Float glass annealing innovation

Thorsten Seidel presents his company's latest annealing equipment developments for the float glass sector.

Looking at float glass manufacturing technology, it is clear that minimal innovation has been made in dross box design for many years. In response to industry requests, Pennekamp has studied current technology over a period of several years and engineered some developments that make the process safer and more operator friendly, while also improving quality levels based on optimised temperature control and glass transportation systems.

The aim was to look at the lehr as a crucial part of the float glass manufacturing process, keeping in mind that any changes to existing processes should be technically comprehended by users. Therefore, the steps achieved had to be introduced with considerable care.

INDIVIDUAL DRIVES

One of the first process elements investigated and modified saw the introduction of individual roller drive systems. In Pennekamp's opinion, this system was required to eliminate the main shaft with its open oil pans which are still in widespread use, despite the availability of more advanced drive systems and components.

In existing drive mechanisms, technological disadvantages include the fixed driving speed of all rollers, even under known conditions that the glass ribbon shrinks as it cools. Classically used stainless steel rollers have a significantly higher thermal expansion than soda lime glass, exacerbating the problem further. In fact, in the case of stainless steel, the roller speed difference from charge to discharge end is 1%. Based on glass composition and the thermal expansion rate of glass, the >

Discharge table.

requirements can readily be calculated. This results in a relative movement of the glass to the roller itself and therefore, in the likely creation of surface scratches.

Although there is no way of compensating for this effect on traditional production lines, it can be minimised by use of a lubricant, involving the introduction of sulphur, with all of its disadvantages in terms of cost and environmental issues. In addition, it sticks to the stainless steel roller, thereby providing a secondary production problem, namely material build up. This requires the rollers to be cleaned, requiring the manufacturing process to be interrupted.

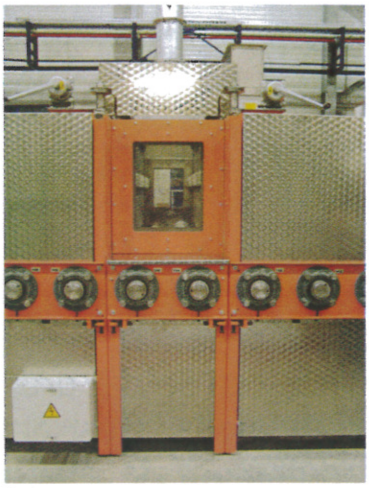
Float line tests have demonstrated the effects of roller speed differences by creating a cross breakage, resulting in a wide gap between ribbon ends at the discharge end of the lehr. By operating each roller individually and the possibility of programming the offset between roller groups, the gap has been removed, along with the relative movement between glass and roller.

Furthermore, individual operation of each roller minimises the possibility of major stoppages and therefore, roller damage. In addition, it was desirable to make the system more fail-safe by introducing overhead electrical backup and automatic switchover.

CERAMIC ROLLER OPTION

The use of ceramic rollers has also been discussed with operators, against the background that secondary processors, as well as several float glass manufacturers, already operate rollers made from this material. Positive results have been realised for more than a decade, making Pennekamp's introduction of ceramic rollers much easier.

Non-drive side.


E-zone.

When evaluating their advantages, it is important to emphasise that silica-based rollers are much harder and tougher compared to 'soft' stainless steel. Roller breakages have not been evident in the majority of installations, although one such incident was recorded, the result of the roller support driving itself, creating a torsion stress. However, even such an unlikely case can be overcome by applying the correct design and individual drive system.

To answer a question that readers may be asking themselves at this point, consider the mechanical strength of ceramic materials, as well as the minimal (almost zero) thermal expansion, resistance to much higher temperatures than during the annealing process and importantly, the non-conductivity of the heat to the outside (and vice versa). According to Pennekamp's research, thermal conductivity is one of the key issues for using such high capacities of edge heating over the entire length of A, B and C zones.

Although this effect and the possible minimisation of energy consumption do not require a scientific team to be assembled, it is helpful to make a closer examination of the temperatures emitted to the environment due to the use of stainless steel rollers.

TEMPERATURE CONTROL

In terms of the temperature control itself, Pennekamp closely monitored the requirements and needs of the glassmaker to find the room for optimisation. One of the major negative factors was the effect of changes in the annealing curve due to draught changes within the building itself. Another issue requested by operators was the repeatability of process temperatures and conditions, as well as heat/cool flexibility over the entire length of the tunnel. Therefore, Pennekamp introduced a combination of infrared scanning temperature measuring, together with the use of thermocouples. The correct combination of these two principles demonstrated improved repeatability and control of the annealing curve.

The avoidance of external influences (factory draught) is achieved by the consequent minimisation of bottom, sidewall and roof lining leakages on the annealing lehr itself, as well as structured inside pressure control and monitoring. Such 'air in' leakages can only be resisted by excessive loads of unnecessary electrical heating.

With regard to process flexibility, Pennekamp has evaluated previous designs and their restrictions, which are due mainly to the clear dedication of zones (sections) to a specific purpose only, for example heating, fine cooling or mass cooling. In addition, the design length of individual zones (sections) reduces flexibility to a minimum. Therefore, Pennekamp followed its basic design criteria of having zone lengths of 2.25m each, which also makes transport cheaper and easier. This reduced zone length also results in an increased number of control zones (improved accuracy), when maintaining the overall tunnel length. There is no basic dedication of each zone to a function, rather 'flexibility'.

Every tunnel zone is equipped with eight side inlet openings, four on each side, two above the roller and two below. The design, space and internal supports are identical, allowing the insertion of heaters, indirect coolers, semi-indirect coolers and direct coolers. This design refers to zones A to C in the classic concept. Each of these eight positions can be 'loaded' by the components mentioned above or kept as a 'dummy' position, according to temperature (annealing) curve requirements. Due to this novel design, future changes are easily possible in the case of production changes and at minimal effort.

Edge heaters are still required, even when using ceramic rollers, to compensate the edge thickness and therefore, heat demands. However, the Pennekamp edge heater design does not require mechanical repositioning for different ribbon widths but executes this job by use of the electric/electronic power distribution shifting over the cross width.

These improvements are just some of the developments employed in the Pennekamp float glass lehr. They are proven technology and far beyond the realms of fairytales. ■

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