Additional Details Regarding the Quality of a Drills Batch Using the Electrical Current at Cutting

DIŢU Valentin
Transilvania University of Brasov, Romania, vditu@unitbv.ro

Abstract
This paper presents additional details regarding the quality of a Ø8 mm drills batch, from HS 6-5-2 based on the electrical current at cutting measurement. The details have the purpose to complete the method presented in the specialty literature, and are useful for taking a decision with a higher accuracy regarding the quality of a drills batch but also for highlighting new aspects resulted from the electrical current at cutting analysis. The details refer to the choice of the processed material land confirm the usefulness of the method presented in the specialty literature. Also, this paper highlight the connection between the drill corner and the electrical current at cutting.

Keywords
cutting, drilling, electrical current at cutting, wear, quality

1. Introduction

In the references [1÷6] it is presented the quality appreciation method of the cutting tools by using the electrical current at cutting. The research [1] presents, detailed, the quality analysis of a batch of 30 Ø8 mm drills from HS 6-5-2. The used experimental stand is presented in Figure 1, where:

1 – electrical insulated mandrel for fixing the drill;
2 – electrical current collector;
3 – multimeter for voltage measurement of the electrical current at cutting;
4 –device for fixing the workpiece;
5 – workpiece.

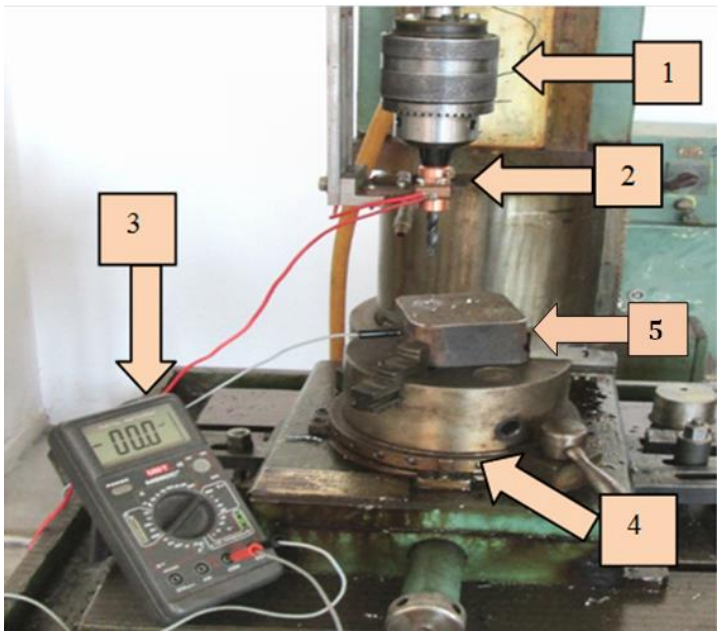

Fig. 1. Experimental stand for quality appreciation of drills [1]

The experiments tries were done on 41MoC11 steel (tensile strength – 950 N/mm^2), with the drilling machine 6GCODA1. The processing time was 10 seconds, while the voltage of the electrical current has stabilized, with the next cutting parameters: v (cutting speed) = 14.07 m/min (n = 560 rpm), s (cutting feed) = 0.25 mm/rot. The obtained results are presented in Table 1 (according to [1]).

Table 1. Obtained values for initial electrical current voltage at drilling 41MoC11 steel (according to [1])

No. of drill	Voltage"U_0" of electrical current at drilling 41MoC11 steel [mV]	No. of drill	Voltage"U_0" of electrical current at drilling41MoC11 steel [mV]
01.	0.5	16.	0.5
02.	0.5	17.	0.3
03.	0.4	18.	0.2
04.	0.3	19.	0.2
05.	0.4	20.	0.6
06.	0.6	21.	0.4
07.	0.2	22.	0.4
08.	0.3	23.	0.6
09.	0.4	24.	0.8
10.	0.2	25.	0.4
11.	0.4	26.	0.7
12.	0.4	27.	0.6
13.	0.5	28.	0.6
14.	0.6	29.	0.5
15.	0.6	30.	0.6

The drills were classified in three categories, as presented:

- Drills quality I: $U_0 = 0.1 \div 0.3$ mV – 7 drills
- Drills quality II: $U_0 = 0.4 \div 0.5$ mV – 13 drills
- Drills quality III: $U_0 = 0.6 \div 0.8$ mV – 10 drills

According to [1], from the analysed batch, 23.33% drills are of quality I, 43.33% are of quality II and 30.34% are of quality III. In this situation, the drills batch has a medium quality.

