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Improving the Tribological and Mechanical Properties of an Aluminium Alloy by Deposition of AlSiN and AlCrSiN Coatings

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This paper presents an improvement to the mechanical and tribological properties of aluminium alloys. AlSiN and AlCrSiN coatings (with different Cr content) were deposited on substrates of Al-Cu-Mg alloy by the cathodic arc evaporation method at 400°C. Surface morphology and chemical composition were estimated by a scanning electron microscope equipped with an energy dispersive spectrometer and mechanical profilometer. The increasing chromium content in the coating led to an increase in the coating hardness. The tribological behaviour of the coated and uncoated Al-Cu-Mg alloy samples was examined using the "Ball-on-Disk" method (ASTM G99-95) at a load of 10N using Al_2O_3 ball as a counterpart.

Keywords: AlSiN thin films; Cathodic arc deposition; Aluminium substrate, Coefficient of friction

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Deflection of Complex Geometry Cutting Tools

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Deflection of cutting tools under the action of cutting forces has a significant influence on the error of machined surface and the stability of cutting process. Considering the complex geometric structure of cutting tools lead to higher calculation accuracy of the tool deflection analysis. Therefore, CAD models of double-sided solid ball end mill and helical drill bit was created in this study. The impact of tool material and clamping of the tool under the influence of cutting forces individually in three axes was obtained via finite element analysis. An error of the numerical model was less than 7.2% and has been validated by analytical calculation. Geometric errors in the case of die and mold manufacturing are provided below or close to 0.02 mm. However, due to the force effect of the cutting process it is not recommended to use HSS tools as the analysis confirmed. Stiffness of sintered carbide tools was more than doubled.

Keywords: Deflection, Clamping, CAD, FEM, Solid Ball End Mill.

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Using the Fourier Transform in the Analysis of Vibration Load Tests of Heterogeneous Mechanical Systems

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The aim of this study was to find possibilities of using the Fourier transform in the analysis of vibration load tests of heterogeneous mechanical systems, especially those of a biological nature. The study applied the idea that the dispersion of a stationary stochastic signal depends on its power spectral density. We have verified that a sophisticated reduction in the spectral power of the ergodic signal may be used to filter it effectively. The proposed procedure is suitable for the detection and separation of harmonic artefacts. We have created an algorithm in the MATLAB environment and tested its functionality when analysing the vibration transfer within the human axial system.

Keywords: Signal Filtering, Vibration Analysis, Heterogeneous Systems, Fourier Transform

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Ultrasonic Testing of Butt Weld Joint by TOFD Technique

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The aim of the article was to check the internal defects in the butt welded joints by non-destructive TOFD (Time of Flight Diffraction) technique. Subsequently, the macrostructure from the defect indication site was evaluated and assigned to the TOFD ultrasound indication. Basic knowledge of ultrasonic TOFD testing are described in the theoretical part of a submitted paper. Ultrasound technique TOFD is non-destructive method that can detect internal defects inside test material without damaging it. It is a reliable method for detecting mainly flat internal defects such as incomplete root penetration, lack of fusion, etc. Ultrasonic test procedures and test results obtained in non-destructive testing of butt weld are shown in experimental part. Evaluation of the ultrasonic TOFD testing results, its advantages and disadvantages are described at the end of this article.

Keywords: Internal defects, Butt welded joints, TOFD, Non-destructive testing.

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Corrosion Properties of AlSi10Mg Alloy Prepared by Gravity Casting and 3D Printing Technology

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Aluminium and its alloys are widely used in the transport industry. In combination with 3D printing technology, lightweight parts can be successfully achieved. 3D-printing of AlSi10Mg alloy is already well-managed. However, corrosion behaviour of such 3D-printed material has not been intensely studied yet. This paper is thus focused on a primary determination of corrosion properties of AlSi10Mg samples prepared by SLM technology and on comparison with conventionally gravity cast samples in thermally untreated and treated state (T6). Audi immersion test has revealed the 3D-printed samples are the most vulnerable to local corrosion attack, while the as-cast samples are the most resistant. In all three material states, selective dissolution occurred as result of microgalvanic processes between silicon particles and aluminium matrix. Eutectics and α-Al solid solution in between the intercellular network were attacked preferentially in the cast and 3D-printed samples, respectively.

