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COMMENTARY

THE SPECTRUM OF CARBON IN AN EAF

By Robert Hunter

Carbon, carbon, carbon...

Percentages of carbon in DRI and the advantages of that carbon are situational based on various steelmaking conditions. There are a few fundamentals to its usage. In the EAF carbon is used to reach the required specification of the steel desired, to reduce any remaining FeO (in the scrap or DRI) and lastly as an additional energy source to help melting.

The amount of carbon to make specification is usually a small amount, for example common AISI 1010 carbon steel needs about 0.1% carbon. Carbon beyond that is used to reduce FeO to metallic iron. DRI at 96% metallization will need less than 1.0% carbon for this purpose. DRI around 93% met will require about 1.5% carbon (Note that each 100 kg of FeO requires 16.7 kg of carbon). Any remaining carbon is available for oxidation and can be burned to provide additional heat energy supplementing the heat from the electric arc.

Carbon can be added through injection into the EAF or charged as contained carbon in the DRI itself. Carbon contained in the DRI can be very valuable to the steelmaker if it can be adequately utilized. The idea is to use the additional carbon to help melt the steel quicker to reduce tap-to-tap time and increase productivity. Excessive carbon in the DRI will be in the bath until it is blown down with oxygen.

Even though additional carbon is viewed as an extra form of energy, it is possible to have too much carbon. Too much carbon is defined as carbon that does not add any value to the production or further decrease the tap-to-tap time of a steel heat. Any carbon above specification of the steel after the iron is melted needs to be decarburized. The extra time consumed in decarburizing causes a decrease in productivity of the EAF.

In addition, there is a maximum rate for decarburizing steel in an EAF. To remove carbon from the steel, the carbon is oxidized and carbon monoxide (CO) is formed. The CO forms bubbles which quickly float out of the steel and then float through the slag. This forms a ‘boil’. Decarburizing attempts at greater than 12 Nm$^3$ per minute per square meter of

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THE SPECTRUM OF CARBON IN AN EAF

<table>
<thead>
<tr>
<th>REQUIRED</th>
<th>USEFUL</th>
<th>DETRIMENTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>For meeting Product Specifications</td>
<td>For reducing FeO in unmetallized DRI/scrap</td>
<td>Available for oxidation. Can be burned to provide additional heat energy but is limited by:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Decarburization Rate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Available Oxygen</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Off Gas Collection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Temperature of DRI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Any carbon higher than specification that remains in melted iron must be decarburized. The extra time consumed causes a decrease in productivity of the EAF.</td>
</tr>
</tbody>
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COMMENTARY

Continued from page 2

steel bath surface causes the boil to be more violent than can be safely contained in an EAF.

Other factors that define whether or not there is an “excess” of carbon, include: the oxygen available to blow down excess carbon; off-gas handling systems sized to handle the addition volumes of gas released during decarburization; and temperature of DRI being charged.

The first two factors are a big limitation for older EAFs as they are not sized to handle the volume of oxygen needed or off gases produced. More modern EAFs are better suited towards this fact but cannot handle unlimited levels of carbon either. Lastly, the temperature of the DRI charged can also have a big impact. This is the subject of our feature article in this issue (page 4). Hot charging DRI at temperature of 500⁰C and higher will add additional energy to the heat. Having more carbon than can be physically removed by the time the iron is melted can occur when large amounts of high metallization, high carbon, HDRI are charged. The hotter the HDRI, the less carbon that can be utilized. If the impact of this temperature is not properly compensated for, there will be excess carbon that will need to be decarburized.

The issue of carbon may seem simple at first but in reality can get to be quite complex. The proper percentage exists as a spectrum of sorts not a fixed point. And if there is anything to keep in mind is that it is possible to add carbon to the EAFs multiple ways, but there is only one way to get rid of it. If more than is needed is already in the charge then it will take time to remove it and that time usually means money.

Too much carbon is defined as carbon that does not add any value to the production or further decrease the tap-to-tap time of a steal heat.
INTRODUCTION

EAF steelmakers have long depended on direct reduced iron (DRI) to help with producing quality steel products. DRI can provide a double benefit to the EAF. First and most important is that it provides clean iron units that can be made into high quality liquid steel; secondly it can provide carbon that is both an alloy of steel and a fuel. Through the years, the benefit of DRI with carbon content at percentages of 2.5% and higher have been discussed as a way to make EAF steelmaking more productive and less costly. However, higher carbon content in DRI that is charged to the EAF is not always beneficial, as it can decrease overall furnace efficiency and increase oxygen usage as well as tap-to-tap times. This article examines a phenomenon experienced at a DR/EAF complex to illustrate the effects that high carbon DRI can have on the bath.

