GLASS MELTING

TECHNOLOGY

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HORN
GLASS INDUSTRIES

GLASS MELTING TECHNOLOGY

HORN Glass Industries AG is a glass melting technology specialist who supplies the float and container glass industry with high quality: from individual products to turn-key plants. The high performance glass melting furnaces and turn-key plants are planned, built and delivered to glass manufacturers all over the world and are used in the production of beverage bottles, food containers, drinking glasses, window panes, automotive glass, glass tubes, glass fibres or special glass.

With more than 130 years of expertise in the construction of glass melting furnaces HORN is well known as a specialist and expert in the glass industry. Over the years, HORN has extended its capabilities and expertise and has grown from being a glass melting furnace manufacturer into an industry leader in technological plants.

The group has also grown considerably, adding subsidiary companies in China, Malaysia, India, Croatia, Ukraine and the Czech Republic, adding value such as proximity and short response time for global customers. Almost 80% of the products are exported from the HORN headquarters in Ploessberg (located in the Bavarian Upper Palatinate, Germany) to more than 75 countries worldwide.

At all times, HORN offers its customers full support and a helping hand. Due to a very high level of vertical integration of all products, HORN offers tailor-made solutions and, at the same time, has ventured into new areas, e.g. in the construction of proprietary tin baths and related equipment. HORN manufactures a wide range of products in its own workshop in Ploessberg and is the service provider for the realization of customer visions and projects in the field of glass production. HORN supports its customers from the first draft through the implementation process to permanent production support on site.

HORN builds a wide variety of glass furnace types for its clients, ranging from the usual end-fired furnace to the fully electric melting furnace. The selection of your furnace depends on your individual customer requirements and demands.

Depending on glass quality, furnace capacity, raw material specifications and glass type, each furnace is customized and optimally designed in compliance with the requirements of the glass industry. HORN's knowhow and experience of many years concerning energy consumption and emissions are also reflected in the design of all melting furnace components.

Important factors for selecting a melting furnace concept can be:

- The existing floor space in the melting furnace building
- New construction or replacement of a melting furnace already in place
- Melting capacity, glass colour, product type, requirements concerning the glass quality, etc.
- Medium for firing of the furnace, such as natural gas, oil, LPG and the possibility of useing oxygen, for example
- Environmental requirements or other legal requirements

However, the basic structure of all furnaces is the same. A framework consisting of steel supports is manufactured to brace refractory bricks. The refractory material is adapted to the respective local temperatures, structural stability and corrosion stress caused by media in the different sections of the furnace. Our experience of several decades with regard to selecting premium quality refractories corroborates the quality of our design.

When the furnace is heated up (tempered), the refractories expand and all expansion joints close. For this purpose bracing elements at the steel structure around the refractory bricks have to be loosened or tightened in different places. Thereupon the melting end is ready for the liquid glass.

Due to continuous operation the melt in the furnace can be conditioned with maximum precision, i.e. locally and timewise.

The individual stages of the glass melting process within the melting furnace need to merge in the most optimal technical way, only then it is possible to achieve optimum results.

Possible heating methods
Natural gas
LPG
Biogas
Light oil or heavy oil
Fully electric
Oxyfuel

Equipment to boost melting
Barrier boosting
Melt boosting
Throat boosting
Bubbling system
Oxyboosting
Batch/cullet preheater

CROSS-FIRED FURNACE

In comparisson to other furnaces the cross fired furnace can be designed in larger overall dimensions, due to a non restrictable flame lenght of the lateral burner arrangement.

General

Similar to the end-fired furnace the regenerative cross-fired furnace ensures low energy consumption and high flexibility with regard to load change.

The energy consumption of a cross-fired furnace is usually higher than that of an end-fired furnace.

However, this furnace type can, compared with the end-fired furnace, be built with larger melting surfaces because of the lateral arrangement of the burners. Therefore the cross-fired furnace is normally used for furnaces with high capacity or in case the existing building does not allow an end-fired furnace.

Description

The regenerators, port necks and burners are positioned laterally. A separate chamber together with a slide at the flue gas channel can be designed for each port neck. This ensures precise control of the furnace temperature over the entire length of the melting furnace. Mostly the flue gas from one port neck or even from all port necks is discharged via one chamber.

The regenerator chambers can be equipped with different checker types and qualities. This facilitates the implementation of a furnace suitable for the raw materials used, with a long life and achieving the perfect melting process. A wall built into the bottom of the melting end, which is also called barrier, and a deepened refining end increase the flexibility and glass quality.

