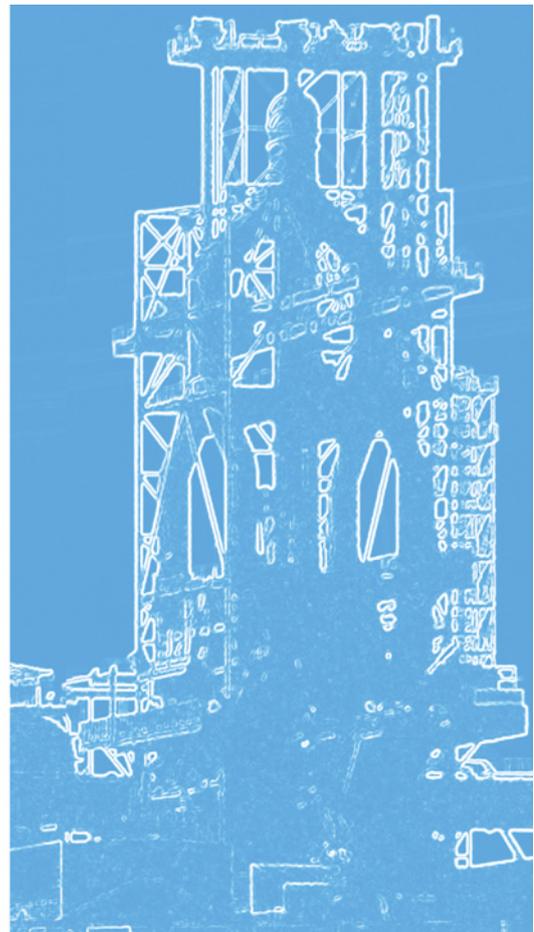


COAL PREP & INJECTION

for Blast Furnaces



Highest Coke Substitution

Flexibilizing Fuel Mix

Boosting Productivity

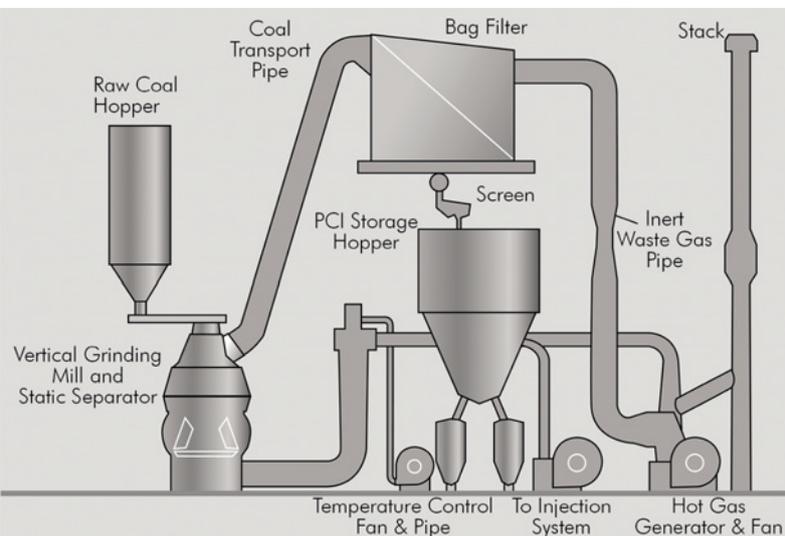
Full Plant Solutions

KÜTTNER

SOLUTIONS CAPITALIZING THE HIDDEN POTENTIAL OF BF

Injecting pulverized coal (PC) into blast furnaces (BF) is an effective process lowering the consumption of expensive fuels. Increasing injection rate gains higher productivity and envirofriendly and ecofriendly operation. Choosing the best available technology further helps to profitably exploit latent potentials.

Efficient PCI is obtained by convenient coal pretreatment as far as moisture and grain size are concerned, appropriate mixing of coal and hot blast, uniform distribution across all tuyeres, low nitrogen input into the BF, and by maximizing the retention time of the coal in the tuyere. To reach this aim, Küttner provides you with both, the necessary equipment and process know how.