AN INTERESTING PHENOMENON

A few years ago, in the EAF Steelmaking part of the industry, an interesting event occurred. A new, modern design, high powered electric arc furnace was melting a heat that consisted of mostly hot DRI (HDRI). When it had finished melting and the temperature was right, a sample was taken. From the sample it was discovered that the carbon was too high; in fact much higher than desired or even anticipated. Because of this, the melt shop manager in charge of the furnace had no choice other than to blow oxygen until the carbon could be brought down to suit the specification of the steel that was being made.

This event might have been chalked up to a weird one-time phenomenon, if not for the fact that it happened again on the next heat and repeatedly afterwards. The same procedure was needed to deal with the excess carbon requiring the EAF to blow oxygen causing additional cost and time. The productivity of the EAF was lowered by ten to twenty percent as the steel shop had to use more time with each heat of steel waiting for the carbon content to be lowered. Clearly, the problem was systematic.
In short the situation was as follows:

- The HDRI already contained a large amount of sensible heat when it was charged to the EAF. Much less electric energy was needed than when Cold DRI (CDRI) was charged, thus, the iron could be brought up to the melting temperature much more quickly.
- The HDRI was highly metallized; there was less iron oxide (FeO) that needed to be reduced in the EAF. In turn, less carbon was needed to accomplish reduction.
- The HDRI was high in carbon.

The issue was that there was more carbon charged to the EAF than could be burned out during the short amount of time that was available. The solution was to either lower the carbon content of the HDRI or to lower the temperature of the HDRI. It was swiftly decided that the cost of making high carbon is greater than the cost of delivering the DRI to the EAF at higher temperatures, so the carbon content was lowered. As a result it also meant that more iron was being charged.

METALLIZATION

A summary review of how carbon is used in the EAF is helpful to explain this case, but we must first explain the definition of metallization. Prior to melting, not all of the iron in DRI is reduced to the metallic state. In all DRI products, a small amount of iron oxide (FeO) remains. Metallization is a quantification of the portion of the iron that is metallic. When it is stated that DRI has a certain degree of metallization, it means the percentage of metallic iron divided by total amount of Iron in the DRI pellet.

% Metallization =
(Metallic Iron / Total Iron) x 100

In contrast, when carbon is mentioned it is calculated as the fraction of the total pellet.

% Carbon =
(Total Carbon / Total Pellet) x 100

For instance, a DRI pellet with 95% metallization (or met), means that 95% of the available iron is metallic and thus, the remaining 5% exists as FeO. Please note that is not the total percentage of the whole DRI pellet, just of the iron-bearing portion. The pellet also contains silica and other trace elements. In fact, a pellet by composition could conceivably have a met of 95% and be also 10% silica by composition. It is necessary to note this as some within the industry use percentages that sometimes can be misleading. This is particularly important when discussing carbon percentages as the percent of carbon is out of the whole pellet, whereas the percent of metallization is out of only the iron bearing content (Figure 1).

**FIGURE 1** Two samples of DRI at 95% metallization

<table>
<thead>
<tr>
<th>Sample A</th>
<th>Sample B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other (Gangue)</td>
<td>Other (Gangue)</td>
</tr>
<tr>
<td>Carbon</td>
<td>3.4%</td>
</tr>
<tr>
<td>FeO</td>
<td>5.1%</td>
</tr>
<tr>
<td>Metallic iron</td>
<td>89.0%</td>
</tr>
</tbody>
</table>

The addition of 10% gangue in Sample B displaces a portion of each of the other constituents in the product.
**CARBON IN THE EAF**

Since DRI contains some percentage of iron in the oxide form, it is necessary for the DRI to also contain enough carbon to reduce this iron oxide to metallic iron. For highly metallized DRI only a small amount of carbon is needed; typically around 1% carbon or less can handle this reduction of the FeO. The efficiency of this carbon is almost perfect due to the intimate mixing of the carbon with the iron and the iron oxide. Essentially, every oxygen atom that is bound to an iron atom will be taken away by a carbon atom. The carbon atoms have no competing reaction available until the Melter begins to blow oxygen to burn them away. Subsequently the efficiency of the carbon use is 100%.