Features

- High furnace capacity up to 750 tpd
- Easily adjustable temperature profile over the entire furnace length
- Low energy consumption
- Low emission values
- High flexibility in case of load change
- High specific melting output
- Long life

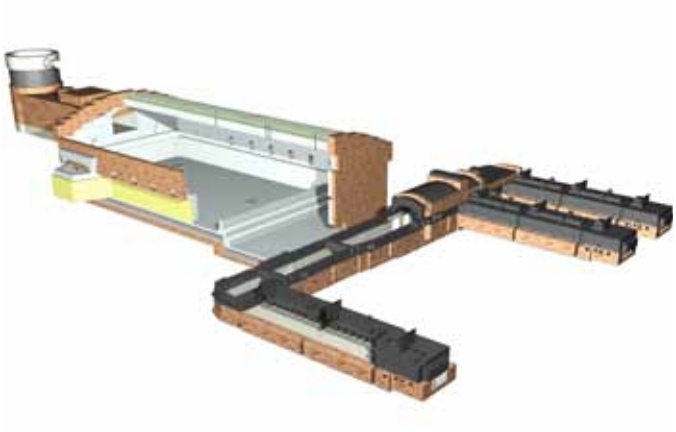
MELTING FURNACE WITH RECUPERATIVE HEATING

General

Large recuperators are usually designed as tube bundle recuperators. Here the combustion air flows through individual tubes (tube bundle) which run in a flue gas channel lined with refractories. In general the tube bundle recuperators are more robust, but also more expensive. The air preheating output of recuperators is far below the output of regenerators. That is why the energy consumption of a furnace with recuperators is relatively high. An advantage, however, is the continuous preheating of the air, so there are no failure times with regard to combustion. The stable operation leads to higher quality. Since preheating occurs with total separation of combustion air and flue gas, the combustion air is very clean, being also advantageous for glass quality

Description

For this furnace type air casing burners specially developed by HORN are used. These burners ensure even distribution of the combustion air around the burner lances. The furnace can be designed as cross-fired or as end-fired furnace. In case of the end-fired system the flue gas outlet opening is positioned above or next to the burners in order to achieve a flame shaped as a standing or lying "U". In case of the cross-fired system the flue gas outlet opening can be positioned either on the front wall or on the side wall. In general recuperative furnaces are used for a melting output of 4 – 60 tpd, in some cases also for up to 450 tpd. The typical features of this furnace type are the low melting surface load and the low investment costs.



Features

- Stable combustion, since there is no fire reversing as with regenerative furnaces
- Easily adjustable temperature profile over the furnace length (for cross-fired furnaces)
- Lower NOx emission than with regenerative furnaces
- Lower investment costs
- Less floor space required
- High flexibility during load change
- Long life

FLOAT GLASS FURNACE

General

Float glass furnaces are the largest type, both with regard to dimensions and to the overall melting output. These furnaces are close to the limit of constructive possibilities.

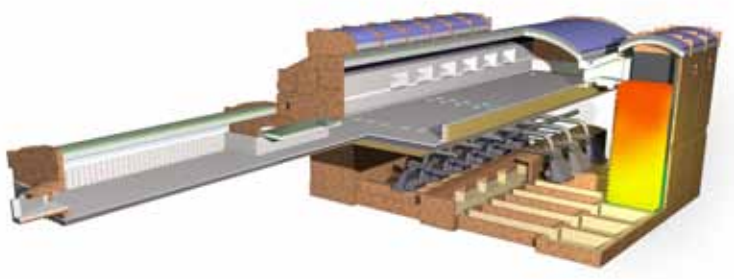
Float glass furnaces are especially designed for the production of soda lime glass. The requirements concerning glass quality are much stricter and differ those for container glass.

Description

Float glass furnaces are usually cross-fired furnaces. The regenerators, port necks and burners are arranged laterally. For each port neck there is a separate regenerator chamber together with a slide at the flue gas channel. This allows precise control of the furnace temperature over the entire length of the melting furnace.

Float glass furnaces are constructed as open furnaces. A clear separation of the hot melting end and refining end and of the working end is not possible. This would lead to optical defects in the glass. Since the throat does not exist, the working end is very large.

The adequate furnace insulation and flow profile of the combustion air as well as efficient preheating of the combustion air allow the operation of the furnace with maximum fuel efficiency and negligible pollutant emissions. The furnace size is designed in such a way that it produces top-quality glass with the lowest possible energy consumption.



