



Micro - Module DRI Plant

Advanced compact plant design
for high quality and high carbon DRI production

Tenova is a worldwide supplier of advanced technologies, products and engineering services for the metals and mining & minerals industries providing innovative integrated solutions. Combined process and automation know-how enhance the value delivered to the customers. Tenova is committed to develop its technology in the areas of greatest significance for the future of the industries it serves: product quality, energy savings and environmental sustainability.

Tenova HYL, the pioneer and technology leader in the direct reduction industry, develops, designs and supplies the most advanced DR technologies under the **ENERGIRON** trademark.

Its plants are able to process even low grade, high sulfur iron ores into quality HCl (high carbon iron), DRI or HBI using different reducing gases such as natural gas, coke oven gas or syngas.

A significant feature of the technology is its low environmental impact, with the lowest NO_x levels of any process, and solids, water and air effluents lower than the world's strictest standards. A unique process feature is the ability to recover CO₂ for commercial use when applicable instead of venting to atmosphere.

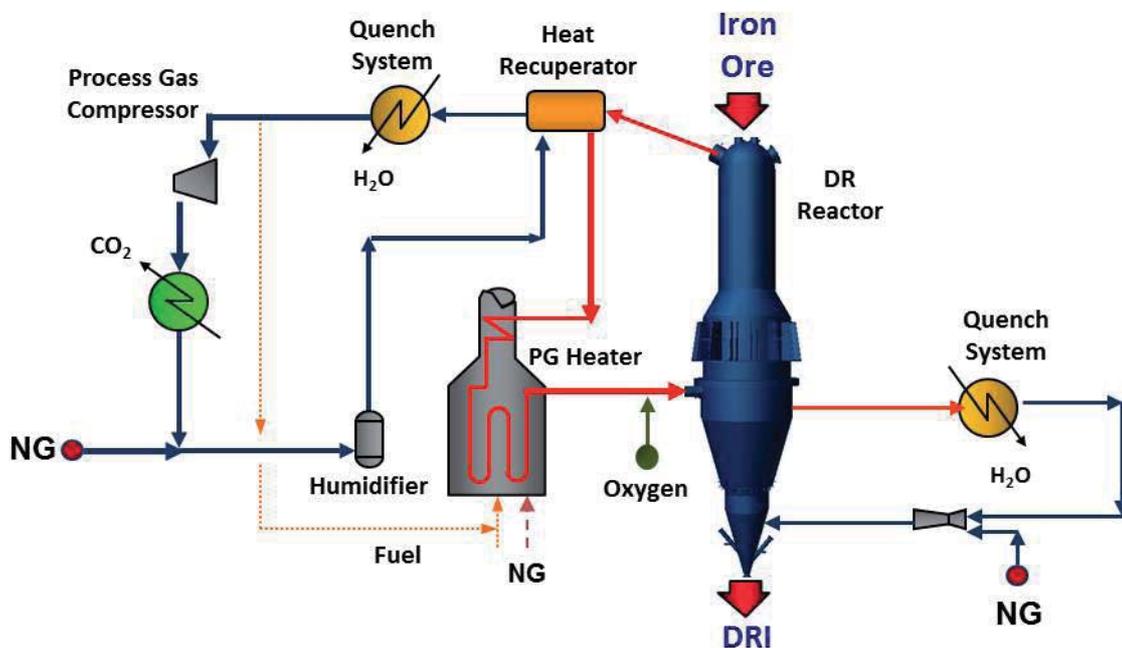
Reformerless Energiron ZR Concept is a ZR plant configuration with no gas reformer and a compact efficient plant design to produce DRI ≥ 94% metallization with a carbon content typically ≥ 3.5%.

The Micro-Module offers clean operation, high quality, and a higher value product. It is an investment that will pay for itself in a short number of years. The first of this type of plant was built and put into operation in Abu Dhabi, UAE.

The typical Micro-Module plant includes the DRI reactor, process gas heater, recycle gas compressor, cooling gas ejector, CO₂ removal system, water systems, material handling system and distributed control system (DCS). A Micro-Module can also be equipped with a complete laboratory for Process Quality Control.

ADVANTAGES:

- Highest yield from iron ore to DRI product
- High carbon (≥ 3.5%) DRI production
- Optional hot direct feeding to the EAF
- State-of-the-art energy recovery design
- Low capex
- Optimized opex
- Excellent internal rate of return
- Financially attractive for investment institutions



OPTIMIZED PROCESS FOR HIGHEST EFFICIENCY

The pressurized operation of the Micro-Module allows for a higher production capability in a smaller reduction unit. The ZR configurations means there is no gas reformer associated with the plant. This reduces the overall footprint, but more importantly saves operating costs and avoids the danger of catalyst contamination and replacement that is common with other systems.

Based on the Energiron ZR process configuration, the Micro - Module exhibits the highest energy efficiency possible, and the lowest iron ore consumption per ton of DRI produced. The carbon content is optimized to fit the requirements of the EAF melting process.

