

SHAFT FURNACE TECHNOLOGY

for Scrap and Waste Recycling

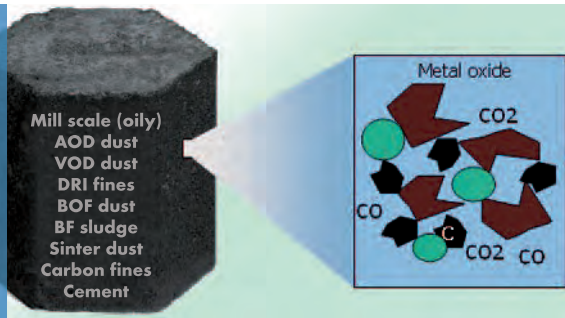
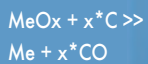


Recycling By-Products
Export of Surplus Gas
Additional Hot Metal
Saving of Resources

KÜTTNER

ZERO WASTE: RECYCLING SAVES VALUABLE RESOURCES

Principle of metal oxide reduction in C-Brick



In contrast to other alternative iron making processes the OXYCUP® melt shop directly produces liquid hot metal similar to blast furnace quality. A C-Brick may be composed of a variety of different ingredients. In particular matter with high iron content like BOF dust or sludge is welcome, but also matter with high carbon content like BF sludge. The agglomerates are produced on site in the C-Brick agglomeration plant.

C-Bricks from dust, sludge, ore fines



BOF dust contains about 65 % of iron – only 10 % less than high grade ores. This is the basis of the Zero Waste Concept of ThyssenKrupp Steel.

The direct reduction of the metal oxides is mainly done by the carbon present in the brick. Compounds like lime and silica contained in the residues determine the basicity of the slag together with about 10 % cement being added as a binder.

Recycling of zinc and alkali containing fines as well as of lumpy residues of unknown analysis is now possible for the benefit of the classic sintering process as well as for blast furnace route and converter operations.

Easy integration into a steel mill, high process flexibility with respect to charge materials and operation, low space and investment requirements are additional advantages of this economic waste and by-product processing technology.

The environment benefits as well: All emissions with respect to SO_x, NO_x, Dioxines, etc. are far below the legal limits.

Since start of operation in 2004 the OXYCUP® process has turned out to be a reliable proven technology. A variety of different residues has been used in C-Bricks mixtures and converted to hot metal. The percentage of bricks in the charge can vary between 0 % and 100 %, the balance being lumpy residues like pit scrap/skulls or zinc coated bales.

BOF pit scrap



Pig iron skulls



OXYCUP®: HOW IT WORKS



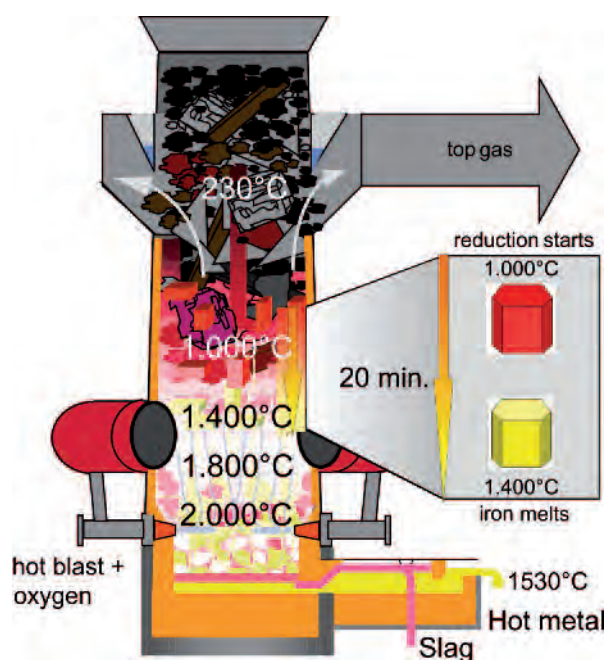
ThyssenKrupp
Steel, Germany

C-Brick making
plant with mixing
tower and curing
hall

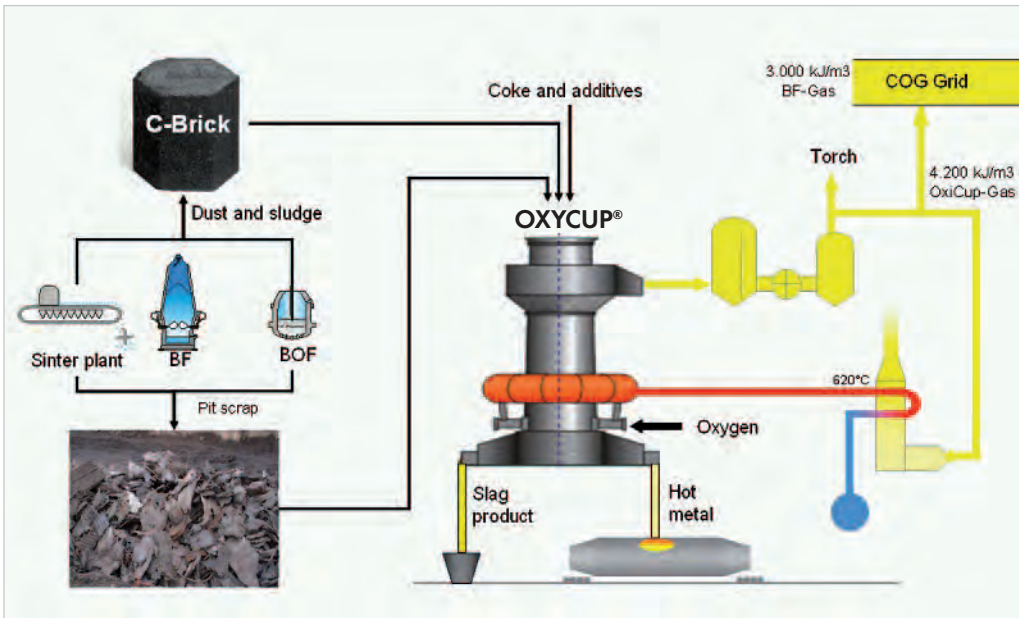
Smelting reduction with self-reducing C-Bricks