Keywords: AlSi10Mg, corrosion, casting, 3D printing

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Issues of Lattice Structures Production via Metal Additive Manufacturing

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Metal additive manufacturing (MAM) is used in the production of parts, where a product is built layer by layer. MAM includes Direct Laser Metal Sintering (DMLS), which allows the production of complex metal parts directly from 3D software models without using sometimes expensive tools such as moulds, dies and cutting tools. New possibilities in the production of complicated components are made available using this advanced manufacturing technology. Nevertheless, this technology has limits, resulting from the method of melting in the powder bed. Therefore, this paper investigates the ability to produce fine cellular lattice structures. Some structures with self-supporting cell units were selected for experimentation and were produced with identical cell size and volume fraction. Based on this, a suitable topology was established for the production of fine structures with small volume fractions.

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

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Determination of Oil Change Interval for Diesel Engines According to the Quantity of Non-Ferrous Metals

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The article deals with the determination of the life of the lubricant based on the determination of the degree of wear or deterioration of the engine oil by wear particles. Non-ferrous particulates of a large diesel engine and their determination based on laboratory tribotechnical diagnostic tests are characteristic for the purposes of article. The combination of Atomic Absorption Spectrometry and Thin Layer Chromatography is used for measurements. The statistical method of discriminatory analysis is used to evaluate the article. The lifetime of the lubricant is thus determined according to objectively determined criteria realized by normalized and customized analyzes of the lubricant at a high degree of accuracy. The proposed and verified method demonstrates the degree of achievement of individual lubricant wear limits of non-ferrous metals in a large compression-ignition engine. The clear advantage of the proposed method is the precise determination of the optimal oil change interval and the possibility of early detection of a vehicle defect.

Keywords: Engine Oil, Wear Particles, Nomogram the Wear, Discriminant Analysis, Atomic Absorption Spectrometry

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Dissemination of Waves in Thin Plates

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The article deals with the wave propagation in thin plate. A wave was caused by the impact force. In the first part of an article the Kirchhoff's theory of thin isotropic plate is given. It is a vertical displacement w, angles of rotation tangent φ_x and φ_y, bending stresses σ_x, σ_y, shear strength $\tau_{yx} = \tau_{yx}$, shear strength from displacement forces τ_{xz}, τ_{yz}. In the second part of an article is solved a Kirchhoff's theory by analytically in MATLAB programme. Analytically were solved only displacements u, v and velocity $\dot{u}$, $\dot{v}$. The solution is performed for two plate materials – aluminium and steel. By result are deformations and velocities graphs in the x-axis and the y-axis at the measurements points given. In the conclusion of an article is comparing of individual deformations and velocities graphs.

Keywords: Displacement, Velocity, Vibration, Thin Plate

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Theoretical Basis of Fractographic Methods and Their Application in Fracture Modelling for Cr-Ni Steels

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Fractographic methods derive their knowledge from Euclidean geometry, set theory, metric theory and chaos theory. In engineering technology, the fractography is primarily used for modeling of fatigue and intergranular fractures. As such defects are not smooth due the principle of their origin, they cannot be described using ordinary mathematical tools. However, if the conditions of self-similarity are met, fractal geometry means can describe various irregular, incomprehensible, crooked or fragmented geometric shapes. Fractographic description of the fracture profile allows more accurate quantification of fractures and it also enables identifying possible causes of their initiation. This study contains several examples of specific cases of Cr-Ni steel failures and a basic explanation of their fractographic description.

