The Cupola furnace with hot blast generation has been established over many years as state-of-the-art for the production of gray and ductile iron for serial casting.

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Küttner designs the dry gas cleaning system in a way that the required limits for dust, CO, and SOx can be achieved reliably. This is ensured by special process technology with complete combustion, cooling, and particle separation in a Bag Filter system.

Approximately 30 percent of the energy of the off-gas from the cupola can be used by generating hot blast. A variety of solutions based on thermal oil and steam systems are available. Solutions for the handling of off-gases for core-drying and painting, and for reparation of crucible chambers, are implemented at site. Blast or denitration systems are efficient in warm and tropical regions. Examples of multistaging and solutions have been implemented between foundries and neighboring companies from paper industries, laundries, and food manufacturers having a need for process heat.

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KÜTTNER is the leading supplier for Cupola technology worldwide, having built more than 450 cupolas of different types, due to their specific know-how and experience with melting capacities up to 100 t/h, as well as for long campaign operation.

The services provided include development of new technologies, engineering and design, supply, installation, and starting-up of plants complete with controls and data processing systems.

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Low melting cost
- High metallurgical flexibility
- Low emissions
Melting on hot coke bed provides highest flexibility for the selection of iron units
- allows residual steel due to reducing atmosphere
- 100% coke heated material can be used, since coke evaporation in the upper furnace and is collected in a 20 t ladle in the lower part
- Shotladle of returns is not necessary
- CO content in scrap can be accepted, with respective reductions applied to the gas cleaning system
- The charge size requirements is lower than in an induction furnace

Coke fired cupola with reducing atmosphere
Cupolas with small capacity are generally refractory lined. KÜTTNER builds small furnaces with long campaign life as an alternative to conventional furnaces which are deactivated daily between being operated and being re-lined. Cold blast furnaces are equipped with Oxygen Injection to assure tapping at high temperatures around 1,500 °C. Furnaces which are operated only 1 shift per day do not require cooling. For furnaces which are operated 2 or 3 shifts per day, the iron temperature is reached by preheated blast and a reasonable mixture of Coke. Continuous operated furnaces are equipped with tuyere and shell cooling.

Cokeless cupola produces low carbon, low sulphur iron
The cokeless cupola was built several times in the early 1990s to produce grey and ductile iron in small amounts. The gas fired design with water cooled grid is a lighter kind of ceramic cupola which has proven its performance in over 20 years of operation. Due to the oxidizing atmosphere and the missing coke bed, the raw material charge has similar restrictions as for electric melting. Specifically, the portion of steel scrap is limited to 30%.

Cupola produces high quality base iron at low cost
Modern cupolas of medium and high capacities are designed to be charged with a variety of scrap iron qualities. Due to the high cost for quality hot blast iron, the energy source is primarily replaced by cheaper subproducts so that typically two grades of coke are used. The required carburization is adjusted by the height of the cupola bed. The carbon pickup can be regulated below the injection of carbon dioxide.

To reduce the primary energy consumption of new plants the daily / weekly iron demands from the studied 5 years of the study, a ‘furnace profile’ is designed to run the furnace in its sweet spot to avoid unnecessary energy losses. Operation with a 100 °C hot blast and a reasonable amount of injected Oxygen, leads to a favorable temperature profile.

Long campaign operation
Long campaign furnaces are equipped with water cooled tuyeres and high AC efficiency. The cooling system cells are operated separately and are backed up by emergency water. Refractory lifetime of 2 weeks for a tuyere, and 6 months for the furnace hearth, can be reached after proper refractory installation and proper furnace operation, resulting in a refractory consumption of 1-2 kg/y.

Environmental impact
Modern cupola plants are equipped with a below charge complete furnace gas extraction with combustion and heat recovery for blast heating in excess 1000 °C. The typical permitted levels can be reached with high reliability.

Oxigen lances influence the temperature profile and increase the thermal efficiency of the furnace
Oxygen is injected at high efficiency via a super sonic OXIJET lance into the offgas of cupolas. The process ensures that the Oxygen stream is distributed, and generates into the furnace center. Such operation provides better melting of shaft line feed.

Treatment of iron and slag
Allured iron grades are produced by addition of the fine alloy into the moving hot metal in small scale cupolas furnaces. The metal is then heated to pouring temperature.
For small size, the cupola iron is dea phosphorized to < 0.01 % in a fist step by addition of Magnesia in a second step to form the typical nodular graphite structure.

