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Powder Metallurgical Techniques for Fabrication of Biomaterials

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Different powder metallurgical techniques have been intensively studied as candidates of methods suitable for fabrication of metallic biomaterials intended for orthopedic applications. The main advantage of powder metallurgical products is that they contain porosity which compromises their mechanical properties closer to those of human bone and allows transport of bodily fluid and growth of ne tissue through the implant. This enhances the healing process; moreover, the pores may be also impregnated by drugs or growth factors, which are eluted during healing and support the healing process. Recently, Ti-based and Mg-based materials have been the most investigated metallic biomaterials; therefore, the powder metallurgical methods are usually studied on those materials. In this paper, the most investigated methods will be summarized and briefly described.

Keywords: Powder metallurgy, biomaterials, porosity

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Hydroxyapatite in Materials for Medical Applications

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Hydroxiapatite is ceramic material with properties and composition similar to the bone tissue. This makes it a suitable choice for biomaterials. However, hydroxyapatite alone has poor mechanical properties. Present paper shows two possible applications of hydroxyapatite in materials intended for medical applications. 1. Hydroxyapatite can be used as a layer which causes the material to be more bioactive. In this article the layer of HA is applied on WE43 by plasma spraying and structure, composition and adhesive properties are measured. 2. Hydroxyapatite can serve as reinforcement in metallic composite materials. Present work sum up properties of composite materials with 2, 5 and 10 wt.% of HA that were prepared by powder metallurgy route. The structure, hardness and compressive mechanical properties are characterized.

Keywords: Hydroxyapatite, magnesium, composite, plasma, coating.

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Investigation of Airflow inside Floor Convector and Its Surrounding

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The article describes experimental and numerical investigation of airflow inside the floor convector. Analysis was divided to two parts. First part was airflow visualization. This part was realized in two areas. At first the visualization was realized in the area between a fan outlet and a heat exchanger inlet using a continual laser and a video camera. Then the visualization was realized in the region above the heat exchanger outlet with a Particle image velocimetry. At last the flow behavior in domain between the fan outlet and the floor convector outlet was analyzed with a numerical simulation. Commercial software ANSYS Fluent in version 15.0 was used. Results from the numerical simulation and the experiments were compared and the flow behavior was examined.

Keywords: floor convector, visualization, particle image velocimetry, numerical simulation

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Comparison of the Influence of Process Fluids on Tool Life in Face Milling

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Thanks to their chemical and mechanical properties, the process fluids (PFs) can significantly affect the process of machining [2], [15], [16], [18]. It is particularly important that PFs should positively influence the quality of the machined surfaces of machine parts and durability of cutting tools [4], [5], [6], [7], [10], [11], [12], [14]. Other significant factors in PFs are economic and environmental [17]. The costs of the acquisition, use and disposal of PFs must not be too high. As part of the research project in collaboration with the company Paramo, a.s. and the Technical University of Liberec, completely new environment-friendly PFs (labeled as PF01, PF02, PF03, PF04, and PF05) have been developed and evaluated. In the Laboratory of Machining at the Technical University of Liberec, the effects of these new PFs were examined from a viewpoint of a number of technological aspects. This article presents the results of experiments conducted on structural steel 16MnCr5 and stainless steel X2CrNiMo18-14-3 face milling using these newly developed eco-PFs.

Keywords: machining, milling, process fluid, environment-friendly, tool durability

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Essential Features of Process Fluids Applied in Machining

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Not only engineering production at present is characterized by increasing an international competition. It is achieved higher productivity with simultaneous improvement of quality parameters of machined parts by using of process fluids. In other words, the use of process fluids positively improves and increases the both the qualitative as well as quantitative parameters of the technological processes. Process liquids in machining occupy an important place and influence the outcome of the all processes. Choosing a suitable process fluid should be carefully considered. It is well known that, different machining technologies have different cutting conditions and thus completely different requirements on process fluids. Selection of a suitable process fluid is more important that the management of manufacturing companies admits. Unfortunately, the selection of suitable process fluids is very often underestimated.

