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ESTABLISHMENT OF SPLINTERING FORCES FOR THE DEEP PERFORATION PROCESS

Alin NIOAŢĂ, Dan DOBROTĂ, Florin CIOFU
University "Constantin Brâncuşi", Engineering Faculty, nalin@utgjiu.ro

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ABSTRACT: The mechanic action of defeating the resistance at deformation of the material layer, of the abrasions from the splintering area and the transformation of that layer into splinter is named splintering force. The total resistance of the F_x, F_y, F_z forces is considered applied in a single point of the splintering edge, this force being directed over the tool, an equal and contrary force will act over the layer of material that will be removed.

1. Introduction

The augers for deep holes are special building tools destined to the processing of holes with the ratio between length and diameter bigger than 10, at which, generally, perforation is the only operation.

At their splintering processing work some specific problems appear, different from those of the augering of the small holes:

- evacuation of the splinters emitted after processing;
- keeping of the right direction of the axe of the processing hole;
- cooling of the active part of the auger, intensely needed at the deep perforation;
- decrease of the splintering efforts because the auger, being long, has a relatively small rigidity.

These problems are solved through the special construction of the auger, the establishment of the adequate splintering conditions, the quality of the machine-tools, special as well.

2. Establishment of the splintering forces

In the work there are analyzed, as a calculation example, two of the deep perforation processes:

- full perforation;
- circular perforation;

considered as applied to the semi-finished products from which pipes are made, the material being that for which it was made the analysis through the finite elements method.

The perforation ends for the two methods are presented, with some simplifications, in figure 1 and figure 2.

The shapes and dimensions of the splintering plates were chosen from (Elekes, C. 1985) for a hole with the diameter of 60 mm.

The important specific feature of the perforation method is that, in the length of the blade, the splintering speed is variable, dependent on the relative rotation between tool and semi-finished product and the position ray of the considered point.

From this reason, every point on the blade (or blades) is characterized by a certain splintering local condition. By consequence, the specific splintering forces are variable in the length of the blades, noticing that there are maintained in the normal planes at blade.

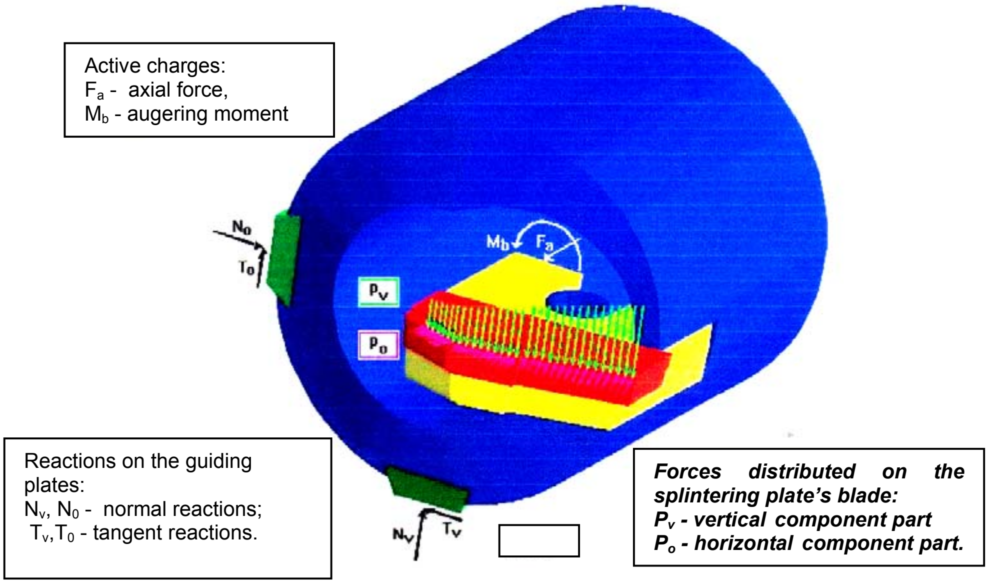

Figure 1. Charging of the perforation end at the full perforation;

