Energy consumption during float glass annealing

Hans Strauven* explains how to reduce energy consumption during the float glass production process.

A classical lehr for a 600TPD float glass line may consume about 10 kWh/T electricity or 25 kWh/T primary energy.

A typical float glass line consumes about 7500 MJ/T of primary energy. As a consequence, a float glass lehr contributes to only 0.33% of energy used to produce float glass.

But, when the price of electricity is 0.1€/kWh, a 600TPD lehr consumes in one campaign of 17 years €3.7 million of electricity, which is of the order of the investment in the lehr.

In the following, the energy consumption of the float lehr in the different parts of the temperature curve is explained.

It is demonstrated how this energy consumption can be halved and even eliminated by extending the investment.

Typical soda lime glass enters the lehr at 600°C and is cooled to 400°C in an insulated tunnel (zone A, B1, B2 and C). The heat in these zones is extracted with air-cooled heat exchangers.

These heat exchangers are fabricated in stainless steel due to the high temperature and SO2 atmosphere in the lehr.

In that way, they reflect a large part of the energy, radiated by the glass because stainless steel has a low emissivity.

This effect was always partially compensated by working with an array of tubes to promote internal reflections. In other words, the apparent emissivity was increased in a geometric way, which requires a much larger air flow.

Emisshield

A ceramic high emissivity coating called Emisshield is applied on the stainless steel heat exchangers to eliminate the reflection and improve the efficiency.

Fig 1 shows that by applying Emisshield on the heat exchanger of zone A reduces the energy consumption by 0.3kWh/T, while the lehr without improvements (classic type) consumes 8.5kWh/T of energy.

Below 400°C, a forced convection to cool the glass is used, with hot air in the RET-zones and ambient air in the F-zone. The simplest way to reduce the energy consumption is to lengthen the forced convection zones.

Doubling the length of the forced convection zones (RET, F) and so increasing the length of the lehr from 123 to 165m brings the energy consumption down to 2.2kWh/T or a gain of 74%.

However, this involves an important extra investment in steel construction, rollers and building. Nevertheless, lengthening in some cases will makes sense, depending on future energy prices.

A study of the pressure drop in the forced convection zones allowed improving the energy consumption from 8.5kWh/T to 5.9kWh/T.

Larger ducts, changing the direction of the flow with curves, optimised distributors and nozzles are the basic ingredients of these improvements, involving a lot of steel work labour, extra engineering and a minor extra use of steel.

On top of that, by using direct drive fans with inverters, an extra improvement down to 4.8kWh/T is possible.

Together, an improvement of 43% without increasing the length of the lehr by thinking, calculations and extra labour was obtained.

Ambient temperature

Another improvement is to lower the ambient temperature. Today, the F zones on the glass is blown in with (warm) inside air.

In case outside air is used and filters to clean this air are invested in, the efficiency of the cooling process is improved.

Lowering the air temperature by only

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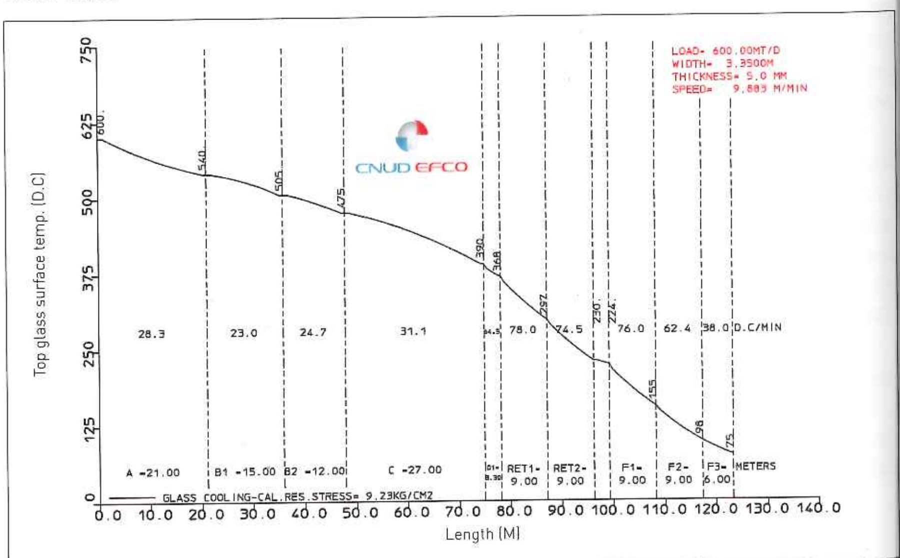

Fig 1. Typical 600TPD float glass lehr curve.

: in the F-zones lowers the energy consumption from 8.5 7.7kWh/T or 9%. Depending on season and continent, an bient temperature decrease of up to 20°C is possible or about % less energy consumption. Today, a lehr simulator allows the tomer to predict the influence of the ambient temperature the consumption.

A future improvement will be the use of the extracted heat in e process instead of emitting in the air. For the lehr in ***Fig 1*** zone A , B,C and RET, about 2966kW heat is extracted from e glass.

Converting this heat into electricity with only 10% efficiency uld generate about 300kW while in the optimised case, the r in ***Fig 1*** consumes only 120kW. Instead of consuming ergy, a lehr should generate electricity, used in other parts of e process.

Converting low temperature heat into electricity is typically ne with the Organic Rankine Cycle. While the standard nkine cycle works with water and needs at least 600°C heat, a v boiling point (organic) liquid is used.

However, 10% efficiency can only be reached by extracting the at with water (or thermal oil) cooled heat exchangers inserted o the lehr. Today, glass manufacturers don't like piping with uids in their lehr due to the 17 years-long campaign.

irling system

r that reason, a lot is expected from the future Stirling motors. e system works with hot air without any liquid in the lehr, ly cooling the heat sink of the Stirling motor may involve ter.

Inserting this system into the exhaust of the fans in zone A, and C and directly into the RET would be an elegant energy cuperation system.

The current state of technology allows already working th a lehr, which generates electricity instead of consuming ectricity. However, a combined Capex/Opex approach is quired to leave our easy way of consuming (still cheap) energy th a minimum of Capex.

But primary energy consumption during the production of at glass will be improved by 0.5% thanks to efforts with the at glass lehr. ■

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