Energiron plants can produce high-quality DRI, with a guaranteed metallization up to 96%

Energiron is proven as the only technology capable of producing high carbon DRI with high metallization ratio. Besides, it significantly reduces the energy cost by utilizing off-gas and steams from the process to generate electricity.

Mr. Alessandro Martinis, Vice-President, Danieli, Centro Metallics, in conversation with Mr. Nirmalya Mukherjee, Editor, Steel & Metallurgy, discusses the advantages of adopting Energiron technology which has brought a revolutionary change in the energy efficiency of steel plants.

Alessandro Martinis,
Vice-President,
Danieli, Centro Metallics

Q: Good day Mr. Martinis! In 2006, Tenova HYL and Danieli joined hands to promote & develop the innovative technology for DRI plant under the trademark "Energiron". During the last 13 years, how many "Energiron" plants has Danieli supplied and commissioned around the world?

A: Since 2006, when the Tenova and Danieli agreement was signed, 5 plants have been commissioned and other 3 are under development. The 5 plants commissioned represent a step forward in the DRI technology because:

- Emirates Steel plants 1 and 2, initially designed to produce 1.6 Mtpy, were soon upgraded to 2.0 Mtpy and represented the most productive DR plants of their time. This was an important step ahead for the gas-based Direct Reduction plants. Moreover, thanks also to the skilled Emirates Steel personnel, these plants reached 105% of target annual production with 8,400 hours in a single calendar year (equal to 105% net availability) and for 315 days continuously without any stoppage.

- Suez Steel and Nucor plants are the most productive Zero Reformer plants rated at 2.0 and 2.5 Mtpy. Both of them reached a very low consumption of Natural Gas, about 2.35-2.38Gcal/t, which is not attainable with any other Direct Reduction technology.

- Ezz Rolling Mill plant was put in operation in less than one month (29 days)thanks to the synergy between the construction and commissioning teams coordinated under the Danieli single point of responsibility.

Q: What are the advantages of installing "EnergironIII" technology which is used in recovering waste energy to produce power/electricity?

A: Normally a DRP consumes approx. 80-130 kWh/t, depending on the size of the plant and the desired product. Energiron III can cut the electricity consumption thanks to the possibility of exploiting the excess of steam coming from the steam reformer to generate electricity or directly move the main compressors, fans and pumps with turbines.Net electricity consumption levels of 30-35 kWh/t are then reached.

Q: The "Energiron" ZR(Zero Reformer) Process is a step ahead in reducing the size and improving the efficiency of the DR Plant. What are the major advantages of using "Energiron" ZR Process?

A: As the name suggests this is the innovative Energiron technology capable to get rid of the natural gas Reformer. All the reforming reactions now can take place directly inside the reactor, in such a way it is not only possible to reduce the size of the plant but also to improve its overall energy efficiency targeting to 2.35Gcal/t DRI compared to other technologies that hit ~2.60 Gcal/tDRI or more. Thanks to this innovative technology it is also possible to use different makeup gasses in addition to the Natural gas such as COG, Reformed gas, Syngas and even Hydrogen without changing the usual process scheme.Moreover, it is possible to produce DRI with a wide range of carbon content, from 1.5% to 5% giving to plant owners complete flexibility.

The intrinsic simplicity of the plant configuration permits to modulate the production according to the specific needs. Turn downs of as much as 60% are possible without loss of performance. Fast start-ups (~20 hours from cold to full production) and shut downs are also possible due to the reduced thermal inertia of the entire plant.

Q: In terms of environment management, the BF-BOF process involves an intensive use of fossil fuels which leads to emission of greenhouse gases, mainly CO_2. How can the "Energiron" process be used to reduce the carbon footprints significantly?

