Continuus-Properzi progresses with new FRHC technology

The environmentally friendly Continuus-Properzi industrial production process for making FRHC copper rod utilising copper scrap, acknowledged as a profitable investment in Europe and BRIC countries, is witnessing its first sure step into the U.S. market via a greenfield 75,000 tpy installation in Indiana.

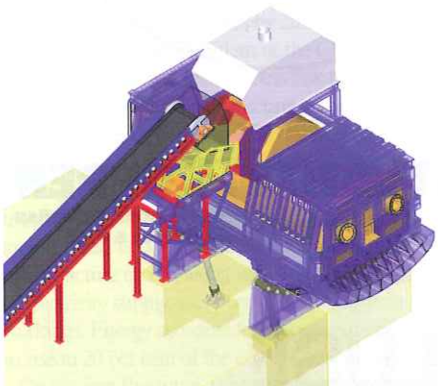
It is interesting to remember today that continuous copper rod, or you could say the process of the continuous casting and direct rolling of copper rod, was born in the early 1960s using scrap as raw material instead of cathodes. At that time, cathodes were practically unavailable, while the majority of copper was commercialised to the wire industry in the form of wirebars which were very expensive.

Early methods

In the late 1950s, Ilario Properzi made his own test on copper using scrap and an oil-fired Sklenar furnace. Later, during the pioneering era of the Properzi process, refining furnaces fed with scrap from the Bell System were used for several years in the USA and, in one case, for many years.

Scrap was what we call first class scrap and the refining process was limited to oxidation and reduction. The reduction was made with green wood (poling). Then, as the Asarco furnace, natural gas and cathodes became more readily available, and as machinery and technology constantly improved year after year, what is now ETP rod, according to ASTM B49, became the starting semi product for all copper wires. There were a few exceptions. About 25 plants throughout the world continued producing FRHC rod.

View of the scrap inside the Refining Furnace type FR 250 *(Courtesy of SDI – La Farga)*



The design concept of the Refining Furnace type FR 250 with loading from the top

Fire Refined High Conductivity rod is made from scrap using furnaces and continuous rod lines designed and fabricated by Continuus-Properzi. This successful process for producing copper rod has had difficulty in receiving proper acceptance by the copper world. Too many remembered the old days when technology, machinery, furnaces, instrumentation and laboratories were far inferior to those of today.

The old fire-refined rod was obtained by low investment installations with rudimentary furnaces fired by oil (polluted by sulphur) where refining (poling) was a medieval operation allowing the casting of second class wirebars to be re-heated and rolled in second class rolling mills. Naturally the quality of the rod was second class, meaning inconsistent, variable and acceptable only for wire diameters not much smaller than 1 mm.

New confidence

Currently the scenario is completely different and FRHC copper rod is an affordable commodity very well known in Europe and China. It is also an environmentally friendly industrial production process due to the renewable aspects of the copper scrap as well as the much lower energy consumption required by the process compared to the conventional steps: scrap – anodes – cathodes – rod.

In 2010 one important scrap dealer in the United States and La Farga Group, the company that created his own success based on the technology which allowed direct production from copper scrap to copper rod and copper billet, formed a joint-venture to establish a plant for FRHC rod production in Indiana, based on a Continuus-Properzi supply. The scrap dealer was OmniSource, a subsidiary of Steel Dynamics, trading steel scrap but also nonferrous scrap. Copper, in particular, accounted for more than one hundred thousand tonnes per year. It was usually exported to China.

The plant, the biggest ever supplied by Continuus-Properzi, is based on one 250 tonne furnace and one 30 t/h CCR line to produce 8mm rod with a maximum annual production of about 70,000 tonnes, but the magnitude of the furnace, a tiltable – reverberatory – refining furnace fired by two main oxy-fuel burners, represented a major step forward, as its previous largest available size was 150 metric tonnes.

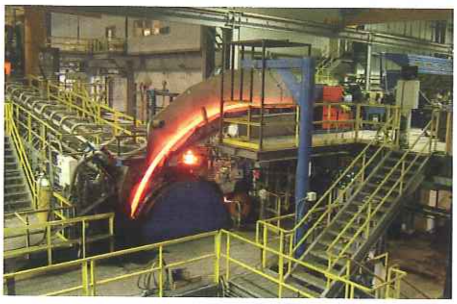
The refining process is the key to the profitability of FRHC rod production and requires 8 hours minimum to complete. Another 8-hour shift is necessary for casting and rod production. Consequently charging and melting must be done in 8 hours or less. Analysing the traditional charging method based on using front loaders to charge about 2.5 - 3 tonnes (at a time) into a side door of the furnace, it was immediately evident that it would be nearly impossible to open the door 70 to 100 times, losing an incredible amount of heat, in order to charge the furnace with front loaders, even if they were driven by Alonso or Vettel style drivers.

