STATE OF THE ART HEAT TREATMENT FOR PLATES

LOI THERMPROCESS GROUP

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Heat Treatment Flat Products

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Agenda

STATE OF THE ART
HEAT TREATMENT OF PLATES

- Tenova LOI Thermprocess
- Introduction
- Heating
- Roll Drives
- Quenching
- Mathematical Models
- Conclusion

LOI Thermprocess

Tenova LOI Thermprocess is one of the leading companies in supplying industrial furnace systems for the heat treatment of metals. Worldwide clients rely on the experience and technical solution competence in the field of material properties and secondary metallurgy.

Heat Treatment Plants for Heavy Plate

INTRODUCTION

31 Customers
27 Q&T Lines

56 Furnaces
31 Quenches

USP‘s

- 3rd Gen. metallurgical model
- Patented nozzle/roller system for quenching
- High Convection Technology for tempering

APPLICATION

- Lightweight constructions
- Infrastructure/Energy industry
- Mining Industry/Raw materials

INSTALLATIONS

- Europe: SSAB, Salzgitter AG, NLMK, thyssenkrupp (tkSE)
- America‘s: SSAB, Nucor, ArcelorMittal
- Asia: Baowu, Xing Cheng, Ansteel, Shandong

Why & Where (some Examples)

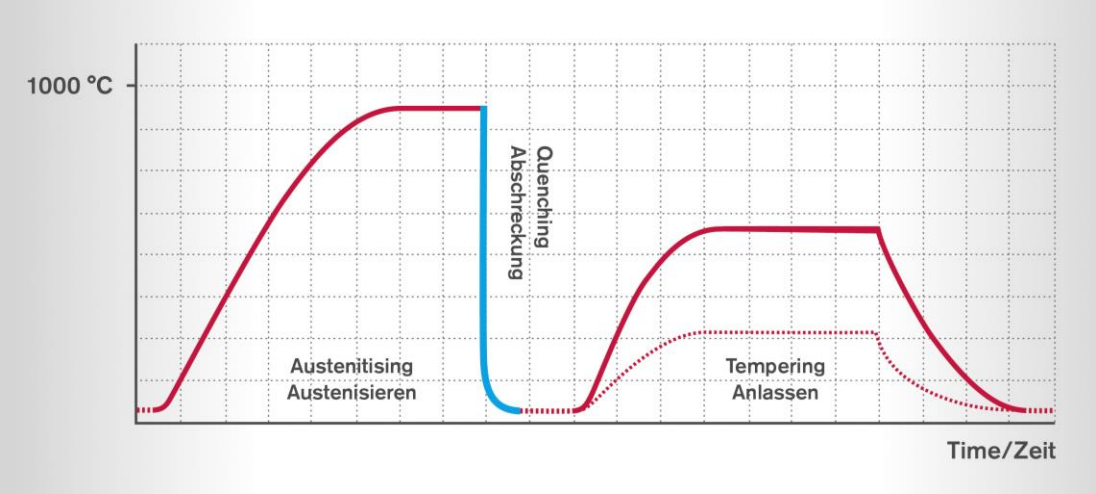
INTRODUCTION

HEAT TREATED PLATES ARE USED

- to increase pay load
- to extend lifetime
- for special construction

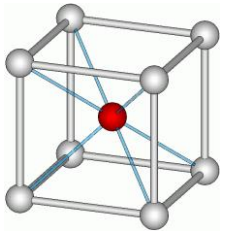
Heat Treatment Process - Basics

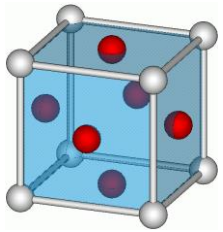
INTRODUCTION

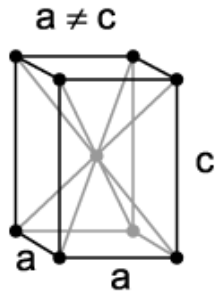


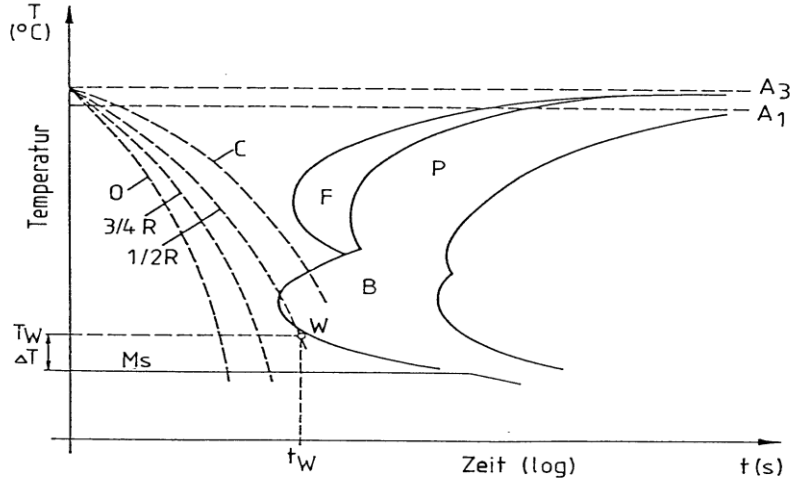
THE HEAT TREATMENT PROCESS

- consists of several steps
- is based on CCT-diagrams
- considers the phase transformations