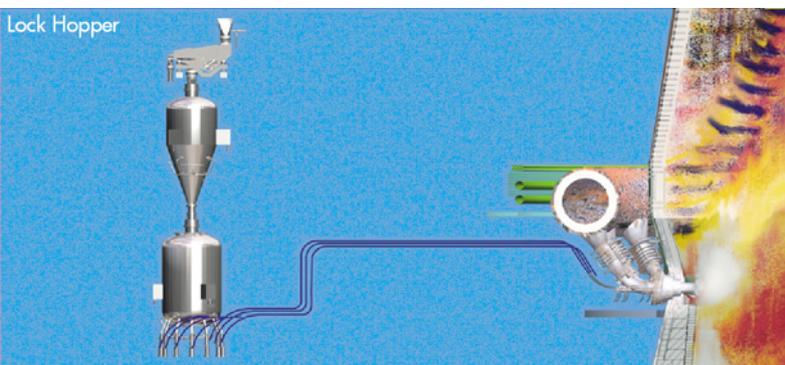


Grinding and Drying

Proper coal grinding and drying is an indispensable pre-requisite for exploiting the full potential of PCI (pulverized coal injection). Moisture has to be removed and grain size must be optimised to obtain a material well-suited for transport and chemical reactions. Both happens simultaneously in the compact grinding and drying (GAD) plant, also achieving a high degree of intermingling. PC is separated in a filter and ready to be injected into the BF.

Küttner places great emphasis on a design resistant to explosion, wear and corrosion. Another sustainable advantage is the possible re-use of hot stove off-gas for coal drying.

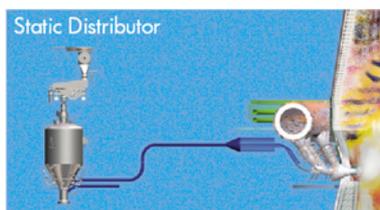
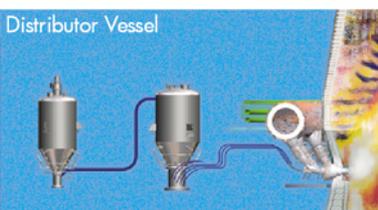
Always struggling to find the very solution which fits your requirements best, we choose between a variety of vertical roller mills - hence, you can get all your equipment at one stop.



Various Layouts of PC Injection

Küttner offers 3 different layouts to serve customers' needs:

- PCI with static distributor, our minimum-cost variant, with normal transport gas loading and normal accuracy for mid-distance transport;
- PCI with distributor vessel for long distances and
- PCI with lock hopper for short distances.



The first two design comprise intermediate hoppers, whereas the latter two feature high transport gas loading and flexibility as well as single-line regulation. No matter whether equal distribution or individual flow control is preferred, every design is individually tailored to customers' requirements. Integration into existing plants is, of course, possible.

OXYCOAL+ / COAL PREHEATING: PROVEN MEASURES TO STEP UP PCI PERFORMANCE

Ultra-Dense Flow Principle

PCI in accordance with Küttner's ultra-dense flow principle offers a series of convincing advantages:

- markedly increased transport gas loading,
- low N₂ input into BF,
- low wear of piping.

You have already PCI? Well done! Anyway, you have not yet reached the top of the flag pole! We can provide you with another two add-ons tuning injection rates and making the most out of pulverized coal injection.

Coal Preheating

Injecting pulverized coal into the BF is the more effective for productivity, the higher the carbon burn-out at the end of the raceway. Coal preheating promotes this burn-out as it drastically reduces the time required for heating up the PC from ambient to gasification temperature. This is ascribed to two facts: coal was dried before entering the BF and pyrolysis has already started outside the furnace.

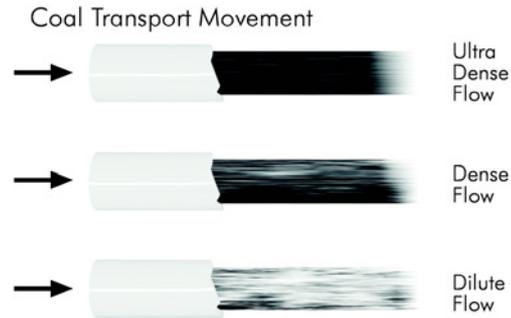
In order to make use of this potential, Küttner offers a special heat exchanger. Furthermore, why not optimizing your overall energy budget by recycling the waste heat from other aggregates for this purpose?

