MANUFACTURING TECHNOLOGY
February 2017, Vol. 17, No. 1

Content

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Tel.: +420 475 285 534
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Print
PrintPoint Ltd, Prague

Publisher
J. E. Purkyne University in Usti n. Labem
Pasteurova 1, 400 96 Usti n. Labem
Czech Republic
VAT: CZ44555601

Published 6 p. a., 300 pcs.
published in February 2017,
132 pages

Permission: MK CR E 20470

ISSN 1213–2489

indexed on: http://www.scopus.com

MANUFACTURING TECHNOLOGY
February 2017, Vol. 17, No. 1

Content

MTAA
Manufacturing Technology
Article Administration

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indexed on databases
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Analysis of the Joint between Blade and Stator Disc in Steam Turbine

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The use of a new method of attaching fixed blades to a stator disc led to the need for evaluating the strength of a riveted joint. Conventional mechanical testing revealed large variations in the strength of this joint. After sectioning the joint, it was found that the shank did not fill completely the hole in the shroud of the disc. Further investigation involved numerical simulations using the DEFORM software, because securing additional samples for physical examination was complicated. The first simulation task focused on determining the tearing-out force, taking into account work hardening of the shank material due to plastic deformation. The second simulation task aimed to identify optimum initial dimensions of the shank. The goal was to ensure that the rotary upsetting process causes the shank to completely fill the hole in the shroud. As a result, the joint strength would be improved and, above all, the variation in strength eliminated.

Keywords: turbine, blade, numerical simulations, DEFORM

Acknowledgement

The numerical simulations and mechanical tests described in this paper were carried out as part of the SGS-2016-036 project entitled "Analysis, development and modification of technologies of treatment of bulk advanced materials for power generation machines, transport equipment and related engineering applications".

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Paper number: M20171

Study of Phosphate Formation on S355J2 HSLA Steel

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In present paper, the growth process of the phosphate coating on S355J2 steel was investigated. The microstructure, surface morphology, coating thickness, surface roughness and corrosion resistance of the phosphate coating were analysed by using several techniques including light microscopy, confocal laser scanning microscopy (CLSM) and electrochemical tests - electrochemical impedance spectroscopy (EIS) in 0.1M Na_2SO_4 solution (simulation of industrial atmosphere). The phosphate coating formation was evaluated after chosen exposure times from 15 minutes to 105 minutes in phosphating bath composed of MnO_2, H_3PO_4 and demineralised H_2O. The optimal exposure time of S355J2 steel in selected phosphate solution was determined from surface quality, corrosion resistance and energy consumption point of view.

Keywords: steel S355J2, manganese phosphate, corrosion resistance

Acknowledgement

The research is supported by Science Grant Agency of the Slovak Republic through project No. 1/0720/14 and by European Regional Development Fund and Slovak state budget by the project "Research Centre of the University of Žilina", ITMS 26220220183. Authors are grateful for the support in experimental works to Slovak Research and Development Agency by the project No. No. APVV-14-0772.

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Paper number: M20172

The Influence of Mould Strength on Shrinkage Production for Castings with Different Wall Thickness for Material EN-GJS-400-18LT

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This paper is dealing with the influence of mould strength on a shrinkage production for ductile iron castings. According to pressures that impact a mould cavity the strength of mould is an important parameter by ductile iron pouring. During the solidification of cast iron a non-metallic particle - graphite is released. Depending on graphite amount released in the liquid and in the solidified skin of casting the tendency to shrinking is varying. In the experiment a furan sand mixture is used. The experiment compares a size of the created shrinkage in the castings with different wall thickness poured into a moulds with different strength. For the occurrence of shrinkage and its size evaluation a non-destructive ultrasonic reflecting method was used.

