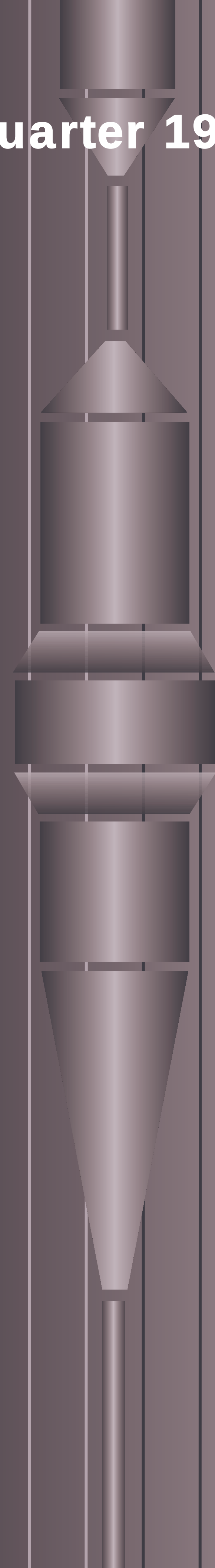
2nd Quarter 1998

DIRECT FROM MIDREX



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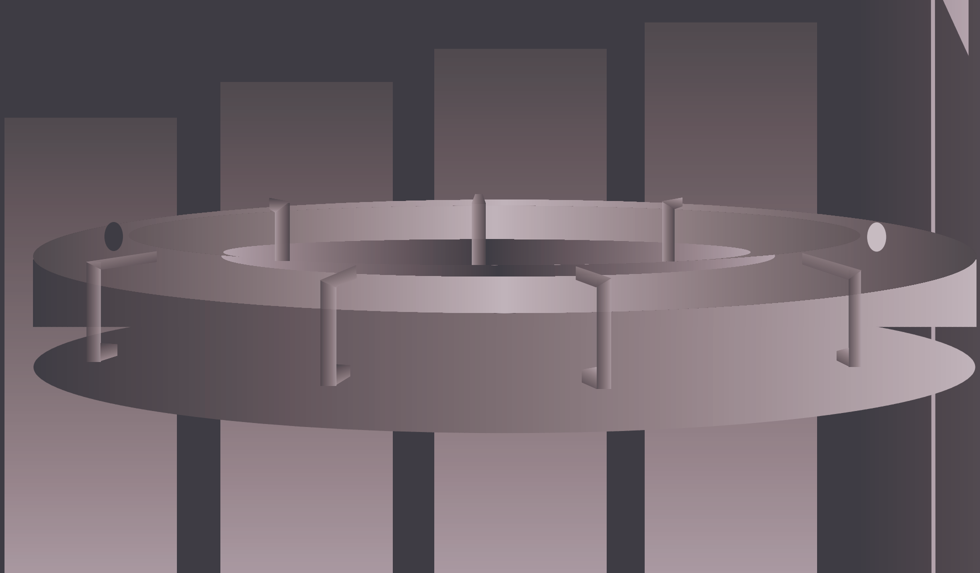

DIRECT FROM MIDREX

2nd Quarter 1998

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DIRECT FROM MIDREX is published quarterly by Midrex Direct Reduction Corporation, 201 South College Street, Suite 2100, Charlotte, North Carolina 28244 U.S.A., Phone: (704)373-1600 Fax:(704)373-1611, Web Site: http://www.midrex.com under agreement with Midrex International B.V. The publication is distributed worldwide free-of-charge to persons interested in the direct reduced iron (DRI) market and its growing impact on the iron and steel industry.

All tons referred to are metric tons (t) or million metric tons (Mt)

Commentary

www.midrex.com and the next millennium

Frank N. Griscom
Vice President
Marketing and Sales

Internet technology and its use are expanding at a rapid pace today as more and more companies find value in doing business on "the net." Over the last few months, Midrex has been developing a web site that we believe will be interesting and valuable. While a good web site is always a work in progress, we do think that the new Midrex web site has sufficient information available now to be of use to most people interested in direct reduction. Over the next few weeks and months we will be adding additional features such as *Direct From Midrex* on-line and our annual direct reduction statistics. So we invite you to log on and check out the new Midrex web site and let us know what you think about it.

Internet technology is not the only new technology that is moving along rapidly at Midrex. The first feature article in this edition of *Direct From Midrex* highlights the newest technology enhancement to the MIDREX® Direct Reduction Process, the introduction of the new, larger SUPER MEGAMOD™ Module. This is the world's first single unit direct reduction module capable of producing over 2.0 Mt/y of direct reduced iron. The larger capacity opens up new frontiers for direct reduction by improving the economies of scale and even offering the potential to replace smaller, less efficient blast furnaces in certain cases.

The MIDREX Process also has ushered in a renaissance in direct reduction technology with the start of production at the American Iron Reduction plant (AIR) in the United States. The plant began production earlier this year and has progressed through a successful performance test and quick turnover of operations to the plant operators. AIR is now shipping DRI to steelmakers throughout the USA and helping these customers discover the benefits associated with using DRI. Again, as in the early 1970s, MIDREX Technology is involved in changing the raw materials scenario for North American steelmakers, electric arc furnace and basic oxygen steelmakers alike.