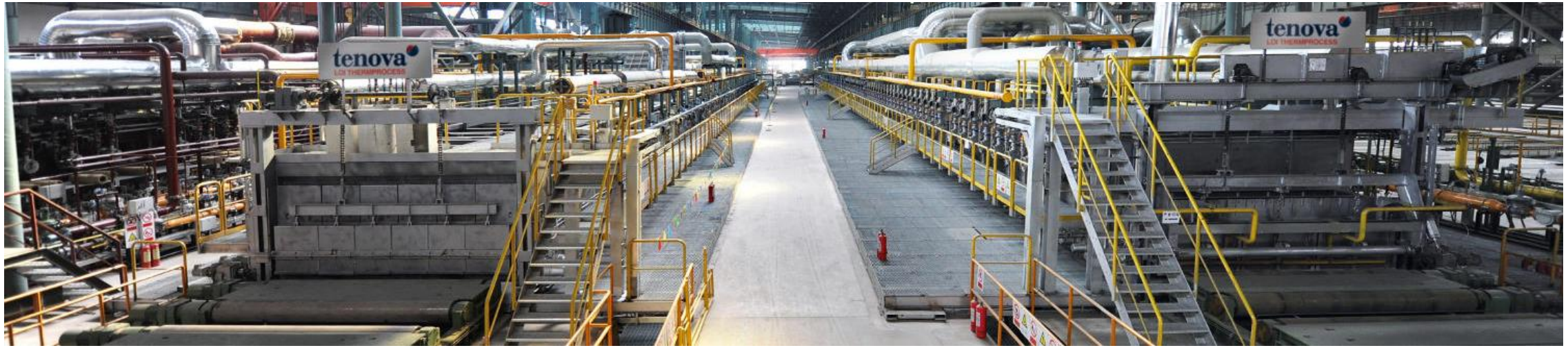






Heat Treatment Equipment

INTRODUCTION



EQUIPMENT

- (Roller Hearth) furnace(s)
- Protective gas atmosphere
- Open fired
- High convection tempering

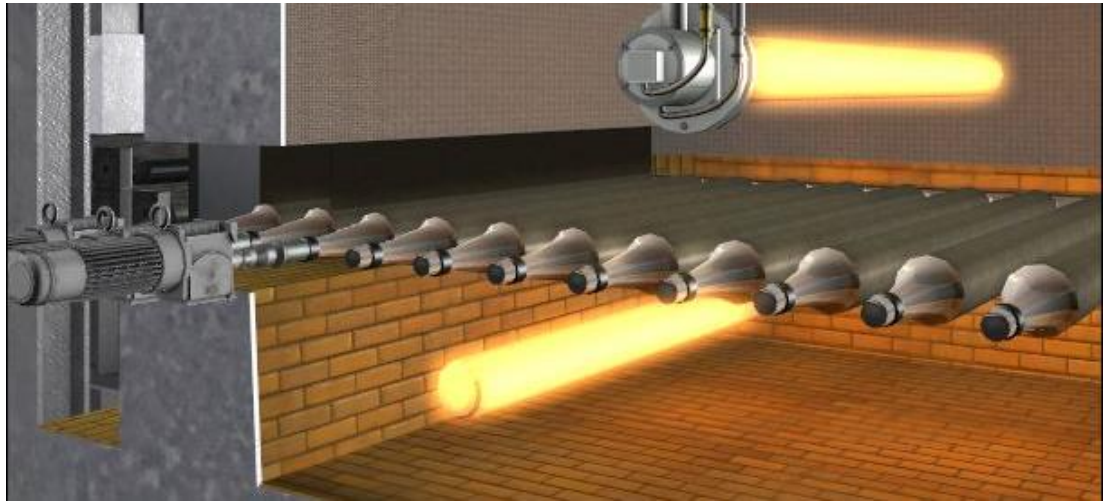
- Continuous quench

REQUIREMENTS TO EQUIPMENT

- Best temperature accuracy
- Low consumption
- Low maintenance
- Fastest cooling rates
- Controlled cooling rates
- High flexibility

