



LEADING PARTNER IN
THE WORLD OF INDUCTION

SMS group – SMS Elotherm GmbH

Technology leader

- > 80 years process experience with induction systems
- > 6000 reference plants
- Worldwide service through skilled staff for induction and converter


Facilities & Equipment

- Laboratory for process development
- R&D and production of converters
- R&D and manufacturing of inductors for heating and hardening applications
- 6700 m² assembly and productions facility & electrical connecting power of 3 MW




SMS group – Furnace Divisions

SMS USA Pittsburgh 

SMS group
Beijing, Tianjin, Shanghai 


SMS SpA
Tarcento and Genoa


Drever International
Liege


SMS group
Düsseldorf 


SMS Elotherm GmbH


Remscheid, Germany

SMS Elotherm
North America LLC 

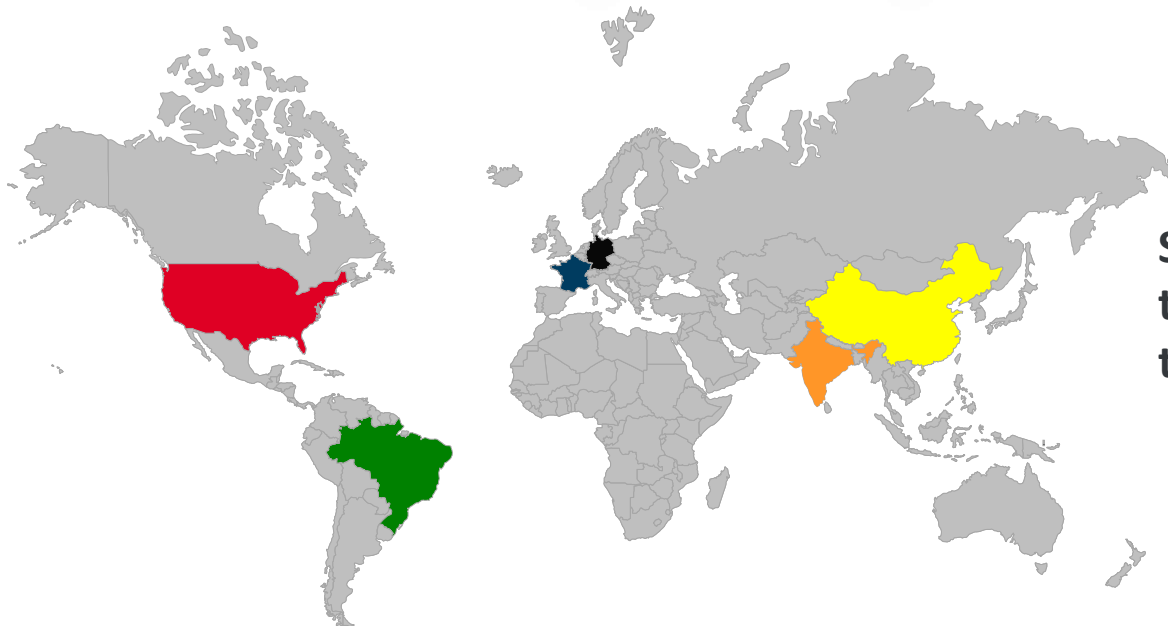
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Induction Ltd. 

