Low-E Glass Tempering: Quality and Technology Requirements

Low-emissivity (low-e) glass has been available since the early 1990's. However, only recently have many global manufacturers started promoting these glasses in India. With the advent of low-e glasses along-with solar control properties, or hybrid glasses, such brands are becoming popular in a hot country like India. Leading among these brands are the *Sunergy*^{TM} series from Glaverbel, or the *Eclipse Advantage*^{TM} series from Pilkinton, or the *Ecologic*^{TM} series from Saint Gobain.

Tempering of low-emissivity glasses poses significant challenges, and is quite different from tempering of clear and tinted glasses. Clear and tinted glasses have rather high emissivity levels and absorb heat inside a furnace very well. Until recently tempering of low-e glasses was done in a similar manner as for clear & tinted glasses. The standard workhorse was the radiation type furnace, much like the electric rod heater in the room. Low-e glasses are designed to reflect heat and by design do not absorb radiation heat inside the furnace evenly. This creates several quality problems like:

1. Bending in glass
2. Distortion
3. Lower strength & uneven fragmentation

Low distortion
forced-convection tempering

High distortion
radiation tempering

The latest advance for tempering low-e glass, has been the advent of the **Forced-convection** tempering furnace. In a forced -convection furnace glass is heated indirectly through hot air-jets in addition to radiation. Heat-exchange inside the convection furnace is through hot air rather than only radiation, which is reflected by the low-e coating on glass. Just like a fan and an air-conditioner cool the room more evenly and faster, forced convection heating is far more even, addressing most of the quality issues above.

Can low-e and other reflective Glasses be tempered on the ordinary radiation furnace?

Tempering Low-e and other reflective glass can be done on radiation furnaces. However, the heating of the glass is extremely slow because these glasses reflect majority of the radiation, and only absorb heat very-very slowly. In such cases, glass spends a lot of time oscillating on rollers in its softened state (600-675°C) waiting to reach its desired temperature for tempering. This results is significantly more roller-wave distortion in the glass.

In forced convection heating, majority of the heating is done through the exchange of heat between the hot air molecules and the glass. Consequently the heating is much faster and glass spends less time in its softened state on the rollers, resulting in much lower distortion.

Disadvantages of Forced Convection

There are three negatives of forced convection tempering. First, it is difficult to control the convection currents inside the furnace and requires proper design in the equipment and operator skill. Secondly, forced convection tempering consumes about 10% more electricity due to indirect heating through air-jets. Additionally, forced convection machines are also more expensive to buy as well as maintain.

Attached you will find, 4 technical papers discussing the topic of Low-e glass tempering to provide you with a technical perspective on why it is important to specify the type of tempering, in addition to merely requiring, “toughened glass” for your low-e glass requirements.

(AIS Glass Solutions Limited)

Attachments:

1. Low-e glass tempering, by Jorma Vitkala, 1997
2. Low-e Tempering- The latest results, Jorma Vitkala, 1999
3. Technology for Low-E tempering, Eero Jalkanen, 2002
4. Connection between Glass Quality and the Convection Furnace, R. Karvinen, 1997