Indirect Heated Furnaces

HEATING



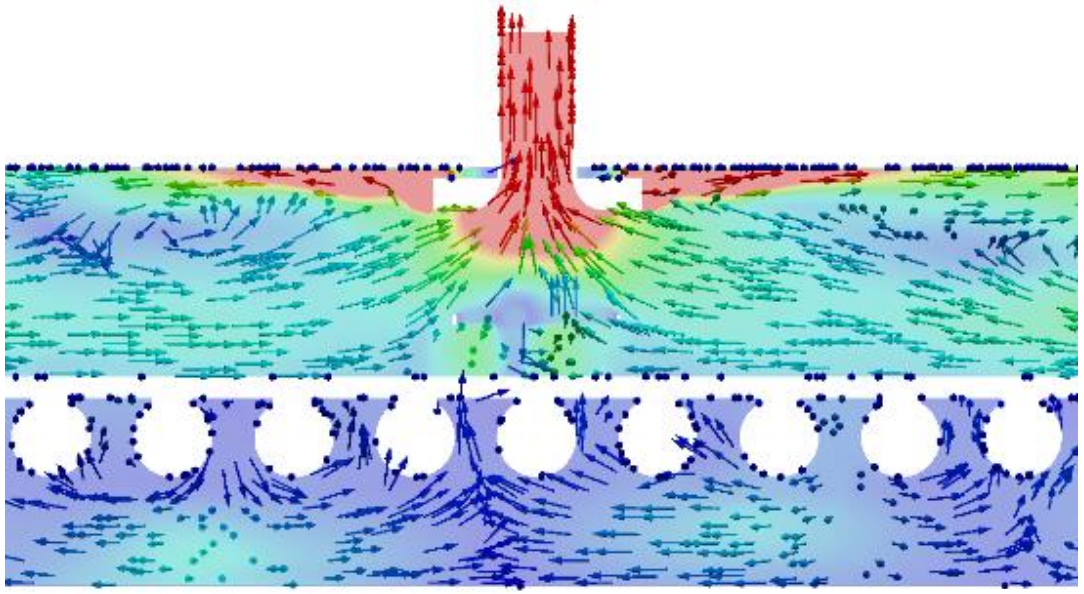
INDIRECT HEATING SYSTEM

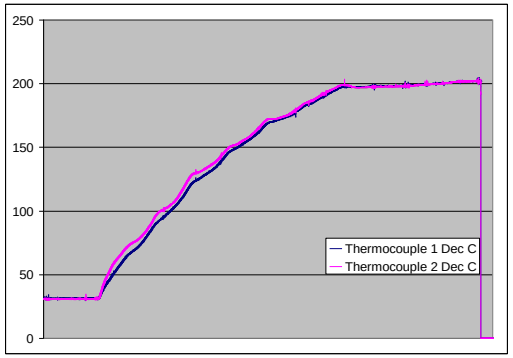
- Roller hearth furnace
- Heating via radiant tubes
- Nitrogen atmosphere

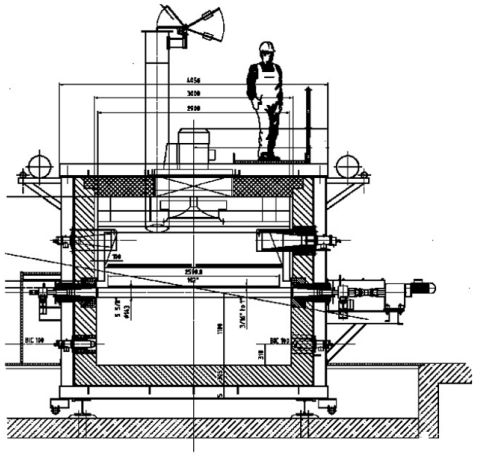
- No scale formation as basis of proper quenching
- No further decarburizing of the plates
- Extremely good temperature uniformity
- Thermal model to calculate the temperature of any plate thicknesses

Tempering Furnaces with High Convection

HEATING





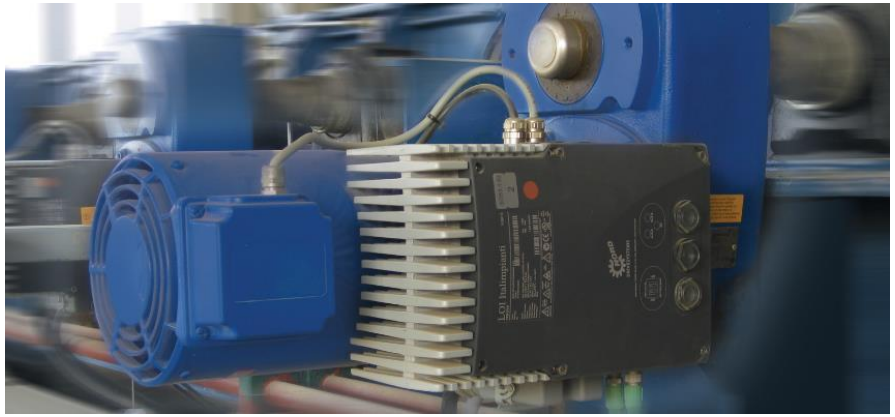


HIGH CONVECTION SYSTEM

- Roller hearth furnace
- Hot gas circulation
- Oxygen atmosphere
- Open fired, central recuperation