Features

- High furnace capacity up to 1200 tpd
- For high-quality glasses used as architectural glass or in the automotive industry
- Low energy consumption
- Low emission values

OXYFUEL FURNACE

General

Oxyfuel furnaces are usually designed as cross-fired melting furnaces where the fuel used (mostly natural gas) is combusted together with oxygen. The greatest advantage is in the low energy consumption, since little nitrogen is used for combustion. Compared with a cross-fired or end-fired furnace the energy consumption of an oxyfuel furnace is reduced by approx. 5 - 10 %, compared with a recuperative furnace the reduction in energy consumption is even 25 - 40 %.

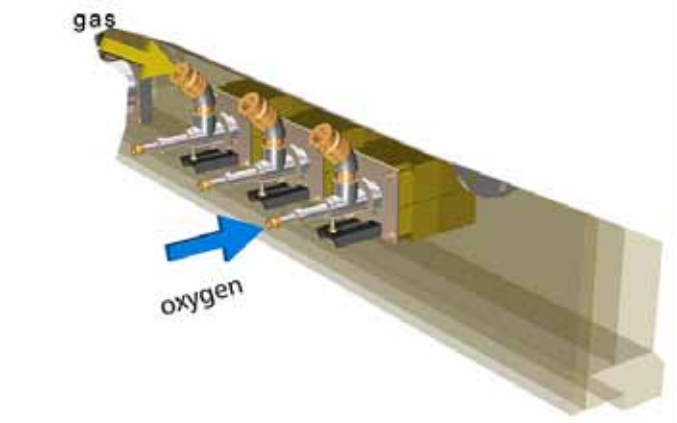
Features

- Low investment costs for flue gas equipment due to low flue gas volume
- Low energy consumption
- Higher melting surface load
- Reduced NOx emission
- High glass quality
- Low investment costs for refractories (and later lower costs for disposal thereof, i.e. lower service costs for construction)
- Stable combustion, since , in contrast to regenerative furnaces, there is no fire reversing
- Easily adjustable temperature profile due to lateral arrangement of burners

Description

HORN oxyfuel furnaces are specially designed for the particular characteristics of firing a furnace with fuel and oxygen. Especially the reduced flue gas volume requires a modification of the superstructure design. If flat flame burners are used, the arch has to be kept relatively low, otherwise it will become too cold and this will lead to burnouts.

Cold spots would lead to damages due to the infiltration of alkalis which cause burnouts in the arch, thus leading to reduced furnace life. To avoid such problems the HORN oxyfuel furnaces are therefore adequately insulated and sealed. In general oxyfuel furnaces are used for a melting output of 50 - 400 tpd, in some special cases for up to 500 tpd.



END-FIRED FURNACE

General

Due to its high flexibility and its low energy consumption the regenerative end-fired furnace is the furnace type most frequently used for nearly all glass types. Its melting capacity is 30 - 500 tpd, in some cases up to 700 tpd can be achieved.

Description

If sufficiently dimensioned, the regenerators effect heat recovery of the melting end firing and thus ensure a reduction of energy consumption of the glass melting process.

A wall built into the bottom of the melting end, also called barrier, and a deepened refining end increase flexibility and glass quality.

The wall increases the convection in the glass bath which improves melting. Additional electric boosting improves furnace flexibility and is advantageous in case of colored glass production.

Features

- Low energy consumption
- Low emission values
- High flexibility in case of load change
- High specific melting output
- Long life

FULLY ELECTRIC FURNACE

General

In general fully electric furnaces with a cold top are used for a production range of 5 - 50 tpd. For this furnace type energy is not supplied by means of fossil fuels, but exclusively by means of electric energy supplied by so-called electrodes.

Features

- No dusting of the batch due to flame gases
- Suitable for production of special glass with expensive, volatile and aggressive components in the batch

Description

It is possible to use rod electrodes with specially developed, water-cooled electrode holders or block electrodes.

The electrodes can be installed in the furnace bottom or in the lateral walls of the tank or inserted from the top.

Appropriate positioning and wiring of the electrodes lead to reduced corrosion of the refractories and thus increase the furnace life. In case of a cold top furnace the batch is supplied by an area batch charger at an open side wall of the top. Alternatively a rotary roof can be used, which produces a homogenous and even batch layer. This layer insulates the glass bath from the environment, making additional insulation unnecessary. The melting, refining and homogenizing processes in fully electric furnaces are effected vertically.

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