Keywords: Ductile iron, furan sand mixture, strength of mould, shrinkage, ultrasonic testing

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Paper number: M20173

Cutting Tool Life when Tapping Nickel Based Super Alloy

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This work deals with the issue of tapping Inconel 718 alloy. This material is known for its unique properties of high strength at high temperatures, corrosion resistance, high hardness, work hardening and low thermal conductivity. The machinability of Inconel 718 is very hard and cutting tool wear is high.This paper deals with creating internal threads by using monoliths taps. The taps are made of powder metallurgy high speed steel.The taps were provided with coating. Preparation of the hole for the thread has a huge impact on the cutting tool life. If the preparation is poor the inner face of the hole will be work hardened. This makes the cutting tool life far shorter. For the test, taps with different threads per chamfer were used. The second part of the paper is focused on the experiment where cutting tool life was monitored.

Keywords: Thread; Cutting tool life; Tool wear; Inconel 718

Acknowledgement

The present contribution has been prepared under project LO1502 'Development of the Regional Technological Institute'under the auspices of the National Sustainability Programme I of the Ministry of Education of the Czech Republic aimed to support research, experimental development and innovation.

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Paper number: M20174

Effect of Cutting Edge Geometry on Cutting Forces when Drilling Inconel 718

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This work deals with the problematics of cutting forces when drilling holes in Inconel 718. Drills with different geometries of cutting edge were used. The cutting forces and torques were measured during the experiment. The feed cutting force had the greatest influence of all the cutting forces, therefore only the cutting force feed was evaluated. The torque was monitored. This material is known for its unique properties of high strength at high temperatures, corrosion resistance, high hardness, work hardening and low thermal conductivity. Part of the paper is focused on the experiment where the effects of the geometry of the cutting edge on cutting forces are evaluated. This paper is limited only to carbide tools. The results of the experiment are compared with results from other research institute.

Keywords: Drilling; Inconel 718, Cutting forces

Acknowledgement

The present contribution has been prepared under project LO1502 'Development of the Regional Technological Institute'under the auspices of the National Sustainability Programme I of the Ministry of Education of the Czech Republic aimed to support research, experimental development and innovation.

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Paper number: M20175

Effect of Heat Treatment Conditions on Micro Structure of Cast Iron

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Article deals with problematice of influencing mechanical properties – tensile strength and hardness – of grey cast iron by heat treatment – refinement. Refinement could be in special cases applied also for grey cast iron castings in order to achieve special parameters of hardness and tensile strength of parts for specific purposes. Hardening and tempering of casting sis commonly used for ductile cast iron, but in special cases could be applied also for grey cast iron castings. Refinement – hardening and tempering – was provided on samples from materiál EN GJL 150, EN GJL 200 and EN GJL 250. Afterwards, measured values of tensile strength, hardness and fractography of materiál in poured state and after tempering on temperatures 250, 350 and 450°C after quenching from austenitization temperature 920°C were compared. Achieved results are formulated in the evaluation part of article.

Keywords: Refinement, Hardening, Tempering, Grey Cast Iron, Ductile Cast Iron

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Paper number: M20176

Optimization of the Pressure Porous Sample and Its Manufacturability by Selective Laser Melting

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New concept for pressure testing samples has been designed based on previous experiments which investigated the maximum load capacity of a Schoen Gyroid. This pre-experiment pointed to the possible lack of measurements and newly designed pressure samples intended to improve measurement accuracy. This paper focuses on the manufacturability of the designed samples made by selective laser melting, which is able to produce complex metal parts using support structures. However, removing the support structures from a porous core is impractical. In this context, the ability to substitute supporting structures by a Schoen lattice structure is also marginally dealt with. The paper concludes with the benefits of the optimized pressure samples over the old concept. An increased maximum load capacity was achieved by the addition of contact plates, which constrain the strut ends.

