MIDA Hybrid: a new milestone, solar-powered by Danieli

Digital controls for EAF melting and casting bring together efficiency, power, and flexibility for a new steelmaking scenario, that combines mini-mill technology, renewable energy and digital process control to achieve high yield, low emission steelmaking.

Energy savings of up to 330kWh/t are possible with MIDA ECR and an additional 90kWh/t with hybrid technology.

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Energy saving and efficiency in metal production is the driving force of Danieli's history and it always has been since Danieli pioneered the mini-mill concept in the 1960s. In the early 2000s, Danieli recognized and understood a new challenge that was met with the MIDA concept, or Micro-Mill Danieli. This is an extremely compact mini-mill where the caster is directly connected to the rolling mill, going from liquid steel (*Figure 1*) to finished products (*Figure 2*) in 12 minutes or less.

Scorecards for this technology have been established all around the world:

- The unique ability to cast billets at speeds above 8m/min for quality rebar production.
- 99% plant yield achieved at a MIDA industrial installation.
- Energy savings of up to 330kWh/t.
- Zero NOX, SOX, and CO_2 during casting and rolling.

Available in four configurations: Nano, Standard, Jumbo and Twin, the MIDA ECR plants (*Figure 3*) can produce straight, coiled and spooled bars, as well as light sections. Capacity ranges from 100,000tpy to 2,000,000tpy. Each configuration offers the most competitive capital expenditure and operating expenditure, giving tangible advantages over traditional mini-mills.

Since the first complete MIDA ECR mini-mill was supplied at CMC Steel in the USA in 2009, Danieli now counts 19 reference plants worldwide (*Figure 4*), including three repeat orders.

THE DIGIMELTER AND Q-ONE TECHNOLOGY

While MIDA layouts have been implemented by Danieli to achieve major energy saving benefits from high speed continuous casting, while at the same time reducing capital expenditure and operating expenditure, steel melting technology has also seen much progress. This has been based mostly on improving process control, using chemical energy to enhance performances and on optimizing the charging processes.

Fig 1 **MIDA melt shop**

Fig 2 **MIDA endless casting and rolling section**

Fig 3 **Aerial view of a MIDA ECR plant**

In 2015, Danieli Automation took advantage of experience in controlling power electronics on high power inverter drives (Danieli Q-Drives), to explore the idea of improving the current and voltage of the arc during the melting and refining processes. The Q-ONE DigiMelter technology was thus born and the electric arc started to be controlled digitally, in the way the speed and torque of stand motors are regulated. The testing of the first prototype in 2016 immediately proved and indeed surpassed the best design estimates and, thanks to a very low flickering and voltage unbalance, Q-ONE proved to be capable of operating with total harmonic distortion within the limits and a power factor constantly above 0.96 to 0.97.

With no further need for compensation, it was also seen that such digital control improved arc stability with very positive effects on electrode and refractory consumption. Paired with the Danieli Q-MELT, which optimizes process performance thanks to artificial intelligence, the Q-ONE provides full digital control of the arc, termed the Danieli DIGIMELTER.

MIDA HYBRID, THE REVOLUTION

While exploring future additional potential for this new technology and having the flexibility of digital controls, as well as the full power capacity of the traditional transformer solution, Danieli immediately understood that efficiency, power and flexibility together open a new scenario for steelmaking: the MIDA Hybrid technology. Just like hybrid vehicles, H-MIDA uses two or more distinct types of power to feed the plant, such as solar and conventional energy. The basic principle is to use solar energy during the day and the conventional energy network during the night.

H-MIDA is setting new rules for steel production and will represent the new benchmark for rebar and wire production. Furthermore, H-MIDA looks to the future thanks to an

Fig 4 **Worldwide locations of 16 MIDA-ECR reference plants**

environmentally sustainable production concept, aiming to become the new standard for steel production in the coming years. Solar feeding can be applied thanks to Danieli Q-ONE DIGIMELTER technology. Q-ONE is the only patented technology that can feed an electric arc furnace using solar, wind or other alternative energy power sources. It is inherently suitable for connection to such sources, which can be seamlessly connected to the Q-ONE DC Link, allowing for an increase in total power available for melting, or refining.

An innovative energy management system controls the availability of alternative electric power and the required loads for the process, to direct the excess energy where needed. This means directing energy not only toward the furnaces, but also to other DC Link based drives, such as induction heaters, inverters for stands, or other variable speed loads. Depending on the weather and the time of day, the system automatically controls plant production and sets up the correct energy source, be that grid, solar panels, batteries or some other source. The excess energy produced as a consequence of furnace cycles can be stored in batteries and used later. The area required for installing solar panels depends on the installed power, which can partially, or totally, cover the plant's actual requirements. As a result, OpEx savings can be estimated as a function of the installed power (*Figure 5*).

Thanks to the high efficiency, high yield of the plant, the absence of NOX, CO_2 and SOX production during casting and rolling, as well as the usage of renewable sources, Danieli H-MIDA is the perfect solution for the green steel industry of the future. **MS**

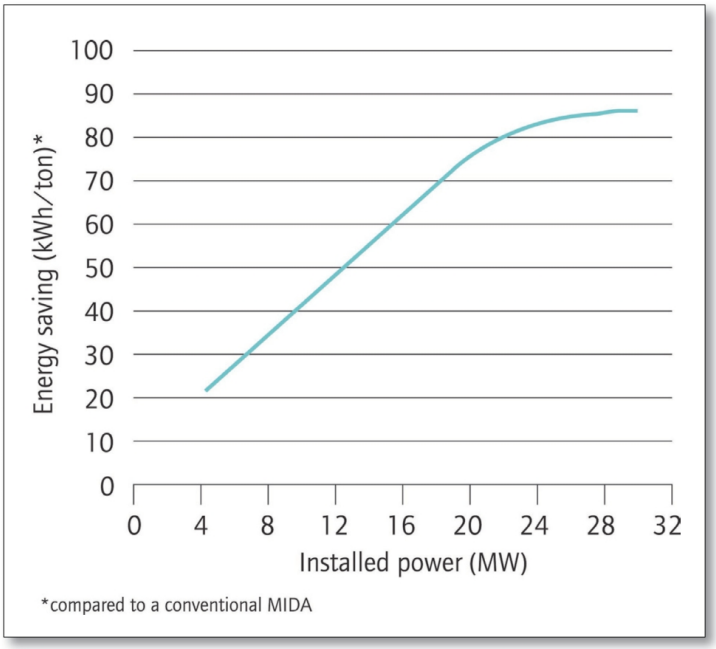

Fig 5 **Saving simulation diagram, using photovoltaics, feeding a 350,000t/y, US-based MIDA plant**

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