A NEW GENERATION SIMULATION EXPERIENCE

TRANSVALOR

FORGE®

Induction forge heating and heat treating

What is the best design for an inductor? What frequency should I apply? What is the impact on part metallurgy? You need to master your induction heating to control cross section temperature profiles and to optimize the power used by the generators?

After some theoretical refreshers, you will study how to implement simulated induction heating with a static billet or one that moves through the inductor. You will be able to analyze the influence of the inductor's design, of the presence of concentrators and test the impact of the various generator parameters. Then you will go on to look at heating for heat treatment placing the emphasis on metallurgical aspects, predicting the area that is thermally affected and the use of static or mobile inductors. This way you will understand the thermal and electromagnetic phenomena for optimizing heating conditions.

LEVEL

Advanced - Users willing to improve their expertise in simulating induction heating applied to forging or heat treatment.

PREREQUISITES

A knowledge of material science or induction technology.
A good grounding in the use of FORGE® is required.
Have completed the 'Starting with FORGE®' training or equivalent course.

GOALS

- **Understanding the theoretical models implemented for the induction process: Maxwell's equations, thermal solver and coupling algorithm**
- **Knowing how to define and modify the various process parameters that may influence heating efficiency (intensity and frequency of the incoming current)**
- **Mastering the mesh immersion technique to generate the overall mesh (air+billet+inductor)**
- **Simulating induction heating prior to forging or heat treatment**
- **Determining the heat penetration depth and assessing the size of the heat affected area**
- **Avoiding defects linked to non-uniform temperature profiles and improving the quality of the manufactured part**
- **Optimizing generator parameters to reduce energy costs and increase productivity**

OTHER RECOMMENDED COURSES

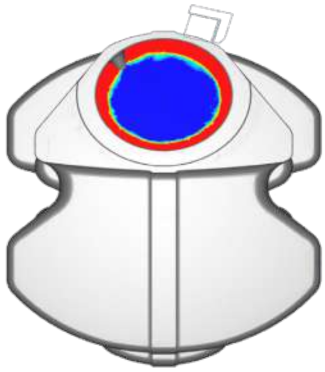
- FORGE® - Automatic optimization

DURATION	DATES 2024		
2 days	21-22 March	18-19 July	14-15 November

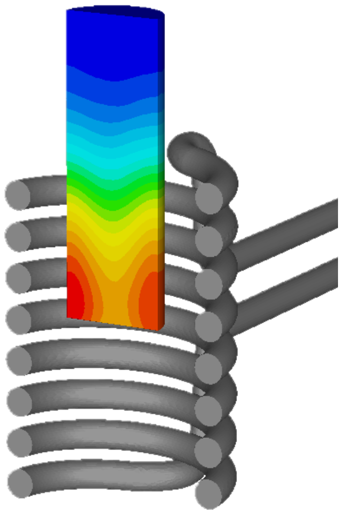
TRAINING	PRICE EXCL. TAX	PARTICIPANTS
Inter-company	1500 € per person	3 to 8 people
In-company	3200 € per training	1 to 3 people

DAY 1 > 8.30 a.m. to 12.00 p.m. & 1.30 p.m. to 5.00 p.m.

Introduction	▪ Presentation of Transvalor ▪ Course goals
Modeling	▪ Maxwell's equations ▪ Thermal equations ▪ Couplingthermal and electrical equations equations ▪ Properties: electrical resistivity, magnetic permeability, skin thickness, etc. ▪ Coupling with metallurgy
Induction heating (Tutorial case)	▪ Electromagnetic computation - Defining of the input and output current - Definition of the mesh for the 'Room mesh' environment - Creation of the global mesh - Mesh suited to the skin thickness - Checking the quality of the global mesh ▪ Thermal computation - Defining the billet - Parameters of the simulation: storage, heating time, coupling with electromagnetic computation ▪ Starting computation - Chaining computations by activating the In Loop option - Chained induction and forming simulation ▪ Analyzing results - Evolution of temperature, magnetic fields, magnetic potential, induced current - Display a field in an isovolume



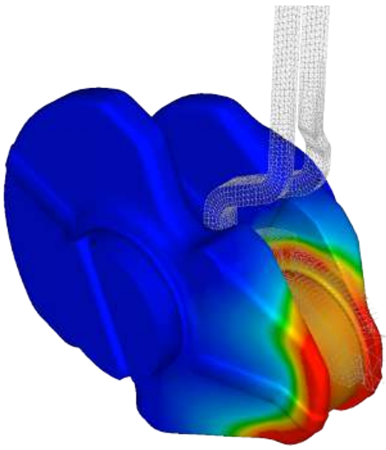
Austenite during induction



Temperature of the billet during induction heating

DAY 2 > 8.30 a.m. to 12.00 p.m. & 1.30 p.m. to 5.00 p.m.

Symetry	▪ How to model symmetry ▪ Boundary conditions of Maxwell's equations
Induction with movement of the part or the inductor	▪ Continuous or step-by-step motion ▪ Application: a multiple of billets moving inside the inductor
Induction treatments	▪ Kinematics applied to the inductor and/or the concentrators ▪ Exercise: induction heating followed by quenching or a hardening process ▪ Analysis of the heat affected area ▪ Change in phase and improvement of the mechanical properties (surface hardness, etc.)
New functions	▪ Self-induction ▪ Various types of control: constant (RMS) or variable potential, constant (RMS) or variable current, use of electrical circuits linking potential and current on inductor (generators, RLC circuits, etc.). ▪ Stationary induction fields ▪ Multi-inductors with the same frequency
Conclusions	▪ Questions and course assessment



Courtesy of Stellantis & EFD Induction