Top loading breakthrough

Many different concepts were considered but none were feasible until a new Properzi patented idea came to light - change the traditional geometrical configuration of the furnace by placing a large door on top of the furnace served by a skip-charging machine or by an industrial belt conveyor. The latter system was preferred and the combination of new furnace geometry and new charging system is facilitating great results by easily allowing 10 tonnes of scrap to be charged in only one minute of door opening.

Not only is loading of the loose scrap easier and faster, it has significantly improved the total thermal efficiency due to the enormous quantity of scrap deposited inside the fire room during each charging cycle. With this arrangement, an 8-hour shift to complete the charging and melting of 250 tonnes of scrap has proved to be more than sufficient. This furnace is also the most advanced on the market for the production of anodes. Using pure oxygen for the combustion of natural gas may appear to be an expensive choice but this is not true considering the temperature of the flame of an oxy-gas burner is higher than that of an air-gas burner, so the transfer of heat to the scrap is higher (faster).

Additionally, due to the absence of nitrogen, which accounts for 78 per cent of the air, the amount of combustion gases will be much lower (by approximately one-third). Therefore, the anti-pollution system which filters the exhaust gases can be much smaller and zero calories are wasted for heating the nitrogen and producing harmful NOx components.



View of the Casting Machine during the operation (Courtesy of Wire Journal International)

Another modern advantage of this furnace is the use of porous plugs on the bottom of the bath insufflating nitrogen for homogenising the melt or facilitating some refining reactions or slagging operation. The working cycle of the furnace is as follows:

Charging and melting

Lasts approximately one shift, followed by the first slagging operation and then, during the second shift, refining takes place in steps. After chemical analysis of the melt, selected additives are deposited on the surface of the bath to react with the contained impurities forming a new slag. Each additive requires its own temperature and oxygen content of the melt and a dedicated slagging operation. Three or four refining steps of this kind are usually enough to drastically reduce the impurities, thereby allowing the casting and rolling operation to be in compliance with the ASTM B49 standard.

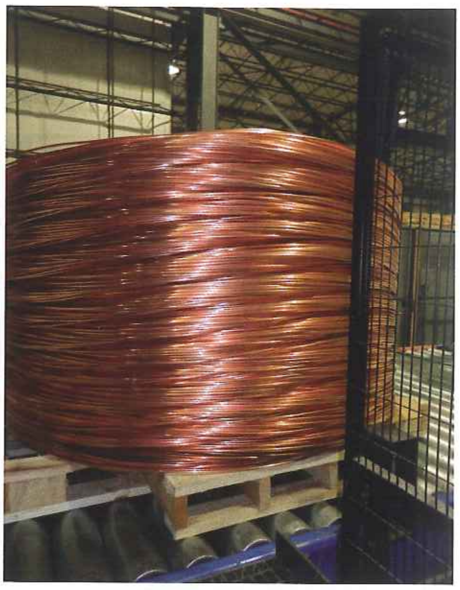
The furnace is then tilted more than 20 degrees and in this way the tuyeres are submerged under the surface of the bath and can inject natural gas that reacts with the oxygen until the O2 level within the melt is reduced to less than 250 ppm.

Casting and rolling shift

The Properzi line is based on a 3 metre wheel and belt caster, one rolling mill with five independent cantilevered rolling stands and one mono block with eight finishing stands of Properzi design each with three rolling rolls. Full instrumentation and automation is integral with the line. Casting and rolling FRHC rod is very similar to casting and rolling ETP rod. Similar, but not identical, when remembering that you are operating on a micro-alloyed copper which requires some critical expertise. Currently, at the Indiana facility, only 8 mm rod is produced in coils up to 5,000 kg each.

Proud of achievement

Continuus-Properzi is proud of this achievement and of their excellent relationship with the local subcontractors, and with the Buyer's team that made the realisation of such a huge plant from a green field possible. Continuus-Properzi remains committed to developing its equipment for FRHC through continuous modernisation and optimisation of the equipment itself in combination with the refining process; from the smallest lines producing 10,000 tonnes per year to the largest lines producing 100,000 tonnes per year.



Typical copper coil weighing 5 tonnes

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