Keywords: Schoen Gyroid, Lattice Structures, Rigid Constructions, Additive Manufacturing, Selective Laser Melting

Acknowledgement

This paper is based upon work sponsored by the project "Regionální technologický institut" reg. no. CZ.1.05/2.1.00/03.0093

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Paper number: M20177

Influence the Composition of the Core Mixture to the Occurrence of Veining on Castings of Cores Produced by Cold-Box-Amine Technology

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Method of cold-box-amine is widespread and frequently used technology for the production of cores. [1] Characteristic defect castings of ferrous alloys, which often accompanies the use of amine - Cold box cores are veining . Survey , it was found that 77 % of those surveyed foundries have problems with veining, 71 % foundries solves this problem (or try to tackle) anti veining ingredients in nuclear and molding compounds , but only 29 % considered their " antiveining " method for successful and favourable. [2] Article discusses the possibilities of elimination veining. Ingredients called additives lower the temperature at which the SiO_2 begin to soften and form a melt at the surface of the grains, reduce the reactivity and increase the temperature of transition to a tridimit and cristobalit. These passages encourage increased tensions subsurface sand and reduce stress for the formation of veining on the surface of the core or mold. Experiments were performed to assess the impact of silica sands and the impact of additives on the quality of the casting surface.

Keywords: core mixture, veining, cold-box-amine

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Paper number: M20178

Comparison of the Structure of CuZn40MnAl Alloy Casted into Sand and Metal Moulds

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CuZn brasses are used for manufacturing highly stressed structural comonents. Their mechanical properties as e.g. strenth, toughness or wear resistance are affected not only by their chemical composition, but also by their structure. This paper is dedicated to the study and comparison of the structure of sand- and metal mould casted Cu40Zn alloy. Scanning electron microscopy supplied by energy dispersive spectroscopy and electron backscatter diffraction were used to evaluate the structure of both samples. Casting into the metal mould produces approximately five times finer grain structure compared to the sand mould. EBSD orientation mapping revealed a strong correlation between both matrix phases, αCu and β' phase. Also, the size of Fe_2MnSi ternary precipitates is affected by the cooling rate.

Keywords: Brass, Structure, Casting, EBSD

Acknowledgement

The results of this project LO1201 were obtained with co-funding from the Ministry of Education, Youth and Sports as part of targeted support from the "Národní program udržitelnosti I" programme.

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Paper number: M20179

Tricanter Production Process Optimization by Digital Factory Simulation Tools

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As a result of globalization the aspects of raising productivity and speed of production with extreme requests on the flexibility of the production systems are gaining importance. These aspects of production are affected by type of product and production and mainly by the capability of companies to correctly manage the manufacturing process. Manufacturing process is globally quicker than it was and the areas of logistics and production planning are still gaining more importance. Gradual changes are also in complexity of production. Without modern tools for production planning it would be very hard to manage production effectively. These tools are part of digital factory concept. Because of those tools the effective planning of production and utilizing the production facilities capacity to its fullest is possible. This paper describes development and implementation of the digital factory concept and its tools in our partner company and is built on previous paper dedicated to common implementation principles of digital factory tools. The main goal of digital factory implementation was optimization of the Tricanter production planning process, elimination of bottle-necks of production system and optimization of manufacturing facilities capacities utilization.

Keywords: Digital Factory Tools, Simulation, Optimization, Production Process Planning, Bottle-Neck Analysis

Acknowledgement

This work was supported by the governmental funding of Technological Agency of Czech Republic – project number TA04020658.

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Paper number: M201710

Maintenance Audit: the Tool for Maintenance Management Quality of Manufacturing Equipment

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The purpose of this paper is to provide an overview of state-of-the-art of maintenance management audit and to show a case study of maintenance audit and its results in the Czech Republic. Authors proposed audit methodology based on world and own experiences. It was defined hundred thirty audit criteria divided into ten maintenance management areas. Using expert approach to review of maintenance managers and documentation according to audit criteria enables to obtain answers and their assessment presented in percentage of audit criteria fulfilment. After that there is applied SWOT analysis method to determine mainly weakness (gaps) in real maintenance management processes comparing with world excellence maintenance class. On the base of the gaps there are recommended topics for maintenance improvement. Value of the results is a help to maintenance managers and supervisors in maintenance audit executing as a tool for maintenance management improvement.

Keywords: Maintenance audit, Audit criteria, Criteria fulfilment, Quality assessment, Recommendation for improvement

Acknowledgement

Paper was created with the grant support – CZU CIGA 2015 - 20153001 - Use of butanol in internal combustion engines.