This is remarkably different from the efficiency of carbon that is charged into the EAF which can often be below 50%, according to how and where the carbon is put into the furnace. If it is not properly used, it will simply burn in the air and have little effect on the steel. For that portion of carbon greater than what is needed to reduce the iron oxide to iron, the Melter will blow oxygen to burn it away. A large amount of energy is derived from this reaction and is helpful in heating the charge. Again, carbon within the DRI is very efficient in providing this heat. Burning carbon charged separately into the furnace will often just heat the air that is passing through the furnace, whereas nearly all of the heat from burning carbon in the DRI goes to heating the iron.

This is extraordinarily useful in that the limiting factor for how much iron a furnace can melt is how fast heat can be input. The melter will operate at full electric power as soon as possible, so any additional heat going to the iron will shorten the time needed to melt the charge. Various arrangements of burners and combinations of carbon input (by injection or by charging in the bucket) are used, but none are as efficient as carbon that is already in the iron.

Although the carbon contained in the DRI can be valuable and seems an almost all-encompassing solution, the practice has limitations in practical application. First, an EAF is not well stirred. Even though the molten steel in one location might be high in oxygen, in another location it might be high in carbon. The liquid in the two locations are not guaranteed to be brought together quickly and subsequently would not have the opportunity to react. Conversely, a basic oxygen furnace (BOF) is well stirred. It is designed as a bottle that is not quite closed at the top. This allows the supersonic oxygen flowing from the lance to strongly agitate the molten metal and the slag. Note that if an EAF was to be so strongly stirred, molten metal would be sprayed up onto the sidewalls and even onto the roof. Since an EAF is not so well stirred it takes more time for reactions to come close to completion than it does in a BOF. Consequently, it takes longer to blow down large amounts of carbon.

Second, when carbon is burned it first burns to carbon monoxide and then the carbon monoxide burns to carbon dioxide. The volume of the carbon dioxide gas is a few thousand times the volume of the solid carbon, if it is at room temperature. The volume of the same gas heated to the temperature inside an EAF it will be more than six times greater in volume (Figure 2).

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**FIGURE 2**
The small dot at the left represents a solid piece of carbon. The smaller square is representative of the volume of carbon dioxide gas formed by burning the carbon, if it were possible to burn at room temperature. The large box shows how big that gas volume would be when heated to the temperature of the EAF offgas.
The result is that for each heat of steel many tens of thousands of cubic meters of hot gas are removed from the EAF and must be cooled and filtered. The gas must not be allowed to exhaust to atmosphere until it is environmentally acceptable.

Offgas treatment equipment for EAFs is enormous and expensive. One large duct carrying offgas to a baghouse filter might be eight meters in diameter and might carry over a million actual cubic meters per hour of gas. A baghouse is a structure building that contains large filter bags. It is analogous to a vacuum cleaner for household use, but it is the size of a building. Another very large cost of treating this offgas is that it must be cooled prior to entering the baghouse.

MODERN EAF STEELMAKING

EAF technology has advanced extremely rapidly over the past decades. Only a few years ago, there were no EAFs on earth that would have been able to blow the large volume of oxygen needed to remove carbon as it is done today and none would have had the offgas capacity to handle the amount of CO₂ generated by burning that carbon. Today, such facilities have become much more common. To demonstrate this let us examine what is considered to be the ideal amount of carbon as judged by those melt shops that have a MIDREX® Direct Reduction Plant supplying them, and compare that to what was considered ideal twenty years ago.

Each steel shop and its DRI plant work together to determine what level of carbon is economically best for them. Looking at 2012 data for cold discharge plants the average carbon was 2.14%. But, it is well known that no two facilities are alike; the values ranged from a minimum of 1.7% up to a maximum of 2.8%. In prior years the maximum had been as high as 3.0%. To calculate the average, each melt shop was counted as one data point. No preference was given for the larger shops. The metallization should also be considered since, as metallization increases, less carbon is needed to reduce the remaining FeO. The average metallization (again, giving each shop equal weighting) was 94.63%, out of a range from as low as 92.9% up to a high of 96.4%. The high had been considerably higher in previous years when it ran as high as 97.0%. A similar study was done using data from 1992 for Direct From Midrex in 1993. Then the average carbon was 1.63% and the average metallization was 93%.

Unmistakably, changing technology in EAFs has led to a much greater ability to blow greater volumes of oxygen and to handle greater volumes of CO₂. This point is especially clear when one considers that the steel company that used 3.0% carbon in recent years was also the one that had 97% metallization. Corresponding data from melt shops using HDRI emphasizes the point made at the beginning of this article that the combination of high temperature HDRI, high carbon DRI and high metallization DRI can lead to a situation where there is actually too much carbon and would require a delay for decarburization prior to tapping the heat of steel. For the steel shops using HDRI the average carbon in 2012 was 1.93%, 0.21% lower than the CDRI average, and the average metallization was 94.04%, 0.59% lower.

