Annals of DAAAM for 2011 & Proceedings of the 22nd International DAAAM Symposium, Volume 22, No. 1, ISSN 1726-9679
ISBN 978-3-901509-83-4, Editor B. Katalinic, Published by DAAAM International, Vienna, Austria, EU, 2011
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Annals & Proceedings of DAAAM International 2011

TESTING OF GRINDING WHEELS FOR TOOLS MANUFACTURING

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Abstract: *The paper deals with influence of technological conditions on roughness during grinding. It evaluates copying surface of the cavity of injection mould to the surface of the part. Experiments were realized on a flat grinding machine at normal cutting speed. Surface-roughness measuring was made for several types of metal materials. Data shows suitability of cutting grains. The grinding wheels contain different types of abrasive materials. Results were evaluated by Ra roughness parameters in comparison of these materials with usual type of abrasive.*

Key words: *grinding, roughness, grinding wheel, abrasive*

1. INTRODUCTION

Mechanical engineering requires the powerful technologies and the modern progressive materials, especially polymers whose properties are effective in technical practice. World usage and consumption have increased parabolically every year and its properties are improved constantly. Some of its characteristics are on the same or higher level if compared with metals. Injection of plastics is one of the most common methods of its processing. Quality of the shape parts surface of injection moulds is closely connected with quality of the product surface. Choice of machining method and all input quantities are necessary for creating of the required quality of components. Development of new technologies leads to new progressive grinding materials production in finishing technologies area. These materials assure improvement of power and ground surface quality (Lukovics et al., 2010).

2. DESCRIPTION OF EXPERIMENTS

Methods of powerful machining are constantly improved because of high requirements for quality and accuracy. The development of finishing operation, especially grinding, leads to increase of cutting speed (Bilek & Lukovics, 2007). Grinding offers higher final precision while at the same time the surface is made up and the tools are sharpened (Bilek & Samek, 2007). The high requirements imposed on the produced manufacturing devices result from the constant rapid increase of production. One of the ways to increase production is improvement of machine productivity by increasing the motion speed of their working parts. The achievements in the development of abrasive machining in the period of 10 – 15 years are essential for the increase of productivity and improvement of product quality (Wieczorowski et al., 2009). High efficiency can be obtained only by the powerful type of abrasives. These must be able to work with high cutting efficiency under difficult conditions and must provide sufficient data of roughness and cutting forces. The topology of the abrasive tool and the cutting parameters are influenced by interaction between the abrasive grains and workpiece (Warnecke & Zitt, 1998). Grinding using common type of abrasives (white electrocorundum-test 80) is compared with mixture of microcrystalline corundum and white electrocorundum (test 85) in 1:1 ratio. Other characteristics of both discs are the same. An influence on the surface quality of the injection mold cavity is evaluated. It is represented by two test materials: The tool steel 19552.4 (ENX37CrMoV51-mat I) and chromium steel 14109.4 (EN102Cr6-mat II). These steels were chosen for their properties and use. Shaped inserts were made from these materials, which surfaces were grinding under specified technological conditions. Grinding was proceeded on BRH 20.03 F flat-grinding machine. The test samples were created by injection for the conditions according to the characteristics of the plastic. ABS and PC materials were used. Then measurement of surface quality was made for inserts and plastic samples. Contacting measurement was used - Mitutoyo SJ-301 measuring instrument. Values of Ra roughness parameter were compared for steel materials and the plastic parts. Acceptance or rejection of the hypothesis that the abrasives mixture shows better results compare with white electrocorundum with the same conditions is a conclusion.

3. RESULTS OF EXPERIMENTS

Data were adjusted for evaluation by box plot diagrams (Fig 1). These are suitable for graphical representation of the distribution, mean, variability, positioning of values in relation to median and determine so called far values. It is necessary to find out a reason of their emergence and remove them. This type of data is suitable for further processing. Surface roughness Ra values were compared for both types of steel. Figures 2 and 3 describe values of Ra parameters for testing wheels (test 85 and test 80). Influence of grain is evident in the EN 102CR6 material. Differences of Ra are higher in comparison with the ENX37GrMoV51 material.