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Paper number: M201711

Analysis of the Impact of the Construction of a Gate on the Macroscopic Structure of a Casting and Its Influence on the Mechanical Properties of Castings

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The macroscopic structure of a casting has a direct impact on its mechanical properties. The porosity and homogeneity of a casting closely correlate with its tear strength characteristics. In order to achieve the best mechanical properties, it is necessary to eliminate internal defects in a casting. The elimination of such defects can be achieved through the suitable adjustment of the input parameters of high pressure die casting machines prior to starting the actual casting cycle. This method is useful for companies that produce castings on the basis of supplied pressure forms, whereby it is impossible to influence the design of the gating systems. A much more appropriate way to influence the homogeneity of a casting is to design the gating system so that possible shortcomings are already underpinned and excluded in the design and development phases. By adjusting various elements of the gating systems it is possible to achieve significant improvements in the properties of a casting. The construction of the gate has the biggest influence on the final homogeneity of a casting. The gate is the point at which the modulation of the melt flow rate takes place for the filling of the die cavity. The mode in which the cavity is filled and the speed of the melt flow rate are the main determinants of the final characteristics and properties of a casting. This paper presents an analysis of the macroscopic structures of castings produced under various gate construction modifications and their effect on the mechanical properties of those castings. Conclusions, which are drawn on the basis of the detailed analysis, describe the correlation between the macroscopic structures and the mechanical properties of castings with precautionary measures that are used and implemented directly in production.

Keywords: macroscopic structure, mechanical properties, construction

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Paper number: M201712

Effects of Aluminium Microparticles and Surface Treatment of AlCu4Mg on Mechanical Properties of Adhesive Bond Strength

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The aim of the research was to evaluate the lapping length, the adhesive bonded surface treatment and the influence of the filler in the form of the aluminium microparticles on the adhesive bond strength. The alloy AlCu4Mg was the adhesive bonded material bonded by means of a two-component epoxy adhesive used in construction of machines. The filler in a form of aluminium microparticles was added into the adhesive. Laboratory experiments were performed on normalized testing samples of alloy AlCu4Mg prepared under standard ČSN EN 1465. Within the research three various treatments of the adhesive bonded surface were evaluated, i.e. without the surface treatment (WT), mechanical treatment of the surface (MT) and mechanical and chemical treatment of the surface (MCHT). The adhesive bonds without the adhesive bonded surface treatment (marked as WT) reach the smallest adhesive bond strength. When adding the filler in the form of aluminium microparticles (10 vol. %) the adhesive bond strength was increased of about 12%.

Keywords: adhesive bonding technology, aluminium alloy, lapping length, surface treatment, microparticles aluminium

Acknowledgement

This paper has been done when solving the grant IGA TF

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Paper number: M201713

Tension of the Surface Layer in Machining Hardened Steels

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The article builds on the existing results of machining testing hardened bearing rings. Some significant results were already achieved in this area. Cubic boron nitride as cutting materiál has been tested and the results were published. Existing measurement proves that values which reaches prescribed level of tolerance IT 4 can be achieved in series production. The evaluation indicater of arithmetic average surface roughness profile deviation was reached in the range of Ra = 0.2 to 0.4. Cutting conditions have also been specified in a certain range of machining. The problem remained on surface integrity. Specifically, the state of the surface layer. Tensile and compressive stresses alternate just below the surface and their size depends on the machining method. The specific size of the pressure and tensile stresses can not be accurately determined. Their presence, however, is a tendency to the formation of surface defects such as microcracks. These microcracks may be the cause of further massive destruction of the surface. Detection of surface layer tension is the subject of this article.

Keywords: hardened steel, CBN, surface integrity, surface tension

Acknowledgment

The work has been supported by the Department of Trade and Industry of the Czech Republic under grant FR–TI4/247. The support gained from this source is very gratefully acknowledged.