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do Brazil 

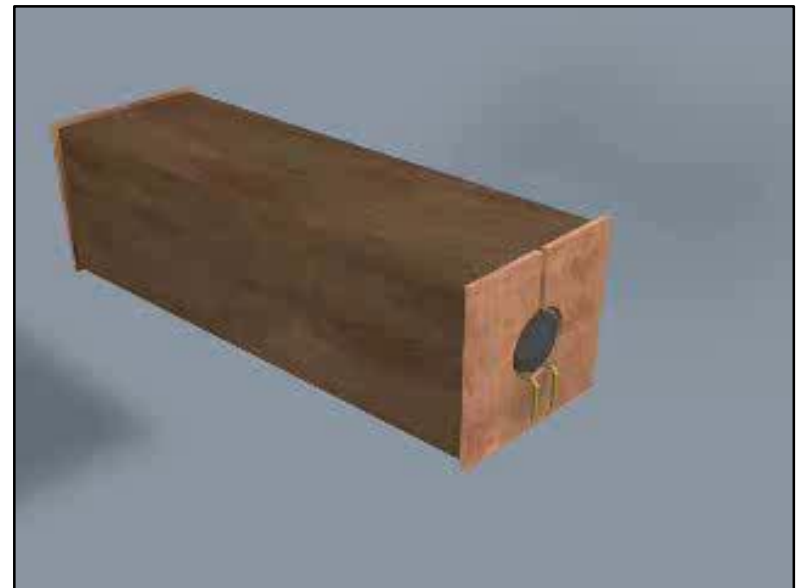
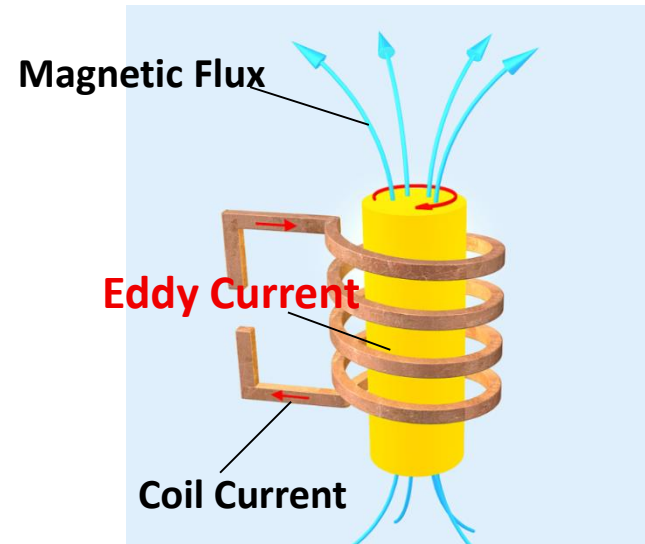
SMS Elotherm
India 



SMS group - more than 600 furnace technology experts

Principle of Induction Heating

- Induction heating belongs to the group of direct electro thermal processes,
- The heat is generated directly in the material
- If a metal part (=work piece) is exposed to an alternating magnetic field an eddy current will be generated close to its surface (AC / sinusoidal current) (eddy current in NDT testing)
- The current flow inside the part causes internal heating according to Joule´s law.



Conventional Gas Fired Furnace



- Gas fired heating system → resulting in CO₂ and NO_x emission problems
- Furnace atmosphere → heat transfers via convection and radiation
- Oxygen content in the furnace atmosphere and long soaking times → scale and decarburization
- Very good temperature uniformity even for large material cross sections



Induction Heating



- Emission-free → **No local CO₂ or NO_x**
- The heating sources are generated inside the workpiece
→ **Fast heating and almost no significant scale and decarburization**
- Very high power density → Small footprint
- Fast control → selective temperature from workpiece to workpiece possible
- No standby losses





Induction Hardening

- ELO-X**
modular machine concept
- ELO-RING**
for bearings and gears
- ELO-CRANK**
for crankshafts
- ELO-INDIVIDUAL**
for special applications



Induction heating

- ELO-FORGE L**
for billets up to $\varnothing 165\text{mm}$
- ELO-FORGE XL/I**
for big billets and special applications
- ELO-BAR**
for bars



Quench & Temper

- ELO-QTT**
for tube material
- ELO-QTB**
For bar material
- ELO-HHM**
Hybrid Heating Module



Tube technologies

- ELO-WELD**
for ERW tubes
- ELO-SEAM**
for seam annealing
- ELO-TUBE**
for tube annealing



Metallurgy Applications

- ELO-FLAT**
for flat rolling mills
- ELO-LONG**
for section rolling mills
- ELO-STRIP**
for strip heating
- ELO-BLANK**
for hot forming

Induction material heating is possible for almost all material shapes, such as long products, flat products, strip, bars, blanks, tubes, etc. which is also reflected in the SMS Elotherm portfolio.



Pre-Heating



Re-Heating



CO2 – Savings
Performance Increase
Process Flexibility

Simple adjustment of the heating time - Oven length
Smaller Overall Footprint

Less scale and decarburization
Selective rolling temperature
Lower furnace temperature longer refractory and burner lifetime

Competence for conventional furnace technology and for induction solutions available within the SMS group. Elsewhere competing divisions are working on joint solutions.

Example Flat Product

ELO-FLAT - Flat Heater

Slab reheating takes place in combined thin-slab casting and rolling lines downstream of a tunnel furnace before the first stand of a finishing line.