Keywords: machining process, process fluids, lubrication, cooling

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Rollers Vibration of Pipe Conveyor

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This article is deals of noise and vibration measurement of rollers for belt conveyor. In the first part of article a stand measuring is described and individual rollers types which were measured. There are five types of rollers for measurement. The first type are the Transroll rollers which were measured with the rubber pads. The second type are the Transroll rollers again. The third type are the Sandvik rollers and the fourth type are "Italian" rollers. Process of noise and vibration measurement of the individual rollers types is given. In conclusion of this article is noise and vibration measurement evaluation. Compared of the Transroll roller with pad and without pads is given. Three the highest acceleration values in depending on the frequency of vibration in individual directions (x, y, z) are given.

Keywords: Belt conveyor, Roller, Vibration, Noise

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Properties, Production and Applications of NiTi Shape Memory Alloy

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Approximately equiatomic alloy Ni-Ti is commercially most successful member of shape memory material group. This paper concludes basic knowledge about properties, ways of preparation and possible applications of this unique material in medicine, industry, construction or everyday life.

Keywords: NiTi, shape memory, properties, production

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Numerical and Experimental Analysis of the Real Load Arising in the Cushion of the Car Seat

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Nowadays people spend still more of their life on the road. Vehicles has been becoming increasingly sophisticated and the main direction of their development is placed primarily into the areas of environment, design, safety and comfort. This work focuses primarily on the last-mentioned point, and that's seating comfort and the phenomena with straight influence on the transported persons. Probably with any of car elements, isn't the person in a direct contact to much as with the seat and therefore the seats and their innovation are still in considerable interest of the customers and manufacturers. This work deals with description of the resulting tensions and distribution of the specific pressures in the cushion of a car seat and also describe the creation of an appropriate computational model.
Based on the real transmission data, that was measured during driving a car, has been carried out an experimental measurements of static and dynamic loading of the overall stiffness and response of the system. Subsequently, depending to the real CAD data were compiled the boundary and materials conditions that describe the statical FEM model of the polyurethane cushion. For the quasi static load was carried out the experimental measurements on a mechanical pulsator, that is suitable for assessing the viscoelastic and hysteresis effects inside the materials. The found results have been verified with using the x-sensor on a model of real human back during the scanning of its specific contact pressure.

Keywords: Car seat, PUR foam, contact pressure, x-sensor, biomechanic

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[18] ČSN ISO 2631-1: *Vibrace a rázy* – Hodnoceni expozice člověka celkovým vibracím

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Evaluation of Degradation of Heat Stressed Pipelines

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Piping systems of boilers are mainly exposed by high temperatures, pressures and corrosive loads. This corresponds to the choice of materials boiler pipeline. These materials are in most cases special stainless steel for energetic equipment. Article deals with the evaluation of the resulting degradation of thermally stressed pipe boiler, which occurred after the increase boiler capacity. Degradation showed an increased amount of corrosion products on the inner surface of the pipeline, which resulted in clogging of pipes, formation of cracks and leakage of steam. Complex analysis was carried out of corrosion products and material microstructure pipelines. The result was that occurred to intergranular corrosion of pipelines in loaded state. On the basis of this was carried out analysis of the material in the unloaded state. Chemical composition and microstructure correspond to prescribed standards and requirements. Test of resistance to intergranular corrosion revealed that in the steel causing damage to the cohesion of the material along grain boundaries. It is for this type of material inadmissible. Therefore it is necessary in the case of increasing the performance of the boiler and thus the increase in temperature and pressure, to ensure a higher resistance to intergranular corrosion of the material.

Keywords: Degradation, Pipelines, Microstructures, Complex analysis.

