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MECHANICAL PROCESSING BY TURNING CUTTING COMPOSITE MATERIALS DESIGNED FOR MAGNETS, BASED ON NdFeB

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Abstract: *The magnets based on NdFeB rare earths are the most powerful magnets in the world from magnetic induction point of view. Unfortunately, the cold mechanical deformation of them is very difficult to achieve. Processing conventional machine tools of this kind of magnets is inadequate because the hardness and granular-crystalline structure does not allow the use of diamond tools, which are abrasives. This is due to the fact that the particles can burn during processing.*
In this paper are presented some experimental researches regarding the cylindrical shape magnet sample behavior during cutting process.
Keywords: *NdFeB magnets, roughness, cutting force, cutting depth.*

1. INTRODUCTION

Neodymium, not found naturally in metallic form or unmixed with other rare earth lanthanide type elements represent one of the most important element due to its contribution for „neo" alloys for magnets since first 1982, and commercially available in 1984 [1,2]. Nevertheless, 3.6 billion years can be considered the beginning of rock-forming meteorite found in Antarctica, which may contain traces of fossil life on Mars. One of these meteorites is ALH 84001, (figure 1), discovered in 1984, contains, among others, neodymium (Nd) and wolfram / tungsten (W).

Figure 1: Martian meteorite rock containing neodymium and tungsten [4a]

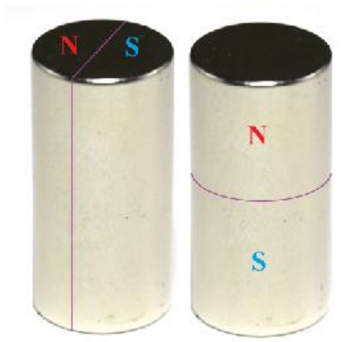

Figure 2: Rare earth magnets, NdFeB based

This paper presents some experimental researches regarding the cylindrical shape magnet sample (figure 2) behavior during cutting process.

Samples represents 8 materials designed for producing of permanent magnets based on NdFeB rare earths, annotated as following symbols: W4, W6, W8, W8H, W10, W10H, W12 şi W12D.

Experiments were carried out on an automatic a center lathe, model KART - E42 from the Laboratory of Machine Tools, Machinery and Production Systems Department, Faculty IMST, Polytechnic University of Bucharest.

Simultaneously, experiments were performed on the same types of specimens using the other lathe from the company SIMAR INDUSTRIAL SA, Bucharest.

Turning tools were used with CM plates (standard carbide) type SN 3-111.

In order to achieve measurements of cutting forces was used a dynamometer, model KISTLER and for measuring of surface roughness technological tests was used a roughness meter, model MITUTOYO SJ-210 from the Laboratory of Machine Tools, Machinery and Production Systems Department, Faculty IMST (figure 3) [3].

Figure 3: Roughness meter MITUTOYO-SJ-210 with diamond palpation element

The thermal study during cutting process was evidenced with an infrared camera; model THERMACUT SC 640 from the Laboratory of Technology, TMS Department, Faculty IMST [4].

2. EXPERIMENTAL TEST SAMPLES TYPESS BASED ON NdFeB, USED FOR MECHANICAL PROCESSING BY CUTTING

Figure 4 shows the geometrical shape of technological tests composite permanent magnets based on NdFeB, subjected to cutting machining.

Figure 4: Technological tests composite permanent magnets, based on NdFeB, subjected to cutting machining

The dimensions of technological samples, of cylinder shapes vary as the following:

- lenght vary in the range: 100-150 mm;
- diameter vary in the range: 25-30 mm.

The cutting process was done by external cylindrical turning roughing without cooling, experimental specimens being fixed (attached) between lathe peaks with a bushing (figure 5) [5].

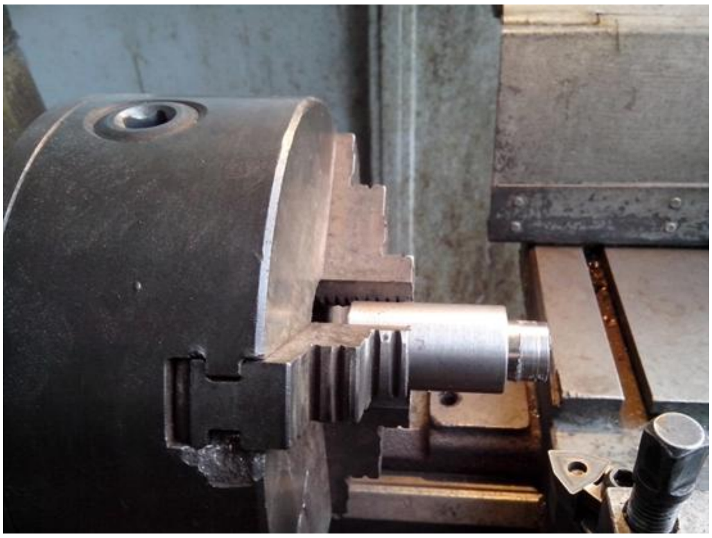

Figure 5: Attach of the cylindrical technological magnet sample between lathe peaks

3. EXPERIMENTAL RESULTS DIAGRAM OBTAINED DURING TURNINGS ROUGHING TECHNOLOGICAL PROCESS TESTS

Figure 6 show the variation of cutting applied force Fz in relation to measuring time, t. As reference, measuring time was mentained constantly to 20 seconds. Each of the eleven samples presents diffrent behavior during cutting process [6-9].

