The crucial role of industrial gases in float glass production

Stephen Harrison* discusses the role played by industrial gases throughout the production of float glass, including the role they play in protecting equipment, improving the quality of the product, and monitoring emissions.

Silane gas has proved itself to be a highly effective glass coating in reducing the ability of ultra violet light to penetrate glass.

Although glassmaking dates back to ancient times, today's production industry still reflects many of the same basic operational processes. A substantial development is the mass manufacturing of float glass to comply with modern building standards and environmental legislation. It is here that industrial gases play a vital role.

The primary process of glass production is melting, using burners typically fired by natural gas and air, or air enriched with pure oxygen. The best way to ensure optimal operation of the burner is to measure and control the amount of oxygen in the burner flue gas to ensure there is a small residual amount of oxygen emerging in the escaping flue gases. To achieve the right balance, oxygen should be measured in the furnace through a feedback process control loop, using instrumentation such as a Zirconia oxygen analyser, which is reliable and robust in this extremely hot operating environment. The instrument's sensor requires periodic calibration with a speciality gas mixture of typically percentage level oxygen in nitrogen, close to the measurement point, to ensure accuracy of measurement.

Final stages

Towards the end of the float glass production process, molten glass is 'fed' through metal rollers. In this reactive environment, measures must be taken

New legislation will mean a leap for glass manufactures in regards to emissions monitoring and reduction.

to prevent the glass from reacting with the rollers and other materials' handling equipment in order to mitigate damage to the final glass product and to extend the life of expensive capital equipment such as the rollers. This is achieved by injecting an atmosphere of sulphur dioxide (SO_2) around the equipment, so that the rollers and the sheets of glass are never actually in contact with each other. Instead, a thin film of SO_2 gas reacts with the surface of the glass to produce desirable chemicals that prevent the molten glass reacting with metals that would damage the rollers and compromise the quality of the glass.

Linde is heavily involved in the supply of SO_2 for this application. The gas is usually supplied in 50kg quantities in cylinders or 500kg quantities in drum tanks where it is stored in liquid form until utilised in the production process in gaseous form. These containers are heavy and SO_2 is a toxic gas, therefore product stewardship must be prioritised.

Coatings for performance glass

The role of industrial gases continues to the final stages of float glass manufacture. The rare gas, krypton, can be used in a technology known as 'sputtering deposition' to coat the surface of the glass with a thin film of metal. This surface treatment maximises its energy efficiency and reduces the requirement for electrical heating in a building. This application is often strictly specified for buildings in the USA and in Europe to ensure these structures comply with energy efficiency regulations.

Additionally, silane (SiH4), has proved itself to be an effective glass coating in reducing the ability of ultra violet (UV) light to penetrate glass – particularly that which is destined for use in window manufacture. Silane reacts with the glass surface in a chemical reaction and forms

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a coating which helps to mitigate the adverse effects of UV rays on human health, including short-term issues such as sunburn and potential longer-term issues including skin cancer. These are points of concern to health authorities, particularly in countries where intense sunlight and heat are unrelenting. In a similar application, the speciality gas hydrogen fluoride is used to etch the surface of the finished glass.

Emissions monitoring

Float glass production facilities are often obliged to monitor and control their emissions profile in order to manage the associated gaseous environmental pollutants such as carbon dioxide, oxides of nitrogen (NOx) and SO_2. Burning air and the fuel produces large quantities of oxides of nitrogen. At high temperatures, nitrogen reacts with oxygen from the air to produce NOx, while some chemicals typically present in natural gas, such as sulphur compounds, also react with oxygen from air to produce SO_2.

Therefore typical stages in flue gas clean-up from the burner are DeNOx and desulphurisation via a SO_2 scrubber, occasionally with carbon dioxide knock down, before gas is emitted to the atmosphere. In some technologies, as emissions gases flow through the DeNOx unit ammonia is added to the flue gas to reduce the NOx back to their molecular nitrogen, while in the SO_2 stripper various chemicals absorb the SO_2, changing it from a gaseous form into a liquid form, where it can be handled and treated more efficiently.

Ammonia can be added to the DeNOx unit because it contains a large amount of hydrogen that is able to reduce the NOx to react with the oxygen in nitric oxide and convert nitric oxide back to nitrogen, which is regarded as a safe gas to emit. Often included under the banner of a speciality gas, ammonia is supplied in bulk deliveries to major float glass facilities, or in drums and cylinders to smaller scale R&D and pilot glass production facilities.

Essential to monitoring the different clean-up operations are process control gas mixtures containing, in this application, oxides of nitrogen or SO_2, and frequent calibration is needed with accurate speciality gas mixtures. These mixtures calibrate the continuous emissions monitoring (CEM) instrumentation in the process train, measuring the flue gas as it comes through all the process steps and eventually goes up the smoke stack. In general, nondispersive infrared sensor (NDIR) sensors or Fourier transform infrared gas analysers (FTIR) are used for these measurements, both of which require a range of calibration gas mixtures, typically mixtures of nitric oxide in nitrogen, or mixtures of SO2 in nitrogen at relatively low concentrations, sometimes in parts per million.

The European Union Directive 2010/75/EU on industrial emissions integrated pollution prevention and control (IPPC) comes into force on January 1, 2016. The new legislation will mean a considerable leap for glass manufactures in terms of what is required of them from an emissions monitoring and reduction viewpoint. The role of speciality gases will be critical to ensuring compliance with Directive 2010/75/EU as they are essential for calibration of the emissions measuring instruments – and are precisely prepared for each glass manufacturer to meet their emission monitoring needs. ■

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