Common Quench & Furnace Features

ROLL DRIVES

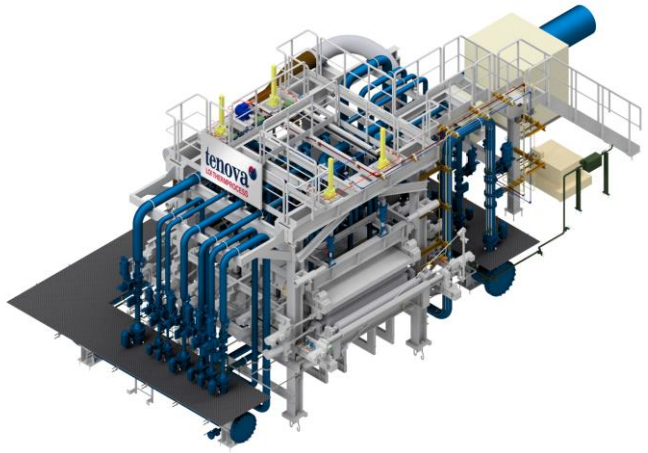


ADVANCED DRIVE UNITS

- Single roller drive
- Robust, local and pluggable
- Reduction of cable length
- Reduced demand on switch cabinets
- Reduced space for switch cabinets
- Plug & Play due to pre-parametrisation

Quench Systems

QUENCHING



QUENCHES FOR THIN PLATE

- High pressure section for fastest cooling
- Martensitic hardening
- Thickness range 2 ~ 15 mm
- Continuous passing mode

QUENCHES FOR THIN AND THICK PLATE

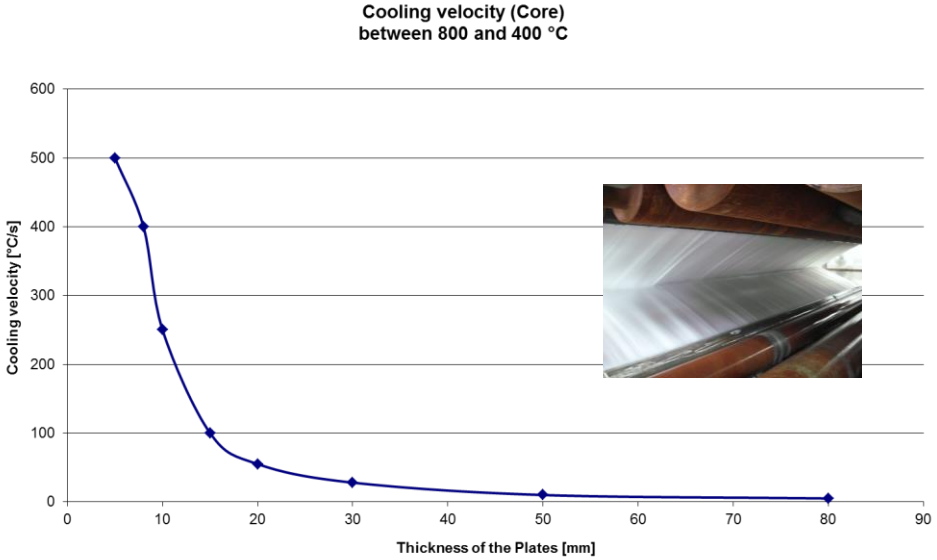
- High pressure section for fast cooling
- Low pressure section for final cooling
- Several cooling modes
- Thickness range 3 ~ 100 mm
- Continuous and oscillating mode

