CO Trim: Rugged automatic ratio control for copper plants

Reliable system fine tunes metal quality

Situation

Sociadad Industrial Asturiana, S.A. (SIA), Lugones, Oviedo, Spain had an ageing melt shop with a cross-connected ratio control shaft furnace combustion system. Combustion system malfunctions were compromising quality. They desired to improve their competitive position in the European copper multiwire industry.

Plant Description

The furnace is a 30' high steel shaft with a six-foot diameter silicon carbide brick lining. Two rows of premix burners are positioned to fire radially through the lining of the furnace. The first row at hearth level has six burners and the second row located five-feet above has four burners.

Pure copper cathode plates are charged at the top of the shaft. The burner flames impinge upon and melt the charge as it descends through the shaft. Ten tons per hour of copper emerges in liquid form from the hearth of the furnace from a single tap-hole at its base.

The temperature of the copper at this point averages approximately 2,020 F, and the oxygen content of the copper is controlled to be between 250 and 350 ppm at casting. The copper transfers through a launder and a premix-burner-fired holding furnace.

The liquid copper feeds between a hollow casting wheel and belt, solidifies, and becomes rod through mill rolling. The final product is a spool of 8mm diameter copper ETP rod weighing approximately 8,000 lbs.

Trim system on shaft furnace

Current Process

The combustion atmosphere and flame characteristics of the melting plant burners determine the optimum oxygen content and cleanliness of the melted copper. The CO in the shaft is varied by manual adjustment of the burner lov's based on combustion sample analysis from the individual burners on the furnace and launders. The resulting oxygen content and cleanliness of the copper melted then influences the metallurgical and statistical properties of copper rod and wire produced from the casting, rolling and subsequent drawing processes. Optimally the combustion ratio must also be varied between start-up, normal, running and shut-down situations and due to metal quality observations and samples.

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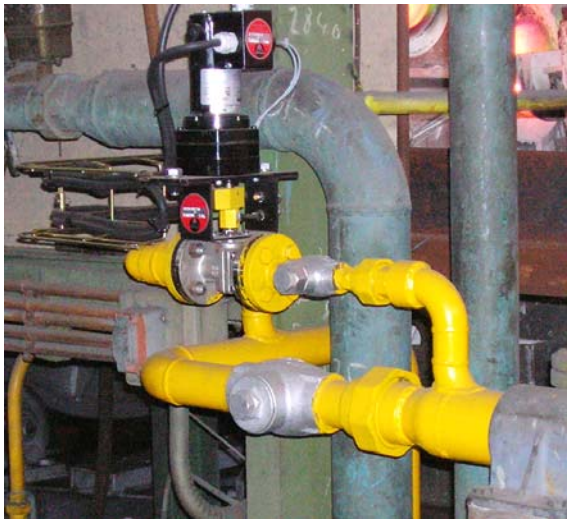
Solution

To automatically maintain a precise furnace atmosphere at each furnace burner and at the five additional launder premix manifolds, custom "automatic trim" control valves with bypass were installed at each burner. A custom PLC control system with a feedback loop to the furnace burner analysis system was designed and installed. The burner PLC controls were provided in an additional panel that was integrated with SIA's existing burner sampling system.

• The rugged automatic trim valves were installed after each cross-loaded ratio regulator to improve the degree of control over the premix ratio.

• To increase precision, the cross-loaded ratio regulators were changed to FivesNA's special 7218-3-H's which have proven more precise in this application. The bottom screw adjustment facilitates easy trimming of the fuel/air ratio even when the furnace is running.

• To homogenize the premix and eliminate the previous troublesome orifice plate-based adjustments, special Fives North American 3065-7 mixers were installed. They are provided with custom designed adapter plates, sight glasses, and have special plating for the high temperature use required of shaft furnace burners.



Results

The customer achieved an increase in the quality of copper product, displayed as a decrease in cup and cone wire breaks and more consistent oxygen content, indicative of more uniform oxide distribution in the cast and rolled rod.

• The 3065-7 mixers produced a perfect premix for the burners.

• The combustion ratio of the premix at the burners controls automatically to produce the desired level of 1.25% CO in the burner combustion gas at each burner.

• Manual and automatic CO control is now available. The operator can vary the settings at will to achieve up to 4% CO.

• Less copper rod and wire is recycled and a higher general productivity of the wire and rod manufacturing process was achieved.

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