Oxycoal+

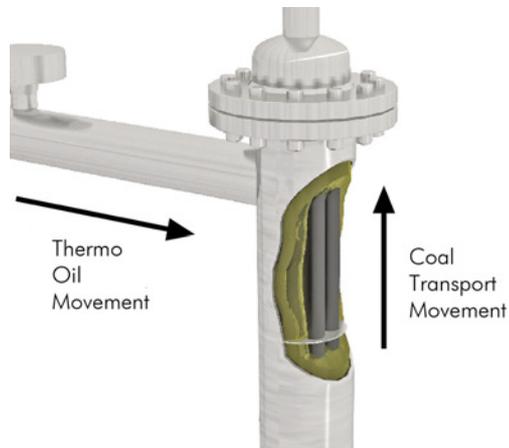
is a registered trademark by Küttner representing the ingenious technology stepping up PCI and boosting BF productivity. The basic idea is to coaxially inject part of the oxygen from the cold blast together with the coal. A coaxial lance serves for the transport of both, coal in the inner and oxygen in the outer channel, to the raceway, where it is blown in at high pressure.

Oxycoal+ benefits are threefold: it increases injection rate without increasing oxygen rates, lowers ignition temperature and improves the process. Oxygen shrouding of the pulverized coal positively effects the temperature difference in the tuyere and optimizes the processes in the raceway.

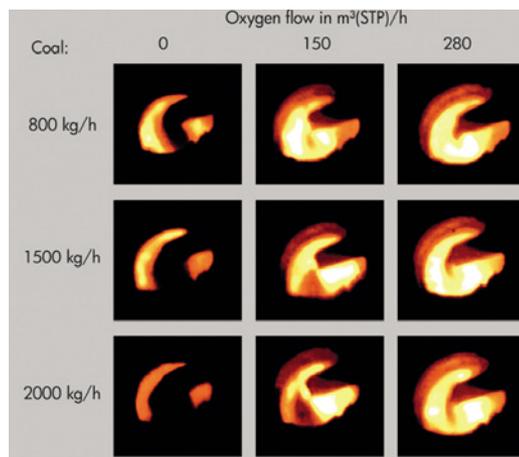
Why not asking our experts for a model calculation using your operating parameters? This will disclose any hidden potential for PCI ready to be exploited in your blast furnace! We can also figure out further potentials and payback. You will be pleased to hear that Oxycoal+ demonstrably succeeds in stepping up PCI rates by 20 - 25 kg/t hot metal.



Ultra-dense flow principle
Flow principles with varying density



Preheating of coal with low-temperature waste heat



Improvement in the BF raceway obtained by PCI & OxyCoal+ at Dillinger Hütte AG, Germany



CUSTOMISED SOLUTIONS GIVING A BOOST TO BF

VASD, Austria, invested in PCI implementation simultaneously supplying two BF with only one line. They chose GAD plus PCI design with static distributor.

HKM, Duisburg, Germany, invested in GAD plus PCI with distribution vessel. This line set world record in maintaining ultra-dense flow of 80 kg PC per kg of transport gas and across a distance of not less than 850 m!

GAD Pros at one glance

- Recycling of waste gas to drying energy
- Dew point control
- GAD operation under inert conditions

China Steel Corp., Taiwan, retrofitted the old PCI supplying their BF No. 4 from dilute to ultra-dense flow system. They decided in favour of PCI design with static distributor. Compared to former figures, they increased coal injection rates by 35 kg/t of hot metal. Advanced injection rate control represents another benefit obtained by this revamp.

PCI Pros at one glance

- High retention time in tuyere
- Flow accuracy & uniform distribution across tuyeres
- Low gas consumption
- Low N₂ input into BF
- Ultra-dense flow
- Low wear of piping

TKSE, Germany, BF 1 is another world record holder in Küttner PCI technology: Having been employing PCI with lock hopper since 1987, they prove long lasting continuity of this investment! The station was extended by the then new add-ons Oxycoal+ (1990) and Coal Preheating (2000).

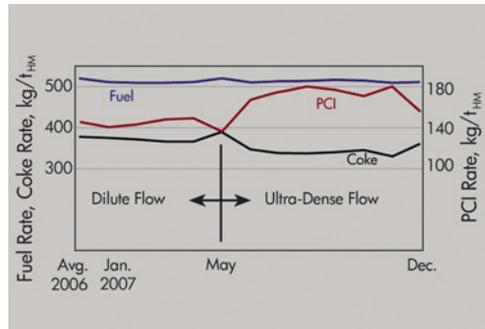
Overall Pros at one glance

- All equipment at one stop
- Highest flexibility
- Added value by individual service
- Entire process control available inhouse
- Corresponding materials handling



