ABOUT USING ELTA SOFTWARE IN SIMULATION OF THE INDUCTION HARDENING METHOD

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Abstract

This paper proposes an analisys of the induction hardening method with ELTA software. All the heating analysis needs solution, in the thermal diffusion problems coupled with eddy currents case. More simulation process we need for a better knowledge of the process.

Key words: Numerical simulation, Electromagnetic field coupled with thermal.

INTRODUCTION

The induction hardening simulation method is used for all kinds of geometry types of metal piece. With this method we can consider the change of both parameters: the electromagnetic parameter and thermal parameter. This parameters is accourding to temperature. We know that the B-H relation is very dependend on temperature, passing from iron-magnetic environment form to air. Regarding to this reason, we observe that the eddy's current problems and thermal diffusion are strongly coupled in the Curie point zone.

Branded programs like the ELTA, adopt the linear pattern (ELTA – tutorial), where the B-H relation is linear, the magnetic permeability is adjusting according to the highest effective value of the magnetic induction (Leuca et. al., 2007).

MATERIAL AND METHODS

The research was conducted in the laboratory of Modeling, Simulation and CAD Techniques from the University of Oradea

We have the case of electromagnetic problem with a parallel – plane structure. The magnetic field problem can be solved by reduced to the determination of a potential vector with a single component, which verifies an similar equation of the scalar potential.

The coupled of thermal diffusion problems with eddy currents is the main problem of every hardening method. For a better analysis of the results we need to find the result of eddy currents problem (power density) and temperature (thermal capacity and thermal conductibility) (Leuca et al., 1997, 2002).

RESULTS AND DISCUSSION

The numerical simulation with ELTA allows to determining accurately the relationship between the used frequencies, and the power density, and also the desired treatment depth.

The optimal frequency can be estimated and is depending by the penetration depth of induced currents.

The process consists in performing a single hardening that is shown in figure 1.

We present the result of the simulated process:

- The temperature from hardening zone (fig. 3)
- The debited current from the source (fig. 4)
- The rezistivity dependence with the temperature of the steel (fig. 5)
- The thermal conductivity depencence with the temperature of the steel (fig. 6)
- The equivalent transfer heat coefficient dependence with the temperature (fig. 7)

