State-of-the-Art

Combustion System Controls and Burner Designs

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Today's heat treating and combustion industries face many challenging issues. Staying competitive in today's market requires companies to produce material to tighter specifications, increase production capabilities, and lower costs. These are combined with stricter government emissions regulations, today's higher fuel costs, and the cost of work-related liabilities, which require increased furnace efficiency, advanced firing techniques, and increased safety. State-of-the-art combustion system controls and burner designs can meet these challenges.

Basically, a furnace provides a means to thermally process materials in a given amount of time. In most cases, increasing the heat input to the furnace increases material output and/or decreases furnace cycle time, assuming no other changes are made to the system. Even with an existing combustion system of fixed firing capacity, the useful heat input into the furnace can be increased by increasing the combustion efficiency. Factors such as air-to-fuel ratio, burner output vs. maximum capacity (burner outlet velocity), combustion air temperature and furnace pressure can and do affect combustion efficiency. Air to fuel ratio should be established as close to stoichiometric ratio as possible throughout the entire burner operating range (high to low fire). Excess air or fuel reduces combustion efficiency. Burners should be sized and fired as close to their maximum output as possible, especially with high velocity burners. At the burner's maximum output, optimal performance is achieved with regard to emissions, convective heat transfer, combustion efficiency, and typically temperature uniformity.

Fig. 1 - IC40 control motor coupled to air or gas control valve

The Kromschröder IC40 control actuator (Fig. 1) combined with the valVario line of combination control safety shut-off solenoid valves (Fig. 2) and Hauck's Super VersaTile (SVG) high velocity burners (Fig. 3) offer a good solution to optimize air/fuel ratio and combustion system efficiency. The IC40 actuator is designed to couple with a multitude of air and gas control butterfly valves.

Fig. 2 - valVario double blocking solenoid valves with pressure switches

Fig 3. - Hauck SVG high velocity burner with Kromschröder controls.

The actuator accepts digital, analog, and a combination of digital and analog control signals; features programmable stroke and speed; and can operate on 50 or 60 Hz power supply. The actuators flexibility and functionality lends to its use in a variety of applications. For instance, simple programming via an optical software interface allows modifications of the operating parameters to include such features as running times, adjustable angles, and low-fire positions, permitting flexible adjustment to process demands. Diagnostic information also can be accessed for ease of field troubleshooting and setup.

The valVario valves were built on the technology behind the reliability and longevity of the single VG gas solenoid valves, with the additional functionality of a combination control. The safety shut-off valves can operate on 50/60 Hz supply power, and can be configured to have the functionality of integrated proof of closure switches, pressure switches, pressure test ports, pressure reducing regulators, air-to-fuel ratio regulators, pilot, and bypass gas lines all rated and suitable for modulated or pulse firing. Using the integrated features, the valVario provides functionality and control capability in a compact, simple design. An added bonus is lower installation cost, because the combination valVario controls required considerably less piping and wiring. A system consisting of high velocity SVG or BIC burners having either modulating controlled air valves via IC40 actuators or pulsing air valves with cross-connected valVario type ratio regulators results in an accurately maintained air/fuel ratio for optimum burner performance and system efficiency.

Recuperation combined with accurate air/fuel ratio control offers an added measure of system efficiency.

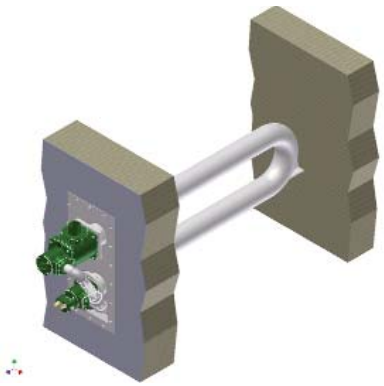

Fig 4. - Indirect-fired RadiFlame gas burner and plug-in recuperator.

Examples of direct-fired self-recuperative burners include the Ecomax, which is capable of air preheats exceeding 1000°F (540°C) and results in fuel savings over 30% that of a conventional cold-air burner system. For indirect-fired applications, Hauck offers a new radiant tube burner, the RFG (RadiFlame Gas) burner in combination with its Radimax industrial-grade plug-in recuperator (Fig. 4). Both burner systems are ideally configured with versatile Kromschröder controls to provide optimum system efficiency.

While increasing overall furnace efficiency is an ongoing goal, increasing furnace and combustion system safety should always be a top priority. Modern combustion systems include (and require) components such as redundant safety shutoff valves, air and fuel pressure switches, and a burner management system. The Kromschröder burner control unit or BCU (Fig.5) features a compact

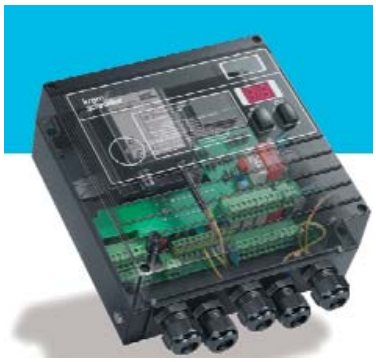

Fig 5. - Burner control unit (BCU).

metal housing that provides flame safeguard (UV or flame rod) located locally at the burner, and includes ignition transformer, manual/automatic mode, and display of fault status information plus other options. It controls, ignites, and monitors gas

burners for intermittent or continuous operation. Multiple models for single or multiburner applications are available with options up to and including control of pilot solenoids and even control of the burner control valve, which could be a modulated or high/low pulse actuator for cross-connected or pulse-fired systems, respectively. The BCU conveniently displays program status, fault codes, and flame signal, and can even be configured with an optional optical interface via laptop computer for added diagnostic information and access to parameter settings. A profibus field bus link for multiple-burner systems is also available, greatly simplifying installation wiring and troubleshooting.

Fig. 6 - Multiburner system with locally mounted burner control units.

Advanced firing techniques are used when striving for increased furnace efficiency, greater temperature uniformity, increased furnace turndown, and improved emissions. Techniques such as pulse firing, variable excess-air firing, or a combination of pulse firing and modulating a system can offer substantial improvements over conventional systems and firing techniques. Key to achieving these advanced firing techniques is the proper system hardware including high cycle-life valves and actuators, regulators, pressure switches, and flame safety controls (Fig. 6).

Hauck's offering of Kromschröder control products coupled with versatile Hauck or Kromschröder BIC burner lines provide a combustion system having the ability and flexibility to maximize combustion and furnace efficiencies and flame safety. Combustion system controls are rapidly becoming high-tech commodities, many with advanced features and capabilities now possible.

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