DIRECT REDUCED IRON NOT DIRECT REDUCED CARBON

Another important fact to keep in mind when considering the value of additional carbon in DRI is simply that carbon is not iron. For each one percent of carbon that is added to the DRI, one percent of the other material in the DRI is displaced. Since the other material is primarily iron, any addition of carbon requires a corresponding decrease in iron content. Additional carbon units will displace both total iron and metallic iron.

As an example, consider a DRI pellet that contains 93% iron and 2% carbon. In order to raise the carbon to 3%, the iron content will be lowered by approximately 1% so that it will now be about 92%. Consequently, increasing the carbon content forces the yield of the DRI to liquid steel to decline.

The primary purpose of using DRI products in an EAF is as a source of clean iron units rather than an energy source. When charging HDRI, especially, at high temperatures, there is more value in having more metal, not less.

For the steel shops using HDRI the average carbon in 2012 was 1.93%, 0.21% lower than the CDRI average, and the average metallization was 94.04%, 0.59% lower.
CONCLUSIONS

EAF steelmaking benefits greatly from economies of scale and thus these steelmakers continuously look for ways to achieve higher production. For many years some have focused attention on additional carbon as a benefit without penalty. This is not accurate. The ultimate objective of any steelmaker is to achieve the lowest cost for liquid steel recognizing both raw material costs and processing costs. Increasing DRI carbon content does not unilaterally increase value to steel shop. Additional carbon units will displace iron units, both total iron and metallic iron. Increasing carbon is at the expense of total iron within a DRI pellet and in some cases results in increased steelmaking costs. If the carbon level is too high, any cost savings will be offset by the increased time for decarburization, which will have a negative impact on the productivity of EAF.

For each one percent of carbon that is added to the DRI, one percent of the other material in the DRI is displaced.

SUMMARY POINTS

- High carbon does not necessarily provide benefit without penalty. Sometimes extra time and additional oxygen is needed for decarburization.
- With more highly metallized DRI there is less need for carbon.
- The higher the temperature of HDRI, the less the need for carbon. The energy included in the high temperature HDRI means that less energy is needed in the form of carbon.
- As carbon increases iron content decreases.
- Higher temperature allows for greater steel production.
- Excess carbon can increase tap-to-tap times as it may require more time for the carbon to be blown down.

**Carbon** How much is required to reduce FeO and how much is available for producing energy?

For the steel company mentioned in the text, higher carbon levels slowed the tap-to-tap times, lowering EAF productivity.

- Below the black line at zero on the vertical scale, there is insufficient carbon to remove all of the oxygen from that iron which is still partially oxidized, the FeO.
- At the black line, there is exactly enough carbon to accomplish reduction of the FeO.
- Above the line, there is excess carbon that may be burned with injected oxygen to produce heat energy. This will augment the heat provided by the electrodes and melt the iron more swiftly, thus shortening the tap-to-tap time.
- However, once enough heat has been added to melt the iron, additional heat is not needed. If there is still excess carbon available, it too must be burned away. This takes time and so will actually lengthen the tap-to-tap time and lower productivity of the EAF.
- The green oval is where the EAF shop mentioned in the article found optimum carbon, metallization and temperature of their HDRI. Whenever they had more carbon, their tap-to-tap times were longer.
INTRODUCTION

Workplace safety is a crucial part of any successful or prosperous business. This is especially true of Heavy Industry. Because the potential for serious or even fatal injuries is very real and always present in heavy industry jobs, the establishment and constant improvement of a 100% effective workforce safety program is paramount. Safety should supersede all other priorities at the worksite. This series will examine some fundamentals of an effective safety program and illustrate how making safety the first priority of everyone working in and around your plant will pay long term dividends for the crew, management and ownership.

SAFETY AS A CULTURE

In the United States alone, the Iron and Steel industry is a safer workplace, statistically speaking, than many other labor-intensive jobs like logging, fishing, and construction. This speaks to our industry’s ongoing commitment to safety, which has in part contributed to the creation of a much safer working environment across all industries in the United States. This is evidenced by the steady decline of fatal work injuries over the past 20 years. In 1992, there were 6,217 on the job fatalities across the American workforce. By 2013, that number was down to 4,383.

