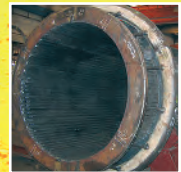


Cooling systems for industrial furnaces



Reining Heisskühlung
For more than 70 years: the name says it all



At home in the world

Reining: Know-how from tradition and experience

Established more than 70 years ago in Mülheim an der Ruhr, today Reining Heisskühlung GmbH & Co. KG is one of the world's leading specialists for the design and construction of cooling systems for industrial furnaces for ferrous and non-ferrous metallurgy.

Market leader

Due to ever stricter legal and environmental regulations and continuously rising costs for providing the necessary primary energy, the demands of

furnace operators for environmentally friendly cooling systems are becoming more and more important. Heat recovery through use of offgas heat by a hot cooling system turns out to be the optimum solution.

Reining was one of the first suppliers in the world to focus on the economical and future-proof solution of hot cooling systems for furnaces with downstream heat recovery. With over 300 installed plants, Reining has by now become an internationally respected business

partner in the steel works and rolling mill industry in the area of industrial furnace cooling, particularly with pusher-type, walking beam and electric arc furnaces.

Since 1994 bis until March 2017 REINING Heisskühlung was an subsidiary of the Oschatz group but since 01.04.2017 the new Reining Holding GmbH took over the ownership of Reining Heisskühlung.



Heat recovery in pusher-type/walking beam furnaces

Hot water cooling or evaporative cooling

Efficient and sustainable

With its innovative and efficient cooling systems Reining has acquired an excellent reputation among customers throughout the world. In addition to cold and warm water plants, today the long-established company especially focuses on offering hot cooling plants which can be optionally set up for hot water or evaporative cooling.

Definition of terms used for cooling plants

The term "hot cooling" may sound self-contradictory, but it does in fact make sense. We can distinguish between three different types of cooling, depending on the temperature of the cooling medium:

- 0 to 40 °C:
cold water cooling
- 40 to 100 °C:
warm water cooling
- over 100 °C:
hot cooling

The term "hot cooling" is applied to furnace elements which are operated with a cooling medium that has a temperature above 100 °C.

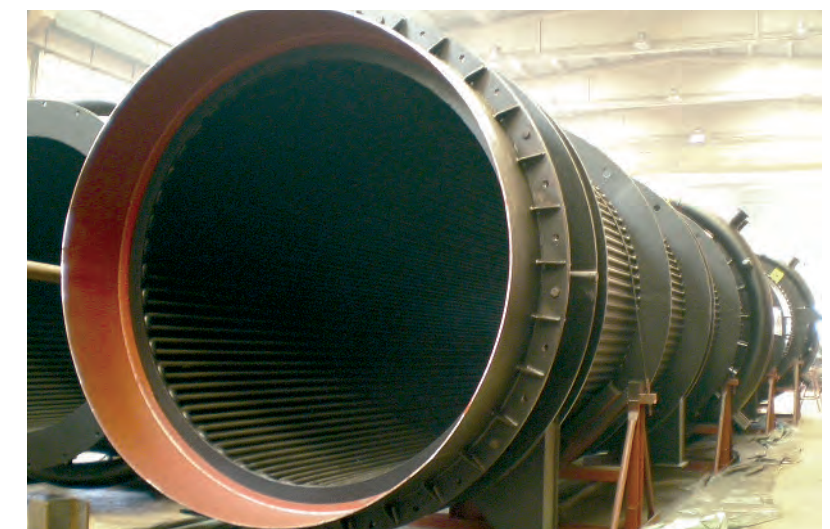
The basic idea

Ideally, evaporative cooling systems are operated at a system pressure of 10 to 30 bar in the steam drum. In evaporative cooling, water at saturated condition is supplied to the cooling elements from a steam drum. The saturated condition is determined by the respective system pressure. Due to the heat absorption that takes place, some of the water in the cooling elements is then converted into steam at a constant temperature. The water/steam mixture flows back to the steam drum, where it is separated into saturated steam and water. While the saturated steam is removed from the drum, the water remains available for recirculation.