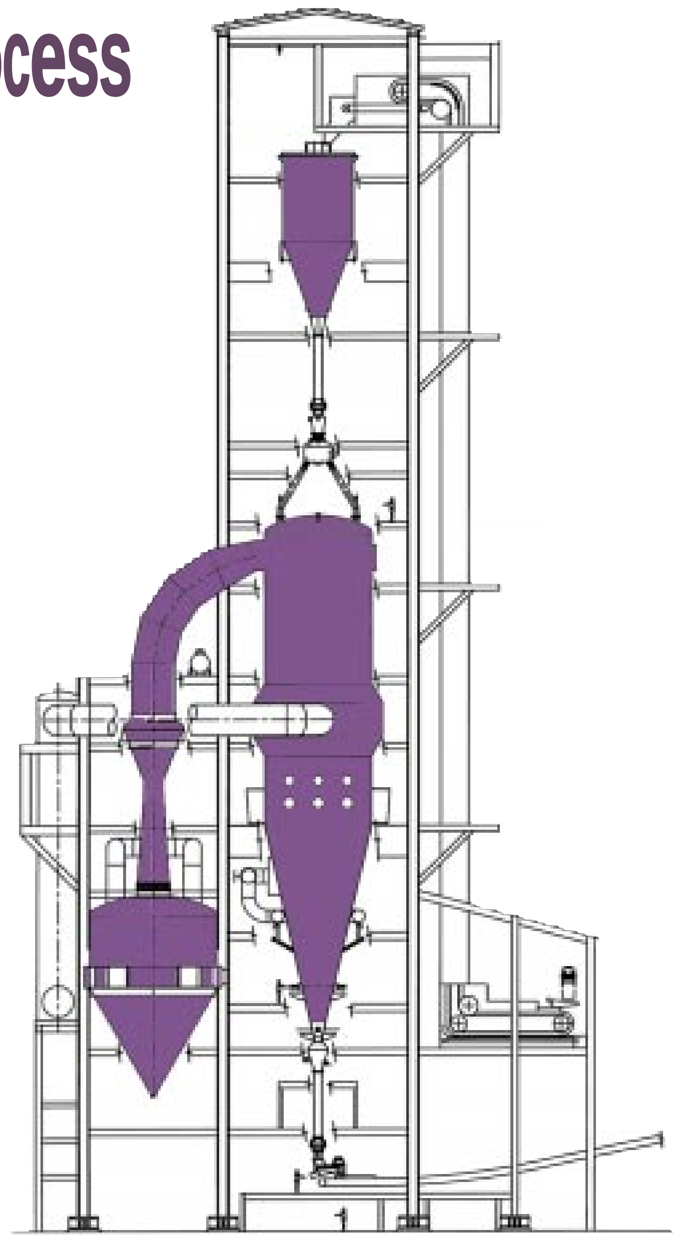
It is commonly accepted that the only constant in life is change, and in today's worldwide iron and steel industries that rings true. Some people have a misperception that iron and steelmaking is old, outdated and static. As we all know, that is far from the truth. Our industry is vibrant, embracing change, and boldly moving ahead with innovations and improvements that will continue to provide the building blocks for industrial development and economic growth well into the next millennium.

MISSION STATEMENT

Midrex Direct Reduction Corporation will lead in the ironmaking technology industry by supplying superior quality services that provide good value for our clients. 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.

Increasing Productivity and Profitability with the MIDREX® Process

By Greg D. Hughes
Manager –Technology



The first MIDREX® Direct Reduction Plant, which was built in 1969, had two shaft furnaces with internal diameters of 3.7 meters and capacity of 150,000 metric tons per year. During the nearly 30 years since that time, Midrex and plant operators have developed a number of improvements that have provided for dramatic increases in productivity. The latest generation of MIDREX Plants offer outstanding performance and economy, and show good promise for meeting the ironmaking needs of the world in the 21st century.

Super MEGAMOD™ Module Design Completed

Midrex Direct Reduction Corporation has continued to "push the envelope" by completing design engineering for a new larger capacity MIDREX® Direct Reduction Module capable of producing over two million metric tons per year of direct reduced iron (DRI) or hot briquetted iron (HBI). The new Super MEGAMOD™ Module has a MIDREX™ Shaft Furnace with an internal diameter of 7.5m and is capable of producing over 275 tons per hour of DRI and over 255 tons per hour of HBI. These hourly production figures equate to 2.2 Mt/y of DRI and 2.0 Mt/y of HBI based on 8,000 and 7,800 operating hours respectively.

In addition to the larger shaft furnace, the new Super MEGAMOD uses a larger MIDREX™ Reformer to produce the additional reducing gas required, and a new compressor design to circulate the reducing gases throughout the plant. For the first time, centrifugal compressors will be used in place of the traditional rotary lobe units for the process gas circuit and cooling zone. A centrifugal compressor has been operating as a part of the new MIDREX Mini-Reformer at the OPCO Plant in Puerto Ordaz, Venezuela, since 1996. Results from this operation have been outstanding and led to the selection of centrifugal compressors for use in the Super MEGAMOD design. The larger MIDREX Reformer will be comprised of 24 bays of thirty 250 mm diameter tubes per bay. The largest MIDREX Reformer to date is at Caribbean Ispat Ltd., where a 17-bay reformer is under construction as a part of the Stretch MEGAMOD™ project at the Point Lisas, Trinidad, site. MIDREX Reformers at American Iron Reduction (AIR), IMEXSA, and Ispat Industries consist of 15 bays. Midrex's higher activity REFORMEX® Catalyst loading, which was used at IMEXSA and AIR, will also be used in the Super MEGAMOD design. Features of the new design are summarized in Table 1 on the following page.