The key to obtaining and/or maintaining a zero lost time accident safety program is not to focus on the reduction in fatal work accidents over the past two decades, but to note that safety programs totally failed 4,383 times last year. The glaring truth is that we must continue to improve upon the safety principles, policies, and procedures that we have – and not be afraid to challenge the status quo - in an effort to make existing programs better.

Real on-the-job safety is more than just slogans and posters. Safety should be part of the culture, not just an inclusion. It is up to everyone to be vigilant, because it is everyone’s responsibility. Hour after hour, shift after shift, a safe workplace is one that allows the crews to work hard and focus on production goals, and then return home safely.

SAFETY BY DESIGN

Iron and Steel production facilities, much like any properly engineered industrial complex, are only as safe as their designs allow them to be. If a large industrial plant is ever to be safe for those who will work in and around it, the original purpose in the design must be to provide the safest working environment possible. Before a plant is purposefully built to maximize production, it must be purposefully designed to be safe. MIDREX® Plants are a good example of this safety by design concept and...
have enjoyed an excellent safety record since the first start up in 1969. The design of the Midrex Direct Reduction Process holds to basic guidelines that have proven time and time again to provide the highest level of personal safety for plant operators, while producing the most tons of DRI. These basic design guidelines are:

**BASIC GUIDELINES**
- Keep it simple
- Provide safety interlocks
- Develop procedures for safe operation
- Train plant personnel to understand the process and follow all safety procedures

**SAFETY IN MANAGEMENT**
Personnel safety has long been included in the goals of heavy industry: produce a high quality product, serve the customer's needs, make a healthy profit...and be safe. The problem with the “Safety as an Inclusion” approach is that it leads to a higher risk workplace. In this approach, other, more tangible business goals are invariably given priority and worker safety becomes an add-on. After all, if companies are in business to make money, it would make sense that profitability must be the #1 goal. Modern production facilities with aggressive safety programs not only challenge the old attitude that profitability is job one, they overturn it completely. Take the Iron and Steel industry as an example. The mills with management-driven safety programs that are absolute and placed at the top of the priority list are also the shops that are consistently the most profitable, industrywide. A top-down approach to the plant safety program translates into every manager, every supervisor, every crewmember being motivated to not just adhere to the safety program, but to constantly be looking for ways to improve it. When everyone on your team is trained, encouraged and motivated towards a total commitment to your facility safety program, the phrase “Safety as a Culture” becomes a reality. Team members follow all safety protocols and insist that others do the same; not because they have to – but because they want to.

**SAFETY IN OPERATION**
If the first priority in the plant design is personnel safety, a deep, personal commitment to the safety program must be instilled in the workforce from top to bottom. Then, zero lost time accidents becomes the reality, not just a goal. The journey to zero lost time accidents can be daunting, and requires cooperation across all departments, but it is none the less, totally attainable. There are many examples of safety programs and procedures that provide a 100% accuracy rate. Consider the following highlights from a study by Robert J. Latino, executive vice president of the Reliability Center, Inc. in Hopewell, Virginia, USA.

**IF PEOPLE WERE 99.99 PERCENT ACCURATE, WE WOULD STILL EXPERIENCE:**
- 2 unsafe plane landings per day at O'Hare Airport
- 500 incorrect surgical operations each week
- 50 newborn babies dropped at birth by doctors everyday
- 22,000 checks deducted from the wrong bank account each hour
- 32,000 missed heartbeats per person, per year
- 114,500 mismatched pairs of shoes shipped each year
- 200,000 documents lost by the IRS this year

It is important at this juncture to note that achieving zero lost time accidents is not dependent on zero mistakes. In fact, it is the proper recording, studying, and management of the mistakes that do occur that help to shape safety procedures into a program that can provide zero lost time performance year after year.

**FOR EXAMPLE:**
During routine maintenance located on the upper levels of the plant, a technician drops a wrench that falls to the floor several stories below, nearly striking a fellow crewmember.

What happens next will determine the long term success of
your facilities safety program. If the prevailing attitudes and individual commitment to the safety program prevents the incident from being reported – if the crewmembers simply shake their heads and get back to work, it means that an opportunity to prevent future serious injury has been lost. Even a glancing blow from the falling wrench could cause a lost time injury, and a direct hit to the head or neck could be fatal.

The ratio of workplace non-injury to injury accidents was explored in 1930s by H.W. Heinrich, Assistant Superintendent Engineering and Inspection Division of The Travelers Insurance Company. In his book, Industrial Accident Prevention – A Scientific Approach first published in 1931 and revised in 1941, Heinrich stated that for every 1 serious injury/fatality there were 29 minor injuries and 300 no-injury accidents (figure 1).