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Paper number: M201714

Cost Modeling for ABC Failure of Machines

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In this paper we analyze Weibull generated failures of equipment in discrete production. At first we will classify failures using ABC analysis. Obtained characteristics of each group of failures can be used to generate time of their occurrence and duration which are essential for assessment of their cost. We use optimization tool Solver from MS Office – Excel to solve problem of maintenance of machines. We optimize strategy of maintenance also according to cost of failures in categories ABC classification. Results of this optimization are tables, graphs, having that it can offer to managers a new unconventional access at the efficiency of investment. We create the proposed approach of solving models on demonstration example.

Keywords: Linear Programming Tasks, Cost of Failures, Weibull Distribution of Failures, Optimization Problems

Acknowledgement

This paper was supported by Project VEGA n. 1/0124/15 Research and development of advanced methods for virtual prototyping of production machines.

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Paper number: M201715

Injection Molding Quality Improvement by Advanced Virtual Simulations

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Main aim of this article and research is to describe exact influence of key parameter in injection molding process. This key parameter is temperature. Nowadays is possible to use wide range of advanced virtual simulation tools, which were in research used. Article is focused on determining optimal temperature of injected plastic material, temperature of mold and temperature of coolant. For veryfing of virtual method was performed real injection molding with same input parameters and results were compared. For evaluating of achieved quality was investigated influence on whole molding process and influence on final product properties. As testing material was choosen High- Density Polyethylene with properties described in article.

Keywords: Injection Molding, Virtual Simulation, Plastics, Temperature

Acknowledgments

The present contribution has been prepared under project LO1502 'Development of the Regional Technological Institute' under the auspices of the National Sustainability Programme I of the Ministry of Education of the Czech Republic aimed to support research, experimental development and innovation.

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Paper number: M201716

Theoretical Regulation of Delimitation of Metal Level Decrease in the Furnace in Case of Pneumatic Dosing Device of Metal

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Article deals with the during operation of pneumatic dosing device designed for die casting machines where the metal level in the furnace decreases stepwise by which the period of dosing of the filling mould is prolonged. We also deal the regulation of delimitation of metal level decrease in the furnace based upon the pneumatic principle.

Keywords: Theoretical Regulation; Die casting; Air pressure; Dosing device

Acknowledgement

This paper has been prepared within the project VEGA 1/0381/15 and KEGA 027TUKE-4/2014.

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Paper number: M201717

Production of High Frequency Elliptic and Hyperbolic Optic Mirrors

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An article provides an overview of production and corresponding issues of one of the most important component of a satellite dish – a high frequency optic mirror that polarizes signals caught by a parabola into a sensor connected to computing (so-called receiver).
The article describes an issue of production of high frequency elliptic and hyperbolic optic mirrors forming one of the most important functional components of parabolic satellites designed for ALMA, the biggest and the highest located international astronomic radio telescope in the world. It is situated at a high plateau Chajnantor in Chile, South America.
Individual parts of the article are outlined in a sense of a flow of a production technological process including both theoretical and practical analyses of the given issue. A content of the article leads especially to a description and explanation of causes of individual problems during production of elliptic and hyperbolic optic mirrors.

Keywords: Elliptic Optical Mirrors, Hyperbolic Optical Mirrors, High Frequency, Aluminium Alloys, Residual Tension, Chemical Nickel Plating, Galvanic Gilding, Pitting, Radio Telescope ALMA

Acknowledgement

This article was supported and co-financed from a specific research FSI-S-16-3717 called "Research in Field of Modern Production Technologies for Specific Applications".
Acknowledgements especially belong to company Frentech Aerospace s.r.o. for possibility to participate in research and to deal with the given issue.
An implementation of an output is done within the international project "ALMA", whose preparation was supported by the Branch Contact Organization for Research of New Technologies also called „OKO – NovaTech" LE14015 financed from a state budget via program MSMT – EUPRO II.