Existing MIDREX MEGAMODS at OPCO, Ispat Industries, and IMEXSA each have set new world standards for maximum production from a single reduction plant. AIR's MEGAMOD, which recently began operations in Convent, Louisiana, is producing at a rate equivalent to IMEXSA. The Super MEGAMOD sets a new standard for single module

MIDREX™ Shaft Furnace:

- 7.5 meter nominal diameter
- 11.75 meters reduction zone height
- 275 t/h cold discharge rate*
- 255 t/h hot discharge rate*

MIDREX™ Reformer

- 24 reformer bays
- Thirty 250mm diameter tubes per bay
- 720 total reformer tubes
- High activity REFORMEX® Catalyst loading

* Production rates are based on:
Use of 100 percent pellet charge
Double bustle design
900 C or higher preheat
Experienced plant operators
Sufficient briquetting capacity for HBI production

Table 1 Features of the new MIDREX SUPER MEGAMOD™

production that is unprecedented in the industry.

With the introduction of the Super MEGAMOD, Midrex is pushing the leading edge of direct reduction technology forward and is opening up new possibilities for use of DRI and HBI. Traditionally, DRI has been used predominantly by electric furnace-based steelmakers. In recent times, blast furnace operators have begun using HBI as a supplement to their feed mix to increase hot metal production. The Super MEGAMOD now provides an option for steelmakers to replace a 2-3 Mt/y blast furnace/BOF complex with a comparable sized direct reduction module and mini-mill at a very competitive capital cost. Feeding DRI produced in the Super MEGAMOD hot to an adjacent electric arc furnace can further enhance the economics.

Ratings of Existing Designs Increased

Midrex has also set new ratings for current plant designs based on technology enhancements and improvements in operating practices at existing plants. The new ratings are summarized in Table II. Technology improvements contributing to the new ratings include oxide coating, double bustle design, and oxygen injection. More aggressive operating practices employed by many MIDREX Plants include higher bustle gas utilization and increased natural gas addition to the shaft furnace to promote in situ reforming.

Oxide Coating

With the productivity of higher temperature operation in the shaft furnace, oxide coating equipment is included as a standard feature of every new MIDREX Plant. The small capital investment is more than offset by increased production. Oxide coating locally at the plant can be omitted if the plant can obtain pre-coated materials either from its iron ore suppliers or an adjacent pellet plant. MIDREX Plants have traditionally been limited to 850 C bustle temperature due to pellet sticking. By coating the oxide pellet with lime, MIDREX Plants can achieve bustle temperatures of up to 920 C without oxygen injection by manipulating the enrichment and cooling zone natural gas addition and turning off the reformed gas cooler.

Oxygen Injection

In the past, Midrex has used 850 C as the design bustle gas temperature. With iron oxide coating now standard practice, Midrex will now use 900 C as the bustle gas temperature for plant design and rating purposes. The higher temperature maximizes gas utilization and plant production.

Higher bustle gas temperatures can be achieved by minimizing enrichment or adding oxygen injection. Midrex has completed a design and HAZOP on an oxygen injection system that should be in operation at IMEXSA by the end of this year. Many other MIDREX Plants are already using oxygen injection or are investigating systems for their plants.

Midrex has found that for every 10 C increase in bustle temperature, plant production can be increased by 1.5-2.0 percent. The oxygen required to accomplish this can be obtained at a low cost relative to the value of the incremental production realized.

Higher Bustle Gas Utilization

All the new operating practices designed to increase burden temperatures within the shaft furnace, such as in situ natural gas, cooling zone bleed, oxygen injection, and oxide coated materials, have increased the kinetics of the reduction reactions and thus increased plant production. This has resulted in a new relationship between bustle temperature and bustle gas utilization, thus increasing fur-

MIDREX® Direct Reduction Plant Production Rates

The following plant production figures, based on actual operations data, are typical for MIDREX Plants operating at steady-state conditions. Actual production rates will vary depending on local conditions: however, use of these values will provide good estimates of yearly production.

