Mechanical Engineering, Automation and Control Systems

Edited by

Anna Bogdan, Nikita Martyushev and Stepan Bogdan

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Mechanical Engineering, Automation and Control Systems

Selected, peer reviewed papers from the
International Conference on Mechanical Engineering
Automation and Control Systems 2014
(MEACS 2014),
October 16-18, 2014, Tomsk, Russia

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Preface

International Conference on Mechanical Engineering, Automation and Control Systems 2014 (MEACS2014) was held at Tomsk Polytechnic University, Tomsk. Russia on October 16-18, 2014. MEACS2014 is a scientific forum for researchers and students to exchange ideas in the field of mechanical engineering, materials science, automation and control systems as well as for industry professionals to discuss technical issues and its implementation. The topics that have been discussed during the conference are as follows:

1 - Integrated Computer Control Systems in Mechanical Engineering

2 - Numerical simulation of applied problems

3 - Material Science in Mechanical Engineering

4 - Mechanical Engineering Processes and Metals Treatment

The main goal of the conference was multidisciplinary approach to solving the problems in the field of mechanics, materials science, control systems and process modeling.

MEACS2014 received more than 250 submissions from different countries. Every submission was reviewed and evaluated on the basis of relevance, originality, technical quality and clarity. The accepted papers were selected for publication in this special issue which covers a wide number of topics including material processing technology, numerical simulation, mechanical engineering etc.

On behalf of Organizing Committee of MEACS2014, we would like to thank the delegates, guests and keynote speakers for their contribution to the success of the conference.

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Table of Contents

Chapter 1: Mechanical Engineering, Processing and Surface Engineering, Metals Treatment, Equipment and Tools

Chapter 3: Modelling and Numerical Simulation, Algorithms and Mathematical Methods for Applied Problems

Chapter 4: Control and Automation Systems, Manufacturing Applications

Chapter 5: Image and Signal Processing, Recognition, Information Processing and Applied Technologies

CHAPTER 1:

Mechanical Engineering, Processing and Surface Engineereng, Metals Treatment, Equipment and Tools

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On the Need to Increase Pressure and Flow Rate SCTE in the Grinding Zone

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Keywords: Grinding, mathematical modeling, the temperature.

Abstract. This work describes the hydrodynamic phenomena in internal grinding team's abrasive wheels with radially movable segments.

Introduction

One of the most pressing problems in modern engineering is the high-abrasion holes of machine parts (e.g. cylinders), the surface layer of which should meet the highest standards.

The processing of the holes with the help of abrasive tools is connected with a number of difficulties arising primarily due to the complexity of supplying coolant technological environment (SCTE) in the cutting zone through a narrow gap between the wheel and the workpiece under the action of strong wind flows generated by a rotating tool. This leads to a decrease in processing performance because of the danger of thermal defect formation in the surface layers of ground parts.

Discussion

The basic ways of increasing the productivity of the tool for grinding holes are the intensification of cutting and increasing the contact area of a circle with the workpiece.

The traditional scheme of internal grinding with the abrasive wheel eccentrically positioned in relation to a solid billet does not allow to ensure the qualitative increase in productivity due to restrictions imposed by the complexity of the supply coolants in the processing area, a small contact area of a circle and the workpiece, the complexity of a substantial intensification of cutting without grinding born in the processed pieces and growing imbalance of tools reducing the accuracy of processed holes.

Therefore, increasing the productivity of the tool for internal grinding by increasing the contact area of the circle and the workpiece and creating conditions for a reliable income of SCTE in the cutting area is promising.

The analysis of scientific technical and patent literature led to the conclusion that the most effective way of internal grinding is a method of centrifugal grinding with the help of the tool with prefabricated radial sliding abrasive segments [1] (Fig. 1).

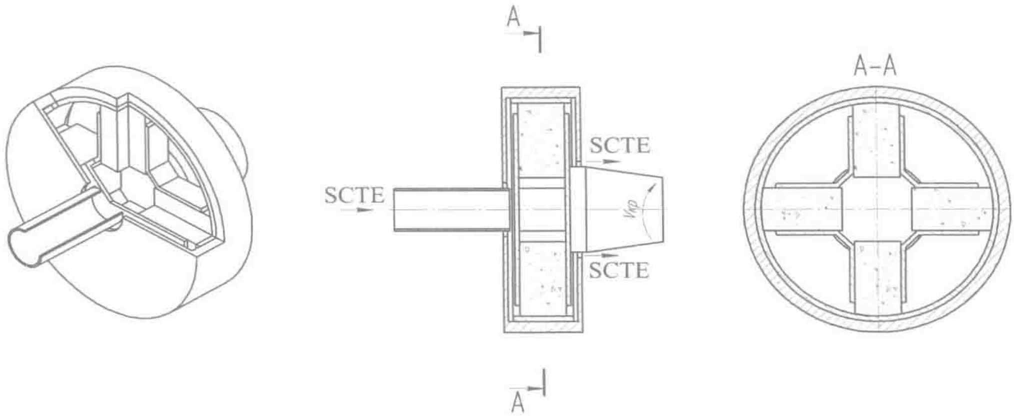

Figure 1. The method of centrifugal grinding with the help of the tool with prefabricated radial sliding abrasive segments

The described method of grinding presupposes that with the help of the precast abrasive tool with a radially movable segments is placed coaxially with two of workpieces (3), flow-organizing capacity of segments 4, 5 for coolants. The liquid is fed through the left hole in lid 6 and discharged through the larger hole on the right-side tank cover (5). When the tool is rotating, coolants accelerate and form rotating-liquid ring, cooling and washing the workpiece effectively. The well-known works recorded the average pressure coolants in the working area reaching 1.3 MPa.

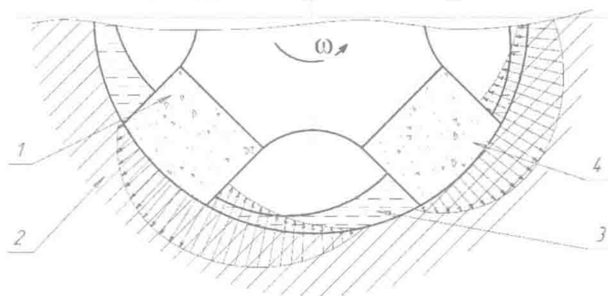

Figure 2. The scheme of heat transfer between the abrasive segments, the workpiece and the cutting fluid

From the viewpoint of heat transfer, the scheme of internal grinding with the abrasive wheel can be represented in the following diagram (Figure 2): abrasive segments 1 and 4 moving one after another produce heat spreading in the workpiece 3 and 4 SCTE. Because of the Peclet criterion (Pe = $5.38*10^4$) abrasive segments 1 and 4 are fast-moving sources of heat spreading to the processed part and SCTE [2]. In this case lowering the temperature of the workpiece in accordance with Newton – Richman's law describes the process of heat exchange between the workpiece and cutting fluids as follows (1)

$$(T_s - T_{scte}) = \frac{q}{\alpha}. \tag{1}$$

where q (W/m^2) is the heat flux density, α (W/m^{2}K) is a heat transfer coefficient defined by the formula (2)

$$\alpha = 6 * 10^4 V^{0.8}. \tag{2}$$

where T_s is the temperature of the detail and T_{scte} is the temperature of coolants.