCENARIO OF THE FUTURE

Undoubtedly, the shale gas 'revolution' has begun to spread around the planet. And with this expansion DRI will become much more common than it is today. In 1974, one of the pre-eminent steel industry analysts of the day, Jack Robert Miller, forecast 80 million tons per year of DRI by 1985. *(Scientific American, June, 1974)**. Had that prediction occurred, DRI would have comprised 16% of world ironmaking. The prediction was made at a time when natural gas costs were much lower in relation to metallurgical coal than they have been since, at least until now.

Immediately after Miller's forecast, the oil crisis struck and economic forecasts everywhere had to be tossed out. If the dramatic change in gas costs already seen in the U.S. moves into other countries as it is expected to do (although few expect the shift to be as extreme elsewhere as it has been here), the bias will once again be strongly in favor of making iron with gas; even more so than it was in 1974, judging from expected gas/met-coal price ratios.

The prediction of DRI comprising 16% of the world's iron may come true. Even without any growth in world ironmaking, 16% would be nearly 200 million tons per year of DRI. How long this prediction will take to become reality? 12-17 years is a reasonable expectation.

Considered from another perspective; this number will mean approximately 125 million tons per year of additional DRI capacity within the next 12 to 17 years, an average of seven to ten MIDREX® Megamods brought on-line every year.

The majority of those modules should be built as ironmaking plants to supply EAF's, just like most DRI modules today. They will produce most of their iron product as hot DRI for direct charging to the steelmaking furnace.

Market forces will drive a larger share than now to produce Hot Briquetted Iron. The HBI will be needed in those cases where it is not practical to construct the DR plant adjacent to the steel shop. Often these will be locations where low cost natural gas can be pipelined to where it can meet the iron oxide, but not to the site of the steel works. The iron reduction will occur there and then the metallic iron will be transported to the steelmaking shop.

HBI will be needed also as charge material for blast furnaces. In such cases the DR plant will use regular blast furnace grade pellets rather than the more expensive DR-EAF grade pellets used by almost all DR plants today. There is no need to pay for beneficiation of the ore up to DR-EAF grade if the iron is to melted and slagged in a blast furnace. In addition to the well-known advantages of expanding the capacity of the blast furnace and lowering the specific energy consumption for making hot metal, molten pig iron, this scenario for ironmaking vastly lowers the carbon footprint for manufacturing iron.

To what extent and at what time these changes occur are subject to the vagaries of economics. But, as a direct result of the technologies that have brought the shale gas boom to the United States, the technologies that are now beginning to diffuse to almost all nations, these changes are almost certain to happen. ■

**To be fair to Miller, his forecast was prepared in an era of sustained growth of the ironmaking industry of nearly 6% per annum that had lasted for almost 30 years.*

MIDREX News & Views

Midrex announces launch of Midrex Global Logistics

Forwarding Services International (FSI) is now MIDREX GLOBAL LOGISTICS, Inc. with Expanded offices and dedicated East Coast Warehouse

Midrex has officially announced the expansion and startup of its new logistics and freight forwarding arm: Midrex Global Logistics (MGL).

MGL is the evolution of Midrex's previous Charlotte-based freight forwarding company, FSI. The new enterprise has expanded its operations with new offices, staff and warehouse located near Charlotte Douglas International Airport.

MGL's core capabilities extend from the group's experience, knowledge and abilities which have helped Midrex supply vital parts and equipment worldwide to MIDREX® Plants globally.

The new expansion now allows MGL to offer greater levels of service to MIDREX® Plants as well as a variety of other industries and companies because of the new warehouse capabilities and expanded sales and logistics staff.

"We have a new name, new offices, new Charlotte warehouse, new website and new expanded services and capabilities, said James D. McClaskey, MGL President. "It is still run by the same staff at FSI that you have known for years but, these new changes mean more options and services that we can now offer worldwide."

MGL's expanded capabilities include Customs Brokerage, Project Cargo, Global Air Freight, Global Ocean Freight, Hazardous Materials, Warehousing Services, NVOCC Services and Insurance.

MGL has added a new Operations Office & Warehouse located at 900 Center Park Drive, Suite F, Charlotte, NC 28217. MGL will continue to maintain its current office at 2725 Water Ridge Parkway, Charlotte, NC 28217.

For more information including additional capabilities please visit www.midrexlogistics.com or call us at 704.424.9905.

MIDREX News & Views

Midrex nominated for two Industry Awards

Midrex Technologies, Inc. is among select executives and companies from 11 countries that have been selected as finalists for the inaugural **Platts Global Metals Awards** recognizing exemplary performance in nearly a dozen categories. The 2013 finalists, chosen from dozens of nominations, were announced in March by program host company Platts.

President & CEO of Midrex Technologies, Inc. James D. McClaskey

Midrex has been chosen as a finalist in both the **Lifetime Achievement Award** for Midrex President & CEO James D. McClaskey as well as **Innovative Technology of the Year** for the MIDREX Process' advances in using coal sources such as coke oven gas to produce direct reduced iron.

Platts Global Metals Awards highlight corporate and individual innovation, leadership and superior performance in categories spanning the entire steel, metals and mining complex. The new awards program is modeled after the highly successful **Platts Global Energy Awards**, established in 1999 and often described as "the Oscars" of the energy industry. Finalists were chosen from a long list of submitted nominations and winners of the 2013 Global Metals Awards will be announced on May 23, 2013 in London.

Christopher M. Ravenscroft: Editor

DIRECT FROM MIDREX is published quarterly by Midrex Technologies, Inc.,
2725 Water Ridge Parkway, Suite 100, Charlotte, North Carolina 28217 U.S.A.,
Phone: (704)373-1600 Fax: (704)373-1611,
Web Site: www.midrex.com under agreement with Midrex Technologies, Inc.

The publication is distributed worldwide by email to persons interested in the direct reduced iron (DRI) market and its growing impact on the iron and steel industry.

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