Further Applications:

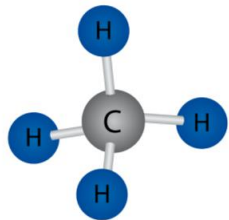
- Preheating for MultiFlex- Quench®
- Boosting temperature after cooling section of caster
- Transversal Flux mode for edge heating

Advantages:

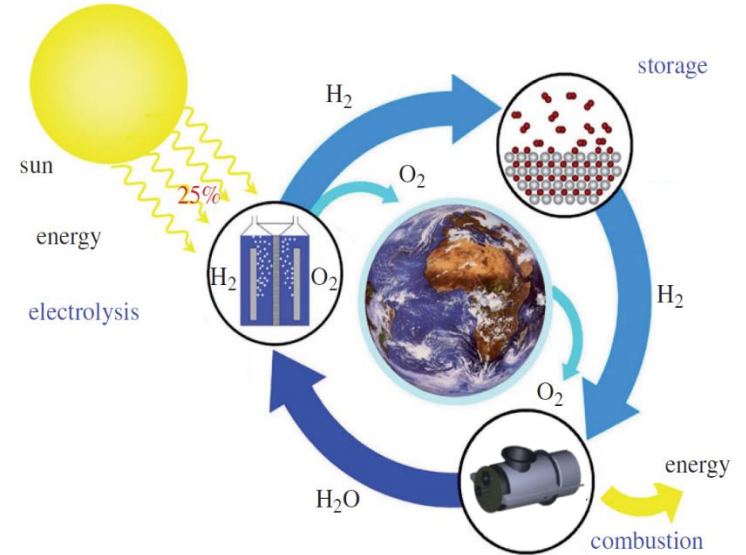
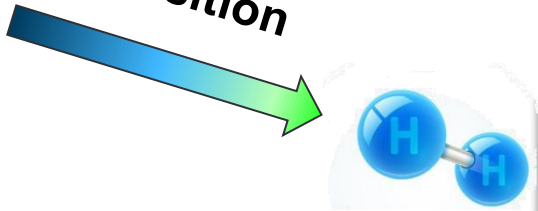
- Complete CO2 free CSP lines
- Furnace temperature can be lowered. Dry furnace rolls are possible. High energy savings. Longer furnace life time (rollers and refractory)
- Temperature wedge in the material can be compensated
- Scale savings
- C-Frame design for independent movement



Reheating Furnaces Combustion Technology – EVOLUTIONARY APPROACH H2



Transition



Flexibility:

From **100% NG**
to **100% H₂**.
With up to **50 O₂**

Safety:

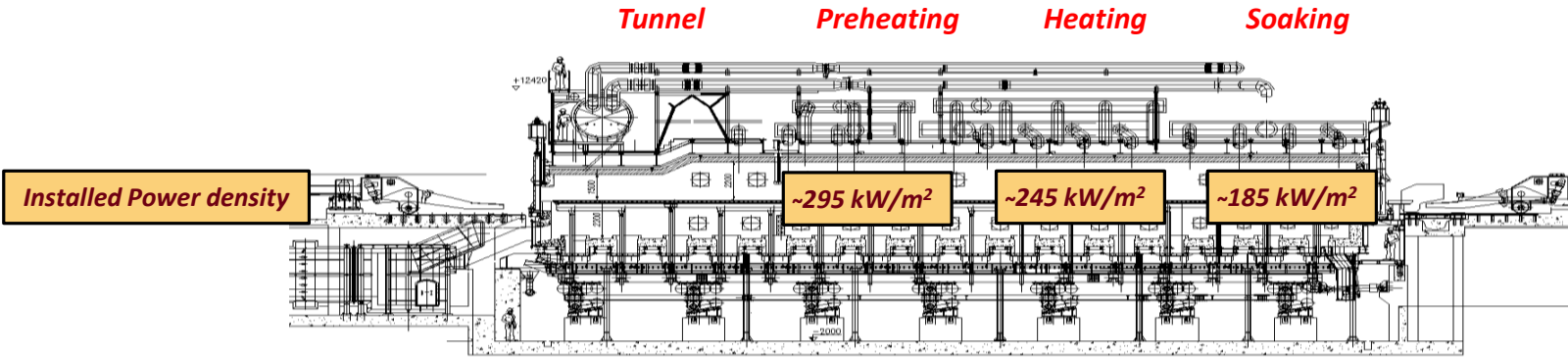
Extensive
laboratory
testing
certified

Environmental:

Flame-less
combustion
under all fuel mix
ratios:
≤ 40 ppm NOx

Reheating Furnaces

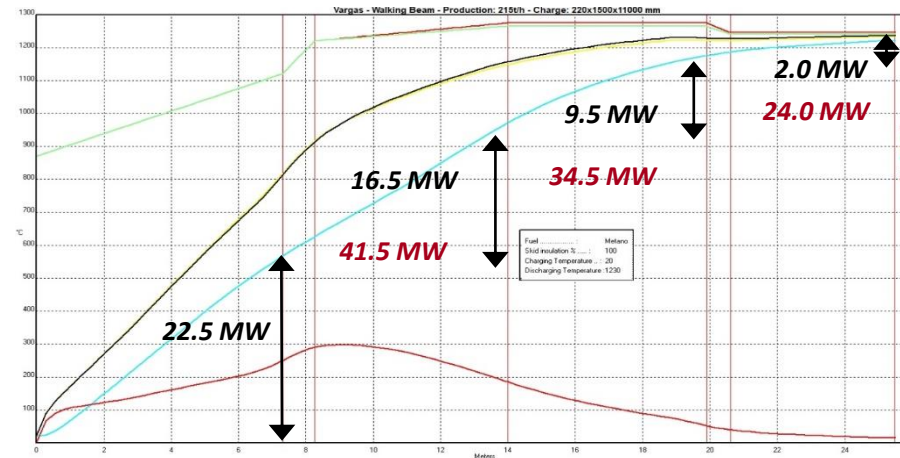
Combustion Technology – EVOLUTIONARY APPROACH - EI



Total power to steel
50.5 MW

Total required power
76.5 MW

Total installed power
100.0 MW



$\eta = 0.66$

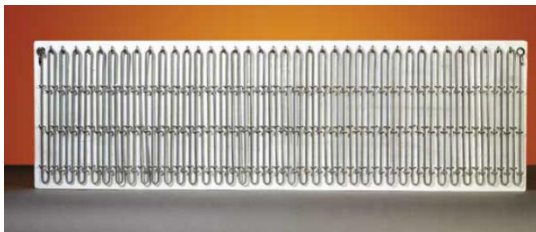
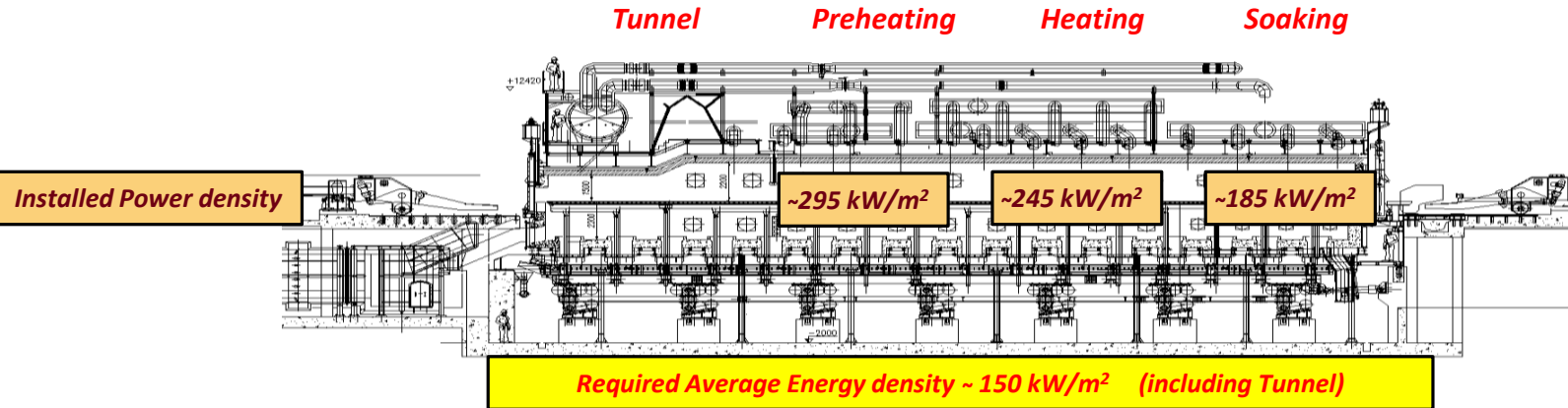
Boundary conditions:
- 215 t/h
- Cold Charge
- Slab 220x1500x11000

Required Average Energy density ~ 150 kW/m² (including Tunnel)

