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 transformations, hardness, stress, etc.). This way you will be able to predict the final properties of the parts and their metallurgy, as part of an overall computation including forging and the related heat treatment.

LEVEL

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

PREREQUISITES

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

GOALS

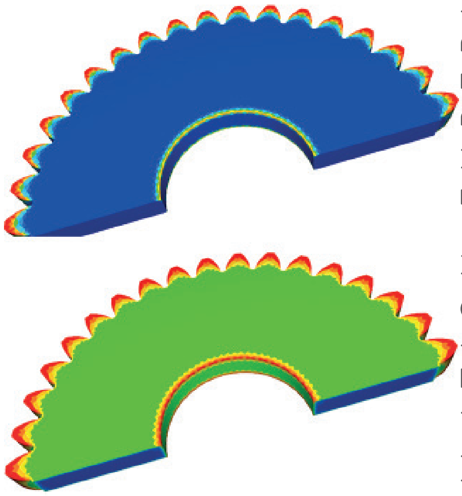
- **Defining process conditions so as to achieve the best mechanical properties: increasing superficial hardness, temperature resistance, ductility and mechanical resistance and residual stress**
- **Being able to predict changes in the microstructure during heating or cooling**
- **Observing the influence 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 2023		
2 days	21-22 March	18-19 July	21-22 November

TRAINING	PRICE EXCL. TAX	PARTICIPANTS
Inter-company	1400 € per person	3 to 8 people
In-company	3000 € per training	1 to 3 people



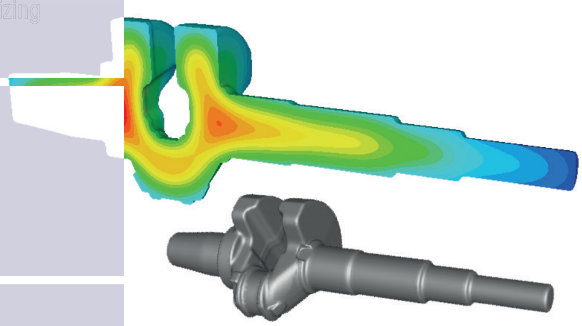
Martensite and hardness during carburizing of a gear

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

Introduction	Transva or presentation Course goa s
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® Coup ed mu ti physica mode Determining the heat transfer coefficient thanks to the optimization modu e Exercise: mode ing quenching in various baths (Houghton oi s, po ymer so utions)
Heat treatment modeling for aluminum alloys	Tempering mode ing by Quench Factor Ana ysis mode Precipitation hardening of a uminum a oys (age hardening) by Scherc iff Ashby mode

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

Austenitization	Generating a materia fi e made of per ite and ferrite Defining the heating cyc e Ana yzing the resu ts: phase transformation, austenite content, optimizing the heating cyc e
Carburizing	Generating the anisotropic mesh Defining the carbon rate Generating the TTT diagram based on the carbon content Resu t ana ysis: carbon content, phase transformation, hardness
Tempering	Mode used to compute hardness evo ution Exercise: mode ing tempering after quenching Ana yzing resu ts: residua stresses, hardness, etc
Other	Using JMatPro® materia datasheets
Conclusions	Questions and course assessment



Temperature evolution during oil quenching