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Energy savings in lehr operation

Thorsten Seidel describes a recently developed proportional burner technology for annealing and decorating lehrs, featuring highly heat-resistant porous ceramic and the latest in efficient pre-mix technology.

The cost of energy is a constant driving force in glass container manufacture, not only for environmental reasons but also in terms of continuously rising manufacturing costs. This includes the electrical efficiency of fans, motors and drives on production lines and specifically within annealing and decorating lehrs. Electrically, many modern technologies have been implemented and become state-of-the-art. However, heating within modern annealing and decorating lehrs is executed in Europe and most other parts of the world by the use of natural gas or even more expensive LPG.

Basically, annealing lehrs should require no heating if glass forming/ manufacturing temperatures, lehr curves and operations are carefully controlled according to requirements and physical restrictions. This means that forcing a temperature curve due to a wrongly designed lehr and process will result in higher energy consumption. Modern technologies such as automatic temperature controls throughout the lehr and fully automatic drift control have assisted usage reductions.

In terms of gas burner efficiency, many promises have been made in the past but very few have resulted in actual energy savings. Simply replacing the gas burners on any lehr type does not do much but may increase problems if the lehr is not designed for such a unit. Consequently, Pennekamp has gone a step further by redesigning the entire 'package' by looking at the following process criteria:

- Proportional heating with high flexibility.
- Proportional cooling (temperature control in both directions from setpoint).
- The minimisation of hot spots (possible temperature inhomogeneities within the lehr).
- Decreasing the inner lehr (zone) volume (height minimisation).
- Solving possible space constraints (top-mounted burner).
- Overall temperature control (not only individually per zone).
- Sensible use of material quality, thickness and weight reductions (inner structure).

One of the key factors was and still is the heating device, specifically the gas burner. Tests over the past three years have proved the latest technology to be useful and ready for the market. Proportional heating has already been used within annealing and decorating lehrs but even so, many users tend to stick with known methods and avoid innovative technologies. Proportional heating is good but requires a high flexibility within its capacity. Pennekamp's BLEU design provides such a capacity range of 1:12, with capacities from 20 to 200 (240kW).

TECHNOLOGY FOCUS

Pennekamp's Burner Low Emission Unit (BLEU) is not just words but represents a different direction in economic gas heating, having been specially designed for the annealing and decorating process. This innovative, in-house manufactured gas burner has received approval from the German TÜV and strictly follows EN 746-2 norms. The working principle is to premix gas/air at the exact ratio to ensure perfect combustion at any capacity within its working range. The speed-controlled combustion blower (up to 10,000rpm) will monitor and add the exact required >

Energy saving opportunities.

The BLEU system in operation.

gas quantity by use of the zero pressure gas controller. In addition, it will monitor the pressure differences (over pressure) within the lehr and compensate for it. The premixed gas/ air will be guided into the distributor channel and onwards to the porous ceramic block.

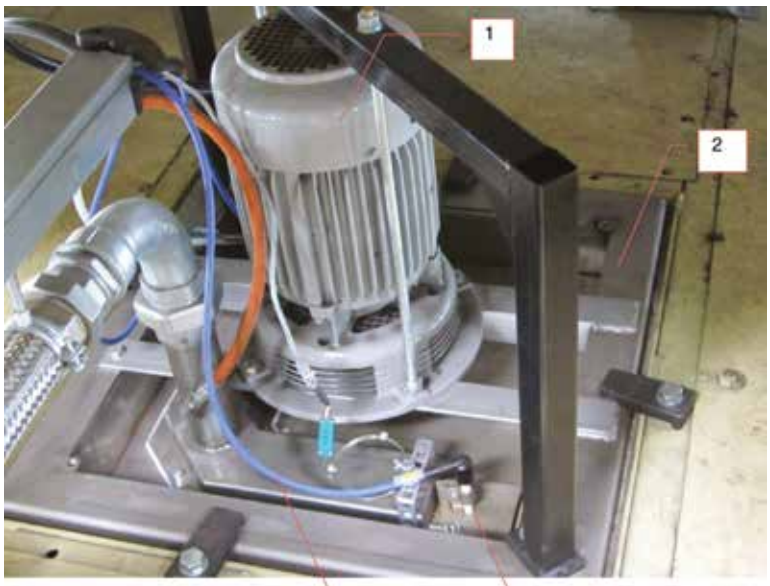
By using such technology, the actual combustion will take place on a wider surface, directly above the air circulation fan wheel. It is designed as a double bladed fan wheel; the lower part takes the internal air and the upper the combustion gases from the burner. Both air streams are mixed prior to contact with the glass itself. All specific safety requirements and features according to relevant regulations such as pressure monitoring, temperature monitoring, gas pressure reduction, gas/air mixture, ignition and ionisation (flame monitoring) lead together within the licensed firing controller.

The actual heating demand may come either from the individual temperature controller or from the lehr PLC to react to the precise needs of the specific zone. During all conditions within working range, the burner will adapt to the needs and requirements of the process. Accurate temperature control is provided during normal operating conditions. At capacities below the above-mentioned 20kW, the burner will shut down and await the next heating demand.

Furthermore, a specialty of Pennekamp's BLEU design is the possibility of proportional cooling. In instances where the temperature within any zone is still rising after the burner shuts off, or due to the glass load entering, the combustion blower will speed up and provide the required amount of cooling air into the air circulation system. This results in accurate temperature control in either direction from setpoint (high and low).

The design of integration of the burner within the air circulation fan allows the removal (non use) of burner tubes or open flames, which traditionally resulted in visible hot spots. Furthermore, the installation of such burners on top of the lehr saves a space of approximately 800mm, as no equipment is installed on either side. Directly connected to it, therefore, this is the possibility to manufacture the lehr at the lower height by approximately 160mm. Such reductions minimise the inner volume and therefore the heat requirement to maintain the temperature of the process room.

In addition, Pennekamp's process control systems (either individual controller or PLCs) are designed to overlook the entire lehr and not each zone individually.



BLEU system components (burner unit).

System components (control and supply unit). Key: (1) Fan motor with fan wheel inside oven; (2) Burner housing with burner head; (3) Reversed side of the burner; (4) Electrode for flame control; (5) Gas/ air mixing system with air collector; (6) Air filter; (7) Gas firing controller; (8) Gas multi-block; (9) Gas supply.

According to process priorities, special functions are implemented to minimise the possibility of zones 'fighting' each other and controlling internal air flows for energy usage optimisation.

Last but not least, the careful use of materials and thickness should be noted. The less material involved, the less heat is required to maintain its temperature. Structural strength is applied by design/knowhow and not simply by material thickness.

ENERGY SAVING

The potential for energy saving relates to the burner and the previously mentioned criteria. The burner technology alone provides significant energy savings in the range of 25% to 30%, due to the following fetures:

- Accurate gas/air mix ratio (stable λ lamda value) at any capacity (no oversupply of (cold) air as usually required).
- Proportional heating operation principle (avoidance of purging cycles).
- No carbon particles created, even in the case of contaminated filters (dust and dirt prevention).

One of Pennekamp's other key objectives has been to make the BLEU system individually exchangeable and usable with existing lehrs. Upgrades and modernisations of Pennekamp lehrs are therefore possible at any time. ■

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