CSP Hybrid – Green Energy

Reheating Furnaces

Combustion Technology – EVOLUTIONARY APPROACH - EI



Super-reflective Electrical Heating Module
Power density
~30 kW/m²

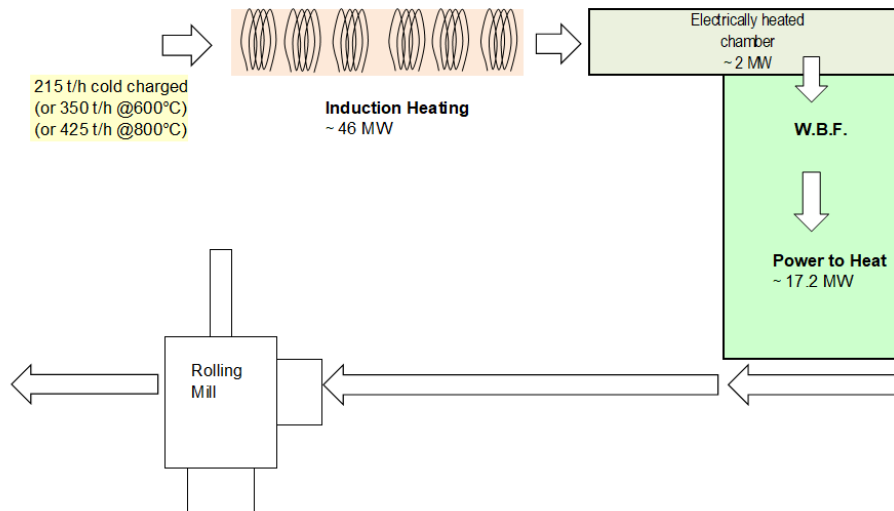


Reheating Furnaces

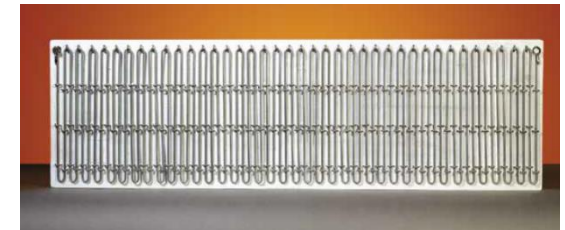
Combustion Technology – EVOLUTIONARY APPROACH - EI

CONCEPTUAL LAYOUT

Phase 2



Slab Induction Heating Coils



Super-reflective Electrical Heating Module

PROS:

- Zero flue
- Still temperature homogeneity ensured compared to IH alone
- You win the Power to H₂ energy conversion

Example Long Product

ELO-LONG Billet Heater

Billets that come from the caster and that are still hot in the core go directly into the rolling line.

There is no intermediate gas furnace.

Further Applications:

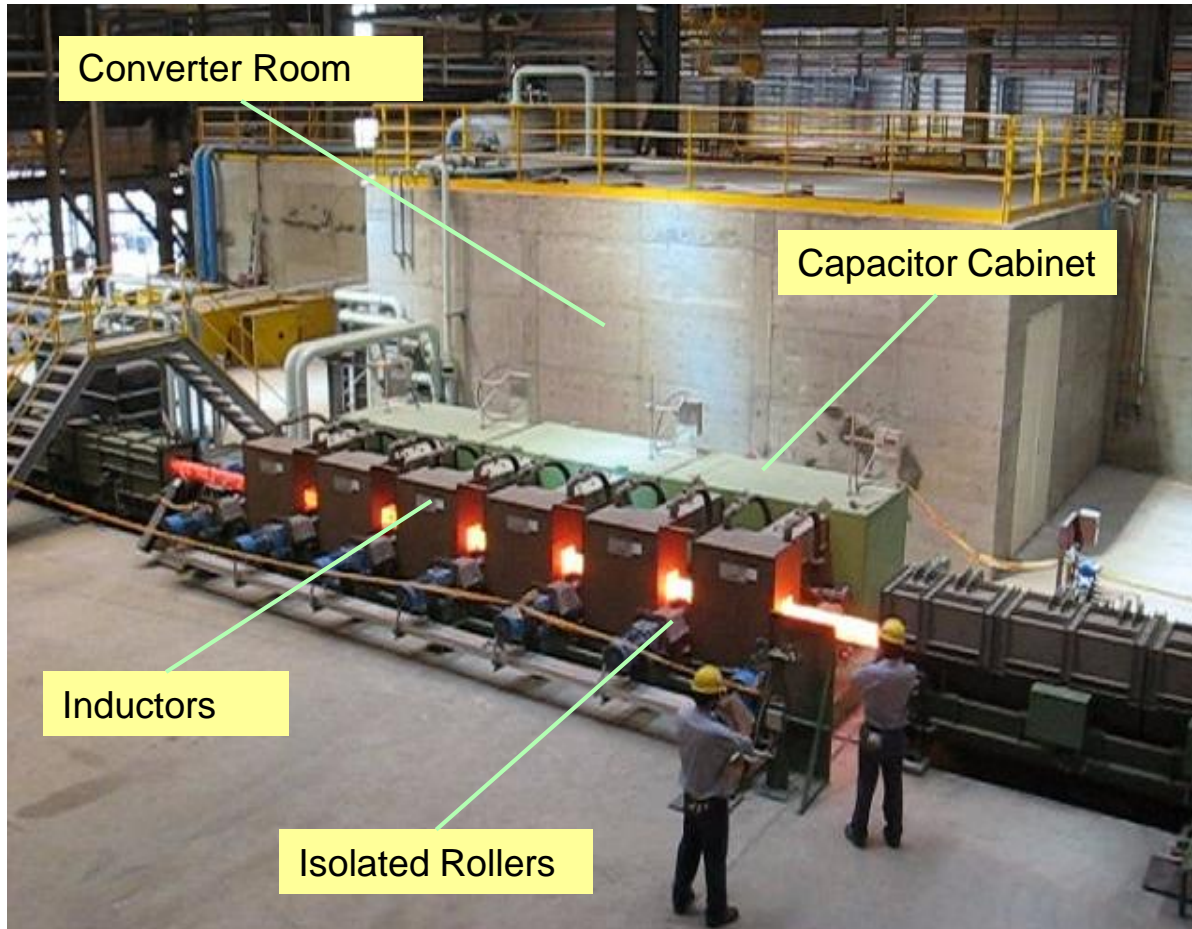
- Performance booster with conventional furnace
- Temperature compensation for billet welder