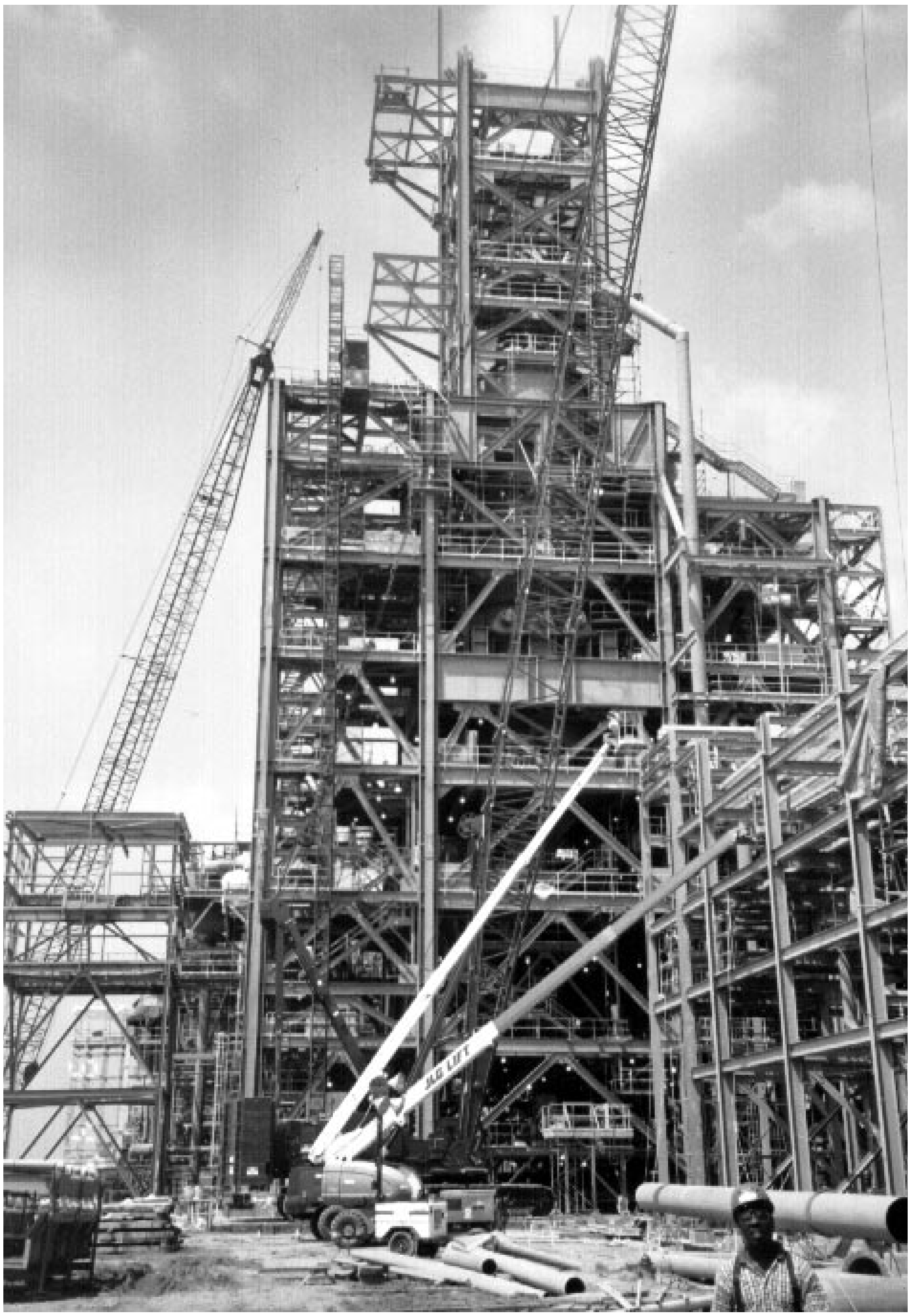
Module	Nominal Furnace ID (m)	Yearly Production (t) DRI	HBI
MINIMOD™	4.25	—	—
5.0 m MIDREX™ Shaft Furnace	5.0	800,000	700,000
5.5 m MIDREX™ Shaft Furnace	5.5	1,000,000	900,000
MEGAMOD™	6.5	1,600,000	1,450,000
SUPER MEGAMOD™	7.5	2,200,000	2,000,000

Assumptions:

- use of 100 percent coated CVRD-grade pellets or equivalent
- double bustle design
- thin wall refractory for all modules except SUPER MEGAMOD
- 900 C or higher operating temperature
- experienced plant operators
- sufficient briquetting capacity for HBI production

Table 2 MIDREX® Direct Reduction Plant ratings

AN AMERICAN DIRECT REDUCTION RENAISSANCE



Construction of the AIR plant in Convent, Louisiana

When the American Iron Reduction (AIR) plant produced its first direct reduced iron (DRI) on January 14, 1998, it marked the first time in over 27 years that a new direct reduced iron plant began operations in the United States. For Midrex, it was a momentous occasion that was meaningful because the AIR plant is a 50/50 joint venture of GS Industries, parent company of Georgetown Steel Corporation, and Birmingham Steel Corporation. Georgetown Steel was among the early pioneers of the MIDREX® Direct Reduction Process, and still operates its original plant, producing 502,978 metric tons in 1997; that is 126 percent of rated capacity.

The new AIR plant is running as well as the original Georgetown Steel plant. Within one month of the first product being produced, the plant passed its performance test by producing an average of 163 metric tons per hour of DRI over the test period. DRI produced during the performance test had an average metallization of 94.5 percent and carbon content of 1.8 percent. Two weeks after completion of the performance test, the Midrex start-up crew completely turned the plant operation over to the new operators and returned to Charlotte. Since that time, the plant has been running above capacity in the 180 t/h range and producing product with metallization as high as 96 percent.

