From old puzzles to complete systems

For copper scrap recycling, Continuus-Properzi is now supplying the knowhow and technology with furnaces, machinery and ancillary systems all in one complete package

Recycling of copper scrap is drawing the attention of Industry as one of the best examples of a circular economy and as a rewarding business. The historical process of melting scrap, producing anodes and final electrolysis to obtain virgin cathodes is now limited to low quality scrap. Instead, new scrap or mill berry is charged into the shaft furnace, saving 10-15% of cathodes for ETP rod production with a good economic result. Copper scrap of lower quality - let us say 94-99% Cu - is fire refined and cast into Fire Refined High Conductivity (FRHC) rod or billet or slab or ingot.

Until recently - as an example - a producer willing to start his business from copper scrap had several suppliers: one for the furnaces, one for the refining knowhow, one for the exhaust filter, one for casting and rod rolling or ingot casting and one for the various related services and ancillaries. This resulted in a very complex matrix of suppliers where each provided their piece of the puzzle which, to a large extent, left it to the producer (end-user) to coordinate and ensure all the pieces came together in synergistic fashion in order to fulfil the overall objective of the end-user. Managing such a puzzle can be very difficult, extremely time consuming, and incur significant cost.

In-house development

Continuus-Properzi's recent strategy has been to collect all existing internal expertise, which began in 1963 when the company pioneered the continuous casting and rolling of copper rod starting from copper scrap and has since supplied nearly 30 FRHC rod/ingot Lines, thereby offering the complete package with expert sub-suppliers and expert consultants.

The kinds of imaginable plants starting from copper scrap are too many to list or even describe in a detailed manner due to the many copper scrap grades that can be utilised, the final product(s) to be made, the product quality, and the required yearly production volume. However, a general idea of what Continuus-Properzi is presently offering to the copper market can be given by the two examples (described below) of complete plants that are scheduled for commissioning within the second quarter of 2021.

The below examples illustrate two very different projects each making use of different equipment and catering to different industries, yet they both utilise the best refining knowhow currently available in the market, which is part of Properzi's offering:

EXAMPLE ONE

Foreseen production: 20 metric tonnes (MT) of FRHC copper per 16-hour cycle starting from scrap with Cu content > 97%.

Plant description

A skip hoist machine charges the scrap (which contains a fair amount of enameled wire) into a vertical shaft furnace with air/gas burners that melt and partially refine it. The flow of molten copper continuously passes through two small stationary furnaces where some slagging takes place and additives are administered as part of the refining process. Finally, the melt, having oxygen content in the range of 2,000 - 3,000 ppm, is collected in a 20 MT capacity rotary furnace where the injection of natural gas through porous plugs reduces the oxygen content to a range of 150 - 250 ppm. All launders are included in the supply.

Table 1. Overall FRHC composition

F.R.H.C. Composition	Unit	Value
(Cu + Ag)	%	> 99.90
Impurities	ppm	≤ 750
Oxygen	ppm	150 - 250

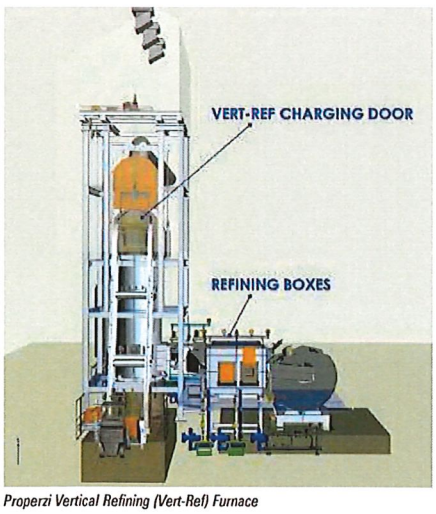
Table 2. FRHC expected final impurity composition ranges

Element	Initial Composition [ppm]	Expected final Composition [ppm]
Zn	800 - 1800	10 - 40
Pb	800 - 4500	> 150
Sn	300 - 700	20 - 90
Ni	100 - 250	70 - 100
Fe	250 - 600	10 - 25
Sb	25 - 100	20 - 40
O_2	------	150 - 250
Se, Te, Bi, Cd, others	Total must be < 20; Concentration of any single element ≤ 2	------

Pollution control is performed with an after-burner chamber to break down VOCs and dioxins, followed by a quenching process to cool down the fumes to a temperature of about 180°C, and then injection of reagents for acids removal, and then to the baghouse filter. The complete supply of the fumes treatment system is shipped from Italy and is economically competitive and superior in performance when compared with systems from other reputable suppliers. The system can withstand stop and go conditions without problems due to the special refractories which were selected.