Advantages:

- Very low energy consumption
- Extremely low scale buildup
- Completely CO2 free



Example Long Product



Key Facts THS 1:

- Throughput Hot Charge
110 t/h
- Throughput Cold Charge
24 t/h
- Energy consumption Hot Charge
23 kWh/t
- CO2 Saving
70.000 t/a
- Scale Saving
1 %

ELO-STRIP Strip Heater

In galvanizing lines or heat treatment lines, strips can be quickly and easily processed by induction, even in an inert gas atmosphere.

Advantages:

- High power densities 2,9 MW per - low footprint
- Fast and precise temperature control
- Thanks to high-frequency converters, even very thin strips can be heated uniformly



Example ELO-STRIP

Bluing

350 – 450 °C

1200 kW

20 kHz



Paint Drying

150 – 250 °C

750 kW

10 – 30 kHz



Anti Fingerprint Heating

35 – 130 °C

1600 kW

30 kHz



Advantages:

- Fast and precise temperature control
- Compact design
- High throughput

ELO-BLANK for Stamping

Currently, blanks are mainly heated by gas-fired roller hearth furnaces prior to stamping. Due to the requirements of the automotive manufacturers for a CO2-free supply chain and due to the reduction of scrap in case of failure, there is a clear trend towards induction.

Advantages:

- Compact plant layout
- High plant flexibility and availability
- Adjustable inductor power
- Heating time of few seconds (high heating rate)
- Emission-free
- Only few scrap parts in case of trouble
- Process-related reduction of post processing
- mech. properties (formability, flow properties) comparable to conventional heating in roller hearth furnace

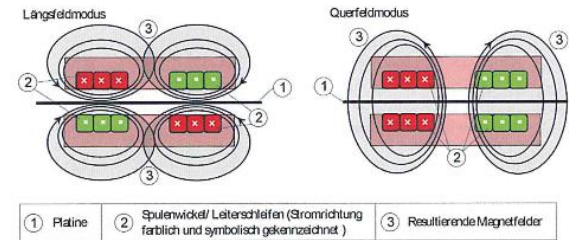


Bild 4: Verschaltung eines Induktors im Quer- bzw. Längsfeld
(Quelle: SMS Elotherm)

