Top quality tempering furnaces

A tempering furnace that uses 35 per cent less energy, does not make roller waves, and guarantees low-E / soft coating glass tempering. This is the new Ianua tempering furnace built for US-based North Western Industries. This article takes an in-depth look at the main features of this furnace and what it can do.

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General view of furnace 1 and 2

HTM/2 - view from the loading section

In 1996, Ianua launched a new tempering system, called *Convair*, in which the concepts of controllable irradiation and convection heating are combined in the same heating chamber, to offer many advantages over conventional toughening processes. Since then, a number of single chamber furnaces have been successfully installed. Most recently, in response to the request of *North Western Industries Inc.*, a company belonging to Japanese *Central Glass Group*, Ianua has developed a double chamber tempering furnace that not only doubles capacity, but also improves efficiency.

DEVELOPMENT

The general manager of North Western Industries, Darrell Aldrich, was looking for a high-capacity tempering furnace, capable of producing a top quality end product and of reducing energy consumption. Ianua's answer to these requirements is the *HTM 218x460/2*, a tempering furnace with a maximum loading area of 2,180 x 4,600 millimetres. Minimum glass size is 80 x 245 millimetres and thickness ranges from 3 to 19 millimetres.

In traditional radiation or gas-fired furnaces, a heating speed of about 40 seconds for each millimetre of glass thickness is reached by maintaining a furnace temperature of between 700 and 720°C, leading to a high temperature in the ceramic rollers. For this reason, when a sheet of cold glass enters the furnace, the overheating and expansion of the lower surface gives rise to upward curvature of the edges of the glass.

HTM/2 - view from the unloading section

In this case, the glass moves inside the furnace, only touching the rollers along a relatively narrow central strip. This causes damage to the glass surface and produces the so-called "white line" effect that can be seen in the middle of the glass sheet. Different steps can be taken to prevent this: by using a heating balance, where heated compressed air can be blown onto the upper surface of the glass in order to equalize the heat transfer; by increasing temperature setting of top heaters; or by reducing the distance between the glass and the upper resistor. However, there are still many problems with the optical quality of the glass in existing toughening systems, especially with coated glass. The combination of irradiation and convection heating in Ianua's patented Convair system is, the company claims, the solution to these problems.

CONVAIR HTM

Convair's double chamber tempering machine is composed as follows: loading table, furnace No. 1, furnace No. 2, quenching unit, cooling unit and the unloading table. Both the loading and unloading tables are equipped with a lifting system, which helps the operator when large loads are to be positioned. The loading length is automatically read by sensors, located at the end of the loading table, and this information is used to calculate the speed and number of the oscillations of the glass load, from end to end of the furnace, ensuring that the glass receives extremely uniform heating. The loading table can also receive the glass from a washing machine, as happens in the North Western Industries installation.

Furnaces No. 1 and No. 2, are identical chambers, where the irradiation effect is com-

bined with convection heating. The irradiation is produced by traditional, individually controlled electric heaters, through radiation plates installed in a longitudinal mode in narrow sections, while the forced convection is obtained by air blowing through the resistors with nozzles in the radiation plates. The hot air is taken from the furnace and blown on the glass surface by electrically driven hot resistant blowers. The bottom part of the furnace is equipped with the same number of electrically controllable heaters but, in this case, the hot air is only blown through the heaters and nozzle blocks.

With this arrangement, says Ianua, it is possible to add a particular profile for top and bottom heaters to ensure the most uniform heat distribution on the glass load at any moment of the heating period. This profile is especially used in case of large glass panes, cut-outs, notches and holes, in order to increase the yield remarkably. Moreover, using the separate convection heating system, top and bottom glass surfaces can be maintained at the same temperature, avoiding any kind of distortions. The speed sequence of the hot air blowers must be created manually only during the first cycle. When necessary, it is reloaded to be used for a complete automatic cycle.

HEATING AND COOLING

According to Ianua, the Convair heating system has dramatically shortened the heating time to 28 seconds per millimetre of glass (a reduction of 30 per cent if compared with standard irradiation furnaces), still maintaining the furnace temperature at 680°C (5.6 per cent less with reference to standard furnaces). These figures show that energy saving is one of the most important features of this furnace. In the double chamber, the heating period is ideally split into two parts, each one to be carried out inside the relative chamber of the furnace. When heating time has elapsed, the glass load in furnace No. 2 leaves the furnace and is transported to the quenching section where the correct tempering pressure has been set by tempering blowers activated by a frequency converter (an optional used in this specific plant). At the end of the tempering phase, the glass is transferred to the cooling section. When glass temperature reaches the specified set value, cooling time is over and the glass is carried out to the unloading table.

The software control of the entire system is very complicated because, in comparison with single chamber furnaces, it must automatically manage a large number of possible variables present in the different parts of the installation. These are long or short loads, thinner or thicker glass, different types of glass (clear, coloured, coated).

HARDWARE AND SOFTWARE

All the hardware and software is from Allen Bradley, and the company's experts have approved the entire project. Theoretically, it is possible to divide the complete control system into four parts, all connected in a single network. The first part is the motion, which is operated by eight axes, all controlled with great accuracy of position and speed by two Allen Bradley axes controllers, which ensure precision in the application of the movement parameters.

The second part refers to the hot part of the system and includes both the resistors and the hot air blowers. The third part is a PC through which the operator can set all parameters, manage the memorized data and monitor all process variables, taking care of the devices connected within the network. The fourth part consists of two pulpits, one positioned along the loading table and the second at the beginning of the quench section.

In this same section, there is also a touch screen, by which the operator can follow all process variables and create or correct the hot air blower sequence.

The expected production per hour for this double chamber tempering plant is (supposing 100 per cent of loading efficiency):

- 645 for 3 millimetres;
- 564 for 4 millimetres; and
- 297 for 8 millimetres. ■

Information Service no. 112

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