CASESTUDY

by Luciano Baccarini | Export Supervisor, Ascon SpA, and Gianluca Masina | Vice Technical Manager, Sacmi Forni SpA

Controlled Combustion

In an effort to increase output rates, Richard Ginori turned to a control system from Ascon SpA for its Sacmi Forni tunnel kiln.

Often called *white gold*, high-quality porcelain tableware is a precious, sonorous material characterized by a bright white color with light blue shadows, almost transparent thickness, and good mechanical strength. These characteristics can only be obtained by an appropriate firing in the kiln; other production stages cannot satisfy the product's essential requirements.

Control, automation and supervision are essential in any ceramic production plant where efficient management and high output rates are required. If the production includes high-quality porcelain, the combustion control of the kiln becomes one of the most important aspects of the production cycle. Porcelain tableware production uses dedicated shuttle or continuous tunnel kilns loaded with cars and outfitted with combustion control systems that allow a controlled firing in a reducing or neutral atmosphere in each zone.

Richard Ginori, established in Florence, Italy, in 1735 and a leader in the production of high-quality tableware, was recently looking to improve the production of its Classic line of art design tableware. The company's main goal was to drastically increase its output rates, so it turned to Ascon SpA for an instrumentation and control system for its Sacmi Forni tunnel kiln.

The Need for Control

Richard Ginori's final product requirements include white color, transparency and high mechanical strength, and the production cycle includes the preparation of raw materials, casting, drying, glazing and firing. The porcelain's white color is obtained by eliminating the iron oxide present in the slip, while mechanical strength is achieved through appropriate sintering.

Iron oxide, which produces undesirable yellow shades in the finished product, is eliminated by controlling the firing to obtain a reducing atmosphere. To obtain the necessary mechanical strength of the thin porcelain, it is necessary to accurately control the firing temperature and ensure the correct sintering of the slip. The kiln temperature control acting on the combustion, combined with the reducing atmosphere control acting on the air/fuel ratio (corrected based on the carbon monoxide measurement), solve both problems with control strategies downloaded into Ascon's AC Station series programmable loop controllers. Ascon developed the control system in close cooperation with Sacmi Forni, part of the Sacmi Group.

Gaining Control

The kiln has eight firing zones with eight gas burners each. The high number of burners and adjustment zones, the control system, and the efficient insulation guarantee progressive, uniform and flexible heating, as well as low fuel consumption. The gas flow and combustion air flow of each zone are measured through orifice flanges connected to transmitters, which include temperature change compensation for the air flow (see Figure 1).

The carbon monoxide (CO) content of each firing zone is measured by an infrared analyzer that scans the eight sampling lines of the zones under control. The signals representing the gas and air flows and the CO% are fed, along with the zone temperature, into the AC Station multiloop controllers. The control strategy software manages:

- zone temperature
- fuel/combustion air stoichiometric ratio
- adjustment of the fuel/air ratio on the basis of the requested % of CO
- setting of the air and gas flow control valves
- alarms

