

TRAINING-ID: 1000-L1-01

Basics of PHS - Heat Treatment & Hot Forming of Steel (3 days)

DESCRIPTION

The overall performance, the variety of methods and the high number of practical examples of the seminar are designed in a most helpful way for efficient learning. You will have the opportunity to experiment with various parameter and experience Hot Sheet Metal Forming in a daily basis and acquire a deep insight and an efficient method of operating for this technology.

A detailed view about the topics will be given below. Although the range of the course is going from the state-of-the-art press hardening process to solution-based problem solving approaches and finishes with new innovative ideas in the hot forming sector.

AUDIENCE

Engineers, technicians and foremen in the fields of production, assembly, process planning QM & QS and technical sales.

BENEFITS

The overall performance and the variety of methods of the seminar are designed most helpful for efficient studying. You will have the opportunity to experiment with various parameters and experience Hot Sheet Metal Forming in the field and acquire a deep insight into the most efficient skills in technology.

METHODS

digicon Academy provides a focused, practically and economically oriented knowledge transfer in the form of seminar lectures and field tests on samples. The involved trainers are highly qualified and experienced key players in the PHS-market.

CONTENT

T1 – Fundamentals

As the topic header already suggests this chapter is all about the fundamentals for press hardening. It aims at creating a basic understanding what press hardening is and what the big advantages behind this technology are. The focus goes towards the automobile industry. Moreover, into the direction of crash performance and the usefulness of press hardened products in this field.

Crash performance

- Steel banana
- Specification of material strength classes
- IHS tests
- UHSS product examples in the automobile industry

Press hardening methods

- Direct press hardening
- Indirect press hardening

T2 – Semi-finished Products (press hardenable materials)

This unit is all about the materials and coatings that can be effectively used for hot forming of steels. It gives a short overview about the material structures and alloy contents that need to be insured. The state-of-the-art material, the 22MnB5 is discussed and compared to new innovative ideas generated from the material- and coating point of view.

Fundamentals for press hardenable materials

- Overview of the needed material structure – ZTU
- Carbon content
- Alloys

Boron alloyed steel – 22MnB5

- Uncoated
- Al-Si coated USIBOR1500P
- Zinc coated

- Diffusion and austenitisation

Non-corrosive stainless steel

Material combinations – tailor made materials (HSLA)

Further materials

T3 – Measurement Systems

Before going into the first practical unit of this seminar a knowledge about the current needed measurement systems in a hot forming process need to be discussed. Measurement systems are needed to guarantee a specific heating rate in the oven but also need to monitor the cooling rates during the forming process.

Overview of state of the art temperature measurement systems

- Thermocouples
- Pyrometer
- Thermo camera

P1 – Laboratory heating fundamentals

Based on the knowledge gathered in the previous units this practice aims on getting a feeling about the material heating and cooling. Experiments are made with different test parameters concerning, material thicknesses, cooling media and transport times. This will give a comprehensive understanding were temperature losses can potentially occur during the press hardening process.

Working with the roller hearth furnace

Heating and cooling of press hardenable materials under different conditions

- Metal sheet thickness
- Transport times
- Cooling on air
- Temperature losses
- Measurement system (Thermocouples, Thermo camera, Pyrometer)

T4 – Heating Technologies

There are various different heating possibilities for press hardening. Still, state of the art tells another story. Roller hearth furnaces are primarily used in the process chain of press hardening. A close look into this technology will be given in this unit. What is the operating principle? What is the efficiency of this technology? How can you calculate the needed energy for your products? Just to name some of the question that will be answered in this unit. Nevertheless also other heating technologies are discussed and compared to roller hearth furnace technology.

Fundamentals

- Radiation
- Convection
- Heat transfer

State of the art roller hearth furnaces

- Operating principle
- Efficiency level
- Energy recuperation
- Advantages and disadvantages of this technology

Alternative heating concepts

- Induction
- Conduction
- Indirect induction (flat iron principle)
- Infrared

T5 – Tool- and Plant Technologies

Tool design plays a big role for hot forming because the cooling of the material during the forming process is the main reason for achieving a high strength product. The unit provides information about overall tool setup and design, different cooling strategies and materials and coatings used tool manufacturing.

Furthermore, knowledge of a hot forming serial production line is provided. This includes the different units needed within the press hardening process, handling in-between the units and measurement systems which provide the quality of the process. Also a fundamental

knowledge of different press designs is created within this unit.

Usefulness of cooled tools

Construction of a cooled tool

- Monocoque construction
- Segmented construction
- Rapid-Tooling
- Casted construction

Tool raw materials & surface treatments (overview)

Structure of a serial production plant

- Handling
- Oven
- Press
- Interface analysis
- Sequences in-between the single components & their linking

Inline measurement

Structure of a press

- Necessary equipment
- Velocities
- Forces

Cooling aggregates

P2 – Laboratory test tool

First press hardening experiments with a simple flat tools are made and investigated. The focus hereby lies on the cooling of the material. Different cooling media are compared and the difference in hardness of the products are measured. Also, the influences of different heating curves in the furnace is considered within this unit.

Micro hardness measurement

- Air cooled part
- Tool cooled part
- Temperature variations

T6 – Simulation for hot forming

The unit aims at creating a comprehensive understanding of simulation as tool for supporting the hot forming process. The unit is not designed for simulation engineers but for forming engineers and technicians to get a better feeling of the importance of simulation as a tool to increase overall development efficiency for a product.

Fundamentals

- Influence parameters
- Interaction of mechanical and thermal properties
- Failure criteria

Outlook tool calculation

P3 – PHS Laboratory

This practical block aims towards the manufacturing of industrial realistic geometries. In detail a sample automotive part is manufactured. The whole process chain, starting from the semi-finished sheet metal, through part heating, direct press hardening with included measurement systems towards product final inspection is shown.

Press hardening of a PHS-part

- Temperature measurement during the forming process
- Temperature measurement after the forming process

Validation of Hot spots

P4 – Follow-up Operations

Follow-up operations are normally the last finishing step in a standard press hardening process chain. This part focuses on the part measurements in terms of quality control and the differences in trimming operations with high- and ultra-high strength steels to normal steels.

Trimming

- Laser trimming (practical)
- Hard trimming (lecture)

Part measurements

- 3MA System (practical)

T7 – Summarization & exam

- Summary of the training
- FAQ
- Feedback