The benefits

Each point in the cooling circuit has a constant temperature independent of the thermal load. By contrast, in conventional water cooling heat absorption leads to a rise in temperature of the cooling water. Therefore, in water-cooled systems it must be absolutely ensured that the water has a temperature that is lower than the boiling point pertaining to the respective pressure at all points of the cooling system. If this requirement is not met, steam is locally generated, which will inevitably lead to damages, causing unintended interruption of furnace operation.

Electric arc furnace with downstream offgas section during manufacturing





Natural circulation/forced circulation

The cooling systems are usually designed as forced circulation systems, where the circulation of the cooling medium in the system is maintained by the operation of circulation pumps. With natural circulation systems, the use of energy-consuming circulation pumps can be fully avoided. This works according to the following principle: The specific weight of the water in the suction pipes between

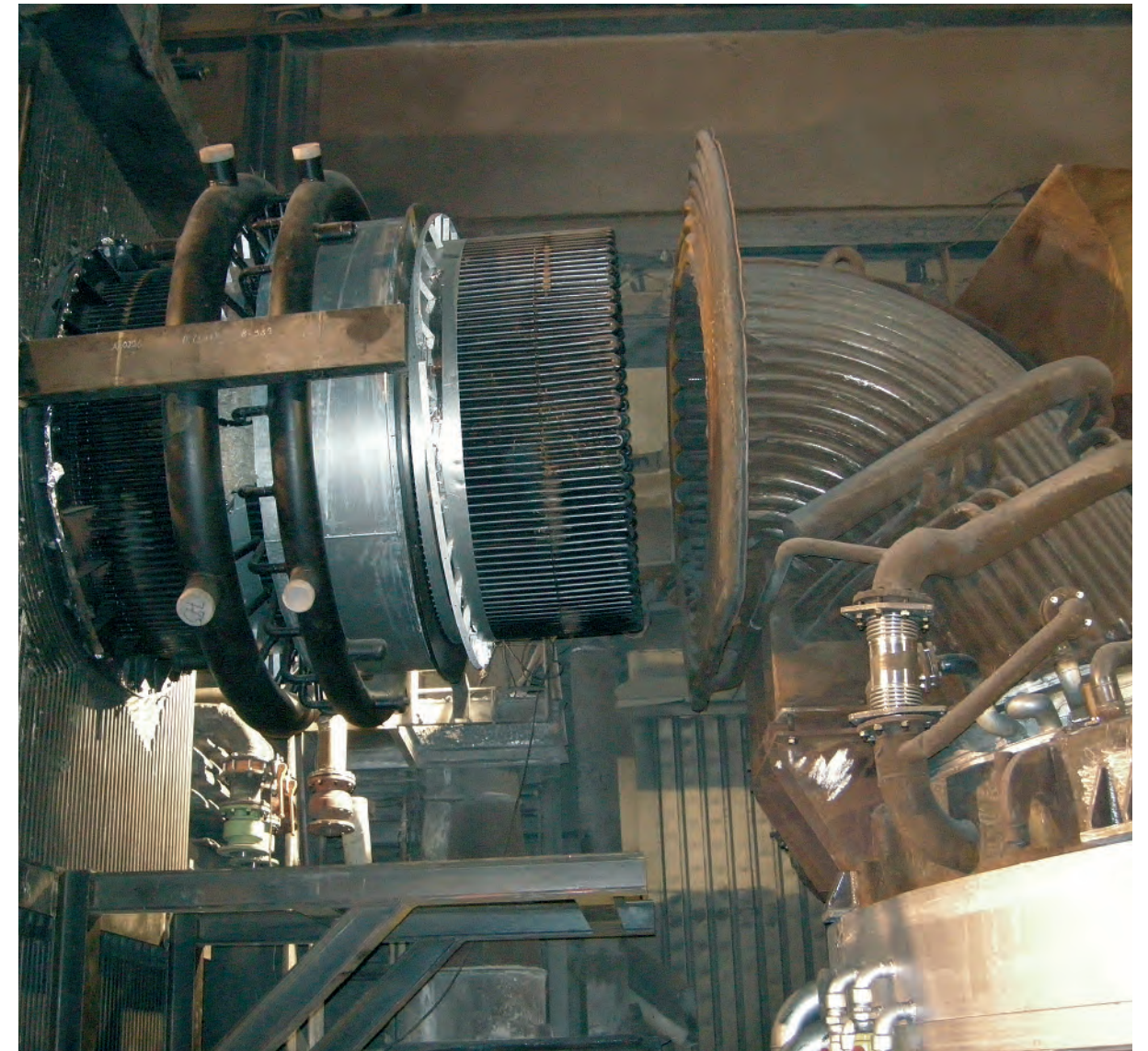
the steam drum and the cooling elements is considerably higher than that of the water/steam mixture in the discharge pipe. This generates a natural circulation force which is sufficient for maintaining the required water circulation.