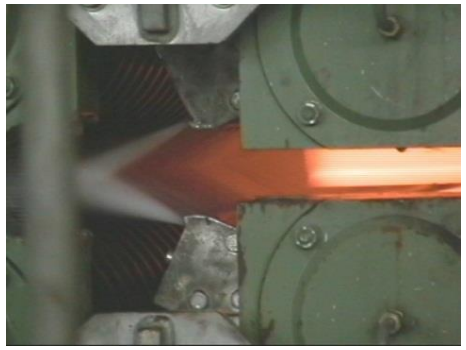
Quench Systems

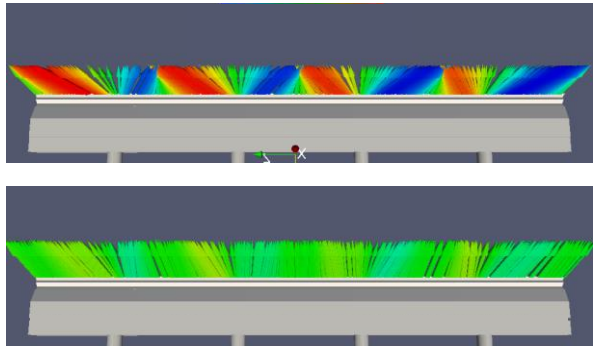
QUENCHING

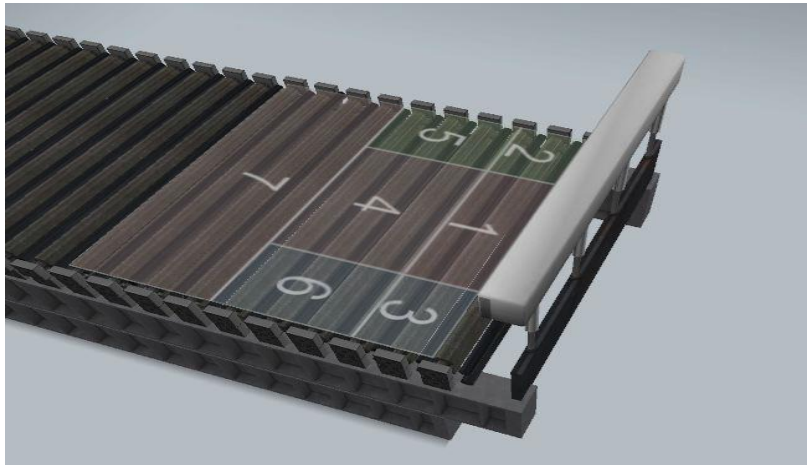
QUENCHES FOR THIN AND THICK PLATE

- Multiple zones across plate width and length
- High precision control of water flows
- Optimized slit nozzle design
- High and low pressure quenching
- Plate pressing by upper roller table
- Various quench modes
- Quench recipe administration