In 1969, Frank Bird, expanded on Heinrich's work. Acting as director of engineering for the Insurance Co. of North America, he performed a study of 1,753,498 accidents reported by 297 companies. These companies represented 21 different industrial groups, employing 1,750,000 people who worked more than 3 billion man hours during the period analyzed. The study resulted in the 1:10:30:600 ratios, which stated that for every 1 single on the job fatality or debilitating accident, there were 600 near misses - like the falling wrench example above (figure 2).

There were also 30 accidents that led to property damage, and 10 accidents that resulted in minor injuries. Now, let’s apply the principals of accident prevention indicated by Birds Pyramid to our no-injury accident example:

> The crew members involved in the falling wrench accident stop and report the incident to the shift manager. In a staff meeting that same week, the shift manager reports the accident, only to learn that other shift managers have dealt with the same type of near misses accidents. Steps are then taken to prevent falling objects from dropping to the floors below.

> As a result, the workforce is safer and the plant is better equipped to ensure uninterrupted production.

Time and money spent on non-injury accidents and the costs associated with continuous preventative safety improvements have historically been frowned upon by many in ownership positions. The change in attitude (and practice) towards a worker safety program that is in continually being improved is directly related to the true cost of a lost time accident.

Much like an iceberg in the north Atlantic, the visible costs of an injury do not often represent how much a major injury will truly cost the company. For a clearer picture, let’s take a look at
the ratio of a company’s direct vs. indirect costs of a disabling or fatal accident.

SAFETY - TOO COSTLY TO IGNORE
Direct cost to the company for a major accident include at a minimum: worker compensation claims, indemnity payments, and legal fees. Direct costs for a disabling on the job injury or death can quickly exceed seven figures. Still, the indirect costs are much more expensive over the long-term. Typically, the indirect costs of a major injury will exceed the direct costs by a ratio of 4 to 1 or higher. The indirect costs for the company after a major worker injury or death spread across all departments and compound into the millions of dollars in total cost over time. With the true costs of major injury accidents in mind, clearly the best way forward for any industrial ownership group is to invest in the ongoing improvement of its established safety program in order to help insure continuous production under the safest possible conditions for the workforce.

In part 2 of this series on safety, we will take a closer look at how an effective safety program increases the morale of all employees, increases the overall efficiency of the plant, and decreases both the direct and indirect operating costs.
MIDREX News & Views

SMS Group becomes MIDREX® Process construction licensee
Kobe Steel and Midrex increase market reach for direct reduction steelmaking

Kobe Steel, Ltd. of Japan and the SMS Group, through its subsidiary Paul Wurth S.A., of Luxembourg, have signed a construction license agreement that enables the SMS Group to market, design and erect MIDREX® Direct Reduction Plants around the world.

Kobe Steel, Ltd. is owner of both Midrex Technologies, Inc., and the MIDREX® Direct Reduction Process. Germany’s SMS Group is a world leader in engineering and equipment for the iron and steel industry. The MIDREX® licensing agreement enables SMS to add a new strength to their core capabilities that cover the full range of facilities for the metals sector. The agreement will further extend the market reach of Kobe Steel, Midrex and the MIDREX® Direct Reduction Technology.

“Paul Wurth has gained an excellent reputation in project and site management as well as in providing superb engineering services, making the company an ideal choice for a MIDREX® construction partner,” said Shohei Manabe, Senior Officer at Kobe Steel and head of its Iron Unit Division.

Paul Wurth S.A. joins Kobe Steel, Ltd., Siemens VAI Metals Technologies GmbH, and Midrex Technologies Inc. as a construction licensee for MIDREX® Direct Reduction Plants. Kobe Steel assigns a specific construction licensee to build each MIDREX® Plant around the world. The MIDREX® Process is the most widely used direct reduction process, accounting for approximately 80% of the world’s annual gas-based DRI production and 60% of the world’s total annual production.

Shohei Manabe, Executive Officer, Kobe Steel, and head of the Iron Unit Division and Marc Solvi, Chief Executive Officer, Paul Wurth, shake hands after signing the construction license agreement.

Also pictured, from left to right: Hiroshi Ishikawa, General Manager of the Iron Unit Division, Kobe Steel; Thomas Hansmann, Chief Technology Officer, Paul Wurth; and James D. McClaskey, President and Chief Executive Officer, Midrex.