ABOUT NUMERICAL SIMULATION OF THE INDUCTION HEAT TREATMENT APPLIED TO REVERSIBLE CLAW OF SCARIFIER

Gabriel CHEREGI[1#], Mihaela Codruţa LUCACI [1] Laura Melinda DERECICHEI [1], Adrian Gabriel CHEREGI [2], Teodora Anca CODĂU [3]

[1] University of Oradea, Faculty of Environmental Protection, Forestry Department, 26 Gen. Magheru Str, 410059 Oradea, Romania
[2] C.C. ALUGARD L.T.D. 407 A, Sântandrei, Romania
[3] "Dimitrie Cantemir" Secondary School, 2A, Sextil Puşcariu St., Oradea, Romania,

RESEARCH ARTICLE

Abstract
This paper proposes an analysis of the induction hardening method of the reversible claw of Scarifier. In the case of the reversible claw of Scarifier the heating analysis needs solution in the thermal diffusion problems coupled with eddy currents case. We make the known simulation to be sure that the requirements parameter is the same in practice.

Keywords: Numerical simulation, Electromagnetic field, Electromagnetic field coupled with thermal, reversible claw of Scarifier.
#Corresponding author: *grcheregi@yahoo.com*

INTRODUCTION

The reversible claw of Scarifier is used for scarification process.

The cutting area of the reversible claw must have optimal linear and angular parameters, depending on the terrain conditions in which it is worked.

In scarifies, the claw-type loosening active organs are mounted on rigid or elastic supports. The elastic supports ensure the vibration of the active organs during work, in the longitudinal and transverse direction, so that the effect of loosening and crushing the soil is more pronounced, and the advance of the aggregate is easier and at the same time the energy consumption is reduced. For this active organ, the application of heat treatment in the electromagnetic field implies a high durability in the technological process of scarification.

In general, the reversible claw must be had a homogeneous structure to respond of imposed requirements.

We know that the induction hardening simulation method is used for all kinds of geometry types of metal piece. This method considers the change of both parameters like the electromagnetic and thermal parameters. Both parameters are according with the temperature.

We must verify that the B-H relation is depended on temperature, passing from iron-magnetic environment form to air. In this case, we observe that the eddy's current problems and thermal diffusion are strongly coupled in the Curie point zone.

As we know the B-H relation is linear and the magnetic permeability is adjusting according to the highest effective value of the magnetic induction (T. Leuca, 2007).

We adopt linear pattern (FLUX 2D – tutorial) and the B-H relation.

MATERIAL AND METHOD

For the simulation we use FLUX 2D software package.

In the analysis of this case, we must solve the 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 a 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) (T. Leuca, 2002, T. Leuca 1997).

RESULTS AND DISCUSSIONS

The numerical simulation with FLUX 2D software (FLUX 2D – tutorial) allows to be determining accurately the relationship between the used frequencies, the desired treatment depth, and the power density.

The desired treatment depth is very important to make a complete map of the hardening process.

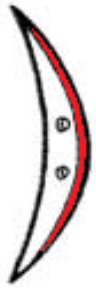

Figure 1. **The reversible claw**

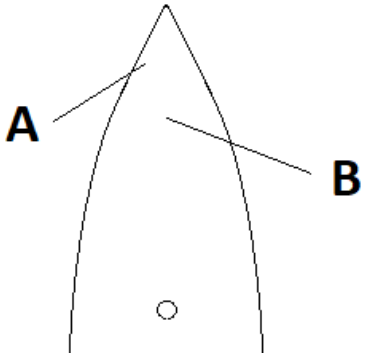

Figure 2. **Positioning of points A and B where the temperature field is analyzed**

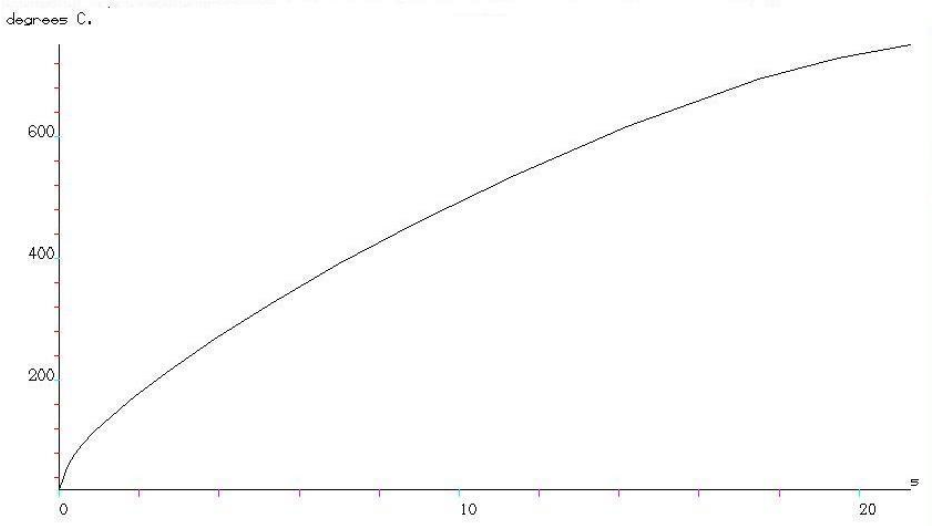

Figure 3. **The temperature in point A**

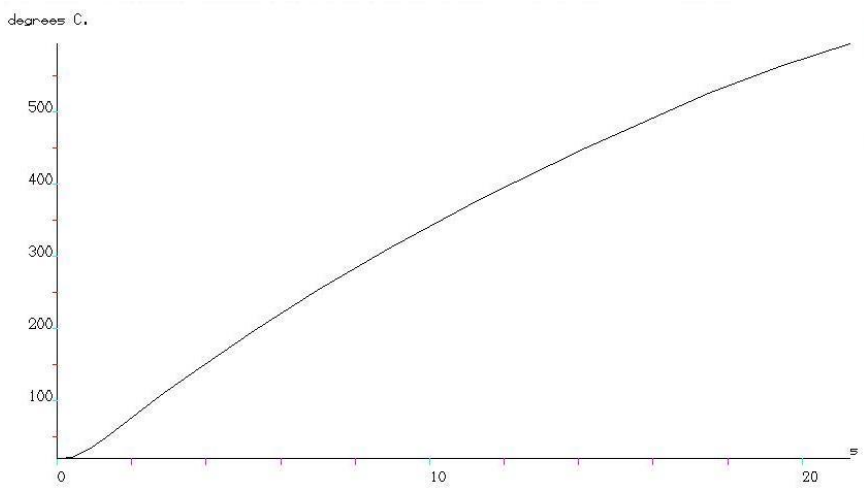

Figure 4. **The temperature in point B**

CONCLUSIONS

The thermal transfer to the surface of the workpiece is characterized by a convection coefficient with the value $\alpha = 20$ W/m^2/°C and by a radiation coefficient (characteristic of the thermal transfer by radiation) $\varepsilon = 0{,}75$ by which the dependence of the thermal transfer coefficient α_e it's a function of temperature

The numeric simulation of the hardening process is a complex problem because the non-linear problems of eddy currents is provided from non-linear relation of B-H.

The non-linear of thermal problem provide from dependence with temperature of thermal parameters (T. Leuca, 2007, 2009, M. Arion, 2008, M. Marincaru, P Minciunescu, 2011, F.I. Hanţilă 2012, A. Burcă 2012, 2013, 2014).

After the simulation process we observe that the coupled of two problems result from strong dependence of relation B-H with temperature. Through proposed heat treatment we get a homogenous structure for the reversible claw of Scarifier.

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