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Research and Analysis of the Sediments from Casting Furnaces and the Mechanism of its Origin

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Paper is focused to analysis of emerging sediment-casting furnace for the casting alloys of Al - Si. The aim in the analysis of of sediment is to confirm or disprove that a substantial portion of sediment are formed due to segregation of particles the wire used for refinement structure of alloys. Subsequently, on the basis of chemical analyzes of the various structural components of the sediment to determine the nature and methylene chanizmus formation of sediment. The optimal delay time at a temperature of alloying when master alloys type of AlTi5B1 is 5-10 minutes. All these master alloys act almost immediately, and in most cases, their effect is not dependent on time, temperature holding time of alloying, only at some alloys (e.g. AlSi11, AlSi9Cu3) after exceeding 30 minutes of holding time smoothing effect worsening slightly. The optimal temperature of alloying coincides with the temperatures that are used in technical practice in the casting of Al-Si alloys. After exceeding this temperature (about 750 C°) represents a slight coarsening of the structure. This is caused a slight deterioration of softening effect due to formation of clusters of particles of TiB_2 or leads to their segregation, which reduces the possibilities of creating of active crystallization nucleuses.

Keywords: alloying, sediments, casting furnaces, Al - Si alloy, macrostructure, microstructure, EDX analysis, TiAl3 particles, TiB2 particles

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Grinding of the Alloy INCONEL 718 and Final Roughness of the Surface and Material Share

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Grinding is currently still an important method for surface finishing. At FPTM JEPU is realized the research, which deals with this issue. There are carried out experiments with grinding various materials under different conditions and then are evaluated the selected components of the surface integrity, which are generally roughness Ra, Rz and Rz, material ratio curve (Abbott Firestone curve) and also obtained roundness. This article deals with grinding nickel alloy Inconel 718, when selected cutting grinding conditions were used and subsequently the surface roughnesses Ra, Rz and Rt, the surface profile and the material ratio curve were measured and evaluated.

Keywords: Grinding, Roughness, Surface Quality, Abbott Firestone curve, Inconel

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Intermetallics – Synthesis, Production, Properties

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This work summarizes recent results in the field of intermetallics achieved during the research in our department. The research was focused on high temperature materials, shape memory alloys and hydrogen storage materials. In the case of high-temperature intermetallics, the development of TiAl-Ti_5Si_3 and NiAl-Al_2O_3 composites and Fe-Al-Si based alloys is described. During this research, powder metallurgy using reactive sintering has been established as an innovative and promising method for easy preparation of these materials. This method is also currently being tested and optimized for NiTi shape memory alloy. Another important property of several intermetallics (as $LaNi_5$ or Mg_2Ni) is the ability to store hydrogen reversibly.

Keywords: intermetallics, production, properties

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Properties of Welded Joints in Power Plant

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This paper deals with evaluation of the controlling processes service reliability of degradation processes leading to embrittlement, fracture at elevated temperatures, fatigue and fatigue fracture with the possible effect of corrosion and with interaction of all the previously mentioned processes.

Keywords: evaluation of the controlling processes, degradation, fracture at elevated temperatures.

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Testing of Zn-1.6Mg Alloy in Model Physiological Solution

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The Zn-1.6Mg alloy was chosen because mechanical properties of this alloy are similar to human bones. It is necessary to describe corrosion behaviour of the Zn-1.6Mg alloy before using it for application as a biodegradable material. In this work, two types of corrosion rate measurements were used. One of them was an exposure test in model physiological solution marked as SBF (the simulated body fluid) and NaCl solution. The second method was measurement of potentiodynamic curves in the SBF and NaCl solutions. The aim of this work was to compare both methods and confirm similar trend of corrosion behaviour in model physiological solution (SBF and NaCl).

