Photo courtesy: ORI Martin

Brescia steel factory pioneers decarbonisation technology

ORI Martin's steel production plant in Brescia, Italy, is a good example of how the sector can play its part in cutting global carbon emissions. **Junior Isles** recently visited the facility to take a look.

When it comes to cutting carbon emissions from steel production, Italy is arguably already ahead of the game. The majority (more than 85 per cent) of its steel is produced from electric arc furnaces using recycled scrap steel as feedstock – a much less energy and carbon intensive method than blast furnace steel production.

But for one of the country's major steel producers, this is not enough. The ORI Martin Group has completed the most recent phase of its ongoing effort to reduce emissions while improving energy efficiency across its plants. The company recently began operating a large scale heat pump in Brescia in its latest move to further improve the plant's energy efficiency and reduce carbon emissions by a further 5000 t/year.

Brescia, a historic city in the region of Lombardy between Milan and Verona, has a long history in demonstrating its commitment to sustainability and energy efficiency. In 1972 it began developing an integrated system for energy production, district heating (DH) and heat recovery from industries. Over the years the expansion of the DH network, the introduction of cogeneration plants and waste to-energy technology has seen the city gain international recognition as a good example of circularity and efficiency.

More recently, recognising the need to play its part in tackling climate change, in 2021 Brescia issued the City Charter for Climate Neutrality. It has set a target of reducing per capita CO_2 emissions by 50 per cent by 2030 compared to 2010. The target does not take into account emissions from the private production, or industrial sector.

Yet industry has a big part to play. Over the last decade or so, ORI Martin has been accelerating its activities in support of the city's sustainable development and climate-neutral ambition.

"The steel industry is one of the biggest industrial emitters of CO_2 emissions. It accounts for more than 7 per cent of the world's CO_2 emissions. We have to decarbonise to be in line with the EU's pledge to decrease emissions by at least 55 per cent by 2030, compared to 1990 levels… ," said Carolina De Miranda, Sustainability Manager, ORI Martin S.p.A. "This year we started our decarbonisation strategy to reduce our Scope 1 and Scope 2 emissions by 30 per cent by 2030, compared to 2018. And we would like to use up to 25 per cent renewable energy in our process."

Commenting on the Brescia site specifically, she added: "We are located next to a residential area, which has always pushed us to work on sustainability. So we started to work on sustainability a long time ago, especially for this location. "

The Brescia site has been a key focus for the company. In 2016 it began working with Turboden, a Mitsubishi Heavy Industries company, to see how the steel plant could contribute to the city's drive to improve energy efficiency. It invested €12 million in a project called 'I-Recovery' to convey the large amount of heat contained in the fumes of the electric arc furnace into a system to avoid it being wasted to the atmosphere.

The heat is recovered by a waste heat recovery steam generator that generates steam, which is then used to feed the district heating network in winter, or converted into electricity in the summer months through a 2.5 MW Turboden turbine using an Organic Rankine Cycle (ORC). Both the heat and electricity are supplied to local energy company A2A to serve its customers. The system has an annual heat recovery capacity of 52 GWh and has reduced CO_2 emissions by 10 000 t/year.

In its ongoing mission to cut carbon emissions and improve energy efficiency still further, ORI Martin again turned to Turboden to recover even more heat from the process. A project known as 'Heat Leap' was launched in 2020 as part of the 'Life' programme funded by the EU. Operation of this €6.5 million project started earlier this year.

Roberto de Miranda, Board Member, ORI Martin, said: "We use a lot of water in the process for cooling. Normally we use a cooling tower to cool down the water used to cool the electrical furnace. Now we can send the water to a large heat pump (LHP) to recover even more heat."

Thanks to the installation of the LHP, the heat from the furnace cooling water can be upgraded and then re-utilised instead of being wasted, i.e. dissipated through cooling towers.

For this project, Turboden designed and installed an innovative LHP system. With a Coefficient-of-Performance (COP) of 8.2, it elevates the waste heat (using electrical energy) coming from the low-temperature thermal waste heat of the steel plant, from about 70°C up to as much as 120°C, to transfer it to the local district heating network. Turboden's LHP has a thermal output of up to 7 MWth and is capable of adapting its operation to specific process conditions, thereby maximising energy recovery from the steel plant.

It will also be able to regulate the heat transfer temperature according to the specific needs of the district heating network, up to a maximum of 120°C. According to the company, this is an important innovation compared to the maximum temperatures achievable by conventional heat pump technology.

It was a complex project. The overall architecture of the installation was carefully studied before proceeding to any real work on site. Overall installation drawings were done, as well as detailed engineering and computer-assisted design, especially on the different interfaces between sub-systems. Firstly, the LHP was connected to the existing waste heat recovery (WHR) system and designed in such a way that it can accommodate variations of the heat source temperature, thus providing constant temperature to the WHR installed downstream.

The LHP was assembled on site, accounting for local constraints and final fine-tuning of connecting pipes. The LHP was then thermally insulated to avoid heat losses, as well as to ensure safe access for authorised maintenance staff.

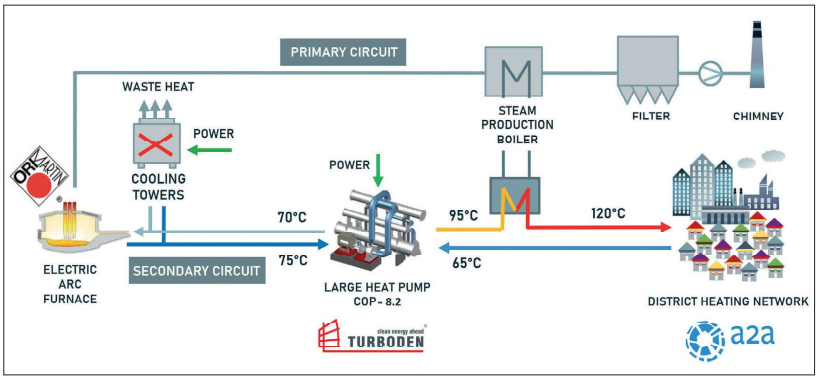
The LHP was installed sufficiently close to the WHR system to minimise temperature drops, and all connecting pipes were thermally insulated. Assembly was carried out on-site. In addition to mechanical and hydraulic works, the LHP installation included electrical works.

The heat pump at the steel works can be split into its main different components: a low-pressure compressor skid, where the inlet pressure is between 4 and 7 bar; a high-pressure compressor skid, where the outlet pressure is between 7 and 10 bar; a condenser; and an evaporator.

Roberto Bertanzi, Product Development Coordinator at Turboden said: "The water needed to cool the furnace used to be wasted but thanks to the heat pump, it can be now heated from about 70°C to around 100°C for feeding into the district heating system. It works in parallel with the system that recovers heat from the furnace fumes." He added: "It's quite a flexible system; we use software to optimise heat production in summer and winter. This is a pioneering project."

Bertanzi noted the growing use of heat pumps throughout various industries due to their ability to provide both heating and cooling as well as the pressing need for decarbonisation. "They are, for example, needed in the food industry and dairies," he said. "They are also well suited for carbon capture processes, which need both heating and cooling for the chemical processes used to remove CO_2."

He concluded: "The heat pump helps support decarbonisation of heat. So every time you are producing heat, you have to ask: 'Can I recover heat somewhere else by using a heat pump to reach my target temperature?' It's not just about saving money; it's about saving the environment."



Maximising heat recovery at the ORI Martin steelworks in Brescia, Italy