Many of the design features of the AIR plant are similar to the IMEXSA module that began operations in September 1997 in Lazaro Cardenas, Mexico. Both modules are rated at 150 t/h of DRI production, have a 6.65m MIDREX™ Shaft Furnace with the thin wall refractory design, and a 15-bay MIDREX™ Reformer. However, as with all new Midrex designs, AIR has several new design features. The most notable of those is the vertical furnace feed conveyor.

Early MIDREX™ Plants, such as the Georgetown Steel plant, used a skip car system to raise oxide feed to the top of the shaft furnace tower. In 1973 at the Sidbec-Dosco I plant, Midrex introduced

The dock at the IC terminal along the banks of the Mississippi River

a pocket furnace feed conveyor set at a 45-degree angle to vertical to carry iron oxide up to the charge hopper. AIR is the first MIDREX Plant to use a vertical furnace feed conveyor design. This design allows the plant to be set on a smaller site and reduces the amount of structural steel required. Both of these result in capital cost savings. To date, the vertical furnace feed conveyor has run extremely well, and it has become a standard feature on new MIDREX Plant designs.

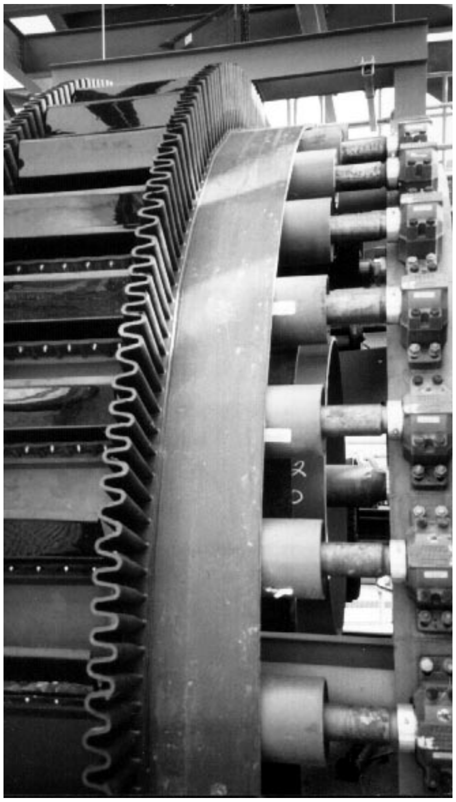
AIR has pioneered other new concepts in its plant. The most notable of those is the partnership arrangement with Illinois Central Corporation (IC) for all of the plant's bulk material handling operations. IC constructed a state-of-the-art bulk materials handling terminal adjacent to the AIR plant site. The terminal includes facilities to handle inbound and outbound shipments by oceangoing vessels, river barges, trains, and trucks. Raw materials are stockpiled at the IC terminal until they are needed by AIR, at which time they are moved by conveyor to AIR's day bins. Once DRI is produced and aged in AIR's storage silos, it is moved by conveyor to the IC terminal for outbound shipment.

Other new concepts included in the plant are designating selected vendors with turnkey responsibilities for various in-plant services. Midrex's affiliated company, Professional Services International (PSI), was selected to provide all of AIR's procurement services and to manage the inventories of certain spare parts and consumable items. Other vendors were selected to provide plant security, water treatment, and vibration analysis services. Currently, there are several vendors providing maintenance services for all of the chutes within the plant. In the near future, AIR will evaluate the performance of the systems in use and select a single vendor to provide all of these services.

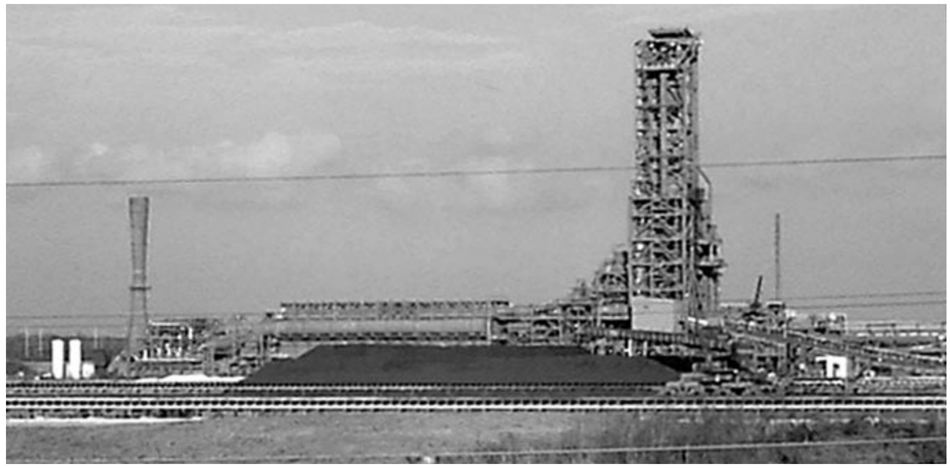
All DRI produced by AIR will be shipped from the Convent, Louisiana, site. The majority of the DRI will be consumed in the meltshops of the joint venture partners GS Industries and Birmingham Steel. GSI operates meltshops at Georgetown, South Carolina, and Kansas City, Missouri. Birmingham has a new shop at Memphis, Tennessee, for supplying high-quality billets to the rolling mills of its subsidiary American Steel & Wire near Cleveland, Ohio, and Chicago, Illinois. Other Birmingham steelmaking operations are located in Birmingham, Alabama; Cartersville, Georgia; Kankakee, Illinois; Jackson, Mississippi; and Seattle, Washington. DRI not needed by these shops is available for sale, and AIR is currently shipping DRI to several other North American steel companies.