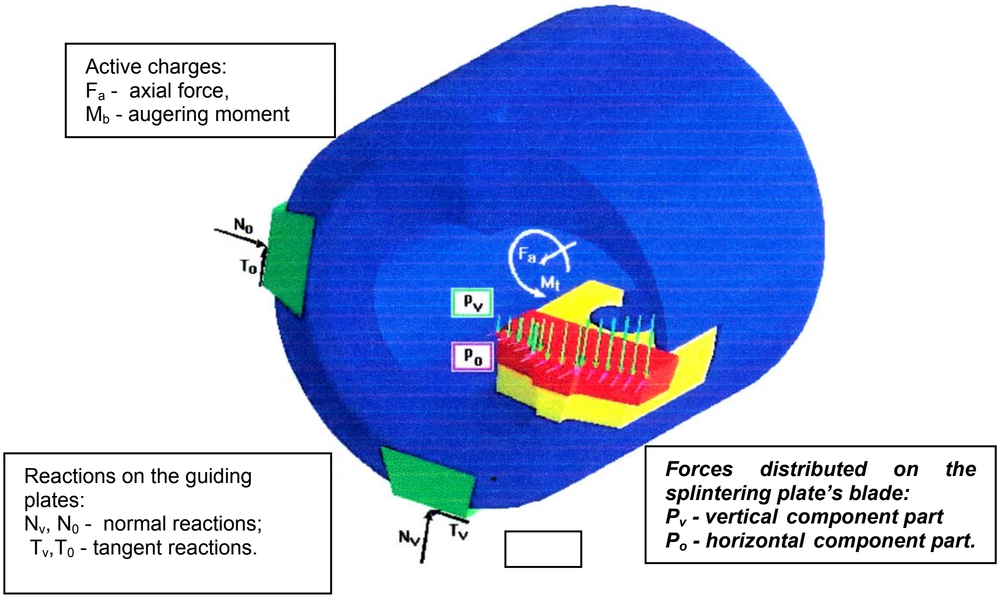

Figure 2. Charging of the perforation hole at the circular perforation

For the complete establishment of the charging state of the perforation ends, also in figure 1 and 2, there were introduced the other forces that appear during functioning and namely: the normal and tangent (of abrasion) reactions on the guiding plates and the active charges, the axial defending force F_a and the augering moment M_B.

The component parts of the resultant of the forces distributed on the splintering plate's blades are named splintering forces and they are represented in image 3 and image 4.

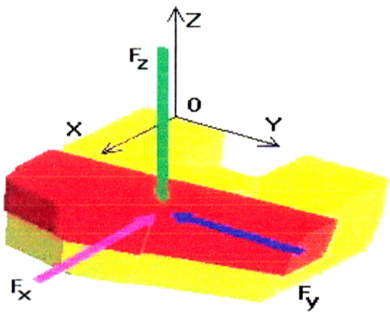

Figure 3. The splintering forces at the full perforation Ø60

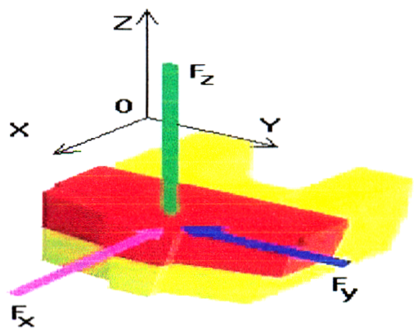

Figure 4. The splintering forces at the circular perforation Ø60

The F_a and M_B sizes are tightly relied on the performances of the machine on which the deep perforation method is applied, while the F_x, F_y, F_z sizes, obviously reflected in F_a and M_B, condition the tool's projection elements.

The calculation method of the above mentioned measures is a simple one, of numerical integration, with necessary interpolations, for establishing the F_x, F_y and F_z splintering forces and for the mechanic equilibration of the forces system on the perforation end for the calculation of the F_a and M_B active charges.

The establishment of the forces distributed on blade, input data in the numerical integration, was made depending on the normal advance adequate to the attack angle of that blade.

