

Glass melting process optimisation

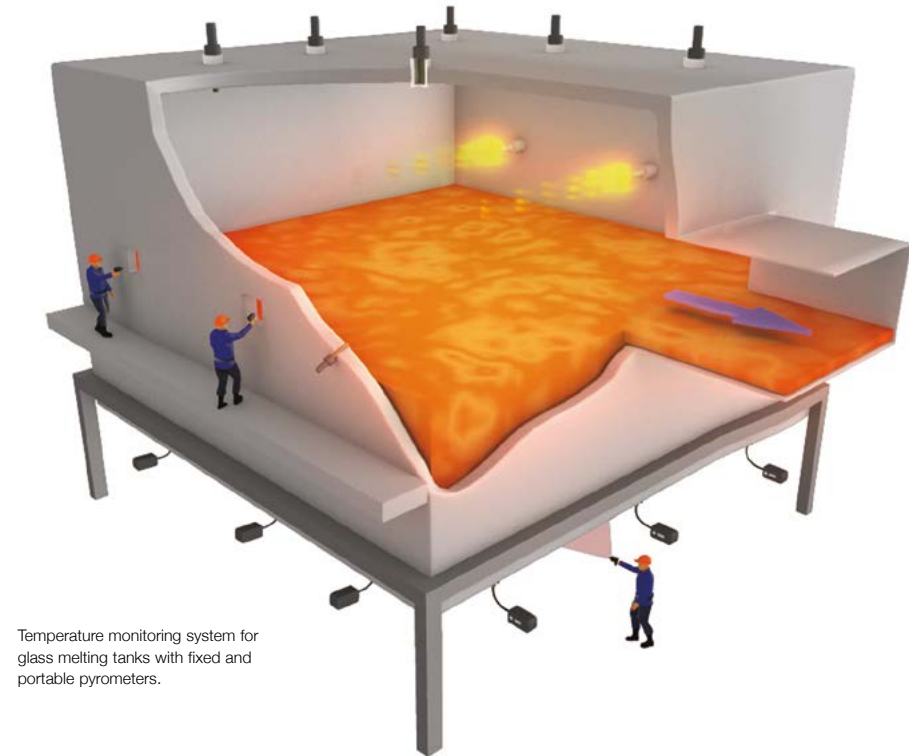
Pyrometers, thermal imagers and SCR power controllers provide effective process control for glass melting furnaces and forehearth. Stefan Schiepe and Kathrin von Rein introduce tailored systems from Advanced Energy Industries for energy-efficient production flow and future-proof furnace operation.

Today's industrial processes require precise measuring systems, especially for applications where high ambient temperatures have a substantial influence on the accuracy and duty cycle of the system components involved. Advanced Energy Industries (AEI), which acquired LumaSense Technologies, Inc. in 2018 to expand its portfolio of photonics-based measurement and monitoring solutions, offers a selection of Impac pyrometers and Mikron thermal imagers to optimally control the glass melting process. In addition, AE's SCR power controllers allow for precise power regulation in electrical heating applications.

This powerful combination enables the user to implement a fully automated measurement and control system for each step of glass production, that meets the requirements of Industry 4.0 standards.

The glass melting tank

An increasing number of furnaces are heated electrically to achieve the perfect process temperatures for an optimal melting performance, while simultaneously reducing unwanted emissions. In order to provide an optimum level of energy for heating, SCR (Silicon Controlled Rectifier) power controllers by AEI are used in



Temperature monitoring system for glass melting tanks with fixed and portable pyrometers.

combination with smaller step transformers for boosting in dynamically controlled processes. AEI's Thyro-Family of SCR power controllers are characterised by a wide range of operating and control modes and have the ability to communicate with various modern fieldbus systems and PLC [programmable logic controller] devices.

