

INTERNSHIP OFFER

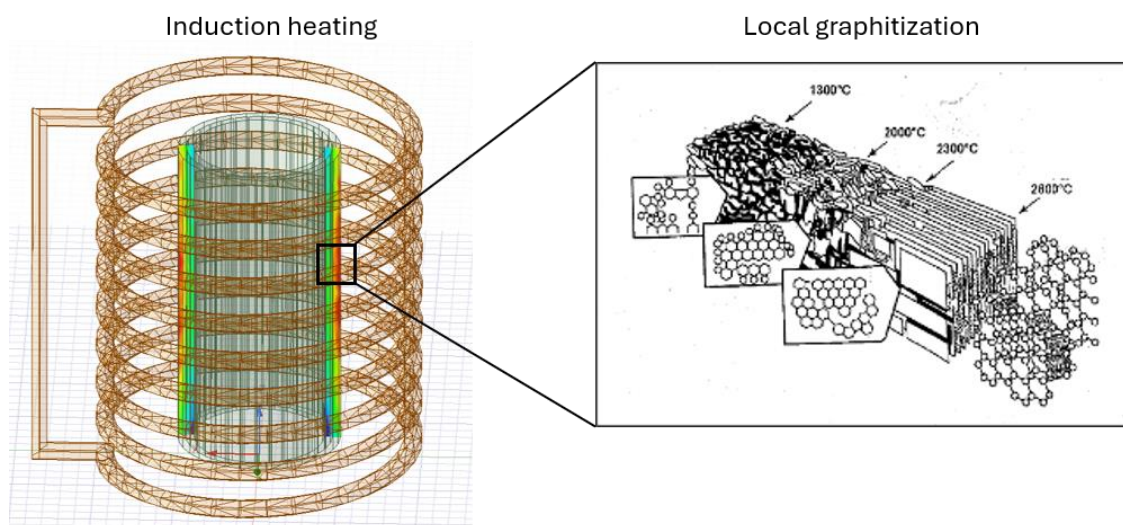
Master 2 or 3rd year of engineering school

Study of a new inductive heating process for localized heat treatment of carbonaceous material

Duration	6 months, started from February 2027
Location	Laboratoire SIMaP, 1340 Rue de la Piscine - BP 75 – 38402 Saint Martin d'Hères – France
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Context & objectives

For tomorrow's industry, new – more performant – material still needs to be invented. More particularly, “hybrid” materials, that combines the best property of two materials, can be very promising. Mersen's company, with which this internship is taking place in the framework of a joint laboratory, fabricates a range of carbonaceous materials, such as graphite. For specific applications requiring low thermal conductivity in the bulk but high resistance to abrasion at the surface, a carbonaceous material which would be highly graphitized on the periphery only would be of great interest. To do so, we first envision to use an induction process which would allow a very high temperature (~2800°C) local heat treatment of the periphery of a part, promoting graphitization mainly at this place. Reaching such a high temperature only on the periphery of a part is however a challenge. Indeed, the local nature of the heating will be governed by the trade-off between radiation losses to the outside and conduction toward the core of the solid, which is governed by the dimension of the object, the operating frequency used, the heating time (pulse) and the electrical and thermal conductivity properties of the material as a function of temperature (which also evolves with graphitization). Generation of thermal stress at places of high temperature gradient is also a challenge. Numerical simulation will be used to design the process and assess its feasibility. If suitable and realistic configuration are identified, a “proof-of-concept” experiment will be initiated at SIMaP. This will involve a dimensioning phase: capacitance value for frequency adjustment, generator impedance adaptation, control module for pulsed heating...



In practice the intern will have to:

- Realize a literature survey on localized heat treatment with induction as well as on graphitization.
- Set up a numerical model (induction heating+heat transfers, transient stage) on a commercial finite element code.
- Run multi-parametric study to evaluate the configurations that would allow a local thermal treatment on the periphery of a load (geometry of the coil and the load, operating frequency, heating time...)
- Include a thermomechanical model to evaluate the thermal stress generated in these configurations
- Develop optimization algorithms to evaluate suitable coil geometry, power, and pulse time to adapt the process to different geometries.
- Initiate the development of a “proof-of-concept” experiment

The internship will take place in the framework of a very dynamic and long-term collaboration between MERSEN company (<https://www.mersen.com/fr>) and SIMaP (<https://simap.grenoble-inp.fr/>), a research lab specialized in materials sciences and associated processes.

Profile & requested skills

We are looking for a highly motivated student (M2 or 3rd year of engineering school) with a background in materials sciences and who shows interest in research and numerical simulation. The student must be dynamic, curious and autonomous. The student must speak French and/or English.