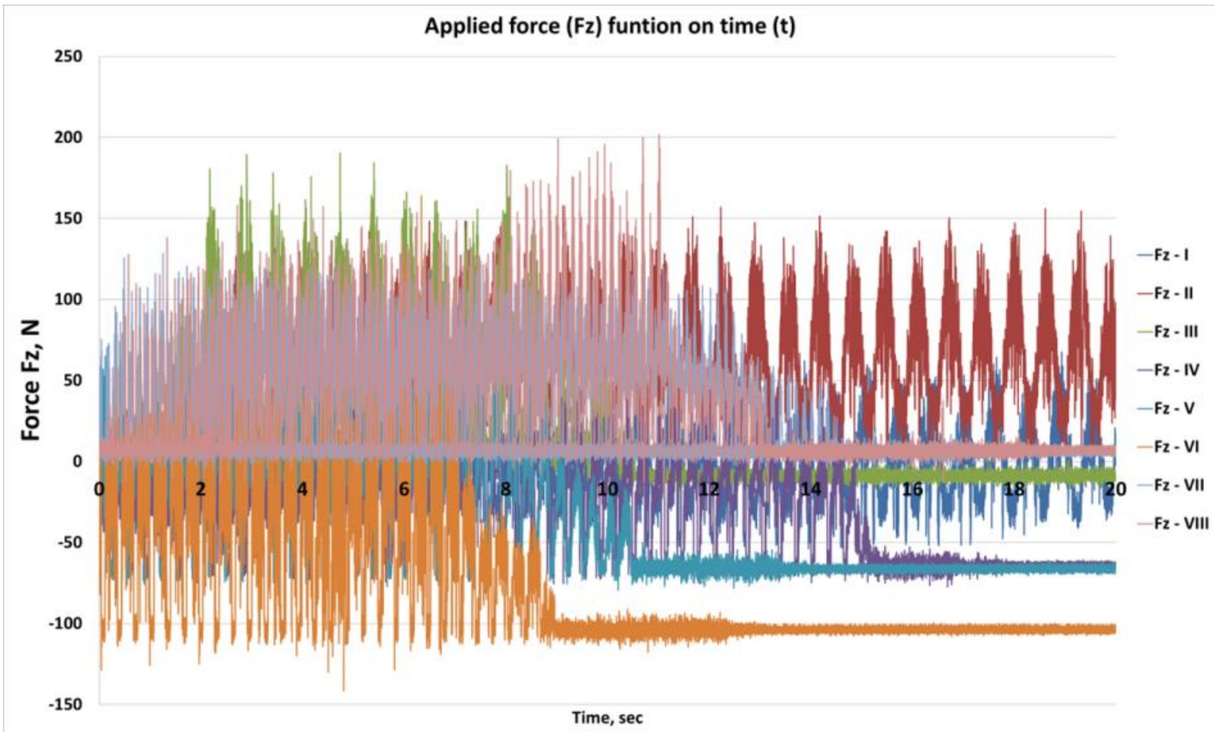

Figure 6: Variation of cutting force F_z, in relation to variation of speed n

The Figures 7a-h present the variation of cutting force F_z in relation to cutting depth variation a_p, for each of the eight samples, as following W4 – sample 1, W6– sample 2, W8– sample 3, W8H– sample 4, W10– sample 5, W10H– sample 6, W12– sample 7 şi W12D– sample 8 [9-11].