Metallization \geq 94%
Carbon \geq 3.5%

	Unit	Consumption Metric Unit / t DRI	Consumption Metric Unit / t DRI
Iron or pellets/lump	Metric tonne	1.38	1.38
Natural Gas	Gcal/t - MMBTU/ton	2.26	8.14
Oxygen	Nm3/t - Scf / ton	58	1964
Nitrogen - core area	Nm3/t - Scf / ton	16	541
Electricity - core area	kWh/ton	90	82
Water	M3/t - US gal/ton	0.90	215
Labor	M-h	0.15	0.15

ENVIRONMENT

The Micro-Module complies with the strictest environmental regulations and has received government permits around the world including in the USA. The plant also provides the added possibility of extracting CO₂ as a saleable by-product and/or as CO₂ credits. If there is no economical possibility of CO₂ sales in a geographical region, a chemical absorption system is used to reduce the CO₂ emissions.

SIZE

The core Micro-Module plant requires an area of approximately 220 ft. x 260 ft. (67 m x 79 m), which can be accommodated in most existing EAF steel plants. The optimal Micro-Module location is near the EAF melt shop for maximization of logistics and the existing infrastructure. The time required to erect a Micro-Module is short, eliminating the need for lengthy shutdowns of adjacent operations during installation.

STEEL PRODUCTION

The Micro-Module DRI can be used to produce all types of steel product grades.

Lower Grades	Steel Products		Higher Grades
Low carbon Rebar Construction Welded Pipe	Machine Structural Cold Heading Interior Automotive Drawing Quality	Alloy Suspension Spring Piano Wire	Bearing Valve Spring Tire Cord Can Stock Exposed Automotive Deep Drawing Quality Line Pipe
EAF (Scrap)			
EAF (DRI, Pig Iron, Scrap)		High DRI Utilization	

MICRO-MODULE DRI PLANT

In recent years the direction of the DRI industry has been for plants to grow in capacity to take advantage of economies of scale. This trend is of little consequence for small to medium sized steel mills or foundries, since the economic justification for investing in a large DRI plant does not exist.

In order to satisfy all segments of the market, Tenova HYL has developed the Micro-Module DRI plant. The concept is a low cost investment solution that provides high efficiency technology for plant sizes up to 250,000 metric tons per year. The Micro-Module provides the flexibility of targeted onsite DRI production that can easily be used as a substitute feed material for pig iron or high quality scrap at a significant savings per ton.

Since the Micro-Module is based on the successful and proven Energiron ZR technology, it will deliver the same high quality, high carbon DRI material as larger DRI plants.

ADVANTAGES:

- Small plant footprint that fits into most existing melt shops
- Low capital cost
- DRI improves the liquid steel quality - new market grades
- Optional hot DRI feeding directly into the EAF for exceptional energy saving and productivity benefits



WHAT IS ENERGIRON DRI?

DRI is a virgin iron product made by reducing the oxygen from the iron ore, typically to 95% metallization, which can then be used to produce steel. The difference from standard DRI compared to Energiron ZR plant DRI, is that the Energiron DRI contains a very high percentage of its carbon content in iron carbide form. Depending on the grade of steel being produced, it can be mixed with different grades of scrap to dilute residuals, or melted 100% for especially high quality steel products.

High carbon DRI can be used in any type of steel producing plant including BF/BOF facilities, EAF mills and foundries - it can be

used anywhere for quality grade steel production. It can be charged in buckets or automatically, using continuous feeding systems for more efficient results.

ENERGIRON DRI ADVANTAGES:

- High carbon content makes the DRI material more stable and easier to transport and store
- Improved foamy slag production
- Increased EAF production and reduction of operating costs due to the extra energy from the high carbon material
- Reduction of injected carbon



ONSITE DRI PRODUCTION PLANT

There are several strategic reasons for installing an onsite DRI facility. First and foremost, you can insulate your operation from the constant fluctuations of the pig iron and quality scrap markets. Having high quality virgin iron units for your charge mix, at a predictable production cost invariably lower than purchased metalics, provides you with an edge on the competition. Lower costs provides higher operating margins.

Having an onsite DRI production plant opens the door for entering into more lucrative steel products production. Residuals levels in steel scrap limit the grades of steel that can be produced without using some type of virgin iron units (HCl, DRI, HBI, Pig Iron) to dilute the scrap residuals to acceptable levels.

Installing an onsite DRI plant and using the DRI in the charge mix allows for a more consistent chemistry in the charge mix for easier operation and enhanced productivity.





Tenova HYL
Av. Munich 101
Col. Cuauhtémoc San Nicolás De Los Garza
N. L. 66450 - México
Phone +52 81 8865 2801
Fax +52 81 8865 2810
hyl@tenova.com

NORTH AMERICA
Tel +1 412 262 2240 - 2265
hylusa@tenova.com

EUROPE & MIDDLE EAST
+39 02 4384 7850
hylitaly@tenova.com

INDIA
Tel +91 22 6681 0409
hylindia@tenova.com

CHINA
Tel +86 10 8447 5656
hylchina@tenova.com

www.tenova.com

TECHINT GROUP