NUMERICAL SIMULATION OF THE INDUCTION HEAT TREATMENT OF THE CONICAL DRILL

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Abstract
This paper proposes an analisys of the induction hardening method of the conical drill. In the case of the conical drill the heating analysis needs solution in the thermal diffusion problems coupled with eddy currents case.

Keywords: Numerical simulation, Electromagnetic field, Electromagnetic field coupled with thermal, conical drill.

INTRODUCTION

The conical drill is used for digging seedlings

The drills used to dig holes for planting seedlings must meet very different conditions, which condition their construction:

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

The drill must have such a construction that the dislocated soil should be evacuated freely, and should it remain in the pit, it should not prevent its advance and withdrawal.

The construction of the drill must ensure easy sharpening, or if possible self-sharpening of cutting edges is possible

During the work, the drills should not cause the walls of the excavated pits to be pressed, nor the mixing of the detached layers of earth, when this is required

The conical drill must be have an homogeneous structure to respond of imposed requirements.

We must verify that the B-H relation is dependend 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 (Leuca, Arion, Cheregi, Horge, 2007).

MATERIAL AND METHOD

For the simulation we use FLUX 2D software package.

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, Cranganu-Cretu, Arion, Tarcau, 2002)

In the analysis of this case we must solve the electromagnetic problem with a parallel – plane structure.

RESULTS AND DISCUSSION

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

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

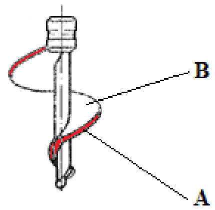

Fig. 1. The conical drill

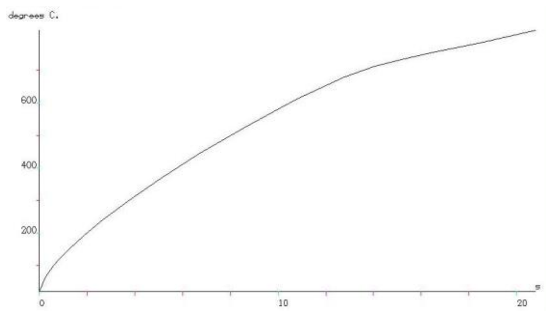

Fig. 2. The temperature in point A

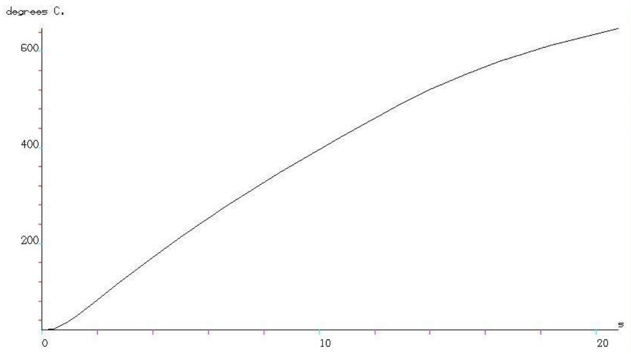

Fig. 3. The temperature in point B

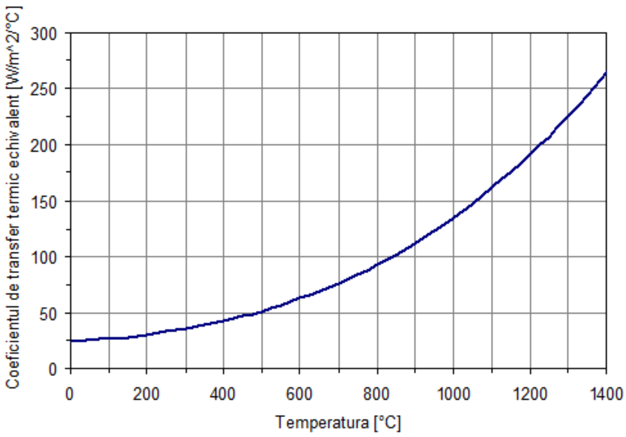

Fig. 4. The temperature dependence of the equivalent heat transfer coefficient in this case

CONCLUSIONS

The numeric simulation of the hardening process is a complex problem because 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 (T. Leuca, M. Arion, G. Cheregi, I. Horge, 2007).

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

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.

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