Keywords: Optical microscopy, Fractography, Cr-Ni steel, Micro fracture, Macro fracture

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Structure and Mechanical Properties of Aluminium Alloy Sampled from a Firefighter Ladder

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Firefighter ladders are manufactured of aluminium alloy AA 6063. These ladders are a widely used technical tool for firefighting, for intervening firefighters and for rescued persons. The quality of the ladders is checked by so-called "user test" which is a non-destructive deflection test defined by CSN EN 1147. Unfortunately, this test is not sufficiently conclusive in terms of safety. Therefore, the project called "Safety improvement of extension ladders for firefighters" (VI20162020021) is focused on the complex assessment of the existing firefighter ladders through mathematical modelling, material analysis and real testing. In the present work structure and mechanical properties of samples (aluminium alloy AA 6063) taken from different areas of a firefighter ladder are presented. The obtained result confirm excellent mechanical properties of selected samples, such as tensile yield strength and ultimate tensile strength, at laboratory temperature but a huge decrease in these properties after exposure to temperatures above 200 °C for even short times. This results in the necessity to control temperatures in the proximity of the ladder, especially in the case when the ladder is located near a flame.

Keywords: Aluminium alloy 6063, firefighter ladder, Electron microscopy, Mechanical characterization

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The Effect of Annealing Temperature on Microstructure and Mechanical Properties of Lightweight Steel with Increased Aluminium Content

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A demand for enlightening of constructions in an automotive industry resulted in an intensive development of high strength steels and in attempts to decrease the weight of the steel by intensive alloying by lighter elements. This work used chemical concept of AHSS (advanced high strength steel) TRIP (transformation induced plasticity) steel with 0.2%C and micro-alloyed by 0.06%Nb and increased manganese content to 4% and aluminium to 6.5% to produce lightweight steel, which was cast and re-forged and subsequently annealed at various temperatures in the range of 300°C – 800°C. The resulting microstructures were analysed by light microscopy, laser scanning confocal microscopy, scanning electron microscopy and X-ray diffraction phase analysis and mechanical properties were measured by a tensile test. Tensile strengths in the region of 600 MPa – 757 MPa and total elongations around 20% were obtained for annealed samples.

Keywords: aluminium alloyed steel, light-weight steel, annealing, microstructure

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Tool Guarantee of Intermittent Cutting Processes

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Reforming obsolete technologies, increasing production of new machines and devices are impossible without modern and reliable instrumentation. The high structural complexity of the manufactured parts creates problems for the use of a blade tool that, along with high hardness, has considerable brittleness. As a rule, the processing of intermittent surfaces by turning is accompanied by chipping of the cutting edges.
The disadvantages of alternative grinding technologies are the high cost of equipment, low productivity, as well as the problems of forming the required quality parameters of the surface layer due to the specificity of operation of the grinding tool.
The solutions protected by patents of the Russian Federation, allowing to exclude negative factors of intermitted cutting are offered. The scientific novelty of the decisions made is to give the damping tool a special position that excludes negative interaction between sharp tip of cutting element and intermittent surface, which provides the possibility of stable operation of brittle tool material on the basis of the developed mechanism for controlling the position of the cutter tip.

Keywords: Composites, intermittent surface, interrupted cutting, damping, quality of surface.

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Laser Welding of Aluminium Alloys

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Laser beam welding is an industrial technology that has seen a significant development from the early stages up to the present. Technological process management ensures high product quality as well as enhanced productivity and competitiveness. The aim of the research is to determine the impact of welding parameters by fiber laser beam on the quality of weld joints from aluminium. Basing on the presented quality assessment methods and computer simulation, we evaluate the weld joint samples. Finally, we discuss optimal welding parameters and conditions allowing the production of weld joints of the desired properties.

Keywords: Pure aluminium, Welding, Fiber Laser, Microscopy, Computer simulation

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Comparison of the Effect of Process Fluid Using the Test by Drilling a Constant Feed Force

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New types of process fluids is very broad. Drilling with constant feed force represents the experiment that follows different properties and effects in machining. The main aim of this scientific paper is to assess the speed of drilling holes by the drilling technology-constant feed force- with the drilling cutting tools made of uncoated high speed steel. Eleven different process fluids were compared used the during the experiment. There were compared eleven different process fluids. In the context of the thesis more process fluids from global suppliers have been tested. In the process of experiments there were used twist drills of high speed steel type HSS, ČSN 221121, ø 8 mm, without coating. Steel samples were 16MnCr5, according to EN 10084-94. During the experiment there was used drilling of holes by hand feed drill machine V 20 that was modified with the mechanical switch and there was also stopwatch. Testing of process fluids in chip machining has been going on at the Department of machining and assembly of the Technical University of Liberec for many years.