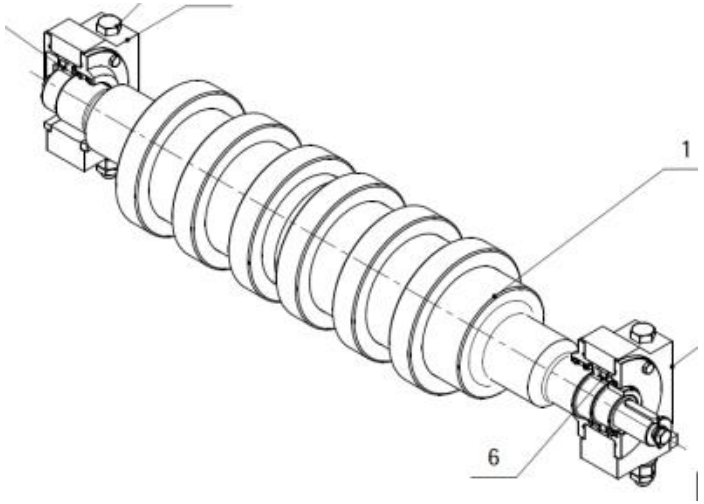


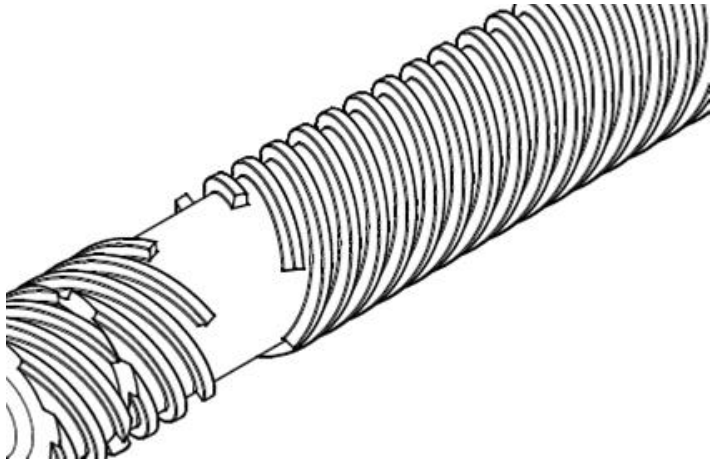


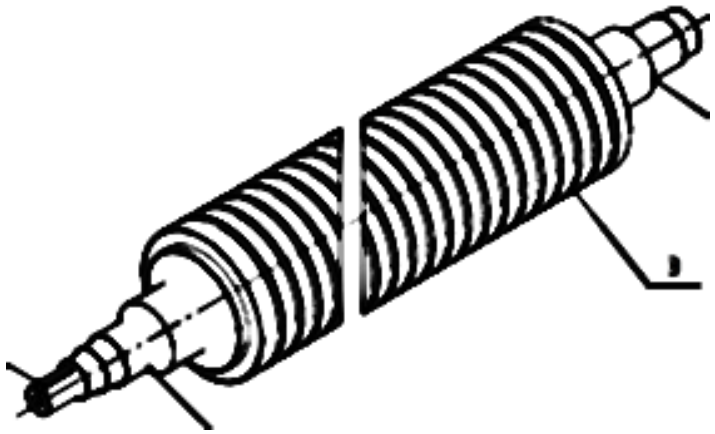


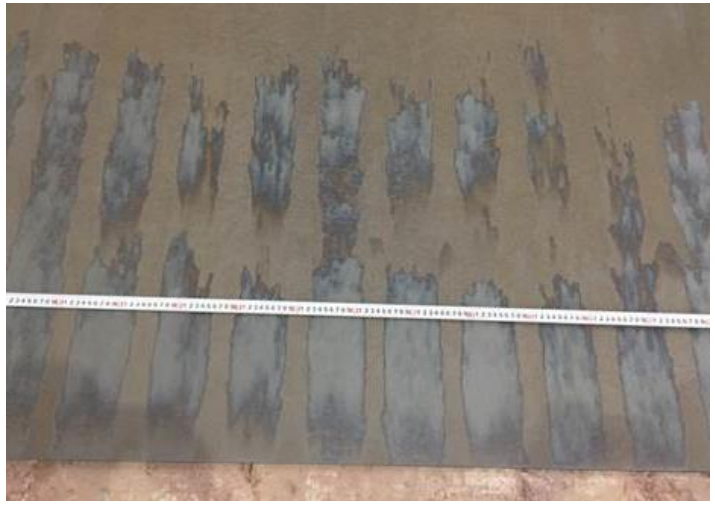
Special Roll Design to minimize Surface Patterns