Slag is a valuable by-product. Dry granulation produces a fine sand that can be sold to the cement industry.

Heat utilization and storage
Modern cupola plants already use 1/3 of the primary energy for blast generation. In typical cases, about 50% of the process heat remains for further beneficial recovery purposes.
Near stand alone like heating systems for annealing or drying furnaces, or for the generation of steam for drying or spray processes, are ideally using the remaining Heat Energy. Combined heating systems reduce the overall consumption of fresh fuels, and of CO₂ emissions.

CUPOLA FOR CAPACITIES BELOW 15 T/H

THE PLANT CONCEPT FOR CAPACITIES FROM 15-100 T/H

PROVEN AUXILIARY INSTALLATIONS

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CUPOLA FOR CAPACITIES BELOW 15 T/H

Molten on hot coke bed provides highest flexibility for the selection of iron units
- allows residual steel due to reducing atmosphere
- 100% coke-coated material can be used, since coke evaporates in the upper furnace and is collected in the base of the tuyere hearth
- Shrinkage of the bath is not necessary
- Coke containment can be ascended, with respective reductions expected in the dry gas cleaning system
- The charge size requirements can be lowered in an induction furnace

Coke fired cupola with reducing atmosphere
Cupolas with small capacity are generally refractory lined. KELLER GmbH builds small furnaces with long campaign life as an alternative to conventional furnaces which are coked daily between being operated and being cooled. Cold blast furnaces are equipped with oxygen injector to ensure top -up of high temperatures around 1,300 °C. Furnaces which are operated only 1 shift per day do not require cooling. For furnaces which are operated 2 or 3 shifts per day, the iron temperature is reached by preheated blast and a reasonable injection of Oxygen. Such continuously operated furnaces are operated with tuyere and shaft cooling.

Cokeless cupola produces low carbon, low sulphur iron
The cokeless cupola was built several times in the early 1990s to produce grey and ductile iron in small amounts. The gas fired design with water cooled grid, a 1-layer bed, the raw material choice has similar restrictions as for a conventional cupola. Due to the oxidizing atmosphere and the missing coke, the carbon pick-up can be controlled by preheated blast and a reasonable amount of injected Oxygen, leading to a favorable temperature profile.

Long campaign operation
Large cupolas are equipped with water cooled tuyeres and high ACC efficiency boiling. The cooling circuits are operated separately and can be backed up by emergency water. Refractory lifetime is 2 weeks for a tuyere; about 6 months for the furnace hearth; can be reached after poor refractory installation and proper furnace operation, resulting in a refractory consumption of 1.5 kg/m³.

Environmental impact
Modern cupola plants are equipped with a below charge complete furnace gas extraction with combustion and heat recovery for boiler heating in the base of the tuyere hearth. The typical permitted limits can be reached with high reliability.

OXIJET lowers lances increase the temperature profile and increase the thermal efficiency of the furnace
Oxygen is injected at high efficiency via super sonic OXIJET lances into all off-group processes. The process ensures that the Oxygen stream is oxidized, and penetrates into the furnace core. Such operation provides better melting rate of steel and heat losses.

The temperature profile reacts more overall higher, but locally more reduced. Peak, leading to higher thermal efficiency, and locally higher tapping temperatures.

Treatment of iron and slag
Alloyed iron grades are produced by addition of the five alloys into the melting hot metal in steel cupola furnaces. The metal is then heated to tapping temperature. For mobile use, the cupola furnace is de- phosphated to 0.01% P in a 1st step by addition of Magnesium as a 2nd step from the typical modular graphite structure to 0.005% P and 0.15% Mg.

Slag is a byproduct. Dry granulation processes a lump material that can be used for road construction, while wet granulation produces a fine raw material to be sold in the cement industry.

Heat utilization and storage
Modern cupola plants already use 1/3 of their heat for hot blast generation. In typical cases, about 50% of the process heat remains for further heat recovery purposes.
Near round seam like heating systems for annealing or drying furnaces, or for the generation of steam for drying or spraying processes, are already using the remaining heat for heat recovery. Combined heating systems reduce the overall consumption of fresh fuel, and of CO2 emissions.