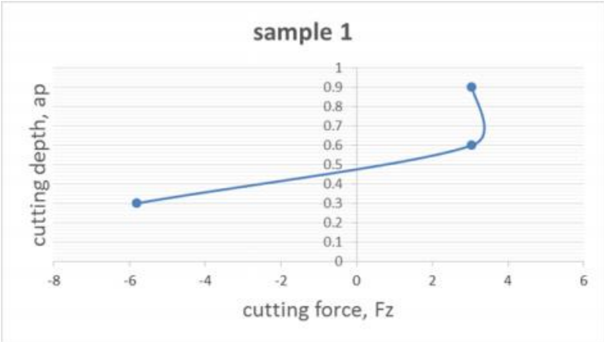

Figure 7a: diagram of sample 1

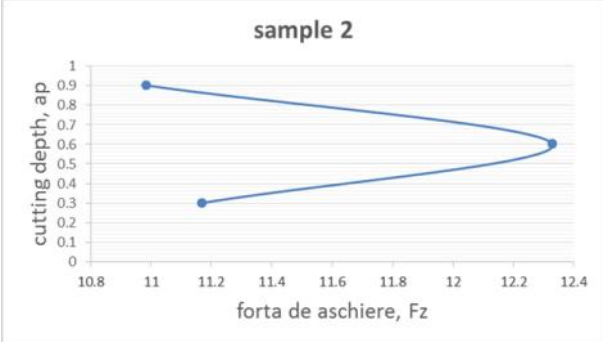

Figure 7b: diagram of sample 2

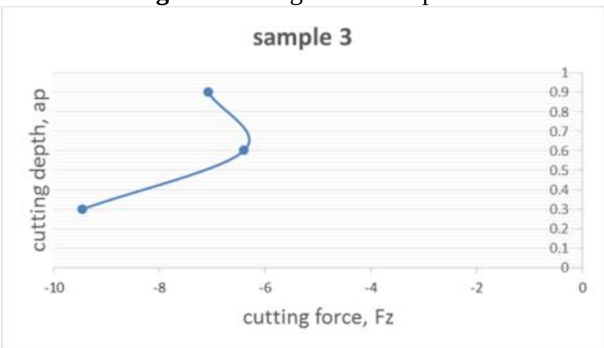

Figure 7c: diagram of sample 3

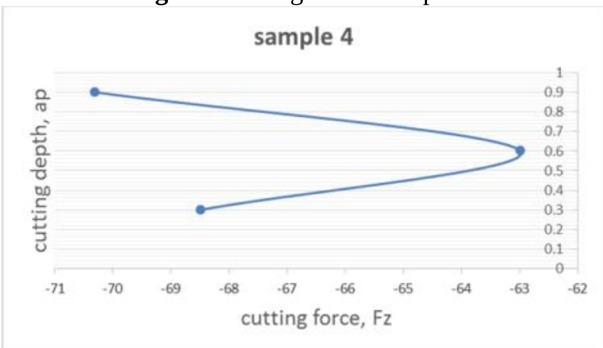

Figure 7d: diagram of sample 4

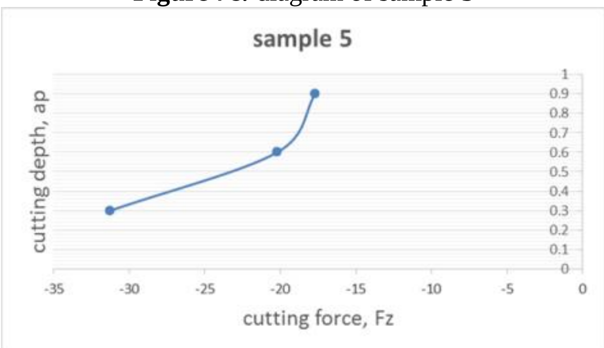

Figure 7e: diagram of sample 5

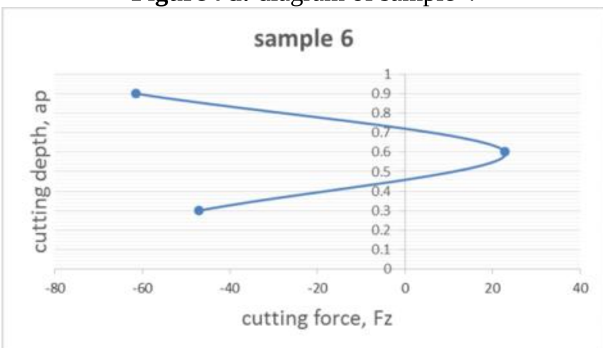

Figure 7f: diagram of sample 6

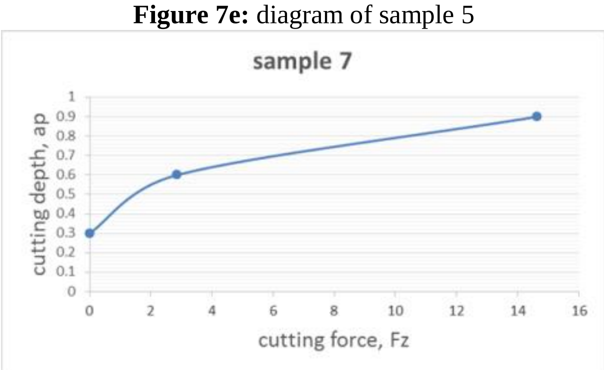

Figure 7g: diagram of sample 7

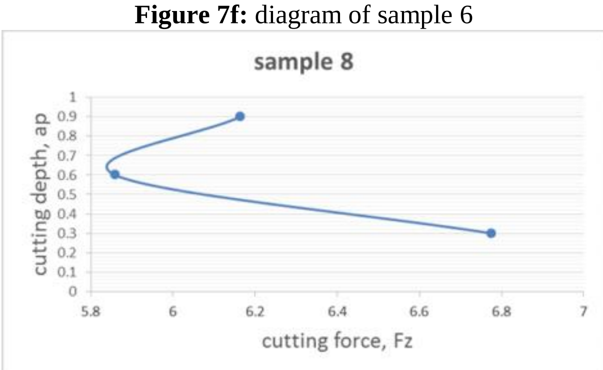

Figure 7h: diagram of sample 8

4. CONCLUSION

Processing conventional machine tools of this kind of magnets is inadequate because the hardness and granular-crystalline structure does not allow the use of diamond tools, which are abrasives. This is due to the fact that the particles can burn during processing.

After cutting processing, the processed samples can be magnetized to saturation.

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