A: The use of Natural Gas instead of Carbon for the process, is already an inherent way to reduce the GHG emissions: from 1900 kg CO_2 per ton of liquid steel produced via the BF-BOF route to the 800 kg CO_2 per t of liquid steel produced via the DRI-EAF route. Moreover, Energiron is the only technology that has embedded in its native process a CO_2 removal system. Energiron was effectively born to have the possibility to eliminate the CO_2 emissions that can be used in CCU or CCS process as in effects it is done by some Energiron users. Just to make some examples: Ternium in Monterrey (Mexico) is selling it CO_2 to food and beverage industry, Emirates Steel is delivering the CO_2 to the oil fields to enhance their productivity.

The total amount of CO_2 produced by ENERGIRON ZR is about 450 Nm^3/ton of DRI, which is lower than what any other DR technology can achieve, thanks to the high energy efficiency of the ZR process. Of the total amount, more than 60% is captured with high degree of purity and made available for other industrial uses. So, a waste becomes an opportunity in the real spirit of the "circular economy"!

Moreover, thanks to the makeup flexibility of ENERGIRON it is possible to use up to 100% of H_2 in the reduction process scheme, achieving in such a way up to 95% of CO_2 emissions reductions.

This advantage is being recognized by the European steelmakers who are facing the pressure of the EU Commission to be Carbon Neutral within 2050. In fact, discussions are going on to study the possible installation of Energiron Plants within integrated steel mills in order to reduce their carbon footprints.

Q: Considering the fact, countries like India suffer from adequate supply of natural gas. Can coal gasifiers be a solution for using "Energiron" process?

A: Sure. Energiron is well known for its great flexibility not only in the products with full control of metallization and carbon content but also for its capacity to use different makeup gases including the syngas coming from coal gasifiers. In this specific field, Energiron holds a patent that describes ways to use Syngas and also Coke Oven Gas where available. The use of these alternative make-up gases is not requiring any modification in the standard plant configuration of the ZR.

Q: How can we effectively increase the efficiency of our EAF by using hot DRI? What is the quantum of saving in such a situation?

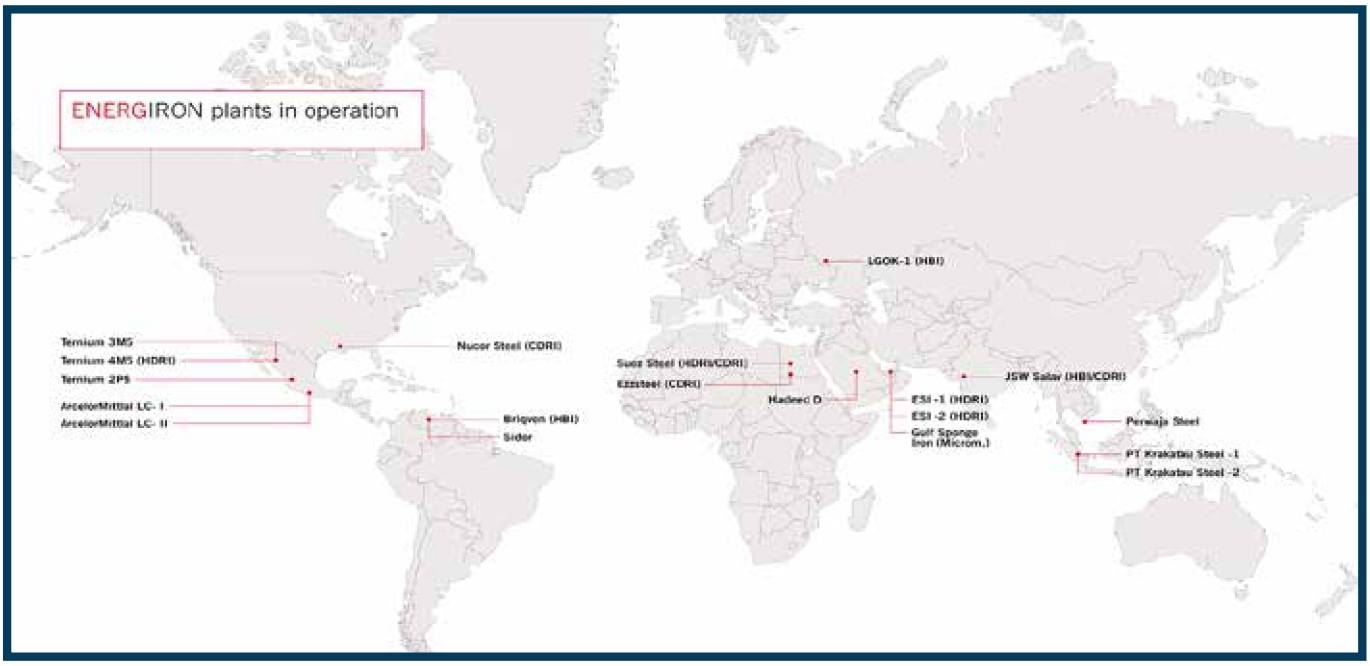
A: Efficiency can be increased by using Hot DRI directly in EAF. Thanks to the increased thermal energy provided by hot DRI, it is possible to save approx. 26 kWh per ton of liquid steel produced during the melting process, for every 100°C increase in DRI temperature. At the same time, the EAF productivity is increased by approx. 5% (for every 100°C increase in DRI temperature)by reduction of the Tap to Tap time.