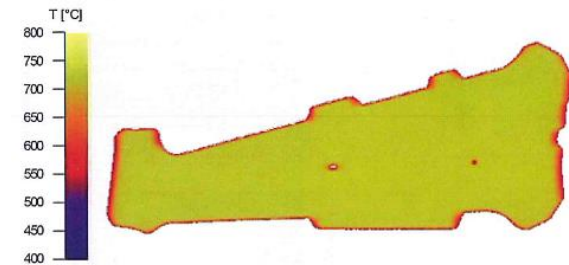
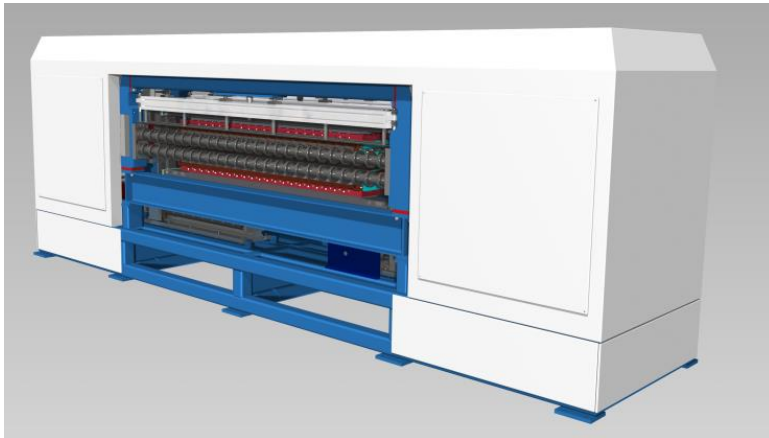


Bild 5: Temperaturverteilung an einer Formplatte (B-Säule) nach induktiver Längsfelderwärmung (Quelle: Volkswagen)

Reference Pre-Heating upstream RHF

Shorter heating time has no influence on material properties (austenitization, hardness)
Heating homogeneity and product quality by induction are comparable with conventional systems

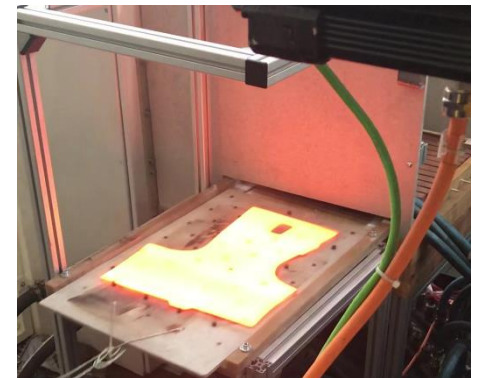
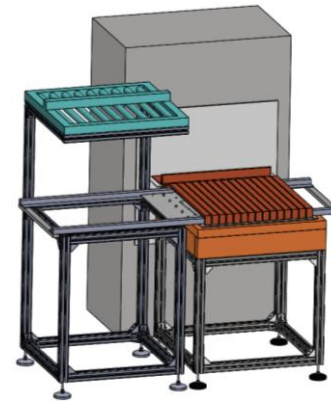
- Temperature: 20 – 700 °C
- Longitudinal / Transverse Field
- Frequency 10 kHz
- Power 800 kW
- No AISI coating shift



Reference complete heating

Heating homogeneity can be ensured by a high-frequency field. Measures against coating shift are necessary.

- Temperature: 20 – 950 °C
- Longitudinal Flux
- Frequency 400 kHz
- Power 340 kW



Induction heating of blanks suitable for mass production for the hot forming process (P 1038/12/2016 / IGF-Nr. 18738 N)

Inductive Tube Heating ELO-TUBE

ELO-TUBE

In addition to tube heating upstream of the stretch-reducing mill, in-line heat treatment such as normalizing can be realized by using high-performance equipment.

Advantages:

- Combined Process – less handling
- Utilization of energy from tubing process
- CO2 savings
- Small Footprint



Reference:

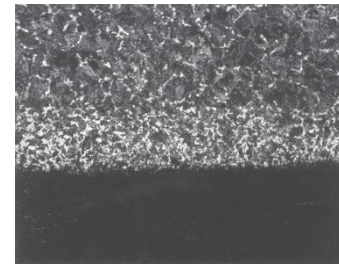
- total power: 12000kW
- amt. of inductors: 8
- frequency: 1,5kHz – 4kHz
- temperature: 750°C – 980°C
- diameter: 245 mm – 255 mm
- wall-thickness: 6 mm – 14 mm
- amt. Pyrometer: 15
- speed: up to 1,5m/s

Quench and Temper line for Bars

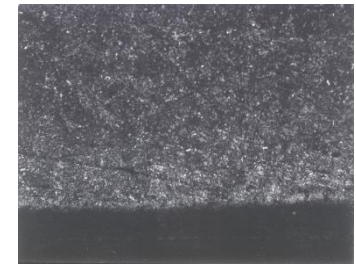
Induction heat treatment of bars is a single process. The material is quenched and tempered head to tail in alignment and thus each tube or bar undergoes a defined and ideal heat treatment. On Elotherm tubes lines are usually produced API grades.