THE PLANT CONCEPT FOR CAPACITIES FROM 15-100 T/H

Cupola produces high quality base iron at low cost
Modern cupolas of medium and high capacities are designed to be charged with a variety of charge iron qualities. Due to the high cost for quality reducing iron, the energy source is partly replaced by cheaper substitutes so that typically two grades of coke are used. The required carbonization is adjusted by the height of the cupola hearth. The carbon pick-up can be regulated either by injection of Oxygen.

To reduce the primary energy consumption of new plants the daily / weekly iron demand has to be studied. Based on this study, a ‘furnace profile’ is designed to run the furnace in its optimal temperature profile. A typical concept study, a “furnace profile” is designed to run the furnace in its optimal temperature profile. For furnaces which are operated 2 or 3 shifts per day, the iron temperature is reached by preheated blast and a reasonable amount of injected Oxygen, leading to a favorable temperature profile.

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Melting on hot coke bed provides highest flexibility for the selection of iron units: 
- allows residual slag due to reducing atmosphere
- 100% coke content material can be used, since coke evaporates in the upper furnace and is collected in the bed in the bughouse
- Combustible dust in return is not necessary
- O2 content in gas can be accepted with respective reduction in the dry gas cleaning system
- The charge size requirements are lower than in an induction furnace

Coke fired cupola with reducing atmosphere

Cupolas with small capacity are generally refractory lined. KÜTTNER builds small furnaces with long campaign life against conventional furnaces which are ideated daily between being operated and being cooled. Cold blast furnaces are equipped with tuyere injector to ensure top of high temperatures around 1,300 °C. Furnaces which are operated only 1 shift per day do not require cooling.

For furnaces which are operated 2 or 3 shifts per day, the iron temperature is reached by preheated blast and a reasonable amount of injected Oxygen. Such continuously operated furnaces are equipped with tuyere and shell cooling.

Cokeless cupola produces low carbon, low sulphur iron

The cokeless cupola was built several times in the early 1990s to produce grey and ductile iron in small amounts. The gas fired design with water cooled grid, a cooler bed of scrap material, and the continuous operation has proven its performance in over 20 years of operation. Due to the oxidizing atmosphere and the missing coke bed, the raw material choice has similar restrictions as for electric melting. Specifically, the proportion of steel scrap is limited to 30%.

Cupola produces high quality base iron at low cost

Modern cupolas of medium and high capacities are designed to be charged with a variety of charge iron qualities. Due to the high cost for quality ductile cast iron, the energy source is partially replaced by cheaper substitutes so that typically two grades of coke are used. The required coalification is adjusted by the height of the cupola hearth. The carbon pick-up can be adjusted offline by injection of coke fines.

To reduce the primary energy consumption of new plants the yearly coke demand has to be studied. Based on this study, a ‘furnace profile’ is designed to run the furnace in its sweet spot to avoid unnecessary energy losses. Operation with up to 600 °C hot blast and a reasonable amount of injected Oxygen leads to a favorable temperature profile.

Long campaign operation

Long campaign cupolas are equipped with water cooled tuyeres and high ACC efficiency. The cooling system is operated separately and can be backed up by emergency water.

Environmental impact

Modern cupola plants are equipped with a below charge complete gas extraction with combustion and heat recovery for hot blast generation and high ACC efficiency. The typical permitted limits can be reached with high reliability.

Heat utilization and storage

Modern cupula plants already use 1/3 of the process heat for hot blast generation. In typical cases, about 80% of the process heat remains for further thermal requirements.

Oxigen lances influence the temperature profile and increase the thermal efficiency of the furnace

Oxygen is injected in high efficiency via a super sonic OXIJET lance into all kinds of furnaces. The process ensures that the oxygen stream is directed, and penetrates into the furnace core. Such operation provides better melting of hot steel and hot slag.

The temperature profile reacts as overall higher, but locally more focused, peak, leading to higher thermal efficiency, and finally higher tapping temperatures.

Treatment of iron and slag

Alloyed iron grades are produced by addition of the five alloys into the melting furnace instead of shaft coil cupolas/furnaces. The need is then limited to pouring temperatures.

For small size, the cupola-based iron is desulfurized to 0.015 % S at a slight step by addition of a sulfur agent. Then its treated by addition of Magnesia in a second step to form the typical nodular graphite structure to < 0.005 % S and < 0.25 % Mg.

Slag is a valuable byproduct. Dry granulation process with a granulator that can be used for steel or construction, while wet granulation produces a fine granulate that can be sold to the cement industry.

KÜTTNER builds small furnaces with long campaign life and flexibility for the selection of iron units.

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