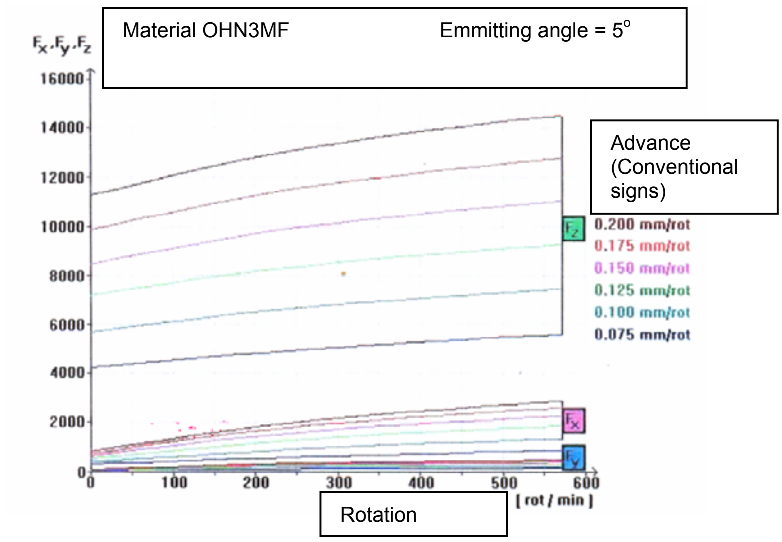

Figure 5. The diagram of the splintering forces at the full perforation

In the numerical calculation automated procedure the following parameters of the perforation condition were considered variable:

- rotation, in the range of values 0 … 570 rot/min;
- advance, with the values 0,075; 0,100; 0,125; 0,150; 0,175; 0,200 mm/rot;
- emitting angle, with the values 0°, 5° and 10°.

All the establishments adequate to the F_x, F_y, F_z sizes have graphic representations for both perforation types and they are presented in figure 5 and figure 6, for a part of the perforation condition's parameters.

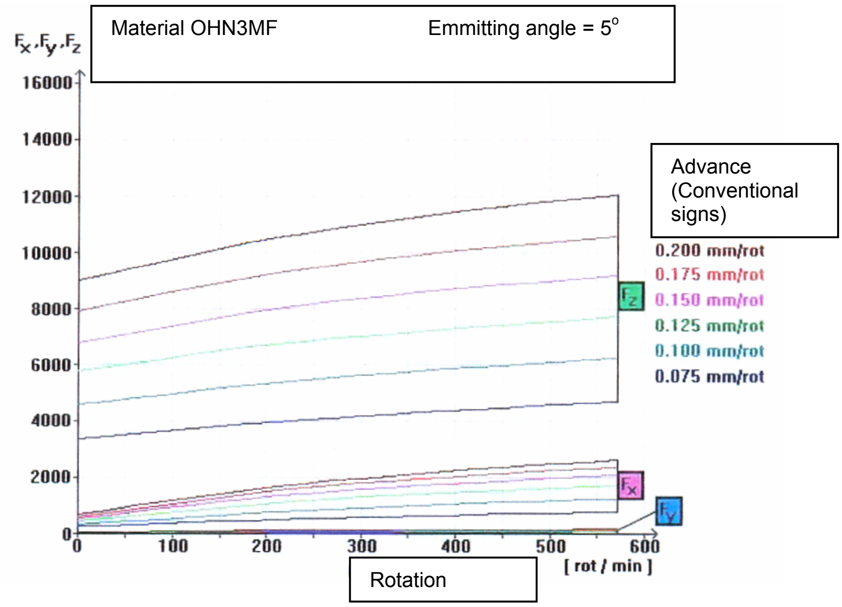

Figure 6. The diagram of the forces at the circular perforation.

3. Conclusions

The immediate conclusion drawn from the gallic acids' analysis is that the splintering forces are increasing once with the advance and the splintering speed and they are differentiated through the emitting angle.

The increase of the splintering forces, conditioned by the advance's increase, is easy to explain through the increase of the splinter's section proportionally to the advance, in this case the normal advance.

In the same way it can also be explained the reduction of the splintering forces at the increase of the emitting angle, by reducing the deformation degree, therefore also of the mechanical energy consumed in the splinter's forming area, according as the emitting angle is increasing.

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