Despite the close ties to its joint venture

Iron oxide is stockpiled in the IC terminal adjacent to the AIR plant



The top of the vertical furnace feed conveyor



A view of the AIR plant from the adjacent IC terminal

The American Iron Reduction plant in Convent, LA

parent companies, AIR operates as an independent company. Consequently, the 67 employees are responsible for all facets of the plant's operation including accounting, human resources, operations, maintenance, transportation, and raw materials purchasing. In fact, according to AIR's president, David Durnovich, the first employees hired were in the accounting and human resources areas in order to establish the company so the plant could be constructed.

Bechtel Corporation was the construction contractor responsible for the job, which required 19 months from groundbreaking to the first product shipment. One of the new construction techniques employed by Bechtel on the AIR project was erection of the shaft furnace tower on a level-by-level basis. Each level of the shaft furnace was completed prior to constructing the subsequent level. By using this method, Bechtel reduced the amount of time typically required to construct a MIDREX Shaft Furnace, and once the structure was "topped out" it was nearly ready to go. This method also provided a safer method for construction because all of the decking, stairways, handrails and other safety items were in place as the structure was erected. Evidence of the benefit is the fact that over the entire course of the construction project there were no OSHA recordable lost time cases. This is a commendable accomplishment, in consideration of the fact that at the peak of construction activities there were 900 workers on the job site. Bechtel also provided detail engineering and cold pre-operation services for the project.

Southern Louisiana has unique soil conditions because of its extremely low height above sea level. There are even areas where ground level is actually below sea level. At the AIR site, which is on the banks of the Mississippi River, the water table is four feet below ground level. Unique construction techniques were required to construct foundations and other facilities under these circumstances. One of the greatest challenges was the clarifier in the plant water system, which goes down 60 feet below ground level.

Within the first week of operation, American Iron Reduction shipped the first DRI produced to Birmingham Steel's new steel shop in Memphis, Tennessee. Coupling AIR's strong operating performance with the high quality levels in the DRI produced indicates a strong future for the new company. In the near future, AIR hopes to erect a second, identical plant to supply additional DRI to the North American market. The site has been permitted and designed to accommodate the module and infrastructure to support the module is already in place.

AIR has ushered in a renaissance in direct reduction in the United States, built on a strong history of DRI production at Georgetown Steel. It remains to be seen how far the renaissance will go, but one thing is certain — AIR will be a major factor in this new age of ironmaking.

CATALYST

The Factors Which Affect Performance

— PART 6 —

By Bruce G. Kelley
Vice President – Technology and Engineering

Carbon Formation in Reformers

Most difficulties in reformer operation relate to carbon formation. Carbon can form in reformers from either carbon monoxide or hydrocarbons as shown in Table XVIII.

The reactions to form carbon from carbon monoxide are catalyzed by a nickel catalyst and are favored by lower temperatures. Low sulfur in the feed gas results in higher catalyst activity, which favors carbon formation from carbon monoxide. Fortunately, the sulfur normally present in the feed gas from the natural gas and the oxide feed is sufficient to prevent Boudouard carbon in a MIDREX™ Reformer so long as the reformer is operated at the normal temperatures and feed gas stoichiometric ratio. Boudouard carbon formation is extremely rare in a MIDREX Reformer.

In the case of hydrocarbons, there are two possible reactions that can occur: the desired reforming reactions and the undesired cracking reactions. The reactions to form carbon from cracking hydrocarbons are favored by high temperatures and low catalytic activity. If the reformer feed gas were heated to reforming temperature over an inert rock, a lot of cracking would undoubtedly occur. However, if the reformer feed gas is heated in the presence of a catalyst, the reforming reactions will predominate.

Table XIX compares the factors that favor carbon from carbon monoxide and hydrocarbons.

Table XX compares the symptoms of carbon formation from these two sources.

By analyzing those symptoms, it is normally possible to determine the source of any carbon formed.

$2CO = CO_2 + C$	Boudouard Reaction
$CO + H_2 = C + H_2O$	Beggs Reaction
$C_nH_{2n+2} = nC + (n+1)H_2$	Hydrocarbon Cracking Reaction

Table XVIII Carbon formation in reformers

Factor	Carbon Source: Carbon Monoxide	Carbon Source: Hydrocarbons
Catalyst Activity	High	Low
Temperature	Low	High
Feed Gas Sulfur	Low	High
Heavy Hydrocarbon Content	No Affect	High

Table XIX Factors favoring carbon formation

Preventing Hydrocarbon Cracking in a Reformer

This section will examine ways to prevent cracking of heavy hydrocarbons in either a MIDREX Reformer or steam reformer.

Minimize Heavy Hydrocarbon Content in Natural Gas

The surest way to prevent heavy hydrocarbon cracking is to minimize the heavy hydrocarbon content of the feed gas. If any natural gas liquids are present in the natural gas, they should be removed with a mist eliminator upstream of the reformer. If the heavy hydrocarbon content of the natural gas exceeds the limits specified by the catalyst and/or reformer supplier, several ways exist to remove the heavies from the natural gas.

