Improving Glass Furnace Performance with Natural Gas Chromatographs

Glass manufacturing is one of the most energy intensive industries, with energy costs representing roughly 14% of the total production costs. The bulk of energy consumed comes from natural gas combustion used to heat furnaces to melt raw materials which then turn into glass. Historically, natural gas composition has been relatively stable. However, dramatic changes in the supply of natural gas (including shale gas and LNG imports), are causing end-users to experience rapid and pronounced fluctuations in gas quality. The efficiency of the furnace can be optimized for the Air / Fuel ratio when the composition of the incoming gas changes, which can significantly reduce energy consumption and provide significant savings to the business.

Reducing Energy Costs
Accurate determination of fuel gas composition allows for the optimal adjustment of the Air/Fuel ratio. The energy value (BTU or Calorific Value) or Wobbe Index output from the GC (via Modbus or an analog 4–20 mA signal) can be used to integrate with the plant process control system to trim the Air / Fuel ratio and ensure maximum production efficiency, as shown in Figure 1. When the air fuel mixing proportion is correct (stoichiometric), all the fuel will be consumed during the combustion process and will burn cleanly, this enables the furnace to operate at its most efficient, cost-effective point.

Ensuring Glass Quality
Additionally, glass manufacturing is sensitive to the combustion processes which can impact the quality of the glass and shorten the lifespan of the melting tanks if not managed properly. Changes in the composition of the fuel gas will cause changes in the physical properties of the gas, the minimum air requirements needed to achieve stoichiometric combustion, the flue gas composition, flame speed and flame position. Failing to respond to variations in the composition of the natural gas can result in losing an entire production run due to poor gas quality.

Wobbe Index for Burner Optimization
Two unique fuel gas compositions may have the same energy content but behave significantly differently in the burner. This is because the different amounts of diluents (nitrogen and carbon dioxide) and different ratios of the hydrocarbons will result in different densities and thus different velocities through the burner restrictors. The Wobbe Index is the ratio of the energy value to the specific gravity (Wobbe Index = Energy/√Specific Density) and provides an index related to how the fuel will act through a burner and provides a better variable to control the Air / Fuel ratio.

Determining Gas Composition
Gas chromatographs are used throughout the natural gas chain of-custody (“from well-head to burner-tip”) to determine the gas composition for quality monitoring and energy content. For “pipeline quality natural gas”, the industry standard is the C6+ measurement method. This method determines the individual composition for each of the hydrocarbons from Methane to normal-Pentane, Nitrogen, and Carbon Dioxide, and combines heavier hydrocarbons (Hexane, Heptane, Octane, etc.) as a “C6+” component. From the composition, the energy content, specific gravity, Wobbe Index, and other physical properties are calculated using calculations from international standards such as ISO 6976, GPA 2172, and AGA 8.
Using a gas chromatograph to determine the gas composition and the Wobbe Index will provide insight into the fuel quality variations from the gas supplier. Additionally, the C6+ measurement is the standard by which custody transfer billing is based, and therefore provides a direct method of ensuring that the energy used matches the billing from the gas supplier.

**Recommended Solution**

Traditional methods to monitor gas quality have required high level of maintenance and experience technicians, which could negate the benefits of online composition monitoring. Often the skills and experience required to maintain complex analyzers cannot be found onsite which can result in expensive service calls and significant down-time waiting for the maintenance to be performed.

The 370XA gas chromatograph has been designed to address these challenges and provides a reliable, online measurement of the natural gas composition to allow the more efficient and precise control of the burners used in glass manufacturing with a variable incoming gas supply. The focus on ease-of-use and the reduction of utility and maintenance costs in the design of the 370XA makes it easier to install, operate, and maintain cost effectively.

**Figure 1 - The 370XA Gas Chromatograph being used to determine the gas composition entering the burner.**