QUENCHING

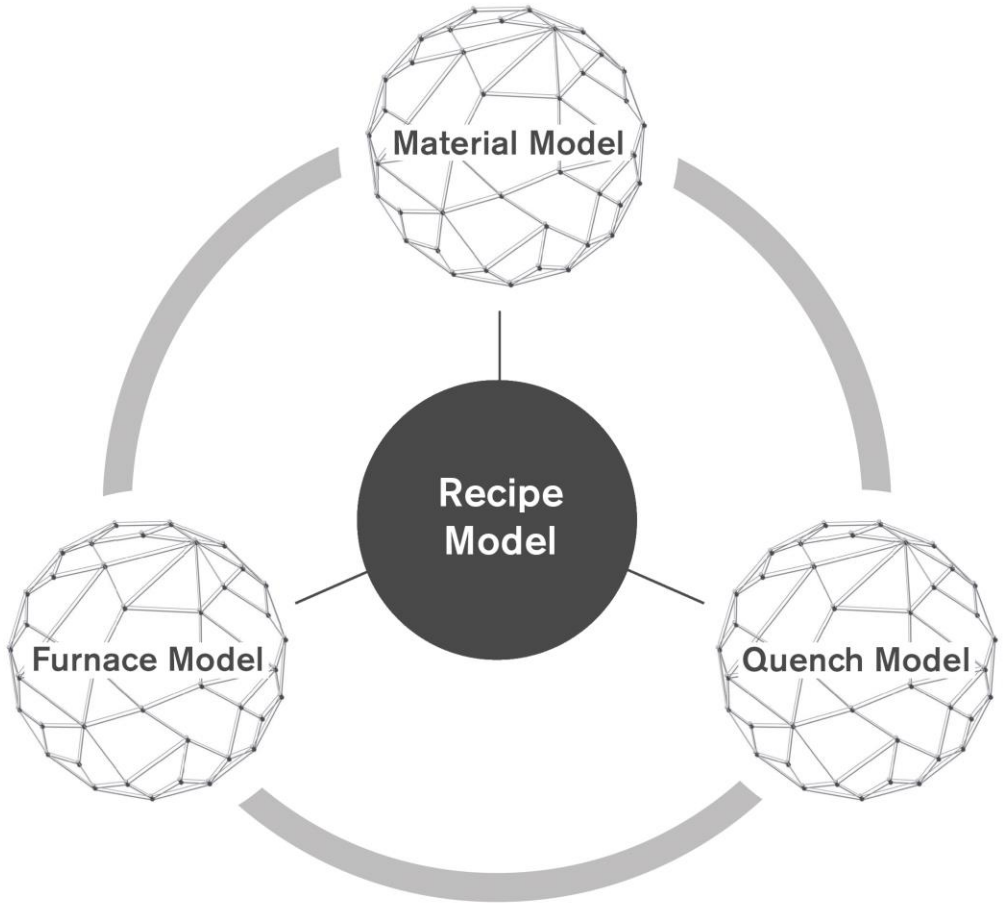








Full Range of Mathematical Models



MATHEMATICAL MODELS

Furnace Model

- to determine the heating process and the control of the heating system

Quench Model

- to determine the cooling process
- to optimize the plate flatness

Material Model

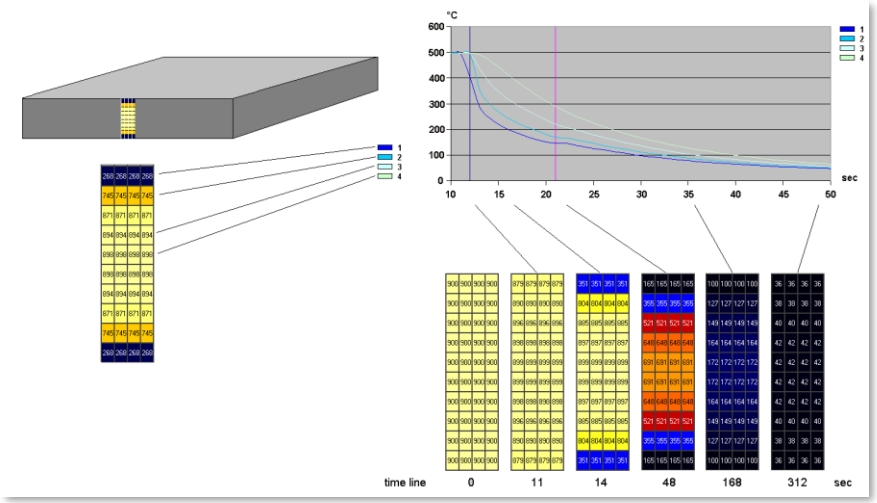
- to determine the microstructure and the mechanical properties

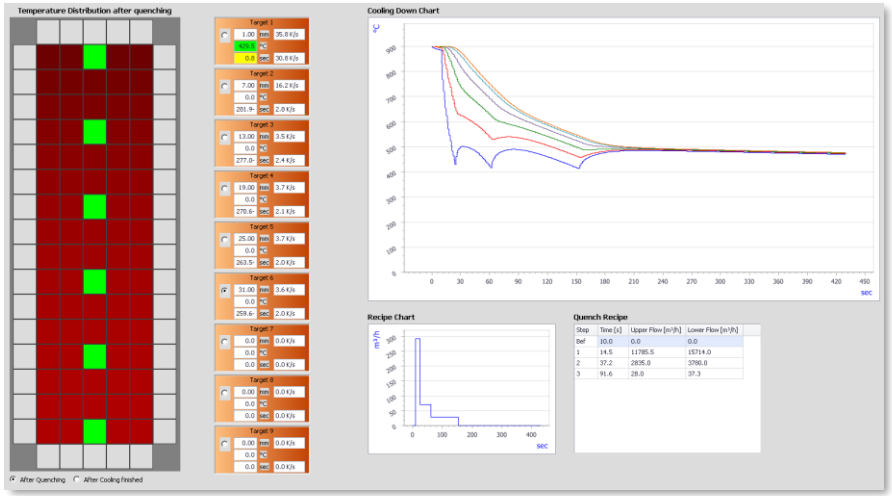
Recipe Model

- to generate recipes according to the required material properties

Recipe Model

MATHEMATICAL MODELS





THIRD GENERATION MQM

- Proven mathematical Model to determine/calculate recipes
- Graphic editor to create/import product profiles
- (shapes)
- Universal model for different shapes/bodys
- Determination of mechanical product properties after heat treatment
- Target quenching