The Energiron plants have demonstrated to be able to deliver to the EAF the DRI at more than 600 °C. This resulted in a reduction of around 150 kWh/t, for a total Electric Energy consumption of approx. 400 kWh/t and tap to tap of 39 min.

Q: Economies of scale are a great significance these days. Could you briefly describe the highest capacity module a single "Energiron" plant can produce and what is the largest DRI module supplied so far? Can "Energiron" also be used for smaller DRI Module?

A: Since Energiron alliance establishment in 2006, great improvements in production capacity were achieved. Until then, the largest plant ever built was ~1.5 MTPY, but thanks to the Energiron team capabilities new records were set.

We were the first to build the biggest



module ever done achieving the capacity of 2.5 Mtpy for Nucor Steel in Louisiana (USA).

As a matter of fact, Energiron can count on a reference of five DR plants capable of exceeding 2.0 million t/year, namely: Emirates Steel n. 1 and 2, Suez Steel Co., Ezz Rolling Mills, and Nucor Steel Louisiana.

Energiron capabilities are not limited only to high capacity modules but also to any capacity is required under 2.5 Mtpy. As an example of the other extreme of the range, in the UAE a Micromodule of 0.2 Mtpy is operating since 2007.

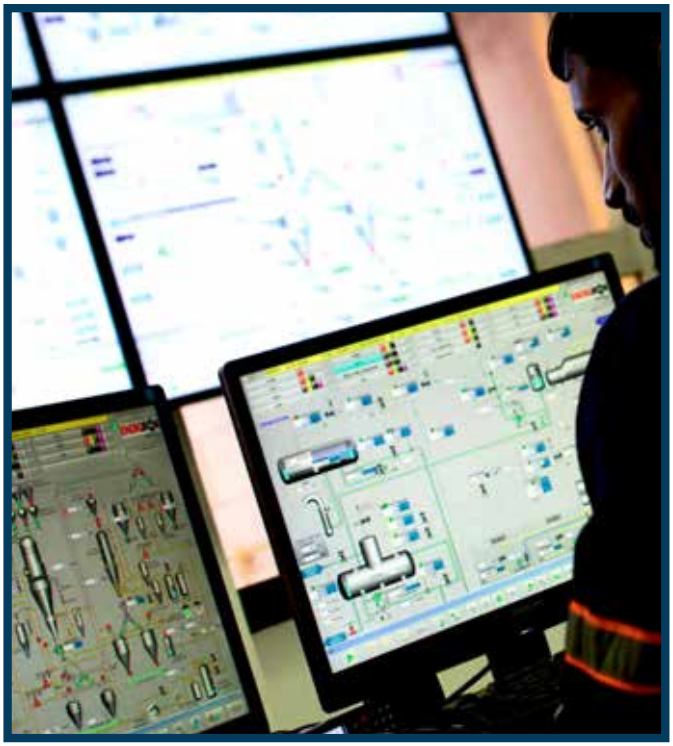
Q: In terms of metallization, modern DRI plant produces DRI with metallization upto94 to 96%. In case of "Energiron"plant, how can we effectively increase the metallization yield?