Charged from the top into the OXYCUP® shaft furnace the self-reducing C-Bricks are first pre-heated in counterflow with the furnace gas to some 500 °C. First metallic iron is formed in the outer shell of the brick. This shell grows and secures the stability of the brick above 1,000 °C when the cement will disintegrate and direct reduction starts with the help of carbon included.

At about 1,450 °C the brick has totally converted into solid iron sponge which is melted together with other metallic charge in the hearth. The hot metal will leave the hearth continuously over an iron-slag siphon system at 1,500 °C with a carbon content of about 4 %.



THE WINNER: THE ENVIRONMENT



OXYCUP®
in an integrated
steel mill

Direct hot metal from in-plant by-products

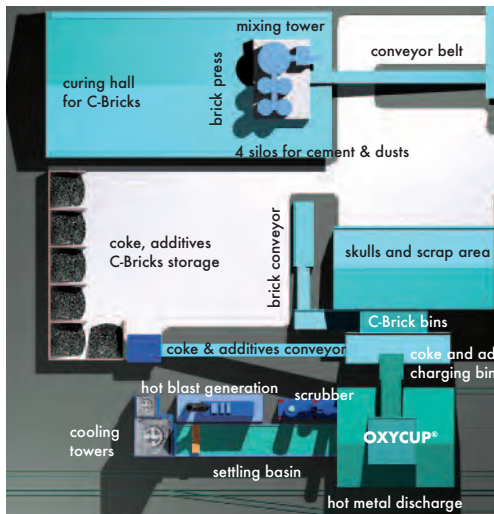
In integrated steel works an OXYCUP® furnace supplements the hot metal from the blast furnace. Because of the comparatively small quantities, torpedo cars or iron ladles first collect a portion of hot metal from the OXYCUP® and then mix it by filling up with hot metal from a blast furnace. After de-sulphurization the hot metal mixture is transferred to the steel shop.

In times of high hot metal demand the OXYCUP® can almost double its production if a high iron containing charge, like 100 % pit scrap, is employed. Only 170 - 200 kg of coke are necessary to convert pit scrap into one ton of hot metal. Low CO₂ emissions are the result.

Environmental authorities from the USA, Mexico, Japan and Germany have confirmed that all other emissions are also far below the permissible limits. The cleaned top gas of blast furnace quality is used in the gas network of the steel plant. In combination with electric melting the OXYCUP® can solve the residue problems of high zinc containing dusts. Charging the liquid hot metal into an electric arc furnace reduces electric power consumption. The winner is always the environment.



OXYCUP®
discharging of
hot metal in a
torpedo car



OXYCUP® plant
exemplary layout
for 350,000 t/yr
input

CUSTOMISED SHAFT FURNACE PLANTS

Sicartsa, Mexico

Shaft furnace producing 2.000 t_{hm}/day from scrap



ThyssenKrupp Steel, Germany

OXYCUP® for recycling of 500 t/day of ferrous dust and sludge material



Nippon Steel, Japan

Shuttle furnace producing 1.350 t_{hm}/day from scrap



JFE, Japan

Scrap melting shaft furnace plant 2.400 t_{hm}/day



TISCO, China

Double OXYCUP® plant for ferrous and stainless steel dusts, sludge and skulls – each for 850 t_{hm}/day



OXYCUP® shaft furnace plants are proven technology for iron recovery from ferrous waste material.

The OXYCUP® process is a smelting reduction process based on self-reducing agglomerates, so called C-Bricks. This technology is a common development of ThyssenKrupp Steel and KÜTTNER.

During the past years Küttner has also supplied a number of large shaft furnace melt shops with focus on scrap operation.

The scrap processing shaft furnace was implemented in works looking for additional hot metal supply for their existing steel making capacities or a way to decrease specific CO₂ emission by supplementing ore-based BF hot metal production. Shaft furnaces are well suited for a variety of different metallic charge materials like:

- dirty heavy metal scrap HMS1/2
- galvanised scrap (baled/shreddered)
- pit scrap or iron/steel skulls

Successful tests have been realized with hot briquetted iron (HBI). Based on this it is now also available for plants for pre-reduced/direct reduced materials from rotary hearth/kiln or natural gas based reduction plants.

OXYCUP® shaft furnace technology is now also available for the recovery of Cr and Ni from stainless steel waste materials.

The first plant processing residues from stainless steel production is now under construction. This plant consists of two independent production lines for both stainless and carbon steel residues.



KÜTTNER GMBH & CO. KG

The engineering company, which was founded in 1949 by Dr. Carl Küttner, has evolved into a group of companies working worldwide in plant engineering and construction. The company supplies and erects turnkey installations for a wide range of process technologies, including melting and material handling in the iron, steel and foundry industries.

KÜTTNER has built different types of furnaces, like fluidised bed, rotary and shaft furnaces for organic/inorganic waste, non-ferrous metals and iron processing. The furnaces presented in this field are developed from the long campaign cupola furnaces for steel mills.

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

The KÜTTNER Group today has a worldwide workforce of more than 500 people. It is represented in the international markets through a network of affiliated companies and agents. Its owners hold active positions within the company organisation.