Advantages:

- Complete CO2 free
- High homogeneity of hardness, mechanical properties and microstructure
- No decarburization during the heat treatment process
- Very good straightness after the Q&T process. Savings due to main elimination of straightening processes.



Microstructure of cold drawn raw bar, as rolled 41Cr4 (magnification: 160 X)



Microstructure of the same bar shown on left after Induction Hardening & Temper process 41Cr4 (magnification: 160 X)

Full Induction Reference Q&T Line for bars

- 2 metric t/h for all sizes
- 20 – 80 mm bar diameter, 12m length
- Footprint 60 x 10 m
- Steel grades: 42CrMo4, SAE 4140, 4145, 4340, 5140

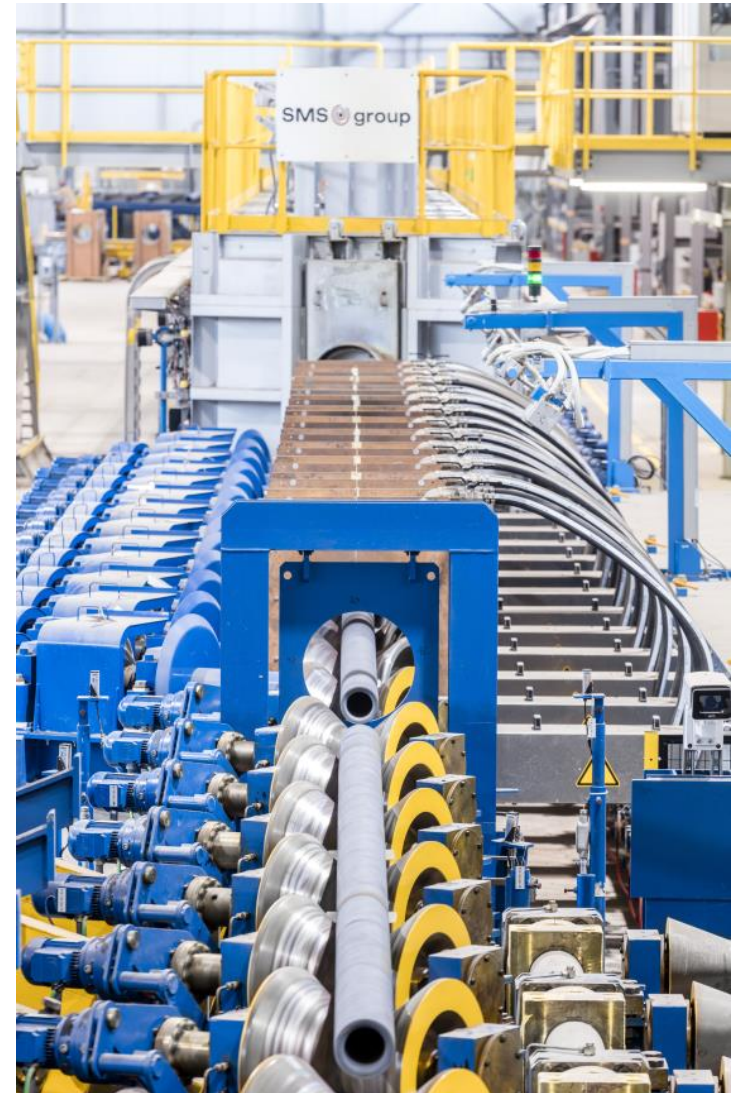


ELO-QTH Hybrid Quench and Temper line for Bars and Tubes

A combination of an induction and an furnace brings significant advantages. For example, Timkensteel used induction preheating.

Advantages:

- Flexible throughput adaptation
- Increased holding time (diffusion, tempering,..)
- Capacity booster
- Flexible energy demand
- CO2 savings
- Smaller Footprint
- Compliance with conventional standards thanks to the downstream gas furnace



Summary

- For CO2 savings, almost all conventional heating processes can be replaced or supplemented
- Induction solutions are characterized by high power densities, small footprint and immediate availability
- The larger the parts and the longer the holding times, a full inductive solution is less suitable
- A combination of induction + conventional furnace is a logical intermediate step towards a CO2 free future



LEADING PARTNER IN
THE WORLD OF INDUCTION

SMS Elotherm GmbH
Thank you for your attention!