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Paper number: M201718

Importance of Diffusion Process on the Fatigue Life of Steel

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Evaluation of the diffusion process is the plasma nitriding technology in connection with an increase of fatigue life of steel. For experiments steels 41CrAlMo7-10 and 34CrNiMo6 were selected. The equivalent of mentioned steel is material no. 1.8509 and no. 1.6582. Plasma nitriding technology belongs to the group of chemical-heat treated process. This process includes the saturation of nitrogen to the core of material. Plasma nitriding technology is effective method usage in practise especially in order to increase the surface hardness, corrosion resistance and fatigue strength. The experimental material samples were heat treated and subsequently plasma nitride. Fatigue bending rotation tests were the major part of the experiments. According to the principle of the experiment the rotation velocity was determined as constant and the load of samples was going down. The experimental measurement were stopped in case of fracture or after 10^7 cycles without damage. Fatigue life of the steel depends on the thickness of a diffusion nitrided layer. This thickness was evaluated by using the microhardness measuring from the surface to the core of the material. The results of experiments shows that these steels are suitable for increasing fatigue life after the plasma nitriding process.

Keywords: Fatigue live, plasma nitriding technology, Wöhler curves

Acknowledgement

The paper has been prepared thanks to the support of the project The Development of Technologies, Design of Firearms, Ammunition, Instrumentation, Engineering of Materials and Military Infrastructure "VÝZBROJ (DZRO K201)." and "Surface technology in applications special techniques SV16-216."

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Paper number: M201719

Results if Machining by Tool of Self-Propelled Rotation Due to Wear

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On the base of a well-known method of machining with disk-shaped rotating tool the self-propelled tool was designed. The principle is based on braking the tool rotation during machining, until the moment of determined wear criterion on the tool flank. As with the growth of tool wear the force of cutting resistance increases, it is possible to use it for automatic tool swinging into a new position by which a new part of cutting edge comes into engagement. The paper describes the tool design, theoretical analysis of *Rz* after machining and actual experimental machining results.

Keywords: machining, disk-shaped tool, quality of machined surface, cutting edge

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Paper number: M201720

Usage of Waterborne Acrylate Anticorrosion Systems for Ecological Environment

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All technical metals used not only in agriculture are subject to degradation processes, there are distinguished two main types: mechanical abrasion and physical-chemical degradation (corrosion). In order to lower abrasion of a machine part, it is necessary to use appropriate technical materials as well as an appropriate heat treatment. To minimize losses caused by corrosion, an appropriate anticorrosion system has to be used. This paper evaluates corrosion and mechanical resistance of waterborne acrylate anticorrosion systems sold on the Czech market. These paints were applied by an air flow technology. Mechanical characteristics of the applied coating were evaluated according to the ČSN EN ISO 4624 (pull-off test for adhesion), ČSN EN ISO 2409 (cross-cut test) and ČSN EN ISO 1520 (cupping test). As used anticorrosion systems were applied also on zinc-dipped coating, this duplex system was also subject to the mentioned tests. Corrosion resistance of the tested anticorrosion systems was analysed in the salt-spray environment (ČSN EN ISO 9227). Based on the results of the individual tests, there can be characterised adhesion, flexibility and mechanical resistance of waterborne anticorrosion systems as well as a further application on zinc layers. Corrosion tests analyse the process and visual appearance of corrosion attack.

Keywords: Corrosion, Ecologic Paints, Paint Tenacity, Wareborne

Acknowledgment

This study was supported by the project no. TP 4/2014 "Analysis of degradation processes of modern materials used in agricultural technology" and financed by Internal Grant Agency Mendel University in Brno; Faculty of Agronomy.

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Paper number: M201721

A Method of Computer-aided Modular Fixture Design, Part 1: Creating the Feature-model Repository of Fixture Elements

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Modular fixture is conventionally designed less concerning the detailed specifications of machine tool. A little of literatures involve the effectively application to the existing CAD systems in CAFD (computer-aided fixture design). The determination of the validity of modular fixture during NC machining lacks for a practical method. This paper put forward that: Firstly, the feature-model repository of elements of modular fixture can be built in CAD packages; the design of modular fixture in NC machining should be accomplished under the concept of NC Manufacturing System (NMS); the Post-NC verification can be applied to check the performance of modular fixture applied in NC machining. Part 1 of the paper focuses on the feature-model repository of the modular-fixture elements. The other jobs will be introduced in the Part 2.

