

FALORNI TECH

Maintaining air and gas ratio constant with AQRatio



Thanks to AQRatio technology, the air/gas ratio is kept constant during the regulation output driven by the temperature profile demand and is independent from the pressure losses in the air/gas mixture line downstream the regulation skid due to any cause (fouling in the pipe or in the burners).

To meet the objectives of evolution and innovation in combustion technology, the system requires stable, uniform, and complete combustion. The combustion plays a crucial role in the right concept and a rigorous design path of FLEX-COND, which embeds integrated solutions that contribute to the overall performance of the glass conditioning system.

In forehearth temperature control processes, the key elements to be kept under full control are basically two:

- The ratio between the air and the gas during the whole working range of each combustion zone;

- The temperature stability duration time.

AQRATIO TECHNOLOGY

AQRatio technology is based on the Differential Pressure Governor principle. A membrane device continuously receives the differential pressure signal taken before and after an orifice, in both air and gas lines. The purpose of the membrane device is to keep a constant preset balancing of the air and gas differential pressure values at variable flow of combustion air. Being assumed that the differential pressure measured before and after an orifice plate inside a single duct with a gaseous fluid in motion is directly proportional to square of the mass flow of the same fluid, the fact to keep these differential pressures in constant relationship consequently means to keep the flow ratio constant. It is important to highlight that the measurement of the differential pressure value is not qualitative but quantitative, so there is no reading of flow

but only the physical correlation inside the system (See Chart 1).

Another characteristic of AQRatio technology is the integration of a linear flow control valve to accurately and repeatedly modulate the flow of air at any servomotor angle. The valve controls Air/Gas ratios up to 25:1 and is suitable for regulating flow rates for modulating or, also, stage-controlled combustion processes.

This type of control valve uses the rotary valve principle in which a control cylinder, with a specially designed opening to determine a linear flow, is installed in the flow body. The rotation of the cylinder around its main axle, sets the desired flow rate in the air pipeline. In addition, the maximum flow can be limited in broad ranges by means of a flow restricting cylinder which allows optimum adaptation to the capacity required, without limiting control quality.

In conclusion, the AQRatio is a modular integration of air and gas

flow control technologies aimed to modulate the temperature of the forehearth zones providing:

- Constant Air/Gas ratio at any admissible flow of the line;
- Easy adjustment of Air/Gas ratio;
- Linear air flow adjustment;
- Suitable working conditions of air and gas flow control devices.

THE ADVANTAGES OF AQRATIO

The main advantages of Falorni Tech AQRatio combustion system technology can be resumed as follows:

- Tailor-made system to fit the FLEX-COND glass conditioning technology by Falorni Tech;
- Steadiness of the Air/Gas ratio regulation during operation and during the time;
- Regulation not influenced by the downstream mix line characteristics and/or by eventual decay of the pressure losses in the same due to ageing, clogging or fouling;



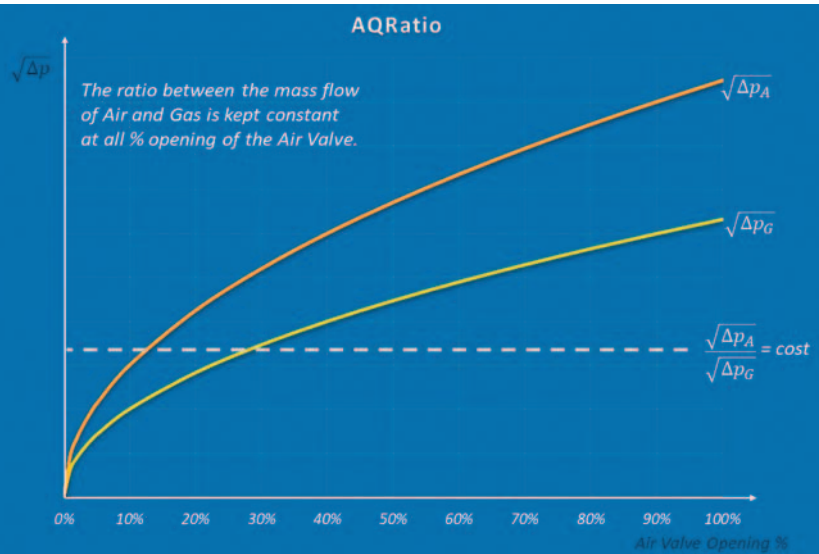


Chart 1 - Qualitative view of the mass flow of air and gas ratio related to differential pressure measurement in the lines.

- Quick response of the temperature regulation loop to the temperature variations of the zone thanks to a fast tuning of the gas flow (slave) to the air flow adjustment (master);
- Linear response of the air flow modulation to the servomotor angle in all working range;
- A number of adjusting parameters that allow engineers and the furnace personnel to fix the air and gas working conditions fitting with the field line requirements and to keep these figures constant for the whole firing range. No need of further adjustments once the system is commissioned up to the time of forehearth maintenance;
- Wide range of temperature setting in the same zone by keeping combustion values constant
- Capability to maintain the optimal combustion atmosphere in case of glass types sensible to oxidation (all reduced glass such as amber or dead leaf, etc.).

AQRATIO AND FLEX-COND: PERFECT INTEGRATION

Falorni Tech has developed his AQRATIO system by means of the experience gained operating the FLEX-COND glass

conditioning technology in the field. FLEX-COND has been conceived bearing in mind the most accurate glass temperature homogeneity regulation in a forehearth in order to produce NNPB container glass with no compromise to the operating flexibility of the same forehearth. So far, AQRatio has been expressively developed thinking to its integration with these strict requirements, not only for NNPB in container glass process but for any other high performance forming process including multi-gob press systems or Press-Blow systems for tableware production.

As a matter of this, it can be said that AQRatio and FLEX-COND are two sides of the same coin as they are so strictly connected that they cannot stand one without the other.

FUTURE DEVELOPMENTS FOR AQRATIO AND FLEX-COND

The next important target of all the industry kinds will be the achievement of Industry 4.0 standards or the Fourth Industrial Revolution standards currently ongoing and aimed to support the traditional manufacturing

and industrial processes with smart technologies, in particular communication and Internet, that will make possible the management of complex processes in full automation and without or with the most limited human intervention.

The next step to complete the evolution of FLEX-COND and AQRatio, will be the ICS or Interactive Control System a new kind of controller philosophy. This will be based on advanced technology developed by glass makers for glass makers to support the whole conditioning phase (and not only).

Interactive Control System by Falorni Tech will generate a database of experience directly from the daily field operation. This database will be the platform to enhance the process efficiency by providing quick response for problem solving, fast setting, sharing of experience.

This controller philosophy, still under improvement, is able to provide the standard control capabilities but with additional features:

- Mathematical and Physical analysis of the process data;
- Support to Operator on process status and data reading;
- Storage of analysis, reports and experience;
- Reporting/interface and sharing of all operators' experience. ■

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glass melting technology

FALORNI TECH
Industrial Division of
Falorni Gianfranco Srl

Viale IV Novembre 15
50053 Empoli (FI) - Italy
Tel.: +39-0571-922333
E-mail: info@falornitech.com

www.falornitech.com