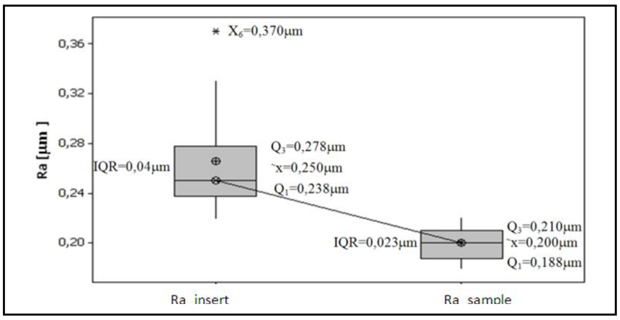

Fig. 1. Box plot diagram

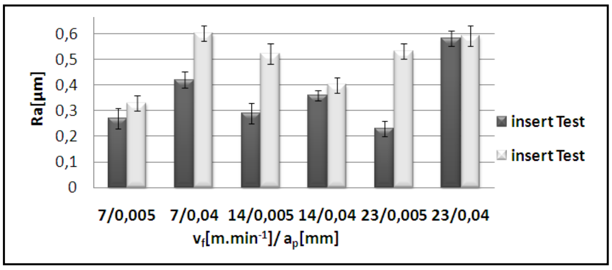

Fig. 2. Comparison of abrasive influence on mat I

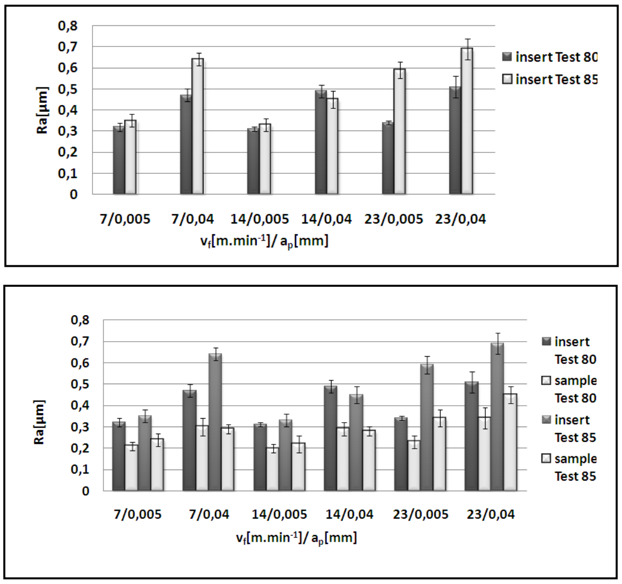

Fig. 3. Comparison of abrasive influence on mat II

Values are higher for higher depth of cut when v_p= 7m/min and for maximal feed rate. Values are higher for machining material Test 85. The measured values are comparable with the results obtained for mat II by wheel 80. Therefore the Test 85 wheel is more suitable for smaller chip and lower speeds when machining Mat I. Subsequently, data determining the influence of the material of the part and product on copying of surface during injection were processed in graphs. Firstly, influence when using PC material was compared -Fig.4.

Fig. 4. Comparison of copying for mat I-PC

It shows higher differences of Mat I shape inserts for Test 85. The differences are evident for demanding cutting conditions. Deviations are almost doubled in some cases. Better results were achieved for mat II by wheel 85.

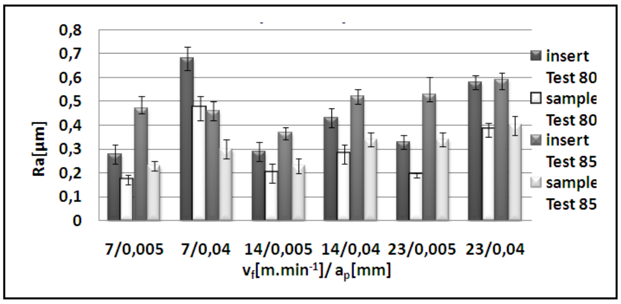

Fig. 5. Comparison of copying for mat II-PC

As mentioned earlier, lower roughness values are obtained with the Test 80 as compared with the Test 85, for the same conditions.

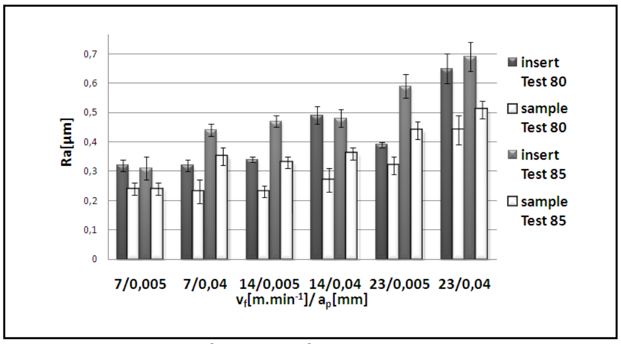

Fig. 6. Comparison of copying for mat I-ABS

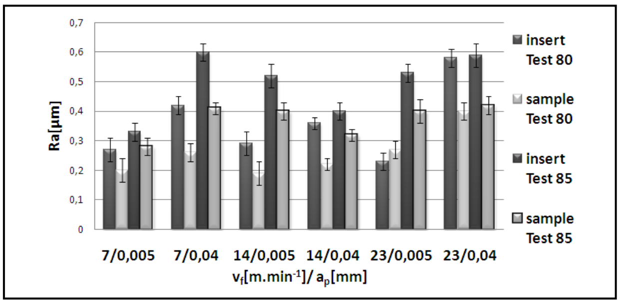

Fig. 7. Comparison of copying for mat II-ABS

Better results of copying are seen for PC mat in two graphs. ABS is the second material for injection. Results show similar dependencies for Mat II. More considerable differences between surface of insert and sample are achieved during grinding by Test 85. Ra values are comparable for small size of chips only. Results of measurement show an increasing tendency.

Differences in roughness of insert and product are raised with increasing size of chip and feed rate.

4. CONCLUSION

The paper (research) assesses a suitability two types of grinding wheels for the application limited to specific conditions. These grinding wheels differ by the type of abrasive. Research indicates whether the mixture of abrasives of first wheel shows better results Ra roughness parameter compared with the second wheel. These assumptions were verified for the range of cutting conditions. Ra values were measured on the shaped inserts of two steel materials and the plastic parts which are injected to these inserts. Ra values were compared for steel inserts and plastic parts subsequently. Results show impropriety of the abrasives mixture (Test 85) for higher chips and speeds compare with white electrocorundum abrasives (Test 80). The initial hypothesis was confirmed only partially. The mixture of abrasives in the ratio does not have a statistically significant effect on the Ra roughness parameters copying. The argument is valid for selected conditions only. These results can be used for design of grinding wheels and further research activities in this field.

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