

## INDUCTION HEAT TREATMENT OF THE TRIANGULAR RECTANGULAR DRILL

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### **Abstract**

*This paper proposes an analysis of the induction hardening method of the triangular rectangular drill. In the case of the triangular rectangular drill 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 are the same in practice.*

**Keywords:** Numerical simulation, Electromagnetic field, Electromagnetic field coupled with thermal, triangular rectangular drill.

### **INTRODUCTION**

The triangular rectangular 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

In general the triangular rectangular drill must be have an 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 consider the change of both parameters like the electromagnetic and thermal parameters.

Both parameters is accourding with the temperature.

We must verify that the B-H relation is dependent 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, et al., 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 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 conductivity) (Leuca, 1997; Leuca et al., 2002)

## 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.

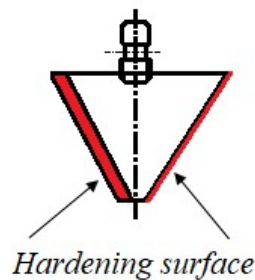


Fig. 1. The triangular rectangular drill

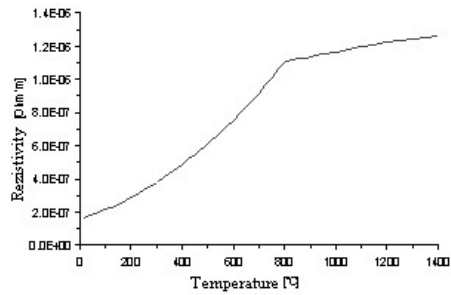


Fig. 2. The temperature dependence of the resistivity of steel

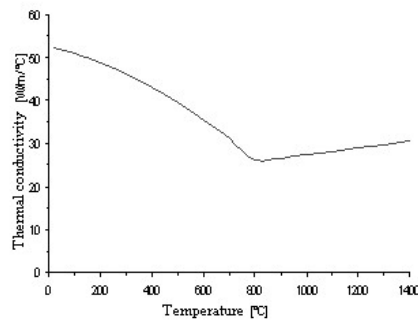


Fig. 3. The temperature dependence of the thermal conductivity of steel

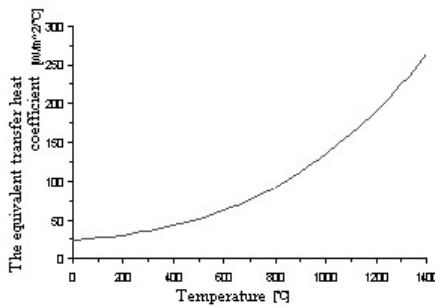


Fig. 4. The temperature dependence of the equivalent heat transfer coefficient

## CONCLUSIONS

The thermal transfer to the surface of the workpiece is characterized by a convection coefficient with the value  $\alpha = 20 \text{ W/m}^2/\text{°C}$  and by a radiation coefficient (characteristic of the thermal transfer by radiation)  $\varepsilon = 0,75$  by which the dependence of the thermal transfer coefficient  $\alpha_e$  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 provide from non-linear relation of **B-H**.

The non-linear of thermal problem provide from dependence with temperature of thermal parameters (Leuca T. et al., 2007; Leuca and Cheregi, 2009; Cheregi and Arion, 2008, 2010; Cheregi et al., 2008; Arion and Cheregi, 2008; Maricaru et al., 2011; Hăntilă et al, 2012; Arion et al, 2012; Burca et al., 2012, 2013; Burca, 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.

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