When the cooling systems are accordingly designed, they can also be operated as combined forced/natural circulation systems. This means that, when a certain degree of natural

circulation is achieved through sufficient heating, operation can be switched from forced to natural circulation via a three-way valve. In the case of reduced heat input, the natural circulation flow rate decreases and the operation is switched back to a forced circulation.



Drop out box for offgas section behind EAF

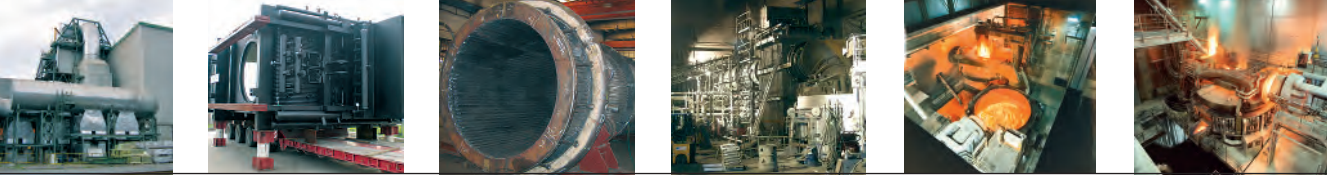


Offgas elbow behind EAF

Open and closed systems

The cooling systems can be designed as open and/or closed systems. In open systems the saturated steam is removed from the steam drum and supplied to a steam network or other consumers for further processing or use. To make up for the amount of steam flow thus removed from the system, an appropriate amount of feed water is added to keep the level

in the steam drum constant. If the steam cannot or can only partially be used by the network and/or the consumers, the saturated steam can also be condensed to avoid water losses. The condensate will then automatically flow back to the steam drum by natural circulation. In this case refilling of boiler water is no longer required.



Evaporative cooling

Efficient and energy saving

The safe way into the future

Contrary to conventional cold or hot water plants, evaporative cooling offers optimum, trend-setting answers to the current questions regarding energy-optimised industrial furnaces at maximum plant availability.

Saving primary energy

At reheating furnaces the temperature difference between inner furnace area and cooling medium is always smaller with hot cooling compared to cold water cooling. Energy savings of up to 15% can be possible, depending on the operating pressure of the hot cooling system.

Minimising energy consumption

The specific heat absorption of evaporating water is approximately three times higher than that of cold water. Consequently, plants with evaporative cooling can be operated at a strongly decreased circulating flow rate, which in turn leads to clearly reduced driving power of the circulation pumps, thus minimising the necessary electrical driving power.