Keywords: Modular Fixture, Feature-model Repository, Typical Part (TP), Serial Part Driven with Table

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Paper number: M201722

Tool Life of PM-HSS Cutting Tools when Milling of Titanium Alloy

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Machining of titanium alloys meets with poor life of a cutting tool. It is caused by a low thermal conductivity and by a high strength-to-weight ratio of the alloys. Various approaches for cost-effective and productive machining titanium alloys are still researched. One of methods can be using the cutters made of modern high-speed steel (HSS) as a product of a powder metallurgy (PM) process. These materials (PM-HSS) possess better and homogenous mechanical properties than conventional high-speed steel. The PM-HSS cutters equipped with any effective coating allow increase cutting speed to the level which is typical for uncoated cemented carbide, while price of the tool is lower. In the article several PM-HSS cutting tool materials were compared to conventional cobalt based HSS from the tool life point of view. It was proved that conventional high-speed steel offers very long tool life and high tool performance at speed of 30 m/min. However the regular tooth pitch significantly decreases tool life for this cutting tool material. The main benefit of PM-HSS cutters can be fully utilized when cutting speed about 50 m/min is applied. The cutters coated by effective thermal barrier showed longer tool life and higher performance of the cutting tools.

Keywords: titanium alloy; milling; high-speed steel; tool life

Acknowledgement

The paper has received funding from the Technology Agency of the Czech Republic (Project TE01020075). The authors would also like to thank the ZPS Frezovaci nastroje, Ltd. for support with supply of the tested tools and their reconditioning during the research.

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Paper number: M201723

Influence of the Workpice Quality on the Cutting Tool Life when Gear Wheel are Machined

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The stability of the machining process is depending on the machined materials properties. But the material properties are influence by the heat treatment process and in this case it is forging. For these study three different company made the "same" forging process and then the material properties are evaluated and their influences on the cutting process were monitored. For the tests the steel DIN 18 CrNiMo 6-7 was used. This material is typically used for the gear wheels where the cutting tools by tool steel is used for the machining. So for the tests the mills from tool steel were used and during the machining the cutting tool life and cutting forces were monitored.

Keywords: Gear wheel, Material analysis, Cutting tool wear, Cutting tool life, Cutting forces

Acknowledgement

The present contribution has been prepared under project LO1502 'Development of the Regional Technological Institute' under the auspices of the National Sustainability Programme I of the Ministry of Education of the Czech Republic aimed at supporting research, experimental development and innovation.

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Paper number: M201724

Kinetics of Gas Emissions from Moulding and Core Sands, Gasification Patterns and Protective Coatings – the New Investigation Method

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Gases evolving from moulds, cores, coatings deposited on sand and metal moulds constitute one of the basic reasons of several casting surface defects: blow-holes, pinholes, pitted skin, etc. In research performed up to now the moulding sands gas evolution is determined in two ways: normalised, in which the gas amount emitted from the sample placed in a heated flask is determined or in the other way, in which the gas amount emitted from the core - covered with liquid metal - is determined. In these both methods the result constitutes the total amount of gases emitted from 1g of a moulding sand and the emission procedure as a time function. The new method of investigating the kinetics of gases evolution from moulding sands (and coatings), applied for making moulds, is presented in this paper. The kinetics is tested not only as the heating time function but also as the temperature function. The method was developed in the Department of Mould Technology of the Faculty of Foundry Engineering, AGH. Amounts of gases emitted from the moulding sand at the given temperature in the time unit are obtained in investigations. The results of testing the group of moulding sands (furan, alkide, moulding sands with water glass) and the group of protective coatings applied for sand and metal moulds, are presented in this paper.

Keywords: Gas Evolution, Moulding Sands, Expanded Polystyrene, Protective Coatings

Acknowledgement

Research was carried out within the project NCBiR: Nr PBS3/B5/47/2015

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Paper number: M201725