Copper scrap of lower quality - 94-99% Cu

Properzi Cu Bundles



Properzi Vertical Refining (Vert-Ref) Furnace

EXAMPLE TWO

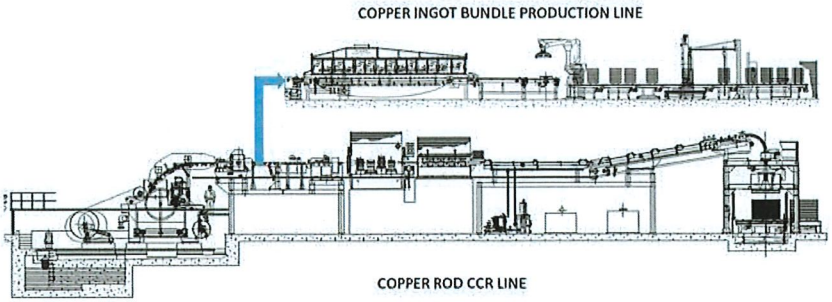
Foreseen production: up to 45,000 MT per year of refined copper in the form of 25 kg ingots starting from scrap with Cu content > 95%. Possible upgrading to produce 80,000 MT per year of ETP rod if/when the investor will add the furnaces for cathodes and the rolling/coiling equipment for the wire rod line. The ingots are produced at a rate of 20 MT per hour.

Properzi CU Ingots after the Rotary Shear

Reverbatory Furnace charged from the Top - Patent by Giulio Properzi

Plant description

The supply includes a powerful shredder that prepares the scrap in dimensions suitable for the belt conveyor and the door of the 150 MT reverberatory furnace that is charged from the top, according to the international patents held by Giulio Properzi.



Schematic of Properzi Copper Line for Ingots and Rod Production

Properzi Cu Bundles in formation.

The refining (theoretical) cycle is as follows: 8 hours charging/melting, 8 hours refining and 8 hours casting and bundling copper ingots. The ingots are produced by a Properzi wheel & belt caster, and then in-line straightened and cut to the correct length by a rotary shear. The ingot dimensions are: length = 700 mm, width = 100 mm, and height = 44 mm. The ingots are water cooled and then stacked by a robot and automatically strapped to form bundles weighing 2 MT each. The operation is totally automated. One operator supervises the casting operation and another one brings the bundles to the storage and/or shipping area. Pollution control is more easily accomplished due to the use of oxygen-gas burners for the reverberatory furnace which reduces the volume of exhaust to only one third that of a reverberatory furnace with air-gas burners.

The fume exit wall of the refining furnace is equipped with an off-gas settling chamber which allows the large particulate matter contained in the dirty off-gas stream to settle. Downstream from the settling chamber, the dirty off-gas enters into an after-burner chamber to break down VOCs, then the off-gas enters into a quenching tube to cool down the fumes to a temperature of about 180°C. They are then subjected to injection of reagents for acids removal, and then to the baghouse filter so that clean off-gas can be released to the atmosphere.

Table 3. Target refined impurity reduction levels of copper ingots

Element	Symbol	Target Refined Chemistry [ppm]	Maximum initial impurity [ppm]
Antimony	Sb	< 50	100
Arsenic	As	< 50	100
Beryllium	Be	< 20	1000
Cadmium	Cd	< 50	1000
Chromium	Cr	< 50	1000
Iron	Fe	< 300	1000
Lead	Pb	< 200	2000
Nickel	Ni	< 250	350
Silicon	Si	< 100	1000
Sulfur	S	< 30	500
Tin	Sn	< 100	600
Zinc	Zn	< 100	1000
	(Se + Te. + Bi)	Not refined	3

Complete system supply

Typical Properzi CCR CU Line

For this project, the scope of supply also includes the cooling towers so the Buyer is preparing only the building, the foundations, and the circuits for the required utilities.

With the experience we have accumulated by the Properzi team through the involvement in numerous copper recycling projects over the last several decades, it is possible to provide a potential customer with a detailed business plan illustrating all of the economic aspects of a copper recycling project so that the economic viability of the project can be easily ascertained simply by inserting the applicable local market conditions.

The era of suppliers to provide just the hardware for copper scrap recycling is over. Today's market demands a supplier that is capable of providing the complete system for the copper scrap recycling process. Continuus-Properzi can provide the complete system: from the equipment hardware to the automation and controls to the technological knowhow to all the required ancillary support systems.

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