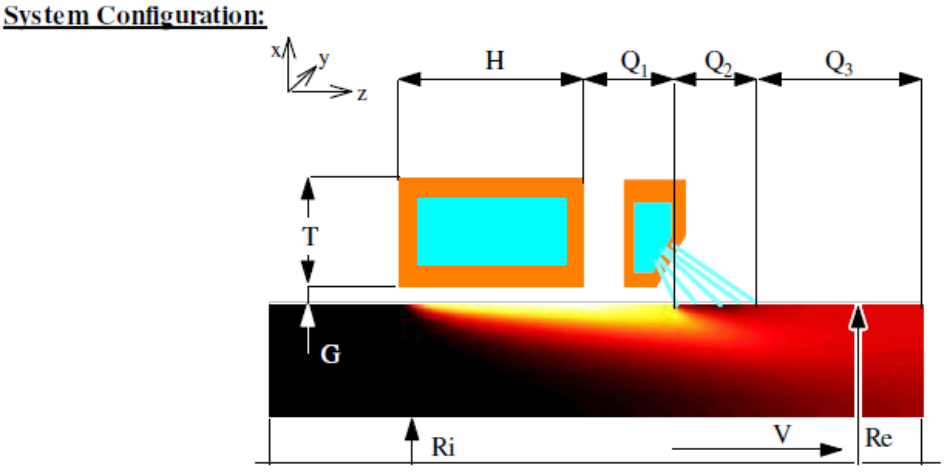

Fig. 1. The model – System configuration

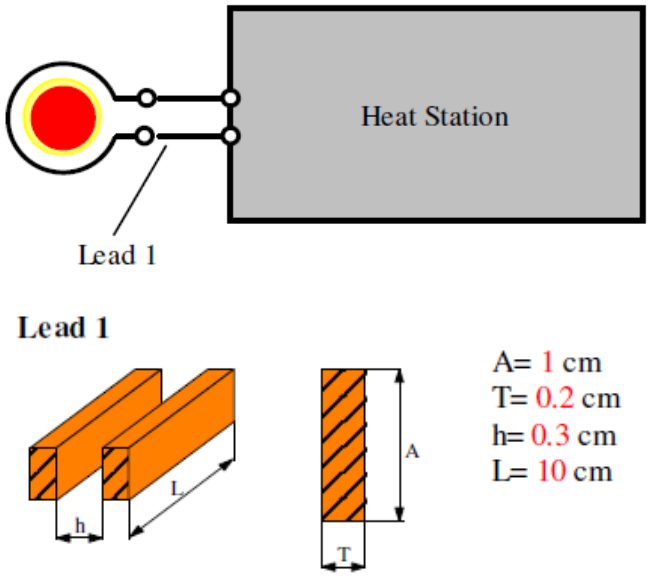

Fig. 2. The circuit model

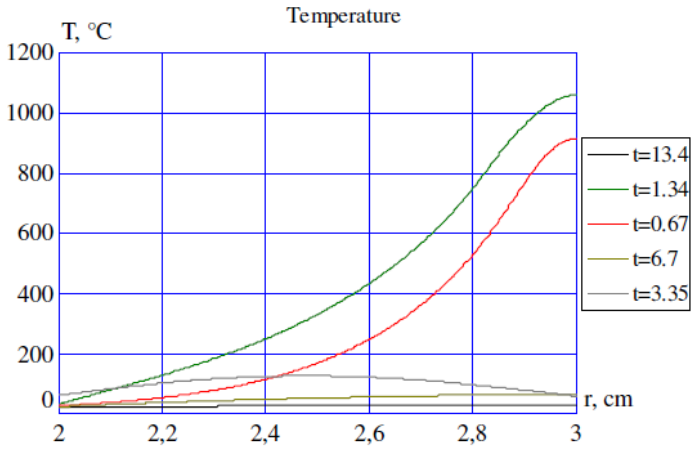

Fig. 3. The temperature from hardening zone

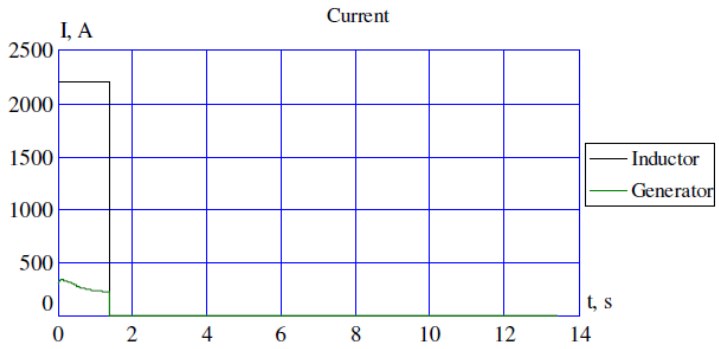

Fig. 4. The debited current from the source

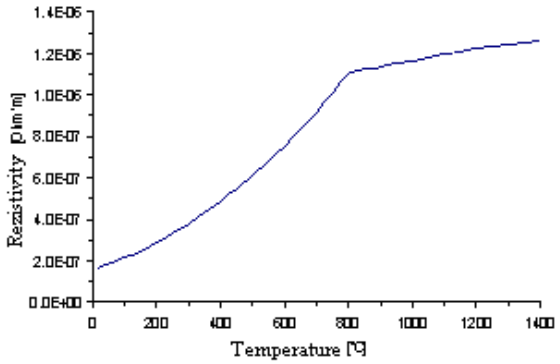

Fig. 5. The rezistivity dependence with the temperature of the steel

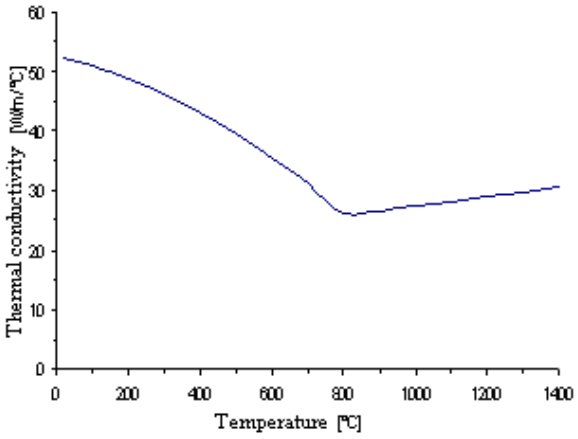

Fig. 6. The thermal conductivity depencence with the temperature of the steel

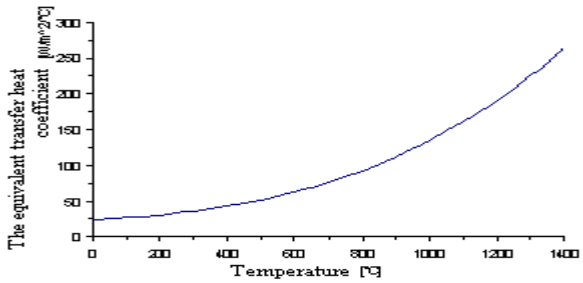

Fig. 7. The equivalent transfer heat coefficient dependence with the temperature

CONCLUSIONS

The numeric simulation of the hardening process is a complex problem. We must solve simultaneous two problems:

- field non-linear one of eddy currents
- the thermal diffusion.

The non-linear problems of eddy currents is provide from non-linear relation of **B-H**.

The non-linear of thermal problem provide from dependence with temperature of thermal parameters (Leuca et al., 2007; Cheregi, Arion, 2008; Cheregi et al., 2008; Arion, Cheregi, 2008; Leuca, Cheregi, 2009; Cheregi, Arion, 2010; Maricaru et al., 2011; Hănţilă et al., 2012; Arion et al., 2012; Burca et al., 2012, 2013, 2014, ELTA – tutorial).

The coupled of two problems result from strong dependence of relation **B-H** with temperature.

In electromagnetic field problem and thermal field source, the result is given by Joule lost.

The advantage of this method is results from the possibility to have almost similar results in practice.

The ELTA software is very friendly with the user and it has a simple interface. The results can be exported in pdf format files where is place the main scheme of the system (fig. 1, 2) and also a series of graphics for more important values of induction heating process.

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