A: Energiron plants can produce high-quality DRI, with a guaranteed metallization up to 96%.However higher grades of metallization can be achieved by increasing the reducing gasses flow rate or either increasing the residence time of the Iron ore pellets inside the reactor. In any case it is important to balance the degree of metallization, the carbon content and the temperature of the DRI: in few words the "energy" content of the DRI. This is also the origin of the name of our technology: Energ-Iron, i.e. the correct mix of Energy and Iron combined to serve at best the user, which normally is the Electric Arc Furnace.

Q: It is believed "Energiron" is the only process which produces high carbon DRI which brings higher stability compared to other DR processes. Can you explain this phenomenon?

A: Yes, Energiron technology is the only proven technology capable of producing high carbon DRI. The advantage of using the Energiron high carbon DRI is that the carbon is mainly in the form of Cementite (Fe3C) instead of graphite. Indeed, the carbon in the cementite is bound to DRI and provides greater stability by creating a stable compound that is a barrier to re-oxidation.

Another advantage of the Cementite



content is due to the fact that, during the melting phase, its decomposition is exothermic, giving an additional chemical energy contribution to the EAF. In addition, the Carbon so provided to the EAF process is 100% available compared to the one added over the liquid bath, which is in great part loss in the fumes extraction (effective yield is in the range of 50%) and which burns over the slag with a very low Heat Transfer Efficiency (HTE).

Q: Since 1998, "Energiron" has been offering the HYTempR system. Could you explain the advantage of using HYTemp?

A: One of the main advantages of the Hytemp system is the possibility to deliver hot DRI directly to the EAF from as far as 500m. The Hytemp® is a pneumatic transport system that has been used for more than 20 years in different plants (Ternium – Monterrey, Emirates Steel 1 and 2, Suez Steel) to connect DRPlants and Electric Arc Furnaces. It features 99% availability and, being a sealed system, provides zero leakages of either gas and DRI dust. Because of this it is intrinsically safe.

Moreover, it is a near-zero maintenance and a fully automated and integrated system.

No other system (including the metallic

belt conveyors) have demonstrated to be as reliable, safe and efficient as the Hytemp®.

Q: As the vice president and head of Danieli Centro Metallic, how optimistic are you about the future of "Energiron" during the next 5 years? How many orders are you expecting during the year 2020-2021? Typically, how would you rate the performance of "Energiron" process in the Danieli iron making portfolio?

A: Nowadays producing Iron in a sustainable way has become a must. Many steelmakers are studying the best way to reduce emissions and almost everyone arrives to the same conclusion: the best way to produce sustainable steel is by means of a DRP/EAF. Of course, this is possible where the sources of gas and energy are available at sustainable prices. So, I firmly believe that many players in the world would consider a transition from BF / BOF to DRP/EAF in the coming years, especially if the local authorities collaborate to create the necessary infrastructure and environment.

I see also new signs of interest for the Direct Reduction from electric steelmakers who want to achieve the most demanding steel grades without having to rely on pig iron.

This is happening not only in the traditional places where natural gas is available and cheap, like the MENA or Central and South America, but also in Europe and even in Cina.

This makes me optimistic about the possible order intake of the next years although I would rather avoid making a definite forecast about the number of new orders. What I can say is that in this moment we are in negotiation with a number of serious customers.

Definitely the Direct Reduction is a strategic asset in the Danieli portfolio of technologies and we want to pursue a continuous development of it because we are convinced that the future of the iron and steelmaking will be more and more dependent on green technologies and the Energiron has the full capacity to answer to the challenges of the new green-steelmaking era.