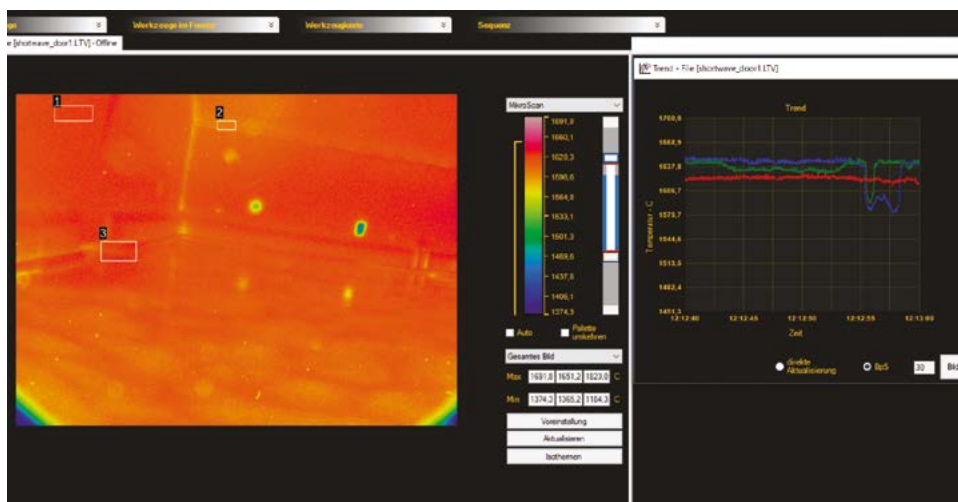
Because of the high temperatures and corrosive molten glass associated with melting furnaces, protecting the expensive bottom refractory from excessive temperature

is essential for longevity. Monitoring the temperatures of the bridge wall and port arch can also provide useful information about the furnace condition.

Temperature measurement is also directly related to glass quality, as well as prolonging the life of critical assets such as refractory walls and the melting tank itself. System solutions involving infrared thermal imagers combined with pyrometers can efficiently help increase production efficiency and reduce waste.

Fixed pyrometer

Advanced Energy designed the Impac IS 50-LO/GL for measurement of glass melting tanks, forehearth and feeder applications. It is a special two-wire digital pyrometer with a fibre optic head and 4–20mA analogue output. The spectral range in the near infrared is especially suited to a fibre optic pyrometer for measurements of molten glass and enables high measurement accuracy. The digital technology of such a pyrometer achieves a repeatability of 0.1%.



Thermal image of melting tank wall temperatures with ROIs via LumaSpec RT control software.

Developed exclusively for glass melting furnaces and feeder areas, the Impac IS 50-LO/GL pyrometer is usually installed in a glass furnace or batch system and uses an optical fibre available in various lengths (standard: 5m, but also 1m, 6m, 10m, 15m, 30m). The optical fibre itself can be fitted with protective tubes made of Inconel or aluminium oxide ceramics, for trouble-free, direct replacement on-site.

By using fibre optics the IS 50-LO/GL pyrometer is able to provide consistently accurate measurement results over many years, without the ageing and drifting phenomena experienced by thermocouples, thus reducing downtime and replacement costs.

An exchange of existing sensors is easy to perform, as the physical dimensions of the pyrometer will match those of the incumbent thermocouple. In addition, the service-life of the sight tubes is considerably prolonged by overpressure inside the measuring tube.

By utilising Advanced Energy's SCR power controllers on electrically preheaters or feeders, very precise temperature control can be achieved, resulting in accurate process control and considerable energy savings.

Portable pyrometer

For measurement comparison and control of the furnace temperature (e.g. burner brick measurement or tank end wall temperatures), portable pyrometers can provide early indications of potential (and expensive) refractory failures. For these applications Advanced Energy provides robust, hand-held pyrometers with through-the-lens sighting for direct readings, high grade optics for detection of contours and ultra-small measuring spots. These portable Impac Series 8 pro pyrometers enable users to store measurement data on-board for easy recall at the touch of a button. The spectral range of the IS 8 pro is chosen to match the stationary pyrometer IS 50-LO. Combined with the IGA 8 pro, which has a slightly longer wavelength, glass mould and refractory temperatures from 250°C can also be measured accurately.

User benefits include flexible inspection capabilities to monitor critical areas and prevent dangerous refractory failures at the melting tank end wall.

Thermal imaging system

Advanced Energy's FurnaceSpection thermal imaging system has been designed and developed for continuous temperature measurement inside high temperature furnaces.