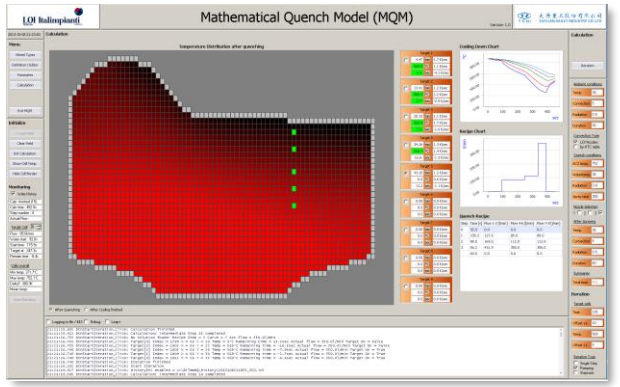


Plate Flatness Model

MATHEMATICAL MODELS

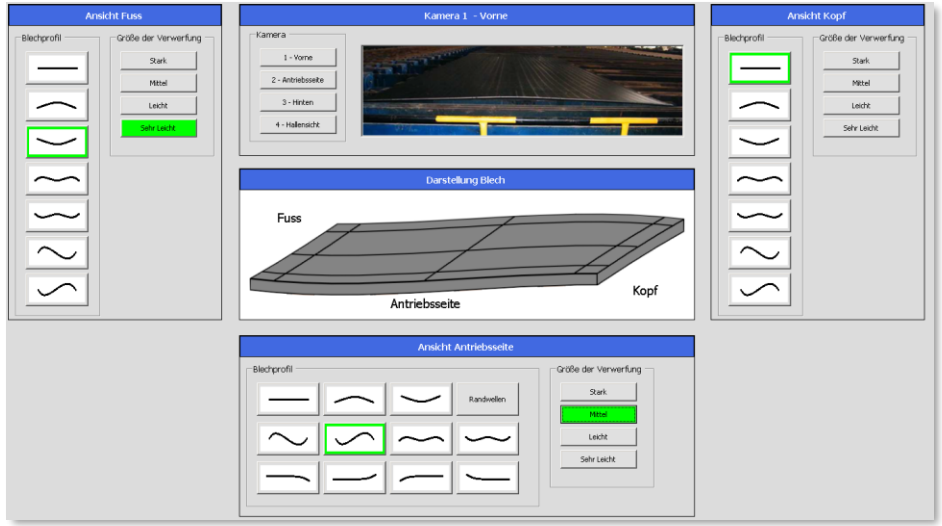
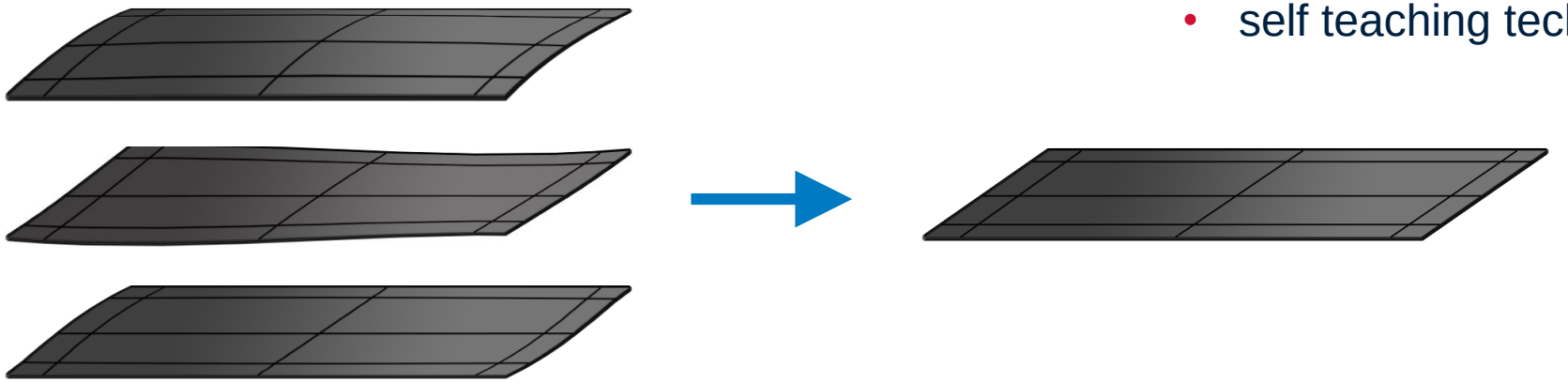


PLATE FLATNESS MODEL

- Optical inspection by operator
- Judging unflatness in dialog with the model
- Setting measures according to the detected unflatness
- Automated process by camera possible
- Creating a new recipe by using
  - basic corrections
  - self teaching technology by experience



Steel Treatment in Perfection

CONCLUSION

- **World market leader** and **your global partner** of plants for the reheating and heat treatment of modern and most advanced materials and secondary metallurgy
- Tenova Thermprocess is **represented in all major markets** throughout the world
- Everything from a **single source**: comprehensive process know-how, design (mechanical, electrical & automation), scheduling & installation as well as modernization, maintenance & service
- Positive **synergies** for the iron, steel, non-ferrous, automotive and aluminium industries due to the international establishment of Tenova Metals

tenova
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THANK YOU

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