The most commonly used method to reduce the heavies is to cool the natural gas by expansion. If the natural gas pressure is high enough, the natural gas may be cooled by expansion though a Joule-Thomson valve. At lower natural gas pressures, cooling is achieved by expansion through a turbo expander. Cooling by refrigeration is also possible.

There are a number of other possibilities for heavy hydrocarbon removal: conversion of the heavies to methane in an adiabatic prereformer or removal of heavies by molecular sieves (with regeneration by either pressure swing or temperature swing), solvents, or permeable membranes. An engineering evaluation is required to determine the optimum choice to reduce the heavy hydrocarbon content based on the natural gas analysis, natural gas pressure, allowable pressure drop, allowable heavy hydrocarbon content, and local site conditions.

Operating Conditions

The reformer should be operated at the temperatures and feed gas stoichiometric ratio recommended by the catalyst and/or reformer supplier. After removal of excessive heavy hydrocarbons, this is the most effective way to prevent or minimize carbon formation.

Catalyst Loading Profile

The catalyst loading profile can be designed to minimize carbon formation either by carrier selection or catalyst activity selection. Carrier selection is the most prevalent way to minimize heavy hydrocarbon cracking. Acid sites are known to promote carbon formation. Alumina carriers, which are used in most reforming catalysts, are acidic, which makes them more susceptible to carbon formation. A magnesia carrier has been developed which is free of acid sites and is less susceptible to carbon formation. The magnesia catalyst should be loaded in the entry portion of the tube that is susceptible to carbon formation. As the gases pass through the tube and reforming takes place, the hydrocarbon concentration decreases and the reductant concentration increases until hydrocarbon cracking eventually becomes impossible from an equilibrium standpoint.

In some situations, adjusting the loading profile so a more active catalyst is installed at the tube inlet can be effective in reducing hydrocarbon cracking. As shown in Table XIX, heavy hydrocarbon cracking is favored by low catalyst activity. If excessive heavy hydrocarbons are present in the natural gas, a high activity catalyst can be installed at the inlet of the reformer tubes to encourage reforming and discourage heavy hydrocarbon cracking. Where this approach is used, the feed gas sulfur level should be kept low to ensure that the catalyst activity remains high.

Symptom	Carbon Source Carbon Monoxide	Hydrocarbons
Rate of Pressure Drop Increase	Rapid (hours)	Slow (days)
Pressure Drop Decreased by Burnout	No	Yes
Visible Carbon when Tube Emptied	No	Yes
Catalyst Degradation	Yes	No
Carbon Location in Tube Cross Section	Center	Wall
Hot Bands Present	Unlikely	Likely

Table XX Symptoms of carbon formation

REFORMEX® Catalysts

Midrex has worked with UCI to develop the REFORMEX family of catalysts to meet the requirements of the MIDREX Reformer. Table XXI compares the chemical and physical properties of these catalysts. Additional information about these catalysts and recommended loading profiles for specific operating conditions can be obtained by contacting MIDREX, PSI, or UCI.

Conclusion

Earlier, catalyst was defined as a material which increases the speed of reaction without being affected by the reaction. In this concluding part of the series on natural gas and catalyst, we have examined how to measure catalyst performance and how to improve that performance. We have seen that this definition is indeed optimistic, as noted in the Catalyst Handbook, since many factors can affect the catalyst performance. However, by using this knowledge to adjust these factors in the right direction, the performance of the catalyst, the reformer, and the direct reduction plant can be optimized.

This is the final installment of the series.

Property	Reformex® 7	Reformex® 7GG	Reformex® 8	Reformex® 14	Reformex® 15	Reformex® 13
Activity	High	Highest	Low	Medium	High	Inert
Shape	Raschig Ring	Gatling Gun	Extruded Cylinder	Rib Ring (9 Ribs)	Rib Ring (9 Ribs)	Rib Ring (9 Ribs)
Chemical Analysis (wt.%)						
% Ni	7.5 – 9	7.5 – 9	1.5 – 3	5 – 7	11 – 13	N/A
% SiO_2	<0.1	<0.1	<0.1	<2	<0.1	<0.1
Al_2O_3	Balance	Balance	Balance	2 – 5	Balance	Balance
MgO	Trace	Trace	Trace	Balance	<0.5	<0.5
Fe_2O_3	<0.25	<0.25	<0.25	<2	<0.25	<0.25
Physical Properties						
Bulk Density (kg/l)	1.13 – 1.30	0.99 – 1.16	1.12 – 1.28	0.95 – 1.15	0.9 – 1.15	1.3 – 1.5
Crush Strength (kg)*	>80	>110	>500	>120	>120	>250
Particle Size (mm)						
Outside Diameter	24.5	32.5	30	30	30	33
Length	18	18.3	25 – 75	28	27	23
Inside Diameter	10.5	6.5 (6 holes)	N/A	11	12	13

*Dead weight load measured across the diameter.

Table XXI Typical Reformex® catalyst properties

Midrex News & Views

Midrex Around The World

Caribbean Ispat DR3 shown above and below

Progress Continues on MIDREX® Plants

Caribbean Ispat Ltd.'s 1.36 Mt/y DR3 project in Point Lisas, Trinidad & Tobago, moves closer to completion as the shaft furnace has been set in place. The third module, dubbed DR3, will be the largest single direct reduction module in the world, edging out AIR and IMEXSA which are rated at 1.2 Mt/y. Start-up is scheduled for late 1998.