**HKM,
Germany**

Vertical roller mill in coal GAD plant



CSC, Taiwan

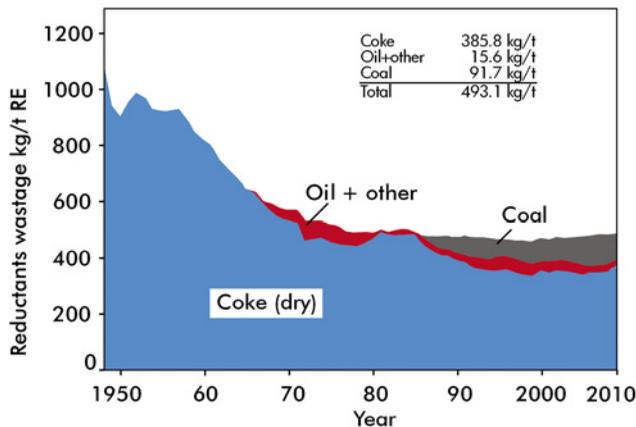
effectively tuned their BF No. 4 by switching to Ultra-Dense Flow



**ThyssenKrupp Steel Europe,
Germany**

Heat exchanger for preheating pulverized coal at BF 1

IT PAYS TO BUY PCI



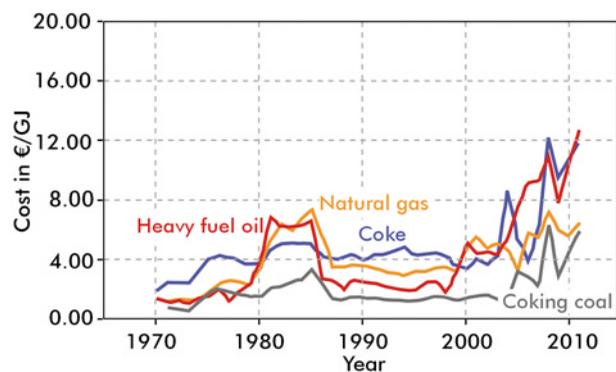
Time for a Change

Iron & steelworks managers face an enormous challenge by volatile prices for raw materials and energy, by environmental obligations, such as, resources conservation, carbon footprint, emissions trading etc. The crucial lynchpin in economically governing the business simply asks for bringing out the utmost in the means available: fuel efficient operation and multiple utilization of all energy in the system. The sole solution reads: detection and capitalization of the hidden potentials throughout the entire process. Improve your degree of efficiency!

Convincing Arguments: Reduce Costs and Carbon Footprint

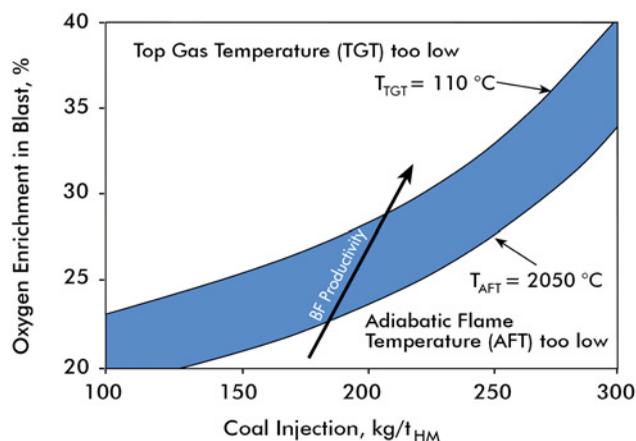
Development of reductant mixes per tonne of hot metal shows that blast furnaces (BF) are mainly fueled with coke and coal, the latter varying by country. The use of oil and natural gas is predominantly limited to a few countries, i.e., Russia, Ukraine, NAFTA, where these are available at low cost. In the EU, oil and gas have to be highly paid for.

Evaluation of energy prices shows that coke, too, ranges at high levels. Throughout the last 2 years, e.g., average coke price volatility was 17 %/a. Today, coke amounts to 11 % of the total costs for 1 t of steel. Its consumption decreased and this trend is expected to continue.