Keywords: Machining, drilling, process fluids, time of drilling, chips

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Hazards in Milling

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This paper is focused on hazards in milling processes. It continues in occupational health and safety in turning. Safety rules are based on general rules and specific ones which relate to milling. It is necessary to formulate hazard and safety rules more precisely for specific production processes and in some cases for different production machines. For satisfactory solution of this problem the rules are formulated on the base of laws, regulations and personal findings of the paper´s authors in enterprises. In the paper occupational health and safety hazard rules in milling on these principles are formulated.

Keywords: Hazards, Occupational health and safety, Legislation, Milling

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The Effect of Changes to Nickel Coating Machine on Surface Integrity and Microstructure after Grinding

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Grinding is an overly used finishing technology, which can obtain very accurate surface integrity. The desirable surface quality after grinding is one of the most relevant parameters. In production, surface preparation such as chromium plating, nickel plating, etc. are more prevalent. These platings are used as protection against corrosion, erosion, abrasion and as a material for the renovation of worn parts. This paper discusses the change of nickel coating machines, which has an influence on surface integrity and microstructure after grinding. The team has built a completely unique and new technical solution for the covered equipment which had never been built in the past. The input parameters were selected based on past experience in the company, related to the area covered in this paper.

Keywords: nickel, grinding, surface integrity, microstructure

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Phase Analysis of EN AW 6023 Aluminum Alloy after Short Time Aging

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The phase analysis of the EN AW 6023 aluminum alloy after the heat treatment by short time aging was investigated. The good machinability of this heat treatable and lead free Al-Mg-Si wrought alloy is achieved by alloying of tin and bismuth. In experimental procedure, the solution annealing at 550 °C for 1 hour and subsequent water quenching of the analyzed alloy was realized. The short time artificial aging at 190 °C for 1 hour was carried out immediately after quenching. The microstructure analyses, the EDS analyses and the phase analyses using the hard X-ray diffraction by synchrotron radiation in DESY Hamburg were realized. Significant changes of the alloy phase composition were not observed after short time artificial aging applied on quenched and/or naturally aged alloy. Above all, the minority β''(Mg_5Si_6) phase was identified as a strengthening phase in alloy α(Al) solid solution as the majority alloy phase. In addition, the minority of Sn, Mg_2Sn, Bi_2Mg_3, $AlCu_2Mn$, $Al_{15}(Mn,Fe)_3Si_2$ phases were identified in alloy microstructure.

Keywords: Aluminum Alloy, Phase Analysis, Microstructure, Natural Aging, Artificial Aging

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Application Fractography and EDS Analyses for Quality Control of the Castings Made of AlSi7Mg0.3 Aluminium Alloy

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Fractography is the study of the fracture surface and is concerned with the quantitative and qualitative evaluation of fracture surfaces [1]. It is based on the knowledge of the relationships governing the formation and propagation of fracture areas and is routinely used to determine the cause of failure of forensic engineering or failure analysis [2]. A large majority of casting defects can be detected in the fracture surface. In the technical practice, the formation of a fracture surface represents in most cases the unacceptable stage of mechanical loading or other damage, for instance corrosion damage, of material [3]. Fracture interpretation is a function of the fracture surface condition. The fracture surface contains a wealth of information and it is important to understand them [3] - [9]. Energy-dispersive X-ray spectroscopy (EDS, EDX, or XEDS), is an analytical technique used for the chemical analysis (characterization) of a sample. Accuracy of EDS spectrum can be affected by various factors. The likelihood of an X-ray escaping the specimen, and thus being available to detect and measure depends on the energy of the x-ray and the amount and density of material it has to pass through. This can result in reduce accuracy in inhomogeneous and rough samples. The present paper is focused on the possibility fractography to control quality of the castings made of aluminium AlSi7Mg0.3 Alloy to take chance of the tensile test samples.