Also in research [1] it was done the connection between the quality of the cutting edge and the electrical current at cutting. In Figure 2 is presented the example of a quality I drill (according to [1]), where 1 and 2 are the main cutting edges, 3 is the chisel edge, 4 is the corner from the 1st edge and 5 is the corner of the 2nd edge.

In Figure 3 is presented the example of a quality III drill (according to [1]).

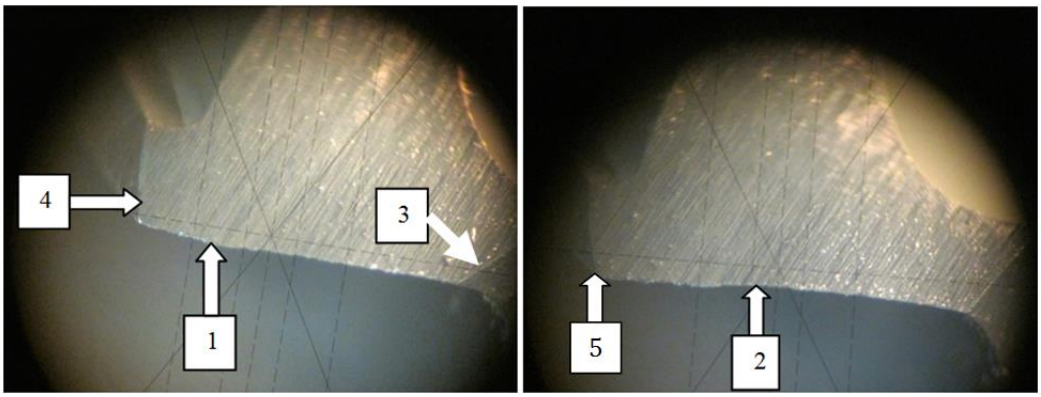

Fig. 2. Drill no. 10 (quality I) from Table 1, with the voltage of the electrical current at cutting equal to $U_{0,10} = 0.2$ mV

2. Additional Details

2.1. Quality appreciation of a drills batch using 1C45 steel, comparatively to 41MoC11 steel

The experimental tries from paper [1] were continued using as workpiece material 1C45 steel because when processing it, the voltage of the electrical current at cutting is greater than when processing 41MoC11 steel, so the obtained conclusions are more clear.

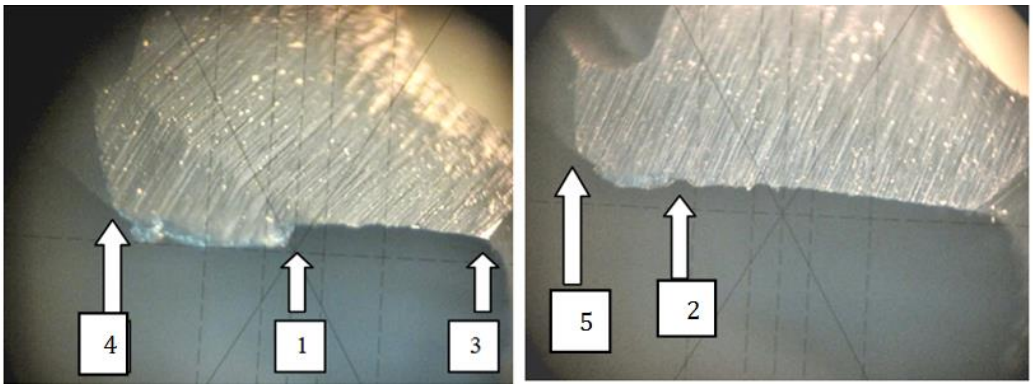

Fig. 3. Drill no. 14 (quality III) from table 1, with the voltage of the electrical current at cutting equal to $U_{0,10}$ = 0.6 mV

The results are presented, comparative, with the data processing 41MoC11 steel, in Table 2.

