

Molybdenum electrode holder design considerations

Grahame Stuart discusses design considerations and selection parameters for molybdenum electrode holders.

Immersed electrode heating systems employing molybdenum electrodes will continue to gain popularity with glassmakers looking for ways to reduce environmental impact or increase melting capacity without the significant costs and engineering of increasing furnace melt area. Much has been written about these systems but the importance of good quality reliable electrode holders is something that can get overlooked and will often determine the success or failure of the entire system.

Electrode holders for molybdenum electrodes provide physical support for the electrode and cooling that prevents glass seepage around the electrode. Many also incorporate a built-in thermocouple to provide an indication of operating temperature. However, their primary purpose and one that is often overlooked is their importance in providing cooling to the molybdenum electrode itself, to prevent oxidation where the electrode surface is not protected by a seal of glass and is exposed to atmosphere.

Oxidation of the electrode can lead to increased local temperature being generated where the electrode diameter becomes 'necked down'. This increase in temperature accelerates oxidation, leading to the eventual failure of the electrode which, if not identified, can lead to rapid refractory wear and possible glass leakage.



Group of 63mm Molycool electrode holders.

Electroglass has developed three ranges of water-cooled electrode holders, designed for use in most glass melting situations and glass types. The company manufactures many hundreds each year for use in its own electric melting and boosting systems and for customers that are looking for holder

design improvements for existing systems provided by themselves or others.

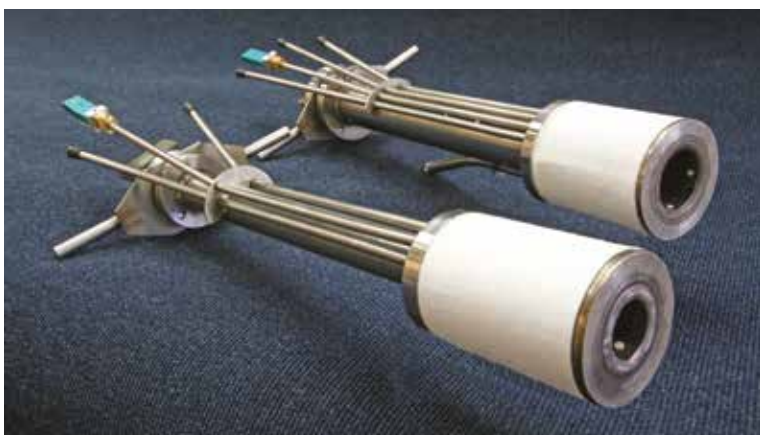
Important points to consider when selecting an electrode holder include:

ELECTRODE ADVANCING

While good design of the electrode system will minimise electrode wear, the oxidising properties of many glass compositions result in electrode wear and the need for periodic advancement of electrodes to compensate. The process of electrode advancing causes some degree of thermal shock on the electrode holder with the stopping and starting of cooling water flow. If the electrode holder is not designed with this in mind, holder life can be reduced.

For glass types in which regular electrode advancement is expected, Electroglass recommends its Vertical Splashguard (VS) range of holders. The VS range is manufactured to suit 50mm (2in), 63mm (2.5in), 76mm (3in) and 102mm (4in) diameter electrodes and features no welds on any of the cooling components. There are no sealed water cooling circuits that could be ruptured by high pressure steam generated when cooling is re-applied following electrode advancing.

The VS range of holders is also recommended for applications where there are concerns about cooling water quality or consistency, as they are extremely resistant >



A 32mm and a 50mm Molycool holder.

to thermal shock and their internal construction means the blockage of cooling ways due to calcium deposits is very unlikely.

ELECTRODE ORIENTATION

Although the majority of electrode holders manufactured annually by Electroglass are destined for vertical installation in the furnace bottom, a significant number are used horizontally in the furnace sidewalls and in risers, refiners and forehearths.

As with the VS range of holders, Electroglass also manufactures a dedicated range of sidewall or horizontal electrode holders. Horizontal Splashguard (HS) holders are manufactured to suit 32mm (1.25in), 50mm (2in), 63mm (2.5in) and 76mm (3in) electrodes and also feature weld-free cooling components, no sealed water cooling circuits and a high level of resistance to thermal shock during water disruptions or following electrode advancing.

Additionally, the HS range features removable cooling ways to allow the cleaning away of any sediment or calcium build-up that may occur.

ENERGY SAVING

While the primary purpose of an electrode holder is protection of the molybdenum from oxidation, water-cooled holders inevitably extract some heat from the furnace, the amount varying by holder design. This energy then has to be replaced to the melting process, increasing the overall operating cost of the furnace.

The high level of heat extraction that can occur with certain electrode holder designs can also generate steep temperature gradients in the electrode refractory blocks, leading to cracking and accelerated refractory wear.

Electroglass electrode holders incorporate insulating design features specifically to minimise the heat extracted from the furnace refractories, helping to reduce energy usage and lessen the temperature gradient through the electrode blocks, meaning a reduced risk of cracking and wear.

The long-established Molycool range of electrode holders, primarily used for vertical electrodes, offers the lowest level of heat extraction from the electrode block through the design of its cooling coils and two-stage thermal insulation. The Molycool range includes holders to suit 32mm (1.25in), 50mm (2in) and 63mm (2.5in) electrodes and again, in common with



Group of 76mm Vertical Splashguard (VS) electrode holders.

all Electroglass holders, features no welds on any of the cooling circuits.

Molycool holders also incorporate an air pre-cooling circuit that allows the use of a small volume of low pressure compressed air initially to cool the electrode holder prior to starting the cooling water flow, helping to reduce thermal shock on the holder's cooling coil.

WATER SYSTEM TYPE

Both the Vertical Splashguard (VS) and Horizontal Splashguard (HS) electrode holder ranges are designed for use with gravity-fed or unsealed water systems and with their water flow returns taken to a holding tank that is situated at a level below the bottom of the electrode holders.

The Molycool range of holders may be used with a gravity-fed or unsealed water system, or with a sealed or fully pumped system.

DISSIMILAR METAL CONTACT

Contact between dissimilar metals in glass can create a DC voltage and galvanic reaction, potentially causing bubbles to be produced in the glass.

These bubbles, typically oxygen, can impact on glass quality but more seriously, can cause oxidation to the molybdenum electrode at the point of generation, leading to electrode failure.

All Electroglass holders include features that prevent dissimilar metal contact, helping to prevent DC voltage generation.

IMPORTANT CHOICES

All of the above are important points to consider when investing in electrode holders and can mean the difference between success and failure of the entire furnace project. With 38 years' experience in electrode holder development and design, Electroglass manufactures all its holders in-house at its own facilities in South East England, ensuring that every holder is produced to the standards required to ensure reliability and long life. ■



Holders under manufacture at the Electroglass in-house holder workshop.

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