Keywords: fractography, fracture surface, casting defects, failure analyses castings, AlSi7Mg0, 3 alloy, EDS analyses, metallographic analyses.

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Surface Machining after Deposition of Wear Resistant Hard Coats by High Velocity Oxygen Fuel Technology

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The article deals with some aspects related to the machining of surfaces that have been deposited by wear-resistant hard coats using HVOF (high velocity oxygen fuel) technology. HVOF coating is a thermal spray process used to improve a component's surface properties, thus extending equipment life by significantly increasing errosion and wear resistance, along with corrosion protection. For a purpose of this research, the chromium-cobalt alloy - Stellite 6 was used as a sprayed material. Considering that the parts made of stellites are widely used in various industries and very popular in specific applications, it is a big drawback that adequate machining processes for stellites have not yet been developed other than the costly and time-consuming technique of grinding. However, in this research, an attempt has been made to reveal the optimal machining parameters for a lower value of surface roughness for the purpose of successful machining of Stellite 6 using inserts with various radii of cutting edge. Authors have evaluated the quality of machined surface not only by means of Abbott curve, but they have also observed the dependency of arithmetical mean roughness value on both cutting-edge radius and feed. The analyses of cutting tips wear at changeable inserts have shown that typical wear appears in the form of a notch.

Keywords: Hard coats, High velocity oxygen fuel, Surface quality, Cutting tip, Wear

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Research on Aluminium Alloy AlCu4Mg Surface Machined by Abrasive Water Jet

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The paper deals with a machining of the aluminium alloy by means of an unconventional technology, i.e. an abrasive water jet (AWJ). The paper deals with a study of an influence of the abrasive water jet at its impact on a surface of the machined material, i.e. the aluminium alloy AlCu4Mg of a thickness 20 mm. A topography of the machined surface is evaluated within the research by means of roughness parameters. A surface analysis is also evaluated by means of a scanning electron microscopy (SEM) depending on a cutting speed and a mass flow of the abrasivum. The research results proved an increased influence of the cutting speed and the mass flow of the abrasivum. The optimum cutting speed was 50 mm.min^{-1}, the cut was uniform without a significant grooved zone typical for cuts by means of AWJ technology.

Keywords: cutting speed, gap width, mass flow of abrasivum, SEM, surface roughness

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The Impact of Technological Parameters on Casting Integrity and Mechanical Properties of AlSi7Mg0.3 Alloy by Using Squeeze Casting Technology

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The article deals with the effect of variaton of the technological parameters on the change mechanical properties and density of the AlSi7Mg0.3 alloy using squeeze casting technology. The AlSi7Mg0.3 alloy has been chosen because the acting pressure has the most significant impact on Al-Si alloys. For the make a samples was used a direct squeeze casting technology. Differently casting temperatures and mold temperatures at the acting pressure of 30 MPa were varied for individual samples. From the mechanical properties was specifically evaluated tensile strength and elongation.

Keywords: Squeeze Casting, Al-Si Alloys, Mechanical Properties, Casting Integrity

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The Influence of SPS Compaction Pressure onto Mechanical Properties of Al-20Si-16Fe Alloy Prepared by Mechanical Alloying

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The Al-20Si-16Fe alloy (wt.%) was prepared by a combination of short-term mechanical alloying and consequential compaction via spark plasma sintering. The compaction was done at two different pressures of 80 MPa and 6 GPa to describe the influence of pressure onto a resulting properties of prepared alloy. The microstructure of both the prepared compact alloys showed presence of sub-micrometre particles embedded in the Al-matrix while some residual porosity was also observed. This corresponded to the lower compaction pressure of only 80 MPa, which, in comparison to the 6 GPa allowed to retain some porosity. The higher compaction pressure of 6 GPa resulted in a increase of the compressive strength of 1426 MPa while the hardness was slightly lower reaching still high 348 HV 5. On the other hand, the sample compacted by a pressure of 80 MPa reached compressive strength of 758 MPa while showing higher hardness of 411 HV 5. The difference in the observed properties can be attributed to a different compaction temperatures of 500°C (for 80 MPa) and of approximatelly 600°C (for 6 GPa).