Making use of heat energy

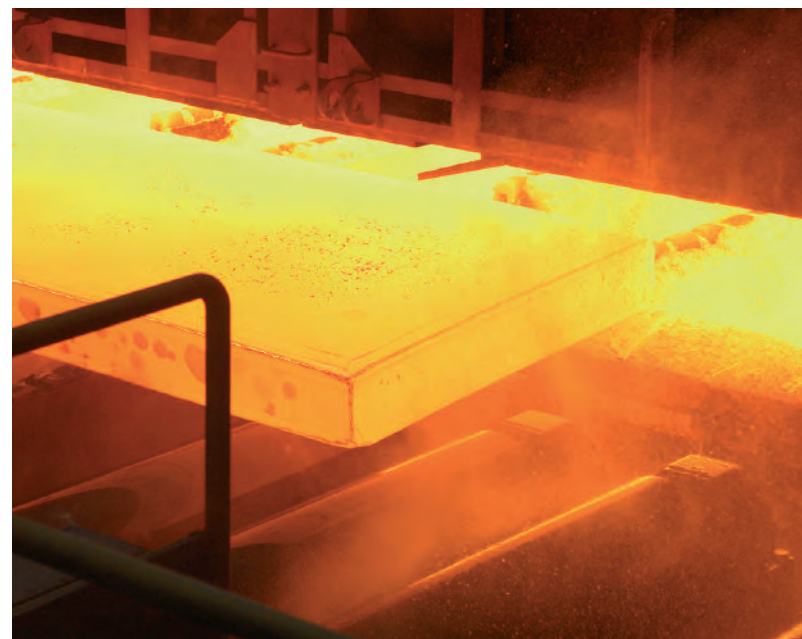
Contrary to cold water cooling, in hot cooling the heat energy from the cooling elements can largely be recovered and made usable for other

processes. The following options are available, depending on demand and existing plant facilities:

- as process heat
- for power generation
- as driving power for pumps, compressor, etc.
- for heating and climate control
- for freezing units

Saving cooling water

During re-cooling of cooling water in a cooling tower, up to 10% of the total flow rate is irrevocably lost to the atmosphere. At a cold water-cooled 250 t/h reheating furnace with a cooling water flow rate of approx. 800 m³/h, this adds up to water loss of approx. 80 m³/h. By contrast, at a plant with evaporative cooling the water losses are substantially smaller. Depending upon the water quality, the losses are limited to 1 to 5 % of the generated steam. Compared to an evaporating cooled reheating furnace with similar reheating capacity and a assumed steam production of approximately 10 to 20 t/h the loss of water besides the steam take off will be approximately 0,1 to 1 m³/h only meaning a fractional amount of the water losses of an open cold water cooling system.



the hot cooling systems with feed water quality which fully complies with boiler code requirements.

No gasside corrosion

The operating temperature of the evaporation-cooled cooling elements is chosen safely above the dew point temperature of the offgas. Thus a gasside corrosion attack on the cooling pipes in the furnace can be positively prevented.

Reduced thermal stresses

Due to the function mode of the evaporative cooling, the whole cooling circuit is operated at a constant operating temperature, which leads to a significant reduction of the stress

level in the cooling elements.

High thermal flexibility

Based on the three times higher specific heat absorption ability, plants with evaporative cooling can react much more flexibly and safely to strongly varying heat load fluctuations and load peaks. Sudden and unforesee-

High productivity and plant availability

The expenditure for the maintenance of cooling systems with evaporative cooling is much lower compared to conventional cold water cooling. The reasons for this are basically a higher service life or lifetime of the cooling elements and the generally higher operating reliability of the plants.

No water-based corrosion

Water-based corrosion is effectively prevented through the operation of



Offgas duct during manufacturing



Groundbreaking technology

Possible applications and product groups

able heat load peaks can be directly and safely controlled, avoiding any risk for the equipment and staff.

Everything from one source

Since its establishment in 1947 Reining has designed and built more than 300 cooling systems.

Depending on customer requirements, the company offers everything

completely from one source: from basic engineering to concept development and consultation, 3-D plant design and the relevant detail engineering, including the necessary process and stability calculations, workshop drawings and project management, through to the manufacturing, supply, installation and commissioning of the complete cooling systems.

This range of services is available both for new plants and for revamping existing systems which are no longer up to date with current technology and which can be rebuilt according to specific, modified customer requirements. Typically the investment costs for new installations as well as for converting the cooling systems from cold water to evaporative cooling are recouped very quickly. Wherever hot process offgases are available, hot cooling and especially evaporative cooling can be used specifically for cooling the system parts in connection with heat recovery.