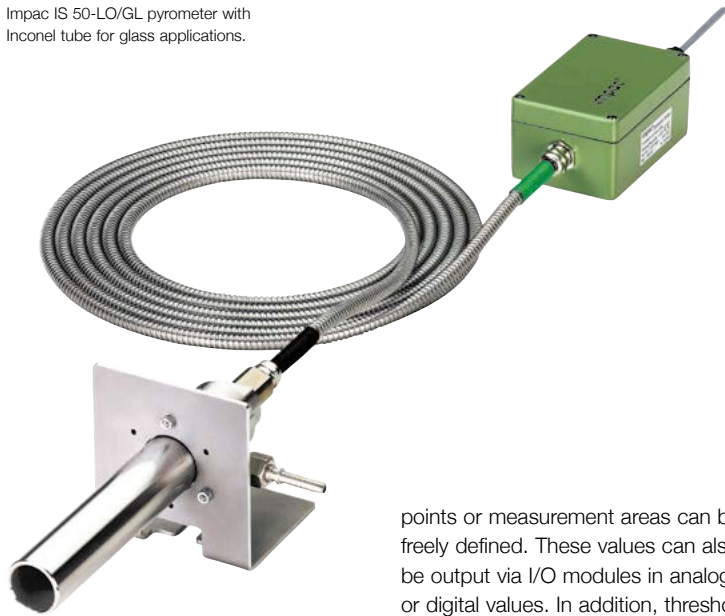
Available in a portable or stationary version, this is a shortwave infrared camera system with a built-in flame filter, which reduces the influence of furnace chamber flame, as well as the CO₂ atmosphere. This system provides users with a real-time tool for quickly and accurately identifying process abnormalities before they develop into problems that can lead to unplanned outages.

The radiometrically calibrated imager accurately measures the temperature of product, refractory and heat transfer surfaces inside natural gas-fired furnaces. The user is also able to monitor the flame condition, thereby reducing the production of NOx pollution, resulting in less environmental impact, while maximising furnace lifetime.

The latest generation of this high-grade thermal imaging system by Advanced Energy is equipped with a Vortex cooler and special borescope optics, which enable monitoring of the temperature distribution inside melting furnaces through the furnace wall, for example. By utilising high quality optics, a resolution of more than 300,000 pixels can be achieved and the borescope lens system is available in a number of different lengths to suit virtually any application and need.

With the addition of special spectral filters, negative influences caused by burner firing can be avoided. Alternatively, a different set-up of the camera with another spectral filter can be implemented, ▶

Impac IS 50-LO/GL pyrometer with Inconel tube for glass applications.



points or measurement areas can be freely defined. These values can also be output via I/O modules in analogue or digital values. In addition, threshold values can be defined by the software.

where the flame image is visible.

Control software for visualisation and closed-loop control enables thermal images to be displayed on a computer screen and viewed with different colour options. Measuring

Process benefits

A significant amount of capital can be lost if a furnace failure goes unnoticed or if the refractory linings are retired too early or too late. With AEI's FurnaceSpection system, multiple

Portable Impac pyrometer Series 8 pro.



FurnaceSpection system, including MCS640 thermal camera heat-protected by a special and very robust housing.



Thyro PX Series Advanced SCR Power Controller.

measuring points on the furnace ceiling, end wall and side wall can be independently monitored by adding measuring regions of interest. The measured values can be used for monitoring and regulation. Furthermore, the batch melting process can be monitored.

By adding temperature limits, which can be defined via the regions of interests, the entire reflow process can be closed loop-controlled using just the FurnaceSpection system. This ultimately reduces the number of individual measurement points, thereby lowering maintenance and replacement costs.

FurnaceSpection helps operators monitor and control process temperature uniformity through streaming images documented by powerful software for analysis and historical trending, outputs to automation and DCS and a real-time web server to broadcast images on the plant's local network.

Conclusion

With the combination of SCR power controllers, infrared temperature measurement instrumentation and control software, Advanced Energy provides a broad range of tailored solutions to efficiently control the heating power of the furnace and accurately monitor the different glass production steps to meet stringent Industry 4.0 standards. The company's tailor-made measurement and control system is designed to enable seamless production flow at minimum energy consumption, while reducing maintenance and installation costs and increasing plant availability for the glass industry. ●

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