Keywords: Mechanical alloying, spark plasma sintering, mechanical properties, microstructure.

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Innovative Process to Eliminate Ledeburite Network in Tool Steel

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Tool steels are a widely-used material with well-known heat treatment procedures for obtaining the desired mechanical properties. Their weakness is the presence of sharp-edged carbides which compromise the material's toughness. When produced by conventional metallurgical routes, high-alloy steels, such as X210Cr12 (1.2080) and X155CrVMo121, contain sharp-edged M7C3 carbides which remain stable even at high temperatures. As these carbides form as early as in the solidification stage, there is no practical conventional heat treatment for removing them or for converting them to more favourable carbide types. As a result, unconventional methods must be sought for these steels. One of them combines short-time conversion to semi-solid state and subsequent thermomechanical treatment. This method was used with both tool steels named above, with a great emphasis on the choice of the heating temperature. The results showed that at an appropriate heating temperature and deformation magnitude, very fine structure can be obtained in which the matrix consists of grains of the M-A constituent and carbide precipitates. In X210Cr12 steel, hardness values of up to 862 HV10 were achieved. In X155CrVMo121, the hardness level was 859 HV10.

Keywords: semi-solid treatment, tool steels, X210Cr12, chromium carbides, thermo-mechanical treatment, refinement of carbides

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Shape Inspection of Gear Prototypes Using Reverse Engineering Method

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Reverse engineering is a technology that enables acceleration of data collecting for CAD, CAM, CAE systems, which also means shortening time of development, construction and components production. It is a transfer process of a physical component to a digital format. Generally, the technology of reverse engineering means a conversion of analogue data to digital data that are further processed. Every single industry branch rising their requirements on accuracy, dimension, quality, etc. Therefore, digitisation is applied in many production fields such as an automotive industry, aircraft or shipping, medicine, industrial design, design, etc.
An article deals with an analysis of prototype models of gears in various stages of production. The realized inspection of a shape of prototype gears lied in uploading of a digitised referential CAD model (the gear after heat treatment and machining), subsequent setting up of digitised prototype gears (the gear after the machining, gear after heat treatment) in respect of this referential CAD model, a control of their dimensions and forming a colour map of deviations in chosen points.

Keywords: Gears, Prototype Models, Digitisation, Component Inspection, 3D Scanner, Reverse Engineering, Technology

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Influence of Ground End Mill Surface Quality on Cutting Tool Life

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Cutting tools made of cemented carbides currently dominate the field of machining. This is due to their outstanding properties and applicability to various materials. However, there are still opportunities for enhancement in the field of cutting tool durability, particularly in the machining of highly resistant super alloys. Grinding critically affects the integrity of the machined surface, which has a significant impact on the durability of cutting tools. Certain cutting conditions and grinding strategies can lead to a sudden failure of the cutting tool in the cut. The main goal of this study is to investigate the influence of the cutting conditions on the end mill flute surface quality and durability of these cutting tools when machining Inconel 718. The surface parameters are described and real machining tests are conducted.

Keywords: Grinding, Electron Microscopy, Cutting Tool Life, Surface, End Mill

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Fatigue Properties of the Aluminium Alloy AW-5182 in dependence on Deformation

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Fatigue properties of the constructional materials belong among the very important material parameters, mainly because they are very closely related with the total fatigue life of the part. Knowledge of the boundary between limited and infinite (endurance) life represents a truly very important fatigue parameter. This paper deals with the influence of pre-deformation on aluminium alloy AW-5182 fatigue properties. These tests were performed under fully reversed harmonic cycle (max/min stress ratio R = -1). As a major aim there was determination of so-called S-N curves (stress vs. number of cycles) and their mathematical description by the Basquin´s equation via fatigue strenght coefficient σ_f' [MPa] and fatigue strength exponent b [1]. Measured S-N curves gave a basic overview about the basic pre-deformation influence on the alluminium alloy AW- 5182 fatigue properties.