Reheating furnaces (pusher-type and walking beam furnaces)

Via the installed skid systems in pusher type and walking beam furnaces the absorbed heat can be made usable with the heat cooling system. Design, fabrication and inspection considering fatigue stress aspects guarantees maximum plant availability and safety. The evaporation-cooled pusher-type furnaces can also be operated with natural circulation, i.e. without using circulation pumps.



Top: Manufacture of skid pipes for pusher-type furnaces. Bottom: Installation of skid frames at walking beam furnace.



Waste heat recovery in downstream pusher-type/walking beam furnaces

swivel heads can be repaired without shutting down the furnace with minimum maintenance.

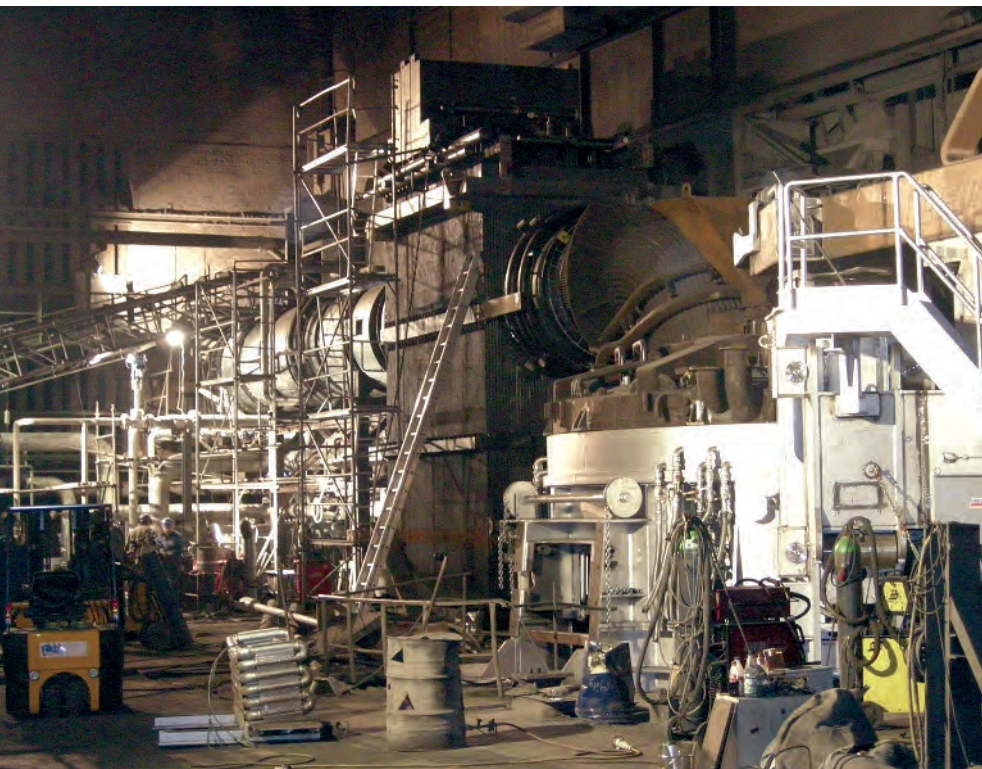
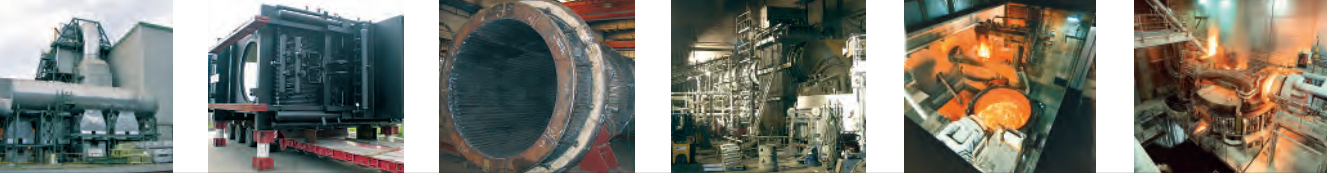
Use of offgas heat

Heat recovery in reheating furnaces can be significantly increased by using additional waste heat systems in the offgas stream. The gas will be cooled down to a lower temperature before it is discharged to atmosphere. Combined with the heat recovery from the skid and supporting pipe systems this results in high energy recovery from the total plant. Multiple reheating furnaces can be combined to form a full heat recovery concept, which increa-