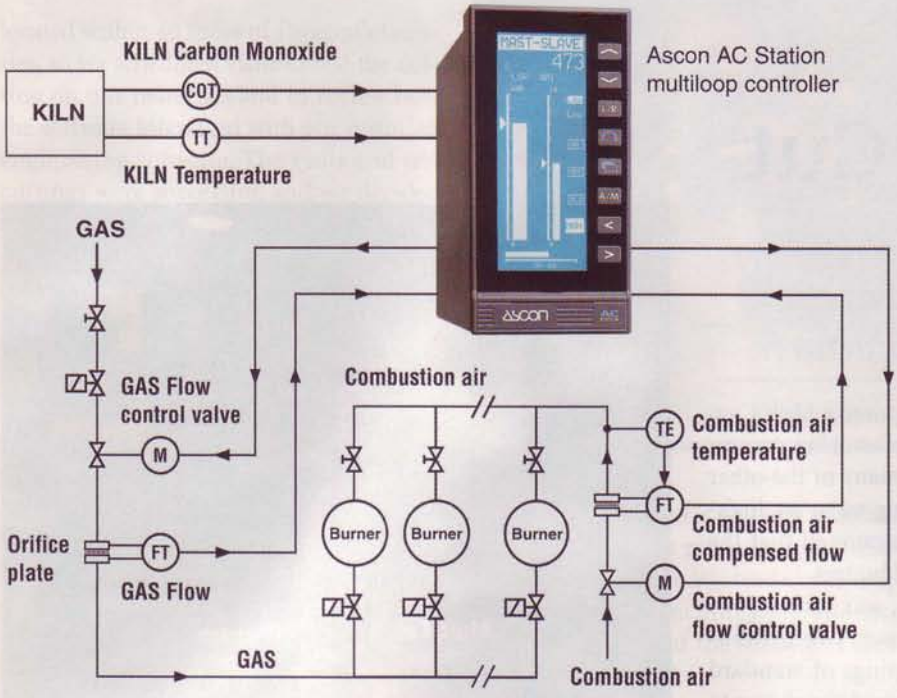

Figure 1. Schematic of the reducing atmosphere combustion control of one zone of the tunnel kiln.

One controller is used for each zone and includes, in addition to the kiln temperature and CO inputs, two PID control loops—one for combustion air and one for gas. This setup also allows the operator to view an interface graphic display for each zone on the 72 x 144 mm front of the controller.

Each zone has its own temperature and its own atmosphere. The first zones fire in a reducing atmosphere to eliminate the iron oxide, while the last firing zone has a neutral atmosphere. Pressure control prevents external air from entering the kiln, thus creating an oxidizing atmosphere. Pressure control, which is essential since the kiln inlet and outlet are open, is managed by separate AC Station controllers that adjust the speed of the flue gas exhaust fans. The cooling stage is indirect to avoid oxidizing the load.

The combustion control system is interfaced with the automatic ignition system and the flame control. The kiln is approximately 48 m long with a useful car width of 1500 mm, and can complete a load cycle in 6 hours. The temperatures in the firing zones range from 1200 to 1350°C. In the zones with reducing atmospheres, the reducing level is kept low (4 or 5% of CO are the most common adopted values).

Control with Ease

The plant also includes the control of the slip production machines and the dryers. The design of the control strategies was simple through the AC Station's AC Prograph graphical programming software, which uses the function block method. A function block diagram (FBD) can replace thousands of lines from a textual program. Graphical programming is an intuitive method of specifying system functionality by assembling and connecting function blocks.

An FBD network primarily comprises interconnected functions and function blocks to express system behavior. Function blocks were introduced to address the need to reuse common tasks, such as proportional integral derivative (PID) control, counters and timers, at different parts of an application or in different projects. The wide range of function blocks available in the software results in the simple integration of the analog functions with the logic and sequencing functions.

The operator interface is a high-definition graphic display with several pre-formatted pages that feature numerical values, bar graphs, trends, alarms and menus. The control and monitoring systems are interfaced with a supervisory control and data acquisition (SCADA) system that provides plant supervision and management information, including the determination of the set points, recipes, alarms and data acquisition.

Burner heads on one side of the kiln, along with the related piping and the flow transmitters of the gas and combustion air.

The kiln inlet (right) and the dryer outlet (left).

Immediate results indicate that the system has been successful in maximizing the production at this facility. Product quality has been dramatically improved while throughput has increased with an added benefit of improved energy efficiency.

"This new Ascon control system has shown benefits from the very beginning," said a company representative from Richard Ginori. "It is difficult to put exact numbers on system performance, but we can say that the payback has been less than one year. We couldn't be more pleased with Ascon and their system."

For additional information, contact:

- *Ascon SpA, Via Falzarego 9/11, 20021 Baranzate (MI), Italy; e-mail info@ascon.it; www.ascon.it.*
- *Sacmi Foni SpA, Via Dell'Artigianato, 10-42010 Salvaterra di Casalgrande (RE), Italy; e-mail sacmi_forni@sacmi.it; http://forni.sacmi.it.*
- *Richard Ginori, www.richardginori1735.com.*