Table 2. Obtained values for initial electrical current voltage at drilling 41MoC11 steel and 1C45

No. of drill	Voltage"U_0" of electrical current at drilling 41MoC11 steel [mV]	Voltage"U_1" of electrical current at drilling 1C45 steel [mV]	No. of drill	Voltage"U_0" of electrical current at drilling 41MoC11 steel [mV]	Voltage"U_1" of electrical current at drilling 1C45 steel [mV]
01.	0.5	1.3	16.	0.5	1.3
02.	0.5	1.3	17.	0.3	1.1
03.	0.4	1.2	18.	0.2	0.7
04.	0.3	1.0	19.	0.2	0.8
05.	0.4	1.1	20.	0.6	1.5
06.	0.6	1.4	21.	0.4	1.2
07.	0.2	0.9	22.	0.4	1.1
08.	0.3	0.9	23.	0.6	1.5
09.	0.4	1.1	24.	0.8	1.7
10.	0.2	0.8	25.	0.4	1.2
11.	0.4	1.1	26.	0.7	1.7
12.	0.4	1.1	27.	0.6	1.3
13.	0.5	1.4	28.	0.6	1.3
14.	0.6	1.4	29.	0.5	1.3
15.	0.6	1.6	30.	0.6	1.7

In Figure 4 is presented, comparatively, the graphical representation of data from Table 2.

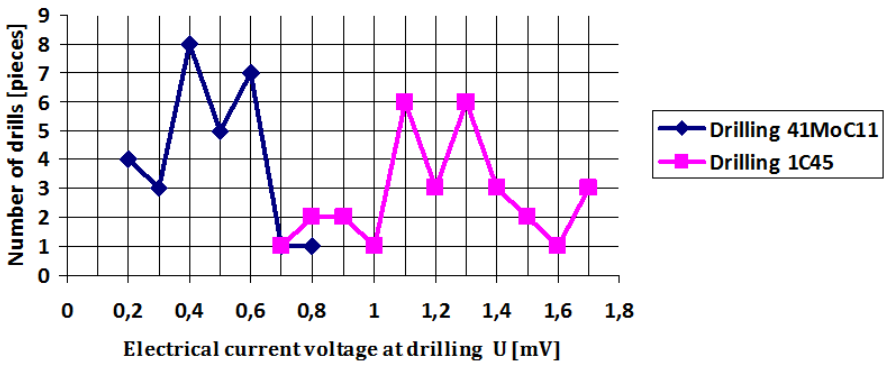

Fig. 4. Graphical representation of electrical current voltage at processing 41MoC11 steel and 1C45 steel

The drills, at cutting the 41MoC11 steel (according [1]) but also at cutting 1C45 steel, were classified in three categories:

- Drills quality I: U_0 = 0.1÷0.3 mV – 7 drills
- Drills quality II: U_0 = 0.4÷0.5 mV – 13 drills
- Drills quality III: U_0 = 0.6÷0.8 mV – 10 drills

Drills, at cutting 1C45 steel, were grouped also in three categories:

- Drills quality I: U_0 = 0.7÷1.0 mV – 6 drills
- Drills quality II: U_0 = 1.1÷1.3 mV – 15 drills
- Drills quality III: U_0 = 1.4÷1.7 mV – 9 drills

In Figure 5 is presented the graphical representation of drills, classified on categories, comparatively, at cutting 41MoC11 steel and 1C45 steel.