As a result, cooling of these skid systems is thus ensured under all operating conditions of the reheating furnace. With walking beam furnaces, emergency situations as power failure can be safely controlled by installing diesel drives and/or turbine drives at the circulation pumps. In walking beam furnaces, swivel joint units developed by Reining are applied to obtain optimum results regarding tightness and maximum operating reliability due to their construction and design. Unavoidable smaller leakages at the



The Reining swivel joint unit



Assembly of offgas section for EAF

ses the number of possible applications and offers a flexible option for the whole rolling mill.

Electric arc furnaces (EAF)

While in the past such elements as the furnace roof, furnace elbow, furnace wall components and offgas duct used to be water-cooled, today the offgas section for the EAF offers optimum application options for evaporative cooling. In particular the batch operation of the EAF with its strongly varying energy level and the sometimes very high heat load peaks in the offgas places extremely high demands on the entire cooling system. Innovative offgas sections with the specific benefits of evaporative cooling can offer optimum solu-

tions. In addition to the conventional applications, the EAF process provides a special option for using steam: The saturated steam which is generated in the offgas section can be properly supplied to the so-called steel degassing process, the phase following the EAF process, via a steam accumulator system. The saturated steam quantities obtained only by the heat recovery in the offgas section usually exceed the quantities necessary for the steel degassing. This means that the surplus saturated steam quantities can be provided to different consumers without any limitations, if required. Potential existing natural gas-fired boilers in the total plant design can thus reduce their load by this amount of heat recovery or even simply be operated in stand-by mode.

A specialist in innovative cooling systems for more than 70 years

- 1947**
Reining Heisskühlung is founded in Mülheim an der Ruhr
- 1949**
Installation of the first Reining evaporative cooling system
- 1965**
The first natural circulation system for the skid system of a pusher-type furnace in Domnarvet (Sweden) is designed, produced and installed
- 1966**
First natural circulation cooling system in a closed cycle
- 1968**
Over 100 Siemens-Martin and Brammen heating furnaces throughout the world work successfully using Reining systems (door cooling frames and skids)
- 1971**
The first walking beam furnace is equipped with a Reining system and with special Reining swivel joints
- 1977**
Development and tests of vertical boiler stands for supporting pipes
- 1980**
The first walking beam furnace with double skids, double stands and vertical boiler stands is produced
- 1985**
The first electric arc furnace is equipped with a Reining system (including a roof with specially designed swivel joints)
- 1990**
By now 200 plants throughout the world are equipped with the Reining systems
- 1992**
The riders for walking beam furnaces are constantly further developed and optimised; the first tests under operating conditions are carried out
- 1994**
Reining Heisskühlung becomes a company of the Oschatz Group
- 1997**
Reining Heisskühlung celebrates its 50-year anniversary
- 2005**
The company moves to its new, modern offices at 60 Dessauer Strasse
- 2007**
In the company's 60th year, 300 plants throughout the world work with systems from Reining
- 2008**
Turnkey revamping of the offgas line behind electric arc furnace from cold water to evaporative cooling at Buderus Edelstahl, Wetzlar, Germany
- 2009**
Turnkey delivery of a waste heat recovery plant behind slab reheating furnace at Salzgitter Flachstahl GmbH, Germany
- 2011/2012**
Revamping of three Ferro-Silicon submerged electric arc furnaces from cold water to evaporative cooling at Finnford AS, Norway with Reining as general contractor
- Turnkey revamping of a skid system inside a pusher type furnace for slab reheating from cold water to evaporative cooling in natural circulation at Eregli Demir, Erdemir, Turkey**
- 2016/2017**
POSCO, Korea, contracted REINING as the leading company about the revamping of in total 7 walking beam furnace skid systems from cold water to evaporating cooling
- 1. April 2017**
The Reining Holding GmbH took over the Reining Heisskühlung out of the Oschatz group



A subsidiary of the Reining Holding GmbH

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