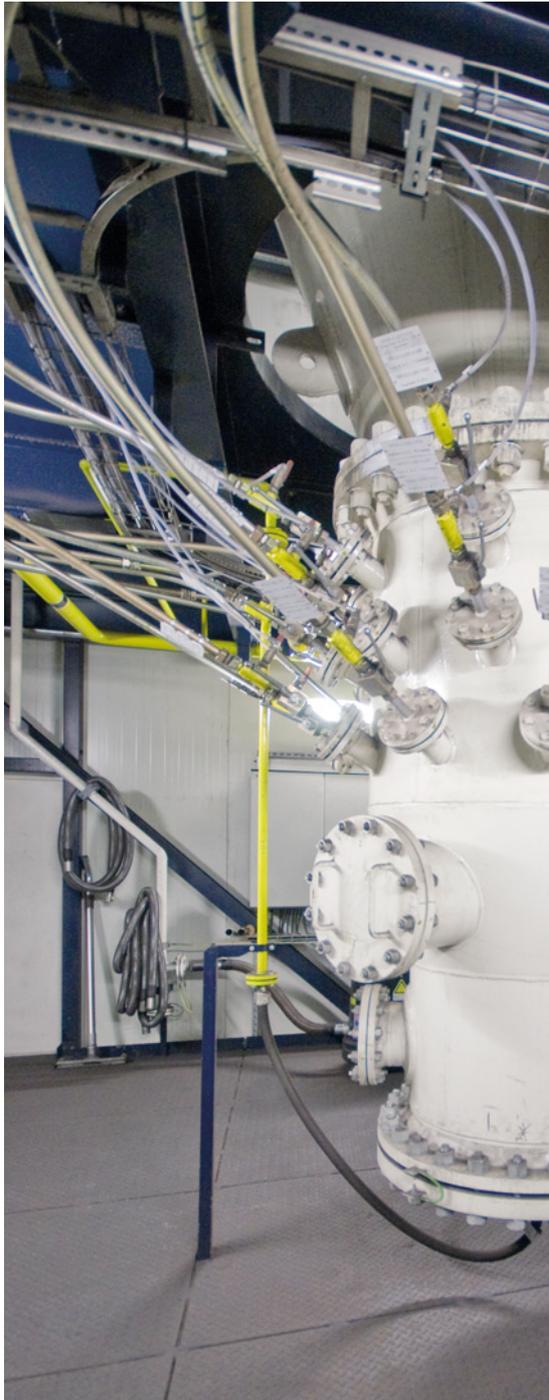


Adding Value by Increasing PCI Rates

Just a simple sample calculation assesses the potential hidden in your plant: BF require typical coke rates of 500 kg/t_{HM}. Substitution by PC helps to drastically lower this consumption. Characteristic replacement ratios from 0.85 to 0.95 depend on coal quality. PCI rates of 200 kg/t_{HM} are just like that practicable, earning you a little fortune of 180 kg coke/t_{HM} plus the carbon footprint involved. What is more, state-of-the-art technology by Küttner enables you to markedly increase PCI rates and benefit from lower raw material costs and higher productivity. How about reaching out for even higher injection rates? Make it reality with Küttner as your reliable partner! PCI has long been believed to be limited to rates of well below 200 kg/t_{HM}. Küttner PCI applications give evidence that this is, by far, not the end of the story, as the optimum BF working range shows.



KÜTTNER GMBH & CO. KG



A globally acting group of companies has developed from the engineering company once founded in 1949 by Dr. Carl Küttner. Nowadays, their main focus is on building turn-key plants for the metal producing and processing industry, especially in the fields of process and smelting technology as well as of materials handling.

Complying with the strong demand for holistic solutions by the ferrous industry, all comprehensive experience gained in the numerous projects in the field of iron and steel metallurgy is concentrated in our PCI team. We commit ourselves to providing our customers with integrated solutions - all available at one stop.

Küttner is supplier of world leading technology for the injection of pulverized coal into the blast furnace. We offer the whole range from coal grinding and drying, preheating up to injection including our innovative inhouse developments ultra-dense flow PCI, Oxycoal+, Preheating. Equipment and technology optionally extended on materials handling is always individually tailored to fully meet the distinct requirements of our customer - as we are well-known for.

You are not sure whether the investment under consideration will be reasonable for your company? You want to learn more about the Pros & Cons? You want to know whether and where latent capacity exists ready to be exploited? Backed up by long-lasting experience in iron & steelmaking and continuously updated by never stop learning, Küttner is also your partner should you be looking for assessment of the hidden potential in your plants and processes.

Our scope of services further comprises the design and engineering, delivery, assembly, as well as the start-up and commissioning of the entire plant including control system and data processing. Küttner is also your essential ally in modernisation, revamps and upgrades. Partnering with Küttner means relying on an experienced team of experts combining process know-how with sophisticated equipment design.

Worldwide personnel of Küttner-Group counts more than 550 employees, their owners themselves being active within the company.

Oxycoal+ is a registered trademark of Küttner GmbH & Co. KG, Essen, Germany

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