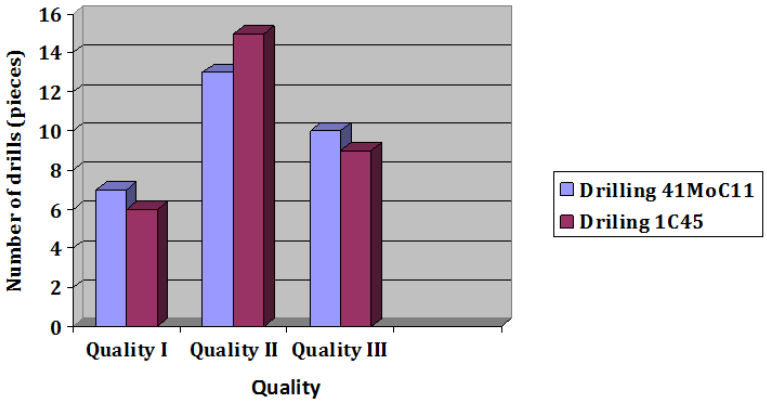

Fig. 5. Graphical representation of the quality categories of drills

It can be seen that when using the 1C45 steel, it can be more clearly observed the concentration of the drills towards to quality II, the number of drills of quality I and III being lower.

2.2. Details regarding the appreciation of the drill corner state

The drills were microscopically analysed. There were selected the drills for which the main cutting edges and the chisel edges were a like but the corners were different. It was observed the fact that for the drills with rounded corners the value of the electrical current at cutting is greater than the one obtained by using drills with improper corners. This result is due to the fact that the roundness of the corner leads to a greater friction, higher temperature in the cutting zone, and as consequence, to higher values of the electrical current at cutting.

In Figure 6 is presented the drill no. 19 from Table 2 where the main cutting edges (1 and 2), the chisel edge (3) and corners (4,5) are appropriate and in this case, during processing 1C45 steel was obtained U_1 = 0.8 mV, and at drilling 41MoC11 steel was obtained U_0 = 0.2 mV.

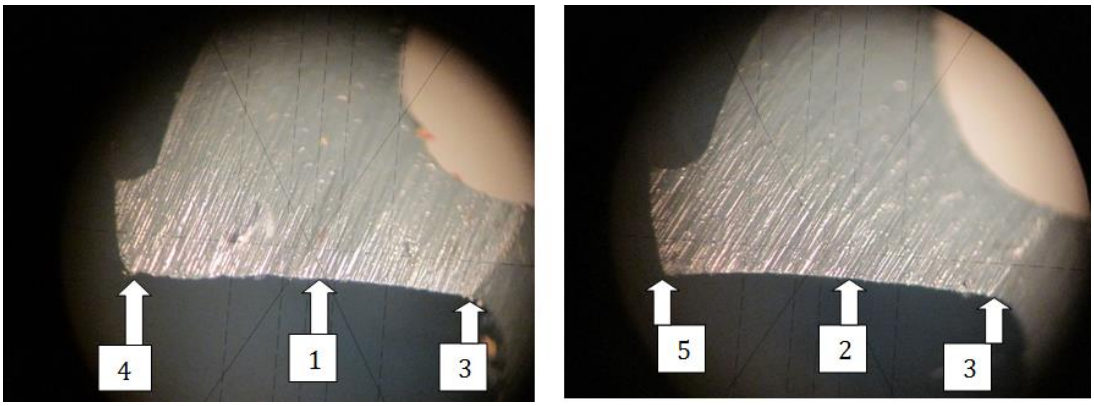

Fig. 6. Drill no. 19 with appropriate edges and corners and U_1 = 0.8 mV

In Figure 7 is presented the drill no. 23 from Table 2 where the cutting edges (1 and 2) and the chisel edge (3) are appropriate, and the corners (4 and 5) are rounded. In this case, at drilling 1C45 steel is was obtained U_1 = 1.5 mV, and at drilling 41MoC11 steel it was obtained U_0 = 0.6 mV.

