FORGE®

Heat treatment of steel and aluminum

How to anticipate mechanical and metallurgical properties after heat treatment? How to predict final hardness and residual stresses? Simulate a complete sequence? It's time to start learning!

This course covers the key points in heat treatments applied to forged steels and aluminum alloys After this course, participants will know how to perform martensitic quenching, carburizing, austenitization, precipitation hardening of aluminum, how to how to work from TTT or CCT diagrams and especially, how to fully analyze all of the computation results (phase, hardness, stress transformation, etc.). This way you will be able to predict the final properties of the parts and their metallurgy, as part of an overall computation comprising forging and the related heat treatment.

LEVEL

Advanced - Users seeking to reinforce their expertise in simulating the heat treatments typically used for forging processes.

PREREQUISITES

A knowledge of material science or metallurgy. A good grounding in the use of FORGE® is a requirement. You need to have taken the 'Starting with FORGE®' or equivalent course.

GOALS

- **Defining process conditions so as to achieve the best mechanical properties: increasing superficial hardness, temperature resistance, ductility and mechanical resistance and residual stress**
- **Being able to predict changes in the microstructure during heating or cooling**
- **Observing the influence of carbon diffusion over the surface hardness variation**
- **Determining the ideal treatment conditions to reduce cycle times**

OTHER RECOMMENDED COURSES

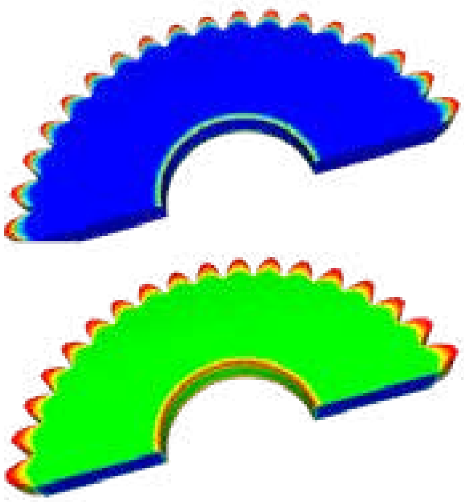
- FORGE® - Induction forge heating and heat treating

DURATION	DATES 2022		
2 Days	15-16 March	19-20 July	22-23 November

TRAINING	PRICE EXCL. TAX	PARTICIPANTS
Inter-company	1400€ per person	3 to 8 people
In-company	3000€ 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.

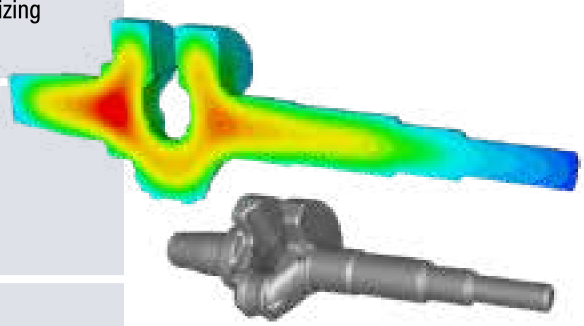
Introduction	• Transvalor presentation • Course goals
General	• Fe-Fe3C diagram • Reminders on TTT and CCT diagrams
Modeling quenching	• Producing an approximation of the CCT diagram from the TTT diagram • Exercise: generating the TTT and CCT diagrams with FORGE® • Coupled multi-physical model • Determining the heat transfer coefficient thanks to the optimization module • Exercise: modeling quenching in various baths (Houghton oils, polymer solutions)
Heat treatment modeling for aluminum alloys	• Tempering modeling by Quench Factor Analysis model • Precipitation hardening of aluminum alloys (age hardening) by Schercliff-Ashby model



Martensite and hardness during carburizing of a gear

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

Austenitization	• Generating a material file made of perlite and ferrite • Defining the heating cycle • Analyzing the results: phase transformation, austenite content, optimizing the heating cycle
Carburizing	• Generating the anisotropic mesh • Defining the carbon content • Generating the TTT diagram based on the carbon content • Result analysis: carbon content, phase transformation, hardness
Tempering	• Model used to compute hardness evolution • Exercise: modeling tempering after quenching • Analyzing results: residual stresses, hardness, etc.
Other	• Using JMatPro® material datasheets
Conclusions	• Questions and course assessment



Evolution de la température durant la trempe à l'huile