Another first for Midrex is quickly approaching with Saldanha Steel's MIDREX Plant under construction in Saldanha Bay, South Africa. The 804,000 t/y plant at Saldanha Steel will be the first direct reduction plant to use COREX® Off-Gas from another process as its reducing gas. The MIDREX Plant will use the off-gas from two COREX® C-2000 Plants which will produce 1.5 Mt/y of hot metal.

Other plants currently under construction include COMSIGUA (start-up – third quarter 1998) and ANSDK III (start-up – fourth quarter 1999.)

Saldanha Steel shown above and below

Midrex News & Views

QASCO to Build Second MIDREX™ Plant for Production of HBI

On Wednesday, May 6, 1998, a Letter of Intent was signed between Qatar Hot Briquetted Iron Co. Ltd. and a consortium of Lurgi and Midrex for a 2.0 Mt/y MIDREX™ Hot Briquetted Iron plant. The parties are bound to sign a contract within 60 days from the date of the signing of the Letter of Intent. This will be the largest Hot Briquetted Iron project in the Middle East. Work on the project is expected to take about 30 months.

Production will start in the second half of the year 2000. QASCO will take responsibility for management of the project, and will consume 20% of its production to meet its requirements after completion of the current expansion to the original QASCO direct reduction plant. Another 20% will be purchased by National Industries Group of Kuwait, and Duferco will purchase the remaining 60% of the production.

AFK Selects MIDREX Technology for Western Australian Project

The following was excerpted from a press release made by An Feng Kingstream Steel Limited on May 21, 1998.

An Feng Kingstream Steel Limited (AFK) has entered into a Heads of Agreement with Mitsui & Co. Ltd. Danieli & C.S.p.A, and Lurgi (Australia) Pty. Ltd. under which Mitsui has been appointed the leader of a new consortium that will finance, build and commission a US$1.08 billion, 2.6 million ton per annum steel slab plant near Geraldton in Western Australia. This followed withdrawal by AFK of its letter of intent issued to Mannesmann Demag AG in respect of the financing and construction of a 2.4 million ton per annum steel slab plant, which had previously been announced to the Australian Stock Exchange on March 20, 1998.

Mitsui has various roles in addition to that of being leader of the consortium, including arranging the project financing and acting as the counter-party for a steel slab offtake agreement.

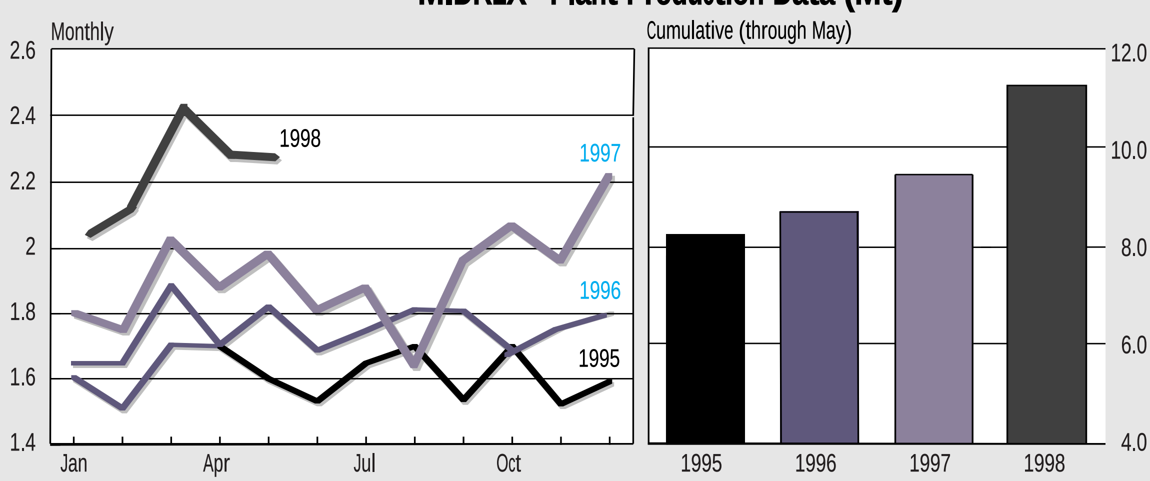
Danieli's role is to design, supply and commission two electric arc furnaces and associated plant and equipment including casters.

Lurgi's role is to design, supply and commission the pelletizing plant, two MIDREX® Direct Reduced Plants and associated plant equipment. Lurgi's obligations are guaranteed by its parent company, Lurgi AG.

The President of AFK, Mr. A.H. Chu, said "Under the new plan, which incorporates fixed price, construction completion and performance guarantees, the plant will produce 2.6 million tons of steel slab annually compared with 2.4 million tons envisaged under previous proposals." Mr. Chu added "The terms of the project finance are to be completed within the next three months and following receipt of the US$50 million cash [infusion], we expect to commence works immediately."

Qatar Steel Company complex

MIDREX™ Plant Production Data (Mt)



Note:
1998 data contains estimates for plants whose data is unavailable at time of publication

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