Keywords: Biodegradable Material, Zinc, Magnesium, Model Physiological Solution, Immersion Test

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Mechanical Alloying: A Way How to Improve Properties of Aluminium Alloys

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The Al-10Si-21Fe and Al-20Si-16Fe (wt.%) alloys were prepared by short-term mechanical alloying and subsequently compacted by spark plasma sintering. Prepared samples were characterized by ultrafine-grained microstructure with average dimensions of each structural component that does not exceed 200 nm. This resulted in excellent mechancial properties e.q. hardness and compressive strength. Hardness of both prepared alloys reached almost 400 HV5 and remained the same value even after 100 hour of long-term annealing at 400 °C. The Al-10Si-21Fe alloy reached ultra-high compressive strength of 1033 MPa. The casting Al-12Si-1Cu-1Mg-1Ni alloy, generally considered as thermally stable, was used as a reference material. Even the reference materail was thermally treated by the T6 regime, it exhibitted lower mechanical properties compared to the investigated alloys event at laboratory temperature. During annealing, the reference alloy significantly softened reducing its initial compressive yield strength and compressive strength from 430 MPa and 680 MPa to 180 and 498 MPa, respectively. Additionally, hardness reduction by 50 % to the resulting 63 HV5 was observed. Compared to this results, the investigated alloys maintained theirs high initial hardness and compressive strength suggesting excellent thermal stability.

Keywords: Aluminium alloys, mechanical alloying, spark plasma sintering, mechanical properties, thermal stability.

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Nusselt Number Criteria Equations in the Cross Flow over Single Tube

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The simple geometry was investigated by analytical simulation in the article. The cylinder cross flow and heat transfer was evaluated. The different Nusselt number equations obtained from literature were mutually compared. The selected range of Reynolds number was from 5 to $2 \cdot 10^6$ with respect to laminar and turbulent regime of fliud flow. The coefficients of Nusselt number equations were also compared with respect to Reynolds number ranges. The Sieder-Tate correction for thermal boundary layer was taking into account and its effect on the Nusselt number values was also evaluated. Differences in result of selected equations are presented. Sieder-Tate correction effect is also discussed. However the equations were applied in its validity intervals of Reynolds and Prandtl numbers, the high differences up to 40 % from each other were found.

Keywords: Heat transfer, Nusselt number, equations, cross flow

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The Use of Colour Metallography and EDS for Identification of Chemical Heterogeneity of Selected Aluminium Alloys Copper and Zinc Alloyed

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Aluminium alloys with higher content of alloying elements are very susceptible to the emergence of crystal segregation that significantly affects the mechanical, physical and chemical properties of these alloys. Crystal segregation is called chemical heterogeneity in microscale and is formed during crystallization. Crystallization of alloys does not occur at a particular temperature, as is the case of pure metals, but in a certain temperature interval. During cooling of the melt occurs to formation of different regions within the dendritic cell that differs in chemical composition. Generally is crystal segregation defined as chemical heterogeneity formed during alloy crystallization that is enriched or deprived of alloying elements and impurities that segregate unevenly across the surface of the dendrites. In the central area of the dendritic cells is alloy deprived of alloying elements, while the outer parts of dendritic cells and in space between dendrites is the concentration of alloying elements richer. This concentration has a hyperbolic course, when the central region of dendritic cells has the lowest concentration of the alloying elements and the outer part of dendrite boughs and interdendritic space have the maximum. Distribution of individual elements has a recurring character and can be described by sine function. The distance between two main axes of dendritic cells is affected by the temperature interval between the liquidus and solidus for the given alloy, the cooling rate of the melt and temperature gradient during solidification. Formation of the crystal segregation in aluminium alloys rich in alloying element and additives cannot be prevented, it is possible only influence its scope and with the right choice of heat treatment parameters can be suppressed. To suppress the crystal segregation the castings are subjected to heat treatment which is called homogenization annealing. It is the diffusion process in which there occurs to a balancing of chemical composition of alloy and the uniformity of its structure.

Keywords: crystal segregation, colour metallography, intermetallic phase, eutectic, colour etching, AlCu4MgMn, AlZn5.5MgCu, EDS

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