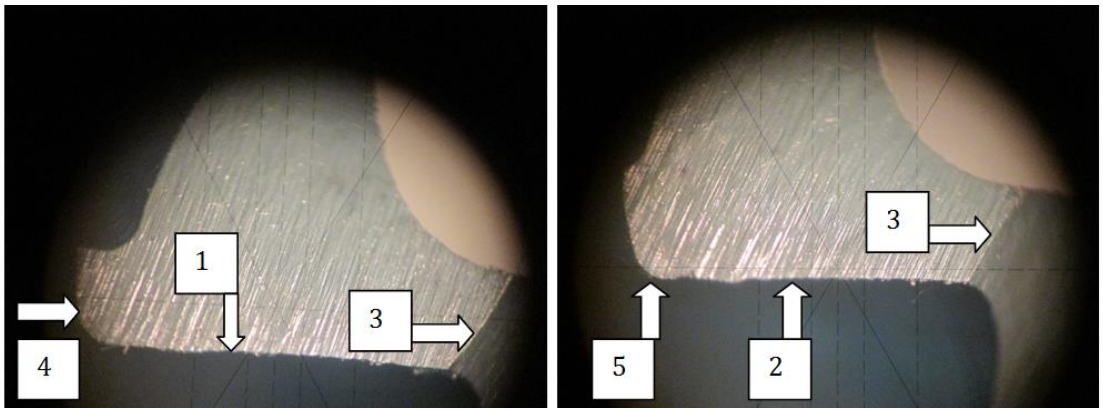

Fig. 7. Drill no. 21 with rounded corners; U_1 = 1.5 mV and U_0 = 0.6 mV

It can be observed that the inappropriate state of the corners is highlighted by the electrical current at cutting.

3. Conclusions

- The presented experimental in the work show the quality appreciation of the 30 drills batch presented in research [1] is correct.
- For the experimental tries it was used a material that during cutting lead to a higher voltage of the electrical current, and the method presented in research [1] and the conclusions are in accordance with this paper.
- When using the electrical current at cutting as method for quality appreciation of a drills batch it is preferred to process a material that leads to a higher value of the voltage.
- Also, the presented experimental tries show the fact that the voltage of the electrical current at cutting highlights the state of the drills corners.

References

1. Daicu, R., Dițu, V. (2016): *Innovative analysis of HS 6-5-2 drills edges quality*. Proceedings of the 4th International Conference on Computing and Solutions in Manufacturing Engineering 2016 – CoSME'16, MATEC Web Conf., vol. 94, Brasov, Romania, https://doi.org/10.1051/matecconf/20179402004
2. Dițu, V. (1977): *Cercetări teoretice și experimentale privind diagnoza procesului de așchiere* (*Theoretical and experimental researches about diagnose of the cutting process*). PhD thesis. Transilvania University of Brasov, Romania (in Romanian)
3. Dițu, V. (2008): *Bazele așchierii metalelor. Teorie și aplicații* (*Bases of cutting metals. Theory and applications*). MatrixRom, ISBN 978-973-755-444-4, Bucharest, Romania (in Romanian)
4. Dițu, V. (2008): *Quality Comparison for Two Drill Lot Made from 6 mm Rp5 and the Relation with the Cutting Thermocurrent*. Academic Journal of Manufacturing Engineering, ISSN 1583-7904, suppl. 1/2008, p. 70-75
5. Dițu, V., Lepădătescu, B. (2013): *The Utilization of Electrical Cutting Signal for the Quality Control of the Metallic Carbide Plates, of the Edge of the Drill, and for the Appreciation in the Cutting Zone*. Proceedings of the 12th WSEAS International Conference Circuits, Systems, Electronics, Control & Signal Processing (CSECS '13), ISBN 978-960-474-349-0, p. 282-286, Budapest, Hungary
6. Daicu, R., Oancea, Gh. (2015): *Electrical Current at Metal Cutting Process: A Literature Review*. Applied Mechanics and Materials, ISSN 1662-7482, vol. 808, p. 40-47, DOI: 10.4028/www.scientific.net/AMM.808.40

Received in November 2017