Keywords: Fatigue, Alluminium Alloy AW-5182, Basquin´s Equation, Endurance Limit, S-N Curves

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The Collision of Unbelted Passenger with Assessment of Various Vehicle Interior

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This paper describes the conception of vehicle interior which can help decrease the injury risk of unbelted passenger. This paper is primarily aimed to the field of rail vehicles, but the results are useful for more transportation industries. Some computer simulations for passive safety performance assessment were conducted in previous years. The FE models of the interiors based on data from actually operated vehicles were prepared for this purpose. The newly prepared simulations are close to the real interior models. Combinations of rigid walls were used for modelling. Each model contains a short python code which allows change of interior disposition. This approach is close to an optimisation process. The main goal is to compare all possible configurations of interior. In practise it is usually obvious which change can improve the passive safety, but with numerical approach is possible to find structures with unknown influences. The simulations were performed in software environment PAM-CRASH. It is used a dummy Multibody model of the human body ARB Hybrid III 50th percentile.

Keywords: Passive safety, interior, crash, crashworthiness, biomechanics

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Failures Caused by Heat Treatment and Their Identification

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The article deals with the failures caused by heat treatment and their identification. The various types of tool failure are occurring from the design through to the tool application stages. Heat treatment naturally plays a major role due to its significant influence on the tool properties, and indeed most defects appear after the heat treatment stages. There are many methods how to study failures of tools and gadgets. One of the most important is metallographic investigation. Metallography is very important part of failure analysis. Thanks to microstructure analysis can be evaluated crack morphology and relationship between the failure and microstructure. Investigation can be performed using classic optical microscopy or SEM (Scanning Electron Microscopy). The aim of this paper is classifying these failures according to type and occurrence to deliver practical solution.

Keywords: Failures, Heat Treatment, Tool Properties, Treatment Stages

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Influence of Sr-Modification on Microstructure, Tensile, Impact and Hardness Properties of Secondary AlSi8Cu2Mn Cast Alloy

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Present work is focused on the study of recycled AlSi8Cu2Mn cast alloy. Furthermore, the effect of Sr-modification (0; 0.03 and 0.05 wt. %) on the microstructure, tensile and impact properties (UTS, ductility, hardness and impact energy) were investigated. For study and identification of intermetallic phases were utilized standard, colour and deep etching (in order to reveal the 3D-morphology of the Si-particles and intermetallic phases). For element composition of the specimen was used X-ray analysis. Finally, the effect of Sr-modification on silicon morphology was examined. The results show that the addition of Sr into AlSi8Cu2Mn cast alloy should act as a modifier, so it supposes to change the eutectic Si-morphology. However, its effect as a Si-modifier is not as significant. Higher number of iron (1.1 %) leads to an increase of precipitation of brittle iron phases with platelets (Al_5FeSi) and skeleton-like ($Al_{15}(FeMn)_3Si_2$) morphology. Al_5FeSi platelets act as preferred crack sites and reduce the tensile and impact properties. Strontium not only refined and modified eutectic Si, but also modified the Al_5FeSi needles and thereby improves tensile (first of all ductility) and impact properties. Sr addition is also associated with porosity formation.

Keywords: Al-Si cast alloy, modification, tensile and impact properties, microstructure.

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Improvements of Prosthetic Limb Design: Cooling and Pressure Reduction in a Socket

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Although important improvements of prosthetic sockets has been implemented another investigation has been done also by solving problems with inadequate stump heating and from that resulting excessive sweating of limb. This phenomenon is further associated with leg volume changes. Therefore for realization of this research the model of prosthetic limb was created with socket that further addresses these issues of artificial limb. Throw the application of holes and tightening bells the pressure to remaining stump decreased and at the same time the heating of limb is lower. These results indicate that the implementation of these design modification will improve the comfort and fit of prosthetic devices in future.

Keywords: Prosthesis, artificial limb, socket, design, stump.

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